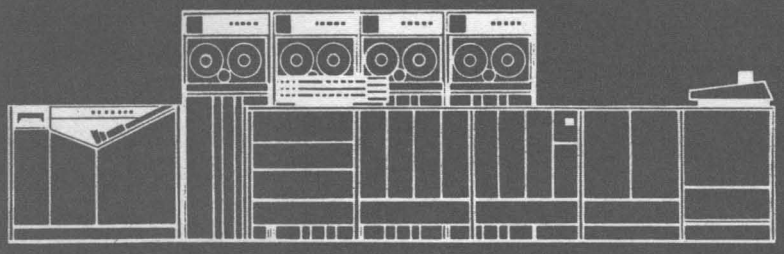
SERIES 200

DATA STATION - Remote Communication Terminal

REFERENCE MANUAL



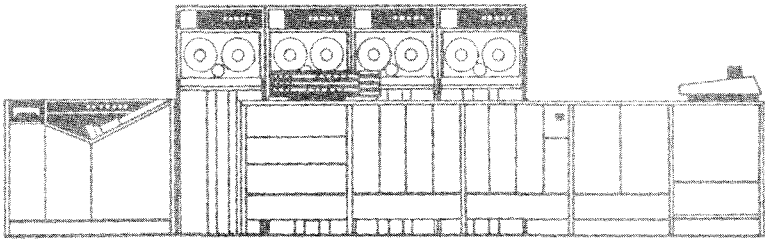
Honeywell

ELECTRONIC DATA PROCESSING


HONEYWELL

SERIES 200
DATA STATION - Remote Communication Terminal

REFERENCE MANUAL



Honeywell

ELECTRONIC DATA PROCESSING

PRICE $2.00

Questions and comments regarding this manual should be addressed to:

Honeywell Electronic Data Processing
Information Services
60 Walnut Street
Wellesley Hills, Massachusetts 02181

Printed in U.S.A.
WP-8396

113.0005.0900.0-032
51065

FIRST EDITION
First Printing, October, 1965

Copyright 1965
Honeywell Inc.
Electronic Data Processing Division
Wellesley Hills, Massachusetts 02181

FOREWORD

This manual presents general hardware and software descriptions and information relative to programming and operating Honeywell's new remote communication terminal, the Honeywell Data Station. The Data Station is a general-purpose device which is used for data preparation and to transmit data to, and receive data from, a distant computer via common carrier facilities.

TABLE OF CONTENTS

TABLE OF CONTENTS (cont)

LIST OF ILLUSTRATIONS

LIST OF TABLES

SECTION I
INTRODUCTION

DATA STATION FEATURES

The Honeywell Data Station is designed to be used with any model of the Honeywell Series 200 Electronic Data Processing System. The versatility of the Data Station, when combined with the power and speed of a Series 200 computer, opens broad new avenues to the field of data communication. Any organization with remote locations (e. g. , widely dispersed branch offices, storage warehouses, or distribution facilities) can obtain a fast, accurate and economical interchange of data between the centralized or home office location of the computer and distant Data Station terminals.

Flexibility/Modularity

A central control unit and a keyboard are required for operation of every Data Station. Beyond these basic equipment requirements, a wide choice of peripheral devices is available to tailor a system to individual requirements. Up to five of the peripheral devices chosen (including the keyboard) may be operated from the power supply associated with the central control unit.

Applications flexibility is provided via three types of machine-readable media which may be used with the Data Station: (1) conventional punched cards; (2) punched paper tape; and (3) bar-coded documents. Bar-coded media is useful in some applications that involve such returnable (or "turnabout") documents as premium notices, utility bills, invoice stubs, and coupons. The bar-code may be pre-printed, printed on a high-speed printer, or hand marked.

Dual-Mode Operation

The Honeywell Data Station can operate in either of two modes, "remote" or "local." In either local or remote mode, several output devices may simultaneously record data received from any one input device (including the computer).

In the local mode, the operator may use the Data Station for a variety of data preparation and editing operations:

1. Creation of a fast-transmission media or file from source documents;
2. Editing of data after it has been received from the computer (e. g. , removing unwanted data, etc.);
3. Merging of data that is on several different types of source media, into a single paper tape file for subsequent transmission; and
4. Off-line printing of invoices, reports, and other operating documents from a previously received file on paper tape.

In the remote mode, the Data Station usually sends data to and receives data from a computer over standard telephone lines under computer control. A feature is provided to allow the local operator to regain control of the Data Station during a computer-controlled transmission period. This feature is used principally to interrupt lengthy data transmissions in order to send urgent inquiries to the computer. When the BRANCH button on the control panel is depressed, the Data Station completes transmission (or reception) of the current block of data and then requests the computer to service the interrupt.

Extended Operations (Feature 088-2)

The extended operating features available for the Honeywell Data Station include the following; however, only those features which are requested by the user will be implemented in the system.

1. Audible alarm (external to the system) in addition to (or in place of) an alarm light;
2. Telephone for voice communication;
3. Terminal address option;
4. Repeat-last-acknowledge option; and
5. Delay-line buffer bypass.

ALARM FEATURE

With this feature, an audible alarm can be sounded in the event of Data Station failure, error detection, or line failure. The audible alarm may be used in preference to a visible alarm light to alert the operator when the Data Station is temporarily unattended. The alarm can be turned off by the operator or, if the Data Station is unattended for a long period (such as overnight), the computer can be programmed to turn the alarm and the Data Station off after a predetermined length of time. Both the audible and visible alarms are optional features.

TELEPHONE FEATURE

The telephone feature allows either the Data Station or the computer to stop all normal data communication and manually switch to voice communication. To initiate a telephone message from the Data Station, the operator presses the TELEPHONE button on the control panel. When the TELEPHONE indicator glows, it indicates that the computer has received the telephone request and all data transfer has been stopped. The telephone feature has several important uses — e.g., initiating a new type of run during the training of new computer and Data Station operators, when a procedural error is detected, and if a catastrophic failure of a link in the data transmission process occurs. If the Data Station operator desires telephone conversation with the computer operator, he merely presses a button on the control panel. If the computer operator desires telephone conversation with the Data Station operator, he instructs

the computer to send a special character which activates the TELEPHONE indicator light on the Data Station control panel. The same transmission line is used alternately for both data transmission and voice conversation.

TERMINAL ADDRESS OPTION

The terminal address option allows the computer to communicate with one of several data stations having a common line. The message format used is STX, SOH, TA, ETX, LRC. When STX and SOH is sensed by all the Data Stations on the same line, all will then be de-activated. The particular Data Station which has an address identical to the character that follows SOH will then be activated and its COMP REQ indicator will be illuminated. Only the Data Station which has been activated will be communicating with the computer.

REPEAT LAST ACKNOWLEDGE

This option allows the computer to query the Data Station once as to the last acknowledgement message sent by the Data Station when the station is in the data receiving condition.

DELAY-LINE BUFFER BYPASS

This option allows the computer to order the Data Station to bypass the delay-line buffer when operating in the remote mode. The message formats for utilizing this option are shown in Table 2-1. All data messages which follow, to or from the devices selected, then bypass the buffer. The buffer is restored by an ordinary DAC message. This option also allows the buffer to be bypassed during operation in the local mode through use of the BUFFER BYPASS switch on the Data Station control panel. A bypassed buffer is restored in local mode by using the MASTER CLEAR switch. All statements in this manual concerning the condition of no delay-line buffer installed are valid when the buffer is bypassed.

SYSTEM ORGANIZATION

The central control unit and each of the associated peripheral devices is contained in a separate free-standing cabinet. Since individual cabinets are connected only electrically, the units of the system may be arranged for the operator's comfort and for ease of system operation.

The central control unit cabinet contains the data channel; control circuitry associated with the data modem (modulation-demodulation equipment); the circuits which perform device selection, error control, and control character functions; and the power supplies for a basic system consisting of the control unit and up to five peripheral devices. The dataset control circuits accommodate the Bell DATA-PHONE 202C or 202D datasets.

Each peripheral cabinet contains an input and/or an output device, the associated switches and circuitry required for activating the device, and circuitry for interfacing the device with the central control unit. Operation of the Data Station is regulated from the keyboard and control panel associated with either the central control unit or the printer cabinet. Most of the functions that the operator can perform from control panel can be simulated by the central control unit when the Data Station is so directed by the computer. Manual switches assign the desired input and output devices to the data channel.

DATA TRANSMISSION

The Data Station transmits and receives data asynchronously (start-stop) at a rate of up to 120 characters per second over telephone toll or leased lines. A Bell DATA-PHONE 202C or 202D dataset or equivalent is required to convert data signals used by the communication units to signals acceptable for transmission over communication networks. At the computer location, Honeywell Series 200 computers use a Type 281-1M Single-Channel Communication Control or the Type 286 Multi-Channel Communication Control with a Type 285-1M adapter unit to communicate with the Data Station. Data flow between the central processor and the Honeywell Data Station is illustrated in Figure 1-1.

Communication between the remote Data Station and the computer involves the following sequence of events: a dialing procedure (optional), an automatic answer, an initiating signal, an acknowledgment signal, and a device selection and activation procedure. Each character is handled by the control unit as eight parallel bits (seven-bit ASCII code plus one even parity bit). When transmitting, the control unit serializes these bits and adds a stop and a start bit to each character. When receiving, the start and stop bits are dropped and the character is transferred as parallel bits.

Data is transmitted in blocks of not more than 132 characters; the last character of each block is an end-of-text (ETX) code. The ETX code must be punched into paper tape, but it need not be included in punched cards or bar-coded documents because the code is automatically generated at the end of a reading card, and at the end of reading a bar-code document.

Data transfer is terminated by the end-of-transmission (EOT) code character. When either the ETX or the EOT code is received by the Data Station or the computer, the message system logic is reversed in direction and an acknowledge (ACK) code is transmitted. Reception of the ACK code by the Data Station or the computer (whichever had transmitted the ETX or EOT code) confirms the proper functioning of the two systems and the transmission line. In case of errors or other failures, specific control codes are transmitted instead of the ACK signal.

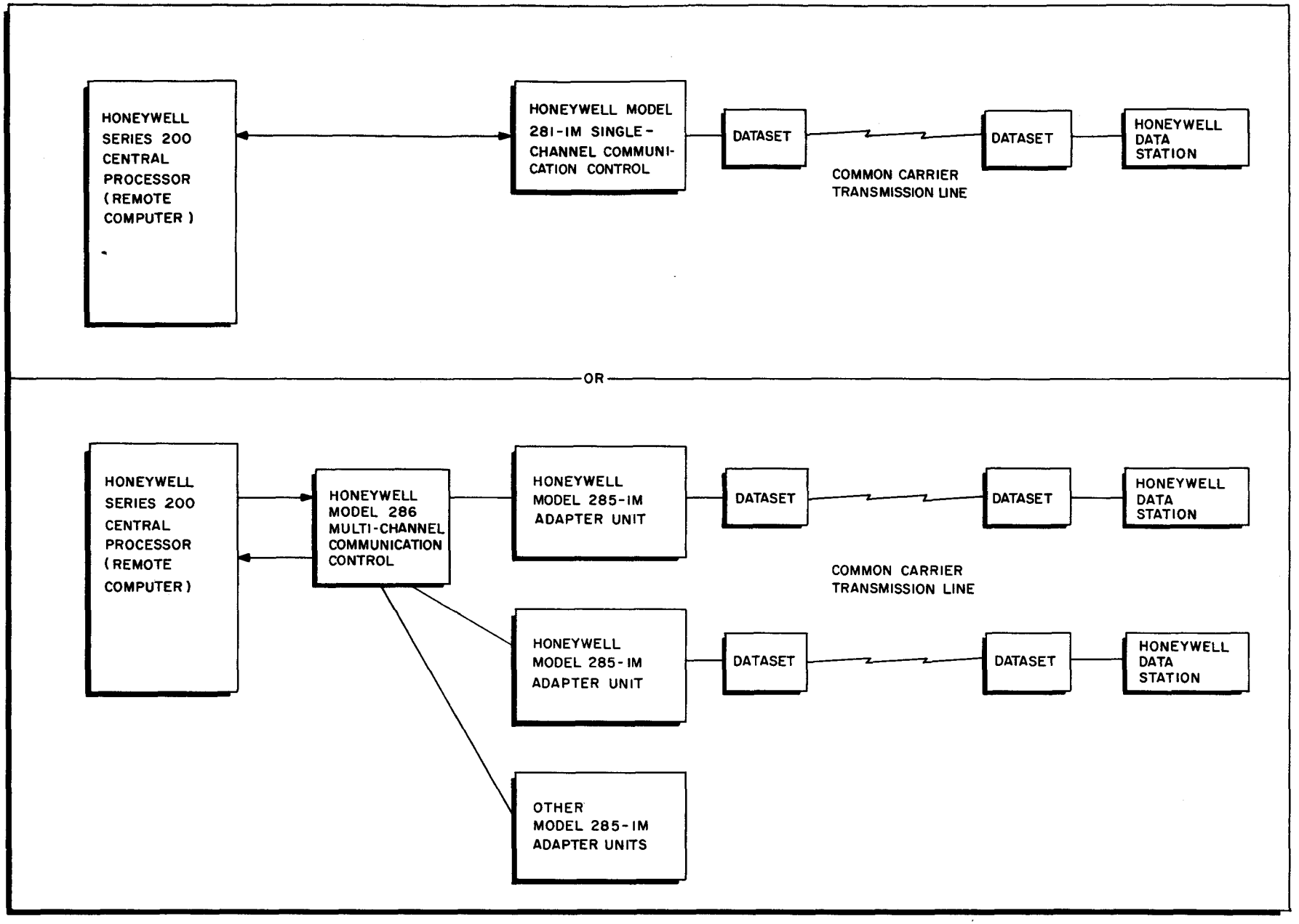


Figure 1-1. Data Flow Between the Central Processor and the Honeywell Data Station

SECTION II
THE CENTRAL CONTROL UNIT

DATA STATION CONTROL

All functions performed by the Data Station are directed by the Type 288 Central Control Unit, whether the Data Station is performing independently (in local mode) or under control of the computer (in remote mode). A keyboard must also be used in conjunction with the Central Control Unit (CCU) when the Data Station is operating in remote mode. Since the page printer comes with a keyboard, a Type 288-1 would be used in a Data Station with a page printer. If, however, a page printer is not desired in a particular Data Station configuration, an optional self-contained keyboard is available for use with the CCU.

The Data Station can operate in either of two modes; the local mode for data preparation, or the remote mode for data transmission. Operation in either mode is enhanced by the addition of the following two equipment options:

1. Delay-Line Buffer (Feature 088-1). The delay-line buffer is a magnetostrictive delay line which acts as a double buffer with a capacity of two blocks of data; each block may have a maximum length of 132 data characters.
2. Extended Operations (Feature 088-2). This option consists of the repeat last acknowledge, delay-line buffer bypass, terminal address, alarm, and telephone features described in Section I.

DATA PREPARATION

Data preparation can be performed by the Data Station when it is operating in the local mode. Under these conditions, any one or more output devices associated with the station can reproduce information from any one input device of that Data Station under the control of the Data Station operator. The effective transfer rate is that of the slowest-speed device which is involved in the operation.

DATA TRANSMISSION

Data transmission in either direction (Data Station to computer, or computer to Data Station) can take place only when the Data Station is operating in the remote mode. In this mode, device selection and control of transmission are directed by the computer. Data is transmitted in eight-bit code in all cases. The code employed is the Proposed Revision to the American Standard Code for Information Interchange (ASCII) as presented in Document X3.2/206. The ASCII code is seven-level; to this is appended a parity bit (even parity) and, when moving over the common carrier medium, a start bit and a stop bit. During transmission, the bits move serially, with

the low-order bits preceding the high-order bits. Hollerith (punched-card) code and the five-level bar code are automatically converted into the eight-bit code. Appendix A shows the eight-level code, with even parity, which is used in the Data Station.

Transmission Speed from Computer to Data Station

With the Data Station in the remote mode, one or more output devices associated with the station may simultaneously record the information supplied by the computer. The data transfer rate over the communication line is 120 characters per second if a delay-line buffer is installed in the Data Station. Without a delay-line buffer, the upper limit for the actual data transfer rate is restricted to the rate of the lowest-speed device that is activated in the system. The variation in rates to accommodate slower devices must be accomplished, whenever data is being transferred from the computer to the Data Station, by programming the computer to insert "delete" characters between each valid character in the necessary ratio.

Transmission Speed from Data Station to Computer

Any one Data Station input device may transmit information to the computer and to one or more output devices of the station simultaneously. The data transfer rate on the communication line is governed by the following conditions:

1. Without the buffer option and with no output devices of the Data Station activated, the data transfer rate is equal to that of the activated input device.
2. Without the buffer option but with at least one output device of the Data Station activated, the data transfer rate is equal to that of the lowest-speed input or output device that is activated.
3. With the buffer option and with no output devices of the Data Station activated, the data transfer rate is 120 characters per second.
4. With the buffer option and with at least one of the output devices of the Data Station activated, the data transfer rate is equal to that of the lowest-speed output device that is activated.

FUNCTIONAL ORGANIZATION

The central control unit of the Data Station is functionally divided into six areas which are described in this manual in the following order:

1. Control panel and power control (a small control panel and a power control switch).
2. Line unit (makes the Data Station compatible with the common carrier dataset interface).
3. Communication control area – CCA (performs control functions and generates certain specific control characters).
4. Data register (provides interface either for the input data bus and the output data bus, or for the delay-line buffer and the output data bus).
5. Input/output data bus (contains the connections used for data transfer and provides interface between the central control unit and the individual device control areas).

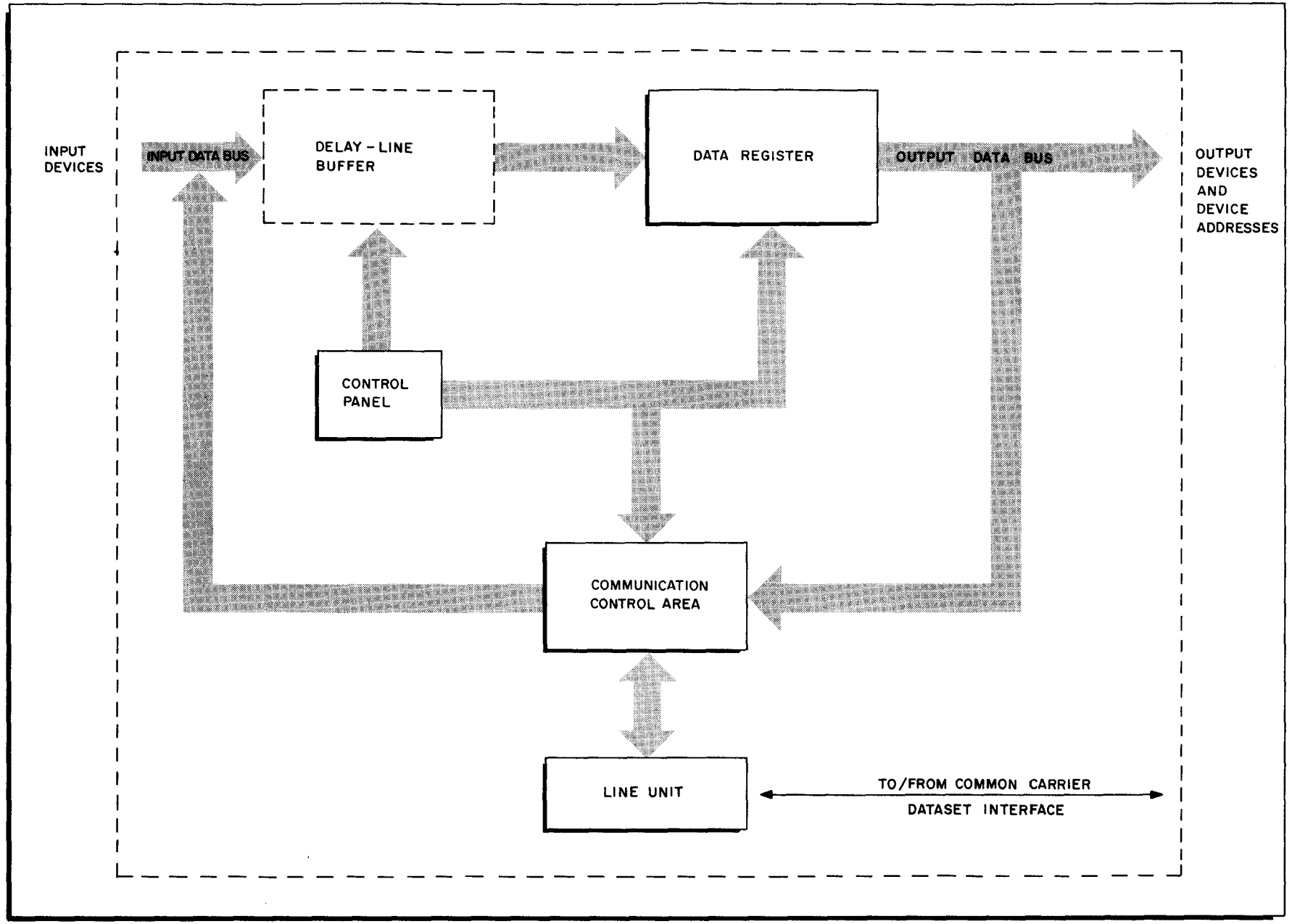


Figure 2-1. Functional Organization of Data Station Central Control Unit

6. Delay-line buffer-optional (a delay line which acts as a double buffer with a capacity of two blocks of data; each block may contain a maximum of 132 data characters).

The interrelationships among the functional areas of the Data Station CCU are shown in Figure 2-1. Note that data may flow from an input device to output devices or to the transmission medium, or data may enter from the transmission medium and flow to the output devices.

