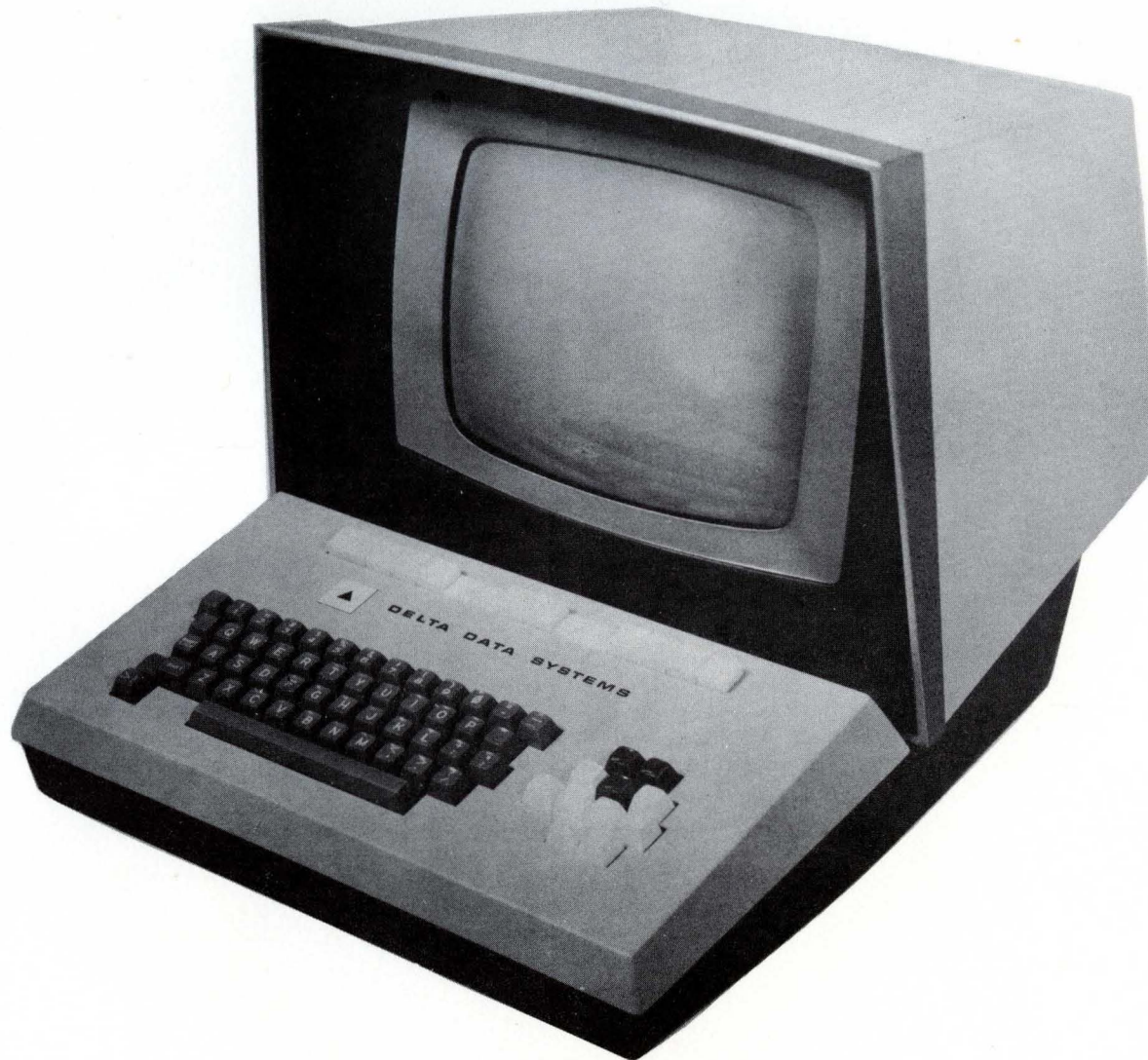DELTA 1

VIDEO DISPLAY TERMINAL

REFERENCE MANUAL

**Delta**
**Data**
**Systems**
Corporation

DELTA 1

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September 1969

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## 1.0 INTRODUCTION

The DELTA 1 VIDEO DISPLAY TERMINAL is a complete stand alone computer terminal for rapid entry, transmission, and retrieval of digital information. It consists of a controller, an alpha-numeric keyboard and a CRT display. A standard T.V. monitor is used for display of an EIA-TV compatible signal. This makes possible the operation of many T.V. monitors in a room or building to display information to many users.

The DELTA 1 has a capacity of 960 characters, 40 on each of 24 lines. A graphics mode provides display of graphic information on a 128 by 64 matrix. Complete capability for editing, formatting and transmitting data is included to provide data manipulation heretofore unavailable with a terminal in this price class.

Communications with the DELTA 1 is provided through an EIA compatible serial communications interface. The serial interface provides ASCII communications capability to make the DELTA 1 compatible with the Model 2701 communications controller of the IBM software. A parallel interface is also available with DTL electrical compatibility. Data is transferred through the parallel interface using a REQUEST-ACKNOWLEDGE control sequence providing compatibility with computer input/output.

The most complete set of editing and format controls are provided to simplify operator manipulation and preparation of data. The character insert and delete keys open or close a space on a line and the line insert or delete keys open or close a line space. The format control permits entering and protecting fixed information while the operator enters variable information. Transmission and clearing of the variable information provides a high level of efficiency of operation.

The selective blink feature permits any characters at selected positions to blink to call the operator's attention to the data.

Complete cursor control from the keyboard as well as the computer is provided by cursor controls to position the cursor anywhere on the screen. Variable transmission and erase data commands provide the ability to handle either the entire screen, a single line, or a message.

Options offered for the DELTA 1 include a light pen,
hard copy devices for printing what is on the screen,
closed circuit T.V. equipment for use in conjunction
with the DELTA 1, and various interfaces for communi-
cation and direct connection to other computers.

A.  Options also include a 96 character set where
the 32 additional characters are either:

1.  Lower case.
2.  Line drawing characters.
3.  ASCII control code graphic symbols.

(The use of any of these options requires that
the blink capability be deleted.)

## 1.1  SELECTIVE BLINK

The SELECTIVE BLINK feature permits the computer to
call attention to important information displayed on
the screen.  Such information blinks on and off at
approximately a once per second rate.  The operator's
eye is captured by the blinking and he can take appro-
priate action to acknowledge receipt of such information.

Blink will cause any field of characters to be in the
BLINK condition.  When BLINK is established for a given
character position, any displayable characters stored
in that position will blink on and off on the screen.
Clearing the position to a space or changing the char-
acter will not stop the blink function.  To stop a field
from blinking, the appropriate command must be entered
for each position for which the blink function should
be terminated.  In this way, each position may be sep-
arately and independently programmed to blink or to
stop blinking as required.

BLINK is independent of the format function and will
be affected by whether a given position is FIXED or
VARIABLE data in the FORMAT MODE.  Edit commands will
change the location of the blink field as well as data.

## 1.2  EDITING PACKAGE

The DELTA 1 has a complete set of data editing features.
Because an important characteristic of a CRT terminal
is the ability to receive data from a computer, mani-
pulate the data and then transmit back to the computer,
the edit features provided by the DELTA 1 are essential.
These are as follows:

## A.   Insert

The Insert Command causes a character space to be
opened up at the position of the Cursor and all
characters at that position and to the right are
moved over one place.  The last character on the
line is discarded.  The Cursor remains in its same
position and repeated operation of this key will
open up a multi-position space.  The data to be
inserted can then be typed directly in without
affecting subsequent lines of data.  This is used
to add a letter or a number in the middle of an-
other group of numbers or letters.

## B.   Insert Line

This command takes the entire line of data on which
the Curosr is located and moves it and all lower
lines down one line.  The bottom line of data is
discarded.  This opens up an entire line of data
for insertion into the body of the text.

## C.   Delete

This command causes the character at the position
of the Cursor to be replaced by the one immediately
on its right and all characters to the right of the
Cursor position to be moved to the left one posi-
tion.  A space is brought into the last position
on the line.  It is used to remove a word or char-
acter from a line without replacing it with some-
thing else.  It differs from the normal typing
operation where any new characters typed over an
old one will simply replace the old character with
the new one.

## D.   Delete Line

This command causes all characters on the same line
as the Cursor to be replaced by all the characters
on the next lower line.  All lines below that are
moved up one line and spaces are brought into the
bottom line from a text without replacing it with
a different line.

## E.   Roll and Crawl

One of the important capabilities of the DELTA 1
Terminal through the edit functions is the ability
to ROLL data up and down by the use of the dele-
tion or insertion command.  New lines of data can
then be entered so that a continuously moving text

can appear on the screen of the terminal.  The
same thing can be true for a single row of charac-
ters, CRAWLING from left to right or right to left.
In each case the appropriate characters or lines
to be entered can be displayed and moved up, down,
left or right.

## 1.3  REMOTE PROGRAMMING

The DELTA 1 display is capable of responding to a vari-
ety of commands to provide for remote operation of the
various function controls.  These include all of the
format controls, the erase controls, and the transmit
control.  In addition, the remote computer can cause the
Cursor to be set at any fixed position on the screen by
providing an absolute address to the terminal.

## 1.4  CURSOR CONTROLS

An extensive set of Cursor Controls is provided on the
DELTA 1.  These are designed with two points of view;
For operator convenience, and to provide complete flex-
ibility to the computer programmer.

At the keyboard, there are 7 Cursor Commands.  These
include UP, DOWN, LEFT, and RIGHT.  Also provided is the
HOME command which moves the Cursor to the first posi-
tion of the first line, the RETURN command which moves
the Cursor to the first position of the following line,
and the BACKSPACE command which moves the Cursor back
one position.

All of the above Cursor Commands are programmable from
the computer which also has the capability for absolute
positioning the Cursor any where on the screen with the
POSITION CURSOR COMMAND.  The Cursor command, given with
a line and position number, will automatically move to
the position addressed.  This provides the ultimate in
manipulative capability from the computer.

## 2.0 SYSTEMS CONFIGURATION

The DELTA 1 display station consists of a number of modular components described in the following paragraphs:

## 2.1 DISPLAY CONTROL

The function of display control is to generate master timing, integrate the refresh memory, generate the character font, and convert the digital character information into a signal capable of being recognized by a standard T.V. monitor. It also contains an EIA RS170 compatible sync generator which produces composite sync and composite video signals. Optionally available is a source of control signals necessary to permit the Display Controller to be the source of synchronization for any closed circuit T.V. facility.

## 2.2 DISPLAY

The technique used for generation and display of data employs a scanned raster approach. The display is a atandard CRT T.V. monitor mounted in a desk top housing. The 12" screen will display 960 characters in 24 rows of 40 characters each. Mounted on the side of the display station are three control knobs, for brightness, contrast, and horizontal hold. At the users option, other displays may be attached to the same controller providing the opportunity to monitor the contents of the screen in several different locations. These monitors can be additional DELTA 12" display screens, or large screen remote monitors can be used.

## 2.3 READ-ONLY MEMORY

The read-only memory is a permanent storage device. It is programmed to contain a pattern of one's and zero's which represent the shape of each of the standard 64 characters which can be displayed on the screen. Since each character is made up of seven rows of five dots each, the memory is broken up into 64 x 7 words of five bits each.

## 2.4 MEMORY CONTROL

Memory control serves the purpose of addressing the refresh memory and controlling the source and destination of the data. During that portion of the raster

scan in which the display is active, memory access is
controlled by a real time clock counter which defines
character position along the line and character line on
the page.  During this time the data is transferred
from core memory to the Display Control.

If new characters are to be entered into the refresh
memory or if some other form of an edit is pending,
during the period of time in which the raster is re-
tracing, the memory address is the cursor address.
Data is either extracted from the memory or entered in-
to the memory during the retrace time, as defined by
Edit Control.


## 2.5  REFRESH MEMORY

The refresh memory is a high speed, random access mag-
netic core storage.  This unit contains 1024 eight-bit
words.  In the DELTA 1, six bits are used for storage
of which of the 64 characters in the set is to be dis-
played.  The other two bits are used to store blink
and format information.  In a 96 character-set display
or in a color terminal, one or the other of the remain-
ing two bits may be used for other information.


## 2.6  EDIT CONTROL

The function of Edit Control is to perform all editing
operations for the data received from either the com-
puter or the keyboard, and for sending all data to the
computer.

The basic edit functions include control of transmission
to and from a computer, clearing all or sections of
the display, entering data into the display, controlling
the cursor on the display, or manipulating data via the
insert, insert line, delete, or delete line commands.


## 2.7  SERIAL I/O CONTROL

The function of the Serial I/O Controller is to permit
the display system to communicate with a computer via
a communications line.  The Serial I/O Controller
transmits and receives serial ASCII Coded data via a
telephone company supplied modem and converts it to edit,
transmit, or control commands for the display.

The Serial I/O Controller also performs the handshaking
operation required to establish communications.

## 2.8  PARALLEL I/O CONTROLLER

The function of the Parallel I/O Controller is to permit
direct communications between the display system and
other I/O devices.  Such devices include small general
purpose computers, paper tape readers or punches, card
readers or punches, magnetic tape controllers, line
printers, and the keyboard.

The parallel I/O Controller contains a party line data
bus permitting the display controller and other peripheral
devices to share common information.  To insure proper
direction of information flowing into or out of the data
lines, an interrupt structure is used.  Thus, any device
requiring service will make a request which is stored in
the Parallel I/O Controller, and when the Controller
completes the processing associated with some other I/O
device control is transferred to the requesting peri-
pheral.  During the time that this peripheral is using
the data bus, all other requests are stored and only
the peripheral presently using the I/O data bus can con-
trol the flow of data to or from the display controller.

## 2.9  KEYBOARD

The keyboard, as shown in figure  9 , contains a stan-
dard typewriter keyboard, a display edit keyboard, and
a display control keyboard all in one package.  The
standard typewriter keyboard permits entry of 26 charac-
ters, ten numbers, and 24 special symbols.

The edit keyboard permits relative motion control of the
cursor (up, down, left, and right), homes the cursor,
permits the establishment of formats and blink fields,
and permits the operator to enter or delete characters
or lines.

The control keyboard permits the operator to request
transmissions, to clear a message, display, line, to re-
set the display, to select the mode of operation, and
the mode of display, and permits a limited number of
special controls which will cause actions on external
I/O devices (up to ten can be supplied).

