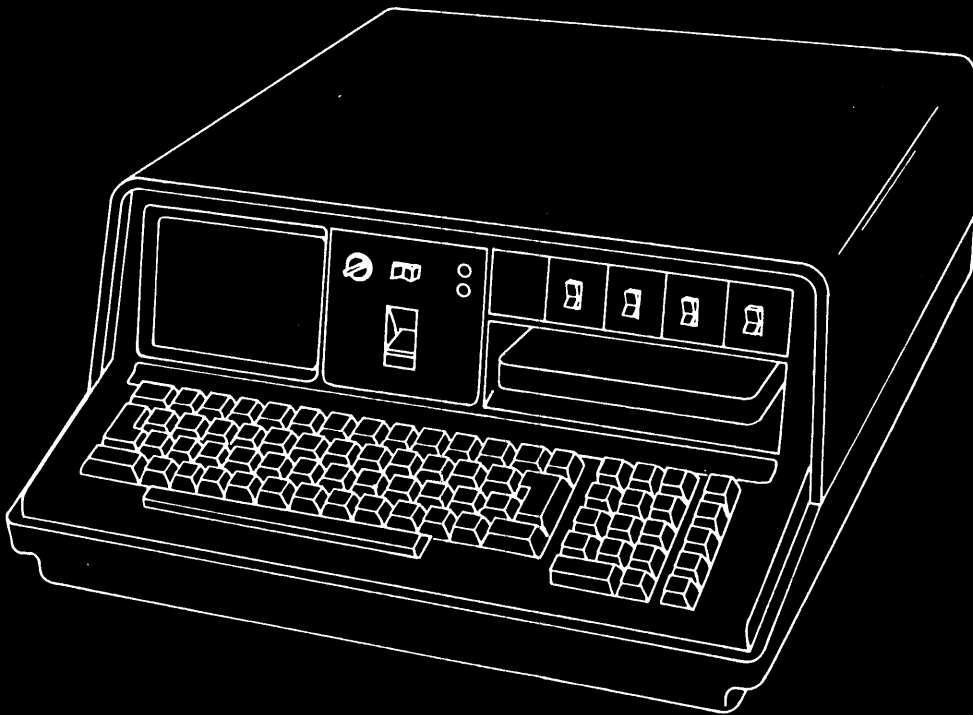IBM

IBM 5100
Communications
Reference Manual

5100

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Preface

This manual explains how to use the communications feature with the IBM 5100 Portable Computer.

To understand this manual, you should know how to operate the 5100 using APL or the BASIC language. You should also be familiar with communications concepts and terminal operations.

Related Publications

- *IBM 5100 BASIC Introduction*, SA21-9216

- *IBM 5100 APL Introduction*, SA21-9212

- *IBM 5100 BASIC Reference Manual*, SA21-9217

- *IBM 5100 APL Reference Manual*, SA21-9213

- *IBM 5100 Communications Reference Card*, GX21-9211

- *Data Communications Primer*, GC20-1668

Contents

How to Use This Manual

This manual is organized into the following topics:

- *Introduction* describes the communications feature.

- *Operation of the Communications Feature* describes how to load and initialize the program, the format of the display screen and extended display, how data is transmitted and received, the format of the communications status line, and the scroll and edit operations.

- *Operation of the Keys* describes the function keys used during communications.

- *Communications Commands* describes the commands used during communications.

- *Message Input and Output Devices* describes the function of the input and output devices during communications.

- *State Indicators* describes the states of the program and what you can do during each state.

- *Error Codes* describes the error codes that are displayed on the status line.

- *Appendixes A, B, and C* contain installation instructions, sample programs, and translation code charts.

After reading the *Introduction* and the *Operation of the Communications Feature*, you should be able to sign on with a remote system, use the IBM 5100 Portable Computer to transmit data from the keyboard, and receive data. The remaining sections of the manual provide you with a detailed explanation of 5100 operations during communications.

With the Communications Adapter feature, the IBM 5100 Portable Computer
transmits data to and receives data from a remote system. The 5100 appears
the same as an IBM 2741 Communications Terminal to the remote system, and can
communicate with many systems that support the 2741 (start-stop mode) with
EBCD (extended binary coded decimal) notation.

The 5100 communications feature allows you two options, T (tape option) or
P (print option). When you select option T, data can be entered from the
keyboard or tape unit and limited-length messages from the remote system can be
printed and/or written on tape. When you select option P, all messages received
from a remote system can be printed as they are received, but the tape unit cannot
be used for input or output. With either option T or P, data transmitted and
received is displayed on the display screen.

Figure 1. A 5100 with a Combined BASIC/APL Keyboard

Comm	Cmd Char	Edit	Line Delete	Shift Lock	Tab Set	Tab Reset	Print	Home	Write		ⵛ
BASIC	LOAD	SAVE	RUN	GO	LIST	UTIL	AUTO	RENUM	RD	REWIND	Calc Result
APL	)LOAD	)SAVE	)CONT	)LIB	)FNS	)VARS	)COPY	)WSID	)OUTSEL	)REWIND	ⵛ

Copy Display Delete Insert

Comm CMD Operations

8	Move lines	9	Move lines
5	Fast up		Fast down
0	Tab	2	Fast left	3	Fast right

Keyboard keys:

`.. 1` `- 2` `< 3` `≤ 4` `= 5` `≥ 6` `> 7` `≠ 8` `∨ 9` `∧ 0` `- +` `÷ ×`

ATTN · ·

CMD `? Q` `ω W` `∈ E` `ρ R` `~ T` `↑ Y` `↓ U` `≀ I` `○ O` `* P` `→ ←` `=` EXECUTE

`7 8 9` `/÷`

`α A` `⌈ S` `⌊ D` `- F` `∇ G` `∆ H` `∘ J` `' K` `⌷ L` `( [` `) ]` `@ #`

`4 5 6` `*×`

`⊂ Z` `⊃ X` `∩ C` `∪ V` `⊥ B` `⊤ N` `| M` `; ;` `: :` `\ \` `$ &`

`1 2 3` `-`

`0` `.` `+`

LOADING AND INITIALIZING THE COMMUNICATIONS PROGRAM

If the communications feature is installed on your 5100, you can now prepare the 5100 for communications. (For customer installation and checkout, see *Appendix A. Installation Instructions.*) First, start the 5100 for normal language operation and insert the tape cartridge containing the communications program in the built-in tape unit. Enter the command)MODE COM if you are using APL or UTIL MODE COM if you are using BASIC, and press EXECUTE. The 5100 then displays the options available: Enter T if you want to use the tape units, or enter P if you want to print long messages. If the printer is not installed, the options are not displayed and option T is selected automatically.

The communications program is now ready to be initialized using the &SYSTEM and &RATE commands. &SYSTEM specifies the type of remote system you intend to communicate with so the 5100 will use the correct EBCD translation; it also specifies the error recovery. &RATE (for option T only) specifies the communication line rate in bits per second (bps). The & is entered by holding down the CMD key and then pressing the alphameric 1 key. The SYSTEM and RATE commands are entered from the keyboard following the &. The commands you use depend on how you are using the communications feature and on the system with which you are communicating. For the correct parameters to be entered with the commands for your system, see *Communications Commands* for &SYSTEM and &RATE.

After entering the commands, establish a line connection with the remote system. If you are using non-switched lines, the 5100 is online; however, if you are using switched lines, you must dial the remote system to put the 5100 online. Enter the appropriate sign-on for your remote system. The 5100 is now ready to communicate.

DISPLAY SCREEN AND EXTENDED DISPLAY

The display screen contains 16 lines, each 64 characters long. The bottom line on the screen is the status line, which contains information on the status of the communications operation. (For a description of the messages that appear on the status line, see *Communications Status Line.*) The next line on the screen (the line above the status line) is the line on which data is displayed as it is transmitted and received; this is called the input line. The remaining 14 lines, plus the extended display, store the transmitted and received data.

The extended display is an area in 5100 storage where transmitted and received data is stored. The approximate size of the extended display for each 5100 model is:

5100 Model	Size
A1, B1, C1	1K (K=1024 characters)
A2, B2, C2	17K
A3, B3, C3	33K
A4, B4, C4	49K

When data is entered in the extended display and the extended display becomes full, the oldest line is deleted when a new line is entered.