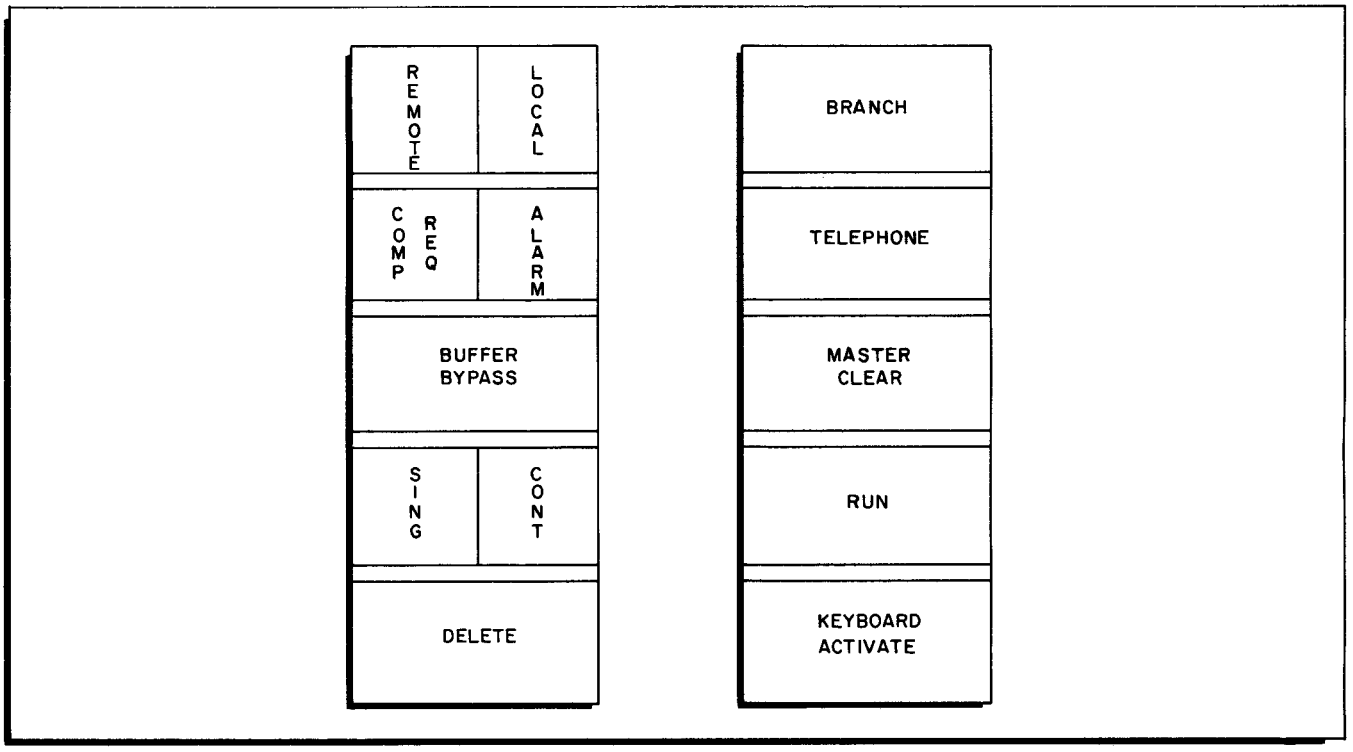


Figure 2-2. Data Station Control Panel

Control Panel and Power Control

The central control unit has a small control panel for use in operating the system. The control panel is an integral part of every Data Station and must be used in every data preparation and data transfer operation.

The controls and indicators which are discussed here are all contained on the CCU control panel with the exception of the power control which is located so that power cannot be easily, inadvertently turned off.

POWER ON SWITCH

The POWER ON switch, located on the bottom frame of the logic cabinet, controls the main line ac power. In the ON position, power is supplied to all dc supplies in the system.

MASTER CLEAR SWITCH

The MASTER CLEAR switch is a pushbutton switch, solid red in color, which is used to initialize all circuits within the communications control area (CCA) of the CCU and all DCA's. The MASTER CLEAR switch also clears the delay-line buffer if this option is present.

REMOTE/LOCAL INDICATOR SWITCH

The REMOTE/LOCAL switch is a pushbutton indicator switch which determines whether the Data Station is in the remote or the local mode. This switch also performs all functions of the MASTER CLEAR switch when it is transferred from one state to the other. As the pushbutton is alternately pressed, released, and pressed again, the modes will change and the appropriate half of the indicator will illuminate to show which mode the Data Station is currently operating in.

SING/CONT PUSHBUTTON INDICATOR

The SING/CONT switch is used only when the Data Station is in the local mode. The switch is a pushbutton indicator type; selecting single block (SING) allows the activated input device to present data characters sequentially to the input data bus when the RUN button on the control panel is pressed. The data register (or the delay-line buffer if the option is present) is continually searching for the end-of-text (ETX) or end-of-transmission (EOT) character. When the ETX character is detected in single block operation, input data transfer from the activated device stops. Input data transfer can be resumed by pressing the RUN button; transfer terminates whenever the EOT character is detected. In continuous read (CONT) operation, input data transfer terminates only when an EOT is detected. Further data transfer after an EOT stop can be effected by pressing MASTER CLEAR and again depressing the RUN button. The SING/CONT switch can be depressed during data transfer; it has no effect on the operation.

RUN PUSHBUTTON INDICATOR

The RUN switch is used in conjunction with the SING/CONT switch in the local mode. After the latter switch has been set in the desired position and the selected peripheral device has been activated, pressing the RUN switch initiates data transfer from the activated input device to the input data bus. The RUN indicator will light when data is being transferred in either the local or remote mode. Data Station terminal devices may <u>not</u> be activated or deactivated when the RUN indicator is lighted.

DELETE SWITCH

The Delete switch is enabled only when the keyboard is activated. This switch can be used in both the local and remote modes but only when the delay-line buffer is installed and is active in the system. The DELETE button is a pushbutton switch which is used to erase from the delay-line buffer a block of data which has just been entered from the keyboard.

BRANCH PUSHBUTTON INDICATOR

The BRANCH switch is a pushbutton indicator switch that is used in the remote mode only. When the switch is pressed, the computer is informed that the Data Station operator wishes to enter information from the keyboard or some other predesignated input or output device(s). Pressing the BRANCH switch causes the indicator to light when the branch message is sent to the computer in one of two ways:

1. Data transfer from the Data Station to the computer. If the delay-line buffer option is not present, the branch message is sent in place of the next data message. With the delay-line buffer, the branch message is sent as the next data message after the buffer is empty (data transfer from the input data bus to the buffer is inhibited when the first ETX (or EOT) character is sensed after the BRANCH button is pressed).
2. Data transfer from the computer to the Data Station. The branch message is sent in place of the next affirmative acknowledgment (ACK) message.

BUFFER BYPASS PUSHBUTTON INDICATOR

This switch is used during local mode operation when the delay-line buffer and the buffer bypass logic of the extended operations (Feature 088-2) are included in the Data Station. Pressing the BUFFER BYPASS switch lights the indicator and allows data being transferred in the control unit to bypass the delay-line buffer during all subsequent operations. In the remote mode, the buffer is bypassed under control of the computer. When the bypass message is properly received from the computer, the indicator will light and the data will bypass the buffer.

TELEPHONE PUSHBUTTON INDICATOR

This switch is used only in the remote mode when Feature 088-2 is included in the Data Station configuration. The switch is used to inform the computer that the Data Station operator desires to talk on the dataset with the computer operator and that the data transfer in progress will be discontinued. Depressing the TELEPHONE button causes its indicator to light and allows the telephone message to be sent to the computer at the next transmission, regardless of the message previously scheduled. All data transfer, except the telephone message, will stop. If the telephone indication is received from the computer, the indicator will also light and all data transfer will stop except for acknowledgment signals.

ALARM INDICATOR

The ALARM indicator, active only during remote mode operation and when Feature 088-2 is included in the Data Station configuration, glows red when an alarm message has been properly received from the computer. This indicator lights only on reception of the ALM control character from the computer.

COMP REQ INDICATOR

The COMP REQ (computer request) indicator, active only when Feature 088-2 is included in the Data Station configuration, will light when the Data Station is addressed by the computer. The indicator light will go out only after the telephone connection is broken.

KEYBOARD ACTIVATE PUSHBUTTON INDICATOR

When the KEYBOARD ACTIVATE pushbutton is pressed, during operation in the local mode, the indicator will light and the keyboard will be energized. The KEYBOARD ACTIVATE indicator will go out when the keyboard is deactivated by depressing the MASTER CLEAR pushbutton. In the remote mode, the indicator will be lighted when the keyboard is activated and will go off when a deactivate message is received.

Line Unit

The line unit makes the Data Station compatible with the common carrier dataset interface. The Bell 202C or 202D DATA-PHONE is usually used with the Honeywell Data Station; however, the use of any other equivalent dataset is not precluded.

The line unit is used only in the remote mode when data is being transferred from the Data Station to the computer or from the computer to the Data Station. In the remote mode, the line unit performs the following functions when the conditions are as stated.

When data is being transferred from the Data Station to the computer, the line unit:

1. Appends one start and at least one stop bit to each character transmitted;
2. Requests a new character immediately after transferring the first stop bit of the last character to the dataset;
3. Acknowledges receipt of each character from the output data bus;
4. Serializes each character; and
5. Synchronizes each bit to the 1200 bits/second rate allowed by the dataset.

When data is being transferred from the computer to the Data Station, the line unit:

1. Determines when a character has been received;
2. Activates and holds the input data ready lead until either the input data acknowledge lead is activated or the next start bit arrives (minimum time of 1.67 ms);
3. Performs serial-to-parallel conversion;
4. Accepts characters from the dataset after the stop-bit of one character and the start-bit of the following character are recognized (stop/start transition) and times delivery of the characters to the Data Station at 1200 bits/second rate;
5. Strips off start and stop bits;

6. Recognizes and discards delete characters (code: 11111111);
7. Checks parity of each character; and
8. Generates substitute character (code: 10000001) for each character received which has bad parity.

DATASET INTERFACE

The dataset interface issues signals for controlling the telephone line and provides an interface between the dataset and the central control unit. Data transfer to and from the dataset is serial by bit.

Communication Control Area

The communication control area of the CCU performs certain control functions and detects and generates specific control characters during both the sending and the receiving of data messages. When receiving data from the computer, the communication control area:

1. Detects the start-of-text (STX) and end-of-text (ETX) characters;
2. Computes the longitudinal record check (LRC) character to check incoming channel parity;
3. Detects the deactivate (DAC) signal;
4. Generates either the acknowledge (ACK) or error (NACK) message for the computer, according to the setting of the error indicator, after each data message is received;
5. Generates the branch (BCH) message in place of the ACK message when the branch indicator is set;
6. Decodes the control sample (CS) signal to indicate that subsequent characters are device addresses and are not data;
7. Detects the start-of-header (SOH) character and the Data Station address (optional).
8. Detects the delay-line buffer bypass (DBP) control character (optional);
9. Generates the telephone message (TEL) when telephone indicator is set (optional);
10. Detects the telephone (TEL) control character (optional); and
11. Detects the alarm (ALM) control character (optional).

When sending data to the computer, the communication control area:

1. Appends a start-of-text (STX) character to each data block;
2. Computes and appends an LRC character to each message after the ETX character;
3. Detects ACK and NACK messages from the computer and responds by:
   a. Retransmitting the last data block to the computer upon receipt of a NACK message (only if the delay-line buffer option is present); and
   b. Sending the next data block upon receipt of an ACK message (with or without the delay-line buffer option);

4. Generates the branch (BCH) message when the Data Station is in the remote mode and the BRANCH button has been pressed (see "Control Panel and Power Control" discussion in this section);
5. Detects a deactivate (DAC) signal from the computer, switches over to receiving mode, deactivates all devices, erases the information contained in the buffer, and clears all status indicators;
6. Detects the telephone control character (TEL) (optional);
7. Generates the telephone message (TEL) when the telephone indicator is set (optional); and
8. Detects the alarm control character (ALM) (optional).

DATA STATION CONDITION SETTING

The communication control area of the CCU maintains the setting of the condition indicator to record whether the Data Station is in the data receiving or the data transmitting condition. The condition is determined by computer control signals in the course of data exchange. Receiving an input address in the device activation message from the computer puts the Data Station in the data transmitting condition. The absence of an input device address in the message leaves the Data Station in the data receiving condition. Within each of the two conditions, two states are permissible: (1) sending data; or (2) accepting data, as maintained by the communication indicator.

LRC VALIDATION AND GENERATION

All messages transmitted between the Data Station and the computer end with an 8-bit longitudinal record check (LRC) character. Each bit position of the LRC character contains the modulus 2 sum of the corresponding bits in all preceding characters of that message, including the STX and ETX characters. (The modulus 2 sum represents the remainder (either 0 or 1) after division of the sum by an integral of two.) The computer LRC character itself has even parity if the LRC is valid.

Data Register

The data register in the central control unit is an 8-bit register which provides the interface either for the input data bus and the output data bus, or for the delay-line buffer and the output data bus. Figures 2-3, 2-4, and 2-5 show the general data paths between the different areas under various modes of operation.

The flow of data through the data register when the Data Station is operating in local mode is controlled by the SING/CONT button. In local mode, with the single block setting, data transfer is initiated by pressing the RUN button. In this mode of operation, one block of information (each block of information is ended by the ETX character; the last block terminates with the EOT character) is transferred for each depression of the RUN button until the EOT character is detected.

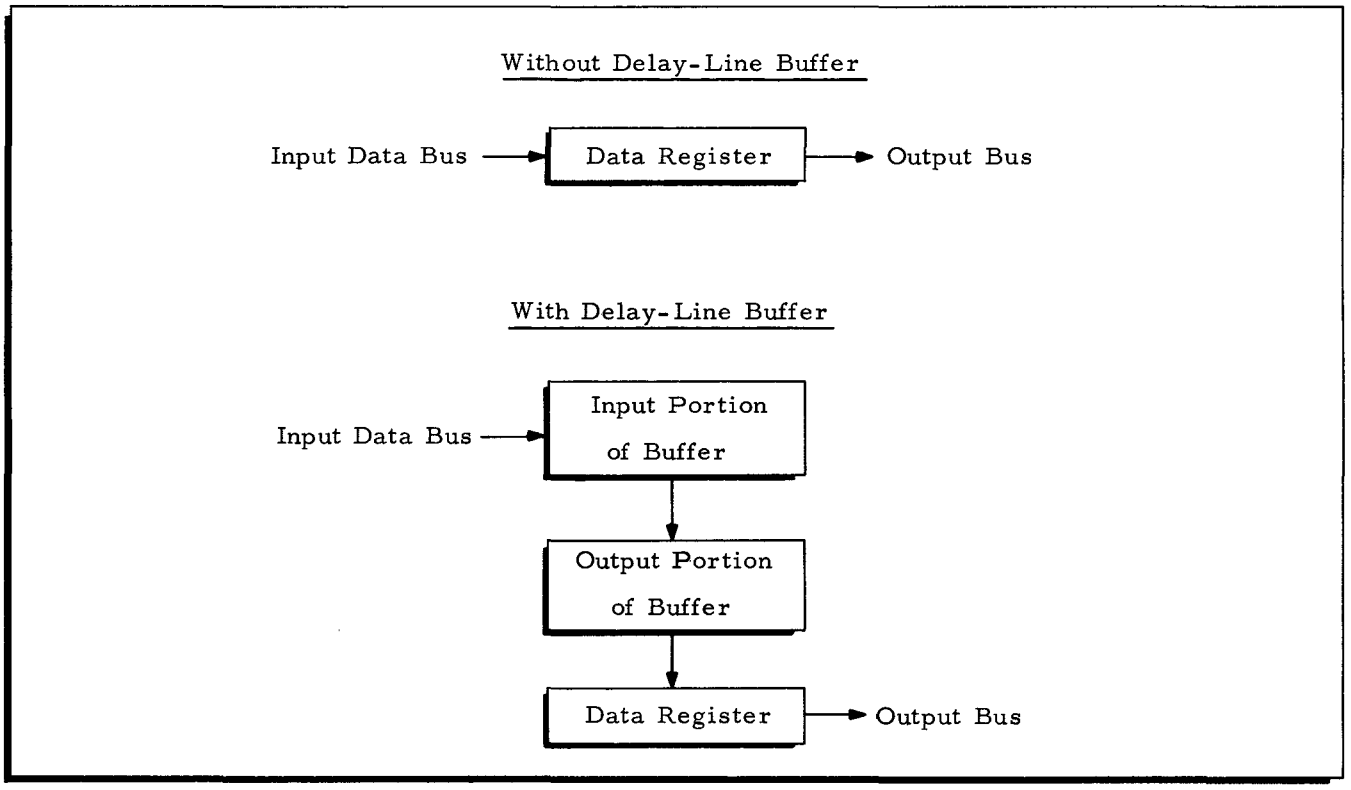


Figure 2-3. Local-Mode Data Paths

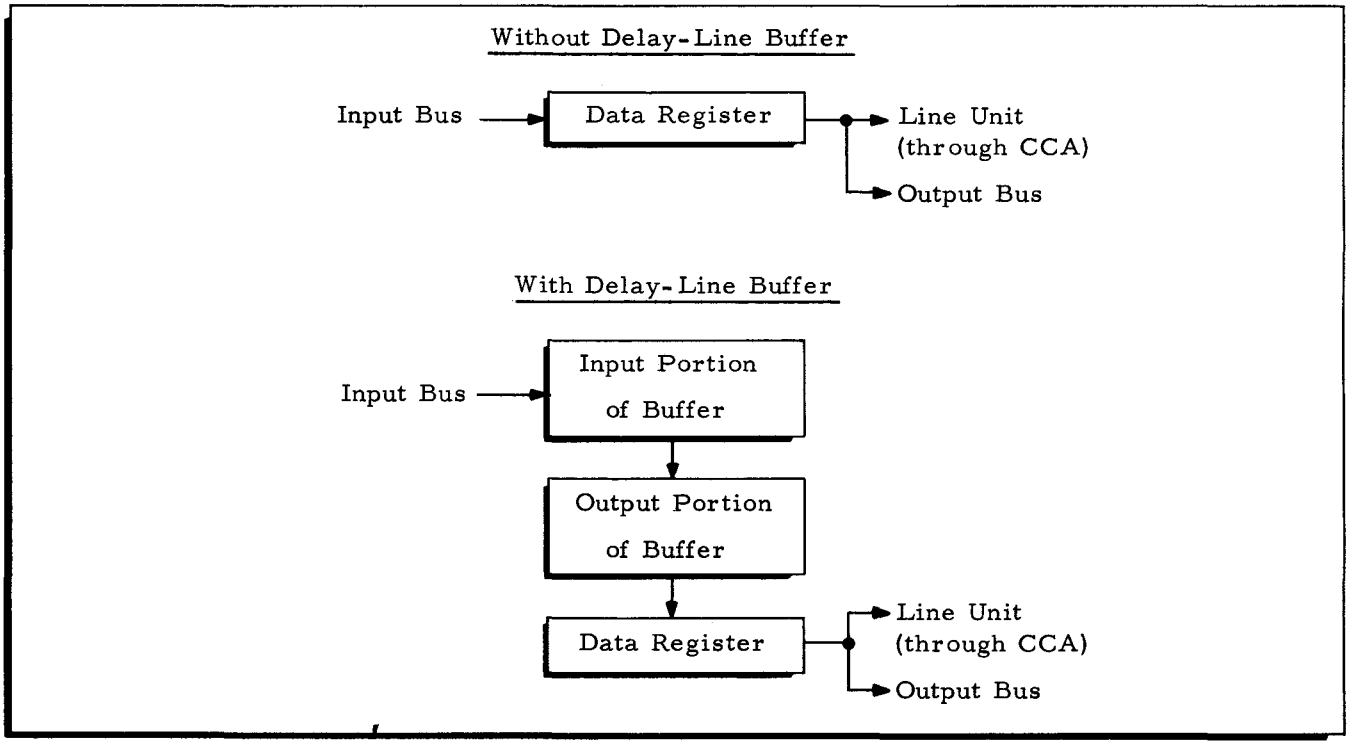


Figure 2-4. Remote-Mode Data Paths (Transmitting Data to Computer)

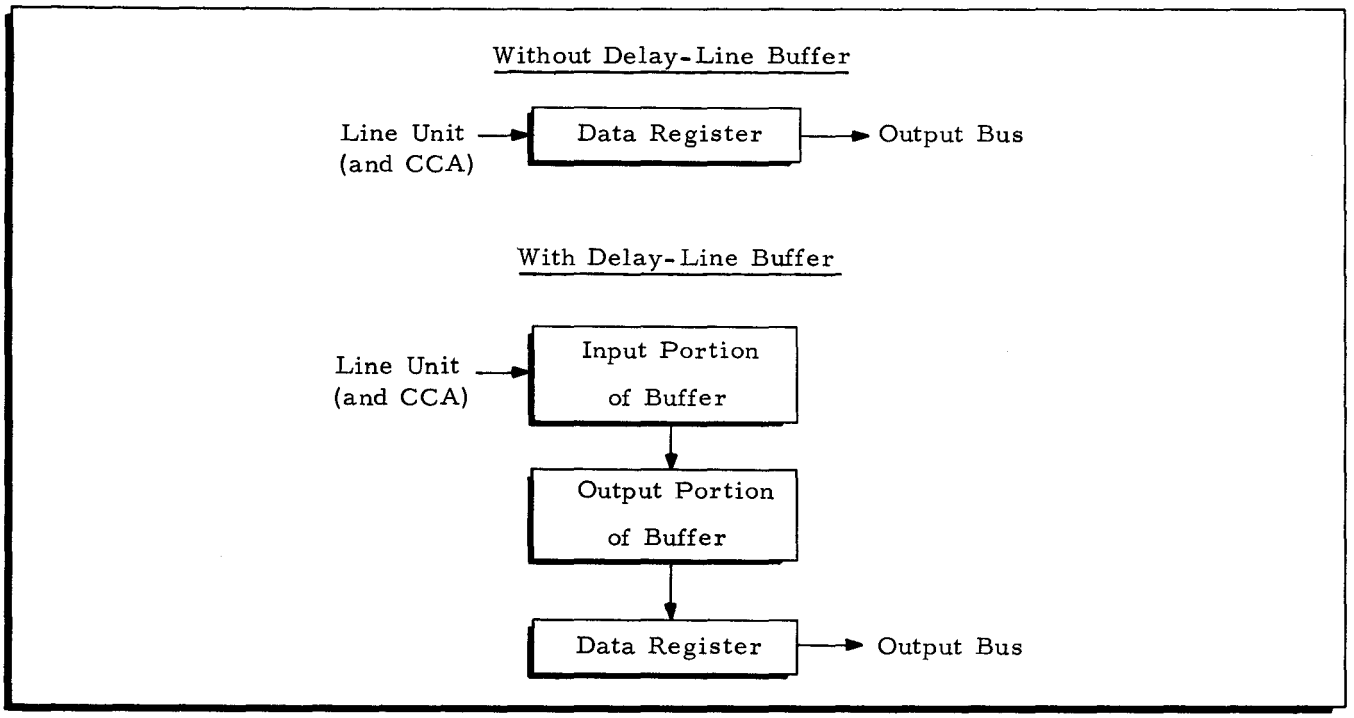


Figure 2-5. Remote-Mode Data Paths (Receiving Data from Computer)

With the continuous read (CONT) setting in local mode, the data transfer from the input data bus to the output data bus is initiated by pressing the RUN button. Data transfer is terminated by sensing the EOT character. The setting of the SING/CONT switch can be changed at any time during data transfer in the local mode.

DATA TRANSFER ON THE INPUT DATA BUS

Data transfer on the input data bus is serial by character and parallel by bits. Each character is requested and acknowledged by the data register, or by the delay-line buffer if this option is present.

DATA TRANSFER ON THE OUTPUT DATA BUS

Data transfer on the output data bus has the same format as in the case of the input data bus, i.e., serial by character and parallel by bits. Each character is again requested and acknowledged by the data register, or by the delay-line buffer if the latter is present.