## 3.0  MODES OF OPERATION

There are three modes of operation for display of alpha-
numeric information.  These are 1) conversation mode,
2) format mode, and 3) normal mode.


## 3.1  CONVERSATION MODE

The Conversation Mode is provided to facilitate conver-
sational dialogue between the computer and the DELTA 1
terminal.  The purpose is to simplify operator actions
in communicating with the computer and to permit the
past conversation with the computer to be left displayed
on the screen.

After Activation of the Conversation Mode Key, the Mode
Light  will go on.  The address of the cursor is stored
in a register and the operator types his inquiry to the
computer.  The last character of the message will be an
End Of Message (EOM) symbol.  The terminal transmits
all information between the cursor locations stored in
the register and the End Of Message symbol.  The com-
puter begins its reply on the next line leaving displayed
the inquiry to the computer.  When the computer has com-
pleted transmission of its message, it sends a Return and
returns control to the terminal.  The terminal again stores
the address of the cursor in the address register and the
operator can type in the next inquiry.

In the Conversation Mode it is not necessary to constantly
reposition the cursor to the beginning of a message in
order to transmit.  Furthermore, the entire dialogue
between computer and operator remains displayed on the
screen instead of being cleared after each communication.

The Conversation Mode is an important factor in the man-
machine interface problem by simplifying communications
with the computer.  It, therefore, simplifies operator
intervention and training.


## 3.2  FORMAT MODE

The Format Mode is designed to simplify man-machine inter-
action.  It is used when a pre-established format is
placed on the screen in the Normal Mode and requested
information (variable data) is typed in Format Mode.

An example of a format would be:

```
NAME:
ADDRESS:
CITY:                    STATE:           ZIP:
S. S. #:
EMPLOYER:
```

The computer would transmit data in the Normal Mode to establish such a format.  Now, operating in the Format Mode, the operator would be unable to erase the format information.  Operation of the tab control would move the cursor to the start of the first variable data field. The operator would then type (TAB) Richard M. Nixon (TAB) 1600 Pennsylvania Ave (TAB) WASHINGTON (TAB) D.C. (TAB) 21111 (TAB) 333-333-3333 (TAB) U.S. GOVERN-MENT (END OF MESSAGE).

The screen would then look like this:

```
NAME: RICHARD M. NIXON
ADDRESS: 1600 PENNSYLVANIA AVE
CITY: WASHINGTON       STATE: D.C.    ZIP: 21111
S. S. #: 333-333-3333
EMPLOYER: U.S. GOVERNMENT
```

Now the operator is ready to transmit the variable data to the computer.  Since the computer established the format in the first place, it knows what the format information is.  The transmit button is pushed and the terminal sends only the variable data.  Now, the clear screen command is activated.  This will clear the variable data and bring the screen back to just the format information, ready for a new entry.

When a delete or insert character editing function is operated in the Format Mode, it only operates on the field from the cursor to the end of the line or the end of the variable data field, whichever shall occur first.


3.3  NORMAL MODE

The Normal Mode is the usual operating condition of the DELTA 1 terminal.  It provides unrestricted use of the editing functions.  Clear commands will operate on all character positions and all data specified will be trans-mitted in a send operation.


3.4  GRAPHIC MODE

An alternate mode of operation from that of ALPHA-NUMERIC display is for GRAPHIC DATA DISPLAY.  In this mode the

screen is divided up into 8192 spots on the face of the
screen.  Each eight bit character in the refresh memory
of the terminal describes an on-off condition for any
one of a corresponding eight spots on the face of the
screen.  The computer can then transmit data to the mem-
ory to provide a pattern of lit and unlit spots that
will draw lines, circles, and curves and generate char-
acters on the face of the screen.  In this way graphic
data may be displayed and annotated using the DELTA 1.

No relationship exists between the positioning of the
alpha-numeric data on the screen and the graphic data.

### 3.4.1  LIGHT PEN TRACKING (OPTIONAL)

Light Pen Tracking permits use of the light pen to draw
lines and curves on the face of the screen.  When the
light pen tracking control has been operated, the move-
ment of the pen across the face of the screen will cause
dots along the path of the pen to be turned on.  This
pattern becomes stored in the refresh memory and can be
interrogated by the computer to provide input data.

## 4.0  T.V. COMPATIBILITY

The DELTA 1 Terminal is a T.V. compatible display.  This
means the signal generated to drive the display portion
of the terminal is compatible with the television signal
generated in any closed circuit television system.  This
opens up a broad avenue of applications for the DELTA 1
Terminal.  Because of T.V. COMPATIBILITY, we are able
to make use of a standard solid state 12" T.V. set in
our terminal at an accompanying savings to the user.
This savings is in the form of initial cost as well as
maintainability because the operation of the circuits
within the display are identical to those of part of a
standard commercial television set.

## 4.1  USE WITH CCTV EQUIPMENT

The T.V. compatible signal drives a standard 525 line
T.V. monitor or modified T.V. set.  The display asso-
ciated with each keyboard can be monitored remotely
through a closed circuit television system.  A single
television distribution amplifier can be used to drive
several remote monitors in different locations.

A standard commercially available Video Tape Recorder
may be used to record the data being displayed for later
retrieval and display.  The output of a closed circuit
television camera can be combined with the signal from
the DELTA 1 terminal to superimpose computer generated
information onto a T.V. signal for display or recording.
This is useful in many applications where existing
closed circuit television systems can be combined with
the output data generated by a computer.  Graphic data
such as pictures from slides or art work can be scanned
by a T.V. camera and annotated by the signal from DELTA 1
terminal.

## 4.2  RASTER SCAN

Characters are created on the screen in the TV raster
mode by blanking and unblanking of the TV beam as it
moves laterally across the screen.  The beam moves across
the screen 525 times to create a normal TV picture.  Suc-
cessive sweeps skip every other line creating two fields
of scan of 262 and 263 lines equally spaced up and down
the screen.  This is known as an interlace.  In the
DELTA 1 terminal, the information on each field is re-
freshed identically so that in effect we have 262 lines
on the screen rather than 525.  Since each is written
30 times per second, an equivalent refresh rate of 60
per second assures a flicker free display.

The display characters are formed in the middle 212 T.V.
lines which made up of seven lines per character and two
lines between rows on each of 24 rows of characters.
The cursor is written on the 8th line of each character
row and the 9th line is always used as a separation to
to row below.

It takes approximately 52 microseconds for the beam to
sweep from one side of the screen to the other and approx-
imately 12 microseconds for it to return back to the left
hand side.  During the 52 microsecond period as it sweeps
the screen, the beam is turned on and off to generate one
line of the character.  However, the first 5 microseconds
of the sweep are not used in order to assure a placement
of the characters in the center of the screen and reduce
maintenance problems from drift of the characters to the
left or right of the visible area of the screen.


4.3  SYNC SIGNAL AND COMPOSITE VIDEO

The output signal from the Delta 1 generator to the dis-
play station and to remote monitors is a standard EIA
Video signal as per specification RS 170 of the Electri-
cal Industries Association.  This specification provides
the exact timing and characteristics of the synchroni-
zation signal for the TV receiver and the composite video
signal.


The sync signal must have a pulse at the beginning of
each line of video data to cause the beam to return from
the right hand side of the screen to the left hand side.
When the proper number of these pulse signals have been
generated at 60 microsecond intervals, a horizontal
synchronization sequence is generated.  These provide the
triggering necessary for the TV receiver to cause return
of the beam from the bottom of the screen on the right
to the top of the screen on the left.  The receiver is now
ready to receive a new vertical sync pulse and video data
for the next field of display.


Standard synchronization signals are available as outputs
from the generator to be used to trigger T.V. cameras
and other closed circuit television equipment used in
conjunction with the DELTA 1 terminal.  Sync signal is
mixed with the digital data to provide a composite video
signal.  This is the type of signal normally received
from the output of a television camera and required by dis-
tribution amplifiers and monitors in a closed circuit TV

system. The compatibility with EIA standard RS 170 assures operation with closed circuit or broadcast TV equipment.

When operating in conjunction with TV equipment, it is necessary to provide the synchronization signals to the equipment from the Delta 1 display in order to provide for compatibility in operation.

## 5.0  INPUT-OUTPUT TRANSFER

All data transferred to and from the DELTA 1 passes
through the party line input/output bus.  This consists
of eight bi-directional data lines and a series of con-
trol lines.  These control lines provide for transfer
of data through the data register.  Data is transferred
to and from the memory via the data register.

A priority input/output structure is provided through
the party line I/O to permit various devices to gain
exclusive access.

The single input/output port provided by the party line
I/O is used by the serial communications interface, the
parallel communications interface as well as other I/O
devices.  All data exchanged with the external world is
passed to the memory through the party line I/O.


## 5.1  PARTY LINE I/O BUS

The DELTA 1 controller employs a "Party Line" I/O bus to
communicate with peripheral equipment.

The party line at the last device must be terminated
with a resistor whose value is the characteristic
impedence of the signal line.  This is done to minimize
reflections.  Since the data lines are bilateral, i.e.
they can be driven from either end, a termination is
required at each end.  The control lines, which are
unilateral, are required to be terminated only at the
receiving end of the line.  Figure 5.1 shows the circuit
schematics of both types lines.  Signal lines should be
twisted pairs.  Peripheral design should try to minimize
the length of the line.  While the controller can
operate at long distances an effort should be make to
keep the party line cable under 12 feet long.


## 5.2  COMMANDS

All commands described in the following paragraphs
may be initiated from a remote source.  To initiate
them the controller expects the first input word to be
the code for the command and the COMEN signal to be true
during the transfer.  If the command is a XMIT the
XMITEN signal must also be true during the transfer.

The DATAVL signal will be turned off from the time the
command data transfer is initiated until the command
has been completed.  At the conclusion of the command
the controller will place an ACK code (for receive
data commands) or an STX character (for send data commands)
into the data register.  Data is then transferred from
the party line to the peripheral controller or other
peripheral device under external control.


## 5.3  TRANSMIT COMMANDS

The transmit commands provide for transmission of data
to a computer.  Information to the right of a new line
symbol on any transmitted line will not be transmitted.
This conserves transmission time.

When the display is in the Format mode, only those
characters located in "Variable" field positions are
transmitted to the I/O device.


### 5.3.1  TRANSMIT MESSAGE (0100000)

This command causes the contents of the display from
the present location of the cursor to an end of message
symbol to be transmitted to some I/O device at a rate
compatible with that device.  At the end of the command,
the cursor is located at the character position following
the end of message symbol.

In the Conversational mode the cursor is backed up
automatically to the first character after the last end
of message indicator before executing the transmission
sequence.


### 5.3.2  TRANSMIT DISPLAY COMMAND (0110000)

This command causes the cursor to reset to the origin
location on the display and transmit the contents of
every location on the display to the input/output
device.  At the conclusion of the transmission, the
cursor is returned to the origin location.

### 5.3.3 <u>TRANSMIT LINE COMMAND</u> (0100001)

This command transmits to the requesting I/O device all
information from the present location of the cursor to
the end of the line.  At the conclusion of the command,
the cursor is located at the first location on the next
line.

### 5.3.4 <u>TRANSMIT X ADDRESS COUNTER</u> (01000010)

This command causes the contents of the X address
counter to be transmitted.  The X address is the position
of the cursor on the line.  It varies from zero to 39.

### 5.3.5. <u>TRANSMIT Y ADDRESS COUNTER</u> (0100011)

This command causes the contents of the Y address
counter to be transmitted.  The Y address is the line
address of the cursor.

### 5.4 <u>CLEAR COMMANDS</u>

### 5.4.1 <u>CLEAR MESSAGE COMMAND</u> (1100001)

This command will reset to a space character code the
contents of all display locations from the present
position of the cursor to but not including the end
of message (EOM) symbol on the screen.  At the
conclusion of this command the cursor will be located
at the character position following the EOM symbol.

### 5.4.2 <u>CLEAR DISPLAY COMMAND</u> (1100000)

The execution of this command causes the cursor to
reset to the origin position and causes the replacement
with a space character code of all character positions
on the display screen.  At the conclusion of the command
the cursor is reset to the origin position.

### 5.4.3. <u>CLEAR LINE COMMAND</u> (1100010)

This command causes the replacement with a space
character code all display positions from the present
position of the cursor to the end of a line.  At the
conclusion of this command the cursor is returned to
the position it had before execution of the command.

## 5.5  ENTER COMMANDS

There are three enter commands acknowledged by the
terminal to permit display of data from the computer.


### 5.5.1  ENTER (1000000)

This command causes data received to be displayed
beginning at the present cursor position.  If more
than forty characters are entered on a line of the display,
an automatic over-flow to the next line of the display
will occur.  No return command need be entered when
it is desired to display more than forty characters
before a return symbol occurs.  If 50 characters are
transmitted followed by a return, the first forty will
occur on a line and the next ten will occur on the
following line.  Subsequent data will begin at the
start of the third line.


### 5.5.2  ENTER ADDRESSED LINE (1010000)

Data will be entered on a line whose number is specified
by the first character after the STX in the message.
The X address counter will be reset to zero so that
the message begins at the first position of the addressed
line.  If a Y address is entered which is greater than
23, the cursor will be positioned in an imaginery
place below the screen.  Line addresses greater than 32
will cause entry on a line specified by the line address
modula 32.


### 5.5.3  ENTER ADDRESSED POSITION (1010001)

This command provides for entering of data on the
screen beginning in a specified position of a line.
The first character after the STX command specifies
the position on the line.  Data following the X
position address will be displayed beginning at the
position specified and continue across the line and on
subsequent lines.  The Y address counter is unaffected
by this instruction.

NOTE:  On all enter commands, the terminal will treat
the first line as if it were immediately after the
last line of the display.  For example, a return
command given on the bottom line of the display will
cause the cursor to go to the home position.

## 5.6  EDIT COMMANDS


### 5.6.1  INSERT COMMAND (1110000)

This command causes a space character code to be
inserted onto a display line at the location of the cursor
and causes all remaining characters to the right of this
location to be moved one character to the right. The
character in the right most position is discarded. At
the conclusion of this command the cursor is returned
to the location of the space character code to permit
the operator or computer to enter a new character.
In the format mode the space character is inserted
and all characters moved right one place until the
end of the variable field.

