DS3100 ASR

VIDEO DISPLAY

TERMINAL

INSTRUCTION MANUAL

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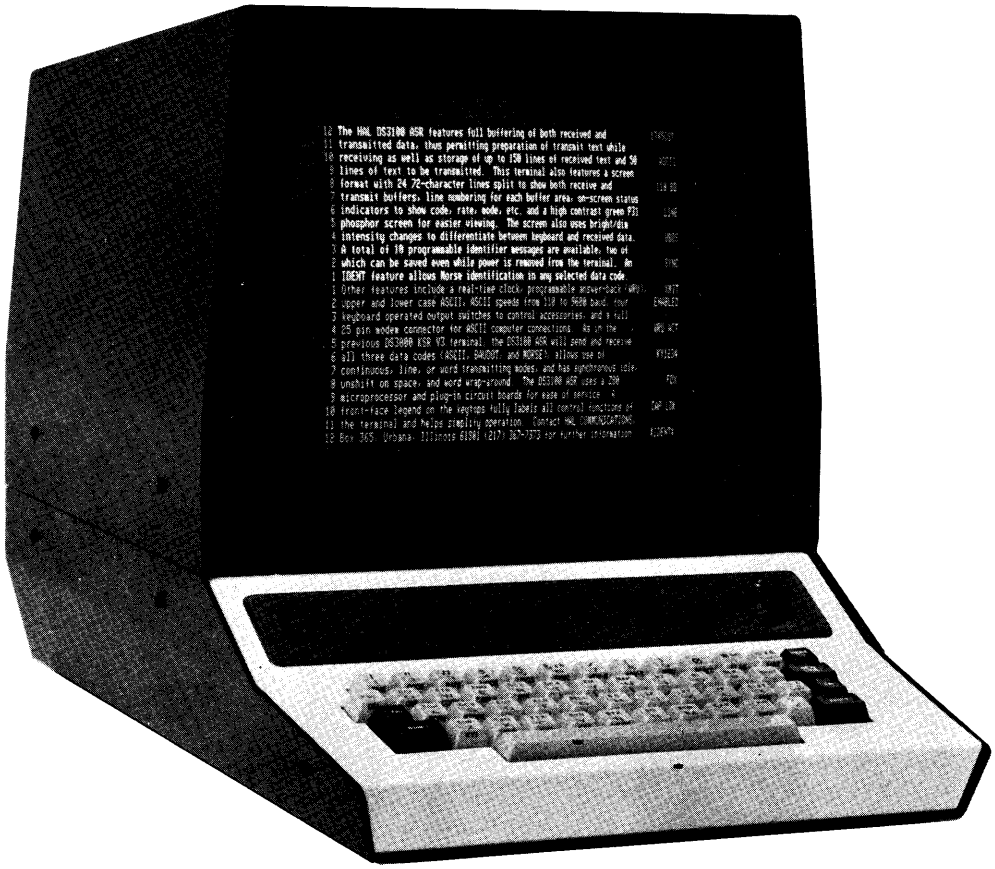
QUALITY COMMUNICATIONS EQUIPMENT

HAL DS3100 ASR VIDEO DISPLAY TERMINAL

TECHNICAL MANUAL



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DS3100 ASR VIDEO DISPLAY TERMINAL

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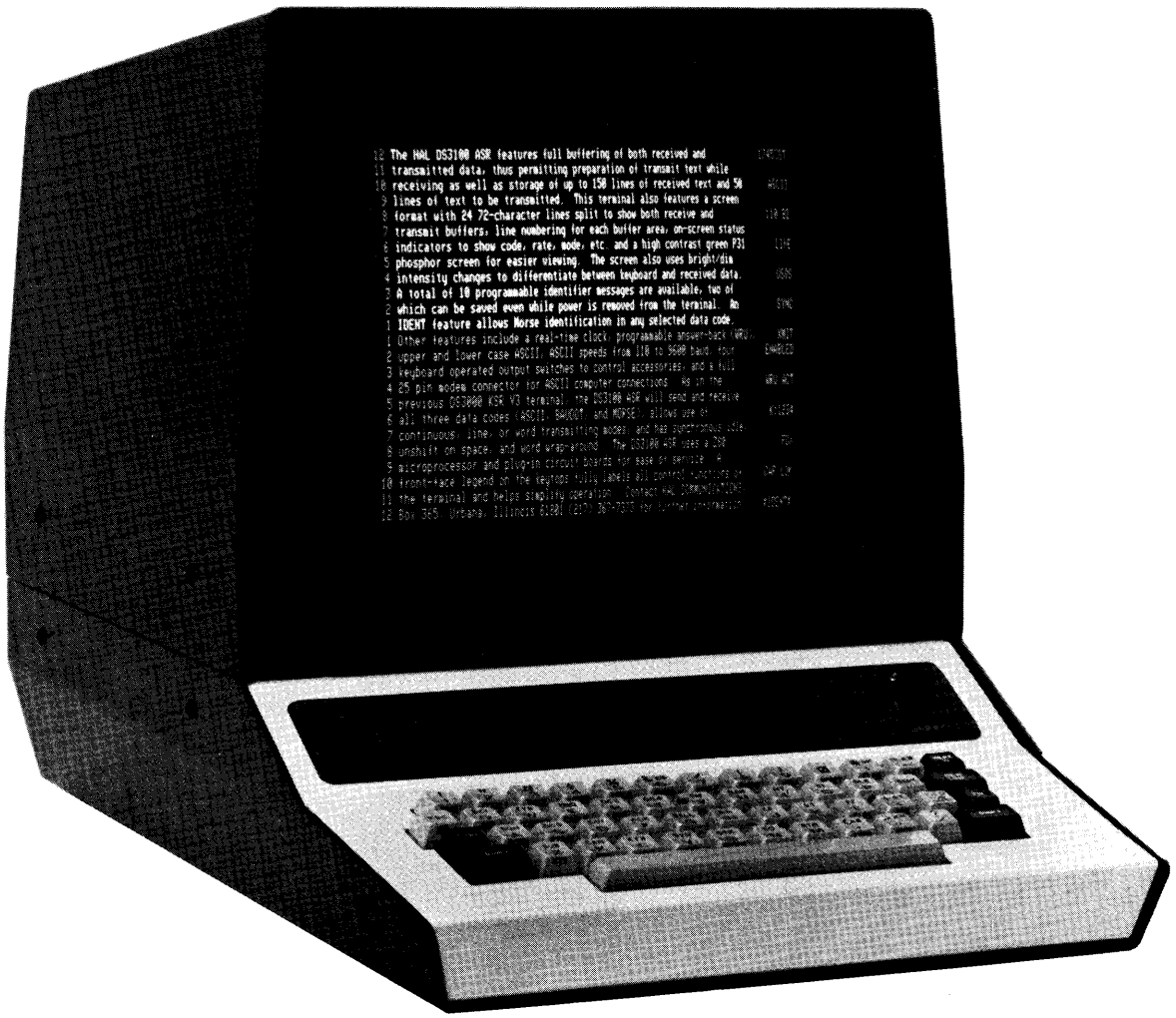


FIGURE 1. THE DS3100 ASR VIDEO DISPLAY TERMINAL

1. INTRODUCTION:

The DS3100 ASR is an electronic communications terminal for transmission and reception of coded communications using either the Baudot or ASCII teleprinter codes or the Continental Morse telegraphy code. The DS3100 is microprocessor controlled and provides many features to assist the operator. In particular, the DS3100 is the *first* multi-code terminal to provide full buffering of receive and transmitted text, thus allowing composition of transmit text *while receiving*. This is the so-called "Automatic Send-Receive" (ASR) or "Buffered Send-Receive" (BSR) type of telecommunications terminal. The DS3100 also features programmable identification messages (a total of ten), internal real-time clock, on-screen display of the terminal status, an answer-back system for *all three codes*, and full keyboard control of the terminal as well as many many more conveniences. Particular attention has been given to the display and keyboard design to make for convenient and enjoyable operation. All terminal control functions are clearly marked on the custom triple-legend keytops and the terminal's operating condition is clearly shown by on-screen *status indicators*.

1.1 THE DS3100 ASR MANUALS:

These DS3100 manuals represent a different approach to technical documentation. Obviously, you, the operator, will have to become familiar with the terminal to take full advantage of the many features offered. However, reading of the formally-organized technical manual is generally boring and *few* really complete manuals are *ever* read! Therefore, for the DS3100 ASR, we offer a two-volume manual system. The first, a pocket-sized 3" x 6" booklet, is written as a short-form operator's guide, intended for *continued* reference while using the terminal; *most* of the terminal's features are briefly described in this booklet. This Operator's Guide will fulfill most of your day-to-day information requirements and you may even be able to determine most of the operating techniques through a careful reading of it alone.

However, all of the features are discussed *in detail* in the larger 8" x 10" Technical Manual. The two manuals are organized in a similar order so that one may be quickly related to the other. In addition, infrequently used information such as installation and connections to other equipment, technical specifications, and trouble-shooting sections are included in the Technical Manual only. Neither manual is intended to be read as a novel - however, you should at least scan the contents of both so that you know where to look when that confusing terminal output happens to you!

2. OPERATION

2.1 DISPLAY:

The DS3100 ASR communications terminal can be used with Baudot, Morse, and ASCII codes. All received communications as well as keyboard-written text are presented on a 12" (diagonal measure) display screen. In a departure from previous terminals, the DS3100 screen uses a green-phospher cathode ray tube to give a higher contrast, eye-easing green character display. To aid in distinguishing between characters received from an external source and those generated internally through the keyboard, the received characters are displayed with a brighter intensity than are characters generated from the keyboard.

2.1.1 TEXT DISPLAY:

A total of 24 lines of 72 characters per line are shown on the screen, generally split so that the upper 12 lines show received characters and the lower 12 lines show characters to be transmitted. If desired, however, the entire 24 line display may be devoted to display of only received characters. The actual received and transmit characters are stored in large buffer areas of 150 lines for receive and 50 lines for transmit; the display is simply a "*window*" on selected portions of the buffer areas. The position of the display window can be moved, through operator commands, to show any line of either buffer area.

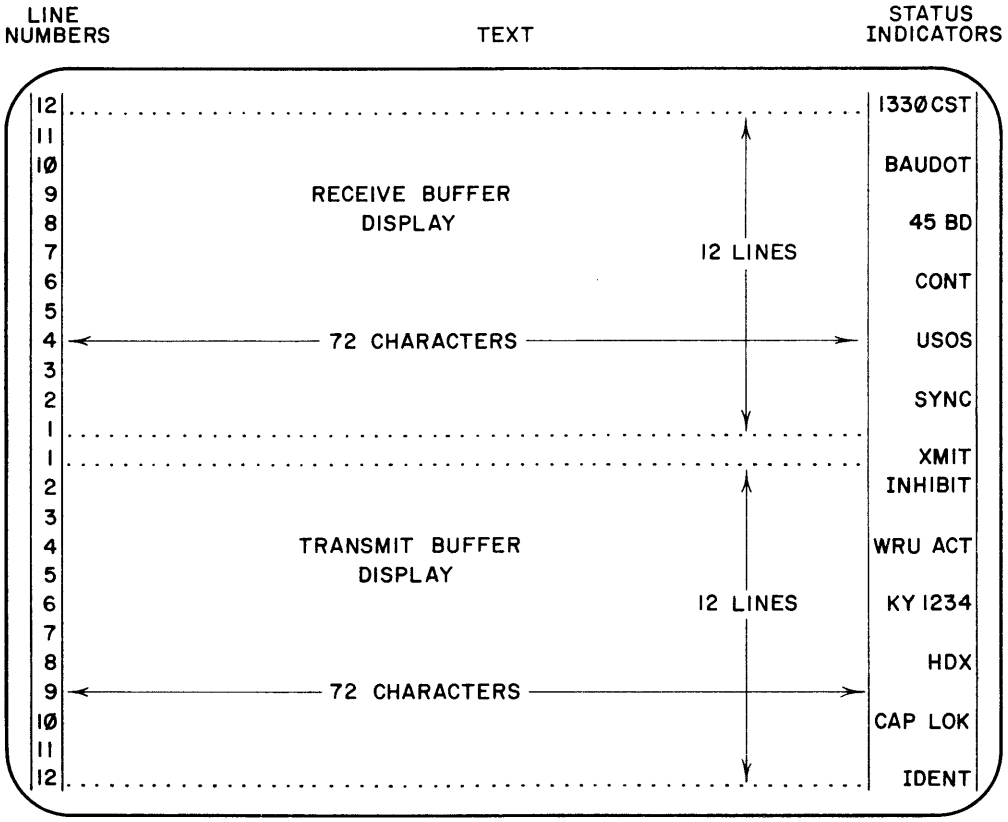
2.1.2 CURSORS:

A total of three cursors are provided on the screen; one in the receive buffer display area and two in the transmit buffer area. The cursor in the receive buffer indicates the position in which the next received character will be entered. The two cursors in the transmit buffer show the transmit output location and the keyboard entry location. Called the "Output Cursor" and "keyboard Cursor," respectively, the functions of the transmit cursors are discussed in greater detail in the *Transmitting Controls* section of this Technical Manual.

2.1.3 NON-OVERPRINT:

Both receive and transmit functions of the DS3100 have non-overprint features to prevent overprinting of a previous line because of a missing line feed operation or extension of a line beyond 72 characters. The receive non-overprint feature will automatically place characters on the next line of the buffer (and therefore the screen) if more than 72 characters are received between line feed characters. Moreover, the *word wrap-around* feature prevents word splitting that might otherwise occur at the end of lines, transferring all characters following the last space to the next line. Any length of word (up to 71 characters) will be transferred intact with the word wrap-around feature. To further prevent overprint, the receive section ignores all received Carriage Return (CR) characters and always executes a Carriage Return and Line Feed (LF) whenever an LF character is received. The only exception to this occurs when receiving Full Duplex ASCII - in this case *all* cursor controls perform as discussed in the *ASCII Operation* section.

The transmit non-overprint feature automatically chooses new lines in the buffer and display as needed while you are typing text. The word wrap-around feature also works when composing transmit text to prevent word splitting. When the pre-composed text is transmitted out of the buffer, the required printer control codes (LF & CR) are *automatically inserted* as the text is transmitted. In Baudot



STATUS INDICATORS

① TIME Status – shows first 7 digits of time message – shows TIME = ØØØØ at turn-on

② CODE Status – shows BAUDOT, MORSE, or ASCII

③ RATE Status – shows Baudot and ASCII baud rates – shows MORSE speed in WPM

④ MODE Status – shows CONT (continuous), LINE, or WORD

⑤ USOS Status – UnShift On Space – blank when USOS is off

⑥ SYNC Status – SYNChronous idle feature – blank when SYNC is off

⑦, ⑧ XMIT Status – shows condition of transmit buffer – XMIT INHIBIT, XMIT ENABLED, or XMIT ACTIVE

⑨ WRU Status – shows WRU ACT (active), SEL CAL (selective call), blank when WRU is off, or WRU PRG (programming)

⑩ KY Status – shows which KY switch is "ON" – KY 1 34 means 1, 3, and 4 = ON, 2 = OFF

⑪ HDX Status – shows HDX (Half-Duplex) or FDX (Full-Duplex)

⑫ CAP LOK Status – if ASCII is locked in capital-letters-only mode

⑬ IDENT Status – shows *IDENT* if XMIT ACTIVE for more than 10 minutes since last IDENT

⑬ PROG Status – shows HI 1 PRG for HERE IS #1 being programmed (etc. for HI 2 – HI Ø), TIM PRG (time being programmed), or STORE (EAROM data being rewritten)

FIGURE 2. SCREEN FORMAT

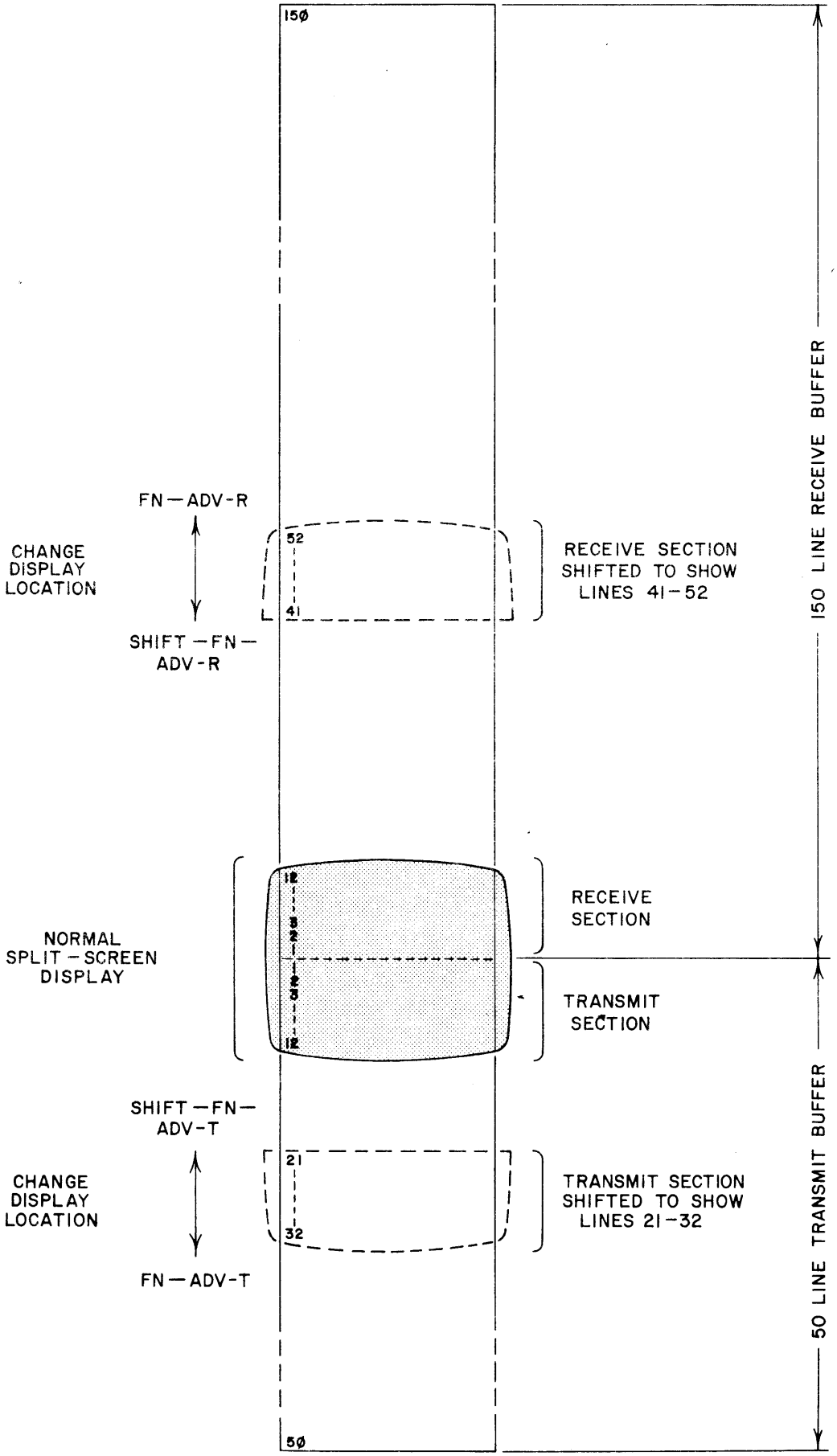


FIGURE 3. BUFFER DISPLAY

code, the beginning of each new line causes insertion of the sequence "CR-LF-LTRS"; in ASCII, just "CR-LF" are added. Obviously, carriage controls are not required for Morse. Thus, when typing straight text, it is not really necessary for the typist to concern himself with line feeds or carriage returns - the DS3100 ASR does it automatically. In ASCII full-duplex (FDX) operation with the DS3100 ASR, a NEW LINE operation may generate either CR-LF or CR only. See section 2.6.6 on SPECIAL OPTION character selection for more information.

However, when typing tables or other text requiring less than full-length lines, use of the NEW LINE key will shift the display and buffer storage to the next line. Again, when the text is transmitted, the control codes are inserted as required.

In some cases, you may wish to manually send control codes separately, such as CR, LF, LTRS, FIGS in Baudot or various controls in ASCII. In this case, simply type the control key combination required (eg, CTRL-M for Baudot carriage return, CTRL-BS for ASCII back-space, etc.). The *control code* itself is now stored in the transmit buffer and will be transmitted in the chosen sequence. A control symbol is placed on the screen to indicate the presence of the control code in the buffer. Key combinations for control codes and display symbols used are noted in the sections describing ASCII and Baudot operation.

2.1.4 TERMINAL STATUS:

In addition to displaying receive and transmit text, the DS3100 ASR screen also displays the status of various terminal operating conditions as well as line numbers for the receive and transmit buffers. The *status indicators* on the right-hand side of the screen give a continuous indication of various terminal operating parameters. As can be seen from Figure 2, the selected data code, rate, transmitting mode, transmit buffer status, and real time as well as several other features are given by these status indicators. The status indicators are always present on the screen, regardless of text changes in either receive or transmit buffers. The function of the various indicators is further discussed in conjunction with use of keyboard controls.

2.1.5 BUFFER LINE NUMBERS:

Line numbers are placed in the left margin of the screen to assist in keeping track of the screen location in the receive and transmit buffers. Since the receive buffer is 150 lines long and the transmit buffer 50 lines, obviously the display can only show a portion of each at one time. The normal situation is for the display *window* to be split equally between receive and transmit buffers, devoting the upper 12 lines to receive and the lower 12 lines to the transmit buffer. If more display of receive text is desired, the entire 24 lines of display can be devoted to the receive buffer. As shown in Figure 3, each section of the display window can be moved to show any 12 (or 24) line portion of the total buffer. Screen position manipulation is discussed in detail in the *Screen Control* section of this manual.

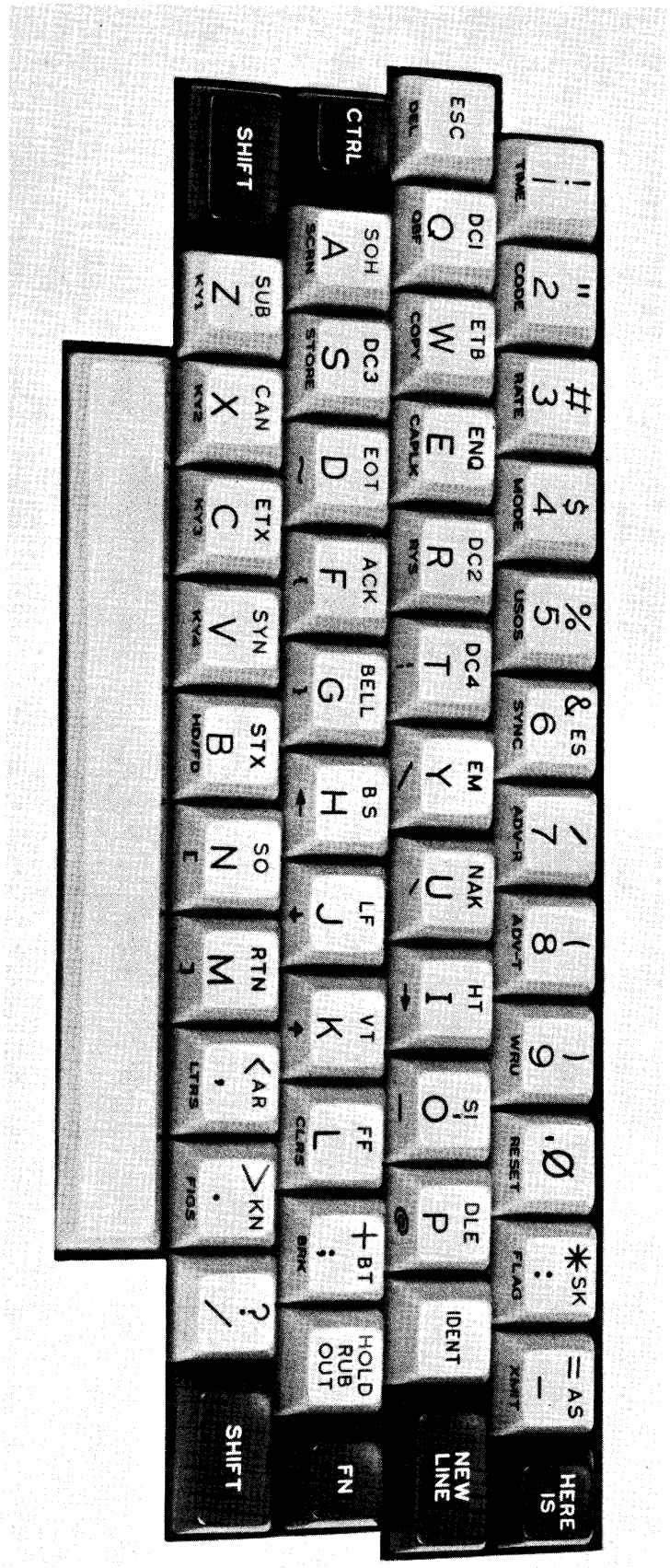


FIGURE 4. THE DS3100 KEYBOARD

2.2 KEYBOARD FEATURES:

The keyboard of the DS3100 ASR is used both to control the terminal as well as to type text to be transmitted. Each major key of the keyboard can be used in several ways, depending upon whether the SHIFT, CTRL, or FN keys are used while a chosen key is operated. These three control keys, SHIFT, CTRL, and FN, operate the same as the non-locking shift button on a standard typewriter - you must *hold* SHIFT (and/or CTRL or FN) *while* typing the selected major key. The following format is used in these manuals:

[FN] - [TIME] = Press and hold FN key while pressing *and releasing* the TIME key (same as number "1" keytop).

[SHIFT] - [FN] - [TIME] = Press and hold both SHIFT and FN while pressing and releasing the TIME key.

As shown in Figure 4, the keytops have been provided with multiple legends to help you remember what operation is associated with each key. The following format has been followed as much as possible:

Major Legend: The *text* that is produced when you type the key *without* a control key (SHIFT, CTRL, or FN). In ASCII when CAP LK is not active, the *lower* case letter is transmitted without the SHIFT key and *upper* case letters with the SHIFT key. ASCII CAPS LK, Baudot, and Morse send upper case letters regardless of whether SHIFT is used or not, and "CAP LOK" is automatically shown on screen.

