# Technical Reference

# DGC DISPLAY 6012

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# SECTION I

# INTRODUCTION

## THE DGC DISPLAY 6012

The DGC display 6012 is an alphanumeric cathode ray tube (CRT) I/O terminal which is used to enter, display, edit, retrieve and update data files.

The terminal is comprised of two major subsystems; a keyboard and a CRT display, both of which operate with seven level serial asynchronous ASCII codes. The keyboard can transmit 98 out of the possible 128 seven-level codes. The display can receive all 128 codes. However, of these, 96 are decoded, stored and plotted as the 64 ASCII ALPHANUMERICS; 14 are decoded and interpreted as control characters; and the remaining 18 are decoded but ignored. All codes which represent alphanumerics are stored in an internal, 1920 character semiconductor memory which refreshes the CRT at the line frequency. The CRT plots the characters corresponding to these codes as 5 by 7 dot matrices. The 12 inch screen has an active area 6 by 9 inches wide which is formatted as a page of 24 lines with 80 characters per line.

The terminal operates in one of two transmission modes, full- or half-duplex, and three switch selectable modes called Page-buffered, Page, and Roll. Page-buffered mode allows an entire page of data to be entered into the terminal's memory, edited off line and then transmitted to the computer in part or in whole. Page mode allows a file to be transmitted to the terminal and any desired changes made simultaneously to both the information stored in the terminal's memory and the corresponding characters stored in the computer's memory. Roll mode simulates a Teletype®.

The figure on page I-3 is an exploded view of the major components of the DGC display. All the control and memory electronics are mounted on one printed circuit board. Two power supplies are mounted inside the chassis: the first provides power to the memory and control electronics while a second independent supply provides the high voltage necessary for the CRT's screen electronics. All connections between the printed circuit board, the keyboard and the display electronics are through convenient, reliable edge connectors.

Internal switches select full- or half-duplex operation, even, odd, or mark parity and the choice of 9 baud rates: 110, 150, 300, 600, 1200, 1800, 2400, 3600, or 4800. When the terminal is operating at 4800 baud, the entire display screen of 1920 characters can be filled in 4 seconds. Either 10-bit or 11-bit codes can be selected; 10-bit codes have seven data bits, a parity bit and one stop bit while 11-bit codes have two stop bits. The code length, parity and baud rates must be compatible with the controller in use.

The controllers normally used with the display are the 4010, 4023, 4026, 4060-4063 and the 4100. The interface between the display and the controller is switch selectable for the 20mA current loop, 60mA current loop or the standard EIA Voltage interface, type RS-232C.

The DGC display 6012 is a tabletop device 13 inches high, 18 1/4 inches wide and 23 3/4 inches deep. Power options are:

1. 6012 — 100-130Vac, single phase 60Hz ±5% @ 1.2A
2. 6012-1 — 100-130Vac, single phase 50Hz ±5% @ 1.2A
3. 6012-2 — 200-269Vac, single phase 50Hz ±5% @ .6A

When ordering specify the appropriate model for the primary line voltage, the controller used and the processor used.

Teletype® is a registered trademark of Teletype Corporation, Skokie, Illinois. All references to teletypes in this manual shall apply to this mark.

| | |
|---|---|
| **PROPERTIES** | |
| Mounting | Tabletop, 13 x 18 1/4 x 23 3/4 inches |
| Weight | 35 pounds |
| Operating Temperature Range | 5° to 45° Centigrade |
| Operating Humidity Range | 10% to 95% non-condensing |
| Power Requirements | 100-130Vac, single phase<br>60Hz ±5%<br>1.2A, 140 watts<br>or<br>100-130Vac, single phase<br>50Hz ±5%<br>1.2A, 140 watts<br>or<br>200-269Vac, single phase<br>50Hz ±5%<br>.6A, 140 watts |
| **SYSTEM CAPACITY** | |
| Number of displays/system | Depends on controller |
| Display Information Capacity | 1920 characters, formatted as 24 lines, 80 characters/line displayed in a 6 by 9 inch area on a 12 inch CRT |
| **CHARACTERISTICS** | |
| Data Transmission Mode | Serial, bit by bit, character by character, lower order bit transmitted first.<br>Full- or half-duplex, user selectable |
| Code Format | ASCII; 10 or 11-bit, user selectable<br>Even, odd, or mark parity user selectable at the terminal |
| Interface | 20mA current loop<br>60mA current loop<br>EIA - RS-232C |
| Keyboard Codes | 98 seven-bit codes plus a parity bit |
| Display Codes | 64 seven-bit codes plus a parity bit which is ignored by the terminal.<br>Letters are upper case only; lower case will be displayed as upper case |
| Character Transfer Rate | User selectable: 110, 150, 300, 600 1200, 1800, 2400, 3600, or 4800 baud limited by controller in use. |
| Screen Fill Time | 4 sec. @ 4800 baud to 3 min. @ 110 baud. |

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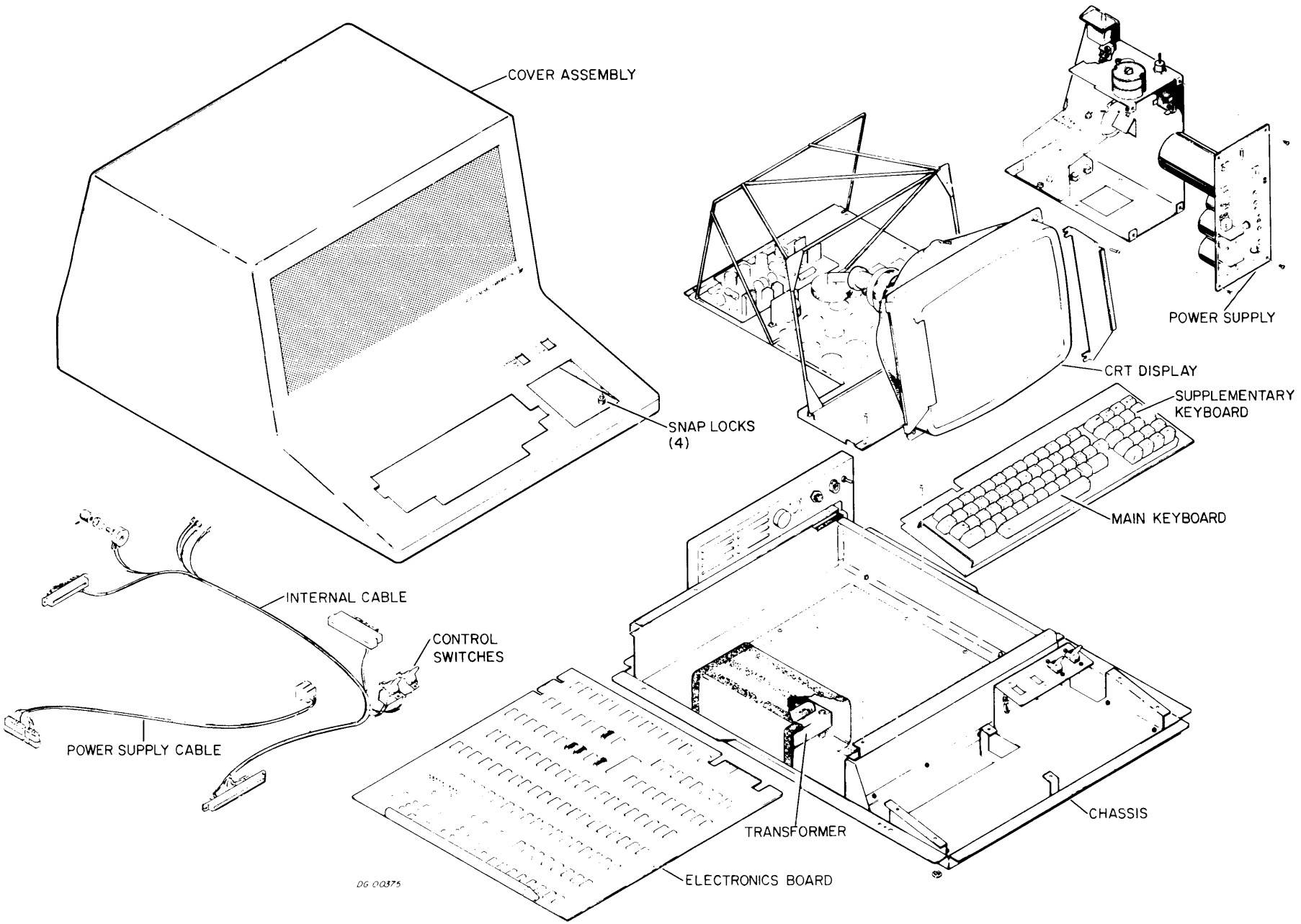
COVER ASSEMBLY
SNAP LOCKS (4)
POWER SUPPLY
CRT DISPLAY
SUPPLEMENTARY KEYBOARD
MAIN KEYBOARD
INTERNAL CABLE
CONTROL SWITCHES
POWER SUPPLY CABLE
TRANSFORMER
CHASSIS
ELECTRONICS BOARD
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# SECTION II

# PRINCIPLES OF OPERATION

## THE TERMINAL

The DGC display 6012 is two separate I/O devices; a console and an alphanumeric CRT display, shown in the figure on the following page. The console is comprised of a standard 53-station Teletype style ASCII keyboard, a supplementary 20-station ASCII keyboard and two switches. The first switch has three positions labeled LOCAL, OFF, and ON LINE. The ON LINE position connects the terminal to the computer. LOCAL, used primarily for testing, puts the terminal off line from the computer and connects the keyboard to the display. OFF removes power from the device. The second switch has three positions labeled BUFFERED, PAGE and ROLL. The position of this switch selects the terminal's operational mode.

The screen is a 12 inch CRT with an active area of 6 by 9 inches, formatted into a twenty-four line by 80 character page. The characters that appear on this screen are from the standard 64 character subset of ASCII, listed in the ASCII Character Codes Plotted by the Display table.

## DATA TRANSMISSION

When a key (or combination of keys) is depressed on the keyboard, a corresponding ASCII code is transmitted to the display and/or the computer. There are 98 possible ASCII codes that can be generated from the keyboard and these codes are classified into three categories; codes which represent commands to the display, listed in the Control Characters table, codes which represent ASCII characters which can be plotted by the display, listed in the ASCII Character Codes Plotted by the Display table and codes which can be used for protocol, listed in the Protocol Characters table.

When a code is received and decoded by the terminal, it responds in one of three ways: if the code represents a control character, listed in the Control Characters table and explained under CONTROL CHARACTERS, the display carries out the associated command; if the code represents a printable character, that character is stored in the terminal's memory and plotted on the screen; if the code does not fall into either of these categories, it is ignored.

When the display receives a code which represents a printable, ASCII character, that character is placed in a memory location in the terminal which is determined by a pointer called the cursor, whose position on the screen is represented by a blinking underscore. After a character is placed in the terminal's memory and displayed, the cursor automatically advances to the next available location.

When the display receives a control character, the associated command is carried out. These manipulate the terminal's memory by moving the cursor, setting protected or blinking areas, clearing areas of the screen and transmitting information from the terminal's memory to the computer. The specific effects of each command are determined by the operational mode of the terminal.

## OPERATIONAL MODES

On line, the terminal operates in three switch-selectable modes called Page-buffered, Page, and Roll. Page-buffered mode allows an entire page of data to be entered into the terminal's memory, edited locally and then transmitted to the computer in part or in whole. In this mode there are six commands for positioning the cursor, and ten additional commands for defining protected and blinking areas, setting tabs, clearing areas of memory, and transmitting characters from memory to the computer.