Data in the extended display can be thought of as a page of data lines. A *line* contains the data between new-line and/or line feed function characters. A *message* contains the data between the start of transmission and end of transmission function characters and contains one or more lines. These function characters are transmitted by the 5100 and the remote system to control the length and spacing of the lines.

Normally, the first 64 characters of the 14 most recent lines of the extended display are displayed on the screen; however, by using the scroll keys, you can move any part of the extended display to the screen.

TRANSMITTING FROM THE KEYBOARD

When the 5100 is online with a remote system, each character you enter from the keyboard is displayed on the screen and transmitted to the remote system. When you enter a line longer than 64 characters, each additional character entered is displayed in position 64 and all data on the display screen moves one position to the left. Pressing EXECUTE indicates the end of the line and moves the data on the display screen up one line and to the right so the first character of each line is in position 1 on the display screen.

RECEIVING

If the 5100 is receiving data, each character is displayed on the screen as it is received. A line containing 64 characters or less is displayed exactly as it is received. Lines longer than 64 characters are formatted into 64-character lines on the display screen as they are received. When the end of transmission character is received, the format of the longer lines changes and only the first 64 characters of each line are displayed. The part of the lines not displayed is stored in the extended display and can be moved to the screen by using the scroll keys.

COMMUNICATIONS STATUS LINE

The bottom line of the display screen is the status line. Functions such as copy display and HOLD may alter the format of the status line. The status line returns to its normal format when the 5100 goes to the home state. The positions of the status line indicate:

Position	Meaning
1-5	The number of the character position in the extended display that appears in position 1 on the display screen.
17-27	General status area.
28-40	Tape status area.
41-51	Printer status area.
53-56	State indicator.
58 and 60	Communication line status:

	□ ↓	No line connection exists.
	□ ↑	The line connection has been made.
	□ ←	The 5100 is receiving.
	□ →	The 5100 is transmitting.

64	Line indicator:

	→	At least one of the lines on the display screen is longer than 64 characters, and the last part of the line is not displayed.
	↑	The last character of the longest line displayed on the screen is in position 64.
	No arrow (blank)	At least one unused character position remains to the right of the longest line on the display screen.

SCROLL

During the scroll operation, you can display any part of the extended display on the screen. Normally, the first 64 characters of the last 14 lines entered in the extended display are displayed on the screen; this is the home position of the extended display. Positions 1 to 5 and 64 of the status line are useful in scroll operations because they indicate whether any data is to the left or right of the display screen (see *Communications Status Line*).

To move data on the display screen, use the scroll keys, which are activated by holding down the CMD key and pressing a specific numeric key. The scroll keys only move the data if there is data in the extended display to be moved to the screen. The scroll keys are:

Key		Function
2	Fast left scroll	Moves the data on the display screen 20 positions to the left.
3	Fast right scroll	Moves the data on the display screen 20 positions to the right.
5	Fast up scroll	Moves the data on the display screen up 14 lines.
6	Fast down scroll	Moves the data on the display screen down 14 lines.
8	Scroll left	Moves the data on the display screen one position to the left.
9	Scroll right	Moves the data on the display screen one position to the right.

The following keys perform the same function in communications as they do in APL or BASIC language operations:

Key		Function
↑	Scroll up	Moves the data on the display screen up one line.
↓	Scroll down	Moves the data on the display screen down one line.

Pressing the home key (CMD and alphameric 8) ends the scroll operation and moves the data on the display screen to the home position. The edit key also ends the scroll operation and starts the edit operation.

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EDIT

During the edit operation, you can edit the data in the extended display, print it, write it on tape, or compose a message offline (see *Composing Messages Offline*). The keys used during the edit operation are activated by holding down the CMD key and pressing a specific alphameric key:

Key		Function
[− 2]	Edit	Starts the edit operation.
[< 3]	Line delete	Deletes all characters on the input line to the right of and at the cursor position.
[> 7]	Print	Prints the data stored in the extended display from the input line to the end of the extended display.
[≠ 8]	Home	Restores the data on the display screen to the home position in the extended display.
[∨ 9]	Write (option T only)	Writes the data stored in the extended display on tape from the input line to the end of the extended display.

You must position the line to be edited on the input line by using the scroll keys before starting the edit operation. When you press the edit key, the first 64 character positions of each line are displayed, and the cursor is in position 1.

During the edit operation, the delete and insert functions and the backspace and forward space keys operate as they normally do during APL or BASIC language operations. If you press the backspace key when the cursor is at the left edge of the display screen (position 1) and positions 1 to 5 on the status line do not indicate 00001, all the data moves to the right. If you press the forward space key when the cursor is at the right edge of the display screen (position 64) and an arrow is displayed in position 64 of the status line, all the data moves to the left. Positions 1 to 5 and 64 of the status line indicate whether any data is to the left or right of the display screen (see *Communications Status Line*).

After the line is edited, you can transmit it by pressing the EXECUTE or ATTN key. *All data in the extended display following the edited line is deleted.* New data is added to the extended display following the edited line.

To terminate the edit operation, press the EXECUTE, ATTN, or home (CMD and alphameric 8) key. If you press the home key after editing is complete, the displayed data returns to the home position, the edited line is not transmitted, and all the data following the edited line in the extended display is deleted as explained previously. If you press the home key before any editing is done, the displayed data returns to the home position and no data is lost from the extended display; therefore, you can end the edit operation without losing any data.

Operation of the Keys

The following keys perform the same functions in communications as they do in APL or BASIC language operations:

Scroll up

Scroll down

Backspace (delete function)

Forward space (insert function)

ATTN KEY

The action of the ATTN key depends on which communications operation is being performed and whether the ATTN key is pressed with another key:

Transmit

When the 5100 is transmitting data from the keyboard, pressing ATTN sends an end of transmission character and ends the transmission. The data transmitted is not printed or written on tape. The 5100 then waits to receive data from the remote system, and any data received is added to the end of the data just transmitted. When the end of transmission character is received from the remote system, the data transmitted and the data received will be printed and/or written on tape as one message.

Receive

When the 5100 is receiving data, pressing ATTN sends a long space (receive interrupt), and the 5100 continues receiving until the remote system sends an end of transmission character. OUT (O backspace U backspace T) characters are placed in the received message to indicate a possible loss of data. When the remote system ends its transmission, the 5100 changes its state to home.

Edit

Pressing the ATTN key during an edit operation transmits the edited line and an end of transmission character. This is the same as pressing ATTN during transmit operations. If you press ATTN after a command is entered, the command is processed.

Shift Key

Holding down the shift key and then pressing ATTN stops the TAPEIN or AUTO operation before the next transmission and opens the keyboard for input.

CMD Key

Holding down the CMD key and then pressing ATTN returns the 5100 to the home state. This key is *only* to be used if the 5100 cannot be returned to the home state from the process (PROC) state by pressing only the ATTN key.

RESEND

When you are using the APL.SV translation with the &SYSTEM command and the remote system transmits RESEND, you can interrupt the retry operations by pressing ATTN while the 5100 is receiving the characters RESEND.

EXECUTE KEY

During a transmit operation, pressing the EXECUTE key transmits the new-line and end of transmission characters. During an edit operation, pressing the EXECUTE key transmits the edited line and the new-line and end of transmission characters. If you press the EXECUTE key after a command is entered, the command is processed.

HOLD KEY

Pressing the HOLD key at any time during communications stops the operation as soon as possible and displays the characters HOLD in position 2 to 5 of the status line. You can continue the operation that was stopped by pressing the HOLD key again. When pressed with the CMD key, the HOLD key stops all operations immediately and may require reloading of the communications program.

SPECIAL FUNCTION KEYS

The top row of alphameric keys and several numeric keys have a special function in communications. Hold down the CMD key and press the appropriate key to activate the special function, which is as follows:

Command Character

The command character is displayed as & and identifies a communications command. It can be entered only when the 5100 is in the home state; in any other state the command character is ignored.

Edit ⌈ ¯ 2 ⌉

The edit key starts the edit operation if the 5100 is in the home or scroll state.
To change the data on the input line of the display screen, use the backspace and
forward space keys and the insert and delete functions. To end the edit operation,
press the ATTN or EXECUTE key to transmit the edited line, or press the home
key.