Upper Legend: In general, the upper legend is associated with use of the SHIFT or CTRL keys. For example, the punctuation associated with the upper row of numbers and with the ";" and "/" keys are all generated by using the SHIFT key. On the other hand, the control codes indicated by DC1, ETB, ENQ, etc. are all ASCII codes that are obtained through use of the CTRL key. There are six further exceptions for Morse code -- the special two-letter groups (prosigns) "ES, $\overline{SK}$, $\overline{AS}$, $\overline{BT}$, $\overline{AR}$, and $\overline{KN}$ are all obtained by using the SHIFT key in the Morse mode only.

Front Legend: The special front-face legend is primarily intended for use with the FN (FunctioN) key to indicate control of the terminal itself rather than a transmittable code. For example, FN-CODE ("2" keytop) changes the terminal's code from ASCII to Baudot to Morse etc. for each operation; FN-MODE changes the transmitting mode; FN-QBF inserts the "Quick Brown Fox . . ." test message into the transmit buffer. In some cases, the front legend also indicates an ASCII control or special symbol that is obtained through use of the FN key (such as FN-DEL).

Because of the space limitations of the keytop surface, there are still a number of special ASCII characters in particular that could not be directly identified - refer to this manual and the Operator's Guide for a listing of these cases.

A repeat feature operates with all keys except SHIFT, CTRL and FN keys. To repeat a key, simply hold it (and the associated SHIFT, CTRL, FN) down for longer then $\frac{1}{2}$ second. After the initial $\frac{1}{2}$ second delay, the chosen key function will

repeat at a 10/sec. rate until released. This feature works with both text and control keys.

2.3 FUNCTION KEYS:

The operation of the terminal itself is controlled directly from the keyboard with the FN plus other selected keys. On-screen *status indicators* show which particular code, rate, mode, etc. have been selected by the keyboard. Some of the more important mode, screen and transmitting controls are shown in the Operator's Guide. The following is offered as a more complete discussion of these controls. Please refer to Figures 2 and 3 as required.

[FN] - [TIME]

Inserts the *current* time message in the transmit buffer, indicated by a *bright intensity*, upper case T. When the text in the buffer is transmitted, the correct time *at transmission* is sent with the time message. The time message can contain up to 20 characters total in the recommended format:

"1345CST MAR 22, 1979"

The first four characters are interpreted as the 24 hour time (HR-HR-MIN-MIN) and updated automatically after first programming. The first *seven* characters of the time message (time + zone) are shown in the top right status indicator.

[SHIFT] - [FN] - [TIME]

Programs the time message as discussed in the *Programmable Features* section of this manual.

[FN] - [CODE]

Selects the transmit/receive code of the terminal. The code in use (either ASCII, BAUDOT, or MORSE) is shown by the second status indicator. Transmit and receive data codes are identical and stay the same unless you change code with FN-CODE. Each operation of FN-CODE advances the terminal to the next code; ASCII - BAUDOT - MORSE - ASCII - BAUDOT - ... etc. The IDENT key is the only feature that does *not* follow the chosen code; IDENT *always* produces a Morse code output of the contents of HERE IS - Ø at the last previously selected Morse rate.

[FN] - [RATE]
[SHIFT] - [FN] - [RATE]

Changes the terminal's data rate, increasing it when FN-RATE is used and decreasing it when SHIFT-FN-RATE is used. The RTTY rates available are:

ASCII:	110, 150, 300, 600, 1200 baud 1800, 2400, 4800, 9600 baud
BAUDOT:	45, 50, 57, 74, 100 baud (60, 66, 75, 100, 133 wpm)

Morse *transmit* words-per-minute (WPM) rates are changed in one wpm increments for each FN-RATE (or SHIFT-FN-RATE to decrease) key operation. Large increases or decreases in rates can be easily made by holding the keys down for longer than ½ second; the programmatic repeat feature will then quickly change the rate. The Morse *receive* wpm rate is automatically adjusted to follow the received signal

and is therefore not set with FN-RATE or SHIFT-FN RATE.

The chosen RTTY or Morse rate is shown by the *third* status indicator.

FN - MODE

Change the *transmitting* mode between CONT (continuous), LINE, or WORD modes. The specified mode applies only to how the terminal responds to typed text *after* the transmitted output "catches-up" with the typed text. The terminal will then transmit characters as they are typed (CONT mode), a line at a time (LINE mode), or a word at a time (WORD mode). Use of these modes and their interaction with other terminal operations is discussed in the *Transmitting Controls* section. The currently selected mode is shown in the fourth status indicator.

FN - USOS

Turns the UnShift On Space (USOS) feature on or off as shown by the fifth status indicator. This feature is only effective when receiving Baudot RTTY transmissions. When activated, the USOS feature automatically resets the receive decoding circuitry to Baudot letters case after reception of a space bar character. This tends to improve reception of noisy Baudot signals by preventing an inadvertent "lock-up" in figures case and subsequent display of numbers and symbols in place of the desired text. The feature is normally turned off on strong signals and when the anticipated text is lists of numbers.

FN - SYNC

Turns the SYNChronous idle feature on or off as shown by the sixth status indicator. This feature provides "fill" characters that can be transmitted if the keyboard entered data is slower than the output transmitting rate. In Baudot, the LTRS character (11111) is used; in ASCII, the NULL character (ØØØØØØØØ); and in Morse the $\overline{\text{BT}}$ (-···-) character. This feature can improve the other station's reception of your signal by maintaining synchronization.

FN - ADV - R

SHIFT - FN - ADV - R

Advance (FN-ADV-R) or retard (SHIFT-FN-ADV-R) the display of the receive buffer. If held, either combination allows fast scanning of the buffer contents through the programmatic repeat feature. As the dis play position changes, the line numbers change. Buf fer manipulation is discussed in detail in the *Scree Controls* section and illustrated in Figure 3.

FN - ADV - T

SHIFT - FN - ADV - T

Advance (FN-ADV-T) or retard (SHIFT-FN-ADV-T) the display of the transmit buffer. If held, either combination allows fast scanning of the buffer contents through programmatic repeat. The line numbers reflect the display position in the transmitter buffer. Buffer manipulation is discussed in detail in the *Screen Controls* section and illustrated in Figure 3.

[FN] - [WRU]

The WRU and SEL CAL features are selected with FN-WRU, as indicated by the ninth status indicator on the screen. When the WRU is active, receipt of the exact WRU code message (or ASCII WRU/ENQ character) causes the following chain of events:

1. Turn KY4 on
2. Delay 4 seconds
3. Transmit contents of HERE IS-1
4. Turn KY4 off

[SHIFT] - [FN] - [WRU]

Program the WRU code message as discussed in the *Programmable Features* section of this manual.

[FN] - [RESET]

This key combination serves as a master clear for the terminal. It is particularly useful as a reset for reception of Morse code as is discussed in the *Morse Operation* section.

[FN] - [FLAG]

The FN-FLAG key combination is a control feature for the transmit buffer to set a start transmit location other than with line one. This feature is described in detail in the *Transmitting Controls* section.

[FN] - [XMIT]

The FN-XMIT combination controls the output of the transmit buffer. The seventh and eighth status indicators show the transmit status of the terminal, showing either XMIT INHIBIT, XMIT ACTIVE, or XMIT ENABLED. The status is changed between XMIT INHIBIT and XMIT ACTIVE (or ENABLED) by alternate operations of the FN-XMIT keys. Operation of the FN-XMIT keys and status indicator are discussed in detail in the *Transmitting Controls* section.

[HERE IS] - #

Up to ten different 32 character identification messages can be transmitted by holding the HERE IS key while pressing a numeral key (1 to Ø).

[FN] - [HERE IS] - #

Program the contents of each HERE IS segment with FN-HERE IS-# as discussed in the *Programmable Features* section of this manual. The bottom status indicator shows "HI # PRG" while programming is in progress.

[FN] - [QBF]

Transmit the test message: "THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG'S BACK 1234567790".

[FN] - [COPY]

Transfer the *bottom* displayed line of the receive buffer into the next available line of the transmit buffer. The COPY feature is discussed in greater detail in the *Transmitter Controls* section.

[SHIFT] - [FN] - [COPY]

Transfer the *top* displayed line of the receive buffer into the next available line of the transmit buffer. The COPY feature is discussed in greater detail in the *Transmitter Controls* section.

[FN] - [CAP LK]	Used with ASCII code only to change between all capital letters or full upper and lower case letters when transmitting. The twelfth status indicator shows "CAP LK" when the all-capital-letters mode is chosen. The receive section of the DS3100 will display whatever ASCII character is received, either upper or lower case. The CAP LK feature is discussed in detail in the *ASCII Operation* section.
[FN] - [RYS]	Transmit one 72 character line of RY chaeacters for use in Baudot testing. In ASCII code, a line of alternate "U*U*U* ..." characters is transmitted for ASCII testing. No output is generated in Morse code.
[FN] - [SCRN]	Change screen from the 12 line receive / 12 line transmit buffer display to a full 24 line display of the receive buffer only and no display of the transmit buffer. The keyboard still writes data into the transmit buffer, however. Buffer and screen manipulation is discussed in detail in the *Screen Controls* section.
[SHIFT] - [FN] - [STORE]	Store the present terminal conditions and selected messages in the non-volatile EAROM memory. Use of the EAROM is discussed in greater detail in the *Programmable Features* section.
[FN] - [CLRS]	Empty the entire transmit buffer. This operation may be desired when using the FN-FLAG keys. Transmitter operation is discussed in detail in the *Transmitting Controls* section.
[FN] - [BRK]	In Baudot or ASCII codes, FN-BRK causes a "break in the RTTY loop" or continuous spacing condition for as long as the keys are held down. This allows testing of equipment in the space condition, such as the space frequency of a modem or transmitter. In Morse code, FN-BRK produces a key-down condition for as long as the keys are held down.
[FN] - [KY1] [FN] - [KY2] [FN] - [KY3] [FN] - [KY4] [SHIFT] - [FN] - [KY1] [SHIFT] - [FN] - [KY2] [SHIFT] - [FN] - [KY3] [SHIFT] - [FN] - [KY4]	Four switching output transistors are turned on with the FN-KY1 through FN-KY4 keys. The transistors are NPN, rated at +200 Vdc or 100 mA maximum and may be used to control external equipment such as radio Transmitters or tape storage devices. The switch turns on (low impedance to ground) with the operation of the FN-KY# keys and turns off (high impedance to ground) with the operation of SHIFT-FN-KY#. The KY4 switch is also turned on and off by the WRU response sequence, and the KY3 switch is turned on by the WRU response sequence if SEL CAL feature is selected. KY3 is turned off in either WRU or SEL CAL modes when a "NNNN" text is received. The status of each KY switch is shown by the tenth status indicator -- only the numbers of the *active (or on)* switches are shown.

[FN] - [HD/FD]

Select either half- or full-duplex terminal operation. Either Baudot or ASCII codes can be operated half- or full-duplex, but the feature is most convenient when the DS3100 ASR is used as a computer terminal in the ASCII code. In half-duplex, the terminal either receives or transmits but *not simultaneously*. Transmit text can be *composed while receiving* ("ASR" feature) but transmitting of the text must await completion of reception. Virtually all radio RTTY operation uses the half-duplex mode. In half-duplex mode, the transmitted text is locally "echoed" (or written) into the receive buffer as it is transmitted. Such "echoed" text is displayed with a dim intensity, however, to distinguish it from the brighter display of received text. Full-duplex allows the transmitter and receiver sections of the DS3100 ASR to operate *simultaneously*. In this case, the transmit text is not "echoed" into the receive buffer. The half- or full-duplex conditions are shown by the eleventh status indicator.

[FN] - [LTRS]

In Baudot code *only*, the FN-LTRS transmits the LTRS character (11111).

[FN] - [FIGS]

In Baudot code *only*, the FN-FIGS transmits the FIGS character (11Ø11).

2.4 SCREEN CONTROLS:

The screen of the DS3100 ASR serves both as a text display device and to provide indication of various terminal operating conditions. The *status indicators* in the right-hand margin of the screen provide a continuous display of the time, data rate, code, mode, etc., as explained in the *Function Keys* section of this manual and in the Operator's Guide booklet.

The majority of the screen is used to display text that has either been received from a source outside of the DS3100 ASR or composed at the DS3100 ASR keyboard. In normal usage, the upper half of the screen (top twelve lines) is devoted to display of received text and the lower half (bottom twelve lines) to display text to be transmitted. Alternatively, the entire 24 line screen can be devoted to receive text only by using the FN-SCRN key combination.

The DS3100 ASR is a *fully buffered* terminal, meaning that *all* received text and *all* text to be transmitted are stored in memories, or buffers. Up to 150 lines of receive text and 50 lines of transmit text may be stored in the two memories, the *receive buffer* and the *transmit buffer*. The screen of the terminal provides a *window* through which you can observe selected portions of each memory. The position of either the receive or transmit halves of this *window* may be shifted under keyboard control to allow viewing of any portion of either buffer area.

Line numbers are generated internally by the DS3100 ASR and appended to the text to provide a reference between the displayed text and either current receive data or text to be transmitted next. In the receive buffer, new text is always entered into line one. Thus the line number in the receive buffer tells you the relationship between the stored line of text and that currently being received. Received text will continue being placed into line one of the receive buffer, even if the display is adjusted so that line one is not being currently viewed. When more than 150 lines of text has been received, the "oldest" line received is lost.

Conversely, the transmit buffer numbers the lines so that line number one corresponds to the line that will be transmitted first when transmitting is started. A total of 50 lines to be transmitted may be precomposed in the transmit buffer and then transmitted at will. As will be discussed in detail in the *Transmit Controls* section, text may also be transferred from the receive buffer to the transmit buffer, edited, and then retransmitted.

The relationship between the screen position, the buffer location, and line numbers as illustrated in Figure 3. The function keys ADV-R and ADV-T ("7" and "8" keytops), combined with either FN or SHIFT-FN control keys allows the screen position to be changed in both buffers. When viewing the receive buffer, FN-ADV-R will *advance* the receive section of the display into the receive buffer, causing the line numbers to *increase*, thus showing lines that were received at an *earlier* time. The display position can be shifted back *towards the current input* with SHIFT-FN-ADV-R. Each operation of ADV-R will shift the screen position by one line. Multiple line shifts in either direction are made by simply holding the keys for more than ½ second, allowing the programmatic repeat feature to operate. The position can be shifted between line numbers 1 and 150, but will not shift below 1, above 150, or "roll-over" when either limit is reached.

The transmit section of the display operates in a similar manner with the ADV-T key. FN-ADV-T operation shifts the display towards higher line numbers, towards the end of a message to be transmitted. Conversely, SHIFT-FN-ADV-T shifts the display back towards line one, the start of a message to be transmitted. As

in the case for the receive display, the screen can be shifted only between lines 1 and 50 of the buffer.

NOTE: Shifting of either receive or transmit sections of the display has *no effect* upon cursor locations. The receive cursor indicates where new text is written into the receive *buffer*, the output cursor shows where data is written out of the transmit *buffer*, and the keyboard cursor shows where keyboard data will be entered into the transmit *buffer*.

In some cases, it may be desireable to view more than 12 lines of receive text at a time. In this case, the entire 24 lines of display can be devoted to the receive buffer by operating the FN-SCRN key combination. When this is used, the line numbers and text shift so that the next 24 rather than 12 lines are viewed. For example, if lines 1 through 12 were shown on the split screen format, use of FN-SCRN will now show lines 1 through 24 on the screen, shifting line 1 from the middle of the screen down to the bottom. The exception to this behavior occurs when the display is positioned at the very end of the receive buffer and line 150 is therefore at the top of the receive display area. In this case, lines 127 through 150 will be shown when FN-SCRN is used. The screen may be returned to the normal split screen format with a second operation of FN-SCRN.

Since the keyboard always writes into the transmit buffer and the data is always transmitted out of this buffer, use of FN-SCRN does *not* affect either composition of keyboard text or the transmitting of text. It does mean however, that when the 24 line display is devoted to the receive buffer, all writing into or out of the transmit buffer is done without the benefit of screen display. This is the electronic equivalent of the "typing in the blind" mode of operating the older paper-tape teleprinter systems. In the case of the DS3100 ASR, however, you may review your typing at any time by simply using FN-SCRN again to regain the split-screen display.

As will be discussed in the *Programmable Features* section, the lower half of the screen (transmit section) is also used to display text associated with programming of the HERE IS messages. When HERE IS messages are programmed, the display of transmit buffer text is temporarily *replaced* with a two line display, an upper line to show previous contents of the HERE IS message and a lower line to show the new text as it is written. To avoid confusion with normal transmit buffer display, all line numbers are removed from the lower half of the screen and the bottom status indicator shows PROG while HERE IS programming is in progress. These indications also serve as a warning to the operator that he must terminate HERE IS programming to obtain normal operation from the terminal. While the HERE IS is being programmed, previously entered text may be transmitted from the transmit buffer but new keyboard text may *not* be entered. These cases are discussed in more detail in the *Transmit Controls* and *Programmable Features* sections.

2.5 TRANSMIT FEATURES:

The DS3100 ASR transmit buffer system allows completely independent use of receive and transmit functions of the terminal. Unlike previous electronic or mechanical KSR terminals, all keyboard text is written into the transmit buffer memory. This transmit text can be written at any time and transmitted as written, saved and transmitted later, or transmitted in segments, all while text is being received and displayed.

The lower half of the DS3100 screen is normally devoted to the displaying 12 lines of the transmit buffer memory. As explained in the previous sections (*Display Features* and *Screen Controls*), the display position with respect to the buffer can be moved at will with the FN-ADV-T or SHIFT-FN-ADV-T controls. Also, the full screen of the display can be devoted to received text with the transmit features still operable but not displayed (FN-SCRN control). To help differentiate between the receive and transmit sections of the display, all transmit characters are displayed with a dim intensity.

2.5.1 TRANSMIT CONTROLS:

Characters to be transmitted are normally typed on the keyboard of the DS3100 ASR. As the characters are typed, they are entered into the transmit buffer memory. However, the output of the transmit buffer is controlled with the FN-XMIT key combination and may be turned off or on at will, whether data is being received or text is being written on the keyboard. The condition of the transmit buffer output circuit is shown by the middle status indicator on the screen. As explained in the Operator's Guide booklet, the status indicator will show one of three indications, XMIT INHIBIT, XMIT ENABLED, or XMIT ACTIVE. The FN-XMIT key combination allows you to pretype the transmit text without transmitting it at once by selecting the XMIT INHIBIT status. While the status is XMIT INHIBIT, you may pretype *and edit* any text into the transmit buffer, even while receiving. The KOS switch remains in receive condition ("off") during XMIT INHIBIT status.

When it is desired to start transmitting the precomposed text, use FN-XMIT keys to change to a XMIT ACTIVE status. At this time, the precomposed text will be transmitted out of the buffer at the set code and data rate. Normally, a 2 second delay is provided between selection of XMIT ACTIVE and actual initialization of the transmission. Section 2.6.6 provides details for removing this delay, by means of reprogramming of the SPECIAL OPTION character. If desired, you may continue typing text into the transmit buffer and it will be transmitted in turn, after preceeding text. The progress of the output is shown by the transmit cursor and keyboard text is entered at the keyboard cursor on the screen. As each line of the buffer is transmitted, it is removed from the screen and the buffer and the next line of text is moved into line one.

When the text in the buffer has been transmitted, the output cursor will have "caught-up" with the keyboard cursor and the transmit buffer will be "empty". At this time, the terminal status will change to XMIT ENABLED, meaning that although all available text has been transmitted, new text will be transmitted immediately as it is made available (by typing on the keyboard). The operator may either continue typing and the characters will be transmitted as he types them or, if the message is complete, he may choose to use FN-XMIT to regain the XMIT INHIBIT status. The KOS switch control only remains in transmit ("on") condition while XMIT ACTIVE status is maintained.

2.5.2 TRANSMIT MODES:

In addition to the ASR, precomposed-text transmit feature, the DS3100 may also be operated in a Continuous (CONT), LINE, or WORD mode, much like the pre-

vious model DS3000 KSR terminal. These modes are chosen with the FN-MODE key combinations and the selected mode is shown in the fourth status indicator. Each of these modes is only invoked when the transmit buffer is empty. Transmit data can only be transmitted when XMIT ACTIVE status is selected. At this time, any precomposed text is transmitted at the chosen data rate. However, when the precomposed text has all been transmitted (output cursor "catches-up" with the keyboard), the terminal now obeys the rules governing the selected transmit mode, CONT, LINE or WORD. These rules are:

CONT: Transmit text is output as each character is typed, XMIT status changes between XMIT ENABLED and XMIT ACTIVE as characters are transmitted; KOS is "on" only when XMIT ACTIVE status is shown.

LINE: Transmit text is output one line at a time; the text within a line is not transmitted until after a NEW LINE is typed. The XMIT ACTIVE and KOS "on" conditions occur while the lines are being typed; status reverts to XMIT ENABLED and KOS "off" between transmission of lines.

WORD: Transmit text is output one word at a time. A word is not transmitted until the first character following a space is typed. The last word in a line is transmitted following a NEW LINE key operation. The XMIT ACTIVE and KOS "on" conditions occur while each word is being transmitted with XMIT ENABLED and KOS "off" between transmission of words.

2.5.3 SYNCHRONOUS IDLE:

Directly associated with use of LINE and WORD modes is also the use of the synchronous idle (SYNC) feature (sometimes also called "diddle"). The SYNC feature may be turned on or off with alternate operations of the FN-SYNC key combination. The purpose of the synchronous idle feature is to provide a continuous stream of data pulses to the station on the receiving end of your transmitted signal to maintain synchronization. This can be particularly effective in improving copy of weak signals in the presence of noise. The most improvement will be noticed when mechanical printers are used on the receiving end. Non-printing characters are inserted by the DS3100 ASR as "fill" characters to maintain a stream of data pulses. The characters used in the DS3100 ASR are:

ASCII:	NULL	(11111111)
BAUDOT:	LTRS	(11111)
MORSE:	$\overline{\text{BT}}$	(-···-)

This SYNC feature has popularly been used with LINE or WORD modes on the DS3000 KSR to provide "fill" characters between transmission of lines or words of text. This same feature is provided on the DS3100 ASR. Note that since there are now continuous characters to be transmitted between words or lines, the status remains XMIT ACTIVE and the KOS stays "on".

To maintain the KOS feature of the DS3100 ASR while SYNC idle is selected, the KOS is "keyed" by the start of new lines of text. Therefore, to stop the SYNC feature and therefore get the XMIT ENABLED and KOS "off" conditions, you must *end the transmission with a NEW LINE key operation.* If, after a short delay, no additional characters are typed after the NEW LINE key, the SYNC characters are turned off and KOS line allowed to go to "off". Conversely, the XMIT ACTIVE and KOS "on" conditions can be re-envoked by simply typing *any* character on the new line in the transmit buffer. The SYNC feature only works when either LINE or WORD modes are selected and the sixth status indicator shows when the SYNC feature is turned on.

Therefore, a good operating habit would be to -

ALWAYS END EACH TRANSMISSION WITH A *NEW LINE* KEY OPERATION.

This procedure will not only assure proper operation of the KOS with SYNC idle, but will also let the other fellow's printer start on a new line, avoiding any potential overprints that might be due to noise.

2.5.4 RETRANSMITTING RECEIVED TEXT:

The DS3100 ASR may also be used to retransmit selected portions of text that were received rather than written on the keyboard. Since only text that is in the transmit buffer may be transmitted, it is first necessary to copy the desired lines from the receive buffer into the transmit buffer. This operation is carried out with either FN-COPY or SHIFT-FN-COPY key combinations. The procedure is as follows:

1. Use the FN-ADV-R or SHIFT-FN-ADV-R controls to position the line to be copied so that it is the *bottom* line of the receive section of the display.
2. Use FN-COPY to copy the *entire* line into the transmit buffer.
3. The copied line is placed on the *next available* line in the transmit buffer memory.

This procedure allows copying of received text in lines 1 through 129 of the receive buffer. However, since the display cannot be shifted beyond the "ends" of the buffer, a different procedure is provided to allow copying from the *top* line of the receive buffer. This procedure will let you copy lines 12 through 150 into the transmit buffer:

1. Use the FN-ADV-R or SHIFT-FN-ADV-R controls to position the line to be copied so that it is the *top* line of the receive section of the display.
2. Use SHIFT-FN-COPY to copy the *entire* line into the transmit buffer.
3. The copied line is placed on the *next available* line in the transmit buffer memory.

This copy feature can be particularly useful in handling messages where you need to relay the text on to the next station ("handling traffic"). After the text has been transferred into the transmit buffer, you may make full use of the edit capabilities of the DS3100 ASR to correct errors, change the heading and signature, and add text, such as the time message, etc.

2.5.5 EDITING TRANSMIT TEXT:

One of the great advantages of the fully-buffered DS3100 ASR is the ability to edit your text before it is transmitted. During the time you are pretyping and the FN-XMIT control has been used to set a XMIT INHIBIT status, you can move the cursor anywhere within the transmit buffer, correcting spelling errors, rewriting letters, words, or sentences or selectively erasing portions of the text. The following keyboard cursor controls are used to move the cursor to the desired location in the buffer:

FN → Move keyboard cursor one position to the right (forward).
FN ← Move keyboard cursor one position to the left (reverse).
FN ↓ Move keyboard cursor one line down (to next line).
FN ↑ Move keyboard cursor one line up (back one line).

All of these controls result in *non-destructive* movement of the cursor - letters are not removed or replaced as the cursor is moved through them. If multiple movements are required, hold the keys for greater than ½ second so that the programmatic repeat feature operates.

When the cursor is shifted between lines, the display of the transmit buffer is automatically adjusted so that the cursor is always on the screen, shifting the display if required.

To correct the errors, you may simply over-write with new characters, replacing the old with the new as you do, or use the RUB OUT key to back-up one space *and erase* that character as you do (thus differentiating between FN ← which does *not* erase). Most typing errors that you catch quickly can be most easily fixed with the RUB OUT key.

When changing words or letters in the middle of a line, the DS3100 will *not* re-adjust line length to correct for more or less letters in the amended line. Rather, you may prefer to either leave extra spaces or retype the balance of the line following the error. An exception to this rule occurs when re-programming a HERE IS message as will be discussed in the *Programmable Features* section.