Page mode allows a file to be transmitted to the terminal and any desired changes made simultaneously to both the information in the terminal's memory, through the terminal hardware, and the corresponding characters stored in the computer's memory, by means of software. The control characters are the same for both Page-buffered and Page modes; the only difference between them is that the keyboard in Page-buffered mode is directly coupled to the display and is off line from the computer until a special transmit key (XMIT) is used, while the keyboard in Page mode is always on line.

Roll mode simulates a Teletype. In this mode there are five control characters for positioning the cursor and three additional control characters for clearing areas of memory and transmitting data. All data is entered into the terminal's memory locations which correspond to the bottom line of the display screen. A line feed causes all lines on the screen to move up one; the bottom line becomes blank and the top line is lost.

Off line, the terminal operates in any mode.

## TRANSMISSION PATHS

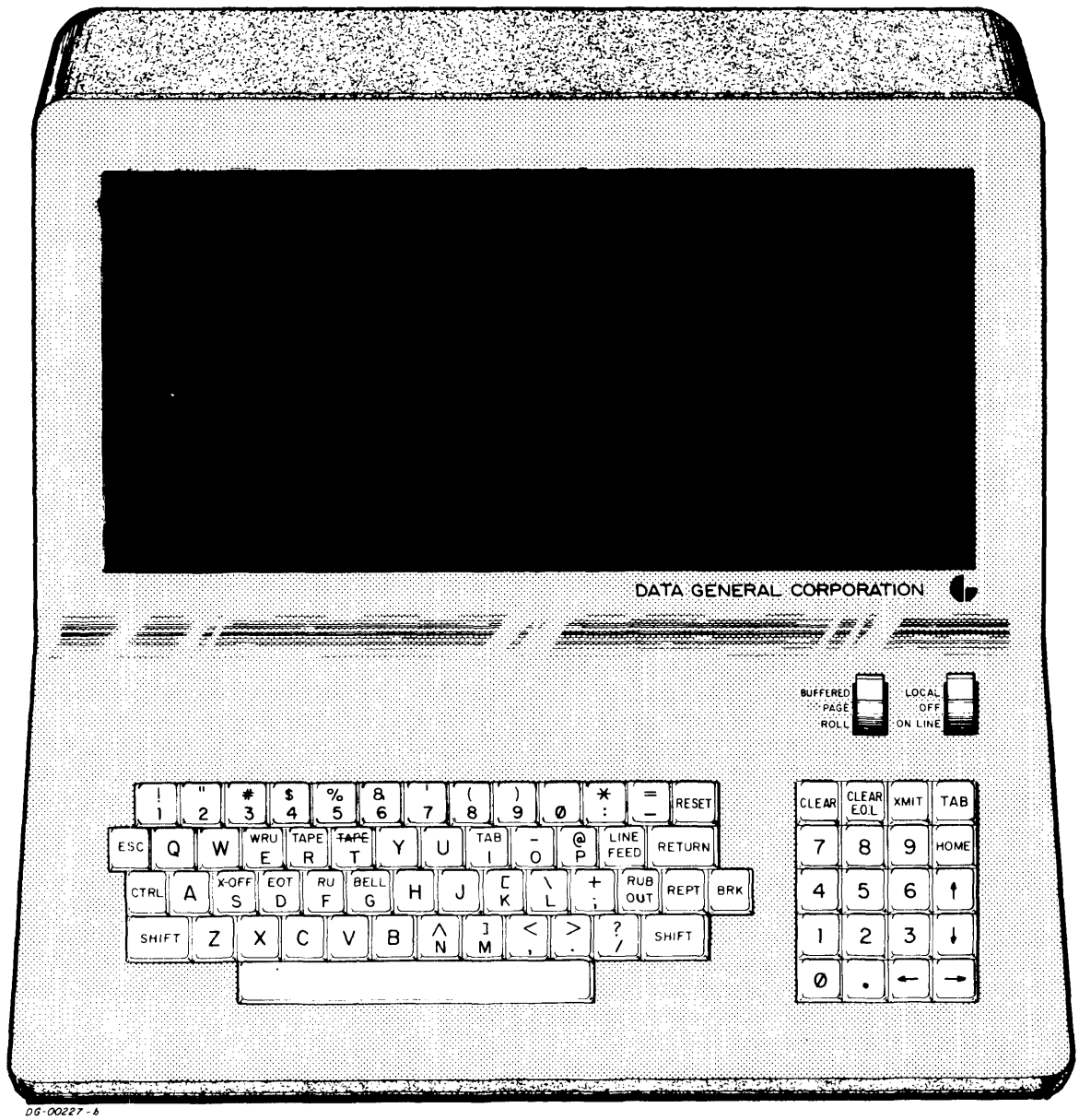
The transmission paths linking the terminal's memory, the keyboard and the computer depend on two variables; the transmission mode of the controller and the operational mode of the terminal.

Page and Roll modes operate in full- or half-duplex. Page-buffered mode operates in full-duplex only.

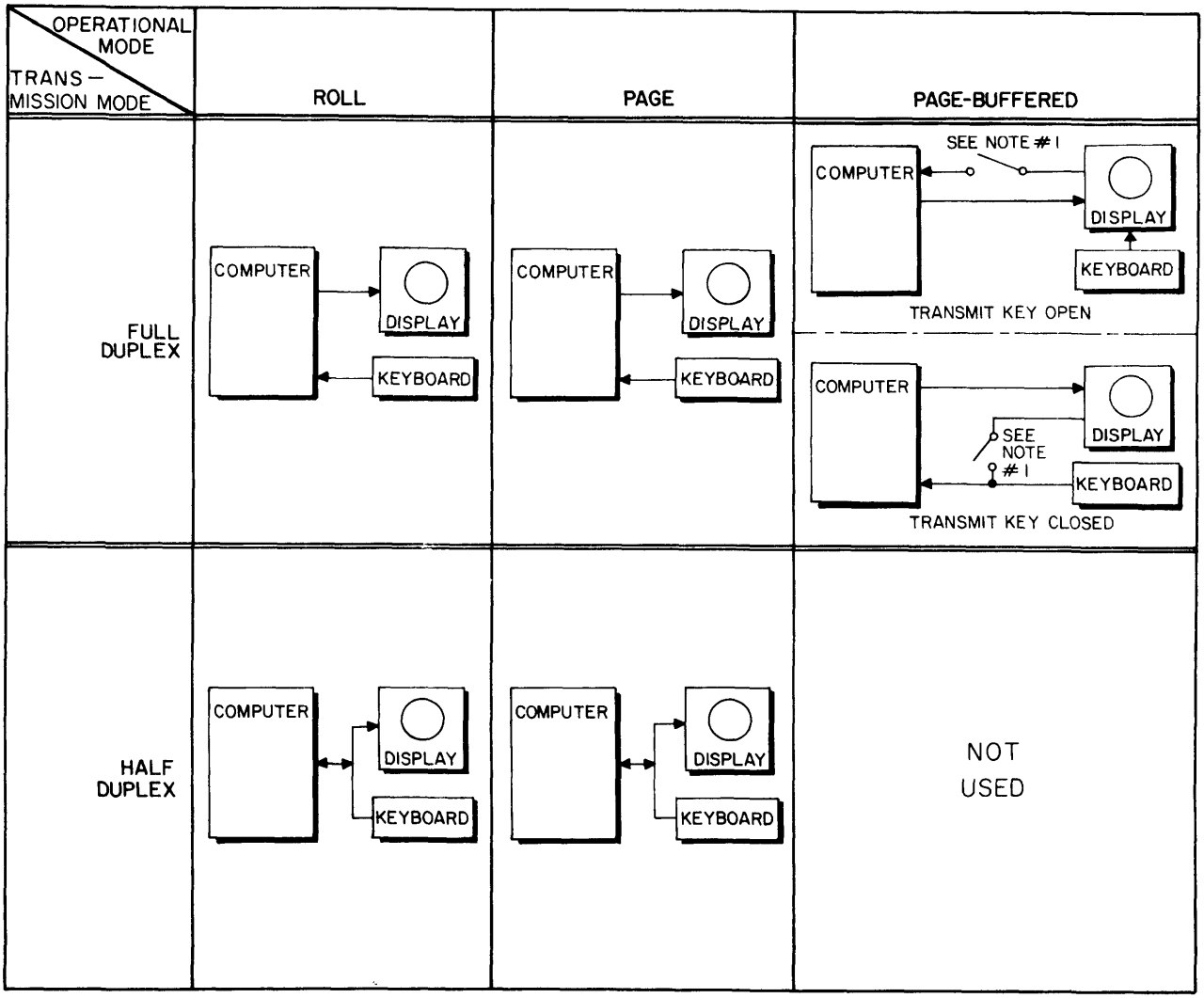
All the possible combinations of the interfacing arrangements are shown in the figure on the following page. In full-duplex, operating in either Roll or Page mode, the keyboard transmits to the computer, and the display receives codes from only the computer. In half-duplex, operating in either Roll or Page mode, the keyboard transmits to both the computer and the display. The display can receive from either the keyboard or the computer.

In full-duplex, Page-buffered mode, the keyboard normally transmits to the display and the display receives from either the keyboard or the computer. However, a special key, XMIT, is provided which allows the keyboard to transmit directly to the computer.

THE DISPLAY TERMINAL



## DGC DISPLAY ON LINE DATA TRANSMISSION PATHS



## ASCII Character Codes Plotted by the Display

| Name | Symbol Display | 7-Bit Octal Code | Key | |
|---|---|---|---|---|
| | | | Main Keyboard | Suppl. Keyboard |
| Space | Non Printing | 040 | Space Bar | - |
| Exclamation Mark | ! | 041 | SH 1 | - |
| Quotation Marks | " | 042 | SH 2 | - |
| Number Sign | # | 043 | SH 3 | - |
| Dollar Sign | $ | 044 | SH 4 | - |
| Percent | % | 045 | SH 5 | - |
| Ampersand | & | 046 | SH 6 | - |
| Apostrophe | ' | 047 | SH 7 | - |
| Opening Parenthesis | ( | 050 | SH 8 | - |
| Closing Parenthesis | ) | 051 | SH 9 | - |
| Asterisk | * | 052 | SH : | - |
| Plus | + | 053 | SH ; | - |
| Comma | , | 054 | , | - |
| Hyphen (Minus) | - | 055 | - | - |
| Period (Decimal Point) | . | 056 | . | - |
| Slant | / | 057 | / | - |
| Zero | 0 | 060 | 0 | 0 |
| One | 1 | 061 | 1 | 1 |
| Two | 2 | 062 | 2 | 2 |
| Three | 3 | 063 | 3 | 3 |
| Four | 4 | 064 | 4 | 4 |
| Five | 5 | 065 | 5 | 5 |
| Six | 6 | 066 | 6 | 6 |
| Seven | 7 | 067 | 7 | 7 |
| Eight | 8 | 070 | 8 | 8 |
| Nine | 9 | 071 | 9 | 9 |
| Colon | : | 072 | : | - |
| Semicolon | ; | 073 | ; | - |
| Less Than | < | 074 | SH , | - |
| Equals | = | 075 | SH - | - |
| Greater Than | > | 076 | SH . | - |
| Question Mark | ? | 077 | SH / | - |
| Commercial At | @ | 100 (140) | SH P | - |
| A | A | 101 (141) | A, SH A | - |
| B | B | 102 (142) | B, SH B | - |
| C | C | 103 (143) | C, SH C | - |
| D | D | 104 (144) | D, SH D | - |
| E | E | 105 (145) | E, SH E | - |
| F | F | 106 (146) | F, SH F | - |
| G | G | 107 (147) | G, SH G | - |
| H | H | 110 (150) | H, SH H | - |
| I | I | 111 (151) | I, SH I | - |
| J | J | 112 (152) | J, SH J | - |
| K | K | 113 (153) | K, | - |
| L | L | 114 (154) | L, | - |
| M | M | 115 (155) | M, | - |
| N | N | 116 (156) | N, | - |
| O | O | 117 (157) | O, | - |
| P | P | 120 (160) | P, | - |
| Q | Q | 121 (161) | Q, SH Q | - |
| R | R | 122 (162) | R, SH R | - |
| S | S | 123 (163) | S, SH S | - |
| T | T | 124 (164) | T, SH T | - |
| U | U | 125 (165) | U, SH U | - |
| V | V | 126 (166) | V, SH V | - |
| W | W | 127 (167) | W, SH W | - |
| X | X | 130 (170) | X, SH X | - |
| Y | Y | 131 (171) | Y, SH Y | - |
| Z | Z | 132 (172) | Z, SH Z | - |
| Opening Bracket | [ | 133 (173) | SH K | - |
| Reverse Slant | \ | 134 (174) | SH L | - |
| Closing Bracket | ] | 135 (175) | SH M | - |
| Circumflex | ^ | 136 (176) | SH N | - |
| Underline | _ | 137 (177) | SH O | - |