Input and Output Data Buses

The interface between the Data Station's central control unit and the individual device control areas contains the lines which are illustrated in Figure 2-6 and described below.

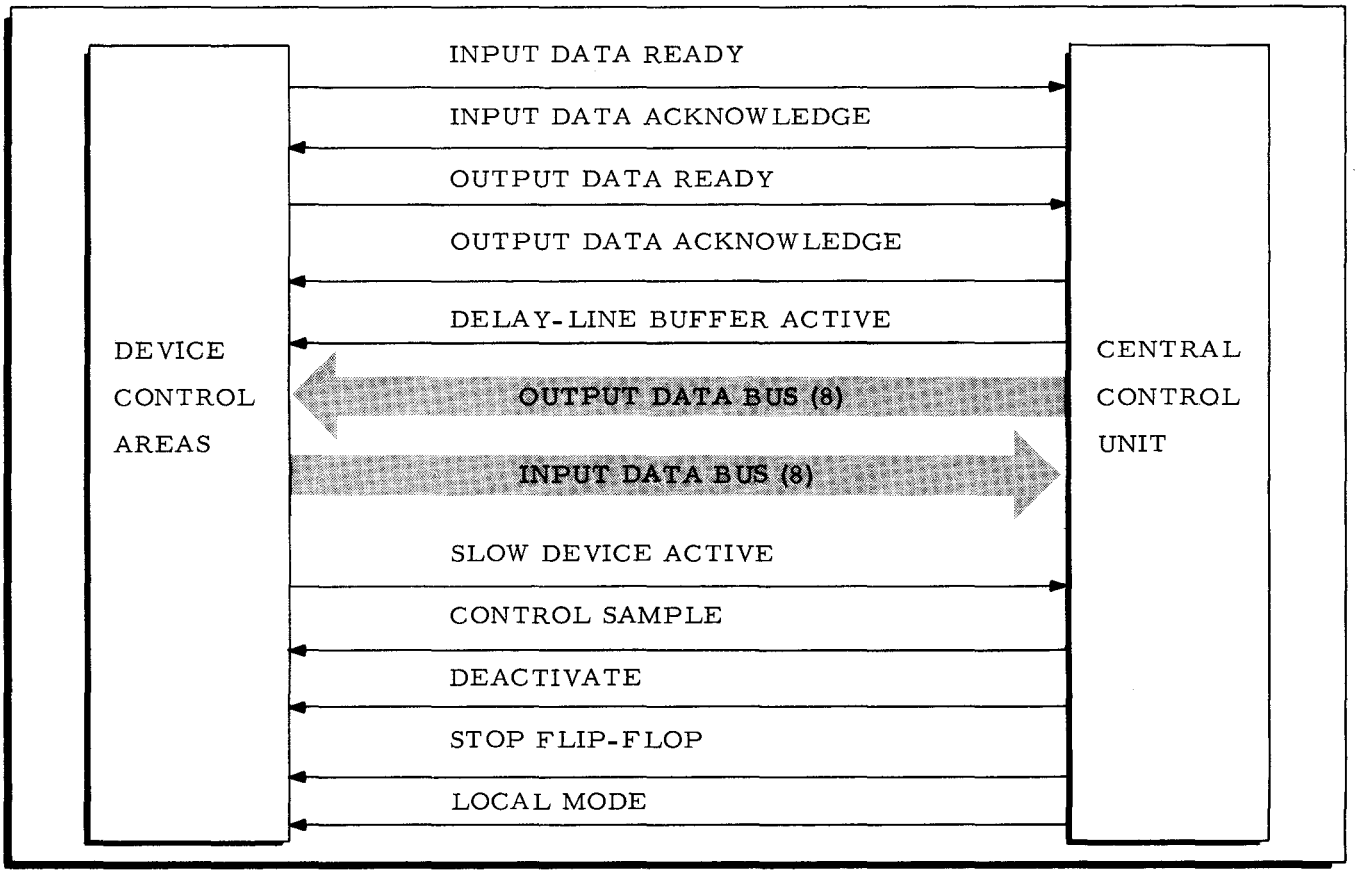


Figure 2-6. Central Control Unit Input/Output Bus

INPUT DATA BUS

The input data bus comprises eight leads on which the line unit and the input DCA's may place their data.

OUTPUT DATA BUS

The output data bus comprises eight leads on which the data register places a data character or an address character for transfer to the line unit and output DCA's. (Input DCA's monitor the output data bus for addressing purposes only.)

INPUT DATA READY (IDR)

The activated input device controls the IDR lead to the data register. A signal on this lead indicates that the next character may be read by the data register (or the delay-line buffer).

INPUT DATA ACKNOWLEDGE (IDA)

The data register (or the delay-line buffer) returns the input data acknowledge signal to the input device when it has accepted the character presented on the input data bus and requests another character.

OUTPUT DATA READY (ODR)

The data register permits each output device to sample the ODR lead, indicating that the next character may be read from the output data bus.

OUTPUT DATA ACKNOWLEDGE (ODA)

The activated output device(s) return a common output data acknowledge indication to the data register when all of them have received the character presented by the data register and are ready for the next character.

CONTROL SAMPLE (CS)

The control sample lead is activated to suspend all normal input data transfer and to indicate that the device addresses are being placed on the output data bus.

DEACTIVATE (MASTER CLEAR)

When the communication control area energizes the deactivate lead, all device control areas (DCA's) are deactivated and all their logical functions are returned to the initial state. All other CCU functions are inhibited during the period that the deactivate lead is enabled.

LOCAL MODE

When energized, the local mode lead enables individual DCA's to be activated by their own activation switches and to operate in the local mode.

STOP FLIP-FLOP

The stop flip-flop lead is energized at the same time that the control sample lead is energized and is de-energized approximately one second after the control sample lead is de-energized to allow for acceleration of activated devices.

SLOW DEVICE ACTIVE

The slow device active is a common lead to the central control unit. It supplies a pulse to restart the line-unit timeout whenever a character slower than ten characters per second is entered into the delay-line buffer from an input device.

DELAY LINE BUFFER ACTIVE

A signal on this lead indicates that the delay-line buffer is incorporated in the Data Station configuration and is not in a bypass condition. Absence of the signal indicates either that the delay-line buffer is not included, or that it is included but is in a bypassed condition.

INFORMATION TRANSFER

In any information transfer between the Data Station and the computer, the receiving device acknowledges each block of data that has been transmitted. In general, control messages are also acknowledged, although there are a few exceptions. In those instances where acknowledgments are not generated, the Data Station is guaranteed to be in the communications receive condition, thereby allowing the computer access to correct communication errors.

The Data Station has two communications conditions, receiving and transmitting; each condition has two states, either sending or accepting data. Four communications states are possible, then, depending upon the settings of the condition and communication indicators:

State #1 - Receiving condition, accepting data;

State #2 - Receiving condition, sending data;

State #3 - Transmitting condition, accepting data; or

State #4 - Transmitting condition, sending data.

Every message generated in a Data Station starts with an STX character and is terminated by an ETX or EOT character followed by the longitudinal record check (LRC) character. The allowable messages for each of the communication states are shown in Table 2-1 and are discussed in the following paragraphs.

Mnemonics referenced in Table 2-1 are:

MNEMONIC	DESCRIPTION
STX	Start of Text
ETX	End of Text
EOT	End of Transmission
LRC	Longitudinal Record Check (mod 2 sum)
DAC	Deactivate Signal (DC4)
DA	Device Address
ACK	Acknowledge Signal
NACK	Negative Acknowledge (error) Signal
BCH	Branch Request Signal (DC3)
ENQ	Repeat Last Acknowledge (computer did not receive it)
SOH	Header Character for Terminal Address Message
TA	Terminal Address (in polling on leased lines)
DEL	Delete (all ones)
CS	Control Sample (header for Device Address Message) (DC1)
TEL	Telephone (DC2)
ALM	Alarm (Bell)
DBP	Delay-Line Buffer Bypass (ETB)

Table 2-1. Data Station Message Formats

RECEIVING		TRANSMITTING	
Accepting Data (State #1)	Sending Data (State #2)	Accepting Data (State #3)	Sending Data (State #4)
STX DATA[1] . . . ETX (EOT) LRC	STX ACK ETX LRC	STX ACK ETX LRC	STX DATA[1] . . . ETX (EOT) LRC
STX[2] DAC[4] 3 DEL STX CS DA_1 . . . DA_n ETX LRC	STX[5] BCH ETX LRC	STX DAC[3] 3 DEL STX[6] CS DA_1 . . . DA_n ETX LRC	STX BCH ETX LRC
Optional Formats	Optional Format	Optional Formats	Optional Format
STX ENQ ETX LRC	STX TEL ETX LRC	STX NACK ETX LRC	STX NACK ETX LRC
STX ALM ETX LRC		STX TEL ETX LRC	STX TEL ETX LRC
STX SOH TA ETX LRC		STX ALM ETX LRC	
STX TEL ETX LRC		STX DAC 3 DEL STX[6] DBP ETX LRC	
STX DAC 3 DEL STX DBP ETX LRC		STX CS[7] $DA_1 \ldots DA_n$ ETX LRC	
STX CS[7] DA_1 . . . DA_n ETX LRC			

NOTES

1. STX, NULL, ETX, and LRC is the dummy message format.
2. With delay-line buffer option, computer sends dummy message before this instruction.
3. STX, DAC, ETX, LRC allows Data Station to time-out (disconnect).
4. STX, DAC, ETX, LRC allows data station to time-out (disconnect).
5. With delay-line buffer option, computer sends dummy message after this instruction.
6. Data Station switches to the receiving condition, accepting data in time for this STX to accept CS and device address(es), or DBP.
7. The control sample (CS) message must immediately follow the DBP message above it. This is the only condition under which the CS message is not part of the DAC message format. If this message is answered by the Data Station with a NACK (or time-out at computer occurs with nothing having been received), then both the DBP message and this message must be repeated.

Receiving Condition and Accepting Data (State #1)

This is the quiescent state of the Data Station. Reception of an ETX will take the Data Station to State #2. A DAC followed by a CS character with input devices requested will take the Data Station to State #4. If the STX message is not decoded correctly, no action will be taken on the message and no acknowledgement message will be sent to the computer. If two STX characters are detected in the same message without an ETX character, the error state will be set and will cause a NACK message to return to the computer at the next acknowledgement.

The DAC message need not terminate with the ETX and LRC characters since the DAC message causes a master clear in the Data Station, erasing all previous information. The computer may immediately activate a new set of devices by following the DAC message with three delete (DEL) characters and a new message. The new message is headed by the control sample character to indicate that the following characters are device addresses and not data. Special programming considerations must be observed when the DAC message is used with the delay-line buffer option. These considerations are discussed in Section III.

The optional repeat last acknowledgement, terminal address, telephone, and alarm messages are allowed in this state as well as data and DAC messages. A properly received activation message is always acknowledged if output devices are requested. An activation message requesting an input device is followed by the first data message from that device.

An optional message series in this state is the buffer bypass (DBP) message followed by a control sample message with the selection of device(s) to be used for the data to follow in the buffer bypassed communication. If either the first or second message of this series is not answered, or is answered with a NACK, then the entire series must be repeated. The delay-line buffer is restored in response to a DAC and CS message.

Receiving Condition and Sending Data (State #2)

In this state, the Data Station will either acknowledge a previously received data block, or issue a branch or telephone message. If the previous data message was received in error, a NACK will be sent in place of ACK. The branch message may only replace an ACK message. The telephone message may replace any of the other three messages.

Transmitting Condition and Accepting Data (State #3)

In this state, the Data Station expects an acknowledgement (ACK or NACK) to its previously transmitted data message. The Data Station, however, may accept the deactivate message which returns it to the receiving condition, accepting data, (State #1) in time for the CS portion if the message is for new device activations. The optional TEL and ALM messages may also be accepted in this state.

Transmitting Condition and Sending Data (State #4)

In this state, three messages can be generated (plus the optional TEL message). One of these, the data message, may contain any number of characters from zero up to the total length of the message the user wishes to send (a maximum of 132 data characters with the delay-line buffer option present). Terminating this message with EOT in place of ETX indicates the end of data from the presently activated input device. The other messages which can be generated are the branch message and the error message. The telephone message may replace any of the other messages in this state. The branch message may replace only a data message when the buffer, if present, has been emptied. The error message is transmitted in cases where an acknowledge message was detectable but not decodable by the Data Station.

Data Station Dataset Disconnect Procedure

If no data or control characters are transmitted or received for more than a 30-second period when the Data Station expects such an operation to take place, the logic will cause the dataset to disconnect. This timeout will time the interval between key strokes if the keyboard is activated. The preferred method for the computer to terminate a transmission is by sending a message consisting of STX, DAC, ETX, LRC. If this message is detected but not decoded, the Data Station will return a NACK message. No acknowledgement is expected if this message is properly decoded.

DELAY-LINE BUFFER

The delay-line buffer is an optional feature which can be incorporated into the Data Station central control unit (CCU). Space for implementing the delay-line buffer is reserved in the CCU cabinet. The buffer is essentially a magnetostrictive delay line which acts as a double buffer with a capacity of two blocks of data (3000 bits) and a recirculation time of 1.5 milliseconds. The maximum length of each data block is 132 data characters. The delay-line buffer functions in both the local and the remote modes of the Data Station.

Local Mode Functions

When the Data Station is operating in the local mode, the buffer allows data that has been prepared at a keyboard to be validated by the operator prior to presentation to the output data bus. The operator of the Data Station controls the data output with the control panel DELETE button and the keyboard end-of-text (ETX) and end-of-transmission (EOT) keys. Pressing either the ETX or the EOT key allows data presently in the buffer to be presented to the output data bus. Depression of the DELETE button causes the block of data presently being entered into the buffer from the keyboard to be erased. When the buffer is full, it can be made ready to accept the next block of data from a data source by depressing either the ETX or EOT key or the DELETE button.

The buffer will be cleared and ready to accept data in 2.2 ± 0.4 milliseconds after the key (or button) has been depressed.

Remote Mode Functions

In the Data Station's remote mode, the delay-line buffer allows data received by the station to be validated prior to presentation to the output data bus. The buffer also permits data sent from the Data Station to be retransmitted if so requested by the computer. By using the delay-line buffer option, the data transfer rate can be made independent of the Data Station's terminal device rates. The data rate on the communication line is 1200 bits per second, except when an output device (or several devices) is monitoring a data transfer from the Data Station. In this case, the data rate on the communication line will be identical to that of the monitoring device with the slowest speed.

Operation with the Buffer

Operating procedures for the Data Station with the delay-line buffer are much the same as when the option is not present in the system. The following exceptions apply, however, to operation in the remote mode:

1. When using the keyboard, the DELETE button is available for use to erase an erroneously keyed block of data from the buffer.
2. Care must be exercised to avoid overloading the buffer. If the buffer is overloaded, the data which overflows will be lost. The current data block would have to be resubmitted to the buffer after removing the cause of the overload.

The computer may send information to the Data Station at a 120-character-per-second rate, regardless of the transfer rate of the output device, when the buffer is present. However, when the Data Station has been receiving data from the computer, a dummy message from the computer must be accepted by the Data Station before any deactivate (DAC) message can be issued by the computer.

The delay-line buffer is capable of holding two variable-length blocks of data. A character within the buffer contains ten bits. Eight bits are presented by the input data bus (seven-level code plus one parity bit), and two indicator bits are appended by the buffer for internal reference purposes. Arrangement and explanation of the indicator bits is shown in Table 2-2.

Table 2-2. Description of Indicator Bits

I_1	I_2	Description
0	0	No data in corresponding character position.
1	0	Data is in corresponding character position.
1	1	First character of the block being written into buffer, or next character to be read from the buffer.
0	1	Unspecified.

The delay-line buffer contains two independent areas, one for writing into the buffer and the other for reading out of the buffer. Erasure and validation of data within the buffer is externally controlled; each buffer area is independently controlled. When a full valid block has been transferred into the write area, an indicator is set. That block of data is transferred to the read area as soon as the read area is empty. Whenever the write area is full, data is not accepted from the input data bus.

WRITING INTO THE BUFFER

Characters (both data and control) are presented on the eight data leads of the input data bus. If the write area is void of information, the first character presented on the bus has two indicator bits (I_1I_2=11) appended as that character is serially transferred into the write area. Subsequent characters presented on the bus are placed in successive character locations of the write area with I_1I_2=10. This is accomplished by placing the first character in an arbitrary write area character location. Thereafter, characters are placed in the first character location with I_1=0 after a character position with I_1=1.

The write full indicator is set when a full valid block has been transferred into the write area. After transfer of data from the write area to the read area, the buffer is ready to accept the next block of data.

In the remote mode, validation or erasure of data in the write area is under the control of the communication control area (CCA). When transferring data to the computer, each block written is immediately accepted when the ETX character appears on the input data bus. When receiving data from the computer, a block is validated if all character parity bits and the LRC character are correct. If they are not correct, the CCA will issue a command to erase the contents of the write area in the buffer.

In the local mode, a block of data is completed in the write area whenever the ETX or EOT character is sensed on the input data bus. In either the remote or the local mode, when

using the keyboard, pressing the DELETE button on the control panel causes the contents of the write area in the buffer to be erased.

READING FROM THE BUFFER

Whenever the read indicator is set, the buffer will present a character to the data register upon receipt of the preceding character by the output data bus. The read area of the buffer presents the character containing 1's in both indicator bits to the register. After this character has been presented, the real area logic sets I_2 of the next data character to 1. If the character just presented is ETX or EOT, at least the following character position of the read area will not contain data (I_1I_2=00). The read area logic searches for the first character of the block (I_1=1) and sets I_2 of that character to 1 when the Data Station is transferring data to the computer. Otherwise, presenting the ETX or EOT character to the data register causes the read area to be erased.

Whenever the read full indicator is not set and the write full indicator is set, the contents of the write area of the buffer are transferred to the read area. After transferring data to the read area, the read full indicator is set. This indicator remains set until the read area is erased. In the local mode, the read area is erased after transferring an ETX character to the data register. When accepting data from the computer, the read area is erased each time it presents an ETX character to the data register.

When data is being transferred to the computer, erasure of the read area is under control of the CCA. The CCA causes the read area to be erased upon positive acknowledgment from the computer. On negative acknowledgment, the CCA causes the read area to be read once again. Pressing the REMOTE/LOCAL button, or receipt of the DAC control character from the computer, causes both the read and write areas to be erased.

SECTION III

PROGRAMMING INFORMATION

The programming reference data presented in this section applies uniformly to all devices which might be incorporated in a particular Data Station configuration and to the central control unit (CCU). Variations in programming information which apply to particular devices are described under the major headings below.

CENTRAL CONTROL UNIT

The character code used by the Data Station is the 8-bit ASCII code previously mentioned and described more fully in Appendix A. Each 8-bit character sent to and received from a Data Station occupies two memory locations in a Honeywell Series 200 computer. Figure 3-1 shows the code as it appears under ideal conditions in a ten-bit character (includes start and stop bits) moving over the common carrier medium. The bits move serially with the low-order bits preceding the high-order bits (start, 1, 2, ...7, 8, stop) in time.

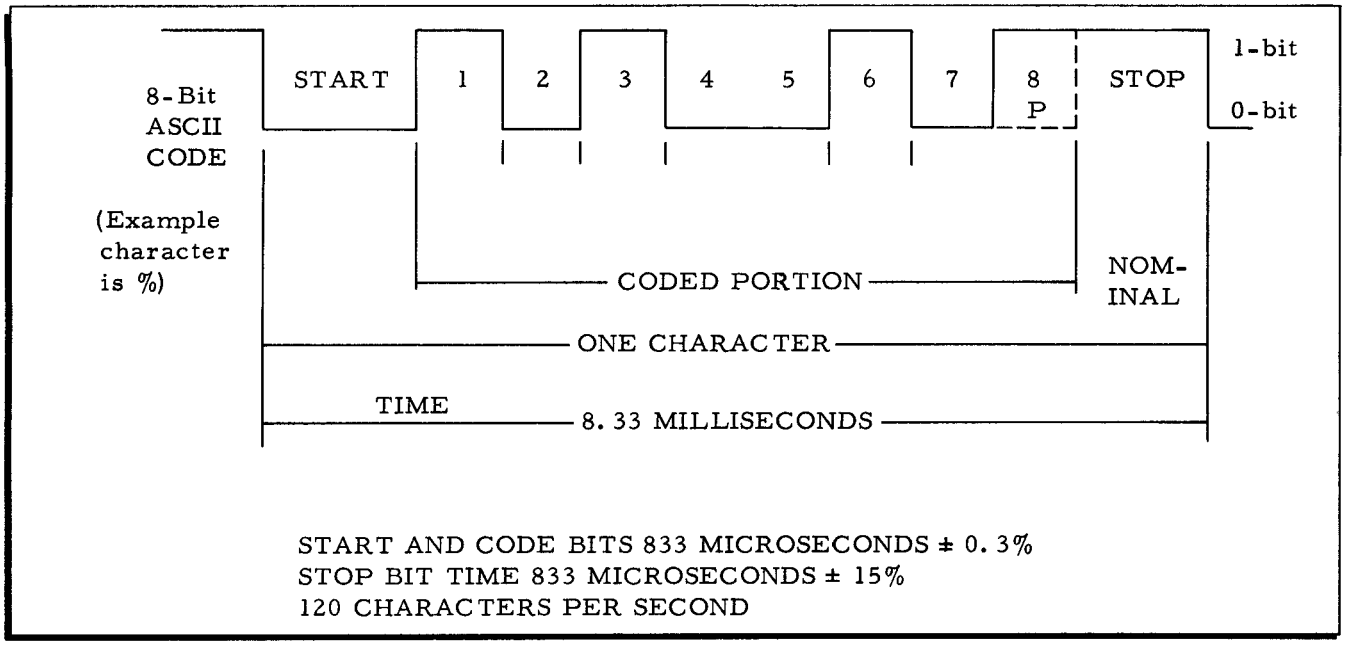


Figure 3-1. Data Station Code Character Over Common Carrier Medium Under Ideal Conditions

Figure 3-2 shows,the code for one character as it appears in Series 200 memory. Note that each ASCII character occupies two locations in memory, with the low-order bits in the low-order portion of each location.

DATA STATION SENDING (COMPUTER RECEIVING)

		0	0	0	0	*	B7	Location A
IM	WM	B6	B5	B4	B3	B2	B1	Location A + 1

*Depending upon the computer/communications interface selected, this bit (B8) will be received into memory as even parity to be checked by the program, or it will be recorded in memory as a zero (0) with parity checking being performed by hardware.