It is important to distinguish between these *local terminal controls* and the *ASCII Control Characters*. The FN- (arrow) and RUB OUT controls only control the composition of transmit text and do *not* insert the ASCII *control character* for the operation. However, the ASCII control character can be inserted into the transmit buffer and transmitted by using the appropriate ASCII key combination; CTRL-BS, CTRL-LF, CTRL-VT, CTRL-HT, CTRL-FF, and FN-DEL. Use of these controls and their appearance in the transmit buffer is discussed in the *ASCII Operation* section.

2.5.6 EDITING TEXT WHILE TRANSMITTING:

All of the above techniques may be used to edit text, even while the text is being transmitted. Obviously, once the characters are transmitted they are "gone" and cannot be corrected! (A possible exception would be in the case of two stations equipped with *full* ASCII display terminals - the ASCII control codes could then instruct the receiving display to back up into previously received text, correct it, and move back to continue displaying new text.) However, a number of special features may be used to great advantage to correct errors before they are transmitted. These techniques are:

1. If the keyboard typing is many characters or several lines *ahead* of the transmitted output, you may use any of the cursor controls and RUB OUT to move to error, correct it, move back to the main text and continue typing. However, time is required to do all this movement and several lines of "buffer" between the error and the output cursor are needed to successfully perform cursor shifting.
2. You may suspend the transmitter output temporarily by typing SHIFT-HOLD. This operation temporarily stops the transmitted output in the mark condition (key up for Morse), retains XMIT ACTIVE status, and holds the KOS "on". The terminal stays locked in HOLD until you type a *printing* character. At this time the transmitter output resumes. This feature allows you to correct that error "just before" it is transmitted.
3. After the transmitter output "catches-up" with the keyboard input, you can use either LINE or WORD mode to hold either the present line or previous word for possible editing.

In general, the most convenient mode of operating will probably be to use FN-XMIT to get the XMIT INHIBIT status and precompose the text while receiving, editing as required, both while typing and then scanning the precomposed text prior to transmitting. When transmitting has started, edit as required using RUB OUT and depend upon WORD MODE when the transmitted output catches-up with the typing.

2.5.7 TRANSMITTING A PORTION OF THE TRANSMIT BUFFER:

Normally, when FN-XMIT is used to start transmission (XMIT ACTIVE/ENABLED status), the transmitted output starts at the beginning of line 1 of the transmit buffer and goes until all of the text (up to the keyboard cursor) has been transmitted. The output or "follow-along" cursor indicates the output progress within a line. When the entire line has been transmitted it is removed from the screen and the next line is moved into line one and transmitted in turn.

To provide for the cases where it may be desirable to start transmitting at some line other than line 1 or where it is necessary to save the text, even after tranmission, a *Flag* mode of using the transmit buffer has been included, invoked with the FN-FLAG key combination. The details of this mode are:

1. Position the keyboard cursor to be in the desired starting *line*. (The cursor is positioned with FN- (arrow) keys and need *not* be placed at the beginning of the line).
2. Type FN-FLAG and note that a "*" symbol has been placed on the screen between the line number and the text.
3. Move cursor to end of text to be transmitted.
4. When transmitting is initiated with FN-XMIT, it will now start at the *beginning* of the * marked line and continue transmitting until the output "catches-up" with the keyboard cursor. (The terminal now goes to CONT, LINE, or WORD mode, as before).
5. The text on lines preceding the * marked line is *not* transmitted and lines are *not removed* as they are transmitted.
6. More than one flag (*) may be set in the transmit buffer - transmission always starts at the flagged line *closest to the keyboard cursor*.
7. The flags (*) remain set until removed with a second FN-FLAG key operation (keyboard cursor positioned in flagged line).
8. Because the transmit buffer no longer "self-clears" itself of text as text is transmitted, the full 50 lines of transmit buffer can be filled easily. If desired, the entire transmit buffer can be cleared with the FN-CLRS key operation, which also removes all flags and restores the output and keyboard cursors to line 1.

This procedure allows you to save some message or messages in the transmit buffer that you may wish to retransmit several times. In general,this technique will be most effectively used when text of more than one line is to be re-used since the multiple-segment HERE IS messages can be used for shorter text storage.

2.5.8 HALF DUPLEX / FULL DUPLEX:

The DS3100 ASR can be operated in either a half- or full-duplex cofiguration. These two transmit/receive modes are:

Half-Duplex (HDX): As text is transmitted out of the transmit buffer, it is internally "echoed" or displayed in the receive section of the display. To help in differentiating between locally generated text (echoed text), and that received externally, all echoed text is displayed with *dim* intensity in the receive display.

Full-Duplex (FDX): In full-duplex there is no local echo of the transmitted text back into the receive buffer or display. Therefore, FDX will support *simultaneous* transmit and receive operations. See section 2.6.6, item 3, for more information on ASCII FDX operation.

Normal radio teleprinter communications are all made using a half-duplex system where only one station transmits at a time. However, full-duplex, simultaneous receive-transmit operation is quite commonly used between computers and their associated terminals. The HDX or FDX can be chosen at will with the FN-HD/FD key combination and displayed by the 11th status indicator.

2.5.9 TRANSMIT BUFFER DISPLAY OF SPECIAL OPERATIONS:

Normally, all characters are displayed on the screen as typed on the keyboard. However, some key operations can produce transmit output that may not be easily represented by a standard character. The entry of the TIME message or KY# switch controls are examples. These special cases are therefore represented in the transmit buffer as bright characters, each corresponding as much as possible to the letter associated with the key operation. These operations and corresponding characters are:

KY1 on, bright "Z"; KY1 off, bright "z".	TIME bright "T".
KY2 on, bright "X"; KY2 off, bright "x".	LTRS bright "<".
KY3 on, bright "C"; KY3 off, bright "c".	IDENT bright "I".
KY4 on, bright "V"; KY4 off, bright "v".	FIGS bright ">".

When a bright "T" (time call-up) is transmitted, the correct time is then called and sent, rather than the time at which the text was pre-typed. Similarly, the KY# switches are not controlled until their turn comes in the transmit sequence. When a HERE IS message is inserted into the transmit text, its *program* is completely written in the buffer. If another HERE IS or special feature has been included within the HERE IS program, all expanded texts are shown in the transmit buffer. When the QBF or RYS test messages are entered, the full line of text is inserted into the transmit buffer. (Note: QBF and RYS messages cannot be entered into a "here is" memory).

As will be shown in the *ASCII Operation* section, a set of special display symbols are used to show the presence of ASCII control codes such as ETB, DC1, NAK, ACK, etc. These standard symbols are used in both the receive and transmit displays to represent the control characters.

2.5.10 UPPER / LOWER CASE ASCII:

The DS3100 ASR is a transmit-receive terminal for the full 128 character ASCII code, including upper and lower case letters. However, a number of computer applications in particular have adopted a reduced set of ASCII characters in which only upper case, or capital letters are used. The receive section of the DS3100 ASR will display whatever ASCII character it receives - if only capital letters are received, that's all it will display. The keyboard, however, is set-up for lower case letters without the SHIFT key and upper case with SHIFT key. The *letters* of the ASCII output can be set to upper case (capital letters) only output if the CAP LK feature is activated with FN-CAP LK. When CAP LK is on (shown by the status indicator), the code corresponding to the capital letter is sent whether a SHIFT key has been used with the letter key or not. Since neither the Baudot nor Morse codes provide for upper/lower case letter distinction, this feature only applies to ASCII operation.

2.5.11 BRK, KOS, AND KY# FEATURES:

The FN-BRK key combination allows testing of the associated equipment by holding the DS3100 ASR transmit output in space (ASCII and Baudot) or key down (Morse) condition for as long as the keys are held. This operation occurs *external* to the transmit buffer and over-rides any transmit data that may be being transmitted, any receive data in process, and does not require a XMIT ACTIVE or XMIT ENABLED status to operate. Likewise, it does not operate the KOS circuit. The BRK key does allow testing of the space tones of a tone keyer or modem and tuning adjustment on a Morse code transmitter.

The KOS (Keyboard Operated Switch) feature allows automatic control of the transmit-receive circuitry of the radio station. The KOS switch is an NPN transistor that presents a low-impedance to ground during transmit conditions (100 ma recommended maximum "on" current) and a high impedance during receive conditions (+200 volts dc recommended maximum "off" voltage). The KOS switch is normally connected to control the push-to-talk (PTT) control line of a transmit-receive set of equipment. Because of the NPN transistor, only *positive* voltages with respect to ground should be switched.

In addition to the KOS, four auxiliary transistor switches are provided, the KY1, KY2, KY3, and KY4 switches. These switches are also NPN and provide a low impedance to ground when "on" and a high impedance when "off." The switch transistors carry the same 100 ma or 200 VDC positive voltage ratings as the KOS switch. The KY# switch will turn "on" with the FN-KY# operation and "off" with the SHIFT-FN-KY#. When the KY# switch command is included in a pretyped message or HERE IS message, the switch is not operated until the time it is to be transmitted. Thus, the switch command could be included early in a HERE IS program to turn on and later in the same program to turn off again. Switch KY4 is also controlled as part of the response to the reception of the WRU code message, and KY3 is also controlled as part of the SEL CAL response to reception of the WRU code message and "NNNN" received text. These will be discussed further in the Programmable Features section.

2.6 PROGRAMMABLE FEATURES:

A number of features of the DS3100 ASR may be user-programmed to fit your requirements. These features are: TIME, HERE IS messages (a total of 10), a WRU answer-back message, and non-volatile storage of some features and messages.

2.6.1 TIME MESSAGE:

The current time plus an additional 16 characters may be programmed and then called for transmission as desired. The circuitry of the DS3100 ASR updates the entered time and assures that the correct time is always used when the TIME feature is called.

The TIME message can contain up to 20 characters maximum, *including* the four digit time numbers. The *recommended* format of the message is:

"1345CST MAR 22, 1979" (20 characters)

The first 7 characters of the message (1345CST in the above example) are displayed in the upper right-hand status indicator on the screen to serve as a convenient operator clock. The last 13 characters are informational and are appended to the time when the message is to be transmitted.

The first four digits of the TIME message are always interpreted by the DS3100 as the time and are updated automatically by the internal clock. The *date* is *not* automatically updated and must be corrected by reprogramming when indicated. (This allows complete freedom in the format used in programming the latter section of the message). If a time has not been specified by programming, the DS3100 ASR automatically starts keeping time at ØØØØ when power is turned on, the status indicator then indicating how long the terminal has been turned on.

The TIME message is accessed by the FN-TIME and SHIFT-FN-TIME key combinations. The rules for programming and use of the TIME feature are as follows:

Program the time feature:

1.	[SHIFT]-[FN]-[TIME]	Starts programming; bottom status indicator shows PROG to remind you to finish the programming sequence.
2.	enter time message	Format: "1345CST MAR 22, 1979"
3.	[SHIFT]-[FN]-[TIME]	Ends programming; bottom status indicator turns off, standard video display returns.

This recommended format need not be used if the following points are considered:

1. The first *four* characters should be the time in a 24 hour format (Hr Hr Min Min) to be compatible with the internal clock feature.
2. The first *seven* characters are shown in the upper right-hand status indicator, showing the 4 digit time plus up to three characters for a time zone designator (EST, PST, MST, CDT, etc). Do *not* put a space between the time digits and a three character designator. Conversely, the universal time designators "UT" or "Z" could be used *with* a space after the time digits.

Some other programming formats that could be used are:

"1145 Z 22 MAR 79"	(16 Characters)
"1145 Z 78F SUNNY"	(17 Characters)
"1945PDT IN SUNNY LA"	(19 Characters)
"1645 UT 25C CLR ROME"	(20 Characters)

You may insert the TIME message into the transmit buffer at any time by typing FN-TIME. To save buffer space as well as to assure that the correct time is transmitted, the presence of the TIME message in the transmit buffer will show as just a lower case, bright intensity letter "T". *When the buffer is transmitted*, the entire TIME message text will be expanded and transmitted, inserting the correct time *when transmitted*. This compression of the 20 character message into a single letter "t" during storage could lead to some confustion about where lines end and where CR and LF characters are to be used. If text is simply typed into the buffer without regard to CR/LF insertions, the DS3100 non-overprint features (including word wrap-around) will *automatically* insert the carriage controls (CR/LF) when the text is *transmitted*, thus allowing for the compressed TIME (or other) message. If, however, you wish to format your own lines, inserting the CR/LF characters yourself, you should allow a 20 character space for the TIME message.

2.6.2 HERE IS MESSAGES:

The HERE IS features of the DS3100 are particularly versatile and flexible. A total of 10 different 32 character HERE IS messages may be programmed and used at will by the operator. Two of these messages, HERE IS-1 and HERE IS-Ø, can be saved even *after* power to the terminal has been *disconnected* (discussed in section 2.6.4). If messages longer or more involved than allowed by 32 characters are required, the individual messages may be chained together in sequence (HERE IS-1 to HERE IS-2 to HERE IS-3 ... etc) to make one long message *or* other HERE IS messages or other features may be *called* by the HERE IS program.

The HERE IS features are accessed with HERE IS-(number 1-Ø) key combinations (hold HERE IS and number down at same time) and programmed with FN-HERE-IS-# key combinations. While programming, the bottom status indicator shows "PROG" to remind the operator to end the programming with a second SHIFT-FN-HERE IS-# operation. Also, during programming, the *entire* transmit buffer section of the screen, including line numbers, is *removed* and the programming text shown instead.

The HERE IS programming is set-up so that you may easily save portions or even the whole *previously* programmed text, allowing such conveniences as insertion or deletion of call letters in a HERE IS text or slight modifications to that text. Opening the programming of a HERE IS message on the DS3100 ASR does *not* necessarily erase the previous message.

Therefore, when programming of a message is opened with SHIFT-FN-HERE IS-#, the transmit text is removed from the bottom half of the screen and, in its place two lines are shown; the top line being the present (or "old") text and the lower line showing the new text as it is written. A cursor is provided in *each* line. New text may be typed into the HERE IS message on the keyboard or sections of old text may be *copied*, letter-by-letter, into the new program. The cursor in the lower, or new text section may be positioned at will with the FN-← or FN-→ keys, overtyping to change text or the RUB OUT key may be used.

To copy "old" text into the new program, position the cursor in the top line to the desired letter(s) with SHIFT-FN-← or SHIFT-FN-→ and then type FN-COPY for each letter to be transferred.

Other HERE IS segments may be called within the HERE IS program by simply typing HERE IS-# corresponding to the desired message. The text of the chosen HERE IS message is *not* expanded on the display, but its *presence* is shown by a bright intensity number (1 to Ø), corresponding to the number of the chosen message (1 for HERE IS-1 etc). Any number of *calls* to other HERE IS messages may be included within a HERE IS program but the operator should be careful to avoid the continuous loop that could result from reciprocal calls between HERE IS segments! A call to a HERE IS message counts as *only one character* in the HERE IS program.

Similarly, other complex features of the DS3100 ASR may be called from the HERE IS message program. These features are TIME and control of the four acessory switches, KY1, KY2, KY3, and KY4. The presence of each of these features in the program requires only *one* programming character and is abbreviated on the screen by bright, upper-case letters (letters correspond to the associated keys).

The programming procedure to follow when programming the HERE IS messages is:

1. [FN] - [HERE IS] -#	Starts programming of this HERE IS message; bottom status indicator shown "PROG" to remind you to finish the programming sequence; the lower half of the screen shows only the previous HERE IS message and the new text as it is written.
2. Type new text or copy sections of previous test.	Use FN-(arrows) or SHIFT-FN-(arrows) to move cursors for copying; simple, *non-chained* messages should use *31 or less* characters. End programming with cursor at *end* of new text.
3. [FN] - [HERE IS] -#	Ends programming, turns off bottom status indicator, restores lower half of screen to display of transmit buffer.

Some further considerations while programming are:

1. If more than 31 characters are programmed in a segment, use of the 32nd character opens the next segment in sequence for programming.
2. Each keyboard key combination counts as *one* character for programming; calls to other HERE IS messages, TIME, KY1, etc *all* require only one programming position apiece.
3. When multiple character features are included in the HERE IS program, the full text of each is *not* displayed to conserve display space. Rather, special *bright* characters or symbols are used to represent these features. When the HERE IS message is transmitted, the *entire* text of each feature is inserted at the proper position. Thus, the TIME message is not actually called until it is to be transmitted, assuring that the currently correct time is always sent. Similarly, the KY1 - KY4 switch functions are not controlled until they occur in sequence as text is transmitted.

   The special bright characters are:

HERE IS-1	1	RYS	R	
HERE IS-2	2	IDENT	I	
HERE IS-3	3	LTRS	<	(Baudot only)
etc		FIGS	>	

HERE IS-Ø	Ø	KY1 KY2	Z/z X/x
TIME	T	KY3	C/c
QBF	Q	KY4	V/v

4. The HERE IS programming may be conducted *either when receiving or when transmitting*. Received text will continue to be entered into the receive buffer and displayed on the upper half of the screen while programming. If transmitting started *before* the programming was started, it will continue until either the transmit buffer has exhausted or it is stopped with FN-XMIT (change to XMIT INHIBIT status). However, while programming is continuing, the display does *not* show the transmit buffer, the keyboard *only* controls the HERE IS program, and other keyboard controls (such as FN-XMIT) will not operate until the programming is completed.

2.6.3 IDENT FEATURE:

The IDENT feature is a special version of the HERE IS message that allows Morse code *only* transmission of the contents of HERE IS-Ø message, *regardless* of the chosen terminal mode. The IDENT can be inserted at any time in the transmit text or called in a HERE IS message program. When the terminal is used in ASCII or BAUDOT codes, the RTTY transmit data circuit remains in the "mark" (logical "1") condition during the time that the IDENT message is transmitted in Morse code. The IDENT is always sent at the *last selected* Morse transmit speed. To remind radio amateur operators of the ten minute Morse identification requirement, the lower status indicator shows "IDENT" approximately 10 minutes after XMIT ACTIVE status is started. The IDENT status indicator is reset when transmission is stopped or by activation of the IDENT key (which starts another 10 minute timing period). The DS3100 does *not automatically* insert the Morse IDENT; the status indicator only *advises* the operator.

2.6.4 WRU AND SEL CAL FEATURE:

The DS3100 ASR also includes answer-back or WRU (Who aRe yoU) and SEL CAL features. The WRU is programmed to provide a response when the desired sequence of characters is received (WRU code message). A typical commercial answer-back TTY installation is used to verify (by transmission of a HERE IS message) that the addressed printer is operational. The WRU code message in the DS3100 can be programmed to respond to messages up to 10 characters long in ASCII, Baudot, or Morse code. In addition, the receipt of the ASCII ENQ (or WRU) code will "trigger" the WRU circuit. Upon receipt of the proper code, the WRU feature turns on switch KY4, transmits the contents of HERE IS-1, and then turns KY4 off. A delay is provided before transmission of the HERE IS-1 message to allow relays, transmitters, etc., to stabilize, and to allow a transmission of mark tone for a short period prior to the start of the HERE IS-1 "answer-back" transmission.

Basically, the same WRU code message will trip either feature. The modes are selected with the FN-WRU ("9" key) and are shown by the Status indicator to be "WRU ACT", "SEL CAL", or blank (off).

The WRU code message is programmed with the following procedure:

1.	[SHIFT]-[FN]-[WRU]	Starts programming of WRU code message; status indicator shows "WRU PRG" to remind you to finish the programming sequence;
2.	Type new text or copy sections of	As in programming of HERE IS text, portions of previous text may be recopied; bottom half of

previous text — screen is devoted to programming. Refer to the procedures explained in section 2.6.2.

3. [SHIFT] - [FN] - [WRU] — Ends programming of WRU code message.

The operation of the two modes is as follows:

1. Select the WRU answerback feature by pressing FN-WRU until the "WRU ACT" status is shown.
2. If the *exact* code message is received, the following sequence is triggered:
   a. The KY4 is turned on (low impedance to ground) and the XMIT ACTIVE status shown
   b. Delay approximately 4 seconds
   c. Transmit the contents of HERE IS - 1 (in selected terminal code and data rate)
   d. Turn off the KY4 and return to either XMIT INHIBIT or XMIT ENABLED
3. Select the SEL-CAL feature by pressing FN-WRU again to get "SEL-CAL" status indication.
4. Upon reception of the *same* WRU code message, or "QST" followed by a space, the KY3 is turned on and will remain on until turned off by four or more letter "N" characters in sequence ("NNNN"). The KY3 transistor switch may then be used to control a printer or other device.
5. When the SEL-CAL mode is selected, the KY3 switch may also be turned on with the sequence "QST space", thus giving an "all-call" option that will trigger all DS3100 ASRs in the circuit.
6. The control of the KY3 may also be made even though the WRU answerback mode is selected by including "FN-KY3" in the program for HERE IS-1, since the WRU response calls HERE IS-1. When used in this manner, KY3 will still be switched off if the "NNNN" sequence is received, but the "QST space" sequence will NOT control KY3.
7. If desired, the KY4 switch may be paralleled with the KOS switch to give automatic transmitter control in WRU answerback mode.
8. The KY3 switch is connected to control the S1 printer option for the DS3100 (KY3 ON = print; KY3 OFF = no print).
9. Note that WRU and SEL-CAL control is made through the WRU ("9") keytop on the top row. The ENQ shown on the upper legend of the "E" key is used ONLY to transmit the ASCII code for ENQ (or WRU), ØØØØ1Ø1. When ASCII is used, reception of this code will *also* trigger the appropriate WRU or SEL CAL response.
10. When the CCITT No. 2 Baudot code is used, the answer-back code of "FIGS-D" may be selected by simply entering "FIGS-D" (FN-FIGS + D) or the "$" symbol as the WRU program. The "$" symbol will be shown on the screen when a CCITT No. 2 code WRU character is received or sent.

The WRU feature could be used as a radio teleprinter answer-back if KY4 controlled the transmit-receive circuit of the station. IDENT could be included at the end of the HERE IS-1 program to assure Morse identification. However, such operation could be interpreted as automatic control of the transmitter which may not be legal for some services, especially if the operator were not in attendance.

It is the responsibility *of the operator* to assure that his station is operated in compliance with rules and regulations pertaining to his particular service.

When "tripped", the WRU feature will cause the transmission of the above sequence, even if in XMIT INHIBIT condition and will insert the sequence in the output text stream if the DS3100 ASR is in XMIT ACTIVE or XMIT ENABLED condition.

2.6.5 NON-VOLATILE MEMORY:

Some of the critical operating conditions and messages of the DS3100 ASR are stored in a "non-volatile" memory device, the EAROM (Electrically Alterable Read Only Memory). This device retains, like a read-only memory, its storage even if power is disconnected. However, the EAROM can be reprogrammed if desired but does *not* need a battery to keep its storage while power is off.

The EAROM serves as a *power off storage device*; when power is turned on, the entire contents of the EAROM are transferred to the standard RAM (Random Access Memory) storage of the DS3100 ASR. All terminal operation and message storage looks to the *RAM memory*, not the EAROM. Thus, the *initial* terminal operating condition and some messages are set by the contents of the EAROM. However, operator changes of terminal conditions (mode, rate, code, etc.) change *only* the contents of the RAM storage, *not* the contents of the EAROM storage.

The following parameters and messages are stored in the EAROM device:

CODE	Baudot, ASCII, Morse
RATE	Baud or Transmit WPM
MODE	CONT, LINE, WORD
USOS	On or off
SYNC	On or off
HERE IS-1	Up to 32 characters
HERE IS-Ø	Up to 32 characters
WRU Code Message	Up to 10 characters

The EAROM contents can be completely reprogrammed to the *current terminal status* by simply typing SHIFT-FN-STORE. This operation can be performed at any time you may choose. However, *EAROM lifetime may be shortened if excessive rewrite operations are performed.* Since the EAROM controls only the turn-on state of the DS3100 ASR, we suggest that you choose your most perferred modes and messages, leave these in the EAROM, and reprogram the EAROM infrequently. (Storage of information in the EAROM should NOT be performed while ASR is transmitting text -- in XMIT ACTIVE mode. This operation may interfere with normal operation of the terminal).

2.6.6 SELECTION OF SPECIAL OPTIONS:

A number of infrequently changed options have been added to the EAROM storage of the DS3100 ASR. These options are selected by bit-specification of one ASCII character stored in the EAROM. The options provided are:

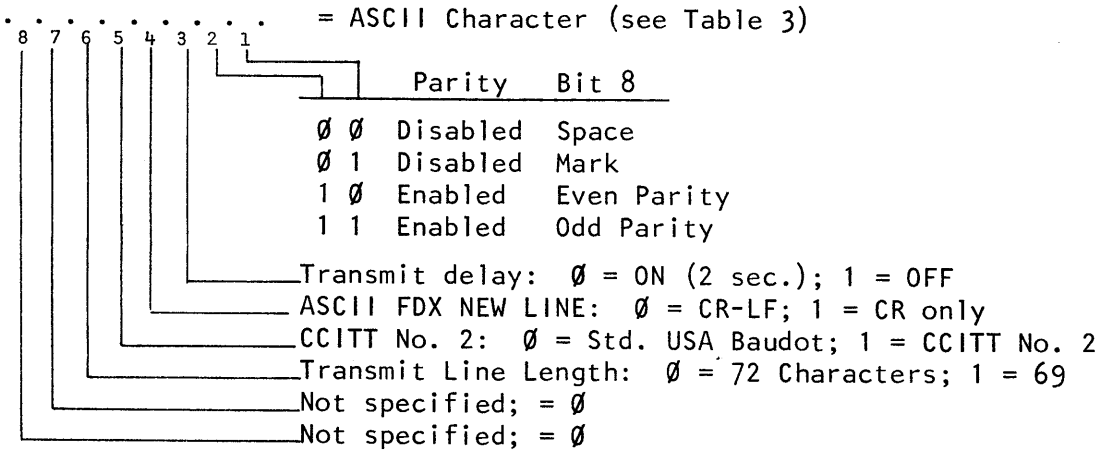
1. Selection of ASCII parity bit to be either mark or space (no parity) or odd or even (parity on).
2. A 2 second delay is normally provided between the time that XMIT ACTIVE is selected (with FN-XMIT) and the time that characters are transmitted. In a radio system, this allows both transmitting and receiving systems to stabilize before characters are sent. This delay may be turned off if not required, such as in a computer system.