Line Delete ⌈ < 3 ⌉

During an edit operation, pressing the line delete key deletes all characters on the
input line to the right of the cursor, including the character at the cursor position.

Shift Lock ⌈ ≤ 4 ⌉

Pressing the shift lock key once locks the keyboard in upper shift. The keyboard
remains locked in upper shift until you press the shift lock key again, the EXECUTE
or ATTN key while the 5100 is online, or press the shift key and enter an upper shift
character.

If the last character transmitted was a lower shift character, pressing the shift lock
key transmits an upper shift function character and locks the keyboard in upper
shift. If the last character transmitted was an upper shift character, pressing the
shift lock key only locks the keyboard in upper shift; no upper shift function
character is transmitted. When the keyboard is locked in upper shift, pressing the
shift lock key transmits a lower shift function character and unlocks the keyboard.
When the keyboard is locked in upper shift, pressing the shift key with the last
character transmitted only unlocks the keyboard; no lower shift function character
is transmitted.

Tab Set ⌈ = 5 ⌉

Pressing the tab set key sets a tab at the cursor location; no tab character is
transmitted. Tabs cannot be set beyond position 132.

Tab Reset ⌈ ≥ 6 ⌉

Pressing the tab reset key clears the tab, if any, at the cursor position. No data is
transmitted when this key is pressed.

Print   `> 7`

To print the data in the extended display during an edit operation, press the print key. Printing starts with the data moved to the input line on the display screen and continues through the last full line of the extended display. (The last full line is the line above the input line when the data is in the home position.)

Home   `≠ 8`

Pressing the home key during a scroll or edit operation moves the displayed data to its home position, which displays the first 64 characters of the 14 most recent lines of the extended display. Pressing the home key also ends the edit operation without transmitting the edited line, and if the line was not edited, no data is lost from the extended display. You can also use the home key to remove the bypass function (print inhibit), if it is active. The bypass function is activated by the remote system to inhibit output from the 5100 for security purposes. To ensure data security, you should not use the edit operation or the &TAPEIN command when the bypass function is active.

Write   `v 9`   **(Option T Only)**

To write the data in the extended display on tape during the edit operation, press the write key. Writing starts with the data moved to the input line of the display screen and continues through the last full line of the extended display. (The last full line is the line above the input line when the data is in the home position.) In order to write data on tape, the tape must have been previously marked and the tape file opened for output. To protect the data written on tape, enter the &CLOSE command after the write operation is complete.
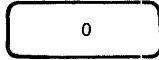

OUT Character   `- +`

Pressing this key displays the OUT character (O backspace U backspace T) on the input line on the display screen and also transmits it if the 5100 is transmitting. Use this key to escape from the quad quote ([ ]) request for input when the 5100 is communicating with an APL system.

Copy Display ⌈ ÷ / X ⌉

To print the data displayed on the screen, press the copy display key. This key performs the same function in communications as it does in APL or BASIC language operations. During the copy display function, error codes are displayed on the left side of the status line. These codes are described in the *5100 APL Reference Manual* and the *5100 BASIC Reference Manual*.

Tab ⌈ 0 ⌉

Pressing the tab key during transmit operations transmits a tab character and moves the cursor to the next tab position if the cursor is not beyond position 132. If there is no tab position to the right of the cursor, the cursor moves to position 132, which is always the last tab position. The tab character does not appear in the message on the display screen or in the extended display. Thus, if a message with tabs is edited and transmitted, blank characters are transmitted to make the message appear as if it contained the tabs. Pressing the tab key with the cursor beyond position 132 has the same effect as pressing the spacebar.

Fast Left ⌈ 2 ⌉

In a scroll operation, pressing the fast left key moves all lines on the display screen 20 positions to the left if an arrow is displayed in position 64 on the status line.

Fast Right ⌈ 3 ⌉

In a scroll operation, pressing the fast right key moves all lines on the display screen 20 positions to the right, but it will not move the data beyond position 1.

Fast Up ⌈ 5 ⌉

In a scroll operation, pressing the fast up key moves all lines on the display screen up 14 lines. This key moves the data up if there is data to be moved to the screen.

Fast Down ⌈ 6 ⌉

In a scroll operation, pressing the fast down key moves all lines on the display screen down 14 lines. This key moves the data down if there is data to be moved to the input line.

Scroll Left ⌊ 8 ⌋   ı

In a scroll operation, pressing the scroll left key moves all lines on the display
screen to the left if there is an arrow in position 64 of the status line. The lines
continue to move to the left if this key is held down.

Scroll Right ⌊ 9 ⌋

In a scroll operation, pressing the scroll right key moves all lines on the display
screen to the right if position 1 of the extended display is not in position 1 on the
display screen. The lines continue to move to the right if this key is held down.

Communications Commands

Communications commands modify the operations of the 5100. Enter the commands as follows: In the HOME state, enter the command character, &, by holding down the CMD key and pressing the alphameric 1 key, enter the command keyword and any parameters, and then press EXECUTE. Include a blank space between the keyword and each parameter entered.

The syntax symbols used in the communications commands are:

Symbol	Meaning
{ }	Braces indicate that one of the required parameters must be entered.
data	The data specified by the lowercase letters must be entered.
[ ]	Brackets indicate that one of the optional parameters can be entered.
parameters	The underscored parameter is the default parameter if none is specified.

&AUTO (OPTION T ONLY)

The &AUTO command enables the 5100 to receive messages that are too large for the extended display. The syntax of the &AUTO command is:

&AUTO

Using the &AUTO command, transmission of a message occurs in the following manner:

1. Start execution of a user-written program, located at the remote system.

2. The remote system sends an auto response text as the last line of each section of the message.

3. After each section of the message is written and/or printed, the 5100 returns the auto response text as a complete line to the remote system to prompt transmission of the next section of the message. The auto response text is not printed or written on tape as part of the received message.

4. Transmission ends when:
   a. The 5100 receives less than four lines.
   b. You hold down the shift key and press ATTN.
   c. A tape or printer error occurs.

   If less than four lines are received, the data is not automatically written or printed so that error messages are not printed or written on tape. If you must save this data, start the edit operation and use the write or print key.

&CLOSE (OPTION T ONLY)

The &CLOSE command makes the tape on the specified tape unit unavailable for further data transfer and completes writing the data to an output file. *You must use the &CLOSE command to close an output tape,* or data may be lost from both the cartridge removed from the tape unit and the next cartridge inserted. The syntax of the &CLOSE command is:

$$\underline{\&}\text{CLOSE} \quad \left[\frac{\text{E80}}{\text{E40}} \right]$$

E80 specifies the built-in tape unit and *E40* specifies the auxiliary tape unit.

&OPEN (OPTION T ONLY)

The &OPEN command makes the file on the specified tape unit available for data transfer. The syntax of the &OPEN command is:

$$\underline{\&}\text{OPEN} \quad \left[\left\{ \begin{array}{l} \text{IN} \\ \text{OUT} \\ \text{ADD} \end{array} \right\} \quad \left\{ \text{file number} \right\} \quad \left[\frac{\text{E80}}{\text{E40}} \right] \right]$$

IN, OUT, or *ADD* specifies the type of tape file:

- *IN* specifies that messages will be transmitted from the tape.

- *OUT* specifies that messages will be written on tape, starting at the beginning of the file. The messages written on tape are determined by the &OUTSEL command. OUT destroys data previously written on the specified file even if no new data is written to the file.

- *ADD* is the same as the OUT parameter except the messages are written following the last existing data on the file and always use at least 512 character positions.

file number specifies the file number.
E80 specifies the built-in tape unit and *E40* specifies the auxiliary tape unit.

Note: If the &OPEN command is entered without parameters and any files are open, the tape unit address and the type of file open are displayed in this format:

    I: DDD O: DDD

I indicates input file, *O* indicates output file, and *DDD* indicates the tape unit address.

For example:

    I: E80 O:

indicates that an input file is open on the built-in tape unit.

&OUTSEL

The &OUTSEL command controls which lines are printed and/or written on tape. If the &OUTSEL command is not entered, all data is printed and/or written. The syntax of the &OUTSEL command is:

    &OUTSEL $\left\{ \begin{matrix} ALL \\ SYS \end{matrix} \right\}$

ALL specifies that all data transmitted and received is printed and/or written on tape.