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Lower case are displayed as upper case
Bracketed codes are not generated by the Keyboard
but are displayed as their unbracketed equivalents.

Control Characters

| Name | Octal Code | Main Keyboard | Supplementary Keyboard | Function* |
|---|---|---|---|---|
| HOME | 010 | CTRL H | HOME | Moves cursor to first unprotected position on the screen |
| TAB | 011 | CTRL I | TAB | Moves cursor to position following the first unprotected TAB STOP/END protect character to the first unprotected end character |
| LINE FEED | 012 | LINE FEED or CTRL J | ↓ | Moves cursor down one line |
| CLEAR TO END OF LINE | 013 | CTRL K | CLEAR EOL | Erases unprotected data to end of line. Cursor does not move |
| CLEAR | 014 | CTRL L | CLEAR | Clears all unprotected data on screen and moves cursor to first unprotected position on the screen |
| CARRIAGE RETURN | 015 | RETURN or CTRL M | - | Moves cursor to first unprotected position in its line |
| TRANSMIT BUFFER | 016 | CTRL N | - | Transmits the unprotected contents of terminal's memory from cursor position to the end of the page |
| CURSOR UP | 017 | CTRL 0 | C↑ | Moves the cursor up one line |
| CURSOR RIGHT | 030 | CTRL X | C→ | Moves the cursor right one position |
| CURSOR LEFT | 031 | CTRL Y | C← | Moves the cursor left one position |
| FORCE ERASE | 034 | CTRL SHIFT L | - | Erases all protected and unprotected data on the screen |
| TAB STOP/END PROTECT | 035 | CTRL SHIFT M | - | Is both a Tab Stop and the end delimiter of a protect zone |
| START PROTECT | 036 | CTRL SHIFT N | - | Is the starting delimiter of a protected zone |
| BLINK | 037 | CTRL SHIFT O | - | Delimits a blinking zone |

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*NOTE: See Section on COMMANDS for details

Protocol Characters

| Name | Standard Mnemonics | Octal Code | Key | |
|---|---|---|---|---|
| | | | Main Keyboard | Supplementary Keyboard |
| NULL | NUL | 0 | CTRL SH P | - |
| START OF HEADING | SOH | 1 | CTRL A | - |
| START OF TEXT | STX | 2 | CTRL B | - |
| END OF TRANSMISSION | ETX | 3 | CTRL C | - |
| END OF TEXT | EOT | 4 | CTRL D | - |
| ENQUIRY | ENQ | 5 | CTRL E | - |
| ACKNOWLEDGE | ACK | 6 | CTRL F | - |
| RING BELL | BEL | 7 | CTRL G | - |
| DATA LINK ESCAPE | DLE | 20 | CTRL P | - |
| DEVICE CONTROL 1 | DCH1 | 21 | CTRL Q | - |
| DEVICE CONTROL 2 | DC2 | 22 | CTRL R | - |
| DEVICE CONTROL 3 | DC3 | 23 | CTRL S | - |
| DEVICE CONTROL 4 | DC4 | 24 | CTRL T | - |
| NEGATIVE ACKNOWLEDGE | NAK | 25 | CTRL U | - |
| SYNCHRONOUS IDLE | SYN | 26 | CTRL V | - |
| END OF TRANSMISSION BLOCK | ETB | 27 | CTRL W | - |
| BREAK | BRK | Sends Nulls | BREAK | - |

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## CONTROL CHARACTERS

The following list of commands for the DGC display 6012 is formatted as follows:

NAME-CODE (LOCATION) D and/or ND
Functional Description

| | |
|---|---|
| NAME: | Command Name |
| CODE: | Octal command code |
| LOCATION: | Keyboard location |
| D | Destructive to some information on the screen |
| ND | Non-destructive to information on the screen |
| FUNCTION: | Effect of the command |

START PROTECT-36 (CTRL SH N) D

In Page-buffered and Page modes, START PROTECT is displayed as a space and is the delimiter of the beginning of a protected region. The end of the protected region is delimited by the first TAB STOP/END PROTECT character encountered, scanning from left to right and downward on the screen from the START PROTECT character. If any command moves the cursor into a protected region, the cursor will move to the first character position following the TAB STOP/END PROTECT character for that region.

Note that every START PROTECT character should have a companion TAB STOP/END PROTECT character between it and the end of the page or the entire protection mechanism is disabled in the terminal, and all START PROTECT and TAB STOP/END PROTECT characters are displayed as spaces.

In Roll mode, START PROTECT has no effect.

TAB STOP/END PROTECT-35 (CTRL SH M) D

In Page-buffered and Page modes, TAB STOP/END PROTECT is displayed as a space and does one of two things; it is either a tab stop or it is the delimiter of the end of a protected region or both. If it is a tab stop, when a TAB command is issued the cursor moves to the first character position following the first unprotected TAB STOP/END PROTECT character encountered on the screen, scanning from left to right and downward on the page from the cursor position. If it is a delimiter of the end of a protected region, then the beginning of that region must be delimited by a START PROTECT character. If any command moves the cursor into a protected region, the cursor will move to the first character position following the TAB STOP/END PROTECT character for that region.

In Roll mode, TAB STOP/END PROTECT has no effect.

HOME-10 (CTRL H) or (HOME) ND

In Page-buffered and Page modes, HOME moves the cursor to the first position in the top line on the screen. If this position is in a protected region, HOME will move the cursor to the first position following the end protect character for that region. If issued from the processor, HOME will terminate a transmission initiated by a TRANSMIT BUFFER command.

In Roll mode, HOME moves the cursor to the first position in the bottom line of the display screen. If issued from the processor, HOME will terminate a transmission initiated by a TRANSMIT BUFFER command.

CARRIAGE RETURN-15 (CTRL M) ND

In Page-buffered and Page modes, CARRIAGE RETURN moves the cursor to the first character position of the line the cursor occupies. If the first position of the line is in a protected region, the cursor will move to the first position following the TAB STOP/END PROTECT character for that region.

In Roll mode, CARRIAGE RETURN moves the cursor to the first character position in the bottom line.

LINE FEED-12 (CTRL J) or (↓) D ND

In Page-buffered and Page modes, LINE FEED moves the cursor down the screen one line. When the cursor is in the bottom line, LINE FEED has no effect. If a LINE FEED moves the cursor into a protected region, the cursor will move to the first character position following the TAB STOP/END PROTECT character for that region.

In Roll mode, LINE FEED moves all the lines of data on the display screen up one line. The top line on the display screen is lost and the bottom line becomes blank. The cursor remains in its current position in the bottom line.

TAB-11 (CTRL I) or (TAB) ND

In Page-buffered and Page modes, TAB moves the cursor to the position following the TAB STOP/END PROTECT character encountered on the screen, scanning from left to right and downward on the screen. If no TAB STOP/END PROTECT character is found on the screen between the cursor position and the end of the page, the cursor moves to the first character position in the top line. If this position is in a protected region, TAB moves the cursor to the first position following the TAB STOP/END PROTECT character for that region.

In Roll mode, TAB has no effect.

CURSOR UP-17 (CTRL O) or (↑) ND

In Page-buffered and Page modes, CURSOR UP moves the cursor up one line. When the cursor is in the top line of the display screen, CURSOR UP has no effect. If the command CURSOR UP moves the cursor into a protected region, the cursor will move to the first character position following the TAB STOP/END PROTECT character for that region.

In Roll mode, CURSOR UP has no effect.

CURSOR RIGHT-30 (CTRL X) or (→) ND

In Page-buffered and Page modes, CURSOR RIGHT moves the cursor one character position to the right. When the cursor is in the last character position of the line, the cursor will move to the first character position in the next line down the page. When the cursor is in the last character position of the bottom line, CURSOR RIGHT has no effect. If the command CURSOR RIGHT moves the cursor into a protected region, the cursor will move to the first position following the TAB STOP/END PROTECT character for that region.

In Roll mode, CURSOR RIGHT moves the cursor one character position to the right. When the cursor is in the last character position of the bottom line, CURSOR RIGHT has no effect.

CURSOR LEFT-31 (CTRL Y) or (←) ND

In Page-buffered and Page modes, CURSOR LEFT moves the cursor one character position to the left. When the cursor is in the first character position of a line, the cursor will move to the last character position on the line above it. When the cursor is in the first character position of the top line, CURSOR LEFT has no effect. If the command CURSOR LEFT moves the cursor into a protected region, the cursor moves to the first position following the TAB STOP/END PROTECT character for that region.

In Roll mode, CURSOR LEFT moves the cursor one character position to the left. When the cursor is in the first character position of the bottom line, CURSOR LEFT has no effect.

CLEAR TO END OF LINE-13 (CTRL K) D
or (CLEAR EOL)

In Page-buffered and Page modes, CLEAR TO END OF LINE erases all unprotected data from the cursor position to the end of the line, inclusive. The cursor does not change position.

In Roll mode, CLEAR TO END OF LINE erases all data from the cursor position to the end of the line, inclusive. The cursor does not change position.

CLEAR SCREEN-14 (CTRL L) or (CLEAR) D

In Page-buffered and Page modes, CLEAR SCREEN erases all unprotected data on the display screen. The cursor moves to the first character position of the top line. If the first position of the top line is in a protected region, CLEAR SCREEN moves the cursor to the first position following the TAB STOP/END PROTECT character for that region.

In Roll mode, CLEAR SCREEN erases all data on the screen and moves the cursor to the first character position of the bottom line. Data cannot be protected in Roll mode.

FORCE ERASE-34 (CTRL SH L) D

In Page-buffered and Page mode, FORCE ERASE erases all data on the screen, including all protected areas. The cursor moves to the first character position in the first line.

In Roll mode, FORCE ERASE has no effect.