3. The NEW LINE key normally inserts the "CR-LF" (ASCII) or "CR-LF-LTRS" (Baudot) sequence each time it is used. This feature may be changed so that NEW LINE just inserts the "CR" operation in FDX (Full Duplex) mode to be compatible with some computer operations.

4. The codes for the signal BELL and the apostrophe (') are interchanged between the commonly used "Military Standard" Baudot code in the United States and the CCITT No. 2 code commonly used in Europe in particular. These two characters may be set for either code. Note: other differences between the two codes such as the inclusion of the "+" and "=" symbols in CCITT No. 2 are NOT selected in this option. As noted earlier, the selection of CCITT No. 2 WRU symbol may be made by programming the "$" symbol into the WRU code message.

5. Some Baudot applications require a 69 character line length rather than the more common 72 character line. The sixth bit of the Special Option character allows selection of either the 72 or 69 character line length in the *Transmit buffer*. Since the receive buffer obeys control characters as received, no change is required; reception of the CR-LF sequence at the 69th instead of 72nd character only shortens the line displayed.

6. The Sepcial Option character is constructed one bit at a time with the following organization:



7. The Special Option Character is programmed in the same manner as the other programmable features. SHIFT-FN-ESC operations open and close the programming sequence. To change the option, first choose the bit pattern corresponding to the options desired. Next, translate this binary word into the corresponding ASCII character using Table 3 in this manual, or the ASCII DATA CODE table in the Operator's Guide.

8. The DS3100 ASR is normally supplied with all Special Option bits set to Ø, corresponding to the ASCII NUL character, shown on the screen as the open square character. Other common options might be:

   a. Parity disabled, bit 8 = mark, delay on, FDX NEW LINE = CR-LF, CCITT No. 2, 69 character transmit line:

      ØØ11ØØØ1 = ASCII Character "1"

   b. Parity enabled, bit 8 = odd parity, delay off, FDX NEW LINE = CR only, Std. Baudot, 72 character transmit line:

      ØØØØ1111 = ASCII Character "SI" = SHIFT IN = CTRL-O

9. The Special Option Character is saved in the EAROM while power is removed, but, as in other EAROM-stored text, hanges in the Special Option Character

must be specifically set in the EAROM with SHIFT-FN-STORE after it has been changed in the RAM storage area.

2.7 BAUDOT OPERATION

The DS3100 ASR terminal may be used in teleprinter-type communications systems where the 5 unit serial asynchronous start-stop teleprinter code is used. This code is commonly called "Baudot Code" (also referred to as the "Murray Code"). The Baudot code of the DS3100 ASR corresponds to that commonly used in commercial and radio amateur applications, as shown in Table 1.

The data rate (in bauds) or speed (in words-per-minute) of the terminal can be set for five standard values; 45 baud (60 wpm), 50 baud (66 wpm), 57 baud (75 wpm), 74 baud (100 wpm), and 100 baud (133 wpm). At this writing, the 45, 50, 57, and 74 baud rates are permitted for use by U.S. Amateur Radio Operators; the 133 baud rate is sometimes used in European systems. The transmitted characters from the DS3100 have the serial format of Start - Data 1 - Data 2 - Data 3 - Data 4 - Data 5 - Stop pulses. All pulses except the stop pulse are of equal length (time duration = reciprocal of the baud rate); the stop pulse is 1.5 times as long as the data pulses.

Because of the limited number of code combinations permitted by the 5-unit Baudot code (32 total), most code combinations are effectively used twice in two different cases, *Letters Case (LTRS) or Figures Case (FIGS)*. Uniquely defined codes are assigned to LTRS (11111) and FIGS (11Ø11) case characters. As can be seen in Table 1, most keys can have two meanings, depending upon which case is chosen, LTRS or FIGS. The receiving device in the Baudot system is equipped with a case memory that is set by reception of the LTRS or FIGS code and keeps the terminal in that case until another FIGS or LTRS changes the case. Thus if a LTRS code (11111) was the last *case* character received, all later codes received will be interpreted as LTRS case - a ØØØ11 code will be interpreted as the letter "A". Conversely, if the last received case character was FIGS (11Ø11), receipt of the same ØØØ11 code will now be interpreted as a dash (-). Even with the "double-use" of the code combinations, the number of possibilities is still limited and extended symbols and punctuation and lower-case letters are not commonly used with a 5-unit code system; the 7 unit ASCII code is commonly used where additional symbols or lower case letters are required.

In transmitting the Baudot code, it is therefore necessary to *precede* the text with the correct case character (LTRS/FIGS). In mechanical teleprinters and simple electronic keyboards, the keyboard is arranged in only three rows with the numbers and punctuation in a second legend on the lettered keytops. The *operator* must keep track of whether he needs to send a LTRS or FIGS character before typing the chosen key. On the other hand, the DS3100 ASR (as well as previous HAL terminals) has a keyboard arranged in a standard typewriter-style format and the LTRS or FIGS Baudot characters are inserted as required. Thus the operator need not be concerned with manual typing of the case characters. However, they are inserted *automatically* and the resulting output teleprinter code will correctly reproduce on mechanical or electronic Baudot terminals.

When receiving Baudot code, the terminal stores the previously received case character (LTRS/FIGS) and chooses the letter or punctuation for each character accordingly. When weak signals are received, noise (or other signals) can interfere with the reception and cause errors in the reproduction ("hits"). If such an error is interpreted as a case change character, not only is that character misprinted but also all *following* characters are misprinted, until the next case character is received.

This can be particularly damaging to reception of straight text; misinterpretation of noise as a FIGS character will cause all of the following text to appear as numerals and punctuation. To improve reception of text transmissions, the Unshift On Space feature of the DS3100 ASR provides an automatic return to Baudot LTRS case after reception of each space character (ØØ1ØØ). Thus, although the display may misprint a few characters following a noise induced case change to FIGS, the print will shift back to LTRS case after the first space character. The Unshift On Space (USOS) feature is controlled with the FN-USOS key combination and the fifth status indicator shows USOS when the feature is active. For general conversation, this feature may be left active most of the time. However, when receiving known strings of numbers, such as from weather stations or in computer listings, the USOS feature should be turned off. Also, USOS is generally not useful when receiving "RTTY Art".

As discussed previously, the DS3100 ASR automatic non-overprint and word wrap-around features work on both transmitted and received signals. When composing text to be transmitted, it is simply necessary to just type the text - the terminal automatically chooses new lines as required and moves characters to prevent word splitting at the end of a line. *When the text is transmitted*, the necessary CR (carriage return), and LF (line feed) characters are added; when Baudot code is used, the sequence "CR - LF - LTRS" is inserted at the end of each transmitted line.

There are some instances, however, where it is desirable to manually transmit the case characters or carriage control characters. Through use of the FN or CTRL keys, all of these characters may also be sent manually. When manual transmission of a control code is used *only* that code is transmitted and the normal non-overprint protection does not apply; use of CTRL-J to send a LF character (ØØØ1Ø) does *not* also trigger the standard new line sequence (CR LF LTRS). The keys used to produce the control codes and their unique symbols in the transmit buffer display are shown below:

	Operation	Code	Type	Display
LF	Line Feed	ØØØ1Ø	CTRL-J	⏎
CR	Carriage Return	Ø1ØØØ	CTRL-M	↵
LTRS	Letters Case	11111	FN-LTRS	<
FIGS	Figures Case	11Ø11	FN-FIGS	>
blank	Null Character	ØØØØØ	ESC	⊖
BELL	Signal Bell (FIGS case)	ØØ1Ø1	CTRL-G	▫

The above special characters are *only* displayed in the *transmit* buffer section of the screen; when received, the appropriate action is taken with the exception of the LF (line feed) character. The non-overprint feature of the DS3100 ASR receive circuitry treats reception of the CR and LF characters somewhat differently. First, reception of an isolated CR (carriage return) character, not accompanied by an LF character, will cause a line feed to occur on the screen, *without a carriage return*. On the other hand, reception of an isolated LF (line feed) character will cause both a carriage return *and line feed* operation to prevent an overprint. Finally, reception of the sequence CR - LF (or CR-LF-LTRS) will cause only *one* line feed, avoiding the double line feed that might otherwise occur.

The key combinations that produce Baudot encoded characters are shown in Figure 5. In Figure 5c, the indicated labels are produced with the CTRL key plus the

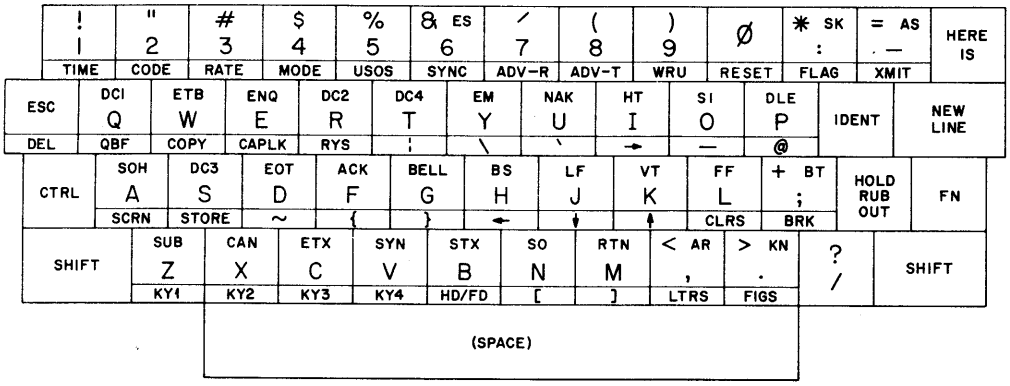
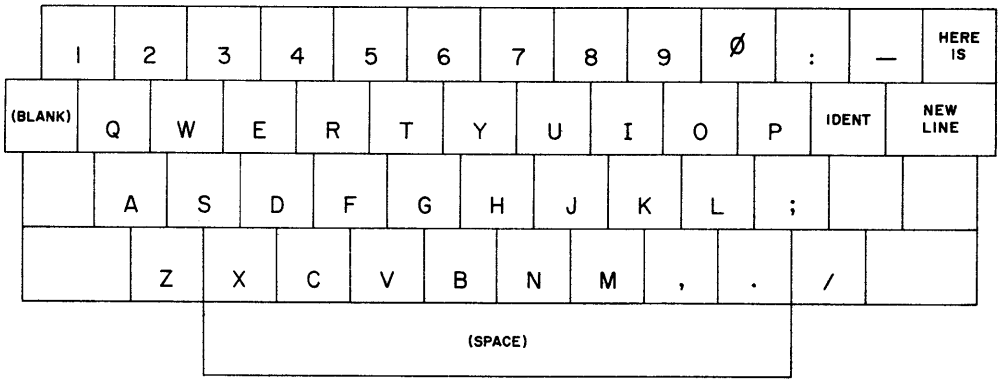


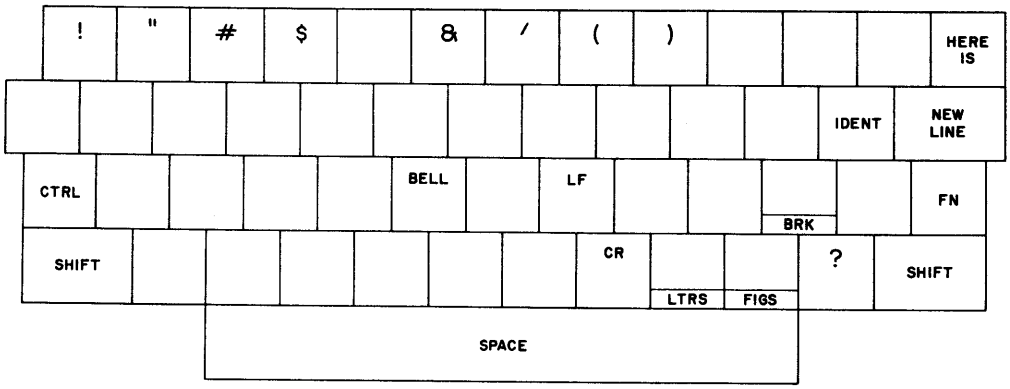
Fig. 5a



BAUDOT

no SHIFT, CTRL, or FN

Fig. 5b



BAUDOT

with SHIFT, CTRL, or FN

CTRL - BELL = BELL
CTRL - J = LF
CTRL - M = CR

FN - BRK = SPACE condition
FN - LTRS = LTRS
FN - FIGS = FIGS

All other combinations produce undefined output

Fig. 5c

BAUDOT KEYBOARD COMBINATIONS

one shown. Similarly, other labels are produced with the FN key or with the SHIFT key. *All other key combinations produce undefined output* (usually no output).

TABLE 1. BAUDOT DATA CODE

Bit Number 5 4 3 2 1	Case: Letters	Case: Figures
0 0 0 0 0	BLANK	BLANK
0 0 0 0 1	E	3
0 0 0 1 0	LF	LF
0 0 0 1 1	A	-
0 0 1 0 0	SPACE	SPACE
0 0 1 0 1	S	BELL
0 0 1 1 0	I	8
0 0 1 1 1	U	7
0 1 0 0 0	CR	CR
0 1 0 0 1	D	$
0 1 0 1 0	R	4
0 1 0 1 1	J	'
0 1 1 0 0	N	,
0 1 1 0 1	F	!
0 1 1 1 0	C	:
0 1 1 1 1	K	(
1 0 0 0 0	T	5
1 0 0 0 1	Z	"
1 0 0 1 0	L	)
1 0 0 1 1	W	2
1 0 1 0 0	H	#
1 0 1 0 1	Y	6
1 0 1 1 0	P	Ø
1 0 1 1 1	Q	1
1 1 0 0 0	O	9
1 1 0 0 1	B	?
1 1 0 1 0	G	&
1 1 0 1 1	FIGS	FIGS
1 1 1 0 0	M	.
1 1 1 0 1	X	/
1 1 1 1 0	V	;
1 1 1 1 1	LTRS	LTRS

Notes:

Mark = "1" = Loop Current On
= Negative RS-232 Voltage

LF = Line Feed CTRL-J
CR = Carriage Return CTRL-M
LTRS = Letters Case Shift = FN-LTRS
FIGS = Figures Case Shift = FN-FIGS

NEW LINE key = CR+LF+LTRS
CTRL-G = BELL
ESC = blank
# = STOP (Figure case H)
FN-BRK = Space condition (for testing)
Transmission Order = Bit 1 to Bit 5
Start Pulse = 1 unit space
Stop Pulse = 1.5 unit mark

Baud Rate	Avg. WPM	Select Pulse
45.45	60.61	22 ms
50.00	66.67	20 ms
56.92	75.89	17.57 ms
74.20	98.99	13.47 ms
100.00	133.33	10.00 ms

Special Baudot Features:

* Automatic LTRS/FIGS generation when transmitting
* USOS (UnShift On Space) switch selectable for reception of noisy signals.
* SYNC (Synchronous Idle) switch selectable to transmit LTRS code to maintain output speed when hand typing. May help reception of your signal.

2.8 MORSE OPERATION:

The advantages of the automatic coding and decoding of a teleprinter are now available when the Continental Morse Code is used with the DS3100 ASR. Virtually all of the standard TTY features of the terminal are also available for use with Morse code, in addition to special Morse abbreviations. The Continental Morse Code used by the DS3100 ASR is shown in Table 2.

The *transmit* speed of the DS3100 can be set on the keyboard to any speed from 1 to 175 wpm (words per minute) by using the FN-RATE or SHIFT-FN-RATE key combinations. *Each operation* of FN-RATE *increases* the wpm speed by one wpm; each SHIFT-FN-RATE operation *decreases* the speed by one wpm. Larger changes in speed are made by simply holding the keys down for longer than $\frac{1}{2}$ second so that the programmatic repeat operates. The selected speed is shown on the screen in the third status indicator. The transmit speed can be changed *at any time*, even while transmitting.

The weight of the transmitted code is set at the correct dot-to-dash ratio. However, some transmitter keying circuits employ filtering that may result in improper keying at the higher Morse code speeds (typically higher than 70 wpm). If such a problem is found, the *transmitter* circuitry should be modified to correct the deficiency rather than distorting the code by modifying the weighting.

The transmit text may be written into the transmit buffer at any time, even while receiving. Use FN-XMIT to set a XMIT INHIBIT status (7th & 8th status indicators) to precompose text without transmitting. When it is desired to start transmitting, use FN-XMIT to set a XMIT ACTIVE status. The text will now be transmitted at the preset speed. You may continue to type text while previously written text is being transmitted and all of the edit and transmit features discussed in section 2.5 are functional in Morse code. If a "fill character" is desired when WORD or LINE mode are used, the SYNC feature may be activated (FN-SYNC, status indicator = SYNC), causing the Morse *pause* character, $\overline{\text{BT}}$ (-···-), to be sent. This technique may help improve automatic copy of your signal at high code speeds and may not be desirable to use at low speeds.

The *receive* speed of the DS3100 ASR adjusts *automatically* to track the speed of the received signal over a range of 1 to 175 wpm. The speed of reception and transmission function independently - setting the transmit speed with FN-RATE does *not* set a receive speed.

Morse reception:

The new Morse reception system contained in the DS3100 ASR features considerably easier tuning and more reliable decoding of hand-sent code. The previous Morse reception system in the DS3000 KSR used narrow-bandwidth audio filters to separate the CW signal from noise and interference. This system very capably "extracted" the signal, but was quite prone to tuning problems, particularly if there was any frequency drift in the receiver or transmitter. The new system in the DS3100 ASR uses a phase-locked loop detection system that will track minor frequency variations and is quite easily tuned. The front panel "THRESHOLD" control varies the *center frequency* of the Morse reception system, rather than acting as a simple noise squelch (as was the case in the DS3000). The adjustment of this control and the tuning procedure for reception of Morse code are as follows:

1. The THRESHOLD control allows adjustment of the reception audio tone frequency of the DS3100 between approximately 400 and 1200 Hz. The control is normally set at the factory for 800 Hz, but the setting should be checked when first installing your DS3100 ASR.

2. After connecting the receiver audio output to the DS3100 audio input, you should set the receiver to a comfortable listening level, in the CW mode with the crystal calibrator (or other strong CW source) turned on. Use FN-CODE to put the DS3100 in the MORSE mode. Tune your receiver frequency until the received signal is centered in the CW filter; on most receivers, this will result in a tone of approximately 800 Hz. Now, observing the CW DETECT light on the DS3100 ASR, rotate the THRESHOLD control and note the relative positions over which the lamp is <u>on</u>. Set the THRESHOLD control in the <u>middle</u> of this range.

2a. If your receiver does *not* have a CW filter, adjust the receiver tuning for a tone frequency of approximately 800 Hz and then follow the above procedure. (Actually, the THRESHOLD control could be adjusted for other frequencies in the 400 - 1200 Hz range if your prefer).

3. To receive Morse code, turn off the crystal calibrator and adjust the receiver tuning so that the CW DETECT lamp flashes in unison with the received CW signal; the lamp should be ON when the key is down and OFF at all other times. The lamp should not flicker on noise or other signals. You may have to "reset" by typing FN-RESET ("9" key) to first start the display of Morse characters.

4. In general, it is recommended that you use manual RF gain, rather than AGC when receiving CW to minimize noise interference between words, particularly when receiving moderately slow CW (20 wpm or slower). If AGC is used, choose the slowest response speed available.

5. If a CW filter is available, try reception both with and without the filter. In the face of strong interference, a narrower filter may help noticeably. However, very narrow filters (less than 400 Hz) rarely help because of the additional "ringing" associated with their use. Each receiver has its own characteristics and you will want to experiment with yours to find the best combination.

6. The volume control setting of the receiver may affect the reception on the DS3100 - too loud a setting will usually give an overload condition, indicated by semi-continuous flashing of the CW DETECT lamp, not necessarily in unison with the received signal. Too low a setting will be shown by reduced flashing of the CW DETECT lamp, often missing dots or dashes. The dynamic range between these two extremes is quite wide and should not be critical. However, the *capture bandwidth* of the phase lock varies with the audio level, being narrow for low level signals and wider for loud signals. Therefore, use of a lower audio level in the face of interference may improve the reception because of this narrowed capture bandwidth.

7. Upon occasion, the DS3100 ASR may cease decoding received Morse signals. This condition is usually caused by extended reception of a continuous carrier. The internal automatic speed adjusting program interprets this as a very long dash and attempts to track a very slow CW speed. The automatic tracking circuitry can be reset by pressing FN-RESET (Ø key on top row). After the Morse reception circuit has been reset, the screen may display several "T" and "E" characters as the speed tracking program adapts to the received signal.

8. The new decoding programs in the DS3100 ASR are even more tolerant of improperly sent Morse code than previous units. However, there are limits! The worst case of hand-sent CW is represented by run-together characters. The DS3100 programs will try to display a valid letter for the dot-dash combination received between word spaces; if the code is run-together, this may or

may not be what the sender *intended*. If a dot-dash combination for the run-together code does not exist, the DS3100 will simply NOT display a character and wait for the next *valid* Morse character. (This differs from the DS3000 display of a star (*) to indicate an invalid character). Another common problem with hand-sent Morse code is improper letter-word spacing. The DS3100 programs may interpret a longer than normal pause in the sending between letters as a word space and space the display accordingly. The practice of sending letters at a high rate with a long space between each letter will therefore produce a display with the letters spaced out rather than clustered in words.

9. The terminal always displays *one character behind* the received signal, *saving* the current character to use as a speed reference when the new character is received (sets reference dot or unit pulse length for next character). If no new Morse character is received for approximately 5 seconds, the final character will be "released" and displayed. FN-RESET will reset the receive decoding circuitry if desired.

10. Your skill in tuning will improve with practice - commercial Morse transmissions and the W1AW bulletin transmissions are good sources of well-sent Morse code.

The key combinations that produce Morse code are shown in Figure 6. Most Morse code characters are transmitted either without a SHIFT (or FN or CTRL) key or with the SHIFT key. The FN-BRK combination produces a key-down output for as long as the keys are held for use in transmitter tuning. Undefined key combinations (shown by "*" in Figure 5) produce the error code (·····).

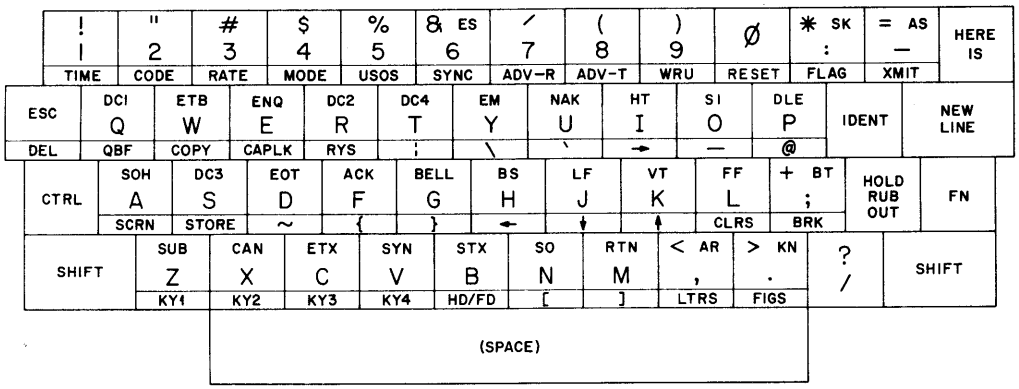
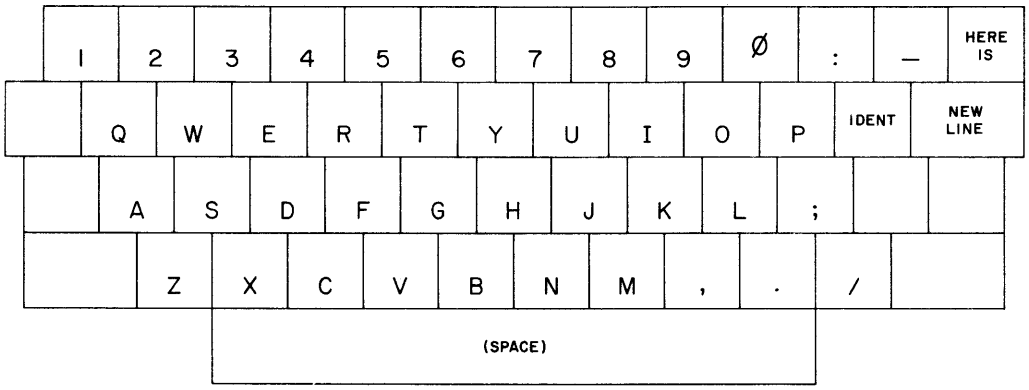


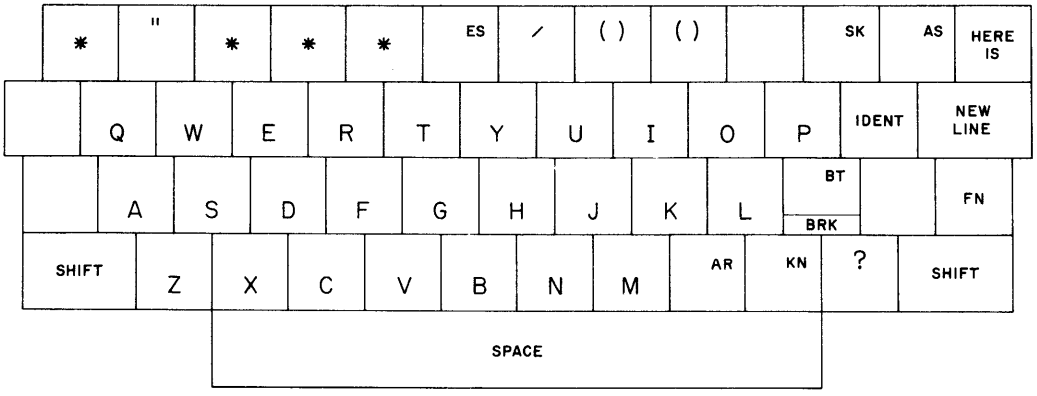
Fig. 6a



MORSE

no SHIFT, CTRL, or FN

Fig. 6b



MORSE

with SHIFT

* = error = ...