SYS specifies that only lines completed by the remote system are printed and/or written on tape. (A complete line is ended with a new-line character.) Lines transmitted from the 5100 and ended by pressing ATTN may also be printed and/or written (see *ATTN Key*). If you do not want the data printed, turn the printer off.

&RATE (OPTION T ONLY)

The &RATE command specifies the communication line rate of 134.5 or 300 bits per second (bps). If the &RATE command is not entered, the rate is 134.5. If you are using non-switched lines, the rate must be set when the characters in position 58 and 60 of the status line indicate ☐ ↑. If you are using switched lines, the rate must be set before the line connection is established. The syntax of the &RATE command is:

    &RATE $\left\{ \begin{matrix} 134.5 \\ 300 \end{matrix} \right\}$

Notes:
1. The remote system must support the selected rate.
2. Option P only supports 134.5 bps.

&SYSTEM

The &SYSTEM command specifies the type of translation that is used for the EBCD notation and the error recovery procedure for errors that can occur at the remote system when the 5100 is transmitting. If the &SYSTEM command is not entered, the translation is OTHER. The syntax of the &SYSTEM command is:

$$\underline{\&SYSTEM} \left\{ \begin{array}{l} APL \\ APL.SV \\ BASIC \\ OTHER \end{array} \right\}$$

The parameter specifies the translation and error recovery:

Parameter	Translation	Error Recovery
APL	APL	Operator error recovery only.
APL.SV	APL	If the remote system receives an erroneous record from the 5100 and transmits RESEND, the 5100 resends the message. (The 5100 will not resend the message if an overflow is encountered.) This continues until the message is accepted by the remote system, or until the retry operations are interrupted when the ATTN key is pressed (see *ATTN Key*). The 5100 keyboard then opens for input, and if transmitting from tape, the tape can be restarted with the &TAPEIN command.
BASIC	BASIC	Operator error recovery only.
OTHER	BASIC	Operator error recovery only.

Note: In the BASIC translation, two characters cannot be combined to form a single character; the overstriking character replaces the existing character. The OTHER translation is the same as BASIC with one exception: When two characters are entered to form a single character, the combined character is replaced with an OUT (O backspace U backspace T) character.

&TAPEIN (OPTION T ONLY)

The &TAPEIN command specifies that the next message will be transmitted from the tape file (see *Tape Input*). The tape file must be opened and specified for input (IN). The tape is automatically closed when the last record is read from the file. The syntax of the &TAPEIN command is:

&TAPEIN
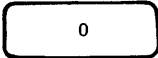
COMMANDS

Command Syntax	Function
&AUTO	Allows the 5100 to receive messages that are too large for the extended display (option T only).
&CLOSE $\begin{bmatrix} \underline{E80} \\ E40 \end{bmatrix}$	Makes the tape unavailable for data transfer and completes writing the data to an output file (option T only).
&OPEN $\begin{bmatrix} \begin{Bmatrix} IN \\ OUT \\ ADD \end{Bmatrix} \{file\ number\} \begin{bmatrix} \underline{E80} \\ E40 \end{bmatrix} \end{bmatrix}$	Opens the tape file for data transfer or lists the open files (option T only).
&OUTSEL $\begin{Bmatrix} ALL \\ SYS \end{Bmatrix}$	Specifies which messages will be printed and/or written on tape. ALL is assumed if no &OUTSEL command is entered.
&RATE $\begin{Bmatrix} 134.5 \\ 300 \end{Bmatrix}$	Specifies the bits per second (bps) rate. 134.5 is assumed if no &RATE command is entered (option T only).
&SYSTEM $\begin{Bmatrix} APL \\ APL.SV \\ BASIC \\ OTHER \end{Bmatrix}$	Specifies the EBCD translation and error recovery options. OTHER is assumed if no &SYSTEM command is entered.
&TAPEIN	Specifies that the input will be from the tape unit instead of the keyboard (option T only).

SPECIAL FUNCTION KEYS

Note: Hold the CMD key down, then press the specified key to activate the special function.

Key   **Function**

[1 ··] Command character   Displayed as &, and is the first character for commands.

[2 −] Edit   Starts the edit operation.

[3 <] Line delete   Deletes all characters on the input line to the right of and at the cursor position.

[4 ≤] Shift lock   Changes the 5100 shift status, and transmits the appropriate shift character if required.

[5 =] Tab set   Sets a tab at the cursor position.

[6 ≥] Tab reset   Clears the tab, if any, at the cursor position.

[7 >] Print   Prints the data stored in the extended display from the input line to the end of the extended display.

[8 ≠] Home   Restores the displayed data to its home position.

[9 ∨] Write (option T only) Writes the data stored in the extended display on tape from the input line to the end of the extended display.

[+ −] OUT character   Displays the OUT character on the input line, and also transmits it if the 5100 is transmitting (APL and APL.SV only).

Key		Function
[0] Tab	Transmits the tab character and moves the cursor.
[2] Fast left scroll	Moves the data on the display screen 20 positions to the left.
[3] Fast right scroll	Moves the data on the display screen 20 positions to the right.
[5] Fast up	Moves the data on the display screen up 14 lines.
[6] Fast down	Moves the data on the display screen down 14 lines.
[8] Scroll left	Moves the data on the display screen one position to the left.
[9] Scroll right	Moves the data on the display screen one position to the right.
[↑] Scroll up	Moves the data on the display screen up one line.
[↓] Scroll down	Moves the data on the display screen down one line.
[÷ X] Copy Display	Prints the data displayed on the screen.

You can use the keyboard and tape units to transmit data and the printer and/or tape unit to record received data. All data transmitted and received is displayed on the input line of the display screen. Commands and incomplete lines of data displayed on the input line are not printed or written on tape. (An incomplete line is a line not ended with a new-line character.)

TAPE (OPTION T ONLY)

You can use the tape unit for input or output if option T is selected. If the auxiliary tape unit is installed on your 5100, you can use either tape unit for input or output; however, you cannot use them simultaneously.

Tape cartridges used in communications are unlabeled (there is no automatic tape labeling or checking) so you must use care to protect your existing tape files. The SAFE feature on the tape cartridge prevents writing to an input file. Do not remove an output tape from the tape unit before closing it with the &CLOSE command, or data may be lost both on the cartridge removed and the next cartridge inserted.

Tape Input

When the tape is used for input, the tape supplies the messages to be transmitted. The specified tape file must contain only character data records (file type 1, 2, or 3). For a description of these file types, see the *5100 APL Reference Manual* or the *5100 BASIC Reference Manual*. Use the &OPEN command to open the file and define it as an input file. Then enter the &TAPEIN command to specify that the input will be supplied from the tape. If a tape, printer, or received error (code 091) occurs, the tape input operation is terminated and can be started by reentering the &TAPEIN command.

When the last record is read from the file, the tape is automatically closed and DONE is displayed on the status line. To stop transmitting from the tape, hold down the shift key and press the ATTN key. No data is lost and you can resume transmitting by reentering the &TAPEIN command.

Tape Output

When the tape is used for output, messages transmitted and received are written on tape, provided the tape was previously marked. The &OUTSEL command specifies the lines to be written on tape, and the &OPEN command opens the file and defines it as an output (OUT or ADD) file. For an OUT file, data is written starting at the beginning of the file. For an ADD file, the data is written following the last existing data on the file and always uses at least 512 character positions. The output file created is a type 2 file if the file is an OUT file and remains as is if the file is an ADD file.

Note: No checking is done on OUT files, and any file can be overwritten.

Tab, line feed, and backspace function characters are not written on tape. Tabs are simulated by inserting the correct number of blanks in the data, and line feed characters are simulated by writing a new-line character and the correct number of blanks to indicate the start of the next line. Valid overstrike characters are written as one character.

PRINTER

The &OUTSEL command controls which lines will be printed if the printer is on during communications. When using option T, the lines are printed after the complete message is received or transmitted. When using option P, the lines are printed as each line is received. If you are using preprinted forms, the character spacing on the printer is 10 characters per inch and the line spacing is six lines per inch.

With option T, the message size is restricted by the size of the extended display. The maximum message size is at least:

5100 Model	Size
A1, B1, C1	1K (K=1024 characters)
A2, B2, C2	17K
A3, B3, C3	33K
A4, B4, C4	49K

The maximum printer width is 132 characters. If the lines are longer than 132 characters, an OUT (O backspace U backspace T) character is printed in position 132 and any characters beyond position 131 of the line are not printed.