## 5.6.2 INSERT LINE COMMAND (1110001)

This command causes a line of space code characters
to be inserted on the line where the cursor is presently
located and causes all subsequent lines below this line
to be pushed down one line. The last line on the display
is deleted from memory. At the conclusion of this command
the cursor is located at the start of the new inserted
line. In the format mode this command is invalid.

## 5.6.3 DELETE COMMAND (1110010)

This command causes the character located at the preset
location of the cursor to be deleted from the display
and all  subsequent characters to the right of the
cursor to be moved one position to the left. At the
conclusion of this command the cursor is returned to
the location at which the delete occurred. A space
coded character is inserted as the last character on
this line. In the format mode only variable data
may be deleted and all characters in the variable
field up to the cursor are moved to the left.

## 5.6.4 DELETE LINE COMMAND (1110011)

This command causes the erasure of all characters on
the line signified by the cursor. All lines below
this line are pushed up one line. At the conclusion
of this command the cursor is located at the starting
position on the line just deleted. This command is
invalid in format mode.

## 5.7 DISPLAY CONTROLS

These characters can be contained as part of any text.

## 5.7.1  SET BLINK (0010010)

This command causes the present cursor location to be
designated as a blink position so data will blink any
time a character is located at this position.  At the
conclusion of the command the cursor is incremented
one character position.

## 5.7.2  CLEAR BLINK (0010011)

This command resets the blink control for the present
cursor location.  At the conclusion of this command
the cursor is incremented one character location.

## 5.7.3  CURSOR LEFT (0011101)

This causes the cursor to move one position to the left.
Data is unaffected.  If the cursor was on the leftmost
position on the line before the key was operated, the
cursor will go to the last position on that line.
Data is unaffected.

## 5.7.4  CURSOR RIGHT (0011100)

This causes the cursor to move one position to the right.
Data is unaffected.  If the cursor was on the rightmost
position of the line before the key was operated, the
cursor will go to the first position of the same line.
Data is unaffected.

## 5.7.5  CURSOR UP (0010110)

Moves the cursor to the same position on the preceeding
line.  Data is unaffected.

## 5.7.6  CURSOR DOWN (0010111)

Moves the cursor to the same position on the next
line down.  Data is unaffected.  If the cursor was
on the bottom line, it will go to the first line on
the screen.

## 5.7.7  RETURN (0001010)

Moves the cursor to the first position on the next line.

## 5.7.8 NEW LINE (1111111)

The character is entered on the screen. This character
defines the end of a line during transmit commands,
and the end of a field if in the format mode.


## 5.7.9 HOME (0011011)

Moves cursor to the first position of the first line
on the screen. Data is unaffected.


## 5.7.10 BACKSPACE (0001000)

Moves cursor back one position. Data is unaffected.
if cursor is in the first position of the line, it
will go to the last position of the same line.


## 5.7.11 TAB (0001001)

The Tab Command is used when the display is in the
Format Mode to facilitate the location of Variable
Fields. Execution of the Tab Command causes the cursor
to move to the first position of the next variable data
field.


## 5.8 PARTY LINE SIGNALS

Data Bus - IDIBON to IDIB7N - eight bidirectional lines
that transmit data between peripheral devices and the
DELTA 1 controller. IDIB7N is the most significant
bit, IDIB1N is the least significant bit and IDIBON is
the parity bit (ignored by the controller unless
longitudinal pary check (LRCC) is utilized).

Control Bus - ten lines that transmit or receive control
signals between the DELTA 1 and I/O devices. The
signals are described as follows:

INCKIN       Input clock. This signal is received
by the Delta 1 and defines the period
of time that new data is available to be
entered into the controller. This signal
must be true until a CKRN is received
at the peripheral.

INDKOTN       Output clock. This signal is received by
the Delta 1 and causes the controller
to place a word on the Data Bus.
Information to be sent to the peripheral
is valid for that period of time from
CKRN true until the INCKOTN is removed.

CKRN            Clock response.  This signal is sent by
               the DELTA 1 and defines to a peripheral
               when input data has been received and
               when output data is available.  This
               signal goes true 250 nanoseconds after
               the INCKIN or INCKOTN goes true and
               lasts for 250 nanoseconds.

SENDEN         Send/Receive.  This signal is transmitted
               by the DELTA 1 and defines to a peripheral
               whether the next data transfer is to be
               from or to controller.  The signal
               will change state about 500 nanoseconds
               after the INCKIN or INCKOTN signal
               becomes true if a change is expected.

COMEN          Command Enable.  The DELTA 1 expects
               that the first word of every transmission
               sequence be a command.  The command
               enable signal must be true from just
               prior to the first INCKIN signal at
               least until a CKRN is received by the
               peripheral.  It may stay true until the
               next INCKIN or INCKOTN.

XMITEN         Transmit enable.  This signal has
               characteristics similar to COMEN and is
               required in addition if the command is
               a transmit.

DATAVLN        Data Available.  This signal is transmitted
               by the DELTA 1 and defines to a peripheral
               when the data bus is available for the
               next INCKIN or INCKOTN.  This signal
               goes false as either clock goes true and
               remains false until the controller has
               completed the operation associated with
               the data transfer.

INTRN          Interrupt Reset.  This signal is transmitted
               by the DELTA 1 and defines to a peripheral
               when in time the message has been completed.
               This signal occurs at the leading edge
               of the last CKRN of a message transfer
               and is 250 nanoseconds long.

VRCERN         Parity Error.  This signal is received
               by the DELTA 1 controller at any time
               during a message transfer and causes
               the controller to retransmit a message
               (transmit screen only) at the completion
               of the message or respond with a NAK
               for received messages.  (This signal is
               normally used with the serial communica-
               tions controllers only.)

RESETN          Reset.  This signal is transmitted by
                the DELTA 1 controller to peripherals
                when an operator depresses the RESET Key
                on the Keyboard.  It may also be received
                from the peripheral.  This signal causes
                the controller to reset all control
                flags to an initial state.

IREQ            Interrupt request.  This signal is
                generated by the interface controller
                and when true indicates that a request
                for service is being made.

IACK            Interrupt Acknowledge.  This signal is
                generated by the Input/Output unit in
                response to an IREQ and indicates that
                the I/O unit is ready to respond to the
                interface controller.

ICL             Interrupt clock.  This signal is gener-
                ated by the I/O unit and is used to
                clock the request FF's in the interface
                controller.  When the IACK is true,
                this signal is not present.

ICP             Interrupt complete.  This signal is
                generated by the interface controller
                when its operation is complete.  It is
                used to reset all request FF's in all
                interface controllers.  The serviced
                unit must reset its request storage
                FF at the same time.  This pulse must
                be > 1 < 2 times the ICL time.

Function Bus - Three lines that transmit pulses to a
peripheral to initiate some action.  All these lines
are related to keys on the keyboard.  (While three are
available up to 10 can optionally be added.)

XMITSWN         Transmit Switch.  This signal is
                transmitted to a peripheral when an
                operator depresses the XMIT key.  The
                signal produced is true for 2 micro-
                second.

PRINTSWN        Print Switch.  Same as above only
                initiated by operation of Print Key.

READSWN         Read Switch.  Same as above only
                initiated by operation of the Read Key.

Table 5.1 defines the connector pin assignment for connect-
ing external peripherals or their controllers to the
DELTA 1.  Figures 5-1, 5-2, 5-3 describe the timing of
control and data symbols for the party line.

## 5.9  INTERRUPT SYSTEM

The interface controllers employ a unit sequential inter-
rupt system which permits several interface devices to
communicate with the display.  To accomplish this, each
interface controller must provide a signal to all sub-
sequent controllers (INTERN) to indicate that it is not
using the DELTA 1.  It can only provide this signal if
no other higher priority device has previously generated
it (INTKN).  Figure 5.5 shows a schematic of the
interrupt structure.

Each interface controller is prohibited from generating
party line clocks until it has received priority.

As shown in Figure 5.5 and INTEN signal is the INTKN of
the next controller.

### OPERATION OF INTERRUPT SYSTEM

The interrupt system shown schematically in Figure 5.5,
operates as follows.  When a request is determined by
the interface controller, the request storage FF ($S_1...S_N$)
is set.  On the next trailing edge of the interrupt
clock (ICL), the request FF is set for each device where
the request storage FF is set.  Since the IACK and each
INTEN is high at this time, the IREQ is brought low.  The
interrupt FF (I) is set causing IACK to go low and the
ICL to be removed from the bus.  When INTKEN of the
first controller goes low indicating that priority is
available, the common input of gates A and C are enabled.
If $R_1$ is set only gate A will have an output which
transfers priority to the next controller in the chain.

When the interface controller finishes its operation, it
generates an ICP which resets all request FF's (even
those in other controllers) and its own request storage
FF.  Since all request FF's are reset, there will be no
IREQ.  The interrupt FF will then be reset, by the CL
during ICP, allowing the ICL to return to the bus and to
set any request FF where there is a corresponding request
storage FF set.  Thus, multiple requests will be serviced
in their order of priority.

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## 6.0  SERIAL COMMUNICATIONS

Communications between a peripheral and the display con-
troller is always half duplex (except echoplex).  For
serial communications this takes the form of either a
two-wire or four-wire system.  For parallel communica-
tions it takes the form of eight-wire communication
plus a number of control signals.

An unpolled system is one in which operator requests for
transmission to or from a computer are initiated upon
his action.

For DELTA 1 displays a polled system permits the use of
a single communication line to address a large number
of display controllers.  The polled system is under the
control of the data processor and requires that the data
processor elicit communications traffic from the display
controller by means of a polling message which identifies
the polling command and specifies the address of a dis-
play controller which it is asking, "Are there any
messages available for transmission?"

Because of the nature of the display command, two seven-
bit words can specify the controller address (this
stimulates an IBM 2848 Display Controller and a 2260
Display Station).  The total number of display controllers
accessible via this mode is in excess of 16,000.

A polled system allows the display controller to non-
simultaneously transmit and receive data to and from the
processor.  If the control computer employs a full du-
plex communication channel, the communications from
multi-display terminals to the computer permits trans-
mitting data or polling messages to one station while
receiving information from another even though at the
display controller stations themselves, only half
duplex operation is permitted.

### 6.0.1  COMMUNICATION INTERFACE

The display controller will operate using either syn-
chronous or asynchronous modes of communication.
Asynchronous Modems. The display controller is com-
patible with Bell data sets Model 103A or Model 202C
or 202D to permit asynchronous communication over
either private line or direct dial switching networks.

The Model 202C Modem permits asynchronous information to be transferred on the dial-up networks at rates up to 1,800 baud, and the Model 202D modem permits asynchronous communication on the private line network up 1,800 baud.  The Model 103A permits communication on either of these networks at rates up to 150 baud.

The display controller also has available an option to remove the modem interface for providing serial communication over a direct connection.


## 6.0.2  SYNCHRONOUS INTERFACE

The display controller also permits operation of a serial interface using synchronous modems permitting transmission speeds of up to 9,600 baud using private line connections.

For synchronous communications at 2,400 baud, the Bell Model 201A Modem can be used.  This modem can be used in either a two-wire or four-wire system on either the dial-up or private line networks.

When a synchronous Modem is used in a polling environment, the message must also contain a synchronization code which is the ASCII SYNC command repeated four times prior to the message normally required with the use of an asynchronous modem.


## 6.1  SERIAL CONTROLLER - IBM COMPATIBLE

The DELTA 1 terminal with this controller operates with the same communications dialogue and features as the IBM 2265 Display with a (2845) Controller.  This means that the IBM Display may be replaced on a plug to plug compatible basis with the DELTA 1 terminal.  To provide this compatibility, the terminal is capable of responding to a four-character polling sequence that is identical to that which the IBM terminal expects.  This sequence consists of a communications command character (EOT or SOH Command), two address characters which the terminal is capable of recognizing and decoding for operation on a shared line, and the fourth character is a command. These commands are the communications commands and are listed in section 5.  They provide for transmission of the terminal data to the computer, entering data from the computer onto the terminal screen, erasing portions of the screen, and absolute positioning of the cursor.

If the transmit button has been depressed and the unit
is in the transmit condition when the terminal is
requested to transmit, it will respond with a start of
text symbol (STX) and the message followed by and ETX
and an LRC code. The unit will respond with an EOT
character if the XMIT key has not been pressed indicating
there is nothing to be transmitted.

When the unit transmits its message, the computer will
respond either with an ACK (indicating the message was
received without error) or an NAK (indicating the mes-
sage was received with errors). If the NAK is received,
the terminal will retransmit the entire message (XMIT
screen only). If the ACK is received, the terminal will
send an EOT character and unlock the keyboard.

## 6.1.2  ASCII COMMUNICATION CONTROL CHARACTERS

To establish and maintain an orderly flow of traffic
over communication lines, particularly in multidrop
applications (where more than one device is attached
directly to the lines), a method of controlling line
traffic is necessary. Line traffic between the computers
and the remote display system is controlled by the use
of six of the ASCII communication control characters.
These six codes, used singly or in sequences, perform
all the control functions necessary to establish and
maintain an orderly flow of traffic between the channel
and I/O devices attached to the communication lines.

The definition of each of these six ASCII characters is
given below. The code structure for each is given in
Figure 6.1

> A.  STX (Start Of Text) - A communication control
>     characters that is to be treated as an entity.
>     This entity will usually be terminated by ETX.
>
> B.  ETX (End Of Text) - A communication control
>     character used to terminate a sequence of char-
>     acters started with STX and transmitted as an
>     entity.
>
> C.  ACK (Acknowledge) - A communication control
>     character transmitted by a receiver as an
>     affirmative response to a sender.
>
> D.  NAK (Negative Acknowledge) - A communication
>     control character transmitted by a receiver
>     as a negative responder to a sender.

E.  SOH (Start Of Heading) - A communication con-
    trol character used at the beginning of a
    sequence of characters which constitute a
    machine-sensible address.

F.  EOT (End Of Transmission) - A communication
    control character used to indicate the start
    or conclusion of a transmission which may
    have contained one or more texts and any
    associated heading (addresses).

    EOT is also used, instead of SOH, as the first
    byte of the addressing sequences in the trans-
    mit command operations.

## 6.1.3  ADDRESSING SEQUENCES

Each command issued by the computer to the remote display
is transmitted in four sequential bytes of a definite
format called an addressing sequence.  The addressing
sequence prepares the display to accept a command, defines
the address, and specifies the operation to be performed.
The following describes the specific function of each of
the four bytes of the addressing sequences.