FN – BRK = key down

Fig. 6c

MORSE KEYBOARD COMBINATIONS

TABLE 2. CONTINENTAL MORSE CODE

A	·-		1	·----
B	-···		2	··---
C	-·-·		3	···--
D	-··		4	····-
E	·		5	·····
F	··-·		6	-····
G	--·		7	--···
H	····		8	---··
I	··		9	----·
J	·---		Ø	-----
K	-·-	.	(period)	·-·-·-
L	·-··	,	(comma)	--··--
M	--	:	(colon)	---···
N	-·	;	(s-col)	-·-·-·
O	---	-	(dash)	-····-
P	·--·	'	(apos)	·----·
Q	--·-	/	(slash)	-··-·
R	·-·	()	(paren)	-·--·-
S	···	"	(quote)	·-··-·
T	-	?	(query)	··--··
U	··-		$\overline{AR}$	·-·-·
V	···-		$\overline{AS}$	·-···
W	·--		$\overline{BT}$	-···-
X	-··-		ES	· ···
Y	-·--		$\overline{KN}$	-·--·
Z	--··		$\overline{SK}$	···-·-
			error	···· ····

Notes:

· = one dot unit of key down time
- = one dash unit of key down time
  = three dot units

Element space = one dot unit
Letter space = three dot units
Word space = seven dot units

Speed in WPM = $\frac{\text{dots/min}}{25}$
= 2.4 (dots/sec)
= number of Ø's repeated in 26 seconds
(1.5% accuracy)

$\overline{AR}$ = FN-P
$\overline{AS}$ = SHIFT-(dash)
$\overline{BT}$ = SHIFT-;
ES = SHIFT-6
$\overline{KN}$ = SHIFT-(period)
$\overline{SK}$ = SHIFT-:

FN-BRK = Key down (for testing)

2.9 ASCII OPERATION:

The DS3100 ASR is a full-capability ASCII communications terminal that may be used in any asynchronous communications or data system using the serial ASCII code. The terminal will receive, transmit, and display the full, 128 character ASCII symbol table, including upper and lower case letters. The data rate may be set from 110 baud to 9600 baud and the connection to the system may be either in half or full duplex configuration. All previously described features and functions of the DS3100 ASR are available for use in ASCII applications.

The ASCII data rate is set with the FN-RATE key combination to any of 9 different rates - 110, 150, 300, 600, 1200, 1800, 2400, 4800, and 9600 baud - virtually *all* of the standard serial data rates in common usage. The data rate chosen is displayed in the third on-screen status indicator. The received and transmit data rates are *both* set with the FN-RATE control. Table 3 shows the ASCII Data Code.

A simplified, 64 character ASCII code is often used where only capital letters are needed and some symbols are not available. The DS3100 ASR can be set-up to transmit only capital letters with the FN-CAPLK key combination (shown as CAP LK in the 12th status indicator). When CAP LK is active, the code for the upper case letter will be transmitted whether the SHIFT key is used or not. When CAP LK is not active, the lower case letter code will be sent when SHIFT is not used and upper when SHIFT is used. This feature *only* affects the *transmitted* code and not the receive display. The receive section of the display will show whatever character corresponds to the received data code, be it lower or upper case letters, numerals, symbols, or special operations.

While composing text to be transmitted, *any* ASCII code may be stored in the transmit buffer, including symbols and control codes (such as the codes for ETB, DC1, DC2, SOH, etc). Where standard display symbols exist (such as for letters, numbers, and punctuation), they will be displayed. The presence of the special ASCII operations codes in the transmit buffer is shown on the screen by the special symbols shown in Table 4. These symbols are somewhat standard for a 5 x 7 dot matrix character generator but may not be the same as used in other ASCII terminals; the symbols simply indicate the presence of a special ASCII character code that will be transmitted in sequence.

When the ASCII control characters are *received*, they are displayed as these special symbols. Reception of the ASCII ENQ (or WRU) code (ØØØØ1Ø1) will trigger the WRU response as described in section 2.6.4. Reception of the WRU code message will also trigger the WRU response in ASCII.

It is important to notice the difference between local DS3100 cursor control and transmission of the ASCII characters for cursor control. The arrows on the H, I, J, and K keytops correspond to *local terminal control* and are used with the FN key to move the DS3100 keyboard cursor *without* causing insertion of the ASCII character into the transmit buffer. Conversely, the BS, HT, LF, VT, and FF on the H, I, J, K, and L keytops are used with the CTRL key to generate the correct ASCII code. The key combinations used to produce the ASCII characters are shown in Figures 7, 8, and 9.

TABLE 3. ASCII DATA CODE

4 3 2 1	7	0	0	0	0	1	1	1	1
	6	0	0	1	1	0	0	1	1
	5	0	1	0	1	0	1	0	1
0 0 0 0		NUL	DLE	SPC	Ø	@	P	`	p
0 0 0 1		SOH	DC1	!	1	A	Q	a	q
0 0 1 0		STX	DC2	"	2	B	R	b	r
0 0 1 1		ETX	DC3	#	3	C	S	c	s
0 1 0 0		EOT	DC4	$	4	D	T	d	t
0 1 0 1		WRU	NAK	%	5	E	U	e	u
0 1 1 0		ACK	SYN	&	6	F	V	f	v
0 1 1 1		BEL	ETB	'	7	G	W	g	w
1 0 0 0		BS	CAN	(	8	H	X	h	x
1 0 0 1		HT	EM	)	9	I	Y	i	y
1 0 1 0		LF	SUB	*	:	J	Z	j	z
1 0 1 1		VT	ESC	+	;	K	[	k	{
1 1 0 0		FF	FS	,	<	L	\	l	¦
1 1 0 1		RTN	GS	-	=	M	]	m	}
1 1 1 0		SO	RS	.	>	N	^	n	~
1 1 1 1		SI	US	/	?	O	_	o	RBO

Notes:

Mark = "1" = Loop Current On
= Negative RS232 Voltage

FN-BRK = Space condition (for testing)

DLE = CTRL-P
FS = SHIFT-CTRL-L
GS = SHIFT-CTRL-M
NUL = SHIFT-CTRL-P
RS = SHIFT-CTRL-N
RTN = CTRL-M
SI = CTRL-O
SO = CTRL-N
US = SHIFT-CTRL-O
^ = SHIFT-FN-N

NEW LINE = RTN + LF (See section 2.6.6, item 3 for discussion of NEW LINE operations.)

ACK = acknowledge
BEL = signal bell
BS = backspace (←)
CAN = cancel
DC1 = device control 1
DC2 = device control 2
DC3 = device control 3
DC4 = device control 4
DLE = data link escape
EM = end of medium
EOT = end of trans.
ESC = escape
ETB = end of block
ETX = end of text
FF = form feed (home)
FS = file separator
GS = group separator

HT = horizontal tab (→)
LF = line feed (↓)
NAK = not acknowledge
NUL = null
RS = record separator
RTN = carriage return
RBO = RUB OUT = DEL
SI = shift in
SO = shift out
SOH = start of heading
STX = start of text
SUB = substitute
SYN = synchronous idle
US = unit separator
VT = vertical tab (↑)
ENQ = enquiry (WRU)
SPC = space

Baud Rate	Char/ Sec.	Select Pulse
110	10.0	9.09 ms
150	15.0	6.67 ms
300	30.0	3.33 ms
600	60.0	1.67 ms
1200	120.0	833 us
1800	180.0	556 us
2400	240.0	416 us
4800	480.0	208 us
9600	960.0	104 us

Transmission order = bit 1 to bit 7
Parity = none; bit 8 = space
Start bit = 1 unit space
Stop bit = 2 unit mark (110 baud)
= 1 unit mark (other rates)

TABLE 4. DISPLAY SYMBOLS FOR THE ASCII CODE

4321 \ 765	000	001	010	011	100	101	110	111
0000	NUL	DLE	NO DISPLAY SPC	0	@	P	`	p
0001	SOH	DC1	!	1	A	Q	a	q
0010	STX	DC2	"	2	B	R	b	r
0011	ETX	DC3	#	3	C	S	c	s
0100	EOT	DC4	$	4	D	T	d	t
0101	WRU/ENQ	NAK	%	5	E	U	e	u
0110	ACK	SYN	&	6	F	V	f	v
0111	BELL	ETB	'	7	G	W	g	w
1000	BS	CAN	(	8	H	X	h	x
1001	HT	EM	)	9	I	Y	i	y
1010	LF	SUB	*	:	J	Z	j	z
1011	VT	ESC	+	;	K	[	k	{
1100	FF	FS	,	<	L	\	l	|
1101	RTN	GS	-	=	M	]	m	}
1110	SO	RS	.	>	N	^	n	~
1111	SI	US	/	?	O	_	o	DEL

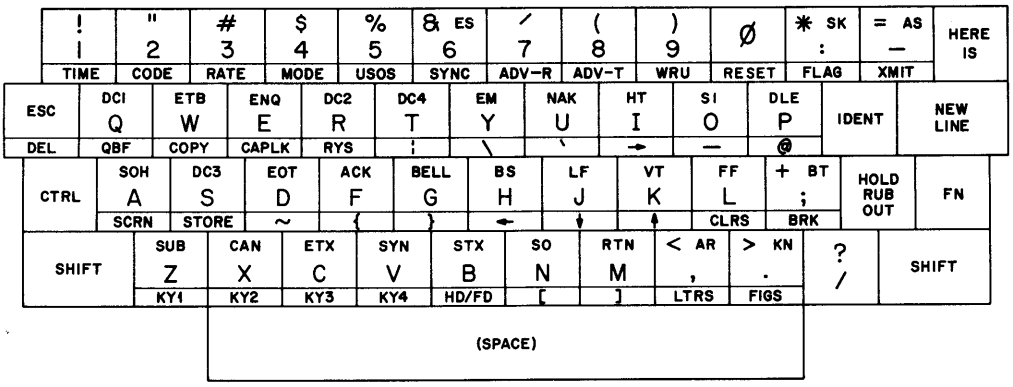
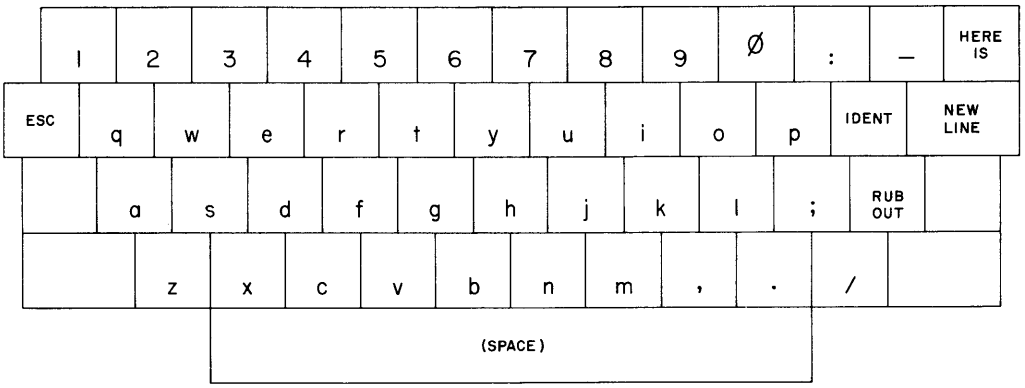


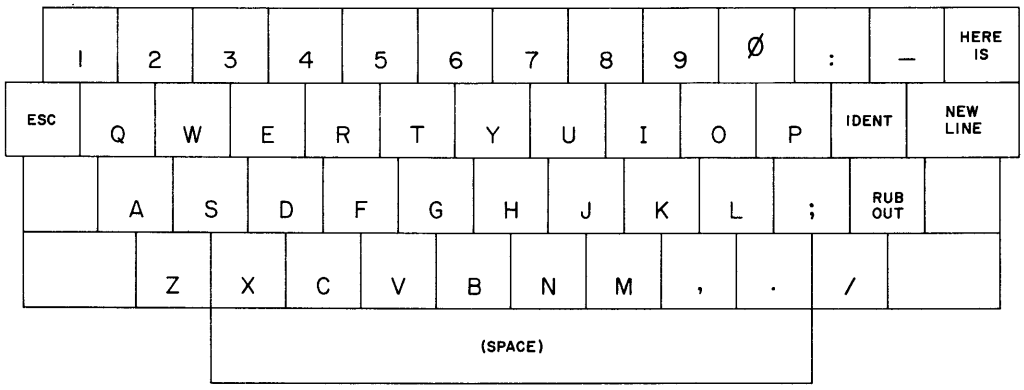
Fig. 7a



ASCII

no CAPLK
no SHIFT, CTRL, or FN

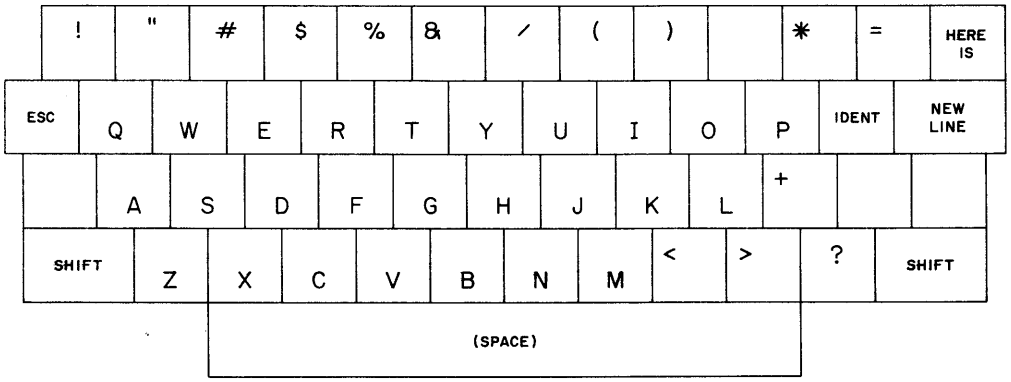
Fig. 7b



ASCII

with CAPLK
no SHIFT, CTRL, or FN

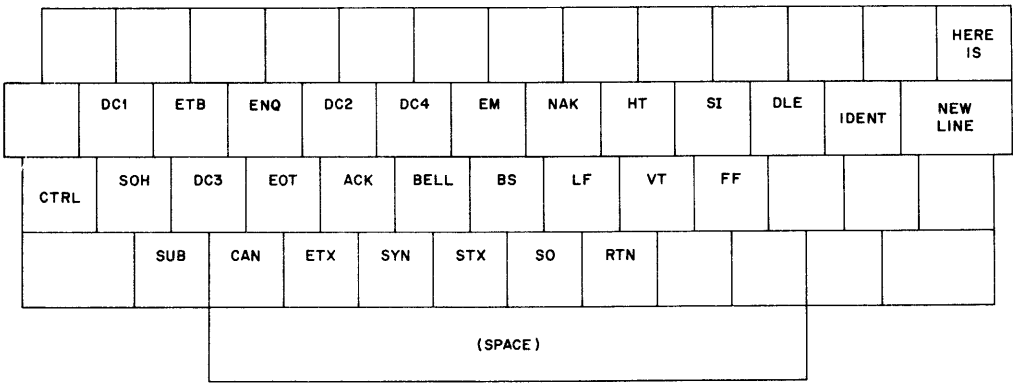
Fig. 7c



ASCII

with SHIFT
with or without CAPLK
no CTRL or FN

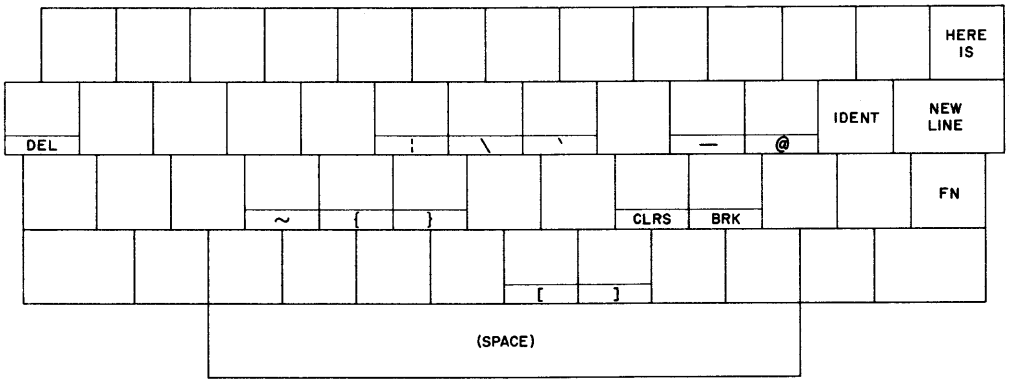
Fig. 8a



ASCII

with CTRL
no SHIFT or FN

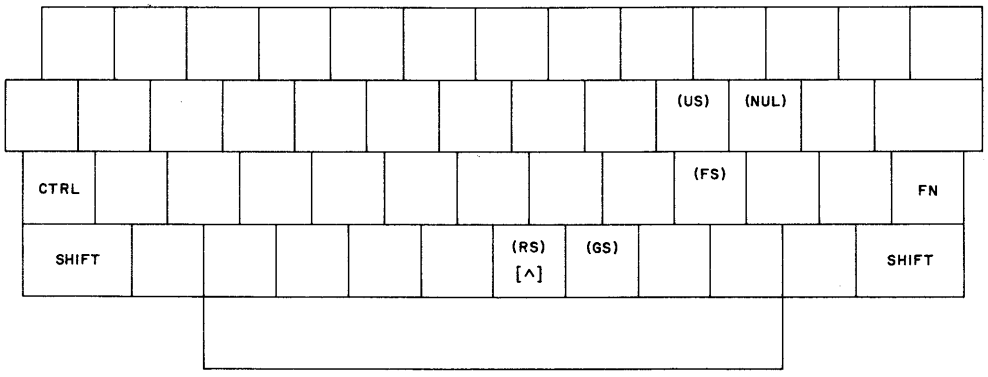
Fig. 8b



ASCII

with FN
no SHIFT or CTRL

Fig. 8c

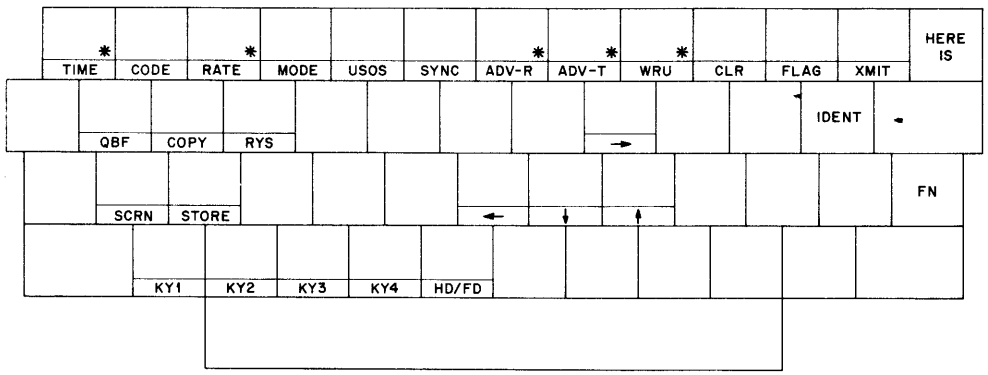


ASCII

with SHIFT and CTRL labels not on keytops

SHIFT-FN-N = [^]

Fig. 9a



TERMINAL CONTROLS

with FN

* also used with SHIFT-FN- combination; see text

Fig. 9b

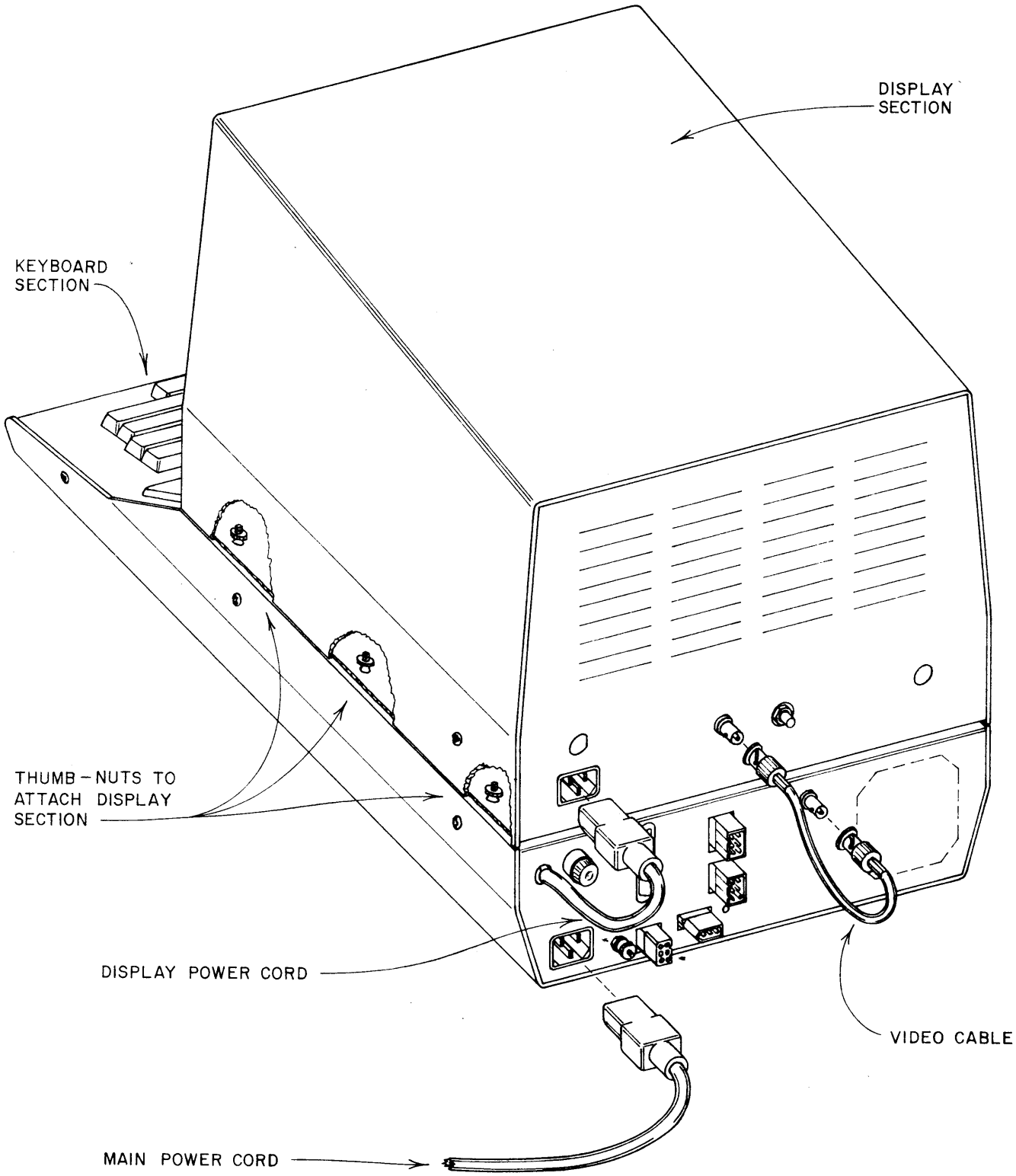


FIGURE 10. FASTENING DISPLAY TO KEYBOARD CABINET

3. INSTALLATION

3.1 UNPACKING:

Your new DS3100 ASR has been packed in two cartons, one for the CRT display section and the other for the keyboard section. Unpack each carton carefully, inspecting each for evidence of shipping damage. If damage is found, contact the SHIPPING CARRIER immediately; you must place a damage report *with the carrier* before any repairs can be started.

After inspecting both sections, locate the accessory package (in the keyboard carton) and check the contents against the list below. Report any shortages to us as soon as possible. To expedite any shortage replacements or additional orders for parts, please give the HAL part number.

Table 4 Accessories for the DS3100 ASR

Quantity	HAL Part Number	Description
1	960-03001	Video cable, BNC connectors both ends
1	333-17250	Power cord, non-captive type
1	960-03002	Loop cable, DS3100/DS3000 type
1	960-03101	Morse audio input cable, DS3100 type
1	960-03005	Morse key out cable, DS3100/DS3000 type
2	770-05001	0.5 amp SB fuse, 3AG type
2	323-91031	3 Pin male connector shell
2	323-92061	6 Pin female connector shell
4	323-91061	6 Pin male connector shell
28	322-91143	Female cable pins
14	320-21430	Male cable pins
1	333-10250	25 Pin D-type connector with pins
1	333-51226	Protective shell for 25 pin connector
1	870-03102	Instruction Manual
1	870-03101	Operator's Guide

3.2 INITIAL TURN-ON:

After unpacking, inspection, and verifying the accessories list, refer to Figure 10 and set the display section on top of the keyboard unit. Note that the two units can be fastened together with the thumb-nuts, if desired, by removing the top of the display (two black screws on each side of the display). For the present, simply set the two units together and connect the power cords and video cable as shown. Note that the main ac power cord connects to the *keyboard cabinet* rather than to the similar connector on the display cabinet.

- *CAUTION* - - - - - - - - - - - - - - - - - -

Be sure that your power line voltage and frequency match that of the DS3100 ASR. A tag on the rear panel will specify if the two units have been factory set for other than 120 vac, 60 Hz power. The power connections can be changed if necessary with the procedures outlined in section 3.7.