BYPASS FUNCTION (PRINT INHIBIT)

The bypass function is activated by the remote system to inhibit output from the 5100 for security purposes. To ensure data security, you should not use the edit operation or the &TAPEIN command when the bypass function is active. Use the home key to reset the bypass function to normal. When bypass is active, characters typed on the keyboard will be sent (the cursor advances with each keystroke), but not printed or written to output devices.

COMPOSING MESSAGES OFFLINE

When the 5100 is offline, you can compose messages, write them on tape for later transmission, or print them. Writing and printing start with the data moved to the input line and continue to the end of the extended display.

To compose a message in the extended display with the 5100 offline, follow these steps:

1. Press the edit key (CMD and alphameric 2) to start the edit operation.

2. Enter a line from the keyboard.

3. Press the home key (CMD and alphameric 8). This enters the line in the extended display and moves the data on the display screen up one line.

Repeat steps 1, 2, and 3 until the message is complete. The data in the extended display can now be written on tape or printed.

To write the data on tape, use the following procedure:

1. Insert the tape cartridge in the tape unit and open the file for output with the &OPEN command.

2. Move the line with the &OPEN command back to the input line, then press the edit key.

3. Press the line delete key (CMD and alphameric 3). This deletes the &OPEN command from the extended display so it will not be written on tape.

4. Press the home key and move the first line of the message you want to write on tape to the input line.

5. Press the edit key (CMD and alphameric 2) and then press the write key (CMD and alphameric 9) to write the data on tape.

6. Enter the &CLOSE command before removing the cartridge to ensure that the data is stored.

To print the data in the extended display, move the first line of the message to be printed to the input line, start the edit operation by pressing the edit key, and press the print key (CMD and alphameric 7). This procedure can be repeated to obtain multiple copies.

TRANSMIT INTERRUPT

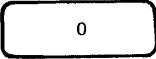When the 5100 is transmitting, the remote system can interrupt the transmission, cause the 5100 to go to receive status, and transmit a message. During option P, this interrupt is honored and the message is accepted. During option T, the interrupt is honored only during sign-on or if no tape or printer operation is in progress.

You can use the state indicator (positions 53-56 of the status line) to determine what the communications program expects for input and what action it takes. The states are HOME, EDIT, SCRL (scroll), XMIT (transmit), and PROC (process). The states, the keys you can press, the results, and the next state the communications program enters are as follows:

Note: The special functions are activated by holding down the CMD key and then pressing the appropriate key.

HOME

Keys		Results	Next State
1	Command	Enters the command character.	EDIT
2	Edit	Starts the edit operation.	EDIT
4	Shift lock	Changes the 5100 shift status, and transmits the appropriate shift character if required.	HOME
5	Tab set	Sets a tab at the cursor position.	HOME
6	Tab reset	Clears the tab, if any, at the cursor position.	HOME
8	Home	Resets the bypass function.	HOME
+	OUT	Transmits an OUT character (APL and APL.SV only).	XMIT
←	Backspace	Transmits a backspace function character (CMD key not required).	XMIT
→	Forward space	Same as space bar (CMD key not required).	XMIT

Keys	Results	Next State
[0] Tab	Transmits a tab character and moves the cursor.	XMIT
EXECUTE	Transmits a new-line and an end of transmission character.	PROC/HOME
ATTN	Transmits an end of transmission character.	PROC/HOME
Any scroll key	Moves the data on the display screen.	SCRL
Any data key	Transmits the data character.	XMIT

EDIT
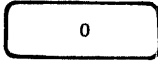
Keys	Results	Next State
[≤ 3] Line delete	Deletes all characters to the right of and at the cursor position.	EDIT
[≤ 4] Shift lock	Changes the 5100 shift status, and transmits the appropriate shift character if required.	EDIT
[= 5] Tab set	Sets a tab at the cursor position.	EDIT
[≥ 6] Tab reset	Clears the tab, if any, at the cursor position.	EDIT
[> 7] Print	Prints the contents of the extended display from the input line to the end of the extended display.	EDIT

Keys		Results	Next State
$\begin{array}{c} \neq \\ 8 \end{array}$	Home	Terminates the edit operation and moves the displayed data up one line.	HOME
$\begin{array}{c} \vee \\ 9 \end{array}$	Write (option T only)	Writes the contents of the extended display on tape from the input line to the end of the extended display.	EDIT
$\begin{array}{c} - \\ + \end{array}$	OUT	Displays the OUT character at the cursor position (APL and APL.SV only).	EDIT
←	Backspace	Moves the cursor to the left (CMD key not required).	EDIT
→	Forward space	Moves the cursor to the right (CMD key not required).	EDIT
←	Delete	Deletes the character at the cursor position.	EDIT
→	Insert	Inserts a blank at the cursor position.	EDIT
EXECUTE		Transmits a message and the new-line and end of transmission characters, or processes the command.	PROC/HOME
ATTN		Transmits a message and an end of transmission character, or processes the command.	PROC/HOME
Any data key		Displays the character at the cursor position.	EDIT

SCRL

Keys		Results	Next State
$\begin{array}{c} - \\ 2 \end{array}$	Edit	Starts the edit operation.	EDIT
$\begin{array}{c} \neq \\ 8 \end{array}$	Home	Terminates the scroll operation, resets the bypass condition, and restores the displayed data to its home position.	HOME
Any scroll key		Moves the data on the display screen.	SCRL

XMIT

| Keys		Results	Next State
$\leq$ / 4	Shift lock	Changes the 5100 shift status, and transmits the appropriate shift character if required.	XMIT
= / 5	Tab set	Sets a tab at the cursor position.	XMIT
$\geq$ / 6	Tab reset	Clears the tab, if any, at the cursor position.	XMIT
- / +	OUT	Transmits the OUT character (APL and APL.SV only).	XMIT
←	Backspace	Transmits a backspace function character and moves the cursor to the left.	XMIT
→	Forward space	Same as space bar.	XMIT
0	Tab	Transmits the tab character and moves the cursor.	XMIT
EXECUTE		Transmits a new-line and an end of transmission character, and does I/O processing.	PROC/HOME
ATTN		Transmits an end of transmission character, and does I/O processing.	PROC/HOME
Any data key		Transmits the data character.	XMIT

PROC

The PROC state indicates that the 5100 is doing internal processing. The 5100 goes to the home state when processing is complete.

Keys	Results	Home State
ATTN	Transmits a long space if the 5100 is receiving.	HOME
Shift and ATTN	Stops the current operation as soon as possible.	HOME
CMD and ATTN	Returns the 5100 to the home state. (This key is *only* to be used if the 5100 cannot be returned to the home state from the process state by pressing only the ATTN key.)	HOME

Error Codes

Error codes are displayed on the status line in positions 17 to 27 (general status area), 28 to 40 (tape status area), and 41 to 51 (printer status area).

The following list provides a brief description of the error codes that are common to communications and APL or BASIC language operations. For a complete description of these error codes and the recovery procedure, see the *5100 APL Reference Manual* or the *5100 BASIC Reference Manual.*

Code	Message
002	Command error
003	Status error
004	Time-out
005	Tape not inserted
006	File protect
007	CRC error
008	Position error
009	End of data—may also indicate a normal condition
010	End of file
011	End of marked file
012	Physical end of tape
013	Device not attached
014	Device not selected
050	End of forms
051 to 059	Printer errors

The preceding error codes are displayed in this format:

SSS: DDD

SSS is the error code and *DDD* is the device address:

E80 = Built-in tape unit
E40 = Auxiliary tape unit
500 = Printer

The following error codes and messages apply only to the communications program:

Code	Message
081	The command entered is invalid.
084	The specified file is not available.
085	The file type is incorrect. (The file type is also displayed.)
086	See *Invalid Tape Data.*
087	The file is not open.
088	The file is already open.
089	The rate is already set.
090 (option T only)	Overflow—The extended display is full (see *Overflow*).
091	The message just received contains invalid characters. (The message is not printed or written on tape.)
092 (option P only)	The 5100 is receiving data too fast for the printer, and the remainder of the message has been lost. Some printing may occur after this code is displayed.
099	The communications program has detected an internal error. Restart the 5100, and retry the operation. If the error continues to occur, call for service.
DONE	The command has been successfully processed.