DATA STATION RECEIVING (COMPUTER SENDING)

		0	0	0	0	**	B7	Location A
		B6	B5	B4	B3	B2	B1	Location A + 1
IM	WM							Location A + 2

**Depending upon the computer/communications interface selected, this bit will have to be issued by the program with even parity, or parity will be generated by the hardware.

where: WM = Word Mark
IM = Item Mark
IM + WM = Record Mark
B_n = Data Bit

Figure 3-2. Data Station Code Character in Series 200 Memory

Data Rate Variation

The character rate on the communication line is always 120 characters per second. The variation in rates to accommodate slower devices in a Data Station that is not equipped with the delay-line buffer option is accomplished by programming the computer to insert "delete" (DEL, coded as all ones) characters between each valid message character in the necessary ratio. Without the DEL characters, data characters that are sent too soon after the preceding data characters will be lost. With the delay-line buffer installed in the Data Station, the computer may send to the Data Station at the rate of 120 characters per second regardless of the rate of the output device.

Deactivation of the Data Station

When the Data Station has been receiving data messages with the delay-line buffer present, a dummy message (STX, NULL, ETX, LRC) must be sent by the computer and accepted by the Data Station before the computer may send the deactivate (DAC) message. This procedure insures that the buffer is empty when the DAC is executed.

Date Transfer and Activations

Certain programming procedures must be observed during data transfer and device activations, depending upon whether input or output devices are being used and also whether the delay-line buffer option is installed in the Data Station.

INPUT DEVICES

If the delay-line buffer is included with the Data Station, the computer should be programmed to send NACK upon receiving a message with improper parity, improper LRC, or an incomplete message. If the delay-line buffer is not installed, the computer must reverse the input media to regain the information, if possible, or to flag the occurrence of the improper information. If the message is properly received, an ACK signal is sent in response. Refer to Table 3-1 for the results of normal and single error activation messages or data. These actions are valid with or without Feature 088-1 (the delay-line buffer option), except where noted.

Table 3-1. Input Device Activations or Data Transfer

	COMPUTER ACTION	DATA STATION ACTION
A.	ACTIVATE MESSAGE/ACK →	→ Received O. K., (acceleration delay occurs)
	Computer received O. K. ←	← (FIRST) MESSAGE
	ACK →	→ (Example of normal message exchange)
B.	ACTIVATE MESSAGE/ACK →	→ Received Bad Parity and/or Bad LRC
	Received O. K. ←	← NACK
	repeat ACTIVATE MSG/ACK →	→
C.	ACTIVATE MESSAGE/ACK →	→ Received DAC, Missed STX of CS (or DBP) Message
	Received nothing, Timeout	(Missed STX of ACK Message)
	repeat ACTIVATE MSG/ACK →	→
D.	ACTIVATE MESSAGE →	→ Missed DAC, received CS (or DBP) Message
	Received O. K. ←	← NACK
	repeat ACTIVATE MESSAGE →	→ (Applicable to activations only)
E.	ACTIVATE MESSAGE/ACK →	→ Missed ETX
	Received nothing, Timeout	
	repeat ACTIVATE MSG/ACK →	→
F.	ACTIVATE MESSAGE/ACK →	→ Received O. K., (acceleration delay occurs)
	Missed STX, received garbage, Timeout ←	← (FIRST) MESSAGE
	if no buffer, repeat ACT. MSG/ACK* →	→
	(or back up, if paper tape).	
	Or if buffer, NACK →	→
G.	ACTIVATE MESSAGE/ACK →	→ Received O. K., (acceleration delay occurs)
	Missed ETX, Received Something, Timeout ←	← (FIRST) MESSAGE
	if no buffer, repeat ACT. MSG/ACK* →	→
	(or back up, if paper tape).	
	Or if buffer, NACK →	→
H.	ACTIVE MESSAGE/ACK →	→ Received O. K., (acceleration delay occurs)
	Received Bad Parity and/or Bad LRC ←	← (FIRST) MESSAGE
	if no buffer, repeat ACT. MSG/ACK* →	→
	(or back up, if paper tape).	
	Or if buffer, NACK →	→

*Flag the occurrence

OUTPUT DEVICES

The computer should be programmed to repeat the last message when it receives a NACK or an unrecognizable or incomplete acknowledgement message. If Feature 088-2 (extended operations option) is installed and the acknowledgement message is incomplete, a repeat-last-acknowledge (RPT) may be used once. If Feature 088-1 is not included, the program should flag the repetition. Refer to Table 3-2 for the normal procedures and single error occurrences and responses. These actions are valid with or without Feature 088-1, except where noted.

Table 3-2. Output Device Activations or Data Transfer

	COMPUTER ACTION	DATA STATION ACTION
A.	ACTIVATION MESSAGE/DATA →	→ Received O. K., (device acceleration delay occurs)
	Received O. K. ←	← ACK
	(FIRST) MESSAGE →	→ (Example of normal message exchange)
B.	ACTIVATION MESSAGE/DATA →	→ Received bad parity and/or bad LRC
	Received O. K. ←	← NACK
	repeat ACTIVATION MSG/DATA →	→
C.	ACTIVATION MESSAGE/DATA →	→ Received DAC, missed STX of CS (or DBP) message
	Timeout, received nothing	(missed STX of DATA message)
	repeat ACTIVATION MSG/DATA →	→
D.	ACTIVATION MESSAGE →	→ Missed DAC, received CS (or DBP) message
	Received O. K. ←	← NACK
	repeat ACTIVATION MSG →	→ (Applicable to activations only)
E.	ACTIVATION MESSAGE/DATA →	→ Missed ETX
	Timeout, received nothing	
	repeat ACTIVATION MSG/DATA →	→
F.	ACTIVATION MESSAGE/DATA →	→ Received O. K., (device acceleration delay occurs)
	Missed STX, received garbage, Timeout ←	← ACK
	if not Feature 088-2, repeat ACTIVATION/DATA →	→
	or if Feature 088-2, RPT →	→
G.	ACTIVATION MESSAGE/DATA →	→ Received O. K., (device acceleration delay occurs)
	Missed ETX, received something, Timeout ←	← ACK
	if no Feature 088-2, repeat ACTIVATION/DATA →	→
	or if Feature 088-2, RPT →	→
H.	ACTIVATION MESSAGE/DATA →	→ Received O. K., (device acceleration delay occurs)
	Received MSG, but Acknowledgement garbled ←	← ACK
	if no Feature 088-2, repeat ACTIVATION/DATA →	→
	or if Feature 088-2, RPT →	→

TIMEOUT PROCEDURES

The program should detect that excessive time has elapsed without complete data reception. This may be implemented by including an interval timer, or the type 281-1M Read-Write Channel Release Timer, or by an add and compare loop in the program. The recommended time interval is 9.5 seconds, which allows the computer to perform three operations to rectify the incomplete data situation before the 30-second timeout occurs at the Data Station. This time interval is long enough to discount the normal data delays. However, when using the buffer, the programmer should allow additional time by ignoring the timeout once per waiting period for the low-speed page printer, card reader, or optical bar code reader, and by ignoring the timeout for as long as necessary when the keyboard is activated. To use the timeout procedures properly, the program must detect whether no information was received before the timeout, or whether the information was improper, or not complete.

BUFFER BYPASS PROCEDURE

The sequence of messages to initialize the delay-line buffer bypass must be as outlined herein. The combined DAC and DBP control message is sent. Upon positive acknowledgement (ACK), the CS message is sent to select the device(s) to be used during the bypass communication. If the first or second message receives a negative acknowledgement, the entire preceding sequence must be retransmitted. Upon receipt of an ACK, the program may transfer as much data as required. This feature allows improper messages or messages longer than 132 characters to be sent to the selected device. The delay-line buffer is restored by the next properly decoded deactivate message.

PAGE PRINTER AND KEYBOARD (TYPE 289-2)

The transmission rate to the printer from the computer in a Data Station without a delay-line buffer must be held to ten characters per second. This is accomplished by programming the computer to send n "delete" (DEL) characters between each data character. The number (n) of delete characters is calculated as follows:

$$n = \frac{\text{rate from computer}}{10} - 1$$

The 8-bit activation address characters for the printer device control area (DCA) are as follows:

	P 7 6 5 4 3 2 1
KEYBOARD:	0 0 1 0 0 0 0 1
PRINTER:	0 1 0 0 0 0 0 1

PAGE PRINTER AND KEYBOARD (TYPE 289-3)

When the page printer is used in a Data Station which does not include the delay-line buffer, data characters must be sent to the printer in pairs starting from each carriage return (CR), line feed (LF) execution, or ETX/EOT character. This method of transmission is required because the printing is performed by paired hammers imprinting selected characters from a rotating print drum. For example, when a Type 281-IM single-channel communication control is sending at 120 characters per second, each PDT instruction should send a block consisting of six DEL characters followed by two data characters. Also, 20 character times (at 120 characters per second transmission rate) must be allowed after each carriage return and after each line feed execution.

The 8-bit activation address characters for this DCA are as follows:

	P 7 6 5 4 3 2 1
KEYBOARD:	0 0 1 0 0 0 0 1
PRINTER:	0 1 0 0 0 0 0 1

PAPER TAPE READER (TYPE 289-4)

The DCA for this device has two addresses, one for each direction of tape motion. The computer is therefore permitted to reverse tape motion to reach the beginning of a message that has already been transmitted, then order retransmission of the message.

The 8-bit activation address characters for this DCA are as follows:

	P 7 6 5 4 3 2 1
DIRECTION A:	0 0 1 0 0 0 1 0
DIRECTION B:	0 0 1 0 1 0 0 0

PAPER TAPE PUNCH (TYPE 289-5)

If the paper tape punch is used with the delay-line buffer present, a dummy message must be accepted by the Data Station before the computer sends a deactivate (DAC) message.

The 8-bit activation address character for this DCA is as follows:

	P 7 6 5 4 3 2 1
PUNCH:	0 1 0 0 0 0 1 0

Error Conditions

If any of the three error conditions (low tape on supply reel, torn tape, tension arms not in position) occurs, the punch stops completely, causing a break in communication with the computer.

PUNCHED CARD READER

Either of the error conditions, feed error or acknowledge error, will cause a disconnection of the Data Station dataset, pursuant to the action of the no-traffic disconnect. (Data Station remains in the accepting data state for more than a specified number of seconds without receiving any data or control characters.)

The 8-bit activation address character for this DCA is as follows:

	P 7 6 5 4 3 2 1
CARD READER:	0 0 1 0 0 1 0 0

OPTICAL BAR CODE READER

Any of the five error conditions, feed check, acknowledge check, operator error, output stacker overflow, or start of document, (see "Error Conditions", Section V) will cause a disconnection of the Data Station dataset, pursuant to the action of the no-traffic disconnect.

The 8-bit address character for this DCA is as follows:

	P 7 6 5 4 3 2 1
OBCR:	0 0 1 1 0 0 0 0

SECTION IV

COMMUNICATION INPUT/OUTPUT PACKAGE

SYSTEM DESCRIPTION

Honeywell has designed a communication input/output software package for use with the Series 200 Electronic Data Processing System and terminal equipment such as the Honeywell Data Station. The package, called Communication I/O B and C, comprises a series of macro routines which may be specialized by either the Library Processor B or C program. Provision has been made in the package to supply all software functions necessary to transmit and receive data between any Series 200 central processor and the Data Station. A functional diagram of the Communication I/O package is shown in Figure 4-1. Allowance for the addition of device-specific subroutines appropriate to other terminal devices is made in the Communication I/O package.

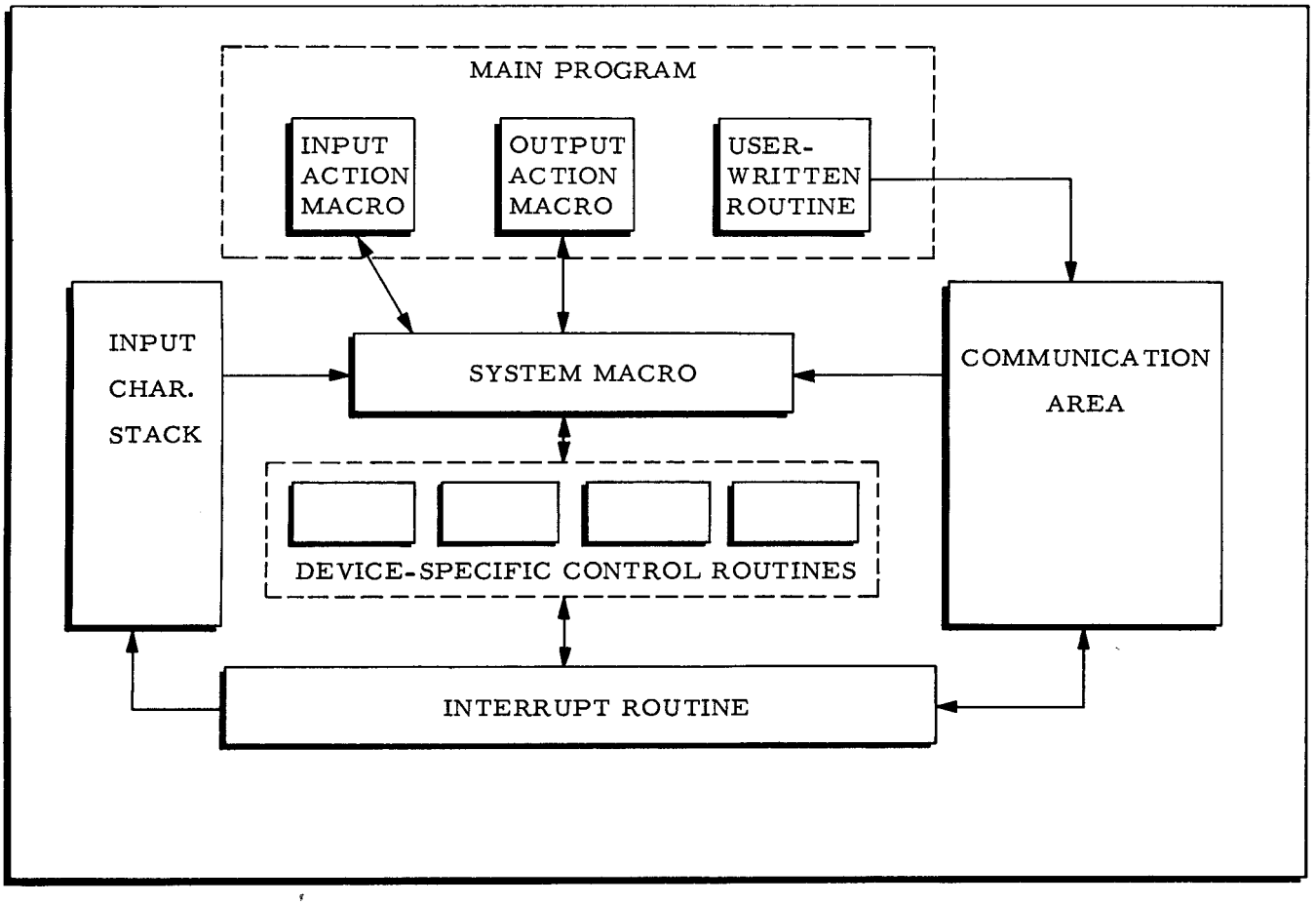


Figure 4-1. Functional Diagram of Communication I/O System

The package accommodates as interface equipment either the type 281 single-channel, or the type 286 multi-channel communication control. Multiples of either or both of these units may be associated with a single central processor. Up to sixty-three communication lines are handled by the type 286 multi-channel control. The type 281 single-channel control handles a single line.

The Communication I/O package can be assembled in either the three-character or the four-character address mode, as required by the main program. The actual address mode of assembly is governed by the source-program ADMODE control statement in effect when an I/O macro instruction is encountered. The same address mode, however, must be chosen for the assembly of all I/O macro instructions which appear in a single source program.

MACRO INSTRUCTIONS

Communication I/O processing is introduced to the user's main program by means of macro instructions. The set of macro routines comprising Communication I/O B is given below, together with details of the macro instruction parameters.

Communication I/O macro instructions are written in accordance with Honeywell's standard conventions. The user must write the macro instructions in-line in his program and, where necessary, supply the appropriate parameters. Macro instruction parameters are entered in columns 21 to 62 of the Easycoder Coding Form and are separated by commas. Parameter values may be omitted by writing the terminating comma for each value to be omitted. After the last parameter to be stated, any number of values may be omitted without including their terminating commas. This is, if the last n values are omitted, no terminating commas need be written for the omitted parameters.

Systems Macro (@CMS)

The @CMS systems macro instruction must appear once, and only once, in the source program. A system control routine is specialized to the main program by means of this macro instruction. Also, the macro introduces to the main program all necessary I/O processing functions. The following subroutines are contained in the @CMS macro routine:

1. Communication I/O initialization routine;
2. Device-specific routines;
3. Interrupt processing;
4. Input Stack routine;
5. I/O-to-User Priority Switch routine;
6. Line buffer processing;
7. Line status table;
8. Error routines; and
9. Code-translation functions.

The @CMS macro routine provides a body of coding comprising common subroutines which are used by subsequent action macro calls to effect the required communication between the central processor and the Data Station. The format of the CMS macro instruction is as follows:

Column	Entry
6	L
15 - 18	@CMS
21 - 62	Parameters, separated by commas

The parameters associated with the @CMS macro instruction will be defined in a later publication.

Communication Area Macro (@CMC)

One @CMC macro instruction is required for each communication line in the system. This macro defines an I/O communication and storage area containing parameters for a particular line. Reference to the @CMC area is made by the system control routine, and dynamic modification of some parameters by the user is permitted.

The line-storage area contains information that is entered by means of the @CMC macro instruction parameters. This area describes completely the characteristics necessary for communication between the central processor and the Data Station. All action macros branch to the associated @CMC area, where the desired action is interpreted in preparation for entry to the main routine.

The @CMC Communication Area macro instruction produces an area of the object program which contains information relative to a particular line. The following characteristics are typical of the parameters of the @CMC macro instruction

Parameter	Description
1	CCU designation
2	Physical line number
3	Line code designation
4	Primary buffer address
5	Secondary buffer address
6	Current buffer location counter
7	Error transfer address
8	Buffer transfer address (full)
9	Line shift register
10	Line status character
11	Terminal specific transfer address

Parameter	Description
12	Condition string base address
13	Selection indicator
14	Selection transfer address
15	Control indicator (coded to describe the transfer condition)

Action Macro Instructions

The remaining five I/O macro instructions used by the Data Station are the action macros #OPEN, #GET, #PUT, #CLOSE, and #POLL, all of which share a common format. Each macro supplies one parameter which is a pseudo line number relating the action macro to the appropriate line. The pseudo name used for the line is identical to that designated by parameter 3 of the associated @CMC macro instruction.

#OPEN

The #OPEN macro instruction is used to establish initial communication between the central processor and the terminal device. Where required, such operations as dialing telephone numbers and establishing line connections preparatory to data transfer are performed. There is generally one #OPEN macro instruction for each line in the system. Some #OPEN calls may be executed repeatedly, with appropriate user modification to the telephone number or other calling information.

#GET

In order to obtain data from the buffers, the user must issue a #GET macro instruction. Appropriate control characters are directed to the remote terminal device to initiate the data flow from the device to the central processor. The data buffers in the central processor are then filled with data characters in Honeywell code until the data flow ceases. If more data is to follow, the user must then issue another #GET instruction.

#PUT

A #PUT macro instruction indicates to the I/O package that data must be translated from the data buffers and transmitted to the remote terminal device. Indicators are available for reference to validate the availability of the current data buffer. One #PUT macro instruction provides for the transmission of a continuous stream of data to the remote terminal. Data buffers are emptied by the I/O package and filled by the user in cyclic order. Transmission ceases when an end-of-transmission (EOT) signal is sensed.

#CLOSE

The #CLOSE macro is used to indicate to the I/O package that transmission on a particular line is completed and applicable disconnect functions should be performed. One #CLOSE macro should be entered for each line used in the application. Provision is made by the package for user modification of terminal information where necessary.

#POLL

In certain applications, a number of Data Stations may share a common line. The #POLL macro instruction enables the user to solicit each device sequentially in order to allow individual terminals to transmit data to the central processor. The polling ends when all polling codes provided by the user have been exhausted. Selection codes for individual terminals are stored by the user for reference by the I/O package. An item mark separates the codes, and a record mark terminates the polling list.

SECTION V

DATA STATION TERMINAL DEVICES

AVAILABLE DEVICES

This section describes each of the terminal devices available for use with the Data Station. The central control unit of the Data Station is designed to operate with a maximum of five terminal devices, all of which can be operated from the basic power supply provided with each CCU. Eight different terminal devices are presently available for use with the Data Station.

1. Type 289-2 Page Printer and Keyboard - a 10-character-per-second printer with a self-contained keyboard; includes two device control areas (DCA's).
2. Type 289-3 Page Printer and Keyboard - a 40-character-per-second printer with a self-contained keyboard. This terminal device includes two device control areas.
3. Type 289-4 Paper Tape Reader - a 120-character-per-second reader and a DCA for handling paper tape input.
4. Type 289-5 Paper Tape Punch - a 120-character-per-second punch and spooler, and a DCA for handling paper tape output.
5. Type 289-7 Punched Card Reader - a 120-character-per-second card reader and DCA for punching 80-column cards.
6. Type 289-8 Optical Bar Code Reader - a 5-inch-per-second (50-character-per-second) optical reader which reads and interprets bar-coded data printed on card or paper documents five to eight inches long by three and one-half inches wide. This terminal device contains a device control area (DCA). The delay-line buffer option is required for operation of the Bar Code Reader with the Data Station.

TOTAL NUMBER OF DEVICE CONTROL AREAS

It should be kept in mind that a Honeywell Data Station configuration can accommodate a total of five device control areas. In addition, a dataset control is required, but this control is not to be included in the total number of DCA's. The majority of the Data Station terminal devices count as one device; however, some must be counted as two devices when computing whether the configuration is within the maximum of five. The following list shows the number of device control areas associated with each terminal device available for the Data Station.

	Terminal Device Type	Number of DCA's
288-1	Central control unit without keyboard	0
289-2	Page printer and keyboard	2
289-3	Page printer and keyboard	2
289-4	Paper tape reader	1
289-5	Paper tape punch	1
289-7	Punched card reader	1
289-8	Optical Bar Code Reader	1

PAGE PRINTER AND KEYBOARD (TYPES 289-2 and -3)

Since there is little functional difference between the two types of page printers, other than operating speed, both are discussed here. Where differences exist between the two, the differences are pointed out.

The page printer includes a self-contained keyboard and a device control area (DCA) which contains the control logic and power supplies that are necessary for operation with the CCU. Operation is asynchronous; operating speeds up to 10 characters per second can be achieved with the type 289-2 printer (up to 40 cps with the type 289-3). The page printer recognizes 7-level ASCII (see Appendix A). The keyboard layout is illustrated in Figure 5-1; keyboard and printer DCA data flow is shown in Figure 5-2.

The keyboard unit contains an operator's control panel as well as an alphanumeric keyboard. The keyboard is asynchronous and may be operated at a speed limited by the speed of the monitoring printer.

Local Mode Operation

The page printer and keyboard is activated by pressing the appropriate device activate button with the LOCAL switch activated on the control panel of the CCU. It is deactivated by repressing the appropriate device activate button.