BLINK-37 (CTRL SH O) D

In Page-buffered and Page modes, BLINK causes any character, or characters, between two BLINK characters to flicker on the display screen. If a single BLINK character is entered on the page, all characters from that position to the end of the page will flicker. BLINK characters are displayed as spaces and are transmitted as underscores. The cursor moves one character position to the right.

In Roll mode, BLINK has no effect.

TRANSMIT BUFFER-16 (CTRL N) ND

In all modes, TRANSMIT BUFFER sends to the processor the contents of the terminal's memory, character by character, from the cursor position to the end of the page. Any protected regions encountered will not be transmitted. The data on the display screen will not be disturbed. TRANSMIT BUFFER moves the cursor to the last character position of the last line. If this position is protected, the cursor moves to the first unprotected position on the page. Transmission can be halted at any point by having the program issue a HOME command.

## CONTROL KEYS

XMIT ND

XMIT allows the operator to transmit a message to the processor while the terminal is in Page-buffered mode. The message is sent by holding down the XMIT key while typing characters on the keyboard. If the terminal is operating in full-duplex and the program does not echo the character back to the terminal, the data on the display screen remains undisturbed. If the terminal is operating in half-duplex or if the program echos characters then the message entered will overwrite data on the display screen.

In Page and Roll modes, XMIT has no effect.

BREAK ND

In all modes, while BREAK is depressed, the terminal's transmitter is disabled so that no characters are transmitted from either the keyboard or the memory.

REPEAT ND

The REPEAT key provides the continuous transmission of any code as long as both the REPEAT key and the code's corresponding key(s) are held down together.

SHIFT and CTRL ND

The SHIFT and CTRL keys produce commands or alphanumeric codes when they are depressed together with other keys.

ESC-33 (ESC) (CTRL SHIFT K) ND

In Page and Roll modes, ESC sends code 33, a protocol character. ESC does not work together with REPEAT.

In Page-buffered mode, ESC can be used with the XMIT key.

CTRL RESET D

CTRL RESET clears the entire display memory, initializes the control, and places the cursor in the first position of the bottom line.

# OPERATIONAL CONSIDERATIONS

### Contrast

A contrast control, shown in the figure below, is located on the back of the terminal. Clockwise rotation of this knox decreases the contrast; counterclockwise rotation increases the contrast.

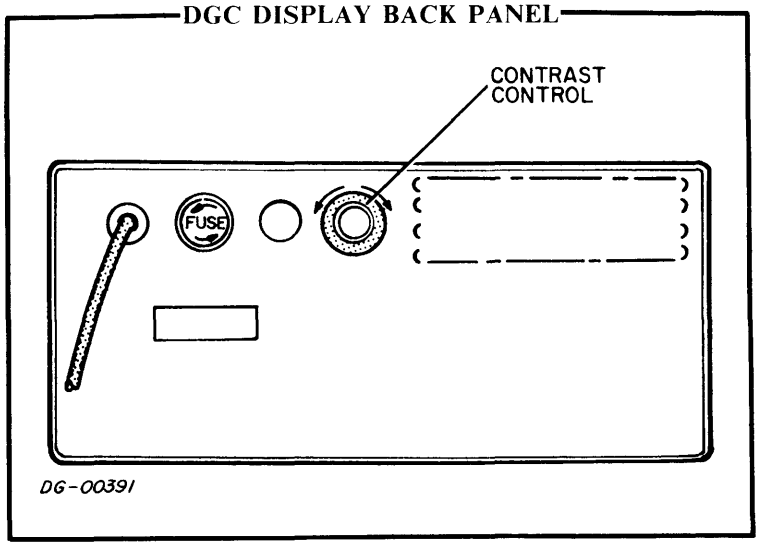
### Changing Operational Modes

The display must be RESET before it is switched from one operational mode to another, to avoid indeterminate states.

### On Line Commands

The command TRANSMIT BUFFER, which is designed to be used primarily in Page-buffered mode, can also be issued when the display is in Page or Roll modes.

The command TAB, which is intended to be used in Page-buffered or Page modes, will nevertheless move the cursor to the first position of the top line in Roll mode. The cursor can be returned to the first position of the last line by issuing a HOME command.



# SECTION III

# INSTALLATION

## GENERAL

Installing the display involves unpacking the equipment, selecting the switches on the display interface board, placing the device, jumpering and installing the controller board, cabling the device to the computer and power source, and running the diagnostic tests.

## UNPACKING THE DGC DISPLAY

The DGC display is enclosed in polyethylene wrap then placed between polyethylene foam end caps. This protective material and its contents is then placed in a cardboard shipping container. The illustration below shows this shipping container and the inspection and unpacking procedure.

### UNPACKING INSTRUCTIONS FOR THE DGC DISPLAY

#### INCOMING INSPECTION PROCEDURES

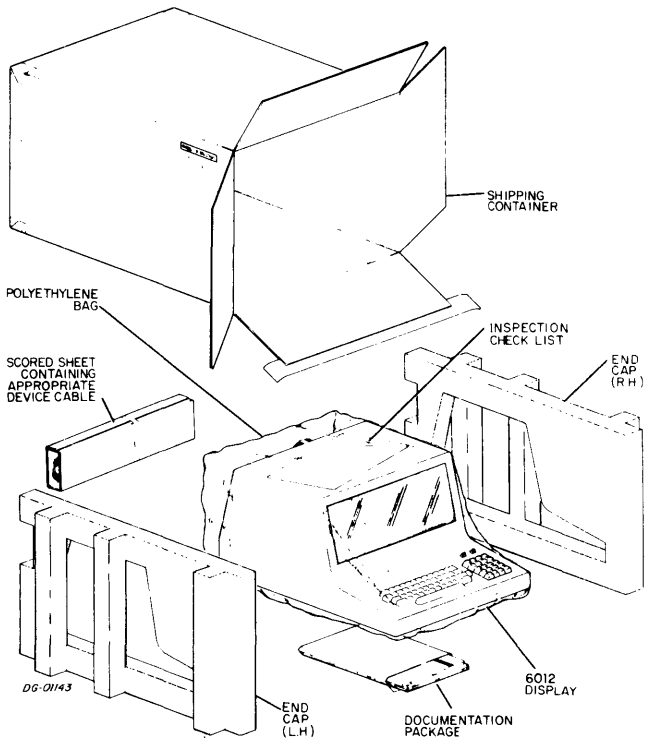
1. Containers should be inspected for any visible signs of damage and reported to DGC and the carrier within 24 hours to validate insurance claims. Damaged cartons should not be unpacked.
2. Shipping containers should not be unpacked if the equipment is to be installed by DGC personnel.
3. Containers should not be dropped or punctured with any sharp objects.
4. Containers and materials should be stored in case any equipment has to be shipped again.

#### UNPACKING

1. Open the shipping container by cutting the tape on the top seams. Remove the documentation package and set aside.
2. Remove the contents of the shipping container and place on a flat surface, right-side up.
3. Remove the 6012 display and the scored pad from the polyethylene foam end caps.
4. Remove the polyethylene bag from the 6012 display. Remove the inspection check list and set aside.
5. Remove the scored pad from around the cables by cutting the masking tape.
6. Remove the wrappings on the cable connectors.
7. **REVIEW ALL DOCUMENTATION BEFORE INSTALLATION.**

DG-01144

#### PACKING KIT FOR THE 6012 DISPLAY



## Unpacking the Controller

Any controller that is shipped separately is packed in a pre-pack cardboard folder protected by "flow pack". The illustration below shows the shipping container and the inspection and unpacking procedures.

### UNPACKING INSTRUCTIONS FOR DATA GENERAL CORPORATION EQUIPMENT

#### INCOMING INSPECTION PROCEDURES

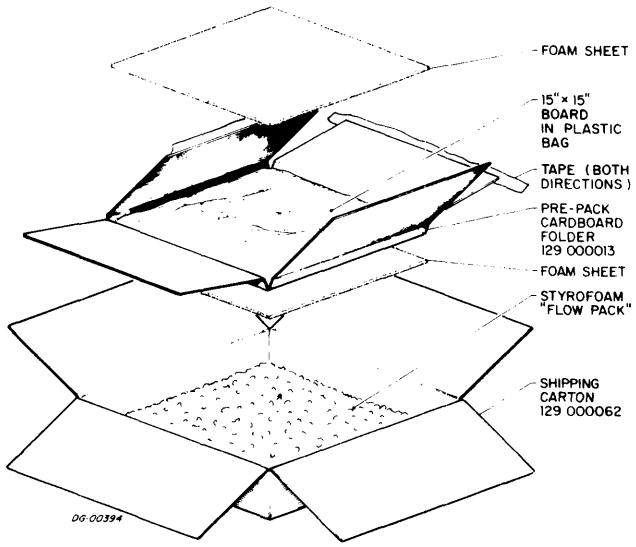
1. Containers should be inspected for any visible signs of damage and reported to DGC and the carrier within 24 hours to validate insurance claims. (Damaged cartons should not be unpacked.)
2. Shipping containers should not be unpacked if the equipment is to be installed by DGC personnel.
3. Containers should not be dropped or punctured with any sharp objects.
4. Containers and materials should be stored in case any equipment has to be shipped again.

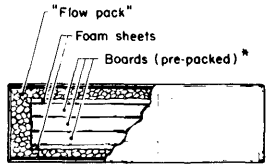
#### UNPACKING

1. Open the top of the cardboard carton and remove the loose "flow pack".
2. Remove each pre-pack folder.
3. Open each pre-pack folder, using scissors to cut the tape.
4. Remove the board in its bag from each folder.
5. Open each plastic bag to expose the board inside.
6. **REVIEW ALL DOCUMENTATION BEFORE INSTALLATION.**

DG-01161

#### PACKING KIT FOR PRINTED CIRCUIT BOARDS




MULTIPLE PACKING

* Up to three (3) 15"x 15" boards, enclosed in plastic bags and sealed in pre-pack folders as shown, can be put in shipping carton No. 129 000062. For four (4) to seven (7) boards, use shipping carton No. 129 000012.