The preceding error codes are displayed as shown under *Code*.

INVALID TAPE DATA

When invalid data (nontranslatable codes, OUT characters, and nongraphics) is read from tape, the error code 086 is displayed on the status line. The 5100 goes to the home state, and the line containing invalid tape data is moved up one line. At this time you can:

- Enter the &TAPEIN command to bypass the line with invalid data and continue transmitting.

- Enter new data from the keyboard, and press EXECUTE to transmit it in place of the line with invalid data. Enter the &TAPEIN command to continue transmitting from tape.

- Move the data to the input line, start the edit operation, correct the data if desired, and press EXECUTE to transmit it. Enter the &TAPEIN command to continue transmitting from tape.

OVERFLOW (OPTION T ONLY)

If a message larger than the extended display is received by the 5100, the error code 090 is displayed on the status line and the data is not printed or written on tape. The last portion of the message is stored in the extended display and the first portion is lost. If the overflow data included tab or line feed characters, some characters in the extended display may not be valid.

PRINTER ERROR RECOVERY

If option T is specified and a printer error occurs during receive operations, the printer stops and the 5100 goes to the home state. You can continue the receive operation or retry the print operation with the following procedure:

1. Move the paper to a new line or page.

2. Move the first line to be printed to the input line on the display screen.

3. Press the edit key (CMD and alphameric 2), and then press the print key (CMD and alphameric 7) to retry the print operation.

4. Press the home key (CMD and alphameric 8) and continue the receive operation.

If option P is specified and a printer error occurs during receive operations, the printer stops, the rest of the message is placed in the extended display, and the 5100 goes to the home state. To continue, use the procedure described for option T.

To prepare the 5100 Communications Adapter feature, connect the RS-232-C cable
(P/N 1608553) between the data set or modem and the 5100 communications
connector as shown:

Communications
Connector
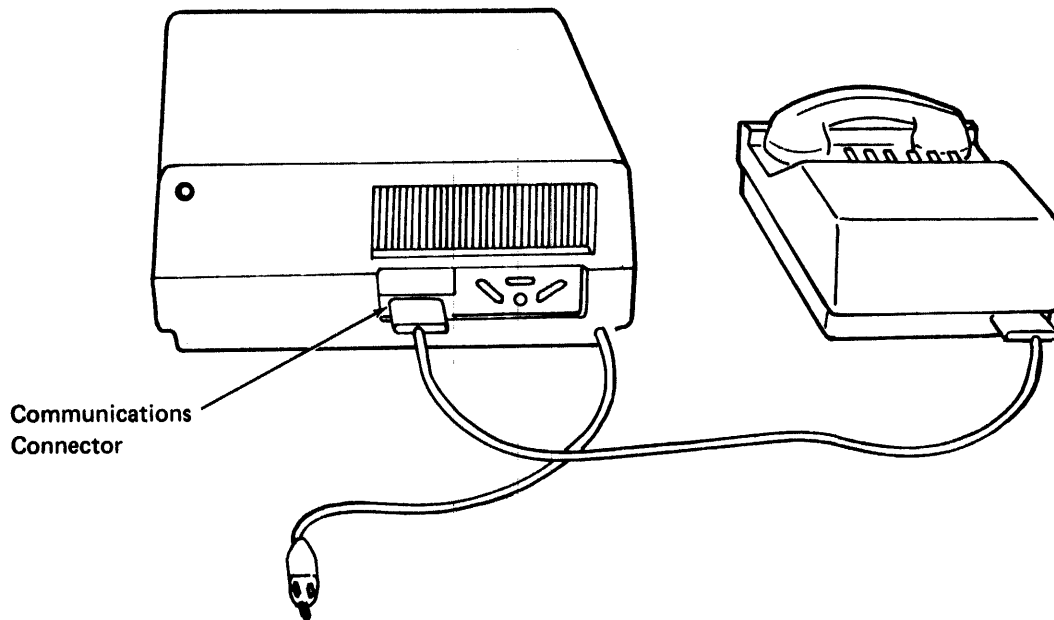
After connecting the cable, use the following procedure to verify the operation of the communications feature:

1.   Insert the tape cartridge containing the communications program in the 5100 built-in tape unit.

2.   Enter the command)MODE COM if you are using APL or UTIL MODE COM if you are using BASIC, and press EXECUTE. If the program displays the options T or P, enter a T. (If the printer is not attached, the options will not be displayed.) The program should load and display HOME on the bottom line of the display screen.

3.   Enter the commands to initialize the communications program:
      a. Hold down the CMD key and then press the alphameric 1 key. The character & should be displayed. Enter the command SYSTEM and the parameter APL, APL.SV, BASIC, or OTHER depending on the remote system you will be communicating with. For example, if you will be communicating with an APL.SV system, the command you enter is &SYSTEM APL.SV. Press EXECUTE to process the command.
      b. Enter the &RATE command in the same manner. The parameters for the &RATE command are 134.5 and 300, which are the bits per second (bps) rate of the communication line. If your system uses 300 bps, enter &RATE 300 and press EXECUTE to process the command.

4.   Establish the line connection by dialing the remote system if you are using switched lines. If you are using non-switched lines, the connection should now be complete.

5.   Enter the sign-on code for the remote system and press EXECUTE. The remote system should acknowledge the sign-on to indicate that the 5100 is online.

6.   Sign off. This completes the installation and checkout of the Communications Adapter feature. If you have any difficulty in checking out the feature, call your IBM marketing representative for assistance.

WRITING BASIC PROGRAMS ON TAPE

A BASIC program can be written on tape with the BASIC command:

SAVE file number SOURCE

The program is written on tape in character record format and can then be transmitted to the remote system during communications by using the &OPEN and &TAPEIN commands.

During communications, BASIC programs residing at the remote system can be written on tape by using the LIST command. The size of the program is limited by the size of the extended display, and a program larger than the extended display cannot be listed in its entirety.

Data transmitted from a remote system to tape for later processing during BASIC language operations must conform to a specific format:

1. Character data must be enclosed in single quotation marks and blocked together in segments that contain a maximum of 18 characters, for example:

    'THE SQUARE OF X IS', 'GREATER THAN Y'

    An apostrophe must be indicated by two single quotation marks, for example:

    'DON''T'

2. Numeric data must also be formatted in strings of less than 19 characters; however, no quotation marks are used. For example:

    11,12,13,14,15

WRITING OTHER LANGUAGE PROGRAMS ON TAPE

Other language programs such as FORTRAN or PL/1 can be entered from the 5100 keyboard in the extended display and then written on tape and transmitted (see *Composing Messages Offline*).

WRITING APL FUNCTIONS ON TAPE (APL.SV)

APL functions cannot be transmitted directly in executable form. Convert the functions to variables using ☐ CR. The functions can then be transmitted as character strings, which can later be converted with ☐ FX and stored in the 5100 APL workspace. Arrays and matrices must be transmitted as vectors.

To receive a function from one remote system, write it on the 5100 tape, and transmit it to another remote system, use the following procedure:

1. Put the 5100 online with the first system.

2. To receive the function, enter:

    <u>&</u>OUTSEL SYS

    <u>&</u>OPEN OUT file number $\begin{bmatrix} \underline{E80} \\ E40 \end{bmatrix}$

    ▽function name [☐] ▽

    <u>&</u>CLOSE $\begin{bmatrix} \underline{E80} \\ E40 \end{bmatrix}$

3. Put the 5100 online with the second system.

4. To transmit the function, enter:

    <u>&</u>OPEN IN file number $\begin{bmatrix} \underline{E80} \\ E40 \end{bmatrix}$

    <u>&</u>TAPEIN

Sample Functions

The following routines are an example of how you can transmit variables from a remote APL.SV system to the 5100 tape. The ΔΔATTR and ΔΔSEND routines should be keyed into a workspace on the remote system, and the ΔΔRECEIVE routine should be keyed into the 5100 workspace. The functions to be transmitted must be converted to variables using □ CR.