- -

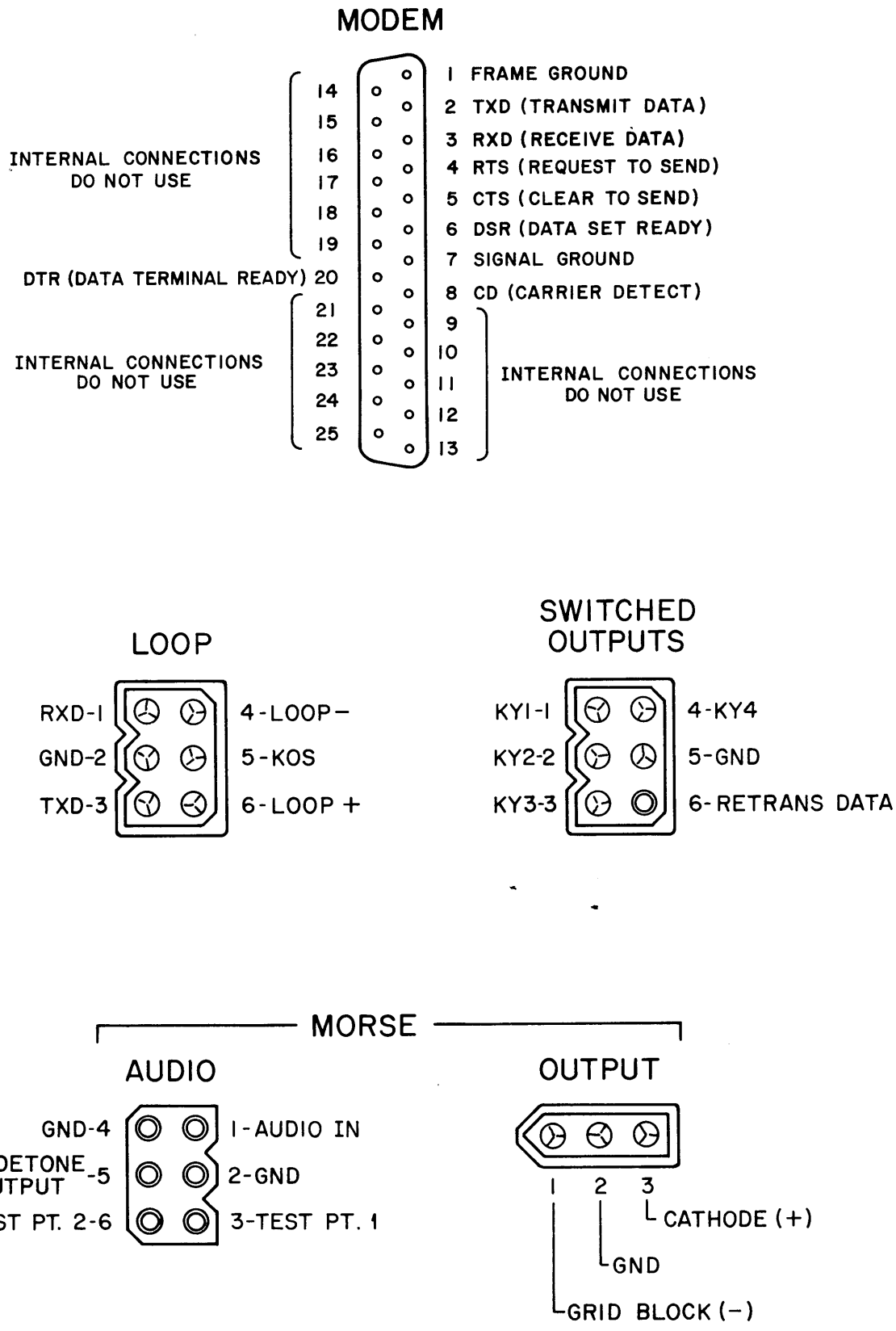
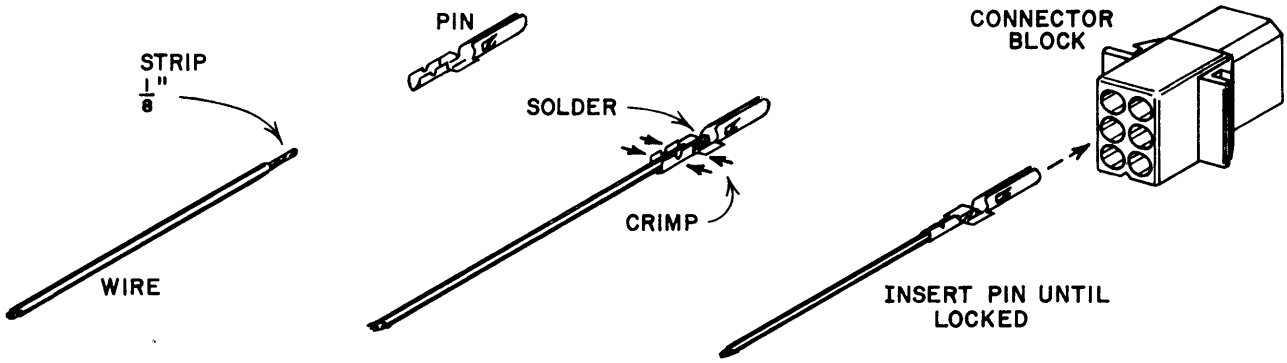
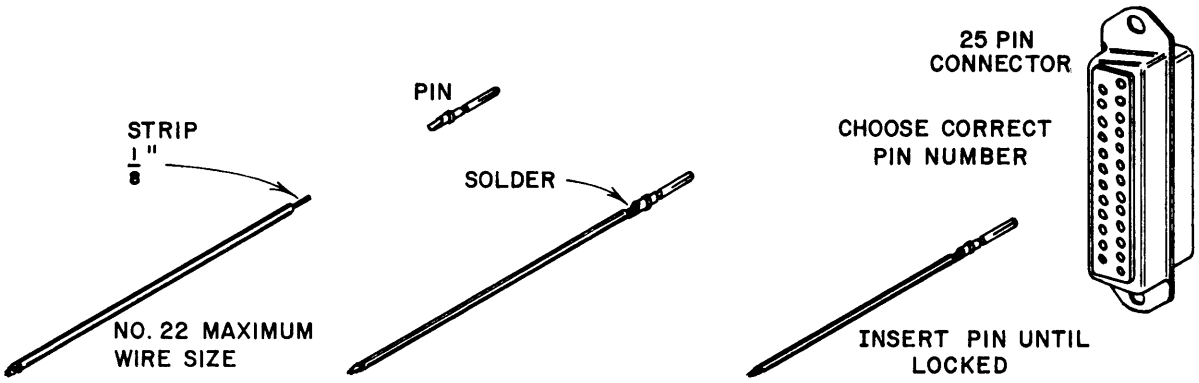


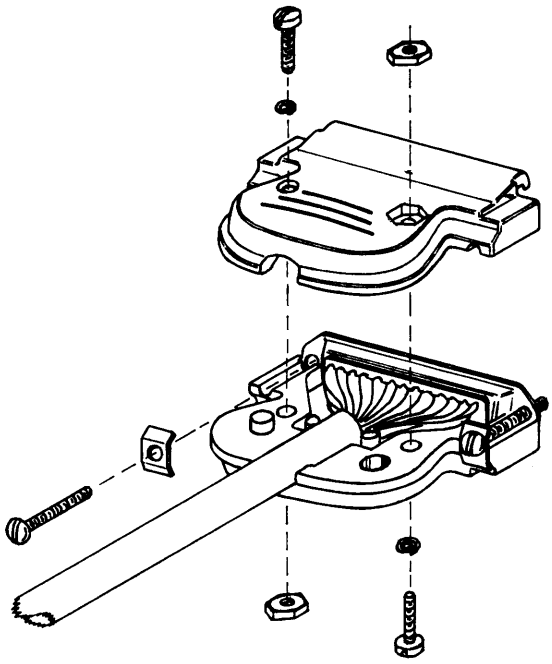
FIGURE 11. DS3100 ASR REAR PANEL CONNECTORS



PREPARATION OF PLASTIC SHELL CONNECTOR



PREPARATION OF MODEM CONNECTOR



ASSEMBLY OF MODEM CONNECTOR SHELL

FIGURE 12. CONNECTOR AND CABLE PREPARATIONS

Now, plug the ac power cord into a suitable power socket (safety grounding type preferred) and turn the front power switch on. As the display tube warms-up you should see line numbers on the left side of the screen and status indicators on the right-hand side (refer to Figure 2 for a typical screen format). If nothing is seen on the screen, re-check the video and power connections to the display section and try adjusting the intensity control on the rear of the display section. If this doesn't help, refer to the *IN CASE OF DIFFICULTY* section.

With the DS3100 ASR turned on but *not connected to other equipment*, you may now wish to become familiar with some of the features described in both this manual and the OPERATOR'S GUIDE. Particularly explore use of the programmable features and how the FN-XMIT keys control the transmit buffer output (use HDX).

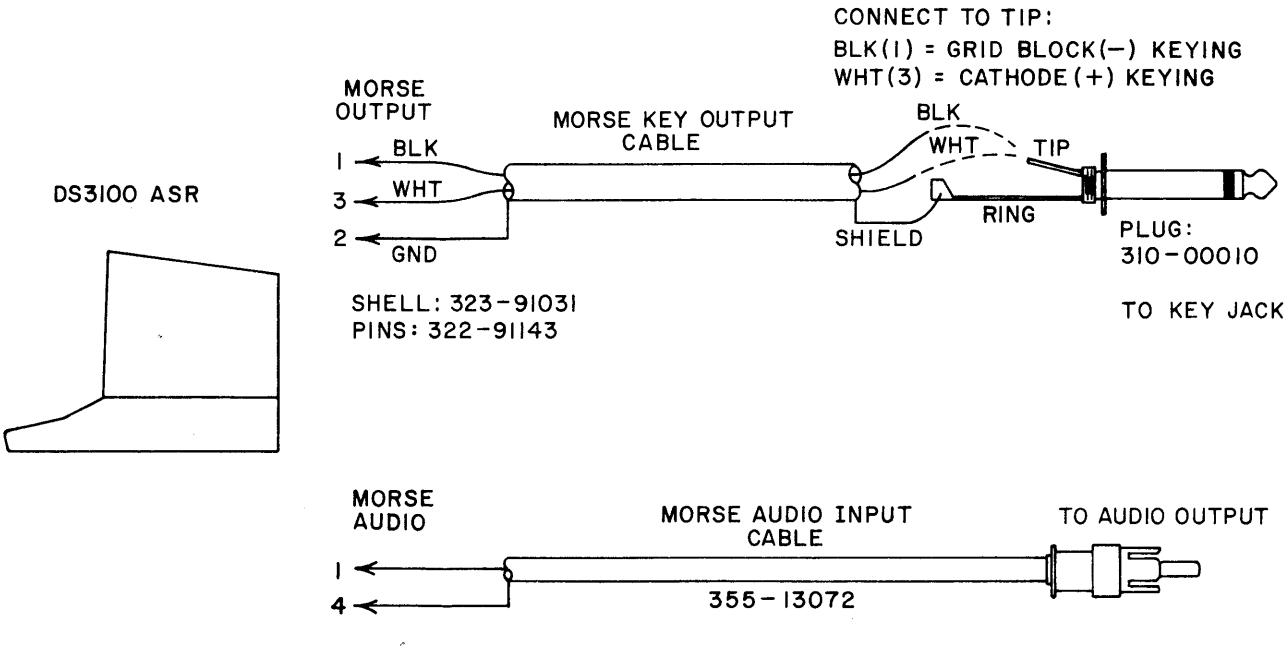
3.3 STANDARD CONNECTIONS:

The many rear panel connectors on the DS3100 ASR allow a great deal of flexibility in how the terminal is connected in the RTTY or Morse communications system. The connections available on each connector are diagrammed in Figure 11. The pins of each connector are numbered and labeled *as you view the connector from the rear of the cabinet.* Two styles of connectors are used - the 3 or 6 pin plastic shell connector and the 25 pin metal shell connector. Study the techniques shown in Figure 12 when preparing these connectors.

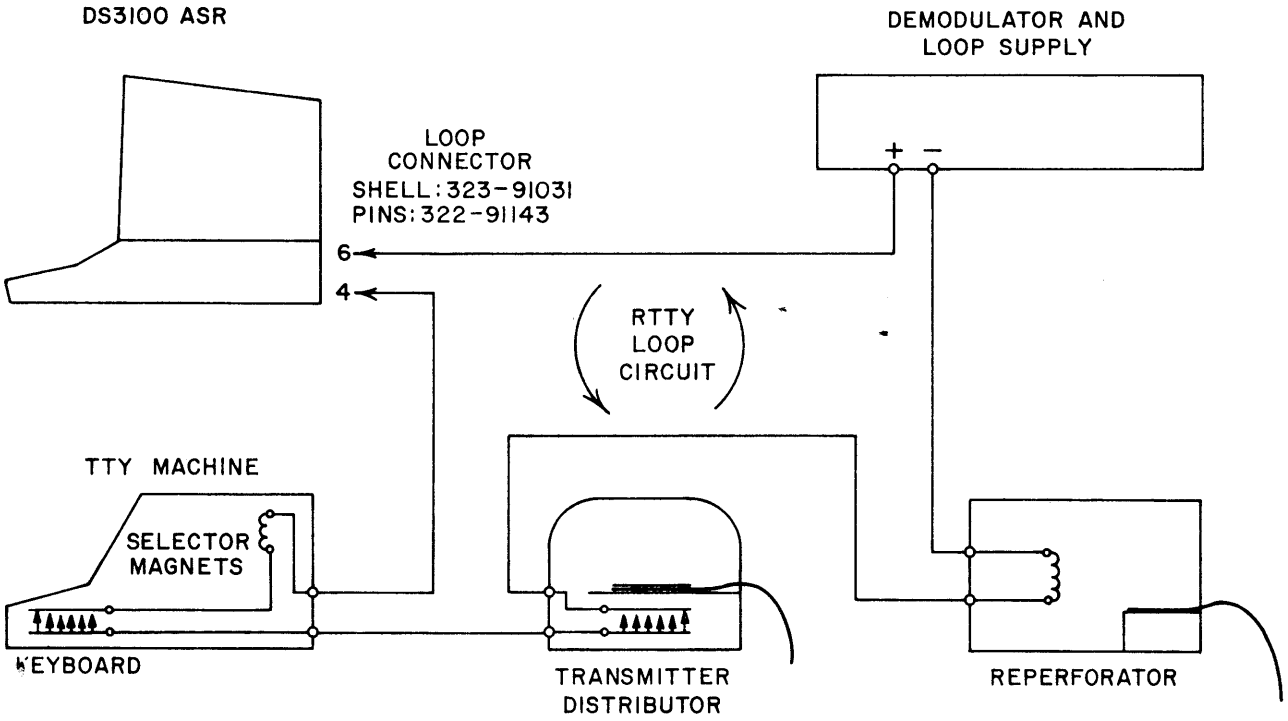
Several factory prepared cables are furnished with the DS3100 ASR to assist in making the "standard" connections, required in any RTTY or Morse installation. Connections using these factory prepared cables are shown in Figure 13.

The RTTY loop cable provided is connected in a *series* connection with the RTTY demodulator, loop power supply, and other teleprinter devices. The loop supply is included as part of all HAL demodulators - other demodulators may require addition of an external loop power supply. The loop power supply should supply no more than 200 vdc when the loop is "open" (loop current = 0, *space* condition) and allow no more than 100 ma of loop current for the *mark* condition. The HAL demodulator provides a standard 175 vdc, 60 ma loop current source. The DS3100 will work quite satisfactorily with much lower loop currents and voltages, but mechanical machines may not work reliably because of distortion caused by their selector magnets. If other electronic devices are connected in the loop circuit, be sure to observe the polarity of the connections. NOTE: *standard loop circuits are returned to ground only at the demodulator and not at a terminal, keyboard, or machine; improper grounding of the loop circuit to a chassis or machine frame may cause a serious electrical shock!*

The Morse Key Out cable furnished allows you to make connection to *either* a "grid-block" or "cathode" type keying circuit (more properly, key a negative voltage or positive voltage, respectively). The maximum ratings of this connection are ± 150 vdc to ground when key is "open" and 150 ma maximum when key is "closed." If desired, the two outputs may be used *simultaneously*; such as to key the CW ID line of the ST6000 with the "cathode" connection and the transceiver key line with the "grid-block" connection.

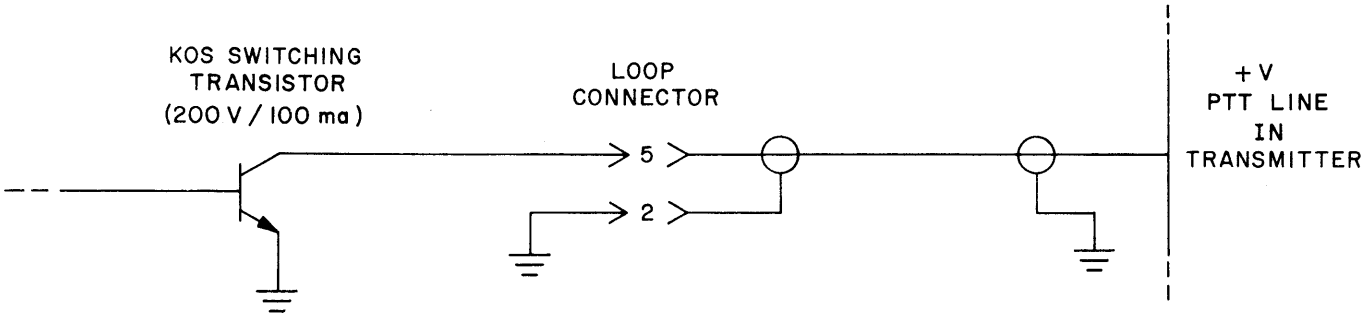


STANDARD MORSE CONNECTIONS



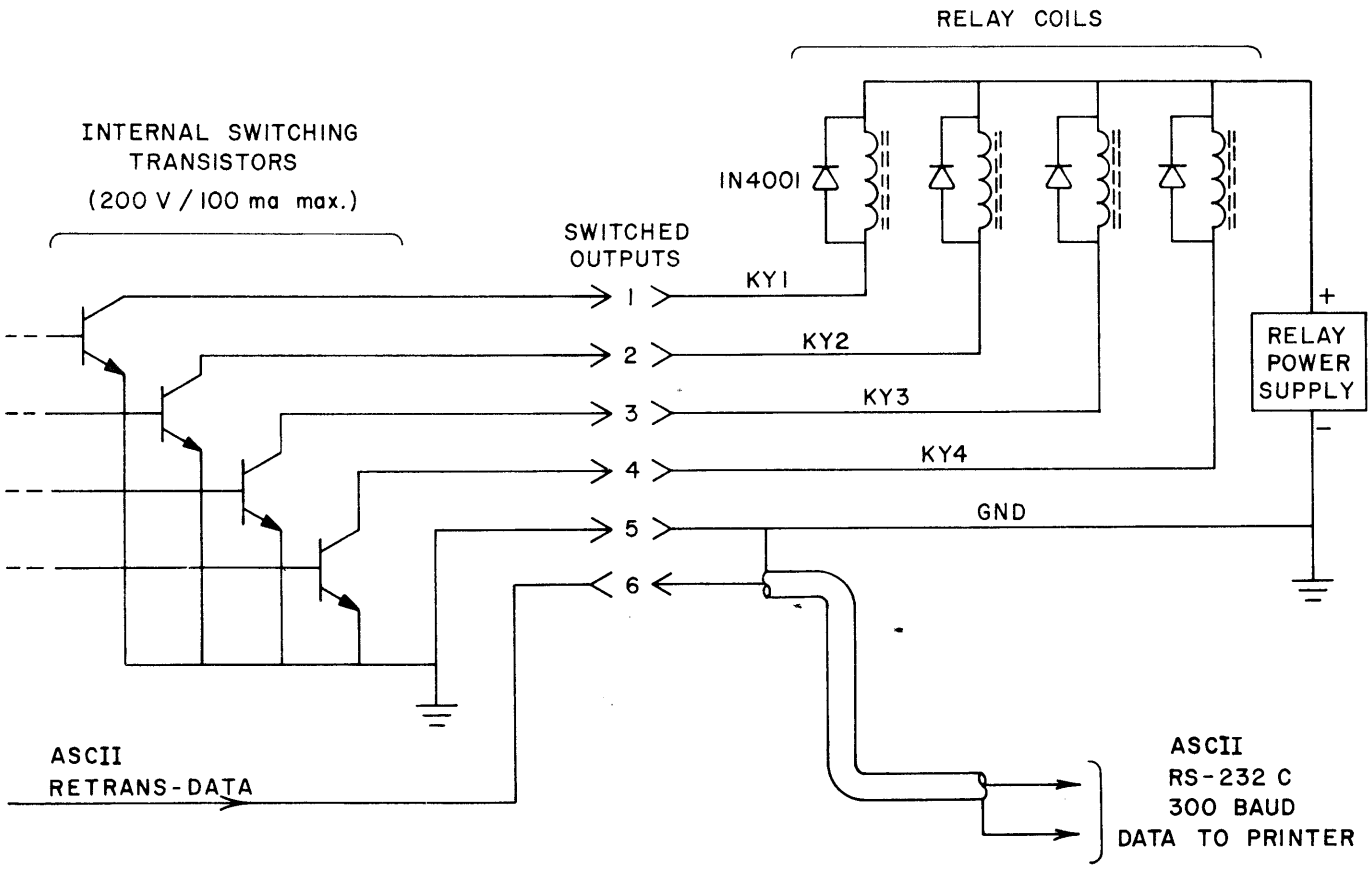
STANDARD RTTY LOOP CONNECTIONS

FIGURE 13. STANDARD RTTY AND MORSE CONNECTIONS



CONNECTION TO KOS CIRCUIT

(POSITIVE VOLTAGE)



CONNECTIONS TO KY SWITCHES AND PRINTER OPTION

FIGURE 14. KOS, KY, AND EXTERNAL PRINTER CONNECTIONS

The Morse Audio Input connection of the DS3100 *does differ* from that of the DS3000 KSR, requiring a different connector. The audio output of the receiver should be connected to the cable provided. If a 500 ohm audio output connection from the receiver is available, it should be used; however, the Morse decoding circuitry will function quite well if connected directly to the low impedance speaker output terminals. Do *not* connect the cable to a high impedance source as the 500 ohm internal impedance of the DS3100 will heavily "load-down" the output. The audio voltage supplied to the DS3100 ASR should not exceed 10 volts peak-to-peak and typically should be of the order of 1.0 volts peak-to-peak.

The DS3100 ASR can also be connected to automatically switch various devices on and off by using the KOS and KY1, KY2, KY3, and KY4 switch features. Each of these features provides a separate NPN, 200 vdc, 100 ma maximum switching transistor that can be controlled by the keyboard. Note that an *NPN* transistor is used and that *only positive voltages to ground may be keyed directly* with these switches; if it is necessary to switch a negative voltage, an additional PNP switching transistor will have to be added by the user. Typical connections are shown in Figure 14.

The KOS switch is controlled by the same criteria as the XMIT ACTIVE status, as discussed in section 2.5; the KOS is "ON" (low impedance to ground) whenever the XMIT ACTIVE status is obtained and "off" (high impedance to ground) whenever the XMIT ENABLED or XMIT INHIBIT status are shown. As shown in Figure 14, the KOS feature is generally connected to the PTT (Push-To-Talk) line of the transmitter in a communications system, providing automatic transmit-receive control.

The four KY switches are independent, keyboard controllable switching transistors that can be used to control a number of devices. The switches might be used to control a tape recorder, the power to an on-line printer (through a relay), or wired in parallel with the KOS switch to provide an alternate means of controlling the transmitter. Typical connections to the switches are shown in Figure 14; the protective diodes should be placed across relay coils, particularly if large power relays are to be controlled. Recall from the discussions of section 2.6.4 that the WRU response controls KY4 switch and SEL CAL response controls KY3. KY4 could be paralleled with the KOS switch to provide a WRU triggered answer-back system. As discussed in sections 2.5 and 2.6, the KY switches can be controlled within a program of a HERE IS message or inserted into the normal text to be transmitted. In all cases, the KY switch is *not* controlled until its turn comes in the transmit sequence, as discussed in section 2.5.9.

Also shown in Figure 14 is a connection for an auxiliary printer on the SWITCHED OUTPUTS connector. This allows connection of a 300 baud serial ASCII printer to the DS3100 ASR. When connected, the printer will print all text that is *written into the receive buffer*, including the "echoing" of transmitted data when half-duplex (HDX) is used. The output from the DS3100 ASR is RS232C compatible and may be adjusted internally for either 300 baud (standard) or 110 baud data rates. The output is *always serial ASCII code, regardless of the DS3100's code*. Therefore, this output provides a code conversion when the terminal is used with Baudot or Morse code and could be used to drive any ASCII device (such as a computer) as well as a printer.

The DS3100 ASR is ideally paired with the HAL ST6000 demodulator and a transceiver to form the ultimate in amateur radio teleprinter systems. Interconnections between these equipment are shown in Figures 15 and 16. These connections provide the following features:

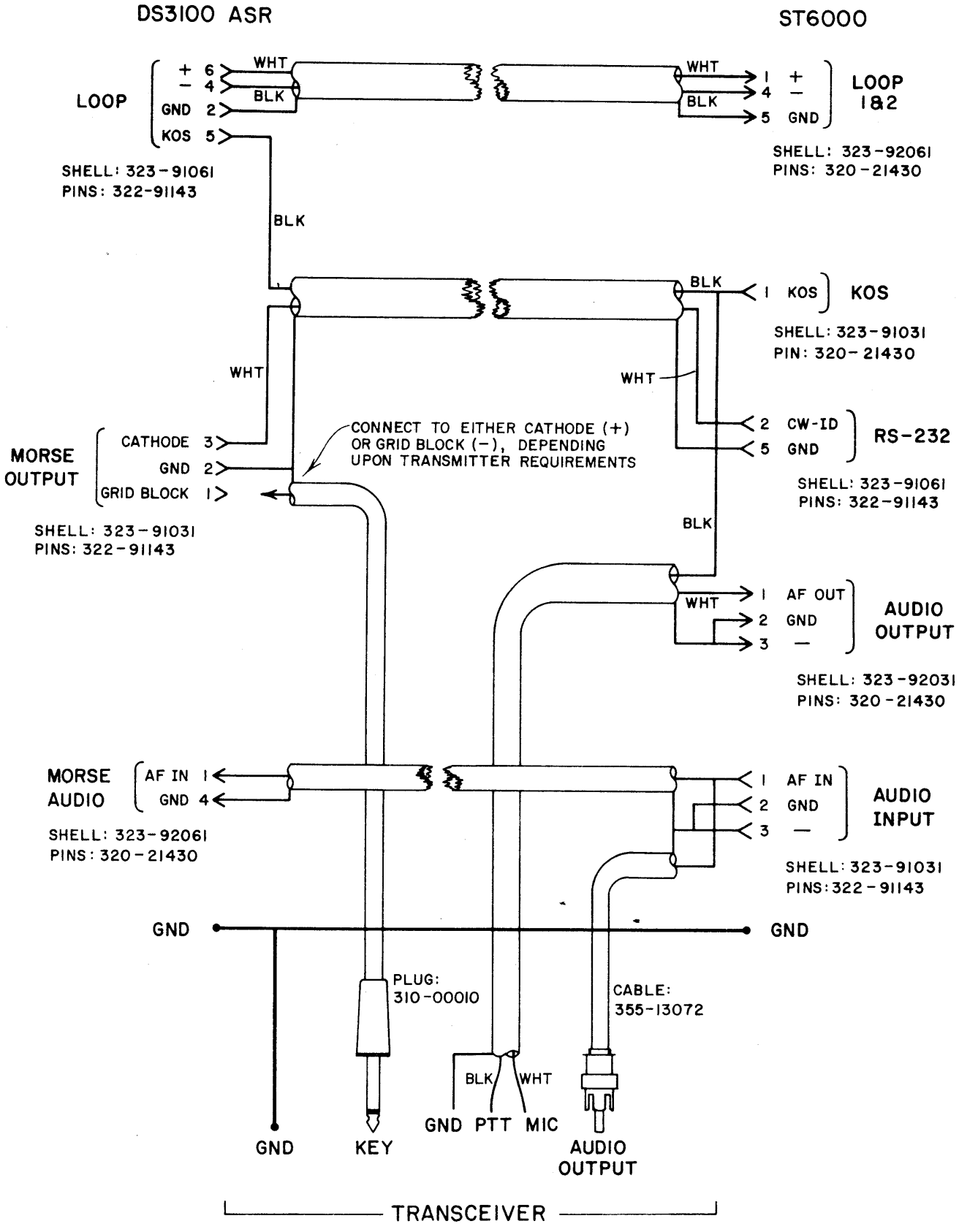


FIGURE 15. SYSTEM CABLE - DS3100 WITH ST6000 AND TRANSCEIVER

Note: The data connection between the DS3100 and the ST6000 is via a loop connection, not an RS232 connection. The "RS232" connector on the ST6000 is only used to connect the CW ID line to the demodulator.