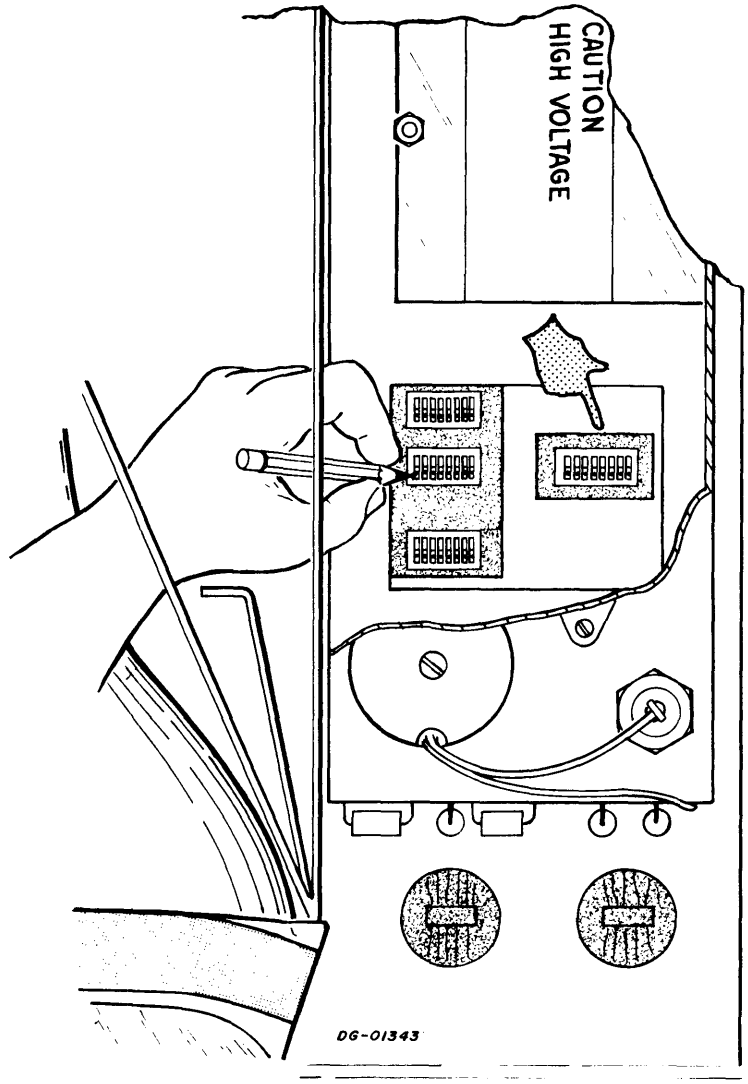
## SETTING THE DGC DISPLAY SELECTION SWITCHES

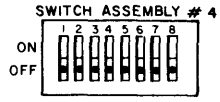
The DGC display interface board is located directly behind the viewing screen. To gain access to this board, open the four snap-slide latches on the underside of the display and remove the top cover. Once accessible the DGC display interface board has four selection switch assemblies which are used to select controller interfacing, code format, and baud rate. These selection switch assemblies are located on the left of the display and accessed through holes in the video monitor chassis. Each selection switch assembly contains eight ON-OFF switches which can be changed with a wooden stylus or a blunt pencil. The tables which follow show the access to and the location of the selection switches with the specified functions of each.

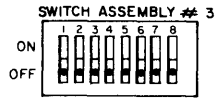
### SETTING THE DGC DISPLAY SELECTION SWITCHES

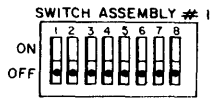
| Switch Assembly #1 | |
|---|---|
| Function | ON/OFF Position |
| Select the EIA voltage loop | ON position 3, 6, 7<br>OFF position 1, 2, 4, 5, 8 |
| Select the 20mA current loop | ON position 1, 2, 5, 8<br>OFF position 3, 4, 6, 7 |
| Select the 60mA current loop | ON position 1, 2, 4, 5, 8<br>OFF position 3, 6, 7 |

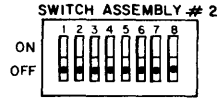
DG-01335



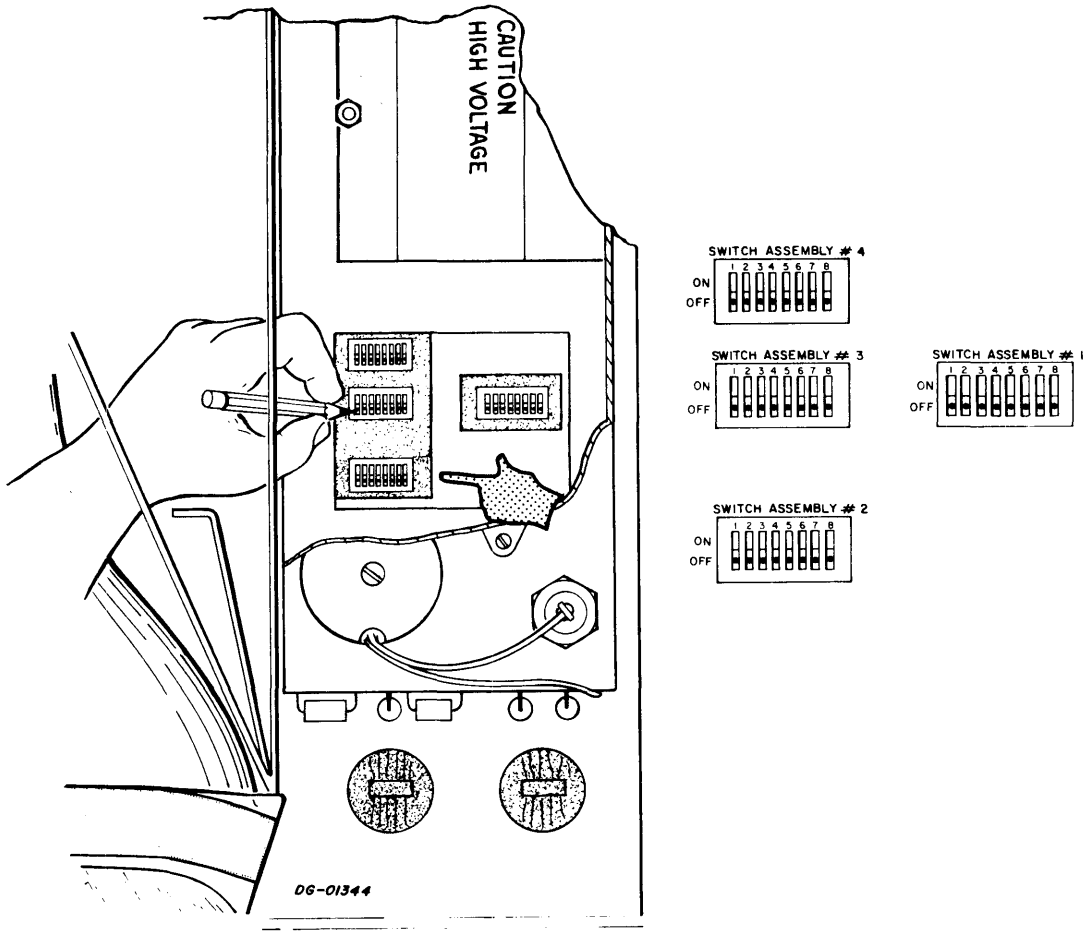



## SETTING THE DGC DISPLAY SELECTION SWITCHES

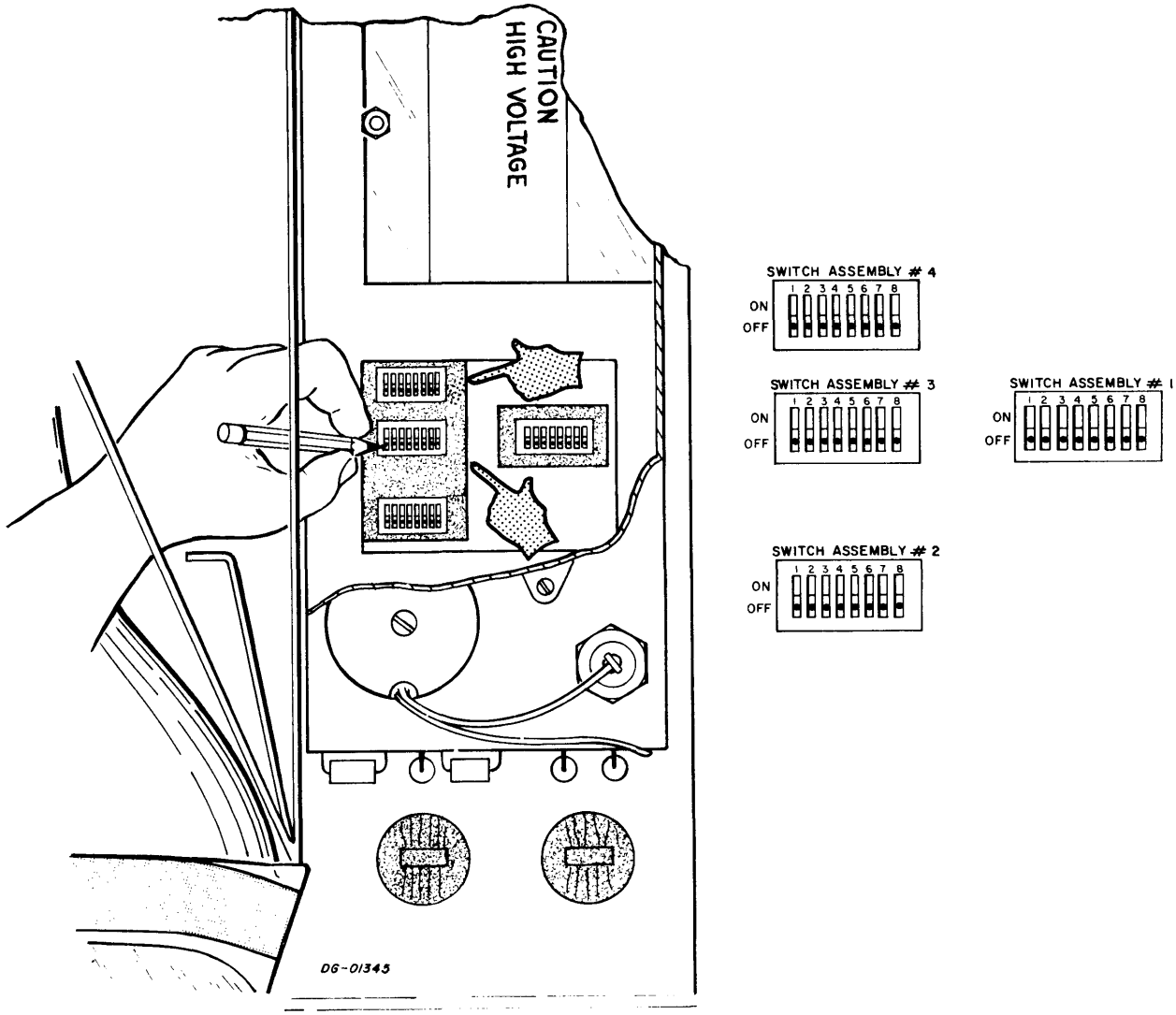
| Switch Assembly #2 | |
|---|---|
| Function | ON/OFF Position |
| Select operation at both 50Hz and 60Hz | ON position 1 |
| Select odd parity | ON position 3 |
| Select even parity | OFF position 3 |
| Select 5 data bits per character for code | ON position 4, 5 |
| Select 6 data bits per character for code | ON position 5<br>OFF position 4 |
| Select 7 data bits per character for code | ON position 4<br>OFF position 5 |
| Select 8 data bits per character for code | OFF position 4, 5 |
| Select 1 stop bit | ON position 6 |
| Select 2 stop bit | OFF position 6 |
| Eliminate the parity bit in transmitted and received codes (mark state for parity) | OFF position 7 |
| Enable switch settings | OFF position 2, 8 |
| Note: The display is designed to operate with 7 data bits per character. | |

DG-01336



| Switch Assemblies #3 and #4 | | | |
|---|---|---|---|
| Function | ON/OFF Position | Switch #3 | Switch #4 |
| Select 110 baud rate | ON position<br>OFF position | 6, 8<br>1, 2, 3, 4, 5, 7 | 3, 6<br>1, 2, 4, 5, 7, 8 |
| Select 150 baud rate | ON position<br>OFF position | 5, 6, 8<br>1, 2, 3, 4, 7 | 5<br>1, 2, 3, 4, 6, 7, 8 |
| Select 300 baud rate | ON position<br>OFF position | 4, 8<br>1, 2, 3, 5, 6, 7 | 4, 6<br>1, 2, 3, 5, 7, 8 |
| Select 600 baud rate | ON position<br>OFF position | 1, 4, 6<br>2, 3, 5, 7, 8 | 4, 5, 6<br>1, 2, 3, 7, 8 |
| Select 1200 baud rate | ON position<br>OFF position | 1, 6<br>2, 3, 4, 5, 7, 8 | 6<br>1, 2, 3, 4, 5, 7, 8 |
| Select 2400 baud rate | ON position<br>OFF position | 6, 7<br>1, 2, 3, 4, 5, 8 | 6<br>1, 2, 3, 4, 5, 7, 8 |
| Select 4800 baud rate | ON position<br>OFF position | 1, 4, 5<br>2, 3, 6, 7, 8 | 4<br>1, 2, 3, 5, 6, 7, 8 |

DG-01337



## PLACING THE DGC DISPLAY

The DGC display is a compact tabletop unit which requires no special mounting procedures. To allow for ease of operation, placement of the display should be in a convenient location for the operator. Other considerations when placing the display include service clearances, and the length of the power cord and device cable. Neither the power cord or the device cable should be pulled or strained during normal operation of the display.