Remote Mode Operation

Whenever the control sample lead is energized, the DCA monitors the output data bus until the next following ETX or EOT character is sensed. The DCA is activated if the address of the printer or the keyboard is placed on the output data bus during this interval. The DCA deactivates the page printer and keyboard when the deactivate lead is energized by the CCU.

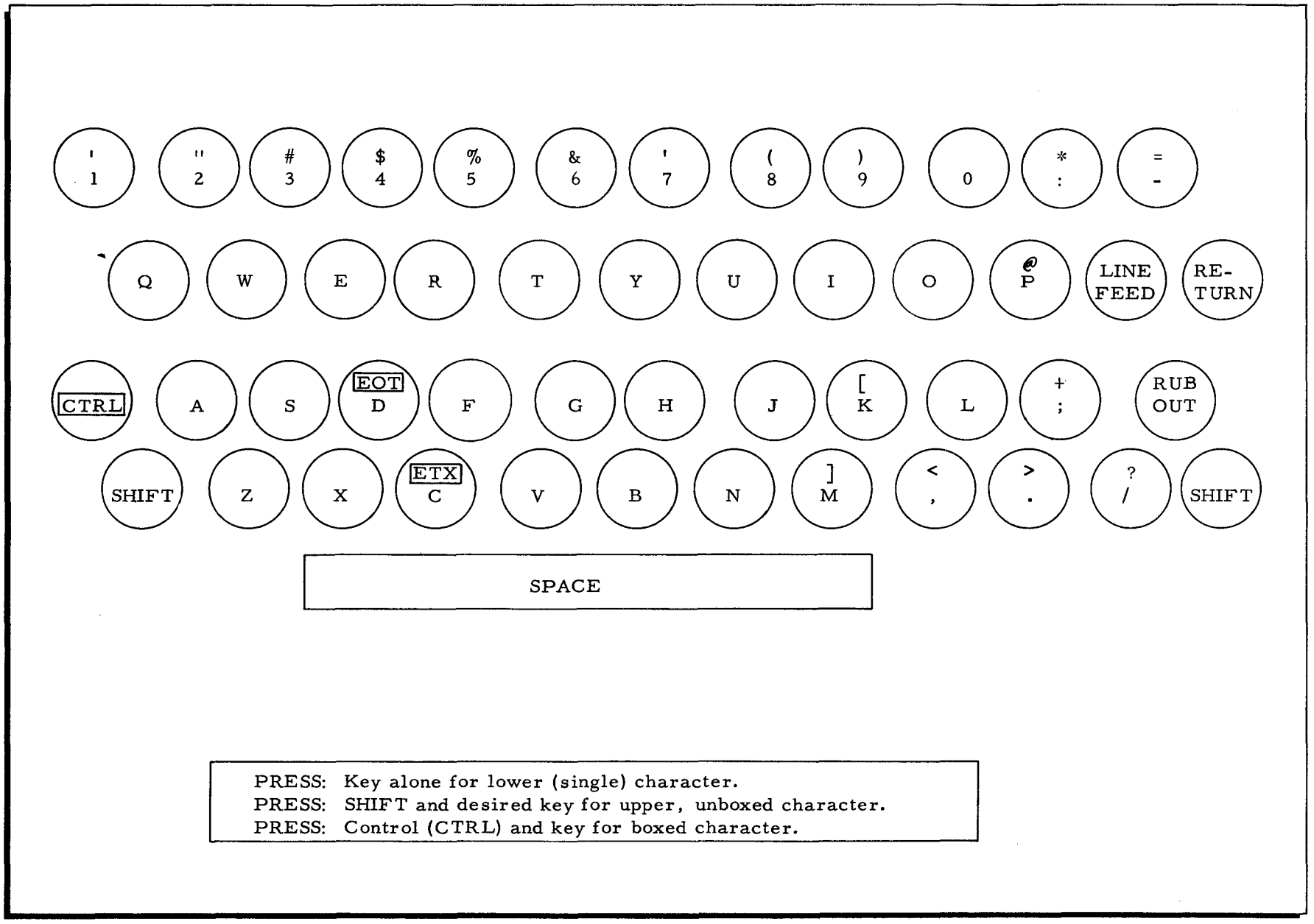


Figure 5-1. Data Station H-289-2 and H-289-3 Keyboard Layout

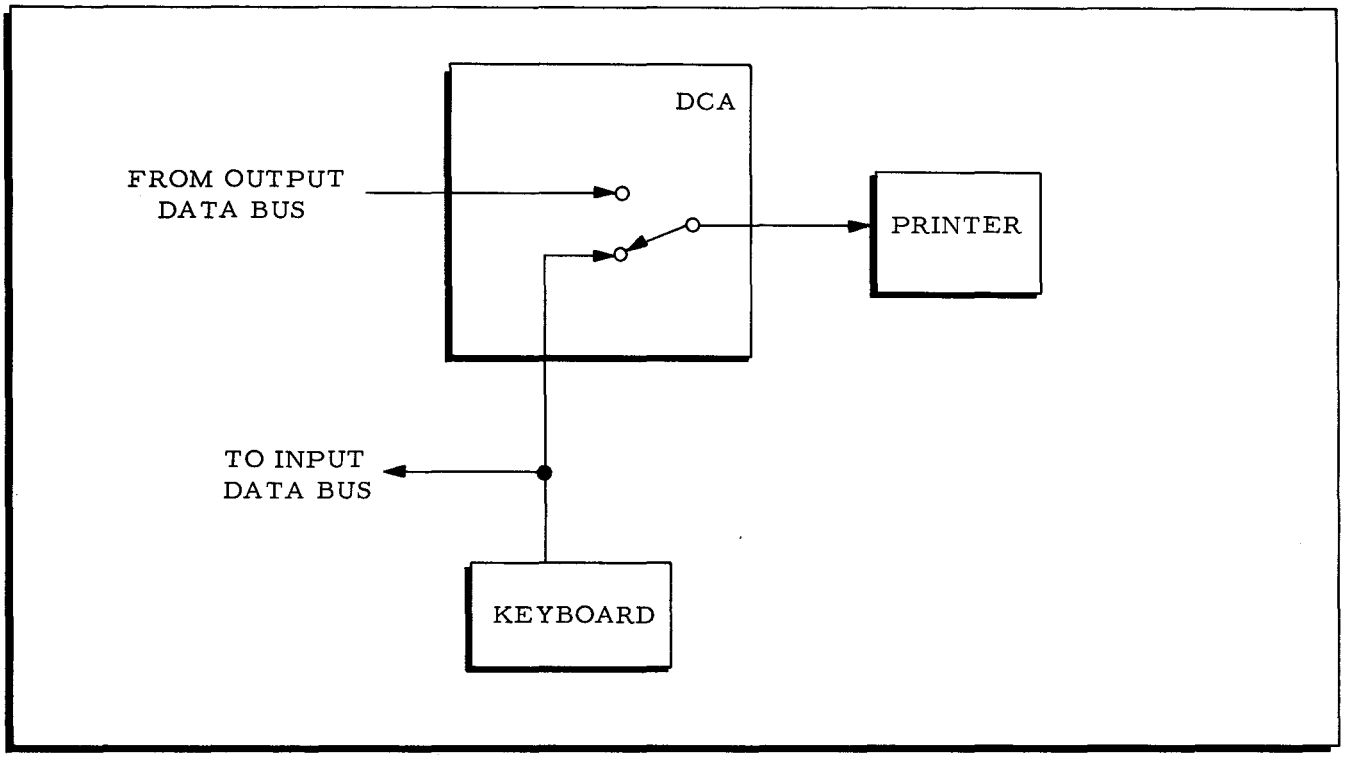


Figure 5-2. Keyboard and Printer Device Control Area Data Flow

Reading Information From the DCA (Keyboard)

When the DCA is activated, it samples the input data acknowledge (IDA) lead. When the IDA lead is energized, it unlocks the keyboard. When a key is depressed, that character is placed on the input data bus, the keyboard is locked, and the input data ready (IDR) lead is energized. The keyboard is released when the next IDA signal is received.

Writing Information Into the DCA (Printer)

When the DCA is activated, it samples the output data ready (ODR) lead. When the ODR lead is energized, it accepts a character from the output data bus, and returns an output data acknowledge (ODA) signal. The page printer has two separate inputs. One input is from the output data bus and is active whenever the page printer is activated. The second input, internal to the DCA, is the direct output from the keyboard and is active whenever the page printer is activated.

Switches and Indicators

The page printer DCA is equipped with two alternate-action indicator switches, each labeled ACTIVATE. The keyboard ACTIVATE switch is located on the control panel, and the printer ACTIVATE switch is on the printer. When the DCA is activated, the indicator switches are illuminated.

PAPER TAPE READER (TYPE 289-4)

The Honeywell type 289-4 paper tape reader includes a device control area which contains the control logic and power supplies that are necessary for operation with the central control unit. The paper tape reader uses the 7-bit ASCII code (plus even parity) described in Appendix A).

This terminal device is a bi-directional, panel-mounted reader capable of reading data from 8-level punched paper tape. It is asynchronous and operates in either direction and at any speed up to 120 frames (characters) per second. The paper tape reader has two reels separated by a read head (see Figure 5-3).

Device control area (DCA) activation is dependent on the Data Station's mode of operation. Activation of the DCA is the process of providing AC power to the device and placing the DCA on-line to the input data bus. Activation also includes selecting the desired direction of tape motion past the read head. Direction A is defined as right-to-left tape motion with respect to the read head; direction B is the opposite direction. Power which is supplied to the DCA is dependent on the mode of operation. In the local mode, for example, AC power is supplied when the DCA is activated. However, in the remote mode, AC power is supplied to the device only when the CCU has determined that the Data Station is being called by the computer.

Local Mode Operation

The paper tape reader DCA operates in one of two modes; either local or remote. In the local mode, the reader is activated, under operator control, to read tape in either direction. Two indicator switches are provided to select the desired direction. Either indicator switch, when depressed with the LOCAL-MODE lead energized, activates the DCA and selects the desired direction of tape motion. When the same indicator switch button is depressed again, the DCA is deactivated.

Two alternate-action indicator switches, with stenciled arrows to indicate direction of tape motion are located side-by-side on the paper tape reader (see Figure 5-3). When the Data Station is in the local mode, pressing either indicator switch activates the DCA, allows the RUN button on the CCU control panel to cause tape motion in the direction indicated by the arrow on the switch and illuminates the indicator of the selected switch. In single block operation, the tape will move until an ETX or an EOT character is sensed. Pressing the switch again deactivates the DCA, stops tape motion, and extinguishes the indicator of that switch.

Remote Mode Operation

In the remote mode, the DCA monitors the output data bus for either of its two activation addresses: direction A or direction B. Activation in the desired direction occurs if either

address is sensed with the control sample lead energized. Deactivation is determined by the signal from the deactivate lead.

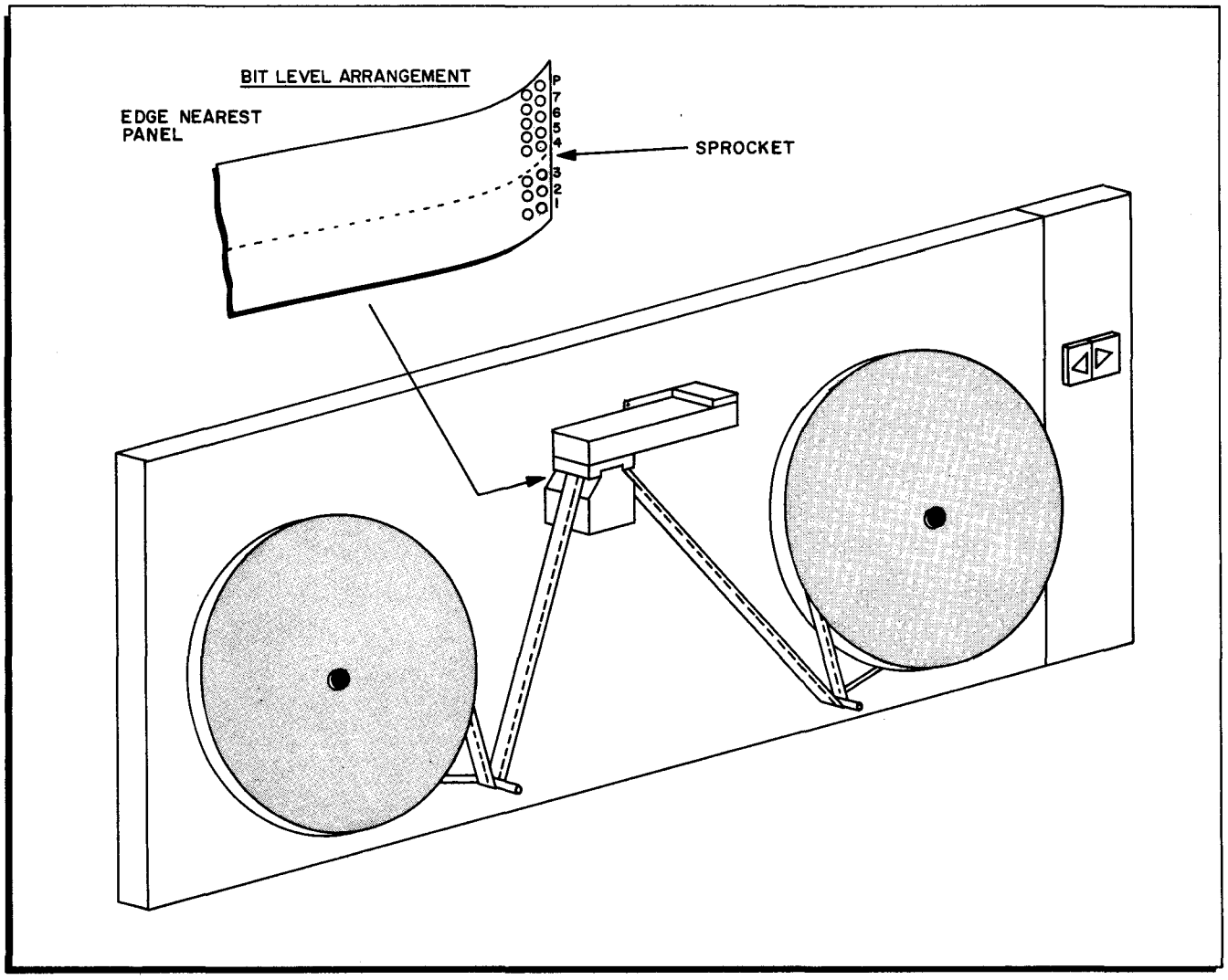


Figure 5-3. Paper Tape Reader Diagram

The remote computer controls the tape direction indicators when the Data Station is in the remote mode. The computer activates the DCA, which in turn illuminates the selected indicator. The indicator is extinguished when the deactivate lead is energized. The switches associated with the indicators are disabled when the Data Station is in the remote mode.

Operating Functions

When activated, the DCA samples the input data acknowledge (IDA) lead. When the IDA lead is energized, the DCA stops the tape until the next character is under the read head, presents that character to the input data bus, and energizes the input data ready (IDR) lead. The

DCA remains in this quiescent state until the IDA lead is again activated. Since the tape can be read in either direction, data should be bracketed with ETX or EOT characters as desired.

The leader of the paper tape is defined as that portion of the tape which comprises the character under the read head at the time of activation and all succeeding characters up to and including the first ETX or EOT character encountered (minimum of one character). During leader runin in remote mode, the IDR lead is inhibited until the first character of the block following the leader is sensed. At this time, operation commences as described above.

PAPER TAPE PUNCH (TYPE 289-5)

The Honeywell paper tape punch, type 289-5, includes a device control area (DCA) which contains the control logic and power supplies that are necessary for operation with the central control unit (CCU). This paper tape terminal device is a panel-mounted punch capable of punching 8-level code. The character code used is 7-bit ASCII code (plus even parity) which is described in Appendix A. The punch is a synchronous device designed to operate at speeds up to 120 frames (characters) per second. The punch assembly is located between the supply and takeup reels on the front panel of the device.

Activation of the paper tape punch device control area (DCA) is the process of providing AC power to the device and placing the DCA on-line to the output data bus. DCA activation and the supply of AC power for the DCA are both dependent on the Data Station's mode of operation.

Local Mode Operation

With the Data Station in local mode; the paper tape punch DCA can be activated by pressing the ACTIVATE switch. When the same switch is pressed again, the DCA will be activated. In the local mode, AC power is supplied when the DCA is activated. The DCA is equipped with an alternate-action indicator switch labeled ACTIVATE/ERROR. The ERROR (lower) portion of the indicator illuminates only when a DCA error condition exists and is independent of ACTIVATE switching. In the local mode, depressing the ACTIVATE portion of the indicator switch activates the DCA, allows paper tape movement, and illuminates the ACTIVATE indicator. Pressing the switch again deactivates the DCA, stops paper tape motion, and extinguishes the ACTIVATE indicator.

Remote Mode Operation

In the remote mode, the paper tape punch DCA monitors the output data bus for its activation address. Activation occurs if the DCA address is sensed and the control sample lead is energized. Deactivation is determined by the signal from the deactive lead. In the remote mode, AC power is supplied only when the DCA has determined that it is being addressed by the

computer. In the remote mode, the ACTIVATE indicator is under the control of the remote computer. The computer activates the DCA for the paper tape punch and the DCA illuminates the indicator. The ACTIVATE indicator is extinguished when the deactivate lead is energized. The ACTIVATE switch is disabled when the Data Station is in the remote mode; only the indicator is permitted to be energized.

Operating Functions

Since the Honeywell type 289-5 paper tape punch is a synchronous device, the DCA is provided with a one-character buffer to guarantee correct data transfer at 120 characters per second. The DCA senses the output data ready signal generated by the CCU. A signal on this lead causes the character from the output data bus to be accepted. When the information is accepted, the DCA energizes the output data acknowledge lead and passes all data on to the paper tape punch within 8.33 milliseconds of acceptance. The DCA is prepared to accept new data only after passing the last character to the punch.

Data on the output data bus may change immediately after a signal appears on the output data acknowledge lead. The punch acknowledges a character in less than 10 microseconds after acceptance. The first character punched on a tape shall be either an ETX (end-of-text) or an EOT (end-of-transmission) character, and the tape shall end with the ETX or EOT character.

PUNCHED CARD READER (TYPE 289-7)

The Honeywell type 289-7 punched card reader includes a device control area (DCA) which contains the control logic and power supplies that are necessary for operation with the central control unit (CCU) and the delay-line buffer. The punched card reader is an end-feed, top-loading device capable of reading 80-column punched cards. The punched card code must be standard Hollerith code as generated by a 48-character keypunch machine; character code generated from the DCA is 7-bit ASCII code (plus even parity), which is described in Appendix A.

The card reader is equipped with an input stacker, a waiting station, a read station, and an output stacker. Cards will be read on a card-by-card basis at a rate of 100 cards per minute (instantaneous rate of 133 characters per second).

Activation of the device control area is the process of applying AC power and of placing the DCA on-line to the input data bus. The method of activating the DCA is dependent upon the Data Station's mode of operation — remote or local.

Local Mode Operation

An alternate-action, split-indicator switch labeled ACTIVATE/ERROR is located on the card reader DCA. The ERROR portion of the indicator is independent of switch action and illuminates when either a feed error or an acknowledge error (or both) is present. The card reader DCA is activated by pressing the ACTIVATE switch (the ACTIVATE portion of the split-indicator is illuminated). The first card in the input stacker then moves into the read station.

A group of four alternate-action indicator switches identified by the numbers "8, 4, 2, and 1" and labeled CARDS PER BLOCK is located on the card reader DCA. When one of these switches is pressed, it illuminates to indicate that its labeled value is set as the desired card count. The values are additive to give a range from 1 to 15. A value of 0 is not permitted; therefore, at least one switch must be pressed for any one operation. Pressing a switch again will extinguish its indicator and remove its value from the count.

In single block operation, a specific number of cards from 1 to 15 is selected by the CARDS PER BLOCK buttons (8, 4, 2, and 1). The number of cards selected, or the remaining cards in the deck if less than the number selected, are read when the RUN button is pressed. Operation is terminated when an ETX or EOT character is encountered.

In continuous read operation, the entire deck of cards is read when the RUN button is pressed, and operation terminates when an EOT character is sensed. Pressing the ACTIVATE button again deactivates the DCA.

Remote Mode Operation

Activation of the DCA and illumination of the ACTIVATE indicator in the remote mode is under the control of the remote computer. When the deactivate lead is energized, the DCA is deactivated and the indicator is extinguished. The ACTIVATE switch is disabled in this mode; only the indicator is permitted to be energized. In the remote mode, the DCA monitors the output data bus for its activation address. Activation occurs if the DCA address is sensed and the control sample lead is energized; deactivation is ordered by the signal from the deactivate lead.

Operating Functions

When activated, the DCA samples the input data acknowledge (IDA) lead, and the first card automatically moves into the read station. When the IDA lead is energized, the DCA presents the current character under the read head to the input data bus and energizes the input data ready (IDR) lead. There is a momentary pause after every card is read. Reading of the next card depends on the receipt of the next IDA signal.

The feed magnet in the card feed mechanism is continuously energized after the beginning of each card, and characters are read at a rate of one every 8.33 milliseconds. Each character is presented to the CCU via the input data bus. The presence of the delay-line buffer guarantees issuance of an IDA signal within 1.5 milliseconds after the IDR lead is energized.

The principal operating functions of the card reader DCA are card feed, end-of-text generation, field definition, and detection of last card and error conditions. These functions are described in the following paragraphs.

CARD FEED

When the first IDA signal is received after DCA activation, the first card in the input stacker automatically moves into the read station (position 3 of Figure 5-4). The second and all succeeding cards are fed lengthwise from the input stacker (position 1) to the waiting station (position 2) when the 32nd column of the preceding card has passed the read station. A card in the waiting station is end-fed into the read station, on command, after the previous card is completely read. When the card has been fully read, it falls into the output stacker (position 4) after leaving the read station. The intercard gap is equivalent to seven columns.

END-OF-TEXT (ETX) GENERATION

As the end of each card is recognized, the DCA advances a card counter and compares it with the desired card count. When the counter reaches the desired count, it is cleared and the DCA generates an ETX character to follow the data on the last card of each block immediately. The subsequent card can be read by energizing the IDA lead after the ETX character is generated.

FIELD DEFINITION

Punched card data fields are defined by "field mark" holes punched in a cardboard program disc (see Figure 5-5). The program disc is fitted over the card synchronization wheel at the left center side of the card reader by the Data Station operator. The card reader cannot operate unless a program disc is properly placed on the synchronization wheel. The read circuits are in a turned-off state at the beginning of every card until the first field, defined by a punched hole, is sensed in the program disc. The read circuits can be turned off again by a subsequent field mark; they will remain off until the next following field mark. A card field is automatically terminated at the physical end of the card columns. The minimum length of a field is two columns. If the only field mark appears at column 1 in the program disc, all 80 columns of each card will be read.