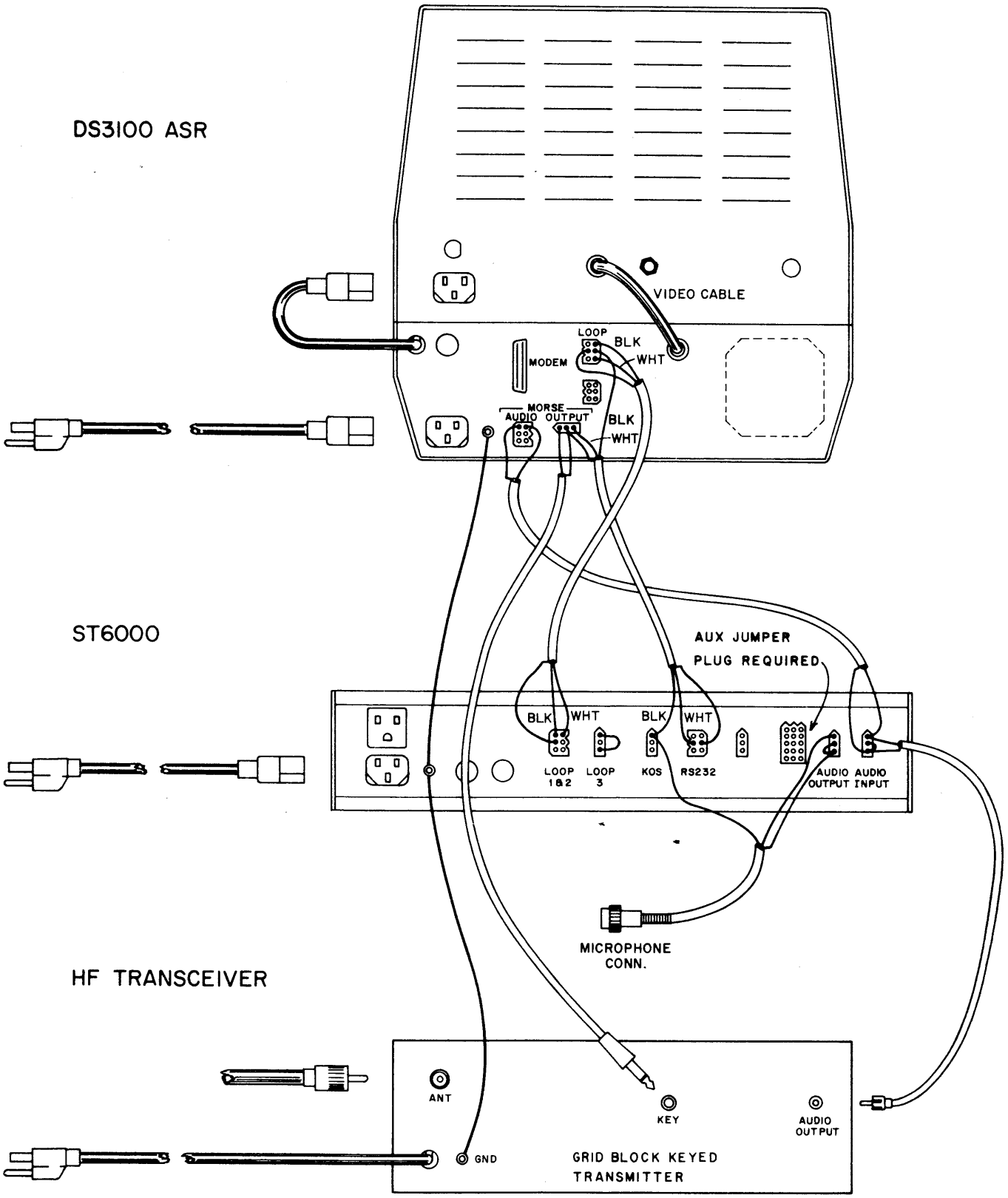


FIGURE 16. SAMPLE SYSTEM CABLE - PICTORIAL

1. RTTY and Morse reception from the receiver audio output.
2. Morse transmit by keying the transmitter through the key jack
3. RTTY transmitting with tones inserted into the microphone jack (Use LSB mode with HF Transmitters to match RTTY standards).
4. Transmit and receive of all three shifts with "true transceive"
5. Narrow-shift CW identification when operating RTTY
6. Automatic transmit-receive control by either the DS3100 KOS circuit or the ST6000 KOS circuit or both.

This cable set may be prepared at the factory to mate most commercially available transceivers for the *additional* cost of $50.00 per set. When ordering a system cable, be sure to specify the make and model of the transceiver to be used. Additional cables, not shown in Figures 15 or 16 are *not* included in the set, but could be manufactured at additional cost. Please consult the factory for further information.

3.4 ASCII MODEM CONNECTIONS:

The DS3100 ASR includes rear panel connections for a standard RS232C modem cable connection. The connections to the 25 pin modem connector are shown in Figures 11 and 12. Be particularly careful when inserting pins into the connector shell - they are *not easily removed!* All signal voltages to or from the modem connector should conform to the EIA RS232C standard voltage levels of -3 to -15 vdc or +3 to +15 vdc, depending upon the signal state. The DS3100 ASR can be *directly connected* to standard modems and cables. However, the user should compare the modem, cable, or data circuit connections with those of the DS3100 to assure this compatibility. The EIA RS232C modem signals used in the DS3100 are shown in Table 5 below:

TABLE 5. RS232C MODEM SIGNALS

Pin No.	Signal Name	Mnemonic	Use
1	Frame Ground	PG-AA	Safety ground connection to the DS3100 chassis.
2	Transmit Data	TXD-BA	Transmit data *output from* DS3100
3	Receive Data	RXD-BB	Receive data *input to* DS3100
4	Request To Send	RTS-CA	Signal *from* DS3100 to modem; tells modem to prepare to receive and retransmit data from terminal. Same as KOS-on and XMIT ACTIVE conditions
5	Clear To Send	CTS-CB	Signal *to* DS3100 from modem; tells DS3100 that modem is prepared to receive data. Internally set "on" when modem is not connected; is over-ridden by modem when connected.
6	Data Set Ready	DSR-CC	Signal *to* DS3100 from modem; tells DS3100 that modem is operational; *not* required for DS3100 operation.
7	Signal Ground	SG-AB	Ground return for *all* data and control signal circuits.
8	Carrier Detect	CD-CF	Signal *to* DS3100 from modem; indicates that local modem has detected carrier of modem at other end of communications circuit; *not* required for DS3100 operation.
9 thru 19	Internal Connections		Do *not* connect to these pins; check the modem and cable before interconnecting.
20	Data Terminal Ready	DTR-CD	Signal *from* DS3100 to modem; tells modem that the terminal is operational; always set "on" by the DS3100.
21 thru 25	Internal Connections		Do *not* connect to these pins; check the modem and cable before interconnecting.

3.5 POWER LINE VOLTAGE AND FREQUENCY CHANGES:

Voltage

The DS3100 ASR can be connected for operation from either 95 to 125 VAC or 190 to 250 VAC power lines. The AC power supplies of the display and keyboard sections are separate and it is therefore necessary to change both sections. In addition, provision is included in each section to compensate for lower than the normal 120 / 240 VAC U.S. standard power voltage.

Keyboard Section

Power transformer primary winding taps must be changed to accommodate the various power line voltage possibilities. Refer to Figure 17 for the following discussion.

110 to 125 VAC

The DS3100 ASR is normally factory-wired for this connection unless the unit was specifically ordered otherwise. Any other power connection will be indicated by a tag on the rear panel. If it is desired to convert a unit previously wired for another voltage range, follow the wiring diagram in Figure 17 (a).

95 to 110 VAC

If the power line voltage available is CONSISTENTLY lower than 110 volts, the transformer may be re-wired as shown in Figure 17 (b). If however, line voltage problems are caused by poor line regulation that allows greater than a 15 volt change in the line voltage, the user should either contact his power company to correct the regulation problem or install a constant-voltage regulating transformer. The terminal could be damaged if the low-voltage taps are used and the line voltage at some point in time is high.

220 to 250 VAC

This connection is normally supplied for export use when so requested by the customer. If this connection has been factory installed, it will be indicated on a tag on the rear panel. If it is desired to change a unit previously connected for 110 to 125 VAC operation, follow the instructions of Figure 17 (c). The primary jumper wires (Jumpers "A" and "B") are purposely long enough to allow conversion that involves removal of Jumper "B" and moving only ONE end of Jumper "A".

190 to 220 VAC

If the power line voltage is CONSISTENTLY lower than 220 volts, the connection shown in Figure 17 (d) should be used. The same precautions discussed with regard to voltage regulation above also apply to this connection. Poor line voltage regulation may not result in satisfactory terminal operation.

When the terminal has been factory wired for 95 to 125 VAC operation, a power cord with the standard 3-prong plug is supplied. NOTE: Changing the power voltage into the keyboard section also changes the power voltage supplied on the A.C. socket.

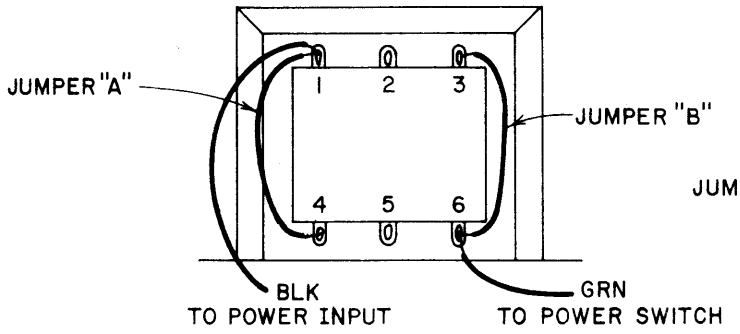
****

CAUTION: DO NOT MAKE ANY CHANGES IN POWER CONNECTIONS UNTIL THE TERMINAL HAS BEEN DISCONNECTED FROM THE POWER LINE AND OTHER EQUIPMENT.

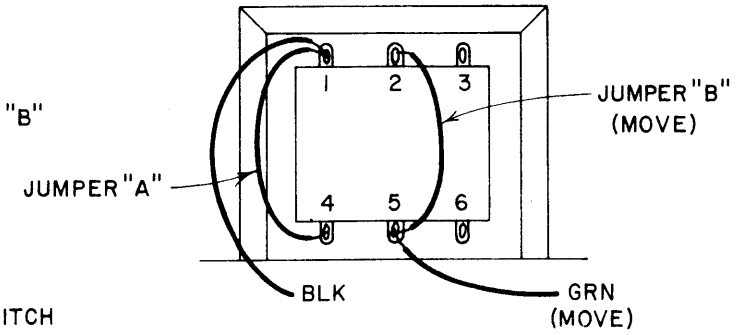
****

Power Frequency Changes:

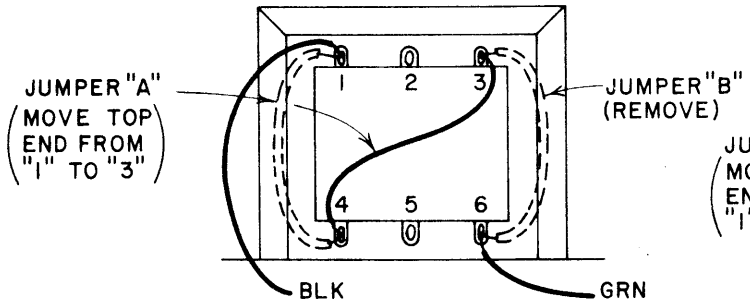
The power supply sections of both the keyboard and display sections work equally well for power line frequencies of 50 or 60 Hz. However, other changes on the circuit boards and in the controlling computer programs are required to optimize a DS3100 for either 50 Hz or 60 Hz operation. Therefore, it is strongly advised that applications requiring 50 Hz power line operation be noted *when the equipment is ordered* so that the proper changes can be made *at the factory*. If it is desired to convert from one power frequency to the other, please contact the factory (or appropriate export distributor) so that arrangements can be made to do the conversion. A terminal set for the incorrect line frequency may have noticeable screen "jitter" and an inaccurate TIME feature.



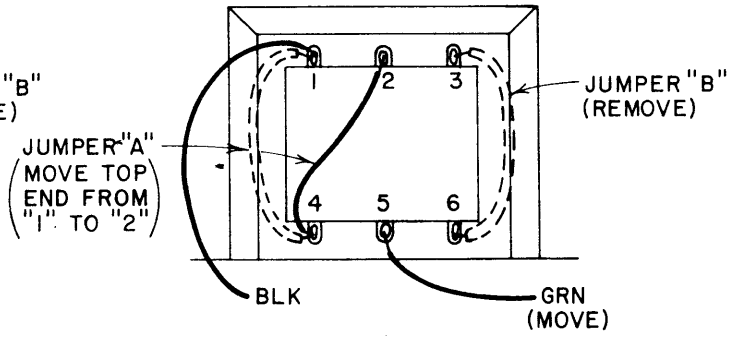
(a) 110 - 125 VAC Connection (Standard)



(b) 95 - 110 VAC Connection



(c) 220 - 250 VAC Connection



(d) 190 - 220 VAC Connection

FIGURE 17. POWER TRANSFORMER VOLTAGE TAP CONNECTIONS

4. In Case of Difficulty

4.1 CARE AND FEEDING OF YOUR DS3100 ASR:

Your DS3100 ASR is the result of four generations of terminal design and manufacture by HAL Communications. In every way, it has been designed, constructed, and tested to assure years of trouble-free operation. However, there are a number of simple procedures that you, the user, can follow that will further improve the reliability, performance, and lifetime of the terminal. The following suggestions are offered to help preserve a long operating life for your DS3100 ASR.

1. Environment:

   Electronic equipment is very susceptible to variations in temperature, relative humidity, and to dust and dirt accumulations. The DS3100 will operate in normal room temperature environments and should be as tolerant of temperature extremes as is its human operator. However, inadvertent blockage of the ventilating holes on the bottom or rear panel surfaces will cause the *internal* temperature of the terminal to rise considerably above the ambient room temperature and may in fact cause a circuit failure. Also, accumulations of dust and dirt, particularly when accompanied by high humidity conditions can also cause over-heating and may result in long-term corrosion of the internal circuitry. Therefore, try to locate the terminal so that its ventilating holes are not obstructed and try to avoid extremely dusty or dirty environments.

   In the normal course of operations, the terminal and its display in particular may eventually attract a build-up of dust or smoke "haze". This may be expected in even the cleanest areas, particularly if tobacco smoking is permitted. The display screen, because of the air flow around it and the high voltage applied to the crt actually attracts particulate contaminants, causing what may appear to be a gradual fading of screen intensity. Therefore, cleaning of both the plastic cover and the face of the crt itself should be done often. The plastic cover on the display is removed with the four black screws on the front. *Be careful when cleaning the plastic cover - it will scratch easily.* The cleaning materials available for phonograph records are excellent for plastic cleaning but may lack in cleaning strength if too much dirt has accumulated.

2. Electrical Connection:

   All electrical connection points of the DS3100 ASR have maximum voltage and current ratings as given in these manuals. If these maximums are exceeded for even a short period of time, considerable damage to the terminal may result. Therefore, be very careful to know the ratings of the DS3100 and the characteristics of the interfacing equipment before connecting the two. Some common causes of electrical failures have been found to be:

   a. Inadequate grounding, causing RF interference problems as well as sensitivity to ac power line transients.
   b. Incorrect connection of the high voltage loop supply causing destruction of the feature to which it was incorrectly connected.
   c. Inadvertent use of more than one loop supply causing a very high loop voltage or current, destroying the loop switching transistor.

d. Damage due to lightning or other transients on the power line or station antenna system. Obviously a good lightning protection system may help as will disconnecting the terminal from the power line and/or other equipment during electrical storms. However, such things are unpredictable and the DS3100 is no more susceptible to such problems than other equipment in the station; protective measures taken for other equipment are probably also wisely applied to the DS3100.

4.2 TYPICAL OPERATIONAL PROBLEMS:

Because the DS3100 ASR offers considerably more features and conveniences than any previous terminal, it is by nature a *very complicated gadget!* Therefore, there will be times when it first appears that the terminal has either quit completely or has "gone off to do its own thing". If some of the circuitry has failed, you may well get these symptoms; however, more likely the terminal is doing what we instructed and we've forgotten what the response is. Such "operator errors" may occur frequently while you are learning how to use the DS3100 - they are part of the learning process.

The DS3100 screen and keyboard were designed to minimize confusion and simplify the terminal operation. A lot can be learned about the terminal's operation by simply checking the status indicators on the screen.

> *IF the DS3100 appears to be in an unexplainable mode, FIRST check the status indicators and confirm that the terminal is doing what you think it should be.*

Often, mistyping one key for another can cause an *entirely different* result from that intended. Some of the more confusing conditions you can get are:

1. Forget to program the TIME feature - causes a lot of Ø's when called!
2. Forget to terminate programming of HERE IS, TIME, or WRU features - you *cannot* enter transmit text into the transmit buffer until the programming is ended with the same sequence used to start it. The bottom status indicator shows when programming is in progress. However, text can continue to be received and text *previously* written into the transmit buffer can be transmitted *while* programming.
3. When SYNC idle is used with WORD or LINE modes and KOS is also used, the KOS stays "on" until after a NEW LINE is typed with *no following characters*. Typing *any* character, including another NEW LINE will restart the SYNC idle and keep KOS "on".
4. When the 50th line of the transmit buffer has been filled, the "bell" of the DS3100 will sound and no further characters will be accepted. The "bell" will also sound if RUB OUT corrections are attempted at the beginning of a line.
5. You may type text or transmit in either split-screen or full-receive screen modes; full screen display can be confusing while transmitting, particularly if FDX is used or if the receive display is offset so that the transmitted text is not echoed in HDX.
6. The "bail-out" keys are:

   FN-XMIT - will stop (or start) transmit output.
   FN-RESET - resets Morse code receive.
   FN-CLRS - CLEARS transmit buffer (total destruction!).
   Power Switch - START OVER! (full panic!)

4.3 REPAIR PROCEDURES:

In the event that your DS3100 ASR develops a malfunction, the first step is to carefully note *all* of the symptoms of the problem. Statements such as "BROKE" or "DON'T WORK" are of little help to the service technician and usually lead to longer repair times than might be otherwise required. Try to provide as much information concerning the failure as you can when you contact the factory. The following are some of the things we will be concerned with at the factory:

1. Model Number
2. Serial Number
3. How long have you owned it?
4. Does the problem happen immediately or only after the terminal is turned on for a while? If so, how long?
5. What terminal modes, rates, codes, etc conditions are associated with the failure? Does it happen only in receive, transmit or both?
6. Are there extenuating circumstances? (Lightning storm, spilled something on keyboard, dropped unit?)
7. Is the problem confined to either the display or keyboard sections (if you can tell).
8. Add *anything* else to the description you think would be helpful.

After you have determined answers to the above, write or phone the factory (or your export dealer) and we will see to a prompt repair of the terminal. The people you talk to at the factory will try to come up with a solution that minimizes the "down-time" to get your terminal working again as soon as possible. Under some circumstances, it may be possible to isolate the problem to one circuit board assembly and supply you with a replacement board; in other cases it may be necessary to have the entire terminal returned for repair. In any case, we both want to have the terminal fixed and returned to service as soon as possible.

Because of the complexity of the circuitry used in the DS3100, we do *not* recommend that you personally undertake repairs beyond the substitution of boards or sub-assemblies following factory instructions.

The one year limited warranty (listed in full at the back of this manual) provides for factory repair of the DS3100 for a full year after purchase. Please read this warranty carefully to determine the full extent of the privileges and limitations. Note especially, that we do ask you to pay shipping charges to us and we then pay the return charges to you. HAL Communications highly recommends that shipping be made via UPS whenever possible; be sure to insure for the full value of any returned materials.

To avoid confusion and delays please *DO NOT RETURN MATERIALS TO THE FACTORY WITHOUT PRIOR COMMUNICATIONS WITH AND APPROVAL OF HAL PERSONNEL.* Usually, HAL will send you a written Factory Return Authorization to be included with the equipment. In no case should you send a piece of equipment back without including in the box with the equipment documentation to identify you, the owner with a specific piece of equipment (serial number and model) and at least a reference as to the nature of the problem and the name of the HAL employee you talked with.

The factory address for shipping of repairs is:

BEFORE NOV. 1, 1980:	AFTER NOV. 1, 1980:
HAL COMMUNICATIONS CORP.	HAL COMMUNICATIONS CORP.
807 E. GREEN STREET	1201 W. KENYON ROAD
URBANA, ILLINOIS 61801	URBANA, ILLINOIS 61801

5. DS3100 ASR SPECIFICATIONS

Input / Output:	Baudot:	18-120 ma / 200 V (maximum) current loop RS232C voltage levels
	ASCII:	18-120 ma / 200 V (maximum) current loop RS232C voltage levels Full 25 pin Modem connection
	MORSE:	10 v p-p MAX (600 ohm), 800 Hz audio input Transistor switches to ground to key either negative voltage ("grid-block") or positive voltage ("cathode") circuits simultaneously.
Data Rates:	Baudot:	45, 50, 57, 74, 100 baud (60, 66, 75, 100, 132 wpm)
	ASCII:	110, 150, 300, 600, 1200, 1800, 2400, 4800, 9600 baud (10, 15, 30, 60, 120, 180, 240, 480, 960 cps)
	MORSE:	Receive: automatically track 1 to 175 wpm Transmit: preset to 1 to 175 wpm in 1 wpm increments
Data Codes:	Baudot:	7.5 Unit code (1 start, 5 data, and 1.5 stop) A - Z, Ø - 9, -?:$!&#'().,BELL;/"LTRS FIGS CR LF Space Blank; Automatic FIGS/LTRS and CR/LF inserted as required.
	ASCII:	110 baud: 11 unit code (1 start, 8 data, 2 stop) 150 - 9600 baud: 10 unit (1 start, 8 data, 1 stop) A - Z (upper and lower case or upper case only), Ø - 9, !"#$%&'()*+,-./:;<>=?@[]^_`{}|~ , NUL SOH STX ETX EOT ENQ ACK BEL BS HT LF VT FF CR SO SI DLE DC1 DC2 DC3 DC4 NAK SYN ETB CAN EM SUB ESC FS GS RS US RUB OUT
	Morse:	Continental Morse Code: A - Z, Ø - 9, .,?:;-'/()" AR AS BT ES KN SK
Transmit Modes:	CONT:	Continuous mode; characters are transmitted as they are typed.
	LINE:	Line mode; text is transmitted in complete lines, allowing editing of each line before transmitting.
	WORD:	Word mode; text is transmitted one word at a time.
	ASR:	All transmit text up to 50 lines may be precomposed and edited *while receiving* and transmitted at will; reverts to CONT, LINE or WORD modes after all precomposed text is transmitted.
	FD/HD:	Full-Duplex or Half-Duplex operation; full-duplex allows *simultaneous active* receive and transmit operations.
Display Screen:	Format:	72 characters per line, 24 lines total; 12 lines receive and 12 lines transmit buffer display or all 24 lines receive buffer display. 5 x 7 dot matrix, Green P31 phosphor, 12 inch diagonal measure CRT.

Text Buffering:

Receive: Up to 150 lines of storage of received text. Screen shows selected 12 (or 24) line segment of buffer with line numbers. In half-duplex, transmitted text is echoed into receive buffer as it is transmitted and displayed with "dim" intensity; full duplex transmit text is not echoed into the receive buffer.

Transmit: Up to 50 lines of transmit text may be precomposed and stored in the transmit buffer. 12 lines of the buffer may be displayed with line numbers and screen position in the buffer may be changed. Transmit buffer may be pre-typed at any time with full edit features; selected lines of receive buffer text may be copied into the transmit buffer.

Programmable Messages:

HERE IS: Up to 10 different, 32 character HERE IS messages may be programmed and inserted into the transmit text as desired. HERE IS programming may include calls to other HERE IS segments, QBF test message, KY switch control and other features. The contents of HERE IS-1 and HERE IS-Ø are permanently saved in the non-volatile EAROM device.

IDENT: IDENT key transmits contents of HERE IS-Ø in Morse code, regardless of the selected terminal code. IDENT may be called from a HERE IS message.

WRU: Up to a 10 character WRU recognition text may be programmed. When the recognition text is received, switch KY1 is activated, HERE IS-1 transmitted, and KY1 deactivated with a delay before and after the HERE IS-1. Reception of the ASCII ENQ (or WRU; ØØØØ1Ø1) will also trigger the WRU response. WRU may be used for automatic control of accessories such as tape recorder or transmitter.