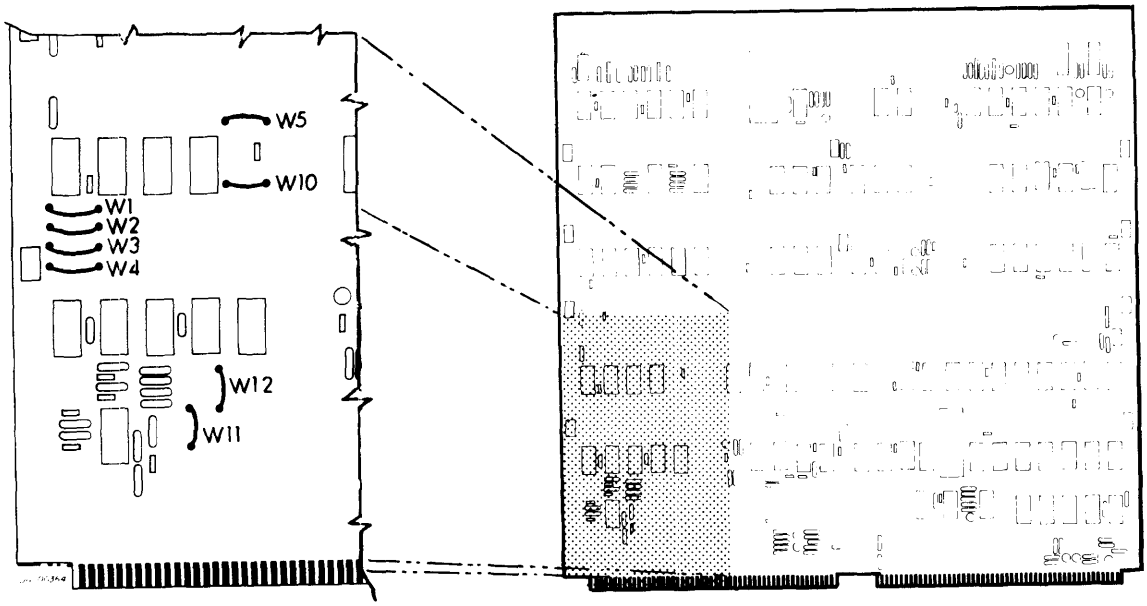
## JUMPERING THE 4010 AND 4077 CONTROLLERS

The DGC display can be interfaced to any Data General computer through the 4010 and 4077 controllers. The 4010 controller has eight jumper positions which are used to select the device code. The 4077 controller has eighteen jumper positions which are used to select device codes, voltage or current loop, and the baud rate. When the 4077 controller is used, it is important that the jumpering scheme corresponds identically to the switch selections on the display interface board. For both controllers, the display responds to the same device codes. For the display input, these device codes are $10_8$ for the primary and $50_8$ for the secondary. The display output device codes are $11_8$ for the primary and $51_8$ for the secondary. The tables which follow show, for both controllers, the location of the jumper positions and the jumpering scheme required for their specified functions.

### JUMPERING THE 4010 CONTROLLER

| Function | Jumpers |
|---|---|
| Select the primary device codes - $10_8$ for the display input, and $11_8$ for the display output | Install jumpers W2, W3, W10, W11<br>Omit jumpers W1, W4, W5, W12 |
| Select the secondary device codes - $50_8$ for the display input, and $51_8$ for the display output | Install jumpers W1, W3, W5, W10, W11<br>Omit jumpers W2, W4, W12 |

DG-01338



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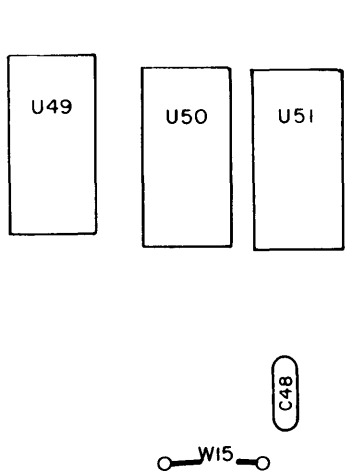
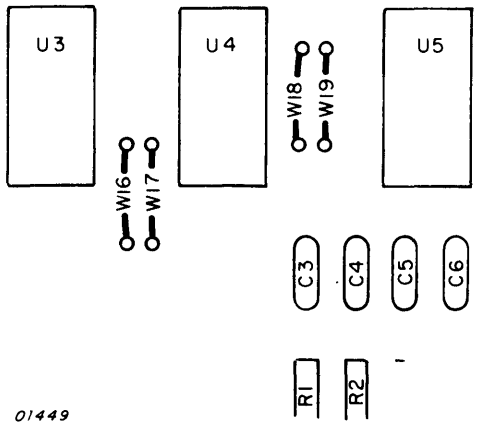
## DEVICE CODES

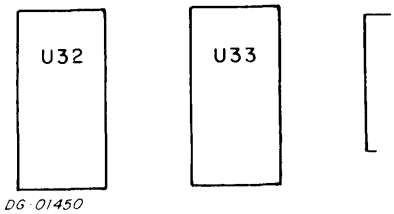
| Function | Jumpers |
|---|---|
| Select the primary device codes - $34_8$ for the cassette, $10_8$ for TTI, $11_8$ for TTO, and $13_8$ for RTC | Install jumpers W16, W19<br>Omit jumpers W14, W15, W17, W18 |
| Select the secondary device codes - $74_8$ for the cassette, $50_8$ for TTI, $51_8$ for TTO, and $53_8$ for RTC | Install jumpers W14, W15, W17, W18<br>Omit jumpers W16, W19 |
| Select the primary device code - $34_8$ for the cassette, and the secondary device codes - $50_8$ for TTI, $51_8$ for TTO, and $53_8$ for RTC | Install jumpers W15, W17, W19<br>Omit jumpers W14, W16, W18 |
| Select the secondary device code - $74_8$ for the cassette, and the primary device codes - $10_8$ for TTI, $11_8$ for TTO, and $13_8$ for RTC | Install jumpers W14, W16, W18<br>Omit jumpers W15, W17, W19 |

DG-01339

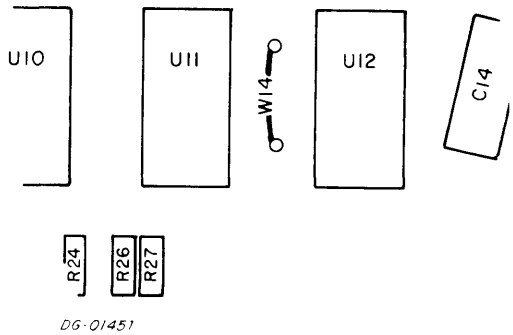



01449




DG-01450




DG-01451

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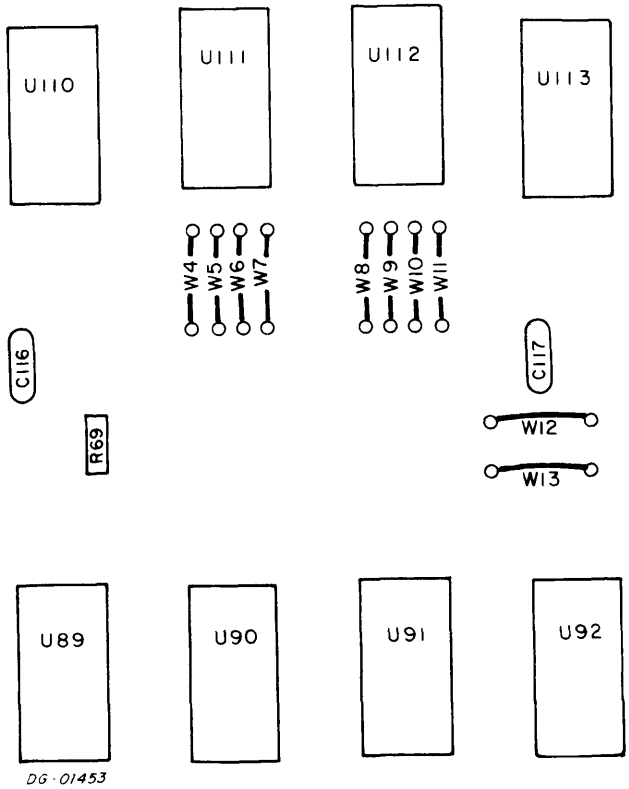
## TELETYPEWRITER BUAD RATE

| Function | Jumpers |
|---|---|
| Select 110 baud rate | Install W5, W6, W9, W11, W12<br>Omit W4, W7, W8, W10, W13 |
| Select 150 baud rate | Install W4, W5, W6, W7, W10, W11, W12<br>Omit W8, W9, W13 |
| Select 300 baud rate | Install W4, W5, W6, W7, W11, W12<br>Omit W8, W9, W10, W13 |
| Select 600 baud rate | Install W4, W5, W6, W7, W12<br>Omit W8, W9, W10, W11, W13 |
| Select 1200 baud rate | Install W5, W6, W7, W12<br>Omit W4, W8, W9, W10, W11, W13 |
| Select 2400 baud rate | Install W6, W7, W12<br>Omit W4, W5, W8, W9, W10, W11, W13 |
| Select 4800 baud rate | Install W7, W12<br>Omit W4, W5, W6, W8, W9, W10, W11, W12 |
| Select 9600 baud rate | Install W13<br>Omit W4, W5, W6, W7, W8, W9, W10, W11, W12 |

DG-01340




DG-01453

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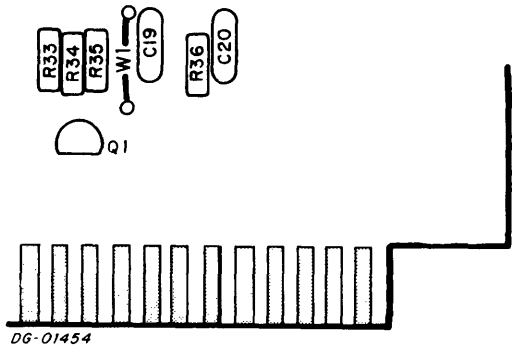
## JUMPERING THE 4077 CONTROLLER

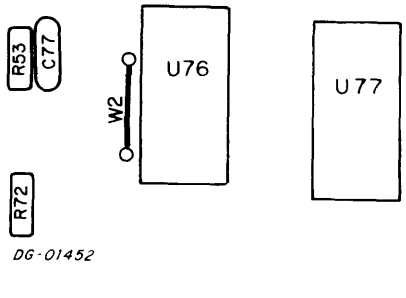
### CURRENT OR VOLTAGE LOOP

| Function | Jumpers |
|---|---|
| Select the current loop | Install jumpers W1 and W2 |
| Select the EIA voltage loop | Omit jumpers W1 and W2 |

DG-01341




DG-01454




DG-01452

## INSTALLING THE CONTROLLER

Once the controller board has been jumpered, it should be installed in its preferred location of the computer or expansion chassis. The preferred location for the controller board in the NOVA® computers is slot 3; and in the ECLIPSE™ computers, slot 5 in model S/100 and slot 6 in the S/200. However, any available I/O slot can be used as an alternate location provided an internal cable is run from the back panel pins to a connector, and the program interrupt and data channel priority chains are preserved. The controller board is installed by using the guide rails in the chassis to insert the board into the back panel socket pins then locking it firmly in place.