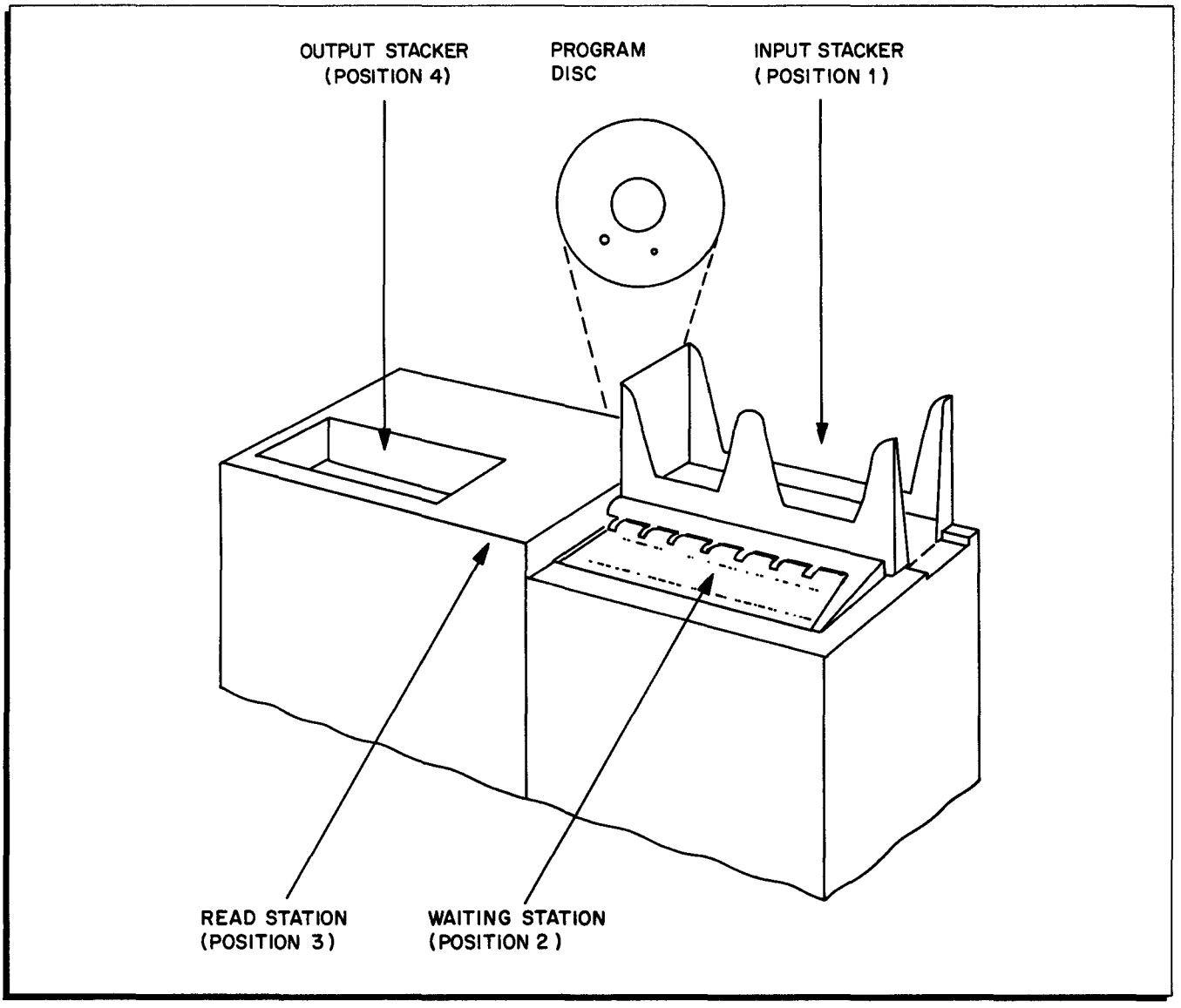


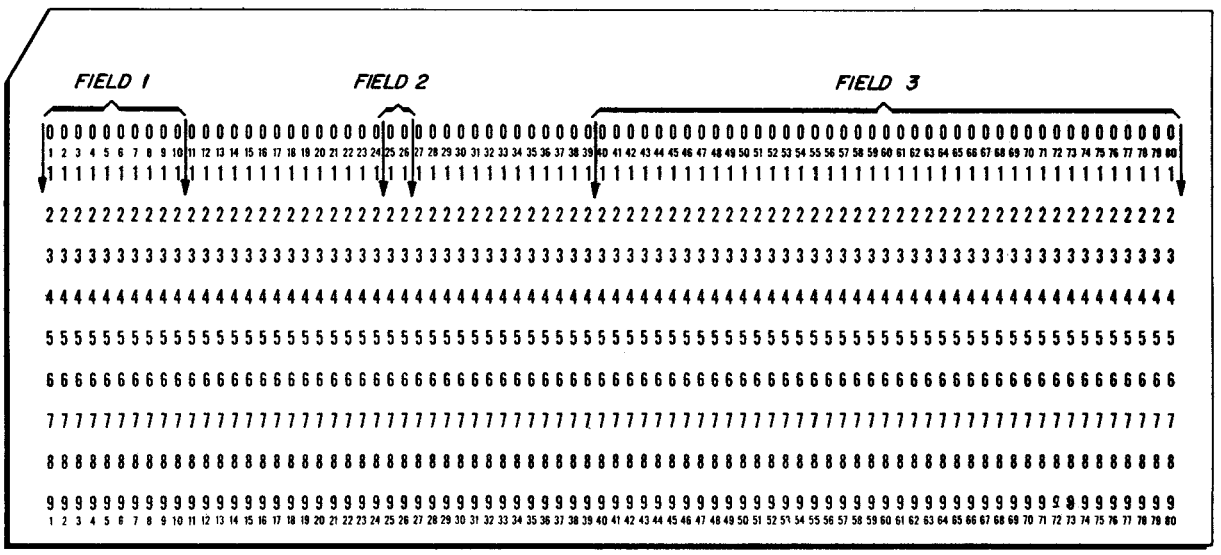
Figure 5-4. Punched Card Reader Sequence of Operation
(Cover Removed)

LAST CARD

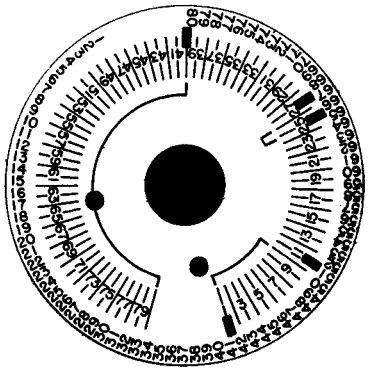
The last card of a stack is automatically run out into the output stacker. The coincidence of two conditions, no cards in the input stacker and no cards at the read station, causes the DCA to generate an EOT (end-of-transmission) character.

ERROR CONDITIONS

There are three error conditions which cause the DCA to stop the card reader at the end of



PUNCHED CARD WITH FIELD DEFINED BY FIELD-MARK HOLES ON DISC



PROGRAM DISC WITH FIELD-MARK HOLES

Figure 5-5. Field-Mark Orientation

the current card. When any of these conditions exists, the error indicator portion of the ACTIVATE/ERROR switch will be illuminated.

1. Feed Error - A feed error occurs when a card in the input stacker is not moved by the picker knife into the waiting station. This condition is detected by the presence of cards in the input stacker and the absence of a card at the read station.
2. Acknowledge Error - An acknowledge error condition occurs if an input data acknowledge signal is not received before the next character becomes available.
3. Operator Error - This error condition occurs if the DCA is activated and the operator has neglected to set any CARDS PER BLOCK switch.

OPTICAL BAR CODE READER (TYPE 289-8)

The Honeywell type 289-8 optical bar code reader (OBCR) includes a 50-character-per-second reader and a device control area (DCA), both housed in one cabinet. The DCA contains the control logic and power supplies necessary for operation of the OBCR with a central control unit and delay-line buffer which is required for operation with this DCA. The type 289-8 OBCR must be arranged at the right-hand end of the Data Station configuration.

The OBCR is capable of reading documents prepared on Honeywell high-speed printers (at a rate of up to 900 lines per minute) or preprinted by lithograph. The printed bar code documents contain five information channels, four data and one parity channel. The code on the input documents is converted by the DCA to the eight-level ASCII code (seven data bits plus even parity) used by the central control unit.

Document Characteristics

Documents which can be processed by the OBCR may be of either paper or card stock and range in length from five to eight inches with a width of three and one-half inches. Paper stock for documents shall be 20-pound rating, card stock shall be 100-pound (document weight is based on a ream of stock; 500 sheets, 17 by 22 inches). Documents must be free of mutilation such as folds, tears and mending materials. All documents must be white and of reflectance greater than 75% (with reference to magnesium oxide as the 100% base) in the area assigned to the bar code.

When the OBCR is in operation, the individual documents pass through the read station at a linear velocity of five inches per second. This velocity, coupled with a character density of ten characters per inch, produces a character rate of 50 per second for the code-track portion of the document. Character density in the mark-scan portion of the document is five characters per inch. Hand marking may only be done in the designated areas of the mark-scan portion and must be performed using a No. 2 black lead pencil.

Documents of differing length and basic weight may not be intermixed within a single run. Documents are fed from the input hopper which accepts a four-inch-thick stack to the output stacker without operator intervention. Approximately 850 paper-stock documents or 500 card-stock documents can be accommodated by the input hopper. The direction of feed, as seen by the operator, is from left to right with the code tracks positioned in the lower right-hand corner and facing away from him. After passing the read station, the documents are transported to the output stacker.

Inter-document gap in the OBCR is not less than 0.350 inches; the reader can be stopped

within this gap. A Stop command may be issued when the physical end of the document is sensed. The transport is capable of accelerating to full speed, after being stopped in the inter-document gap, by the time the first printed code character of the next card comes into the read station. Six photocells are used in the read-station cell block; five are used for reading information and mark-scan, the other is used for detection of document presence at the read station.

Code Characteristics

The coding used by the Honeywell type 289-8 optical bar code reader is of two variable-length types; five-level code track and two-level mark-scan (see Figure 5-6). Mark-scan codes have a preprinted clock track with two positions per frame available for hand marking. The code band which extends along the bottom edge of each document must be free from all printing other than machine-readable codes; however, documents may have human-readable characters printed above the code band. The ASCII code that is translated from the OBCR codes is shown in Table 5-1.

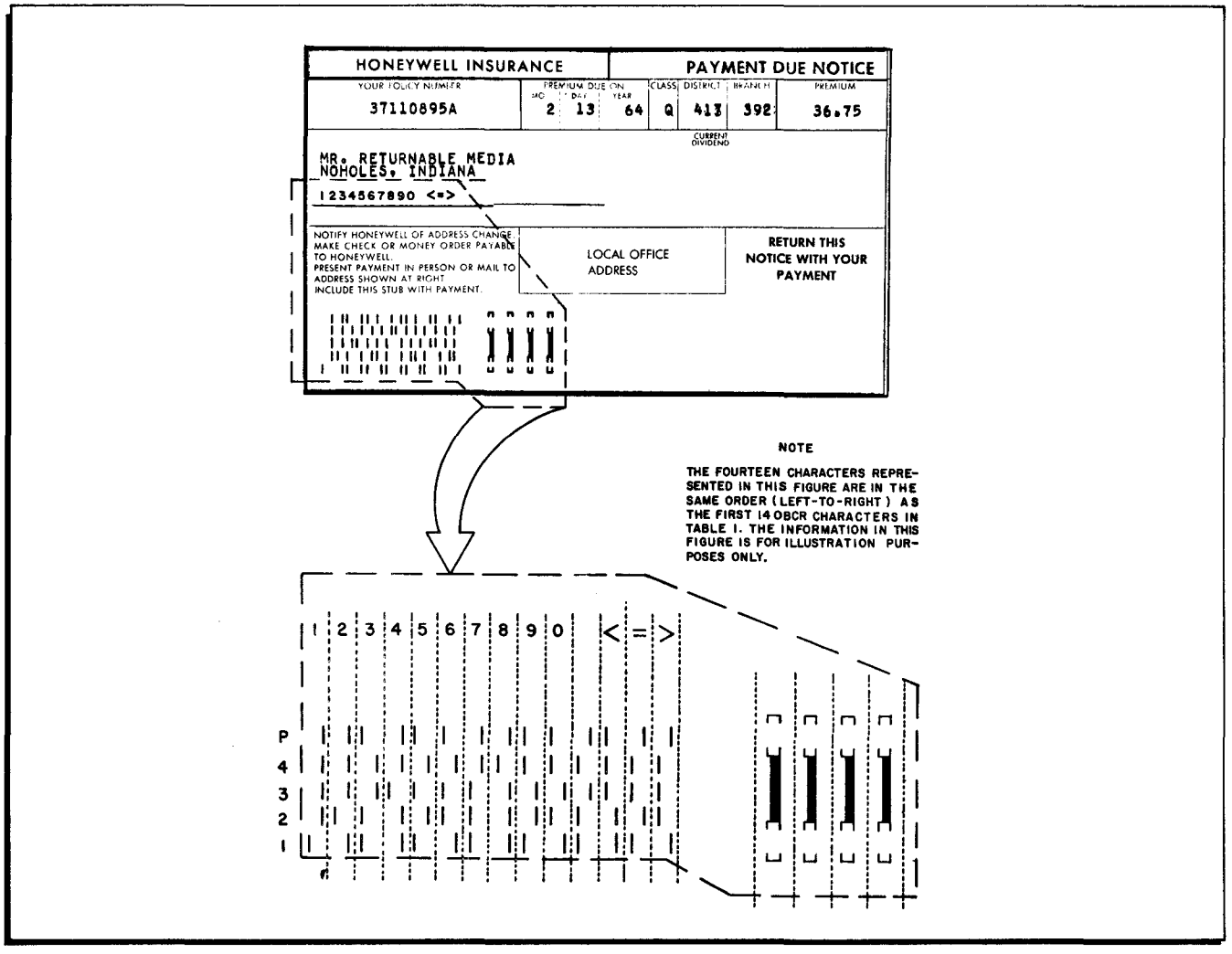


Figure 5-6. Typical Document Representation

Table 5-1. Data Station Optical Bar Code Reader and ASCII Codes

OBCR CHARACTER	OBCR BIT CONFIGURATION	ASCII CHARACTER GENERATED	ASCII BIT CONFIGURATION
	P 4 3 2 1		P 7 6 5 4 3 2 1
1	0 0 0 0 1	1	1 0 1 1 0 0 0 1
2	0 0 0 1 0	2	1 0 1 1 0 0 1 0
3	1 0 0 1 1	3	0 0 1 1 0 0 1 1
4	0 0 1 0 0	4	1 0 1 1 0 1 0 0
5	1 0 1 0 1	5	0 0 1 1 0 1 0 1
6	1 0 1 1 0	6	0 0 1 1 0 1 1 0
7	0 0 1 1 1	7	1 0 1 1 0 1 1 1
8	0 1 0 0 0	8	1 0 1 1 1 0 0 0
9	1 1 0 0 1	9	0 0 1 1 1 0 0 1
0	1 1 0 1 0	0	0 0 1 1 0 0 0 0
space	0 1 0 1 1	space	1 0 1 0 0 0 0 0
Start of Information/ End of Information	1 1 1 0 0	<	0 0 1 1 1 1 0 0
Unspecified	0 1 1 0 1	=	1 0 1 1 1 1 0 1
Mark-Scan Follows	0 1 1 1 0	>	1 0 1 1 1 1 1 0
D	- - - 0 0	D	0 1 0 0 0 1 0 0
E	- - - 0 1	E	1 1 0 0 0 1 0 1
F	- - - 1 0	F	1 1 0 0 0 1 1 0
G	- - - 1 1	G	0 1 0 0 0 1 1 1
Illegal - Parity or Dual - Bit Error		?	0 0 1 1 1 1 1 1

CODE TRACKS

Code tracks must be positioned within the code band across the bottom of each document with the following edge clearances: left (leading edge, 0.500±0.040 inch; bottom edge, 0.200 ±0.025 inch; right (trailing edge, 0.250 ± 0.025 inch. The code band shall be 0.875 ± 0.025 inch in height from the bottom of the card. The code tracks must be printed at a vertical density of eight lines per inch on the left side of the machine-readable code band and preceding the mark-scan code if present. A preprinted bench mark indicates the position of the first bar in the code-track field. There are five code tracks; a single character is represented by a bar in each of five tracks. Each character is represented by four information tracks and one odd-parity track. The parity track is at the top of the code band, the highest-order track next, and the lowest-order track at

the bottom. Characters which present dual-bit or parity errors during reading will have a DCA generated substitute character placed on the input data bus in their stead.

Dual-bitting is employed so that each bit is represented as a zero or a one by the placement of a bar in one of two positions: a bar in the left position of the track denotes a one, in the right position a zero. Thus, the code for each character is designated by the presence of bars in five of the ten possible positions. Bars in the code tracks are printed at a density of 20 per inch horizontally, providing a density of 10 dual-bits per inch or 10 characters per inch.

MARK-SCAN

The mark-scan code field consists of three lines of print arranged in the machine-readable code area in such a way that the clock track of mark-scan coding and the third line of code track shall have a common center line. The mark-scan characters are printed in a horizontal density of five characters per inch. The three lines of coding in the mark-scan field are, from top to bottom: high-order area to be manually marked, a clock track, and the low-order area to be manually marked. The two-bit characters, D through G, are available to the mark-scan field. The presence of the mark-scan field is signalled by the mark-scan follows character at the end of the code-track field. Presence of the end-of-information character at the end of the code-track field signals the absence of any mark-scan field. The end of the mark-scan field, when present, is signalled by the physical end of the document.

Local Mode Operation

Device control area (DCA) activation is the process of applying ac power to the device and placing the DCA on-line to the input data bus; however, the activation method is dependent upon the Data Station mode of operation; local or remote. A split-indicator pushbutton labeled ACTIVATE/CHECK is located on the OBCR cabinet. The CHECK portion of this indicator is independent of switch action; it is illuminated when any check condition is present (see "Error Conditions" discussion below). With the Data Station operating in local mode, the DCA is activated by depressing the ACTIVATE switch. The ACTIVATE portion of the split-indicator will be illuminated, but device motion will not occur until the RUN button is depressed.

In SINGLE BLOCK operation, one block of information, terminated by ETX or EOT, is read each time the RUN button is pressed. The number of documents in each block shall be that selected by the DOCUMENTS-PER-BLOCK switches, or the remaining documents in the input hopper if less than the number selected. The DOCUMENTS-PER-BLOCK switches are a group of three alternate-action indicator switches labeled "4", "2", and "1" and located on the OBCR cabinet. When each switch is pressed, it illuminates to indicate that its labeled value is set as the desired count. The values are additive to give a range of 1 through 7. A value of zero is

not permitted, that is, some switch must be depressed for any operation. Depressing the switch again will extinguish its indicator and remove its value from the count.

In CONTINUOUS operation, the entire stock of documents will be read when the RUN button is depressed (EOT terminates the operation). However, the operation may be stopped at the end of a current block by switching from CONTINUOUS to SINGLE BLOCK. Depressing the MASTER CLEAR button will deactivate the DCA.

Remote Mode Operation

In the remote mode, the DCA monitors the output bus for its activation address. Activation occurs if the DCA address is sensed and the control sample lead is energized; deactivation is ordered by the signal from the deactivate lead. Activation of the DCA and illumination of the ACTIVATE indicator in this mode is under control of the remote computer. When the deactivate lead is energized, the DCA is deactivated and the indicator is extinguished. The ACTIVATE switch is disabled in this mode.

Operating Functions

When the DCA is activated by application of ac power, the read station light source will come up to standby condition at half-brilliance. After receipt of an Initial command from the CCU, the OBCR transport will start to feed in the first document and the light source will come up to full brilliance. When the first document reaches the read station, each character in turn is read and processed before being presented to the CCU via the input data bus. At the detection of the physical end of the document by the photocell, a decision is made by the DCA logic whether to read the next document or to stop. A Stop command issued at this time will stop the transport with the inter-document gap under the read station. The transport will restart whenever the CCU requires more input data and the input hopper is not empty. The transport will accelerate to operating speed before the first character of the succeeding document reaches the read station.

The transport mechanism will not normally stop while reading a document. Normal start/stop decisions are only made at the detection of the physical end of the document. While the document is feeding through the transport, the bar-code characters will be read and processed at the rate of 20 milliseconds per character. The presence of the delay-line buffer guarantees issuance of an input data acknowledge signal within 1.5 milliseconds after the character is presented to the input data bus.

DOCUMENT FEED

When the Initial command is received by the DCA after activation, the transport will start and automatically pick up and feed in the first document from the input hopper. The document

is wrapped around the transport drum; the drum moves the document past the read station (see Figure 5-7). When the trailing edge of the first document is clear of the input hopper, the next document is picked up. When the leading edge of the first document reaches the adjustable document stop, the trailing edge of this document is cleared away for the leading edge of the following document. The operation continues serially, document-by-document, until the DCA orders the handling procedure to stop.