A.  First Byte - The first byte of an addressing
    sequence must be either an SOH or EOT communi-
    cation control character.

B.  Second Byte - The second byte in the addressing
    sequence contains an address.

C.  Third Byte - The third byte contains the second
    address character of the display to be selected.

D.  Fourth Byte  - The fourth byte of an addressing
    sequence specifies the command to be executed
    by the selected display.

Each of the four bytes of every addressing sequence is
parity-checked by the DELTA 1 as it is received (as is
every character).

## 6.1.4  SEQUENCE/RESPONSE DIALOGUE

### 6.1.4.1  TRANSMIT DATA COMMANDS

Figure 6.1 is a sequence/response diagram for transmit
data commands from the computer.  These are required in

a polling environment.

An EOT (or SOH) command will cause the terminal to treat
the next two characters (TA1 and TA2) as a terminal
address. These two characters will be coded and checked
and if the proper address sequence is received, the
fourth character received will be decoded as a command
to the terminal. This four character sequence is pre-
sent for all communications commands. The fourth
character could be any of the several transmit commands.

The terminal will respond dependent upon whether the
transmit button has been pressed putting the machine in
the transmit mode. If it has not, the terminal will
send an EOT character back to the computer indicating
the fact that the terminal has no data to transmit. If
the operator has pressed the transmit button, then the
terminal will transmit a STX command (indicating the
start of text), TA2 (the second of the two terminal
addresses that were transmitted to it by the computer
in the fourth character command sequence), and the text
of the message that the terminal has to send. This
will be followed by an ETX (indicating the end of text)
and an LRC (longitudinal redundancy check character)
for parity checking by the computer.

The terminal remains in the transmit mode until the
response is received from the computer. If an error
was detected in transmission, the computer will send
back an NAK which will cause the terminal to send STX
and begin the transmission of the text again. If no
ACK command and the terminal will respond with an EOT
which will then unlatch both the computer and the ter-
minal from the communications. The on line light on the
terminal will be turned off and the machine will return
to its previous mode.


6.1.4.2  ENTER DATA COMMANDS

 Figure 6.2 is a sequence response diagram for Enter Data
Commands from the computer. The first character communi-
cations sequence will be either an SOH or EOT. The
terminal will see a two character terminal address which
it will decode to determine if it is being addressed.
If so, it will decode the fourth character, the command
character. Upon receipt of an Enter Data Command and
detection of the correct address, the terminal will send
to the computer an ACK character. The computer will
transmit an STX character which would be used in those
commands which involve entering data on a specific line

or character position on the line followed by the text
to be displayed.  An ETX command follows the text and
then an LRC.  The terminal will respond with an ACK
(acnkowledge) indicating receipt of the message and
the computer should respond to that with an EOT which
will remove the keyboard and the terminal from the
Enter Data condition.  If an error was detected by the
controller it will respond with an NAK and the computer
may (via software) retransmit or terminate.

## 6.1.5  ERROR CONTROL

### Vertical Parity

As each character is received from the modem it is checked
for even parity.  If a parity error is detected an error
flag is set and the character replaced by a CAN ( \ )
character.  As each character is sent to the modem an
even parity is generated.

### Longitudinal Parity

An accumulator is used to keep account of all input and
output data from the first character after an STX to an
ETX.  This longitudinal accumulator is compared with the
first received character after an ETX (LRCC) and any
difference sets an error flag.  During data transmission
the contents of the accumulator is transmitted as the
first character after an ETX.

### Error Retransmission

If the error flag is set during receipt of data the con-
troller will respond with an NAK character after the
message is complete.  The computer may be programmed to
cause retransmission upon detection of the NAK.

If the computer responds to the receipt of a message
with an NAK the controller causes the message to be trans-
mitted.  (This is only valid if the transmit command is
a XMIT SCREEN.)

## 6.2   TELETYPE COMPATIBILITY SERIAL CONTROLLER

The DELTA 1 terminal with this controller operates with
the same communications dialogue as a TTY.  It can
operate with either of two options -- Normal or Echo-
plex.  It is designed to communicate with a remote
computer via a 103 serias Dataphone using either a pri-
vate line or the dial-up network.  It may also be
connected to an acoustic coupler.  The communications
are full duplex at 110 baud.  (Up to 300 baud option-
ally available.)

### 6.2.1   ECHOPLEX MODE

In this mode the communications line is the only source
of data to be entered on the CRT.  As each character is
typed on the keyboard it is transmitted to the computer.
The computer returns either the same character or an
error character (CAN, if a transmission error is detected)
and displays it.  The display advances the cursor one
position.  If a vertical parity error is detected on
receipt of a word the CAN character is also displayed.

For TTY compatible communications initiation of commands
from a remote source is not permitted.

### 6.2.2   NORMAL MODE

While the controller operates with a full duplex modem
in this mode data cannot be sent and received simul-
taneously.  Received data is displayed (except control
characters) as it is received.  The operator may
create a display and then after editing it transmit it
as a block to the remote computer.  This action is
initiated by the operator depression of the XMIT key.

If the operator has selected the Conversational mode
the transmit command is a XMIT MESSAGE and the infor-
mation transmitted is that information from the previous
EOM symbol to the latest EOM symbol (typed by the
operator after creating the display).

If the operator has not selected Conversational mode
the transmit command is a XMIT SCREEN and all informa-
tion on the screen is transmitted (if also in a format
mode only variable data and new line characters are
transmitted).

For all transmissions the transmitted data is bracketed
by an STX character and an ETX character.

For all receptions of data the detection of a parity
error (even parity) cause a CAN symbol ( \ ) to replace
the normal character.

## 6.3  SERIAL INTERFACE (RS-232B)

### 6.3.1  GROUNDS

#### Circuit AA -- Protective Ground

This conductor shall be electrically bonded to the ter-
minal frame.  It may be further connected to external
grounds as required by applicable regulations.

#### Circuit AB --Signal Ground

This conductor establishes the common ground reference
potential for all interchange circuits except circuit
AA (Protective Ground).  In the data communication
equipment this circuit shall be brought to one point,
and it shall be possible to connect this point to cir-
cuit AA by means of a wire strap.

This wire strap can be connected or removed at the
installation, as may be required to meet applicable
regulations or to minimize the introduction of noise
into electronic circuitry.

### 6.3.2  DATA SIGNALS

#### Circuit BA -- Transmitted Data

Direction:  From Terminal

Signals on this circuit are generated by the terminal and
are connected to the transmitting signal converter for
transmission to remote data processing equipment.

Ther terminal equipment holds Circuit BA in marking con-
dition during any time interval between characters or
words, or at such other times when no signals are to be
transmitted.

The marking or spacing signal condition is held for the
total duration of each signal element.

Circuit BB --Received Data

Direction:  To Terminal Computer

Signals on this circuit are generated by the receiving
signal converter in response to data signals received
from remote equipment.

In half-duplex service, the receiving data set shall
hold marking condition on Circuit CA (Request to Send
in the OFF condition.  Alternatively, in half-duplex
service, the Received Data circuit may be used to moni-
tor transmitted signals (e.g., for local copy).

A data set equipped for Transmit-Only service shall hold
Circuit BB in the marking condition at all times.

The marking or spacing signal condition shall be held
for the total duration of each signal element.


6.3.3  CONTROL SIGNALS

Circuit CA -- Request to Send

Direction:  From Terminal

Signals on this circuit are generated by the terminal
equipment to condition the local data set to transmit.
For example, if the data set contains a modulator, the
carrier signal shall be transmitted during the ON condi-
tion of Circuit CA.

The ON condition is maintained whenever the terminal
equipment has information ready for transmission or
being transmitted.  The signal converter shall transmit
all data on Circuit BA (Transmitted Data), while the
ON condition is maintained on Circuit CA, Circuit CB
(Clear to Send), and Circuit CC (Data Set Ready).

In half-duplex service, the OFF condition shall hold the
data set in the receive-data condition, and the ON condi-
tion shall hold the data set in the transmit-data condition.
The above conditions shall be established without regard
to signals on Circuits BA (Transmitted Data) and BB
(Received Data).

On a multipoint communication channel which may succes-
sively carry data signals transmitted by several data
communication equipment stations, Circuit CA shall be
used by each data processing terminal to condition its
local data set to transmit.

## Circuit CB -- Clear to Send

Direction:  To Terminal

Signals on this circuit are generated by the transmitting data set to indicate that it is prepared to transmit data. The ON condition is a response to the ON condition on Circuit CA (Request to Send), delayed as may be appropriate to the data communication equipment for establishing a communication channel to a remote data processing terminal.  When Circuit CA is turned OFF, Circuit CB shall be also turned OFF.

In Receive-Only service, the data set shall hold Circuit CB OFF at all times.

In Transmit-Only or Full-Duplex service, if the data communication equipment is arranged to be in transmit condition at all times, then Circuit CB shall be held in the ON condition at all times.

## Circuit CC -- Data Set Ready

Direction:  To  Terminal

Signals on this circuit are generated by the local data set to indicate that it is ready to operate.

The OFF condition shall be used to indicate either:

   A.   Any abnormal or test condition which disables
        or impairs any normal function associated with
        the class of service being furnished.

   B.   That the communication channel is switched to
        an alternate means of communication (e.g., al-
        ternate voice telephone).

   C.   That the local data set is not connected to a
        communication channel (i.e., the data set is
        "on hook").

The ON condition shall appear at all other times.

This circuit shall be used only to indicate the status of the local data set.  The ON condition shall not be interpreted either as an indication that a communication channel has been established to a remote station or the status of any remote station or equipment.

## 6.3.4  ADDITIONAL CONTROL SIGNALS

Additional interchange circuits may be required in some
systems:

### Circuit CD -- Terminal Ready

Direction:  From Terminal

Signals on this circuit are used to control switching of
the signal converter to the communication channel.  The
ON condition causes the signal converter to be connected
to the communication channel.  However, if the station
is equipped only for call origination by means external
to this interface (e.g., manually or an automatic call
origination unit), then the ON condition serves only to
maintain the connection established by these external
means.  When the station is equipped for automatic
answering of received calls, connection to the line may
be arranged to occur only in response to a ringing signal.

The OFF condition removes the signal converter from the
communication channel, for such reasons as:

   A.  Freeing the line for alternate use (e.g., voice
       or use by other terminal stations).

   B.  Permitting use of the data processing terminal
       equipment for an alternate function.

   C.  Terminating a call (i.e., going "on hook").

The OFF condition shall not disable the operation of
Circuit CE (Ring Indicator).

### Circuit CF -- Data Carrier Detector

Direction:  To Terminal

Signals on this circuit are used to provide an indication
that the data carrier is being received.  When the data
carrier is lost because the transmitting signal converter
is turned OFF or because of a fault condition, the OFF
condition follows after an appropriate guard time delay.

In Half-Duplex service where the signal converter is
arranged for local copy (see Circuit BB, Received Data),
Circuit CF may respond to carrier signals from either
the local or remote transmitting signal converter.

The ON condition indicates reception of the data carrier.
The OFF condition provides an indication of the end of
present transmission activity or a fault condition.

## 6.3.5 ELECTRICAL SIGNAL CHARACTERISTICS

The maximum open-circuit voltage to either Circuit AA
(Protective Ground) or Circuit AB (Signal Ground) on any
interchange circuit shall not exceed 25 volts, and the
maximum short-circuit current flow between any two con-
ductors (including grounds) shall not exceed one-half
ampere.

For Circuit BA (Transmitted Data) and Circuit BB (Received
Data), the signal shall be considered in the marking con-
dition when the voltage on the circuit is more negative
than minus three volts with respect to Circuit AB (Signal
Ground), and the signal shall be considered in the spac-
ing condition when the voltage is more positive than
plus three volts with respect to Circuit AB (Signal Ground).
During transmission of data, the marking condition shall
be used to denote the binary state ONE (e.g., hole punched
in paper tape), and the spacing condition shall be used
to denote the binary state ZERO. Note that marking is
the normal condition on a data circuit when no signals
are present.

### SUMMARY OF DATA CIRCUIT INTERFACE TERMS

| | | |
|---|---|---|
| Binary state | ONE | ZERO |
| Signal condition | Marking | Spacing |
| Voltage | Negative | Positive |
| Paper tape | Hole | No hole |

The control function shall be considered ON when the volt-
age on the circuit is more positive than plus three volts
with respect to Circuit AB (Signal Ground), and shall be
considered OFF when the voltage on the circuit is more
negative than minus three volts with respect to Circuit AB
(Signal Ground).

### SUMMARY OF CONTROL CIRCUIT INTERFACE TERMS

| | | |
|---|---|---|
| Control function | OFF | ON |
| Voltage | Negative | Positive |

The operation of the circuitry that receives signals
from an interchange circuit shall be dependent only on
the signal voltage, as specified above, and should,
therefore, be insensitive to the rise time, fall time,
presence of signal overshoot, etc. The design of this

circuitry shall minimize the effects of any circuit time
constants which would delay the circuit response, thus
introducing time distortion in the signals.

The terminating impedance at the receiving end of an
interchange circuit shall have a DC resistance of not
less than 3000 ohms or more than 7000 ohms, and the  olt-
age in open-circuited condition shall not exceed two
volts.  The effective shunt capacitance at the receiving
end of a signal interchange circuit, measured at the
interchange point and including any connecting cable,
shall not exceed 2500 picofarads.

The source impedance of the sending end of an interchange
circuit is not specified.

For both data circuits and timing signal circuits (Cir-
cuits BA, BB, DA, DB, DC, and DD), neither the rise time
nor the fall time, through the six volt range in which
the signal condition is not defined, shall exceed three
per cent of the nominal duration of a signal element.
The circuitry used to generate a signal voltage on an
interchange circuit shall meet this specification with
any receiving termination which complies with the pre-
ceding section.

## 7.0  PARALLEL INTERFACE CONTROLLER

The DELTA 1 can be provided with a parallel interface controller which permits connection of a number of different types of parallel devices (mini computers) to the DELTA 1.  It provides a means of receiving input data, sending output data, interpreting a device address, and generating an interrupt address all on separate lines.  It is organized to permit all of these functions to be separate or "or'd" together to permit the controller to accept and transmit data directly from the party line of a peripheral computer.

The data, address, and control signals are designed to have the characteristics of the DELTA 1 controller party line.  Figures 7.1 and 7.2 describe the word parallel, character serial communications flow.

## 7.1  PARALLEL CONTROLLER I/O BUS

The parallel controller I/O cable consists of a number of lines grouped according to function.