Follow this procedure:

1. Using the)LOAD command, load the remote system with the sending routine and the variables to be sent.

2. Insert the tape cartridge in the 5100 tape unit.

3. Enter the following:

    &OUTSEL SYS

    &OPEN OUT file number $\left[\frac{E80}{E40}\right]$

    ΔΔSEND 'variable name' (for each function to be sent)

    &CLOSE $\left[\frac{E80}{E40}\right]$

4. Return the 5100 to normal APL operation.

5. Using the)LOAD command, load the 5100 workspace with the ΔΔRECEIVE function.

6. Execute the function ΔΔRECEIVE.

The following are samples of the ΔΔATTR, ΔΔSEND, and ΔΔRECEIVE functions:

```
      ∇ ΔΔSEND ΔΔNAME;ΔΔDATA;⎕IO;⎕PW
[1]   ⍝ ΔΔNAME IS A CHARACTER VECTOR
[2]   ⍝ OF THE OBJECT NAME
[3]   ⍝
[4]   ⍝  THIS ROUTINE SENDS A VARIABLE
[5]   ⍝ (FUNCTIONS MUST BE ⎕CR'ED)
[6]   ⍝  FROM A REMOTE APL.SV SYSTEM TO THE 5100.
[7]   ⍝
[8]   ⍝  WHEN ΔΔSEND IS EXECUTED THE 5100 SHOULD BE SET
[9]   ⍝  TO PUT THE OUTPUT ON TAPE.  THIS ROUTINE
[10]  ⍝  AND ΔΔATTR RESIDE ON THE REMOTE SYSTEM.
[11]  ⎕PW←390
[12]  ⎕IO←1
[13]  'ααα',ΔΔNAME,' ',ΔΔATTR⍎ΔΔNAME
[14]  ΔΔDATA←⍎,⍎ΔΔNAME
[15]  ΔΔDATA[(ΔΔDATA=⎕AV[157])/⍳ρΔΔDATA]←''''
[16]  ΔΔLOOP:→(0=ρΔΔDATA)/ΔΔEND
[17]  'ααα',(125⌊ρΔΔDATA)↑ΔΔDATA
[18]  ΔΔDATA←(125⌊ρΔΔDATA)↓ΔΔDATA
[19]  →ΔΔLOOP
[20]  ΔΔEND:'ωωω' ∇
```

```
      ∇Z←ΔΔATTR X;R
[1]   ⍝ 1↑Z IS S OR A FOR SCALAR OR ARRAY
[2]   ⍝ 1↑1↓Z IS C OR N FOR CHARACTER OR NUMERIC
[3]   ⍝ 2↓Z IS THE SHAPE OF X (CHARACTER)
[4]   R←ρρX
[5]   Z←((R=0),(R>0))/'SA'
[6]   Z←Z,((0=1↑0ρX),(' '=1↑0ρX))/'NC'
[7]   →(R=0)/0
[8]   Z←Z,⍕ρX ∇
```

```
      ∇ ΔΔRECEIVE ΔΔNAME;ΔΔDATA;ΔΔLINE;ΔΔHEAD;ΔΔIN;ΔΔI;⎕IO;⎕PW
[1]    ⎕PW←390
[2]    ⎕IO←1
[3]   ⍝   TO RECEIVE VARIABLES ON THE 5100.
[4]   ⍝
[5]   ⍝   THIS ROUTINE READS THE TAPE CREATED BY THE 'ΔΔSEND'
[6]   ⍝   ROUTINE ON THE REMOTE SYSTEM.
[7]   ⍝
[8]    →(2≠1 ⎕SVO 'ΔΔIN')/0
[9]    'SPECIFY DEVIVCE/FILE NUMBER'
[10]   ΔΔIN←'IN ',⍞
[11]   →(0≠+/ΔΔIN)/0
[12] ΔΔFIND:→(0=ρΔΔHEAD←ΔΔIN)/ΔΔEOF
[13]   →(∼∧/'ααα'=3↑ΔΔHEAD)/ΔΔFIND
[14]   ΔΔI←(ΔΔHEAD←3↓ΔΔHEAD)⍳' '
[15]   →(0=ρΔΔNAME)/ΔΔCONT0
[16]   →(∧/ΔΔNAME=(ρΔΔNAME)↑ΔΔI↑ΔΔHEAD)/ΔΔFND
[17] ΔΔNEXT:→(∧/'ααα'=3↑ΔΔLINE←ΔΔIN)/ΔΔNEXT
[18]   →ΔΔFIND
[19] ΔΔFND:ΔΔNAME←''
[20] ΔΔCONT0:ΔΔDATA←''
[21] ΔΔLOOP:→(∧/'ωωω'=3↑ΔΔLINE←ΔΔIN)/ΔΔFORMIT
[22]   →(∼∧/'ααα'=3↑ΔΔLINE)/ΔΔLOOP
[23]   →(((125↑3↓ΔΔLINE)⍳⎕AV[170])>125)/ΔΔCONT
[24]   ⎕←ΔΔLINE
[25]   ΔΔLINE←⍞
[26] ΔΔCONT:ΔΔDATA←ΔΔDATA,125↑3↓ΔΔLINE
[27]   →ΔΔLOOP
[28] ΔΔFORMIT:ΔΔDATA[(ΔΔDATA='¨')/⍳ρΔΔDATA]←⎕AV[157]
[29]   →('A'=1↑ΔΔI↓ΔΔHEAD)/ΔΔARRAY
[30]   →('C'=1↑(ΔΔI+1)↓ΔΔHEAD)/ΔΔSCHAR
[31] ⍝NUMERIC SCALAR
[32]   ⍎(ΔΔI↑ΔΔHEAD),'←',ΔΔDATA
[33]   →ΔΔDONE
[34] ⍝CHARACTER SCALAR
[35] ΔΔSCHAR:⍎(ΔΔI↑ΔΔHEAD),'←ΔΔDATA'
[36]   →ΔΔDONE
[37] ⍝ARRAYS
[38] ΔΔARRAY:→('C'=1↑(ΔΔI+1)↓ΔΔHEAD)/ΔΔACHAR
[39] ⍝NUMERIC ARRAY
[40]   →(0=ρΔΔDATA)/ΔΔNNULL
[41]   ⍎(ΔΔI↑ΔΔHEAD),'←',((ΔΔI+2)↓ΔΔHEAD),'ρ',ΔΔDATA
[42]   →ΔΔDONE
[43] ΔΔNNULL:⍎(ΔΔI↑ΔΔHEAD),'←⍳0'
[44]   →ΔΔDONE
[45] ⍝CHARACTER ARRAY
[46] ΔΔACHAR:→(0=ρΔΔDATA)/ΔΔCNULL
[47]   ⍎(ΔΔI↑ΔΔHEAD),'←',((ΔΔI+2)↓ΔΔHEAD),'ρΔΔDATA'
[48]   →('Δ'≠1↑ΔΔHEAD)/ΔΔDONE
[49]   'FUNCTION ',(⎕FX⍎ΔΔI↑ΔΔHEAD),' CREATED'
[50]   ΔΔI←⎕EX ΔΔI↑ΔΔHEAD
[51]   →ΔΔFIND
[52] ΔΔCNULL:⍎(ΔΔI↑ΔΔHEAD),'←'''''
[53] ΔΔDONE:'VARIABLE ',(ΔΔI↑ΔΔHEAD),'CREATED'
[54]   →ΔΔFIND
[55] ΔΔEOF:→(9=+/ΔΔIN)/ΔΔFIND
[56]   '⊂⊂⊂ END OF FILE ⊃⊃⊃'∇
```

SAMPLE PROGRAMS USING THE &AUTO COMMAND

Sample BASIC Program

```
00010 REM THIS PROGRAM IS AN EXAMPLE
00020 REM OF USING THE AUTO COMMAND.
00030 REM
00040 FOR N=1 TO 16
00050 PRINT N
00060 PRINT N+1
00070 PRINT N+2
00080 PRINT N+3
00090 REM THIS LAST NUMBER IS THE
00100 REM AUTO RESPONSE TEXT.
00110 INPUT I
00120 IF I=N+3 GOTO 150
00130 PRINT 'ERROR'
00140 GOTO 180
00150 N=N+2
00160 NEXT N
00170 REM ALL IS OK.
00180 STOP
00190 END
```