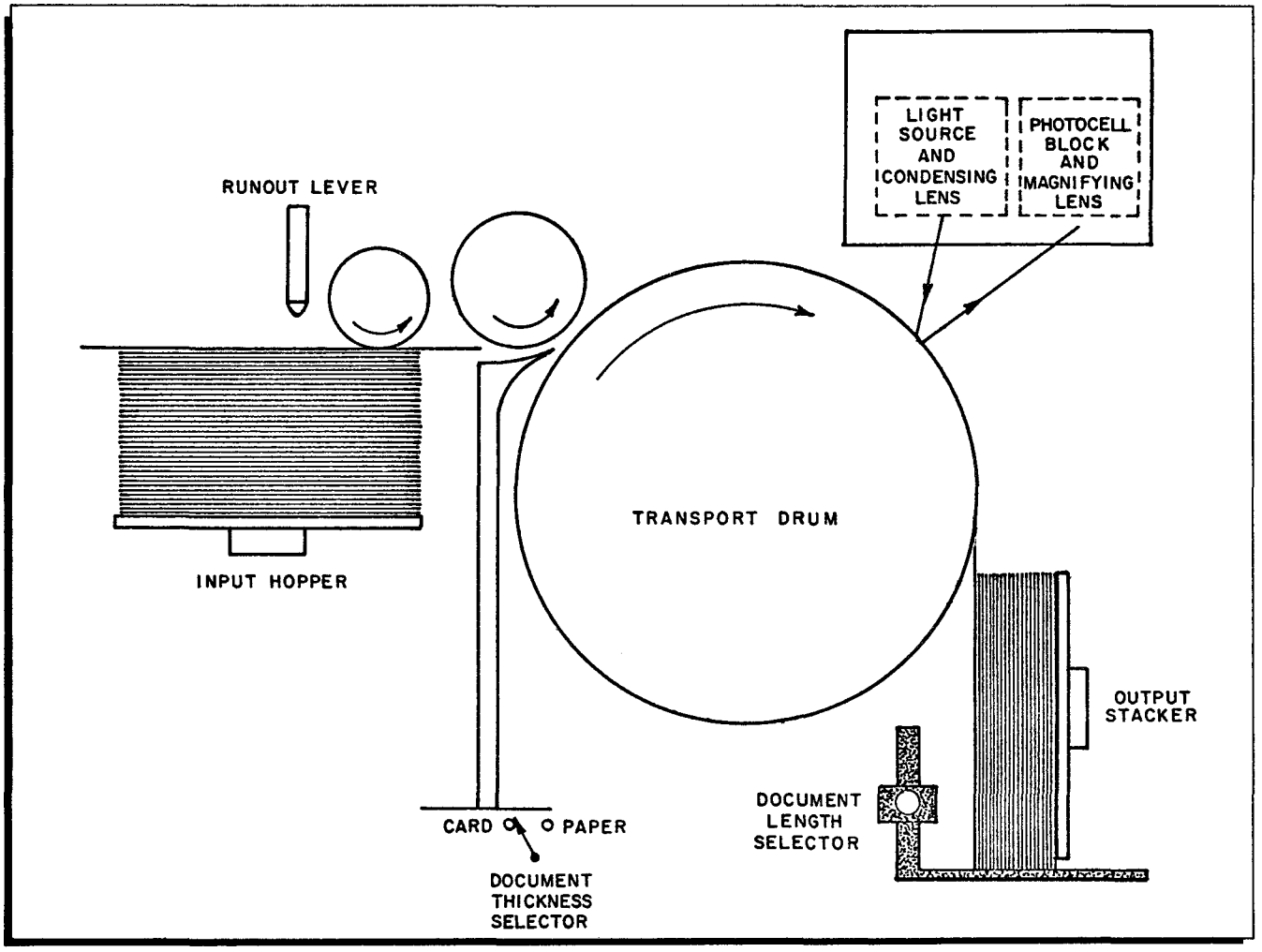


Figure 5-7. Optical Bar Code Reader Schematic Diagram

In addition to the ACTIVATE/CHECK indicator switch and the DOCUMENTS-PER-BLOCK switches, a runout lever and document thickness and length selectors are used to regulate document feeding (see Figure 5-7). The runout lever is located behind the input hopper. Depressing the lever causes the transport mechanism to operate and permits documents which are stopped on the transport drum to feed to the output stacker without processing.

A two-position thickness selector and an adjustable length selector must be set by the operator before document processing begins. The document thickness selector lever is located at the left front of the transport drum. The lever has two positions — CARD and PAPER — which adjust the throat-knife opening and which must be set according to the basic weight of the documents to be read. Intermixing of documents of different weights is not permitted. The document length selector is an adjustable stop located near the right front of the reader. Its function is to stop the motion of each document in the output stacker so that the trailing edge of a document enters the stack and clears the way for the leading edge of the following document. The selector must be set according to the length of the documents being read; indicator lines are provided at one-inch intervals over the range from five to eight inches. Documents of varying lengths may not be intermixed within one stack of documents.

END-OF-TEXT (ETX) GENERATION

Since the information on a document is variable in length, the user must select the optimum number of documents (from one to seven) to constitute a transmission block in order to assure full utilization of the delay-line buffer. The physical end of the document is sensed by the DCA through a photocell at the read station. A document counter is incremented when the physical end of each document is sensed. When the document counter reaches the desired count, it is cleared and an ETX character is generated by the DCA to follow the last character from the document whose physical end has just passed the read station. The first document of the subsequent block is ordered to start being read when the input data acknowledge lead is energized after the ETX character.

LAST DOCUMENT

The last document of a stack is automatically run out into the output stacker after being read. Coincidence of the two conditions — no documents in the input stacker and no documents at the read station — will cause the DCA to generate an end-of-transmission (EOT) character. The transport motor will then stop and the read station light source will go to half-brilliance.

Error Conditions

There are five error, or check, conditions which cause the DCA to stop the OBCR document reader. The CHECK indicator portion of the ACTIVATE/CHECK switch will be illuminated when one of these conditions occurs.

FEED CHECK

A feed-check condition occurs when the input hopper is not empty and a document is not picked up within two seconds during a normal run.

ACKNOWLEDGE CHECK

The acknowledge-check condition occurs if an input data acknowledge signal is not received before the next character becomes available.

OPERATOR ERROR

This check condition occurs if the DCA is activated and the operator has neglected to put a non-zero setting on the DOCUMENTS-PER-BLOCK switches.

OUTPUT STACKER OVERFLOW

The output stacker is limited to document stacks of no more than four inches in thickness. The output stacker overflow condition will be set if the limit is exceeded.

START OF DOCUMENT

This error condition occurs if the start-of-information character (see Table 5-1) is not detected, i.e., decoded within 200 milliseconds after detection of the leading edge of the document.

SECTION VI

OPERATING PROCEDURES

The operating procedures for the Data Station are all oriented around the operation of the central control unit (CCU). This section describes the procedures that are required for operation of the CCU and, secondarily, of the various terminal devices which may be associated with the CCU in any particular Data Station.

CENTRAL CONTROL UNIT

The following procedures must be observed in operating the Data Station, regardless of the equipment configuration.

If operating in the local mode:

1. Turn power ON to the Data Station's CCU and allow time for equipment warmup.
2. Depress the MASTER CLEAR switch.
3. Select the LOCAL position of the REMOTE/LOCAL switch.
4. Load all terminal devices which are to be used (cards in reader, paper tape in reader and/or punch, paper in printer, etc.).
5. Select the desired terminal devices by pressing the ACTIVATE button on each device that is to be used.
6. Select either single block or continuous read operation.
7. Press the BUFFER BYPASS switch, if this feature is desired.
8. Press the RUN button to commence operation. No device activations or deactivations may be performed when the RUN indicator is lighted.
9. The MASTER CLEAR switch must be depressed after transfer of any EDT character.

If operating in the remote mode:

1. Turn power ON to the Data Station's CCU.
2. Load all terminal devices that are to be used (cards in reader, paper tape in reader and/or punch, paper in printer etc.).
3. Select the REMOTE position of the REMOTE/LOCAL switch.
4. Ensure that the dataset is ready for operation.

If the delay-line buffer is installed, the following procedures shall be observed when operating in the remote mode:

1. When using the keyboard, the DELETE button is available to erase an erroneously keyed block of data from the buffer.
2. Care must be taken to avoid overloading the buffer. If the buffer is overloaded, the data which overflows is lost. The current data block must be resubmitted to the buffer after removing the cause of the overload (by issuing an ETX or EOT character, etc.).

PAGE PRINTER

In addition to its two ACTIVATE switches (the keyboard ACTIVATE switch located on the control panel and the printer ACTIVATE switch on the printer) which must be pressed to activate the page printer and its self-contained keyboard, the following procedures must be observed for local operation:

1. The keyboard may be activated for use with any other output device in addition to the printer, which always prints from the keyboard.
2. The printer may be activated for use with any one input device and other desired output devices.
3. If the delay-line buffer option is present, the DELETE control button on the control panel may be used to erase erroneous blocks from the buffer.

PAPER TAPE READER (TYPE 289-4)

Operation of the paper tape reader must conform to the following basic procedures:

1. Load the paper tape onto the reader with the sprocket holes five data channels from the tape edge nearest the reader panel. Thus, the tape orientation determines the location of the supply reel on the reader (see Figure 5-3, page 5-6). Note that for remote mode operation the supply reel must be installed to read the tape in the direction specified by the computer.
2. For operation in local mode, prepare and activate the devices that are to be utilized. Then select either single block or continuous operation, and press the RUN button on the CCU control panel to initiate data transfer.
3. After the DCA has first been activated in the remote mode, all leader characters are discarded by the DCA, and the output devices and/or the computer receive only the characters following the leader. The tape does not stop at the first ETX or EOT character, which is part of the leader.

PAPER TAPE PUNCH (TYPE 289-5)

To operate the paper tape punch in either the local or remote mode, the following procedures must be observed:

1. Load the supply reel of blank paper tape onto the left spindle of the punch (see Figure 6-1).
2. Set up the tension arms and the head release, thread the tape through the head and the tension arms to the takeup reel: reset the tension arms and the head release using the leader as required to insure proper takeup.
3. Should the ERROR indicator come on, correct the error if the Data Station is operating in the local mode. In the remote mode, the correction of the error condition is under the control of the computer program.

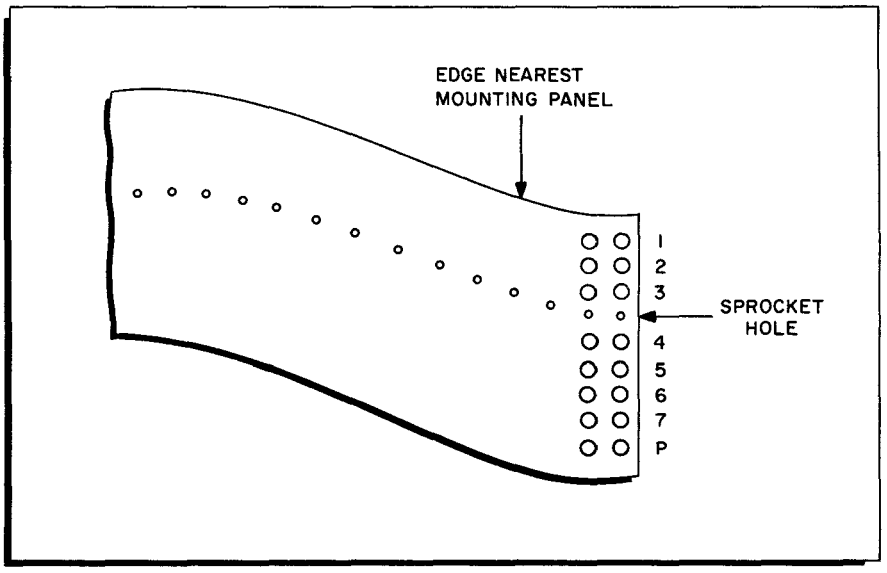


Figure 6-1. Paper Tape Code Alignment (Paper Tape Punch)

CARD READER

The basic operating procedures for local and remote operation of the card reader are as outlined for the central control unit. The following procedures are presented as supplementary information concerning operation of the reader.

When operating in the local mode:

1. Load the deck of cards which is to be read in the operation into the input stacker (see Figure 5-4).
2. Insert the desired program disk at the left center side of the reader.
3. Select the desired number of cards which shall be processed per block by setting the appropriate CARDS PER BLOCK switches.
4. Press the ACTIVATE switch to activate the DCA; the first card will automatically move into the read station.
5. Prepare and activate any other devices which are to be used with the card reader.
6. Select single block or continuous operation and press the RUN button to initiate data transfer.

When operating in the remote mode:

1. Load the deck of cards which is to be read in the operation into the input stacker.
2. Insert the desired program disk at the left center side of the reader.
3. Select the desired number of cards which shall be processed per block by setting the appropriate CARDS PER BLOCK switches.
4. Prepare any other devices which are to be operated with the card reader; do not activate any devices, and leave the Data Station in the remote mode.

Error Correction Procedures

The following error correction procedures apply to the card reader only when the Data Station is operating in the local mode.

1. Feed Error - If a feed error occurs, deactivate the DCA and remove the deck of cards from the input stacker. Remove the jammed card, correct it as necessary, replace the deck of cards, and resume operation at a convenient point.
2. Acknowledge Error - If an acknowledge error occurs, attempt to restart the operation as described in the above paragraph for a feed error. Check that the delay-line buffer is not being overloaded. If the buffer is being overloaded, decrease the number of cards specified by the settings of the CARDS PER BLOCK switches. If the error persists, correction is beyond operator control.

OPTICAL BAR CODE READER

The basic operating procedures for local and remote operation of the OBCR are the same as those outlined for the central control unit. The following procedures are presented as supplementary information concerning operation of the OBCR.

When operating in the local mode:

1. Load the stack of documents that is to be read into the input hopper (see Figure 5-7).
2. Set the adjustable document length selector to the correct length of the documents that are to be read; select either CARD or PAPER on the document thickness selector.
3. Set the number of documents to be processed as one block by depressing the appropriate DOCUMENTS-PER-BLOCK switch(es).
4. Depress the ACTIVATE switch to activate the DCA.
5. Prepare and activate any other devices which are to be used with the OBCR document reader.
6. Select single block or continuous reading and depress the RUN button to initiate data transfer.

When operating in the remote mode:

1. Follow Steps 1, 2, and 3, above, of the procedures for operating in the local mode.
2. Prepare any other devices which are to be operated with the OBCR; do not activate any device, and leave the Data Station in the remote mode.

Error Correction Procedures

The following error correction procedures apply to the optical bar code reader only when the Data Station is operating in the local mode.

1. Depress the MASTER CLEAR button on the Data Station control panel.
2. Ascertain that the DOCUMENTS-PER-BLOCK switches are set to a value other than zero, but are not set to so high a value as to cause delay line buffer overloading.

3. Check settings of the document length and document thickness selectors.
4. Check output stacker for overloading.
5. Make certain that documents are correctly loaded into the input hopper.
6. Remove or correct documents if necessary and attempt to restart at a convenient point.
7. If the error persists, correction is beyond operator control.

SECTION VII

SAMPLE APPLICATIONS

This section presents a summary of applications in which the Honeywell Data Station is being used, including discussions and diagrams of four Honeywell Data Station/computer communication systems which are currently being installed. The examples shown here are but a few of the data communication systems that have been successfully implemented using Honeywell electronic data processing equipment. These four have been selected for discussion because of the varied approaches used to achieve the desired results.

SYSTEM CONFIGURATION

Many variables must be considered when tailoring a computer-based communication system to a specific application. Major considerations which must be analyzed before a communication system can be implemented are as follows:

1. Which Honeywell Series 200 central processor and associated peripheral devices are required for the data processing/communication system being considered?
2. How many communication lines are required in the system in order to obtain the real time processing results required?
3. Are leased or toll lines more economical for present and future requirements and communications volume?
4. What will be the ratio of real time processing to scheduled production? What is the effect of this ratio on the total systems concept?
5. What Honeywell Data Station options are required to achieve optimum operating efficiency both at the remote terminals and at the computer center?

The manner in which these problems were solved by four different companies is reflected in the following examples.

A MANUFACTURING COMPANY

A manufacturing company has its corporate headquarters and main facilities in Wisconsin and also maintains two special processing plants in Michigan and Tennessee. This company required a communication system linking the two remote locations to the home office computer to accomplish its data processing operations. Primarily, three data processing applications were desired: (1) inventory control; (2) manufacturing control data transmission; and (3) centralized computer processing of all corporate business data.

Major considerations for this system configuration can be summarized as follows:

1. The central processor selected by this company for its data processing applications was a Honeywell Model 200 with 12,288 main memory locations and the peripheral devices and their associated controls shown in Figure 7-1. To meet their communication requirements, an additional 4,096 memory locations, a type 286-2 communication control, and a type 285-1M communication adapter were ordered by this company.

2. Since the total volume of data transmission is modest, there is no requirement to transmit simultaneously from the two remote plants to the central plant; one line at a time was considered adequate.

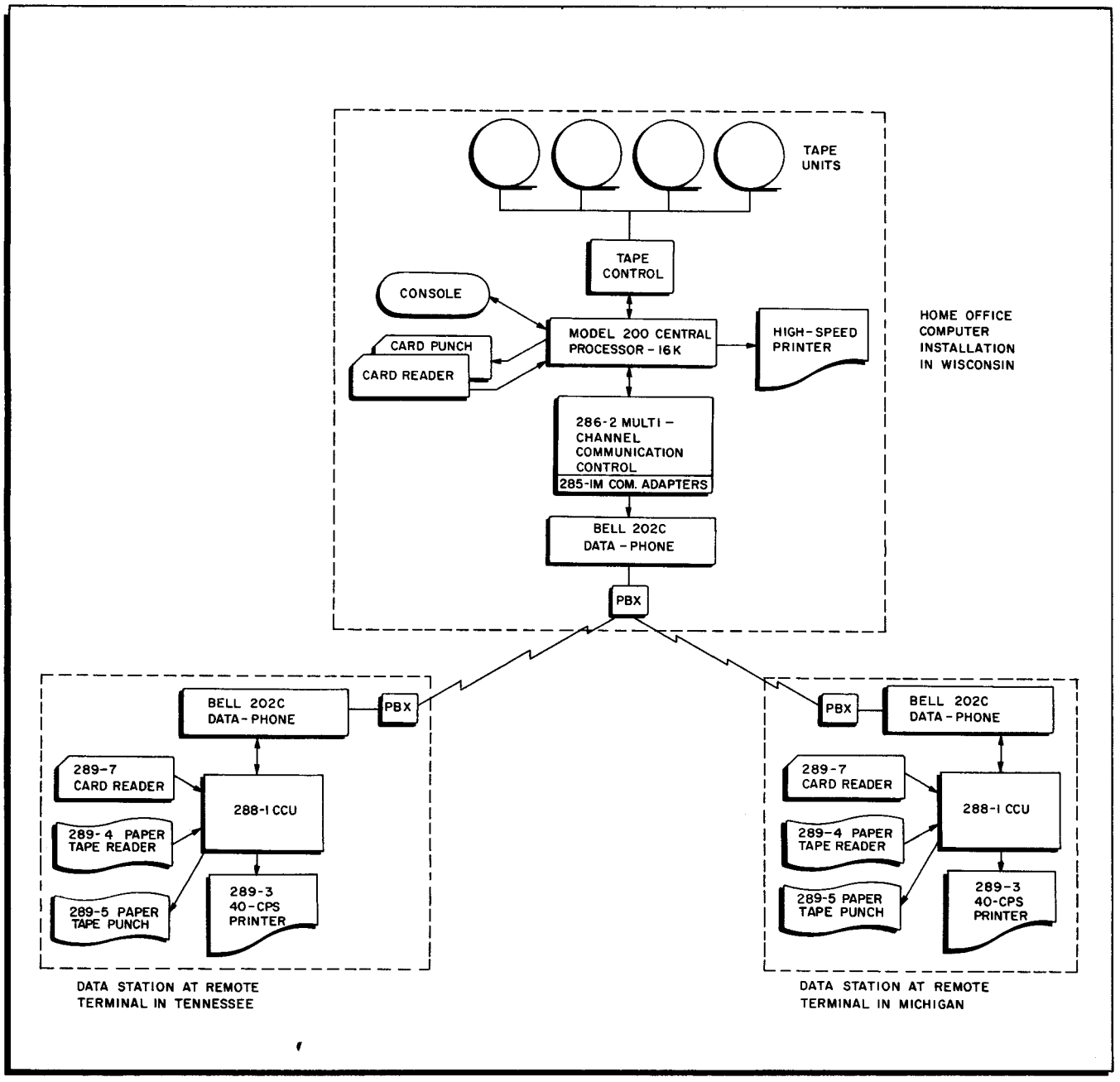


Figure 7-1. Manufacturing Company Communication System

3. Since the company already had tie-line service, privately leased, from the main plant to the two remote plants for regular telephone voice conversations, it was found to be most economical to use the existing service through the private branch exchange (PBX) for data transmission.

4. A schedule for data transmission every half hour was established. An interrupt program resides in the main memory of the computer at all times ready to accept the scheduled calls to the Data Station through the PBX switchboard. Depending on the batch of transactions transmitted, the interrupt program can run communication programs and data processing programs either concurrently or individually.

5. The equipment selected for the communication network configuration is as follows:

Home Office Computer Installation	1 - 286-2 Multi-channel Communication Control 1 - 285-1M Communication Adapter (Honeywell Data Station)
Two Remote Terminals	2 - 288-1 Central Control Unit 2 - 088-1 Delay-Line Buffer Option 2 - 289-4 Paper Tape Readers 2 - 289-5 Paper Tape Punches 2 - 289-7 Punched Card Reader 2 - 289-3 40-cps Page Printer and Keyboard

Manual call origination/answering from the computer location is used, and the Data Station can be operated whether attended or unattended. Data is transmitted at a 120-character-per-second rate between the computer and the remote terminal locations.

A CHEMICAL MANUFACTURER

A chemical manufacturing company with its home office on the eastern seaboard also has three other plants located in the South, the Midwest, and the Southwest. The plants are linked to the home office by a communication system, the heart of which is a Honeywell Series 200 Electronic Data Processing System.

The central processor selected for the system was a Model 200 with 24,576 main memory locations. Peripheral devices included in the system are an interval timer, five magnetic tape drives and their control, a punched card reader, a card punch, and a high-speed printer. Applications of major importance which are handled by the computer/communication system are: (1) inventory control; (2) centralized computer processing of all business data; and (3) up-to-date reporting of the company's business statistics.

The communication system implemented for this manufacturer included Honeywell Data Stations at each remote plant location. Each Data Station has a punched card reader and a 40-character-per-second printer; a delay-line buffer is installed in each station. At the home office computer location, a Honeywell type 286 multi-channel communication control with type 285-1M communication adapters (for Honeywell Data Station) is installed.

Three WATS (Wide Area Telephone Service) general switched network lines are used, with alternate (voice/data) operation. Bell 202C DATA-PHONES are installed at each remote terminal and at the home office computer location. Transmission of data is at the rate of 120 characters per second; data transmission and reception are initiated from the home office computer location by manual dialing. The remote terminal Data Stations can be operated whether attended or unattended. A diagram of this computer/communications system is shown in Figure 7-2.