Data Bus

DILOXN -- Input Data Lines.  These lines are used to transfer data from a peripheral to the DELTA 1.  These lines can be jumpered to the DOLOXN lines if the peripheral has a party line data bus.  They may also be connected to the ADROXN and/or interrupt address data on its party line data bus. DILO0N is parity, DILO1N and DILO7N is MSB.

DOLOXN -- Output Data Lines.  These lines are used to transfer data from the DELTA 1 to the peripheral.  (x = 0 to 7 where 0 is parity, 1 is LSB and 7 is MSB)

Address Bus

ADROXN -- Device address.  These lines are interrogated by the parallel controller (a specific code) at the time an ADRSYN signal is available.

IADROXN - Interrupt address.  These lines are transmitted to the peripheral (a specific code) when an IUACKN is true.

## Control Bus

INCKN --- Input Clock.  This signal causes the data
on the DILOXN to be transferred to the
controller.

OUTCKN -- Output Clock.  This signal causes the data
on the DELTA 1 party line to be transferred
to the DOLOXN lines.

ADRSYN -- Address sync clock.  This signal causes the
contents of the ADROXN lines to be interro-
gated for a specific code.

INST ---- Input Strobe.  This signal is "and" ed with
the INCKN and OUTCKN to permit synchroniz-
ation fo data transfers.

IURN ---- Interrupt request.  This signal is trans-
mitted by the controller upon operator
action and causes the generation of an
INTEN if the INTKN is not true.

IUACKN -- Interrupt acknowledge.  This signal is
received by the controller when the peri-
pheral has responded to an interrupt.

IARN ---- Interrupt address request.  This signal
is received by the controller and causes
the wire selected interrupt address to
appear on the IADROXN lines.

Since the use of this parallel interface controller will
cover many peripherals, it is suggested that to obtain
a specific interface for a peripheral the user contact
a DELTA sales engineer.

# DELTA 1 USASCII CODE

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| b4 | b3 | b2 | b1 | COL / ROW | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b7 | | | | | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| b6 | | | | | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| b5 | | | | | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 0 | 0 | 0 | 0 | 0 | NUL | DCO | | 0 | @ | P | @ | P |
| 0 | 0 | 0 | 1 | 1 | SOH | | ! | 1 | A | Q | A | Q |
| 0 | 0 | 1 | 0 | 2 | STX | SET BLINK | " | 2 | B | R | B | R |
| 0 | 0 | 1 | 1 | 3 | ETX | CLEAR BLINK | # | 3 | C | S | C | S |
| 0 | 1 | 0 | 0 | 4 | EOT | | $ | 4 | D | T | D | T |
| 0 | 1 | 0 | 1 | 5 | | NAK | % | 5 | E | U | E | U |
| 0 | 1 | 1 | 0 | 6 | ACK | CURSOR UP ↑ | & | 6 | F | V | F | V |
| 0 | 1 | 1 | 1 | 7 | | CURSOR DOWN ↓ | ' | 7 | G | W | G | W |
| 1 | 0 | 0 | 0 | 8 | CURSOR BS | NORMAL MODE | ( | 8 | H | X | H | X |
| 1 | 0 | 0 | 1 | 9 | TAB | FORMAT MODE | ) | 9 | I | Y | I | Y |
| 1 | 0 | 1 | 0 | 10 | CR/(LF) | | * | : | J | Z | J | Z |
| 1 | 0 | 1 | 1 | 11 | | CURSOR HOME | + | ; | K | [ | K | [ |
| 1 | 1 | 0 | 0 | 12 | | CURSOR RIGHT → | , | < | L | \ | L | \ |
| 1 | 1 | 0 | 1 | 13 | (CR) | CURSOR LEFT ← | - | = | M | ] | M | ] |
| 1 | 1 | 1 | 0 | 14 | SO | A/N | . | > | N | EOM ↑ | N | EOM ↑ |
| 1 | 1 | 1 | 1 | 15 | SI | GR | / | ? | O | NEW LINE ← | O | NEW LINE ← |

( ) with Teletype Keyboard

FIGURE 3
DELTA I SYSTEM CONFIGURATION
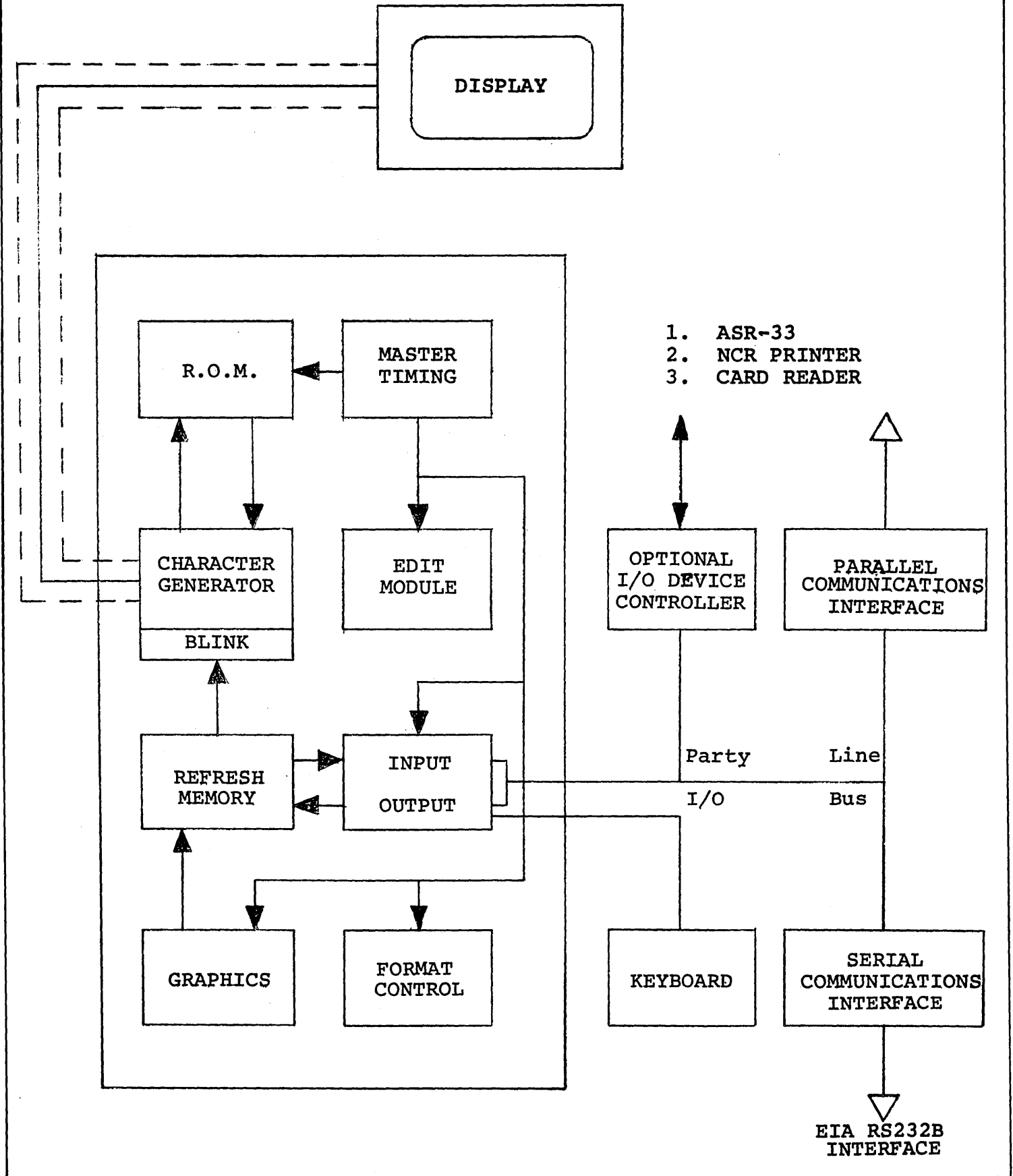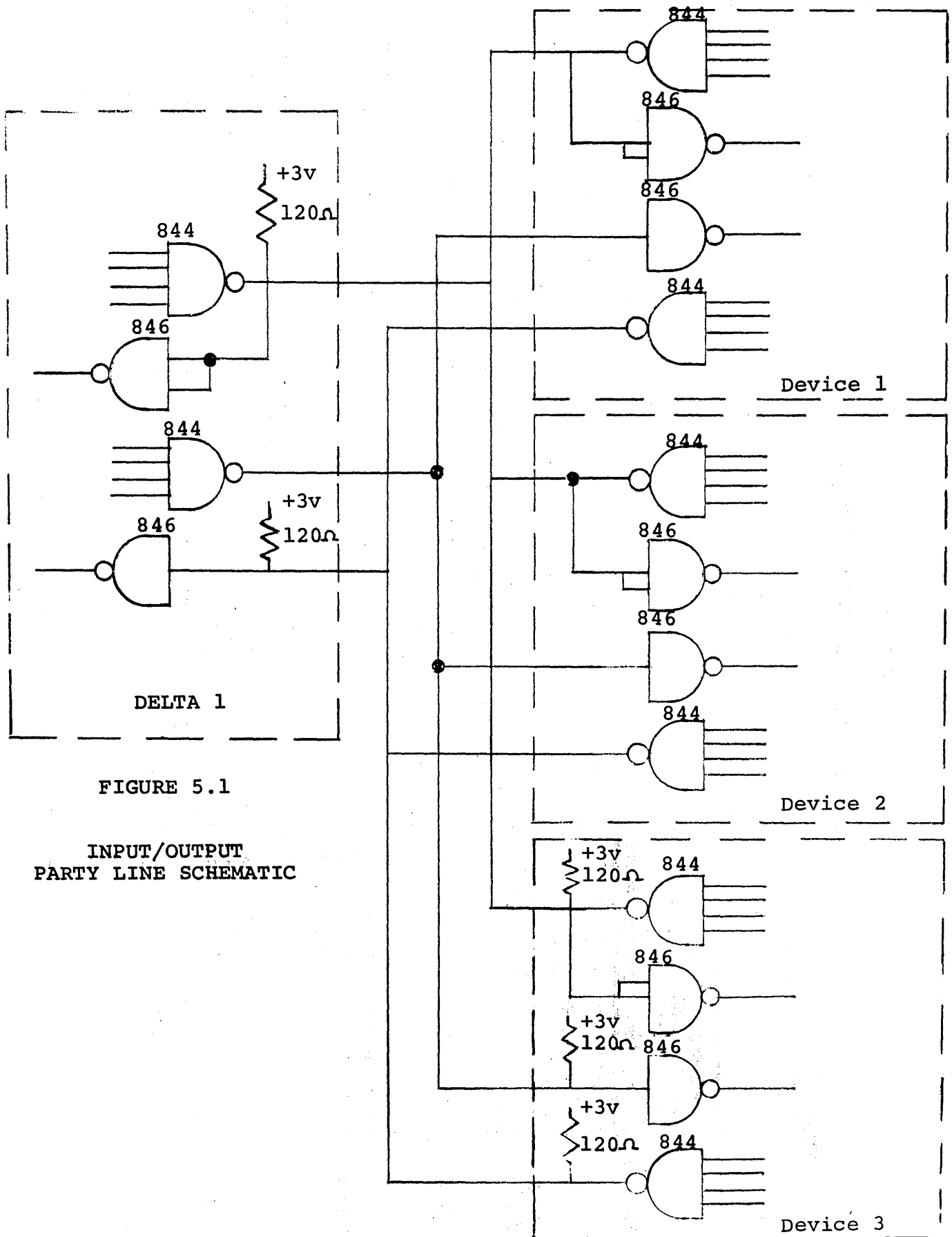
FIGURE 5.1

INPUT/OUTPUT
PARTY LINE SCHEMATIC

# FIGURE 5.2

## PARTY LINE DATA INPUT TIMING



**INCKIN** — 250 nsec

**COMEN (XMITEN)**

**CKRN** — 250 nsec

**SENDEN** — .600 nsec

**DATAVLN**

**DATA BUS**
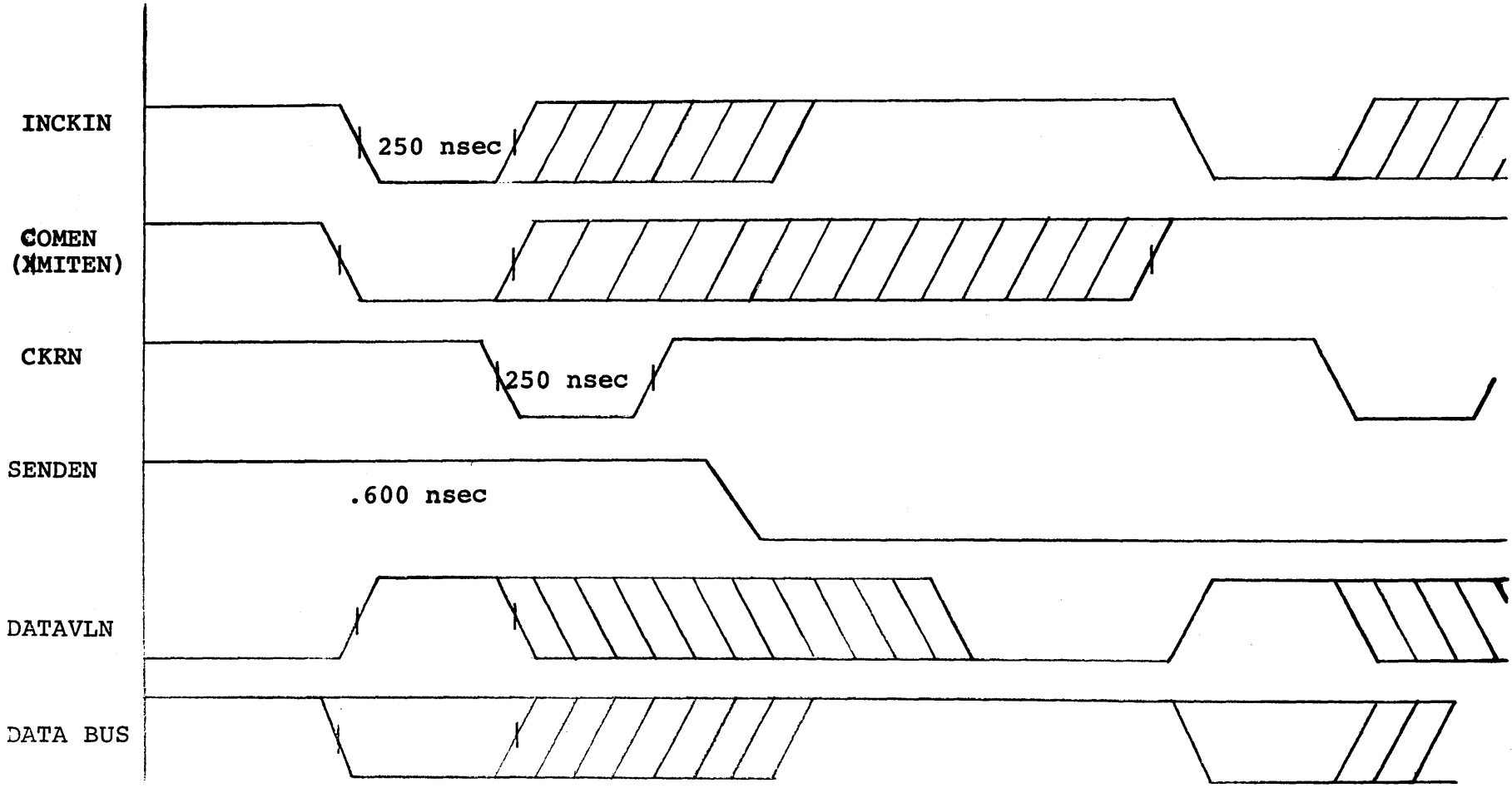
NOTE: See figure 5.4 for proper relationship of **sequential clock signals**