The printed output is:	The extended display using &AUTO contains:	The extended display without &AUTO contains:	
1	&AUTO	1	
2	RUN	2	
3	1	3	
4	2	4	
5	3	?	4
6	4	4	
7	4	5	
8	5	6	
9	6	7	
10	7	?	7
11	7	7	
12	8	8	
13	9	9	
14	10	10	
15	10	?	10
16	11	10	
17	12	11	
18	13	12	
	13	13	
	14	?	13
	15	13	
	16	14	
	16	15	
	17	16	
	18	?	16
	19	16	
		17	
		18	
		19	
		?	19

Sample APL Program

```
        ∇ ΔΔSENDΔΔLL ;I
[1]    ⍝THIS ROUTINE WILL SEND THE LARGE CHARACTER
[2]    ⍝ARRAY CHAR TO THE 5100 IN 10 ROW SECTIONS
[3]    ⍝FOR PRINTING AND TAPE USING THE AUTO COMMAND.
[4]    I←0
[5]    S:CHAR[I+⍳10;]
[6]    →(30=I←I+10)/E
[7]    'CONTINUE'
[8]    →(∧/'CONTINUE'=⎕)/S
[9]    →0
[10]   E:'STOP'
[11]   →(∧/'STOP'=⎕)/0
[12]   'ERROR' ∇
```

The character array 'char' is:	The extended display with &AUTO contains:	The printed output is:
ABCDEFGHIJ	&OUTSEL SYS	ABCDEFGHIJ
KLMNOPQRST	&AUTO	KLMNOPQRST
UVWXYZABCD	AUTOSEND	UVWXYZABCD
EFGHIJKLMN	ABCDEFGHIJ	EFGHIJKLMN
OPQRSTUVWX	KLMNOPQRST	OPQRSTUVWX
YZABCDEFGH	UVWXYZABCD	YZABCDEFGH
IJKLMNOPQR	EFGHIJKLMN	IJKLMNOPQR
STUVWXYZAB	OPQRSTUVWX	STUVWXYZAB
CDEFGHIJKL	YZABCDEFGH	CDEFGHIJKL
MNOPQRSTUV	IJKLMNOPQR	MNOPQRSTUV
WXYZABCDEF	STUVWXYZAB	WXYZABCDEF
GHIJKLMNOP	CDEFGHIJKL	GHIJKLMNOP
QRSTUVWXYZ	MNOPQRSTUV	QRSTUVWXYZ
ABCDEFGHIJ	CONTINUE	ABCDEFGHIJ
KLMNOPQRST	WXYZABCDEF	KLMNOPQRST
UVWXYZABCD	GHIJKLMNOP	UVWXYZABCD
EFGHIJKLMN	QRSTUVWXYZ	EFGHIJKLMN
OPQRSTUVWX	ABCDEFGHIJ	OPQRSTUVWX
YZABCDEFGH	KLMNOPQRST	YZABCDEFGH
IJKLMNOPQR	UVWXYZABCD	IJKLMNOPQR
STUVWXYZAB	EFGHIJKLMN	STUVWXYZAB
CDEFGHIJKL	OPQRSTUVWX	CDEFGHIJKL
MNOPQRSTUV	YZABCDEFGH	MNOPQRSTUV
WXYZABCDEF	IJKLMNOPQR	WXYZABCDEF
GHIJKLMNOP	CONTINUE	GHIJKLMNOP
QRSTUVWXYZ	STUVWXYZAB	QRSTUVWXYZ
ABCDEFGHIJ	CDEFGHIJKL	ABCDEFGHIJ
KLMNOPQRST	MNOPQRSTUV	KLMNOPQRST
UVWXYZABCD	WXYZABCDEF	UVWXYZABCD
EFGHIJKLMN	GHIJKLMNOP	EFGHIJKLMN
	QRSTUVWXYZ	
	ABCDEFGHIJ	
	KLMNOPQRST	
	UVWXYZABCD	
	EFGHIJKLMN	
	STOP	

Appendix C. Translation Codes

The &SYSTEM command allows for a different translation to the EBCD notation. Both the 5100 and the remote system must use the same translation.

When the APL or APL.SV translation is used, valid APL overstrike characters are allowed. Invalid overstrike characters are replaced by the OUT (O backspace U backspace T) character on the display screen, but are transmitted as they are entered from the keyboard. When invalid codes are read from tape, they are converted to OUT characters and the error code 086 is displayed on the status line.

In the BASIC translation, two characters cannot be combined to form a single character; the overstriking character replaces the existing character.

The OTHER translation is the same as BASIC except that combined characters are replaced by OUT characters.

CHARACTER CODE CHART

The character code chart shows the bit value of the EBCD characters that are transmitted and received by the 5100.

All lower shift BASIC alphabetic characters are displayed as uppercase characters, but are transmitted as lowercase characters. Alphabetic characters received are displayed as uppercase whether they are uppercase or lowercase. For example, if the A key is pressed, an uppercase A is displayed on the screen, but a lowercase a is transmitted. Other BASIC characters are displayed and transmitted as shown on the chart.

All APL characters are displayed and transmitted as shown on the following chart:

APL Characters		BASIC Characters		EBCD Characters		Bit Value						
Lower Shift	Upper Shift	Lower Shift	Upper Shift	Lower Shift	Upper Shift	B	A	8	4	2	1	C
A	α	A		a	A	B	A				1	
B	⊥	B		b	B	B	A			2		
C	∩	C		c	C	B	A			2	1	C
D	⌊	D		d	D	B	A		4			C
E	∈	E		e	E	B	A		4		1	C
F	‾	F		f	F	B	A		4	2		C
G	∇	G		g	G	B	A		4	2	1	
H	Δ	H		h	H	B	A	8				
I	ι	I		i	I	B	A	8			1	C
J	○	J		j	J	B					1	C
K	'	K		k	K	B				2		C
L	□	L		l	L	B				2	1	
M	|	M		m	M	B			4			C
N	T	N		n	N	B			4		1	
O	○	O		o	O	B			4	2		
P	*	P		p	P	B			4	2	1	C
Q	?	Q		q	Q	B		8				C
R	ρ	R		r	R	B		8			1	
S	⌈	S		s	S		A			2		C
T	~	T		t	T		A			2	1	
U	↓	U		u	U		A		4			C
V	∪	V		v	V		A		4		1	
W	ω	W		w	W		A		4	2		
X	⊃	X		x	X		A		4	2	1	C
Y	↑	Y		y	Y		A	8				C
Z	⊂	Z		z	Z		A	8			1	
.	:	.	⌐	.	⌐	B	A	8		2	1	
[	(	$	!	$	!	B		8		2	1	C
,	;	,	|	,	|		A	8		2	1	C
]	)	#	"	#	"			8		2	1	
←	→	@	¢	@	¢		A					
×	÷	&	+	&	+	B	A					C
+	-	-	‾	-	‾	B						
/	\	/	?̄	/	?̄		A				1	C
1	∙∙	1	=	1	=						1	
2	‾	2	<	2	<					2		
3	<	3	;	3	;					2	1	C
4	≤	4	:	4	:				4			
5	=	5	%	5	%				4		1	C
6	≥	6	'	6	'				4	2		C
7	>	7	>	7	>				4	2	1	
8	≠	8	*	8	*			8				
9	∨	9	(	9	(			8			1	C
0	∧	0	)	0	)			8		2		C

Note: For OTHER and BASIC translations, the following characters are entered when the CMD key is held down and the indicated key is pressed:

Key   **Character Entered**

Key	Character Entered
` \ ` ` l `	¬
` @ ` ` # `	¢
` : ` ` . `	"
` \ ` ` / `	%
` $ ` ` & `	!

FUNCTION CHARACTER CODE CHART

The function character code chart shows the bit configuration of the function characters and whether they are received or transmitted.

Function Character	Bit Value B A 8 4 2 1 C	
Tab	B A 8 4 1	Received and transmitted
Upper Shift	8 4 2	Received and transmitted
Lower Shift	B A 8 4 2	Received and transmitted
Backspace	B 8 4 2 C	Received and transmitted
Space	C	Received and transmitted
New-line	B 8 4 1 C	Received and transmitted
Start of transmission	8 2 1	Received and transmitted
End of transmission	8 4 2 1 C	Received and transmitted
Bypass	A 8 4	Received only
Restore	B 8 4	Received only
Line feed	A 8 4 1 C	Received only

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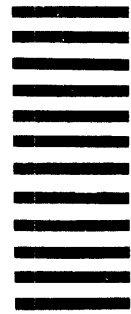Fold   Fold

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