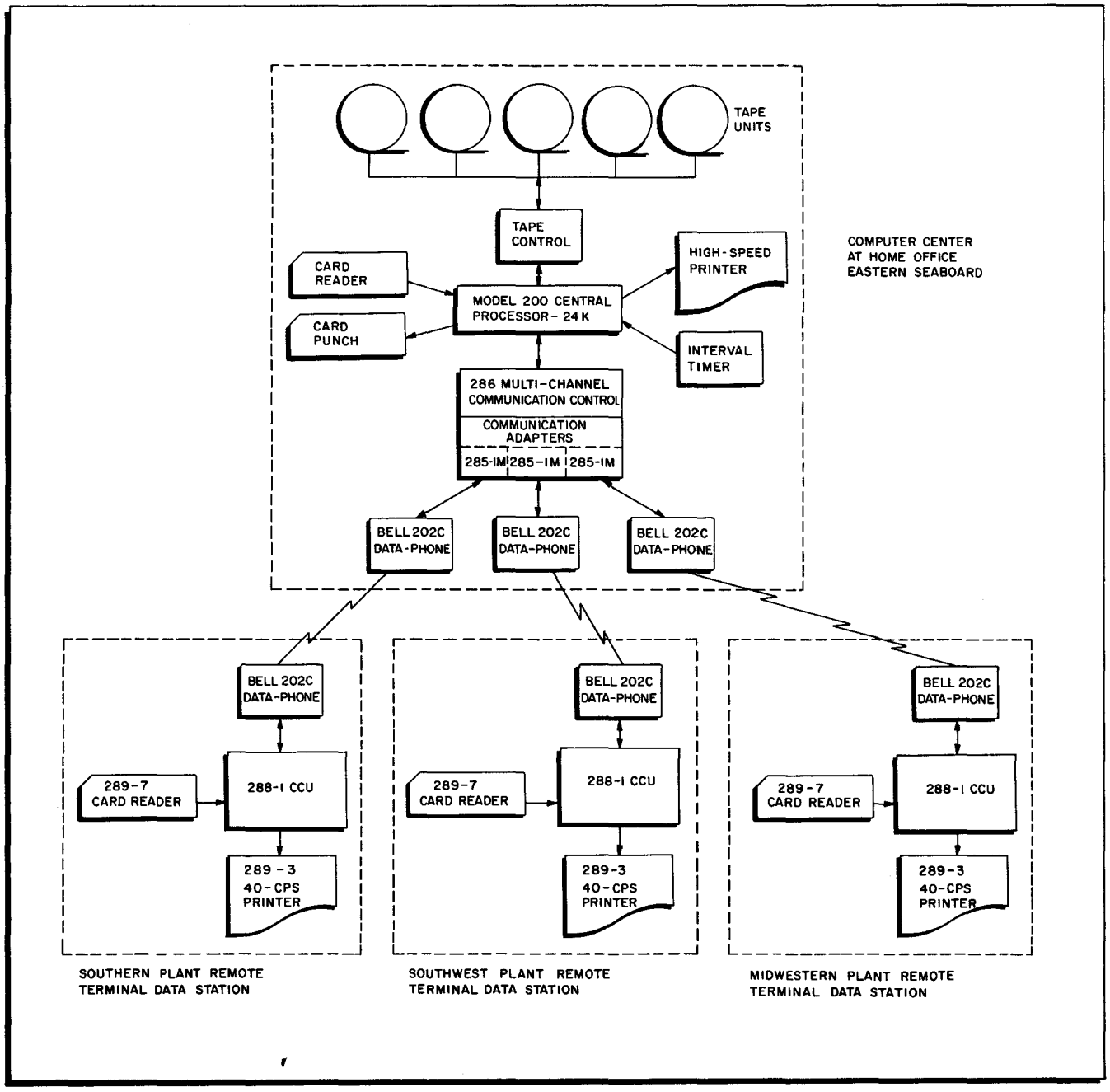


Figure 7-2. Chemical Manufacturing Company Communication System

A BROKERAGE COMPANY

An eastern brokerage house with headquarters in New York desired to establish a computer/communication system between its home office location and branch offices in Chicago, Portland, Seattle, Los Angeles, and San Francisco. Computer applications and communication tasks desired for immediate implementation were:

1. On-line brokerage accounting (clearance, cash receipts, deliveries, and journals).
2. Trade data transmission (stock quotations and the like).
3. On-line, up-to-date reporting of sales, posting, and open-balance account reports.
4. Operation of the communication system at night with WATS (Wide Area Telephone Service) to handle all other daily transactions.

The computer system selected to handle these tasks was a Honeywell Series 200 assembled around a Model 200 central processor with 24,576 main memory locations and operated from an associated console device. Peripheral devices in the system include six magnetic tape drives and their control, a card reader, a card punch, and a high-speed printer. A Honeywell type 286-2 communication control with an interval timer and five type 285-1M communication adapters was installed at the computer location. Data transmission, at the rate of 120 characters per second, is over five WATS lines in the telephone company's general switched network.

The five Honeywell Data Stations at the remote terminal locations are identical. Each Data Station includes a punched card reader and a 40-character-per-second printer. Bell 202C DATA-PHONES are used at each of the remote terminals and at the home office computer location, thus permitting alternate (voice/data) operation. The system can be operated at night with the Data Stations unattended or during the normal business day when an operator is present at each station. Manual call origination/answering is used to initiate data transmission from the computer location at the home office. A diagram of this computer/communication system is shown in Figure 7-3).

A TRUCKING COMPANY

A major, nationwide trucking company desired to establish a computer/communication system to link its home office with all its trucking terminals and warehouses across the country. The applications and systems required in this installation were: (1) accounting and inventory control; (2) rating and operational control; and (3) scheduling of equipment and manpower.

A diagram of the system implemented to perform these various jobs is shown in Figure 7-4. A Honeywell Series 200 Electronic Data Processing System was selected as the computer for the installation. The central processor is a Model 200 with 28,672 main memory locations.

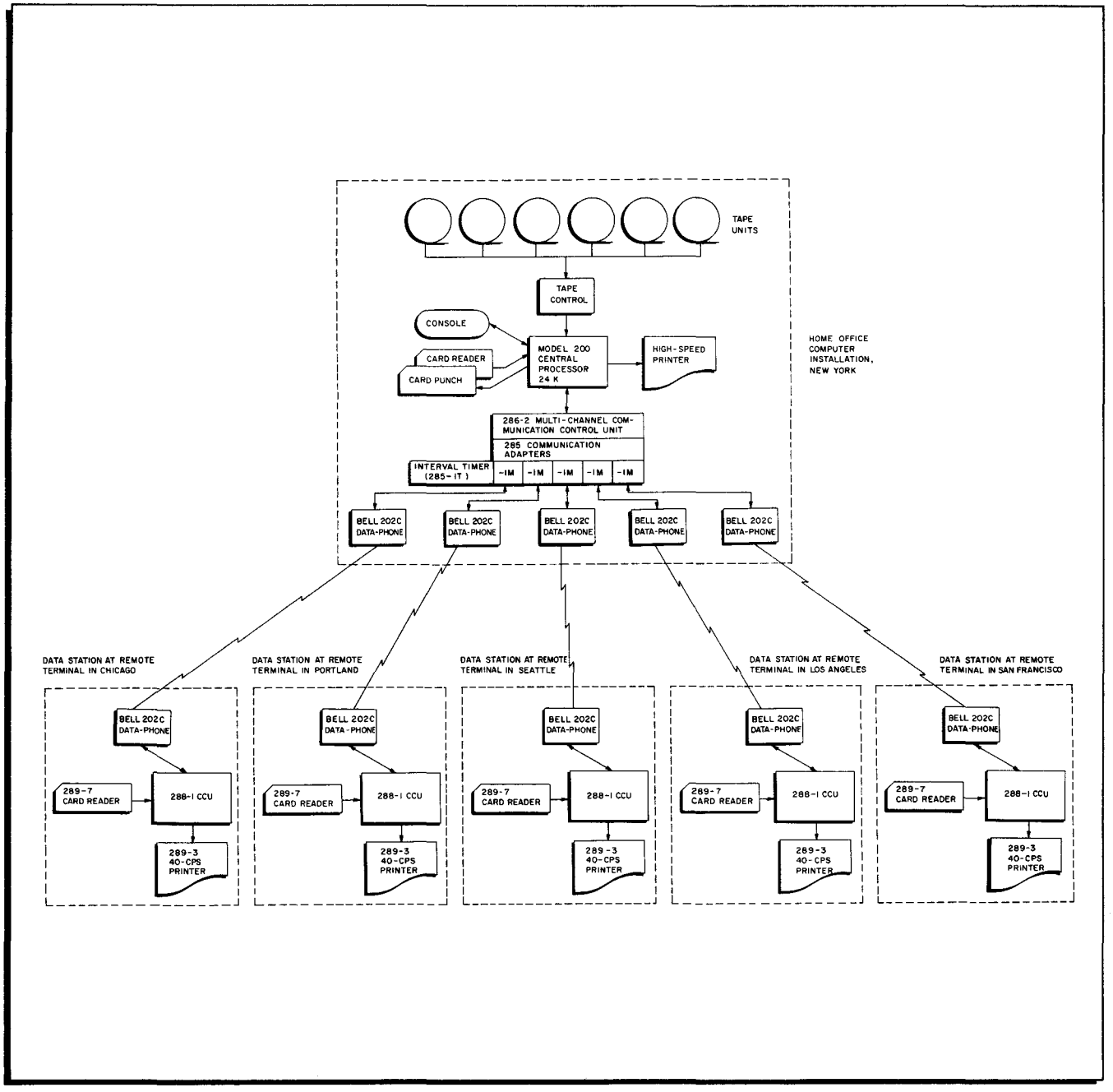


Figure 7-3. Brokerage Company Communication System

Peripheral equipment used in the computer system includes six magnetic tape drives and their control, a card reader/punch and its control, a high-speed printer, and a random access magnetic drum unit for on-line information storage.

Two different equipment configurations are used for the remote terminals of the communication system; the configuration of each terminal is dependent upon the volume of data that must be transmitted/received. The 14 low-speed terminals are composed of a Bell 103A DATA-PHONE dataset and a Data Station, with a paper tape reader and a paper tape punch and a 10-character-per-second

printer. In the eight high-speed terminals, a Bell 202C DATA-PHONE dataset is used, and the Data Station has a paper tape reader, a paper tape punch, and a 40-character-per-second printer.

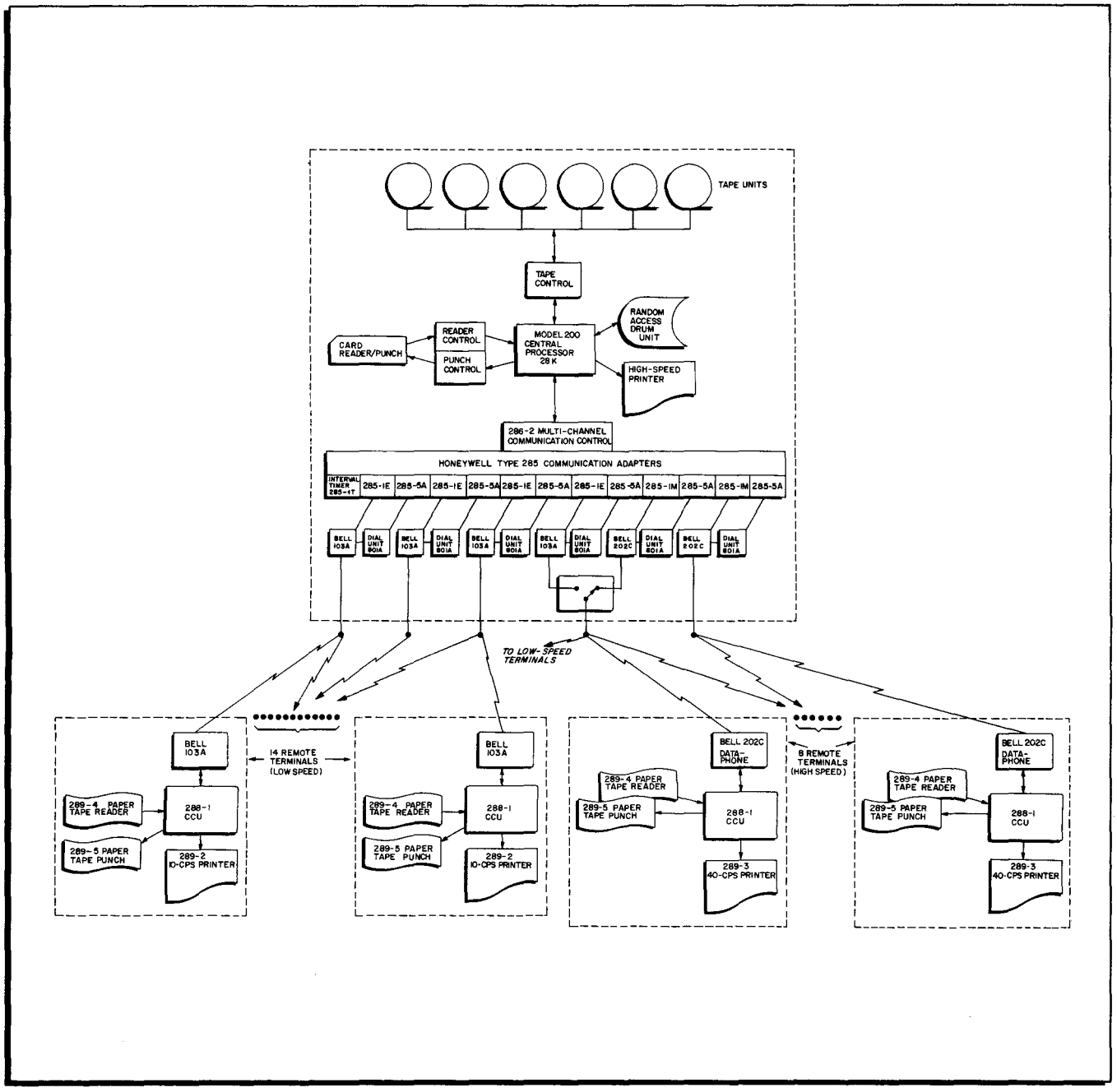


Figure 7-4. Trucking Company Communication System

At the home office computer location, a Honeywell type 286-2 communication control is installed to control data transmission between the computer and the remote terminals. Type 285 communication adapters are used to interface the communication control unit and telephone company equipment. All data transmission is over WATS (Wide Area Telephone Service) general

switched network lines; three lines are used with low-speed terminals, and two lines are normally used for high-speed terminals. One high-speed line can be switched over for use as a backup transmission line with the low-speed terminals.

Data transmission rates over the communication lines are 15 characters per second for low-speed terminals and 120 characters per second for high-speed terminals. Alternate operation (voice/data) is permitted between the computer and both low- and high-speed terminals. The low-speed terminals use Bell 103A DATA-PHONE datasets; Bell 202C DATA-PHONE datasets are used for the high-speed terminals. Each line is further controlled by a Bell 801A automatic dialing unit; thus, remote terminals can be addressed by the computer through a polling routine, and data transmission/reception is automatically handled.

APPENDIX A

DATA STATION CHARACTERS AND CODE

(SEVEN-LEVEL PLUS EVEN PARITY)

CHARACTER	BIT CONFIGURATION P	7	6	5	4	3	2	1	KEYBOARD CTRL and *	DATA STATION CONTROL CHARACTERS
NULL	0	0	0	0	0	0	0	0	n/a	
SOH	1	0	0	0	0	0	0	1	n/a	SOH
STX	1	0	0	0	0	0	1	0	n/a	STX
ETX	0	0	0	0	0	0	1	1	C	ETX
EOT	1	0	0	0	0	1	0	0	D	EOT
ENQ	0	0	0	0	0	1	0	1	n/a	ENQ
ACK	0	0	0	0	0	1	1	0	n/a	ACK
BELL	1	0	0	0	0	1	1	1	n/a	BELL
BS	1	0	0	0	1	0	0	0	n/a	
HT	0	0	0	0	1	0	0	1	n/a	
LF	0	0	0	0	1	0	1	0		
VT	1	0	0	0	1	0	1	1	n/a	
FF	0	0	0	0	1	1	0	0	n/a	
CR	1	0	0	0	1	1	0	1		
SO	1	0	0	0	1	1	1	0	n/a	
SI	0	0	0	0	1	1	1	1	n/a	

CHARACTER	BIT CONFIGURATION P	7	6	5	4	3	2	1	KEYBOARD CTRL and *	DATA STATION CONTROL CHARACTERS
DLE	1	0	0	1	0	0	0	0	n/a	
DC1	0	0	0	1	0	0	0	1	n/a	CS
DC2	0	0	0	1	0	0	1	0	n/a	TEL
DC3	1	0	0	1	0	0	1	1	n/a	INT
DC4	0	0	0	0	0	1	0	0	n/a	DAC
NACK	1	0	0	1	0	1	0	1	n/a	NACK
SYNC	1	0	0	1	0	1	1	0	n/a	
ETB	0	0	0	1	0	1	1	1	n/a	
CNCL	0	0	0	1	1	0	0	0	n/a	
EM	1	0	0	0	1	0	0	1	n/a	
SS	1	0	0	1	1	0	1	0	n/a	
ESC	0	0	0	1	1	0	1	1	n/a	
FS	1	0	0	0	1	1	0	0	n/a	
GS	0	0	0	1	1	1	0	1	n/a	
RS	0	0	0	0	1	1	1	0	n/a	
US	1	0	0	1	1	1	1	1	n/a	

CHARACTER	BIT CONFIGURATION P	7	6	5	4	3	2	1	KEYBOARD; SHIFT and *
SPACE	1	0	1	0	0	0	0	0	
!	0	0	1	0	0	0	0	1	1
"	0	0	1	0	0	0	1	0	2
#	1	0	1	0	0	0	1	1	3
$	0	0	1	0	0	1	0	0	4
%	1	0	1	0	0	1	0	1	5
&	1	0	1	0	0	1	1	0	6
'	0	0	1	0	0	1	1	1	7
(	0	0	1	0	1	0	0	0	8
)	1	0	1	0	1	0	0	1	9
*	1	0	1	0	1	0	1	0	:
+	0	0	1	0	1	0	1	1	;
,	1	0	1	0	1	1	0	0	
-	0	0	1	0	1	1	0	1	
.	0	0	1	0	1	1	1	0	
/	1	0	1	0	1	1	1	1	

CHARACTER	BIT CONFIGURATION P	7	6	5	4	3	2	1	KEYBOARD: SHIFT and *
0	0	0	1	1	0	0	0	0	
1	1	0	1	1	0	0	0	1	
2	1	0	1	1	0	0	1	0	
3	0	0	1	1	0	0	1	1	
4	1	0	1	1	0	1	0	0	
5	0	0	1	1	0	1	0	1	
6	0	0	1	1	0	1	1	0	
7	1	0	1	1	0	1	1	1	
8	1	0	1	1	1	0	0	0	
9	0	0	1	1	1	0	0	1	
:	0	0	1	1	1	0	1	0	
;	1	0	1	1	1	0	1	1	
<	0	0	1	1	1	1	0	0	,
=	1	0	1	1	1	1	0	1	-
>	1	0	1	1	1	1	1	0	.
?	0	0	1	1	1	1	1	1	/

* Refer to Figure 5-1, page 5-3, for Keyboard Operation Using CTRL and SHIFT Keys.

n/a = not available

CHARACTER	BIT CONFIGURATION P	7	6	5	4	3	2	1	KEYBOARD
\	1	1	0	0	0	0	0	0	s.c.
A	0	1	0	0	0	0	0	1	
B	0	1	0	0	0	0	1	0	
C	1	1	0	0	0	0	1	1	
D	0	1	0	0	0	1	0	0	
E	1	1	0	0	0	1	0	1	
F	1	1	0	0	0	1	1	0	
G	0	1	0	0	0	1	1	1	
H	0	1	0	0	1	0	0	0	
I	1	1	0	0	1	0	0	1	
J	1	1	0	0	1	0	1	0	
K	0	1	0	0	1	0	1	1	
L	1	1	0	0	1	1	0	0	
M	0	1	0	0	1	1	0	1	
N	0	1	0	0	1	1	1	0	
0	1	1	0	0	1	1	1	1	

CHARACTER	BIT CONFIGURATION P	7	6	5	4	3	2	1	KEYBOARD
P	0	1	0	1	0	0	0	0	
Q	1	1	0	1	0	0	0	1	
R	1	1	0	1	0	0	1	0	
S	0	1	0	1	0	0	1	1	
T	1	1	0	1	0	1	0	0	
U	0	1	0	1	0	1	0	1	
V	0	1	0	1	0	1	1	0	
W	1	1	0	1	0	1	1	1	
X	1	1	0	1	1	0	0	0	
Y	0	1	0	1	1	0	0	1	
Z	0	1	0	1	1	0	1	0	
[	1	1	0	1	1	0	1	1	
~	0	1	0	1	1	1	0	0	s.c.
]	1	1	0	1	1	1	0	1	
^	1	1	0	1	1	1	1	0	s.c.
—	0	1	0	1	1	1	1	1	s.c.

CHARACTER	BIT CONFIGURATION P	7	6	5	4	3	2	1	KEYBOARD
@	0	1	1	0	0	0	0	0	s.c.
a	1	1	1	0	0	0	0	1	n.a.
b	1	1	1	0	0	0	1	0	n/a
c	0	1	1	0	0	0	1	1	n/a
d	1	1	1	0	0	1	0	0	n/a
e	0	1	1	0	0	1	0	1	n/a
f	0	1	1	0	0	1	1	0	n/a
g	1	1	1	0	0	1	1	1	n/a
h	1	1	1	0	1	0	0	0	n/a
i	0	1	1	0	1	0	0	1	n/a
j	0	1	1	0	1	0	1	0	n/a
k	1	1	1	0	1	0	1	1	n/a
l	0	1	1	0	1	1	0	0	n/a
m	1	1	1	0	1	1	0	1	n/a
n	1	1	1	0	1	1	1	0	n/a
o	0	1	1	0	1	1	1	1	n/a

CHARACTER	BIT CONFIGURATION P	7	6	5	4	3	2	1	KEYBOARD
p	1	1	1	1	0	0	0	0	n/a
q	0	1	1	1	0	0	0	1	n/a
r	0	1	1	1	0	0	1	0	n/a
s	1	1	1	1	0	0	1	1	n/a
t	0	1	1	1	0	1	0	0	n/a
u	1	1	1	1	0	1	0	1	n/a
v	1	1	1	1	0	1	1	0	n/a
w	0	1	1	1	0	1	1	1	n/a
x	0	1	1	1	1	0	0	0	n/a
y	1	1	1	1	1	0	0	1	n/a
z	1	1	1	1	1	0	1	0	n/a
{	0	1	1	1	1	0	1	1	n/a
—	1	1	1	1	1	1	0	0	n/a
}	0	1	1	1	1	1	0	1	n/a
|	0	1	1	1	1	1	1	0	n/a
DEL	1	1	1	1	1	1	1	1	RUBOUT

NOTE: n/a = not available

s.c. = subject to change

HONEYWELL EDP TECHNICAL PUBLICATIONS
USERS' REMARKS FORM

TITLE: SERIES 200
DATA STATION - Remote Communication Terminal
REFERENCE MANUAL

DATED: October, 1965

FILE NO: 113.0005.0900.0-032

ERRORS NOTED:

Fold

SUGGESTIONS FOR IMPROVEMENT:

Fold

FROM: NAME _____ DATE _____

COMPANY _____

TITLE _____

ADDRESS _____

_____

Cut Along Line

FIRST CLASS
PERMIT NO. 39531
WELLESLEY HILLS
MASS.

BUSINESS REPLY MAIL

No postage stamp necessary if mailed in the United States

POSTAGE WILL BE PAID BY

HONEYWELL
ELECTRONIC DATA PROCESSING DIVISION
60 WALNUT STREET
WELLESLEY HILLS, MASS. 02181

ATT'N: PUBLICATIONS AND WRITING SERVICES DEPARTMENT

Cut Along Line

Honeywell
ELECTRONIC DATA PROCESSING

HONEYWELL
ELECTRONIC
DATA
PROCESSING
WELLESLEY HILLS,
MASSACHUSETTS 02181