# FIGURE 5.3

## PARTY LINE OUTPUT TIMING



INCKOTN

4 usec max

250 nsec

CKRN

250 nsec

DATA BUS

DATAVLN

63.5 usec max

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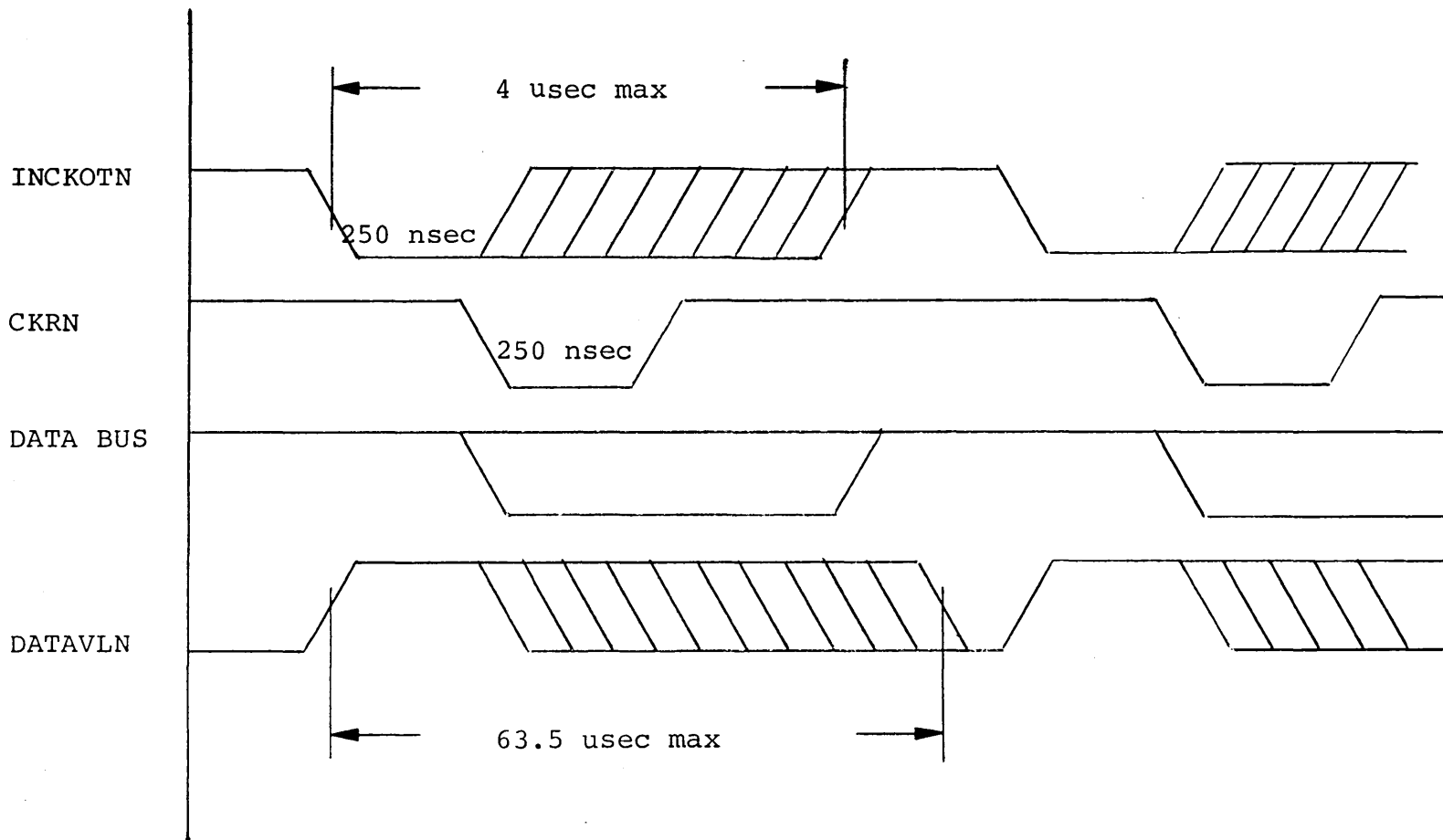
# FIGURE 5.4
## PARTY LINE TIMING



OUTPUT CLOCK (INCTOTN) ODS

INPUT CLOCK (INCKIN) IDS

COMMAND ENABLE (COMEN)

CLOCK RESPONSE (CKRN)

SEND / RECEIVE (SENCEN) S

R

DATA AVAILABLE (DATAVLN)

DATA BUSS

INTERRUPT RESET (INTRN)

250 n SEC.

COMMAND EXEC TIME

250 n SEC.

63.5 μ SEC. MAX.    63.5 μ SEC. MAX.

COMM (WRITE) (IN)    ACK (OUT)    STX (IN)    TEXT (IN)    TEXT (REPEAT) N TIMES    ETX (IN)    LRCC (IN)    ACK (OUT)    EOT I

### RECEIVE DATA SEQUENCE

OUTPUT CLOCK (INCKOTN)

INPUT CLOCK (INCKIN)

COMMAND ENABLE (COMEN)

CLOCK RESPONSE (CKRN)

SEND RECEIVE (SENDEN) S    R

250 n SEC

DATA AVAILABLE (DATA VL)

DATA BUSS

250 n SEC.

INTERRUPT RESPONSE (INTRN)

COMM (READ) OUT    STX OUT (ODS)    ADR OUT    63.5 μ SEC. MAX.    TEXT I OUT    63.5 μ SEC. MAX.    TEXT LAST OUT    ETX OUT    LRC OUT    ACK IN    EOT OUT I

XMIT ENABLE (XMITEN)

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FIGURE 5.5

SEQUENTIAL PRIORITY INTERRUPT SCHEMATIC DIAGRAM
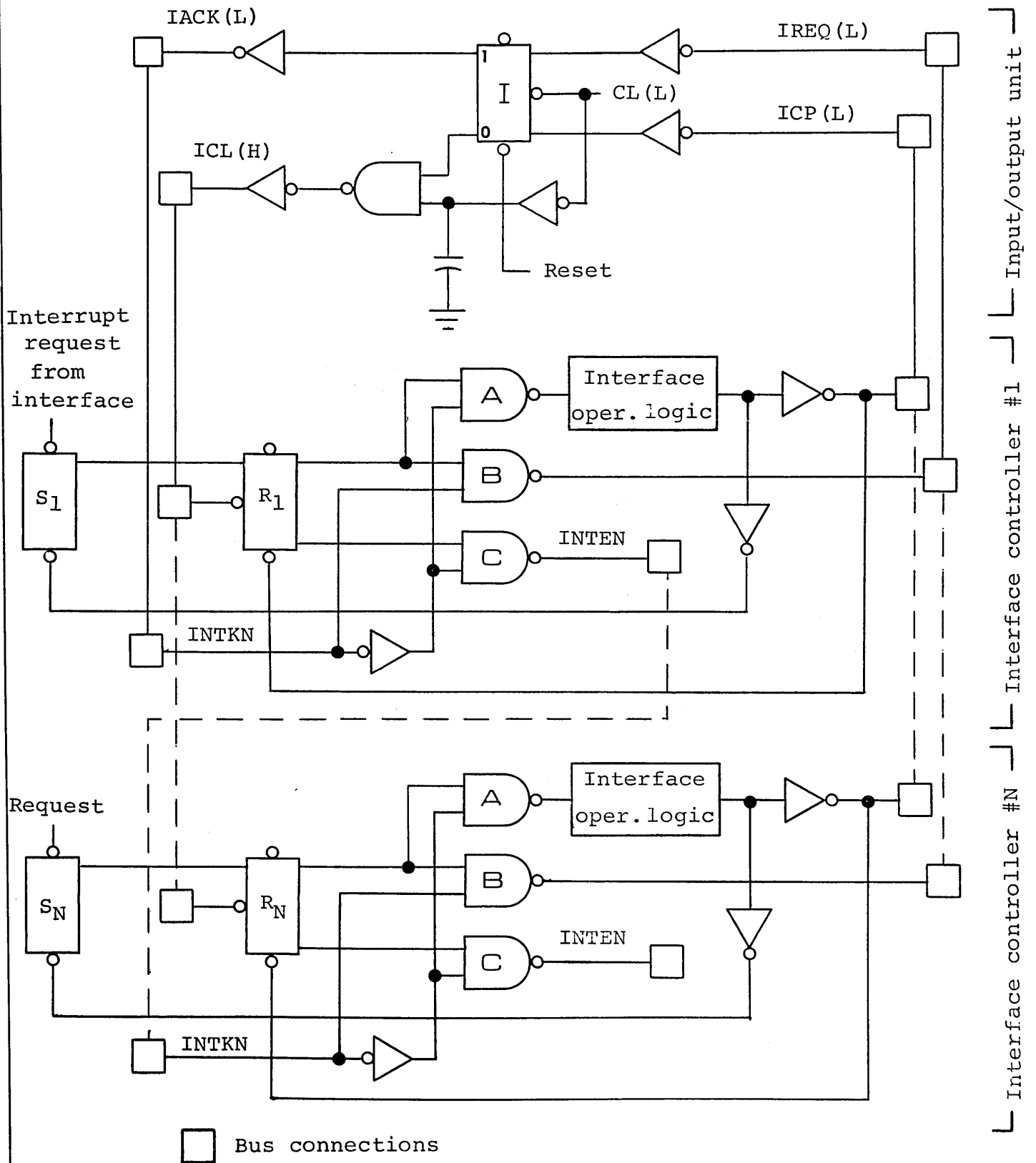
FIGURE 6.1

SEQUENCE/RESPONSE DIAGRAM FOR TRANSMIT DATA COMMANDS FROM THE COMPUTER

TERMINAL IS IN THE
TRANSMIT MODE

EOT
TERMINAL ADDRESS (TA-1)
TERMINAL ADDRESS (TA-2)
COMMAND                                    YES                          NO

                                                    STX                          EOT
                                                    TA-2

                                                    TEXT

TRANSMISSION ERROR?                                 ETX
                                                    LRC
NO                YES

ACK               NAK

                                    EOT

            COMPUTER                    TERMINAL
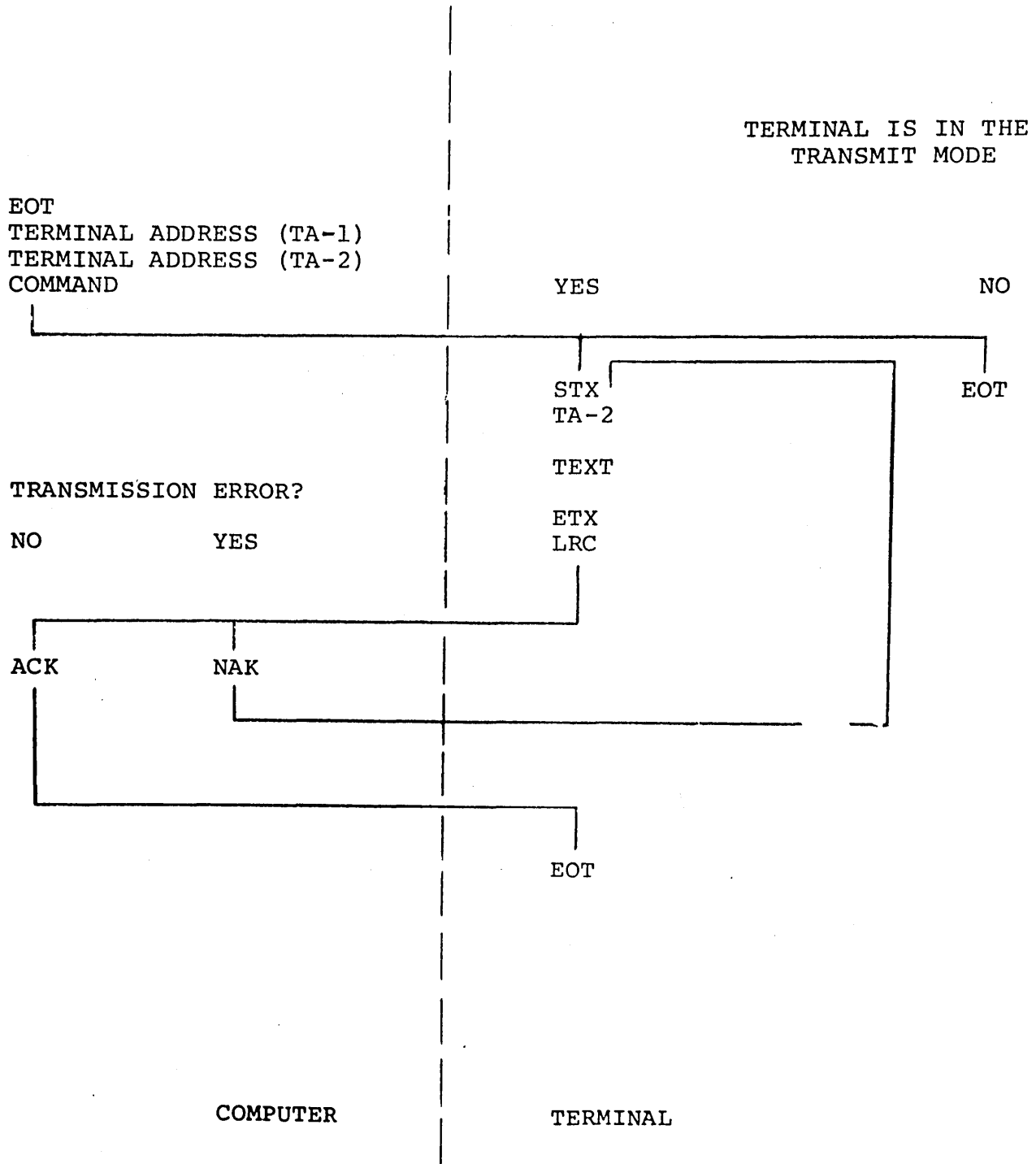
FIGURE 6.2