## CABLING THE DGC DISPLAY

The DGC display has two cables; one power cord, and one device cable. However, internal cables may be required if the display is purchased as an addition to an existing system, or if the controller board is not installed in its preferred location. Internal cables are run from the computer back panel pins to a connector following the appropriate wire list as shown in the table which follows.

When cabling the DGC display, the system must be turned off and the cables to the power source unplugged. Then:

1. Install any internal cables not factory installed following the appropriate wire list as described in the table.
2. Install the device cable from the display to the computer. In all paddleboard computers which use the preferred location, this cable plugs directly into the back panel pins. In all cannon connector computers, which use the preferred location, the cable plugs into connector P2.
3. Check to see that all cables are properly connected and that none are strained.
4. Measure the line voltage at the service outlet to make sure that it meets the power specifications of the display.
5. Plug the power cable of the display into the service outlet most convenient.
6. Plug in the cable to the power source, turn the system on, and run the diagnostic test.

The next three illustrations show the cabling scheme for the appropriate DGC computer when the controller board is installed in its preferred location. When installed in its alternate slot, the device cable connects to the connector previously wired from the wire list.

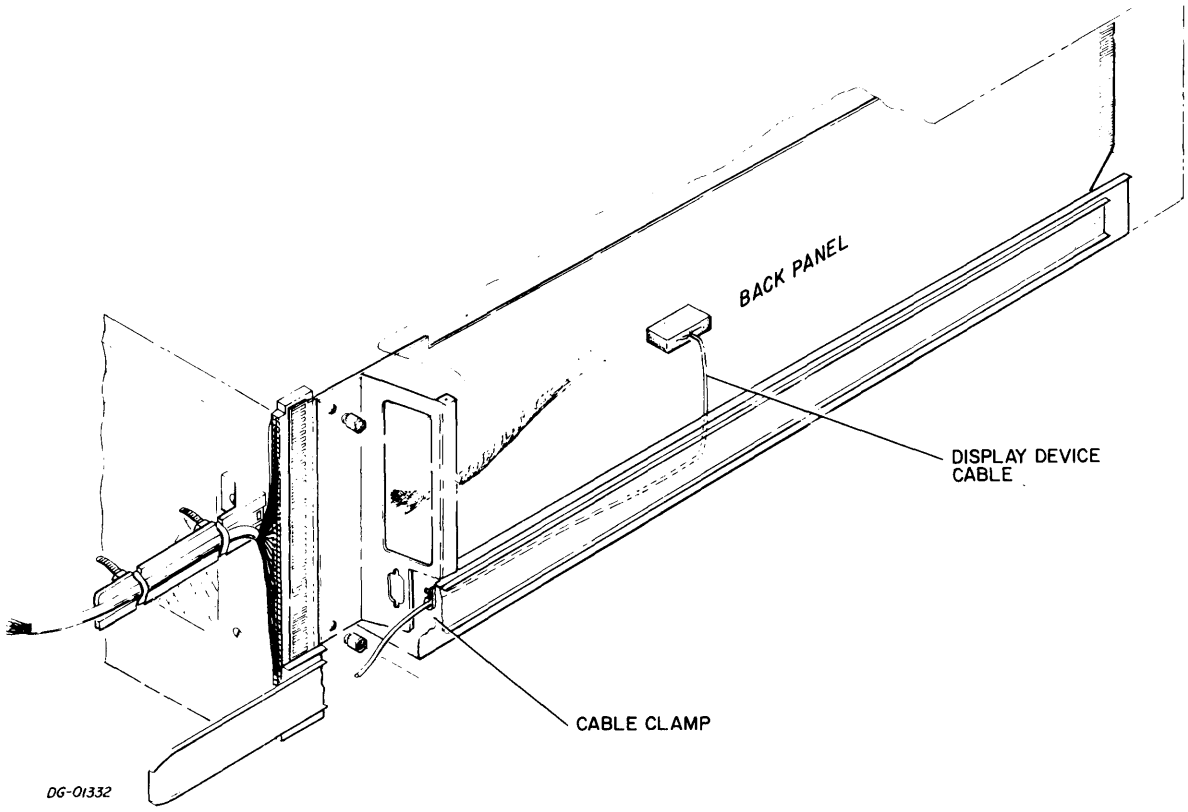
Internal Cables

| DGC Display | | | |
|---|---|---|---|
| System | Slot* | Location | Wire List |
| NOVA 2, 4, 2, 10, 820, 1210, 1220, and ECLIPSE computer | P | From EIA connector to back panel | None Required |
| | A | From PCB connector to back panel pins for the desired slot | 008-000269 |
| NOVA 800, 840, and 1200 | P | From connector P2 to back panel pins in etch | None Required |
| | A | From cannon connector to back panel pins for the desired slot | 008-000116 |

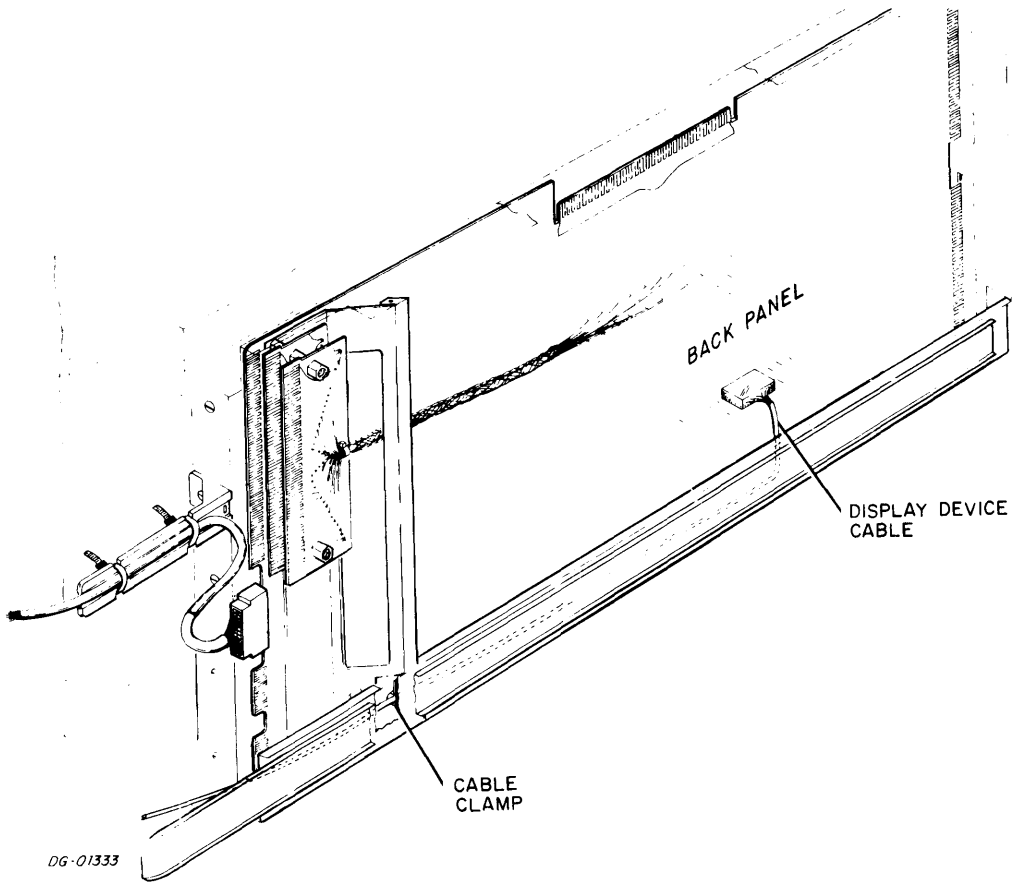
*P = preferred slot for the controller board
A = alternate slot for the controller board