SEQUENCE/RESPONSE DIAGRAM FOR ENTER DATA COMMANDS FROM THE COMPUTER

SOH
TERMINAL ADDRESS (TA-1)
TERMINAL ADDRESS (TA-2)
COMMAND

ACK

STX
ADDRESS *

TEXT

ETX
LRC

ACK

EOT

* **Where applicable**

COMPUTER                    TERMINAL
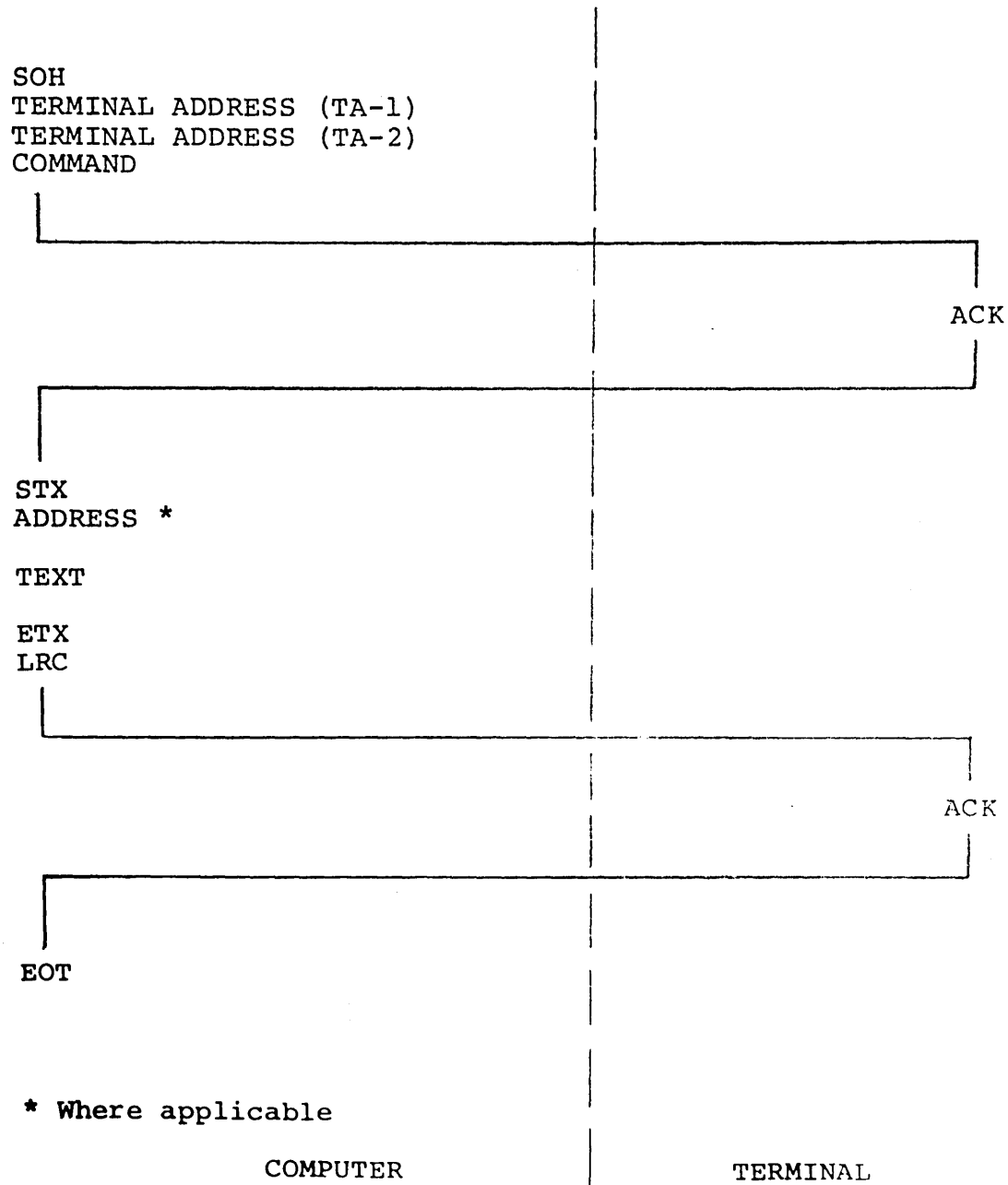
FIGURE 7.1

SEQUENCE/RESPONSE DIAGRAM FOR TRANSMIT DATA COMMANDS FROM THE COMPUTER
VIA A PARALLEL INTERFACE

TERMINAL IS IN THE
TRANSMIT MODE

COMMAND                              YES                          NO

                                     STX                          EOT
                                     TA-2

                                     TEXT

                                     ETX
TRANS ERROR                          LRC

NO        YES

ACK          NAK

                                     EOT

COMPUTER                              TERMINAL
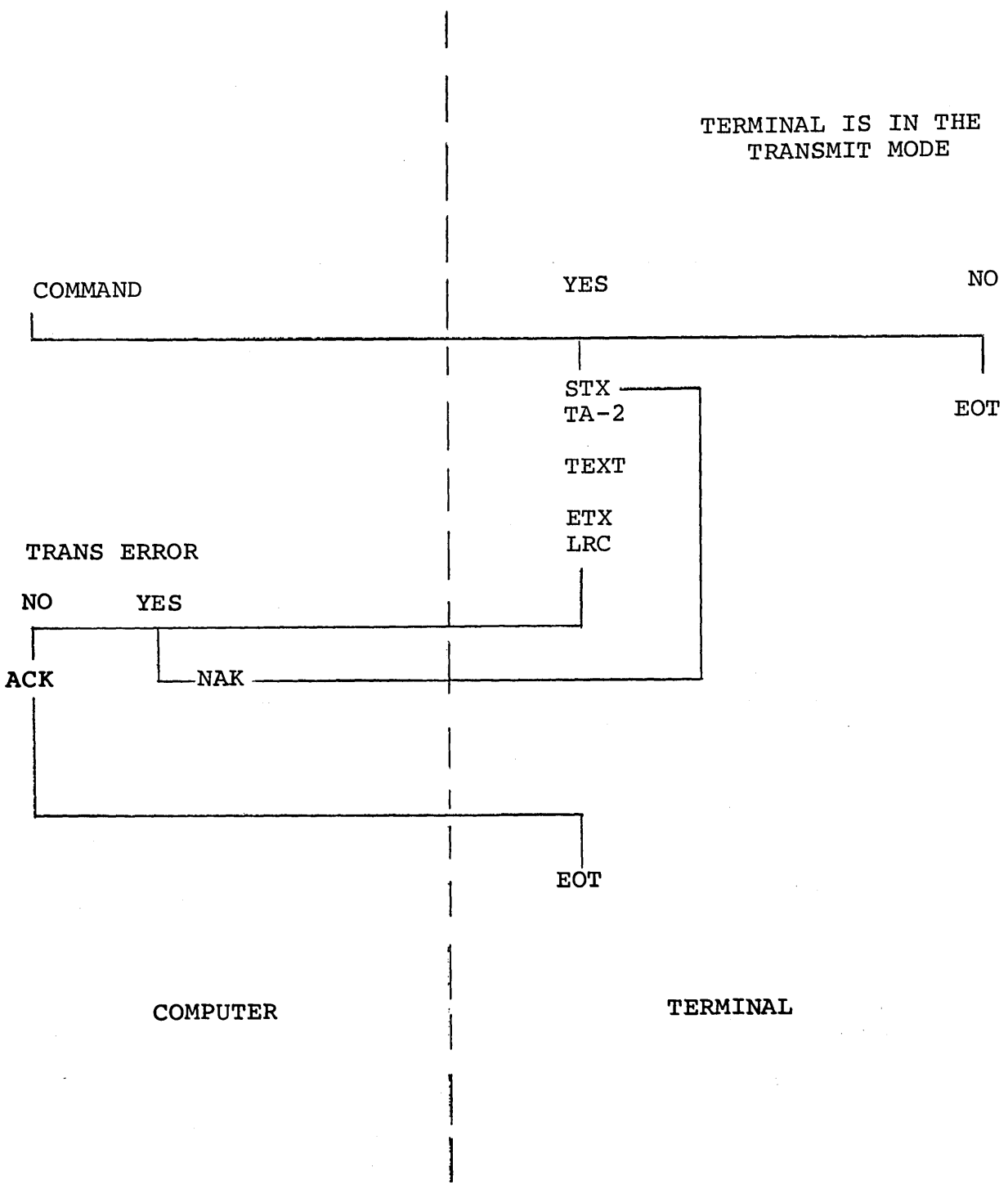
FIGURE 7.2


SEQUENCE/RESPONSE DIAGRAM FOR ENTER DATA COMMANDS FROM THE COMPUTER
VIA A PARALLEL INTERFACE


COMMAND




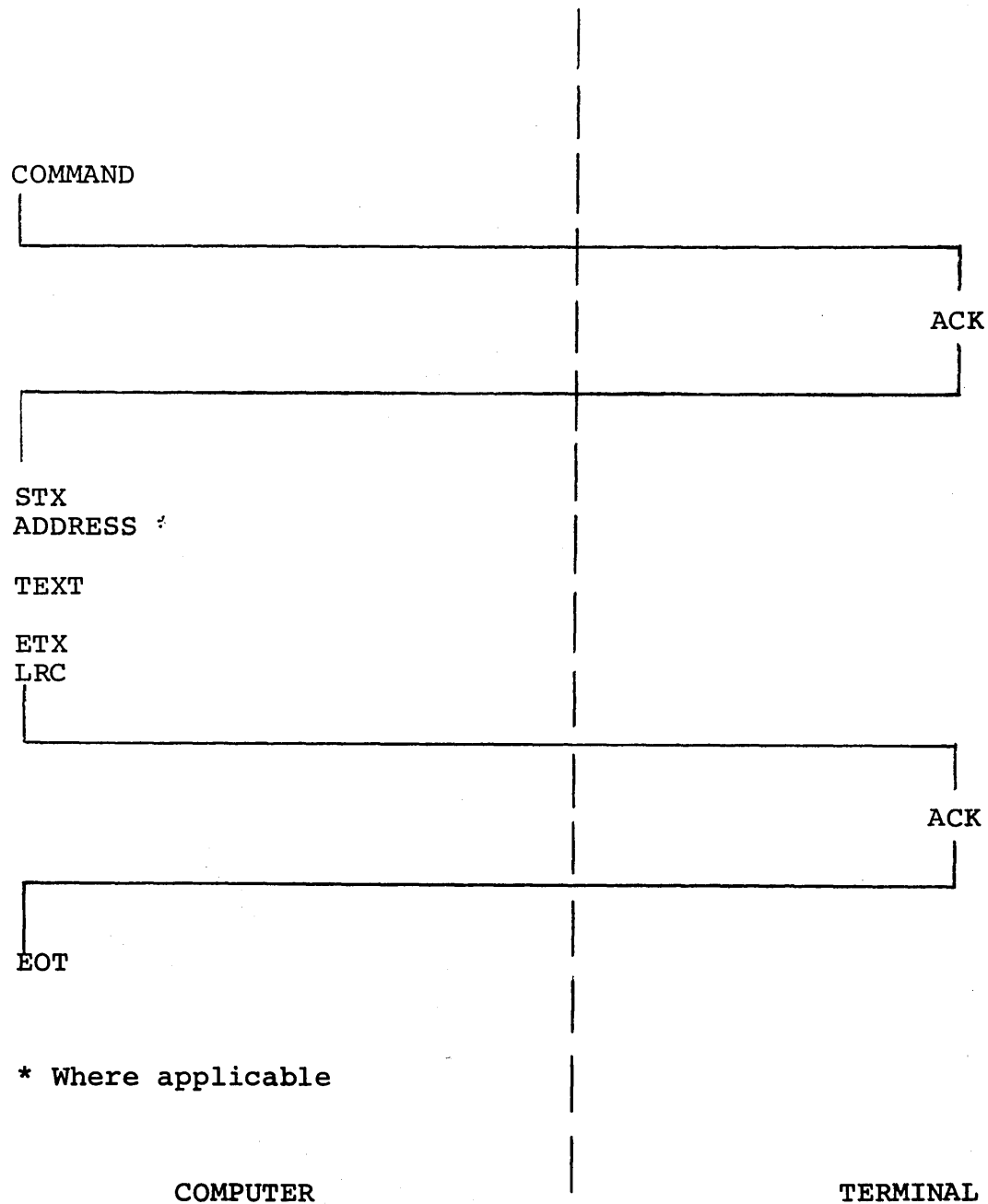                                                                ACK



STX
ADDRESS *

TEXT

ETX
LRC




                                                                ACK



EOT



* Where applicable



               COMPUTER                              TERMINAL

FIGURE 8

| BITS 7654321 | DELTA 1 CONTROL CODES |
|---|---|
| 0000000 | NUL Control Character |
| 0000001 | SOH Control Character |
| 0000010 | STX Control Character |
| 0000011 | ETX Control Character |
| 0000100 | EOT Control Character |
| 0000101 | |
| 0000110 | ACK Control Character |
| 0000111 | |
| 0001000 | BS |
| 0001001 | TAB |
| 0001010 | RETURN |
| 0001011 | |
| 0001100 | |
| 0001101 | |
| 0001110 | SO DISPEN |
| 0001111 | SI DISPDN |
| 0010000 | DCO |
| 0010001 | |
| 0010010 | SET BLINK |
| 0010011 | CLEAR BLINK |
| 0010100 | |
| 0010101 | NAK Control Character |
| 0010110 | CURSOR UP |
| 0010111 | CURSOR DOWN |
| 0011000 | NORMAL MODE |
| 0011001 | FORMAT MODE |
| 0011010 | |
| 0011011 | HOME |
| 0011100 | CURSOR RIGHT |
| 0011101 | CURSOR LEFT |
| 0011110 | A/N |
| 0011111 | GR |
| 0100000 | TRANSMIT MESSAGE COMMAND |
| 0100001 | TRANSMIT LINE COMMAND |
| 0100010 | TRANSMIT X ADDRESS COMMAND |
| 0100011 | TRANSMIT Y ADDRESS COMMAND |
| 0110000 | TRANSMIT DISPLAY COMMAND |
| 1000000 | ENTER COMMAND |
| 1010000 | ENTER Y ADDRESS COMMAND -- RESET X ADDRESS COMMAND |
| 1010001 | ENTER X ADDRESS |
| 1100000 | CLEAR DISPLAY COMMAND |
| 1100001 | CLEAR MESSAGE COMMAND |
| 1100010 | CLEAR LINE COMMAND |
| 1110000 | INSERT COMMAND |
| 1110001 | INSERT LINE COMMAND |
| 1110010 | DELETE COMMAND |
| 1110011 | DELETE LINE COMMAND |

FIGURE 9
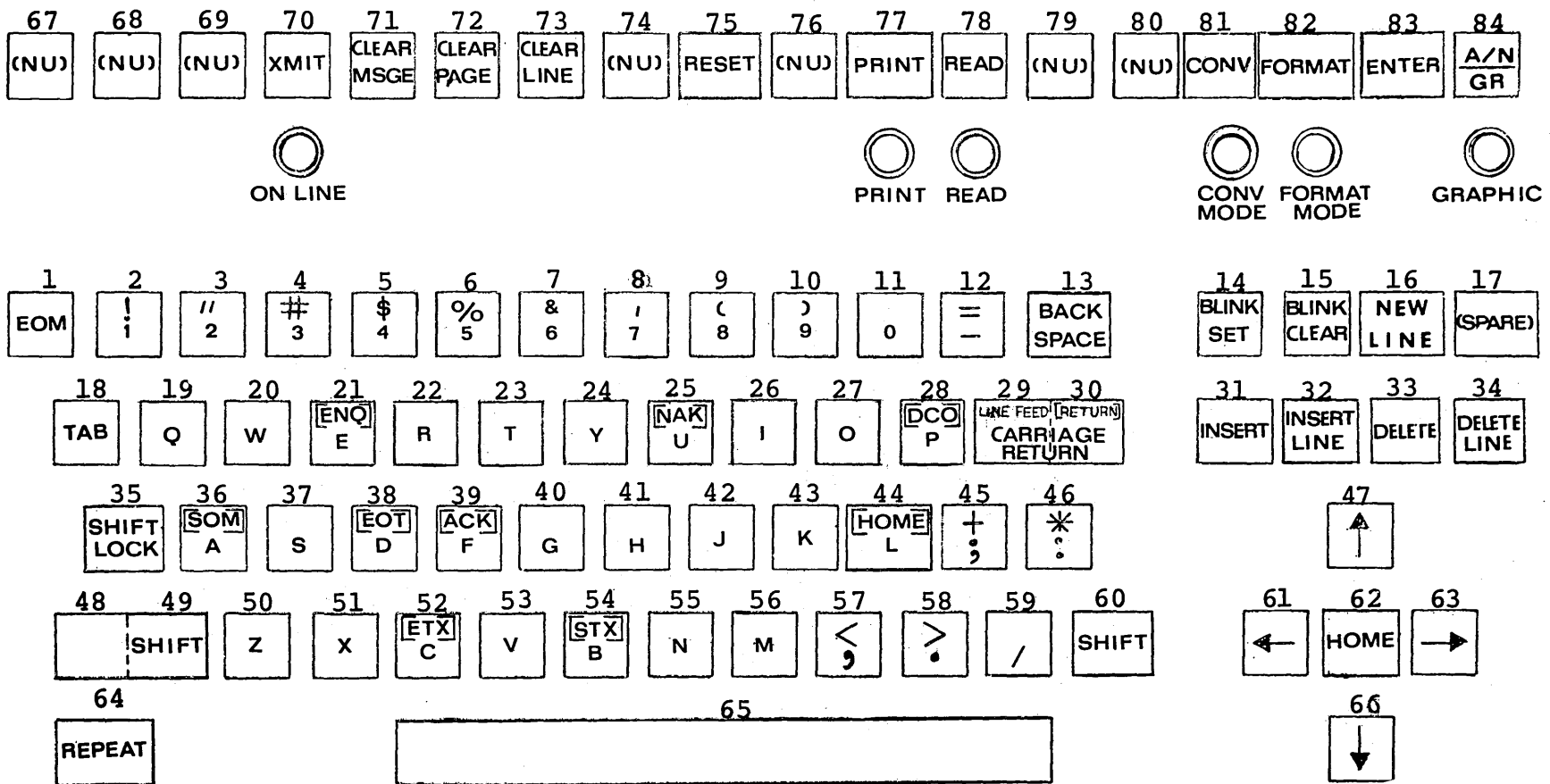
# TABLE 5.1

## PARTY LINE I/O CONNECTOR

| NAME | DESCRIPTION | CONNECTOR | PIN |
|------|-------------|-----------|-----|
| IDIB0N | DATA BIT 0 (parity) | | A |
| IDIB0N-R | RETURN | | L |
| IDIB1N | DATA BIT 1 (LSB) | | B |
| IDIB1N-R | RETURN | | M |
| IDIB2N | DATA BIT 2 | | C |
| IDIB2N-R | RETURN | | N |
| IDIB3N | DATA BIT 3 | | D |
| IDIB3N-R | RETURN | | P |
| IDIB4N | DATA BIT 4 | | E |
| TDIB4N-R | RETURN | | R |
| IDIB5N | DATA BIT 5 | | F |
| IDIB5N-R | RETURN | | S |
| IDIB6N | DATA BIT 6 | | H |
| IDIB6N-R | RETURN | | T |
| IDIB7N | DATA BIT 7 (MSB) | | J |
| IDIB7N-R | RETURN | | U |
| VRCERN | ERROR | | K |
| VRCERN-R | RETURN | | V |
| INCKIN | INPUT CLOCK | | W |
| INCKIN-R | RETURN | | a |
| INCKOTN | OUTPUT CLOCK | | X |
| INCKOTN-R | RETURN | | b |
| DATAVLN | DATA AVAILABLE | | Y |
| DATAVLN-R | RETURN | | c |
| INTRN | INTERRUPT RESET | | Z |
| INTRN-R | RETURN | | d |
| CKRN | CLOCK RESPONSE | | e |
| CKRN-R | RETURN | | h |
| XMITEN | XMIT ENABLE | | f |
| XMITEN-R | RETURN | | j |
| COMEN | COMMAND ENABLE | | k |
| COMEN-R | RETURN | | p |
| RESETN | RESET | | l |
| RESETN-R | RETURN | | r |

TABLE 5.1 (CONT.)

## PARTY LINE I/O CONNECTOR

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| NAME | DESCRIPTION | CONNECTOR | PIN |
|------|-------------|-----------|-----|
| XMITSWN | XMIT SWITCH | | m |
| XMITSWN-R | RETURN | | s |
| PRINTSWN | PRINT SWITCH | | DD |
| PRINTSWN-R | RETURN | | t |
| READSWN | READ SWITCH | | n |
| READSWN-R | RETURN | | u |
| SENDEN | SEND/RECEIVE | | EE |
| SENDEN-R | RETURN | | V |
| VCCPL | +5 VOLTS | | HH |
| GNDPL | 0 VOLTS POWER RETURN | | JJ |

TABLE 7.1

PARALLEL INTERFACE CONNECTOR

| NAME | DESCRIPTION | CONNECTOR | PIN |
|------|-------------|-----------|-----|
| DILO0N | DATA INPUT BIT 0 (parity) | PI1 | A |
| DILO0N-R | RETURN | PI1 | L |
| DILO1N | DATA INPUT BIT 1 (LSB) | PI1 | B |
| DILO1N-R | RETURN | PI1 | M |
| DILO2N | DATA INPUT BIT 2 | PI1 | C |
| DILO2N-R | RETURN | PI1 | N |
| DILO3N | DATA INPUT BIT 3 | PI1 | D |
| DILO3N-R | RETURN | PI1 | P |
| DILO4N | DATA INPUT BIT 4 | PI1 | E |
| DILO4N-R | RETURN | PI1 | R |
| DILO5N | DATA INPUT BIT 5 | PI1 | F |
| DILO5N-R | RETURN | PI1 | S |
| DILO6N | DATA INPUT BIT 6 | PI1 | H |
| DILO6N-R | RETURN | PI1 | T |
| DILO7N | DATA INPUT BIT 7 | PI1 | J |
| DILO7N-R | RETURN | PI1 | U |
| DOLO0N | DATA OUTPUT BIT 0 (parity) | PI1 | K |
| DOLO0N-R | RETURN | PI1 | V |
| DOLO1N | DATA OUTPUT BIT 1 (LSB) | PI1 | W |
| DOLO1N-R | RETURN | PI1 | a |
| DOLO2N | DATA OUTPUT BIT 2 | PI1 | X |
| DOLO2N-R | RETURN | PI1 | b |
| DOLO3N | DATA OUTPUT BIT 3 | PI1 | Y |
| DOLO3N-R | RETURN | PI1 | c |
| DOLO4N | DATA OUTPUT BIT 4 | PI1 | Z |
| DOLO4N-R | RETURN | PI1 | d |
| DOLO5N | DATA OUTPUT BIT 5 | PI1 | e |
| DOLO5N-R | RETURN | PI1 | h |
| DOLO6N | DATA OUTPUT BIT 6 | PI1 | f |
| DOLO6N-R | RETURN | PI1 | j |
| DOLO7N | DATA OUTPUT BIT 7 (MSB) | PI1 | k |
| DOLO7N-R | RETURN | PI1 | p |
| INCKN | INPUT CLOCK | PI1 | l |
| INCKN-R | RETURN | PI1 | r |

TABLE 7.1 (CONT.)

PARALLEL INTERFACE CONNECTOR

| NAME | DESCRIPTION | CONNECTOR | PIN |
|------|-------------|-----------|-----|
| OUTCKN | OUTPUT CLOCK | PI1 | m |
| OUTCKN-R | RETURN | PI1 | s |
| DATAVLN | DATA AVAILABLE SENSE LINE | PI1 | DD |
| DATAVLN-R | RETURN | PI1 | u |
| INST | INPUT STROBE | PI1 | n |
| INST-R | RETURN | PI1 | t |
| VCCPI | +5 VOLTS | PI1 | HH |
| GNDPI | GROUND | PI1 | JJ |

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TABLE 7.1 (CONT.)

PARALLEL INTERFACE CONNECTOR

| NAME | DESCRIPTION | CONNECTOR | PIN |
|------|-------------|-----------|-----|
| ADRO0N | ADDRESS DATA BIT 0 (LSB) | PI2 | A |
| ADRO0N-R | RETURN | PI2 | L |
| ADRO1N | ADDRESS DATA BIT 1 | PI2 | B |
| ADRO1N-R | RETURN | PI2 | M |
| ADRO2N | ADDRESS DATA BIT 2 | PI2 | C |
| ADRO2N-R | RETURN | PI2 | N |
| ADRO3N | ADDRESS DATA BIT 3 | PI2 | D |
| ADRO3N-R | RETURN | PI2 | P |
| ADRO4N | ADDRESS DATA BIT 4 | PI2 | E |
| ADRO4N-R | RETURN | PI2 | R |
| ADRO5N | ADDRESS DATA BIT 5 | PI2 | F |
| ADRO5N-R | RETURN | PI2 | S |
| ADRO6N | ADDRESS DATA BIT 6 | PI2 | H |
| ADRO6N-R | RETURN | PI2 | T |
| ADRO7N | ADDRESS DATA BIT 7 | PI2 | J |
| ADRO7N-R | RETURN | PI2 | U |
| IADRO0N | INTERRUPT ADDRESS BIT 0 | PI2 | K |
| IADRO0N-R | RETURN (LSB) | PI2 | V |
| IADRO1N | INTERRUPT ADDRESS BIT 1 | PI2 | W |
| IADRO1N-R | RETURN | PI2 | a |
| IADRO2N | INTERRUPT ADDRESS BIT 2 | PI2 | X |
| IADRO2N-R | RETURN | PI2 | b |
| IADRO3N | INTERRUPT ADDRESS BIT 3 | PI2 | Y |
| IADRO3N-R | RETURN | PI2 | c |
| IADRO4N | INTERRUPT ADDRESS BIT 4 | PI2 | z |
| IADRO4N-R | RETURN | PI2 | d |
| IADRO5N | INTERRUPT ADDRESS BIT 5 | PI2 | e |
| IADRO5N-R | RETURN | PI2 | h |
| IADRO6N | INTERRUPT ADDRESS BIT 6 | PI2 | f |
| IADRO6N-R | RETURN | PI2 | j |
| IADRO7N | INTERRUPT ADDRESS BIT 7 | PI2 | k |
| IADRO7N-R | RETURN | PI2 | p |
| ADRSYN | ADDRESS SYNC CLOCK | PI2 | l |
| ADRSYN-R | RETURN | PI2 | r |

TABLE 7.1 (CONT.)

PARALLEL INTERFACE CONNECTOR

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| NAME | DESCRIPTION | CONNECTOR | PIN |
|------|-------------|-----------|-----|
| IURN | INTERRUPT REQUEST | PI2 | m |
| IURN-R | RETURN | PI2 | s |
| IUACKN | INTERRUPT ACKNOWLEDGE | PI2 | n |
| IUACKN-R | RETURN | PI2 | t |
| IARN | INTERRUPT ADDRESS REQUEST | PI2 | DD |
| IARN-R | RETURN | PI2 | u |
| INTKN | INTERRUPT ENABLE REQUEST | PI2 | EE |
| INTKN-R | RETURN | PI2 | v |
| INTEN | INTERRUPT ENABLE TRANSMIT | PI2 | FF |
| INTEN-R | RETURN | PI2 | w |