DG-01342

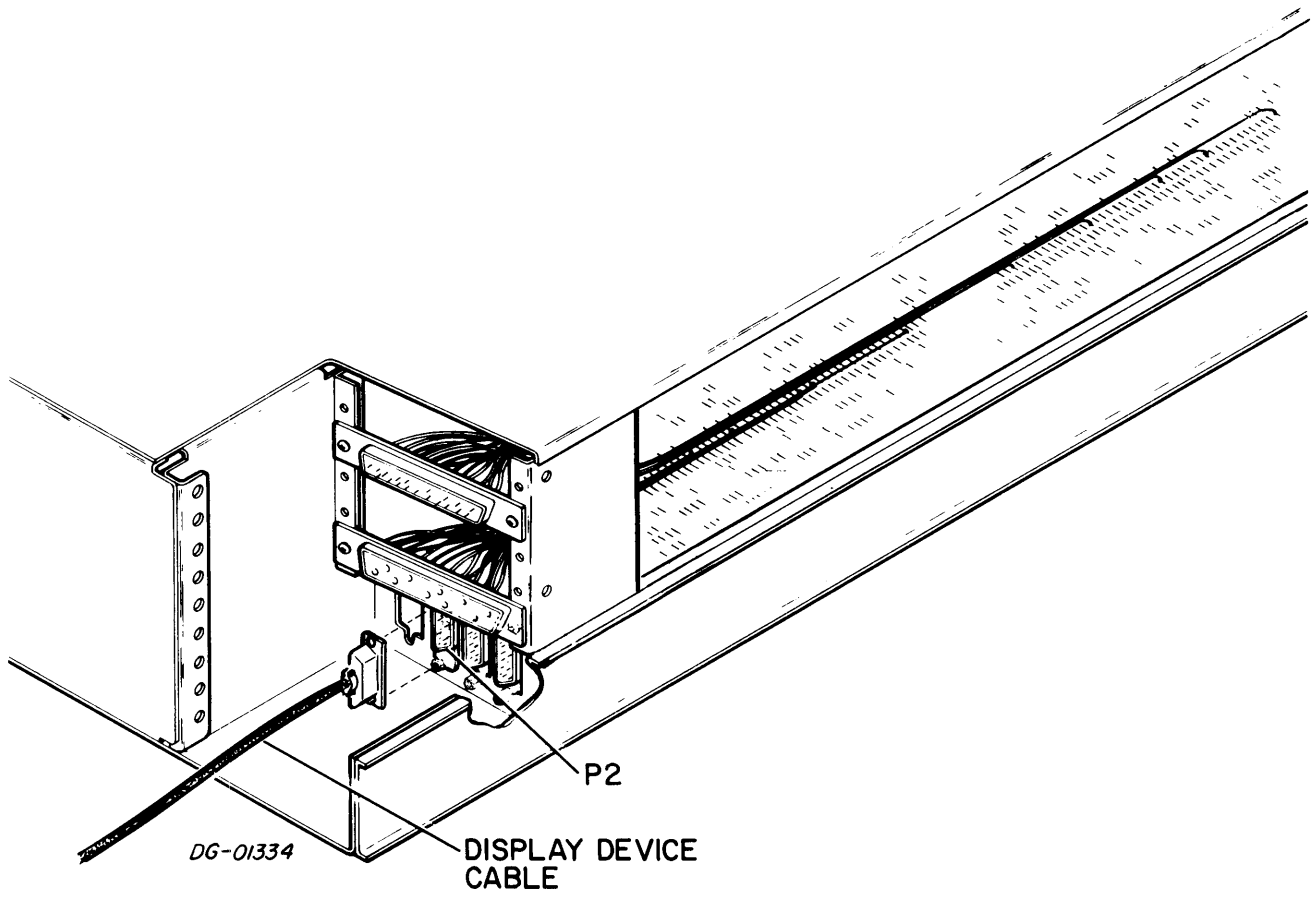
## NOVA 2/4 AND 1210 COMPUTERS BACK PANEL




## NOVA 820, 1220, 2/10 AND ECLIPSE LINE COMPUTERS BACK PANEL



NOVA 800, 830, 840 AND 1200 COMPUTERS BACK PANEL



# SECTION IV

# PROGRAMMING

## INTRODUCTION

The DGC display 6012 is two separate I/O devices; a console and an alphanumeric CRT display, as shown in the Display Terminal figure. The console is comprised of a standard 53-station Teletype style keyboard, a supplementary 20-station keyboard and two switches. The first switch has three positions labeled LOCAL, OFF and ON LINE. The ON LINE position connects the terminal to the computer. LOCAL, used primarily for testing the display, puts the terminal off line from the computer and connects the keyboard to the display. OFF removes power from the device. The second switch has three positions labeled BUFFERED, PAGE and ROLL. Each position of this switch selects the terminal's operational mode.

The display is a 12 inch CRT with an active area of 6 by 9 inches, formatted into a twenty-four line by 80 character page. The characters that can be plotted on this screen are taken from the standard 64 character subset of ASCII, listed in the ASCII Character Codes Plotted by the Display table.

The terminal operates in three switch selectable modes called Page-buffered, Page and Roll. Page-buffered mode allows an entire page of data to be entered into the terminal's memory, edited off line and then transmitted to the computer in part or in whole. In this mode there are six commands for positioning the cursor, and ten additional commands for defining protected and blinking areas, setting tabs, clearing areas of memory, and transmitting characters from memory to the computer.

Page mode allows a file to be transmitted to the terminal and any desired changes made simultaneously to both the information in the terminal's memory, through the terminal hardware, and the corresponding characters stored in the computer's memory, by means of software. The commands are the same for these two modes; the only difference between them is that the keyboard in Page-buffered mode is directly coupled to the display and is off line from the computer until a special transmit key is used, while the keyboard in Page mode is always on line.

Roll mode simulates a Teletype. In this mode there are five commands for positioning the cursor, and three additional commands for clearing areas of memory and transmitting data. All data is entered into memory locations which correspond to the bottom line of the display screen. A LINE FEED command causes all lines on the screen to move up one; the bottom line to become blank and the top line to be lost.

### SUMMARY

MNEMONIC (FIRST CONTROLLER)

INPUT ..... TTI
OUTPUT ..... TTO

DEVICE CODE (FIRST CONTROLLER)

INPUT ..... $10_8$
OUTPUT ..... $11_8$

MNEMONIC (SECOND CONTROLLER)

INPUT ..... TTI1
OUTPUT ..... TTO1

DEVICE CODE (SECOND CONTROLLER)

INPUT ..... $50_8$
OUTPUT ..... $51_8$

PRIORITY MASK BIT

INPUT ..... 14
OUTPUT ..... 15

CHARACTERS/LINE ..... 80

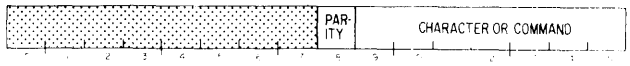
LINES/DISPLAY ..... 24

TOTAL STORAGE
CAPACITY (7-BIT CHARACTERS).. 1920

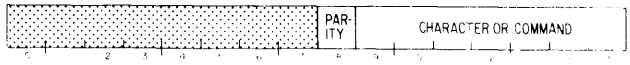
DATA TRANSFER RATE
MAX (BAUD) ..... 4800

### ACCUMULATOR FORMATS

READ CHARACTER ..... (DIA)




WRITE CHARACTER ..... (DOA)




### S, C AND P FUNCTIONS

S Set Busy to 1, Done to 0 and either load the input buffer or write a character into the display's memory.

C Sets both Busy and Done to 0 and terminates all data transfers. If issued before transmission is complete, partial character codes are received.

P No effect.

# INSTRUCTIONS

The following instructions and timing information are for the DGC display 6012 when it is used in conjunction with a 4010 controller. The instruction sets for the other controllers can be found in the "How To Use The NOVA Computers" manual, DG015-000009.

## Coding Aids

The <>, and = are used in this manual to aid in defining the instructions. These symbols are not coded; they act only to indicate how an assembly language instruction may be written. Their general definition is given below:

<> Indicates optional operands. The operand enclosed in the brackets (e.g., <#>) may be coded or not, depending on whether or not the associated option is desired.

= Indicates specific substitution is required. Substitute the indicated accumulator, address, name or number.

The following abbreviations are used throughout this section:

ac or AC = Accumulator

f or F = Flag Control Field

## Flag Control Functions

The display controller's Busy and Done flags are controlled using two of the device flag commands as follows:

f=C Sets Busy and Done to 0, thus stopping all data transfer operations. A Clear command issued in during a transfer will result in the partial reception of the code being transferred.

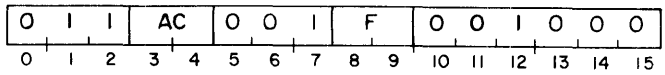
f=S Sets Busy to 1, Done to 0 and either reads a character into the input buffer or writes the character in the output buffer into the display's memory.

f=P No effect.

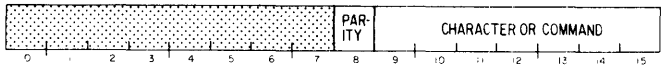
Since the display is actually two devices, both a Busy and a Done flag are available for input operations and a separate set of Busy and Done flags are available for output operations.

## READ CHARACTER

DIA<f> ac, TTI



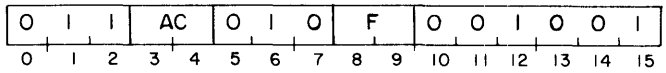

The contents of the input buffer are placed in bits 8-15 of the specified AC. Bits 0-7 of the specified AC are set to 0. After the data transfer, the controller's Input Busy and Done flags are set according to the function specified by F. The format of the specified AC is as follows:



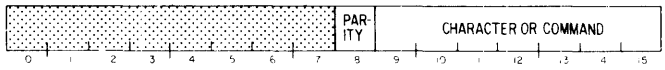

| Bits | Name | Contents |
|---|---|---|
| 0-7 | --- | Reserved for future use. |
| 8 | Parity | Parity bit selected at the terminal; even, odd or none. |
| 9-15 | Character | The 7-bit character or command read from the Input Buffer. |

## WRITE CHARACTER

DOA<f> ac, TTO




Bits 9-15 of the specified AC are loaded into the display's output buffer. After the data transfer, the controller's Output Busy and Output Done flags are set according to the function specified by F. The format of the specified AC is as follows:




| Bits | Name | Contents |
|---|---|---|
| 0-7 | --- | Reserved for future use (always 0). |
| 8 | Parity | Even, odd or no parity for the 7-bit code. Ignored by the display. |
| 9-15 | Character | The 7-bit character or command transmitted to the output buffer. |

## PROGRAMMING

Since the terminal is actually two separate devices, input and output are discussed separately.

### Input

Neither full- nor half-duplex input operations have to be initialized by the program. Striking a key in either Page or Roll modes automatically transmits the corresponding character to the controller. While the controller is assembling the character, its Input Busy flag is set to 1. After the character is assembled, the Input Busy flag is set to 0, the Input Done flag is set to 1 and a program interrupt request is initiated.

The character can then be read by issuing a READ CHARACTER instruction (DIA). The Input Done flag should then be set to 0 with either a Start or a Clear command. This allows the next character to initiate a program interrupt request when it is fully assembled.

The TRANSMIT BUFFER command transmits the contents of the terminal's memory character by character to the controller.

### Output

A character is loaded into the Output Buffer of the controller by issuing a WRITE CHARACTER instruction (DOA). The character can then be transmitted to the terminal by issuing a Start command. While the character is being transmitted, the Output Busy flag is set to 1. Upon completion of the transmission, the Output Busy flag is set to 0 and the Output Done flag is set to 1, thus initiating a program interrupt request.

Each time a character is to be sent to the terminal, the Output buffer must be reloaded with a WRITE CHARACTER instruction. A sequence of WRITE CHARACTER instructions together with Start commands is used to transmit a multi-character message. The program must allow each character to be transmitted before transmitting the next character.

## TIMING

### Input Timing

After Input Done is set and before another key strike can destroy the character in the input buffer, the character is available for a READ CHARACTER instruction for a time interval determined by the baud rate.

| Time Available (ms) | Baud Rate |
|---|---|
| 21.59 | 110 |
| 15.84 | 150 |
| 7.92 | 300 |
| 3.95 | 600 |
| 1.97 | 1200 |
| 1.31 | 1800 |
| .98 | 2400 |
| .65 | 3600 |
| .49 | 4800 |

### Output Timing

After Output Done is set, the program should provide another character within a time limit determined by the baud rate to keep the transmission line operating at its maximum rate.

| Time Limit (ms) | Baud Rate |
|---|---|
| 9.15 | 110 |
| 6.64 | 150 |
| 3.32 | 300 |
| 1.66 | 600 |
| .83 | 1200 |
| .55 | 1800 |
| .42 | 2400 |
| .27 | 3600 |
| .21 | 4800 |

## CONSIDERATIONS

### Input

The codes receives from the terminal can be selected, at the terminal, to have 5, 6, 7, or 8 data bits; with even, odd, or a mark state parity bit. The terminal is designed to operate with 7 data bits per character. The programmer should determine the code structure used in the terminal and make sure that the controller is compatible.

When the terminal is operating in full-duplex, the program must "echo" the characters if they are to affect the display screen.

Half-duplex operation requires a protocol to be set up between the computer and the terminal. The protocol should be formed to resolve any conflicts over the use of the transmission line.

### Output

The codes received by the terminal can be selected, at the terminal, to have 5, 6, 7, or 8 data bits. The terminal is designed to operate with 7 data bits per character. The parity bit is ignored in all codes received by the terminal.

When characters are sent to the terminal, all lower case characters are displayed as their upper-case equivalents.

Half-duplex operation requires a protocol to be set up between the computer and the terminal. The protocol should be formed to resolve any conflicts over transmission line use.

When operating in either Page-buffered or Page mode, characters will automatically continue to the next line when the end of the current line is reached. When the last line on the page is filled, any other characters received will overwrite the last character on the last line. When operating in Roll mode, the last character in the bottom line will be overwritten by subsequent characters. In order to avoid overwriting any line, both a CARRIAGE RETURN and a LINE FEED command should be issued.

CUT ALONG DOTTED LINE

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