EAROM: EAROM (Electrically Alterable Read Only Memory) storage allows semi-permanent storage of critical parameters when power is disconnected. The contents of HERE IS-1, HERE IS-Ø, WRU code message, and terminal CODE, RATE, MODE, USOS, and SYNC status are all stored. Upon power application, the EAROM status and messages are set in the DS3100. The operator may change the parameters or the EAROM storage at will.

TIME: Internal clock keeps time (24 hour format); an additional 16 characters may be programmed to give zone, date, or other information with the time. The TIME can be inserted into the transmit buffer or called from a HERE IS message.

Deluxe Features:

Word wrap-around: Full non-overprint; will not split a word at end of line.

USOS: On Baudot reception, reverts to LTRS case after reception of each SPACE character.

	SYNC:	Synchronous idle to assist other station's reception. Fills time between transmitted characters with LTRS (11111) in Baudot, NUL (ØØØØØØØØ) in ASCII, and $\overline{BT}$ (-···-) in Morse.
	CAPLK:	Allows transmission of only capital letters or of both upper and lower case letters in ASCII code only. Upper or lower case letters are displayed as received.
	KOS:	Keyboard Operated Switch to control the transmit-receive circuitry of a radio installation.
	KY1, KY2, KY3, KY4:	Accessory switches that may be turned on or off by keyboard control or included in HERE IS message programs. KY4 is also controlled by the WRU response sequence. KY switches may be used to control external equipment.
	STATUS INDICATORS:	Key parameters or conditions of the DS3100 ASR are shown by 13 on-screen Status Indicator messages. Included are: TIME, CODE, RATE, MODE, USOS, SYNC, XMIT Buffer Status, WRU, KY 1234, FDX/HDX, CAP LK, IDENT, and PROG. The indicators occupy the far right-hand seven screen locations.
	Keyboard:	Arranged in a standard 52 key ASCII / typewriter format with SHIFT, CTRL, and FN keys. All terminal parameters are keyboard controlled by the FN plus second (or third) key. FN operations are shown by special front face legends on the keytops. Keyboard also features high-reliability keyswitches and N-key rollover.
	Test Messages:	The standard QBF test message (THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG's BACK Ø123456789) or alternate code patterns (RYRY in Baudot, U*U*U* in ASCII) may be transmitted with FN keys.
Mechanical Data:	Size:	13.5" W x 20.5" D x 15.25" H; 45 lbs net, 60 lbs ship (34.3 x 52.1 x 39.4 cm; 20.4 kg net, 27.2 kg ship)
	Colors:	Castle tan and Chocolate Brown with color coordinated keytops and green characters on screen.
	Power:	105-130 vac 50/60 Hz; 210-250 vac 50/60 Hz; 70 watts

APPENDIX A

RF-INDUCED PROBLEMS

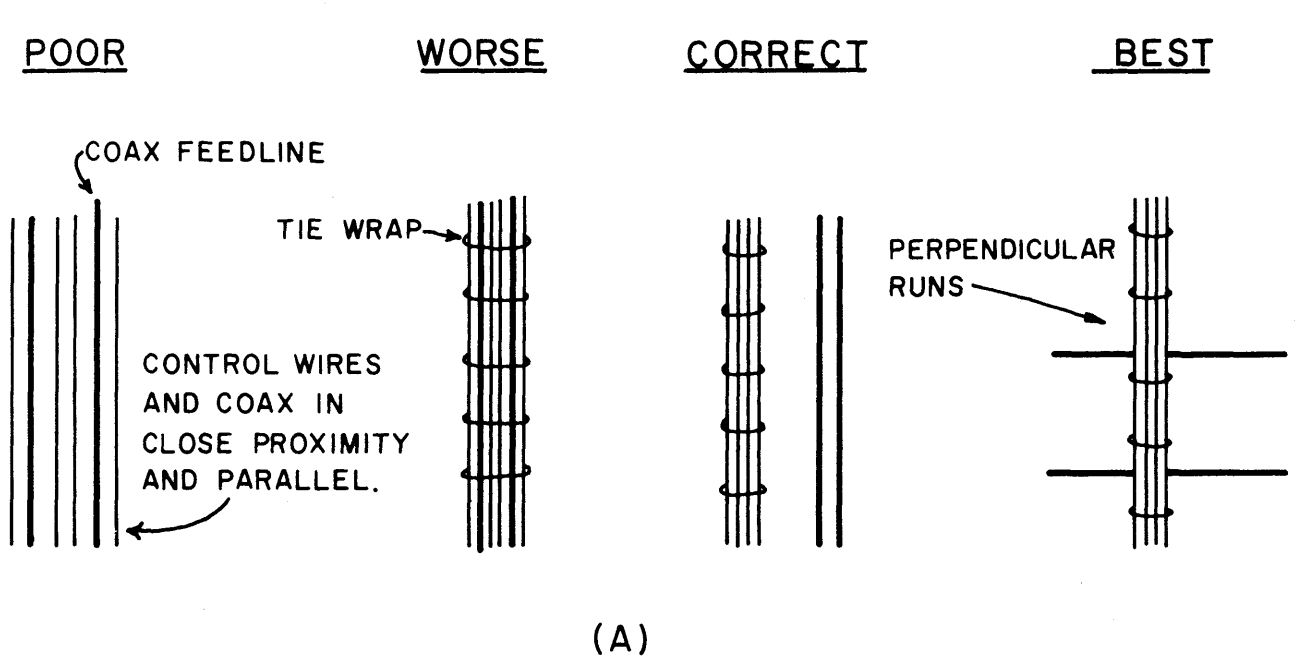
The DS3100 ASR is designed to operate in close proximity to radio frequency transmitting and receiving equipment. Particular attention has been paid to the shielding of the DS3100 circuitry through the use of an all-metal enclosure and good common grounds. However, under certain conditions in an rf-saturated environment, the DS3100 may be susceptable to rf-induced interference. This may manifest itself in any of a number of ways, such as partial or complete lack of response to the keyboard, or erratic behavior of the video display.

The first thing that should be checked if rf problems are suspected is the ground system. The transmitter should be properly grounded for rf (in addition to electrical ground) and all other station equipment grounds should be connected to the transmitter chassis. The rf ground should consist of a short length of heavy copper wire or braid terminated at a good earth ground (ground rod or copper cold-water pipe). If a water-system ground is used, be sure that the pipes are 100 percent metal from the point of connection to the water mains -- plastic plumbing will break the ground path. If the distance between your transmitter and ground rod or water-main ground is more than a quarter wavelength at the highest operating frequency, make the ground wire a half-wavelength, or a multiple of a half wavelength long. If you plan to operate on 10 and 15 meters you may need to run a separate ground wire for each band if the distance requires the use of half-wavelength wires. For example, if the distance from the ground point exceeds about 8 to 10 feet, a 10-meter half-wave ground wire (16 feet long) and 15-meter half-wave ground wire (22 to 23 feet long) would be used. Consult any of the amateur handbooks or antenna books for a more in-depth discussion of grounding techniques.

The best way to confirm that a problem is being caused by rf induction is to temporarily eliminate the source. This may be done in stages, starting with a partial reduction in exciter drive, and ending with transmitter shut-off. Since rf energy can be induced in the DS3100 circuitry through several paths, connecting the transmitter to a dummy load may not eliminate all rf related problems, although this is an excellent first step in verifying rf problems.

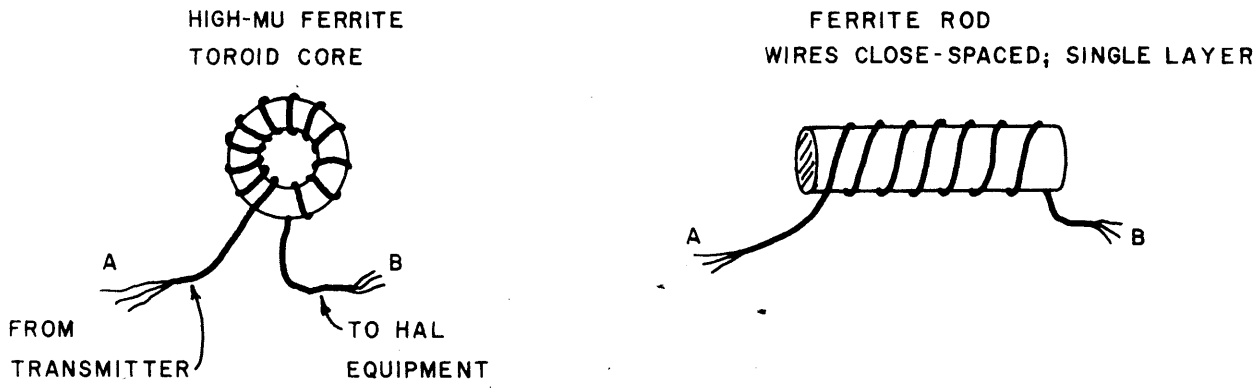
Radiation of rf energy from linear amplifiers, antenna tuners, coaxial switches, monitor scopes and interconnecting coax-cable jumpers is also possible. In fact, it is this type of radiation that is most likely to be coupled into nearby I/O and power cables going to the DS3100. To locate the point or points of radiation, experiment with different cable arrangements ro see if the rf-induced problem can be eliminated by reducing coupling between any of the DS3100 cables and nearby coaxial lines carrying rf power. Fig. 1A contains several cable arrangements, both bad and good, showing how to keep rf coupling to a minimum. The drawing in Fig. 1B shows the use of high-mu (950 or 2000) ferrite toroids or rods to choke the flow of rf on audio and control lines.

If cable rearrangement doesn't yield positive results, then begin eliminating pieces of equipment and sections of coaxial cable until the transmitter is connected directly to a shielded dummy load. As each piece of equipment is removed from the transmission line, check to see if the rf-related problems have diminished or dissapeared. If the rf problem persists with the exciter connected directly to a dummy load, reduce the drive level to see if that eliminates the problem.



(A)

PLACE RF CHOKE CLOSE TO REAR PANEL OF EQUIPMENT



(B)

FIG. 1 -- (A) Cable arrangements, showing ways to reduce rf coupling.
(B) Use of high-mu toroids and rods to choke the flow of rf on audio and control lines.

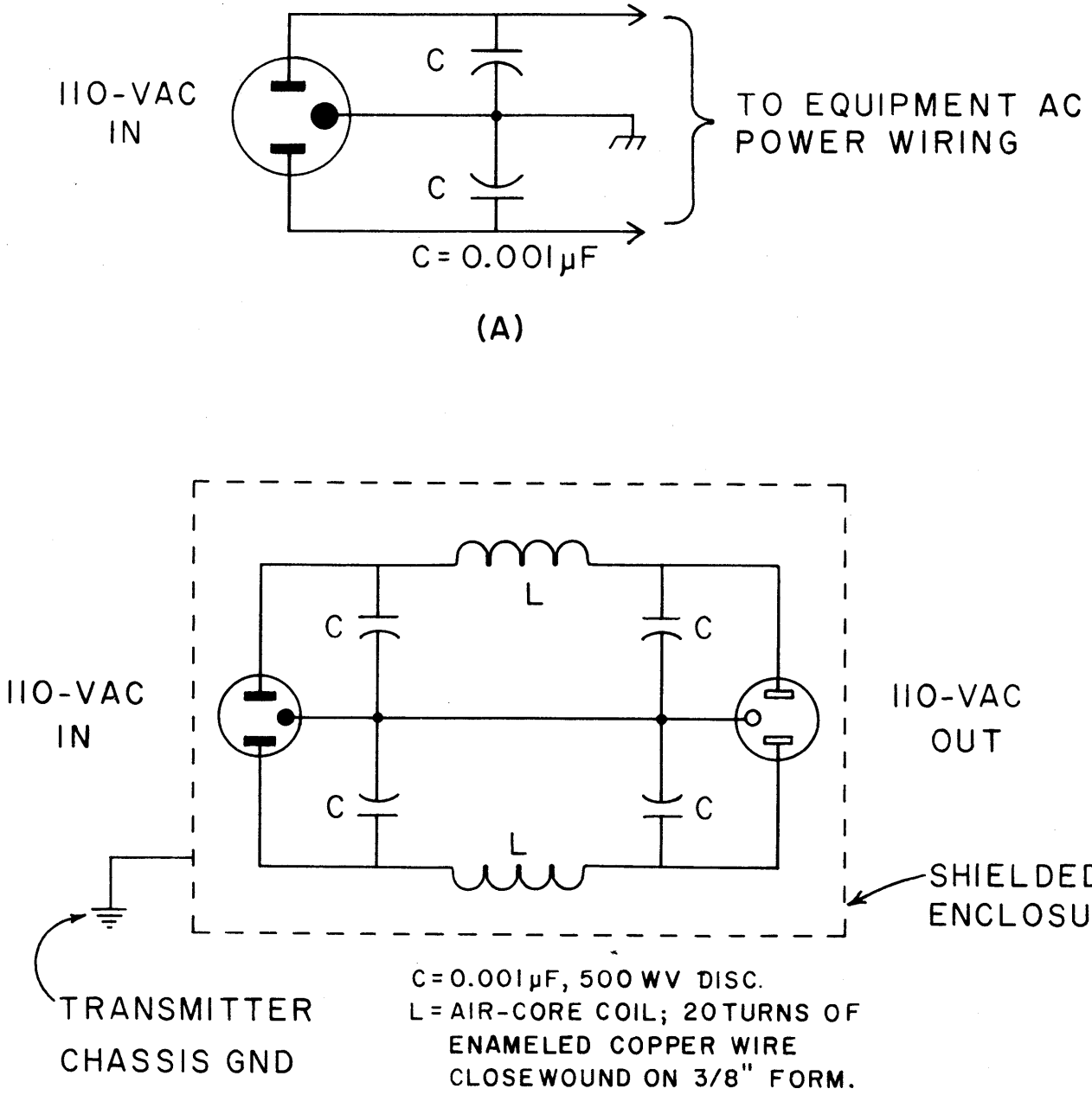


FIG. 2 -- (A) Simple rf-bypass method used in many transmitters.
(B) Brute-force ac-line filter that can be added to reduce or eliminate the flow of rf on power lines.

If operation into a dummy load does not significantly reduce the rf-related problems, disconnect all I/O cables from the DS3100. Test the operation while it is connected only to ac power. At the same time, enable the transmitter so that it sends a CW signal into a dummy load. If rf problems are still present, then rf energy is probably being introduced to the DS3100 through power cord by means of the common ac power line. This is usually indicative of poor ac-line filtering in the radio transmitter power supply section. Fig. 2A shows a common bypass-filter method used in many transmitters. The drawing in Fig. 2B depicts a brute-force ac-line filter that can be added to transmitters or other equipment to eliminate the flow of rf on ac power lines.

Rf-induced problems that cannot be cured, or ones that appear not to be the fault of inadequate transmitter filtering should be referred to HAL factory Customer-Service personnel. In cases where this is not feasible, or where station rearrangement is necessary to affect complete elimination of the rf problems, the information in the following section may be of some help.

4.6 Minimizing Rf-Related Problems Through Antenna Selection and Deployment

In addition to the liberal use of rf bypassing capacitors on station equipment, the use of certain antennas may offer reduced levels of rf in the radio room in many cases. Whenever possible, use resonant Yagi, quad, dipole or vertical antennas, and try to achieve a good impedance match at the antenna instead of relying on an antenna tuner. Random-length wire antennas and others that require tuning from the shack are more likely to create high levels of rf within the vicinity of the operating position.

The location of the transmitting antenna with respect to the radio room also has an effect on the rf energy that is coupled into interconnecting cables. Apartment dwellers may have the most difficulty achieving a good installation since many times an indoor antenna is the only type allowed. Where outdoor antennas are allowed, they should be placed as high as practicable. Not only will this provide for better reception, but it will also reduce the level of rf in the shack. Excellent antenna installation information can be found in many radio & electronics handbooks, antenna theory/construction booklets, and in articles published in electronics periodicals.

In most situations, coaxial cable feed line is preferred over open-wire, twin-lead, or single-wire type feed systems as its self-shielding property reduces the chance of rf coupling.

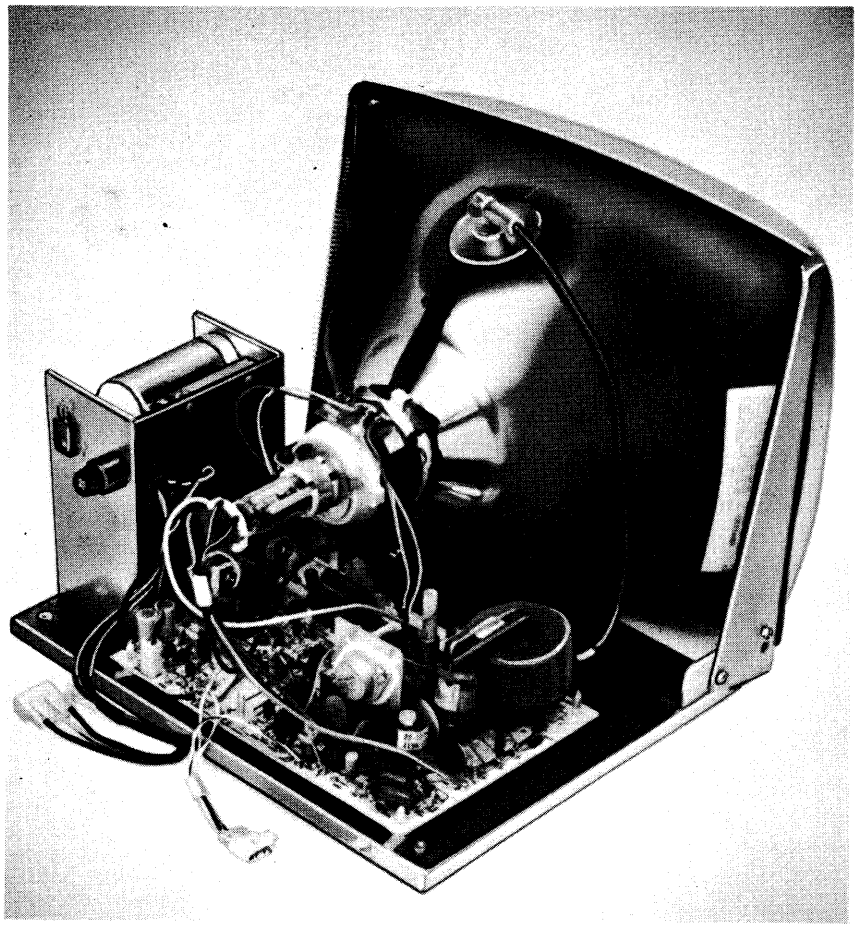
Rf energy may also be conducted back to the station by coupling of rf between the antenna and the outside shield braid of the coaxial cable. The use of a balun on a center-fed dipole fed with coaxial cable may also help reduce coupling, and therefore reduce RFI. An rf choke constructed by winding five or six turns of coaxial cable in a coil approximately six inches in diameter may also help reduce the flow of rf currents on the outside of the coaxial-cable braid. If such a choke is used, it should be wrapped with electrical tape to hold the windings together, and be secured as close as possible to the feed point of the dipole (or driven element if a beam antenna is used).

Try to dress coaxial cable lines so that they drop perpendicular to the dipole wire and not parallel to the radiating wire. In some cases, it may be necessary to run the coaxial cable straight to the ground and bury it for the run to the transmitter to reduce the coupling between the outside shield braid of the

coaxial cable and the antenna. If there is a moderate SWR in the line, try adjusting the coaxial cable length so that a low impedance (high feed current) is presented to the transmitter. This may help reduce the level of rf in the vicinity of the transmitter.

APPENDIX B

DV-3000 HAL TERMINAL DISPLAY



1.0 MONITOR DESCRIPTION

The V15 series of Data Display Monitors are provided in two versions:

a) for operation with composite video signals
b) for operation with "direct drive" or TTL level signals

An optional power supply is available for both versions.

The monitors are designed with high reliability solid state circuits and all components are located on one printed circuit board for small volume packaging requirements.

2.0 CONTROLS

All controls – except the contrast control – are located on the printed circuit board. These are as follows:

Vertical Hold
Height
Vertical Linearity
Focus
Brightness
Horizontal Frequency – composite version only
Width

Note: The contrast control must be 500Ω, ≥1/8 Watt. It is not supplied with the monitor.

3.0 PERFORMANCE SPECIFICATIONS

Input Signals:
Composite: 1V p-p ± 6db, sync negative.
Direct Drive: See page 3 for levels and timing.

Input Impedance:
Composite (Video): terminated 75 Ω ± 5%
Direct Drive:
Video – 2.5K Ω shunted by 30pF max.
Vertical – 10K Ω shunted by 30pF max.
Horizontal – 820 Ω shunted by 30pF max.

Video Amplifier:
Bandwidth: 12MHz ± 3db
Rise Time: ≤ 30nsec (10% to 90% amplitude)
Fall Time: ≤ 30nsec (90% to 10% amplitude)

Resolution:
Centre: 900 lines at 40 ft/lamberts
Corners: 800 lines at 40 ft/lamberts
Note: Resolution is given for P4 phosphor, polished face plate picture tubes, measured according to EIA RS-375.

Deflection:
Horizontal Retrace Time: 7.4μsec
Vertical Retrace Time: 800μsec
Horizontal Frequency Range: 14,000-18,500Hz
Vertical Frequency Range: 48-62Hz
EHT: 12KV nominal

Geometric Distortion:
The outline of a full screen of characters shall approach an ideal rectangle to within 1.5% of the rectangle height.

Power Requirements:
Volts: 15V DC ± 0.5V
Current: 1.0 amp. nominal 1.5 amp. max.

CRT's:
Standard: 9" and 12"; P4 phosphor, 90° deflection, polished face plate.
Options: P39, P31 phosphors; antiglare panels with 55% or 92% transmission.

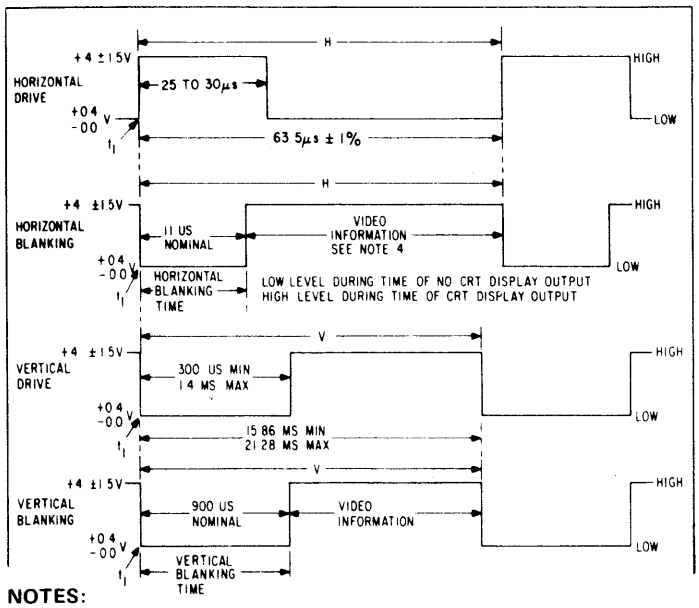
Environment:
Operating Range:
Temperature: +5°C to +55°C ambient
Humidity: 5% to 85% non-condensing
Altitude: to 10,000 feet
Storage: -40°C to +60°C

POWER TRANSFORMER SPECIFICATIONS FOR 9" and 12" CRT'S

Input Connector - Molex 03-06-2055 supplied with unit; mating receptacle – Molex 03-06-1055 is required (not supplied with unit).

Input Voltage – 105V-130V RMS (120V nominal) 50/60Hz.
Option: 120/220/240V RMS ± 10%, 50/60Hz

Input Power – 25W nominal.



NOTES:

1. The leading edges of Drive and Blanking waveforms must start at time t_1. Nominal Blanking times should be observed.
2. H = time from start of one line to start of next line.
2. V = time from start of one field to start of next field.
4. Video pulse width should be 100 nsec niminum.

Synchronization and Blanking Waveforms for the V15 Series Direct Drive Version.

4.0 INSTALLATION

When installing the monitor into a system care should be taken to insure good ground connections of the monitor to systems ground, preferably metal to metal.

Video input leads should be as short as possible and routed away from pulse or noise sources. In some instances, where electromagnetic radiation is high, it may be necessary to use low capacity shielded leads. Coaxial cables or shielded leads must have their outer conductor well grounded.

5.0 CONNECTIONS

The printed circuit board is supplied in two versions.

In the "direct drive" version all signals and power are connected via one 10 pin edge card connector. The signals for "direct drive" must be as specified on Synchronization and Blanking Waveforms diagram.

In the "composite signal" version two Molex connectors are utilized – one for the video signal and one for power. Consult schematic for correct pin connections.

6.0 SET-UP PROCEDURE

1. Connect drive, video signals and power.
2. Place power switch in the "on" position.
3. Advance brightness and contrast controls until the video information is visible.

4a. Direct Drive Version:
Adjust vertical hold control R621 until picture is locked.

4b. Composite version:

1. Short junction of C903 and R903 to ground.
2. Adjust oscillator coil L901 until oscillator is at centre frequency. Remove short from junction of C903 and R904.
3. Adjust vertical hold control R621 for picture lock.
4. Fine trim oscillator coil L901 if required to straighten characters in top line.

The following adjustments should be done after the monitor has been switched on for 15 minutes minimum.

5. Turn contrast control fully counter-clockwise.
6. Adjust brightness control until raster just extinguishes.
7. Advance contrast control for desired brightness of characters.
8. With the centering rings on the back of the deflection yoke centre the video display.

Note: It is assumed that the video information is centered on the raster. If this is not the case a compromise between good focus and centering of video information must be made, as the centering rings can effect focus if the raster is shifted off centre.

9. Adjust the width coil L902 for the desired width.
10. Adjust height control R609 for the desired height.

Note: The vertical hold control setting effects height therefore the vertical hold control must be set before height is adjusted.

11. Adjust the vertical linearity control R618 for best linearity.
12. Adjust the focus control for best overall focus.

7.0 THEORY OF OPERATION

7.1 Video Amplifier

The video input stage is comprised of transistors Q301 and Q302 which are connected in a "super emitter follower" configuration. This configuration provides high input impedance and amplifies the signal.

The signal From Q301, Q302 is coupled via the contrast control and capacitor C303 to Q303 which drives the video output stage Q304. The signal from Q304 is direct coupled to the cathode of the CRT via diode D503 and resistor R320. Diode D503 serves to limit the CRT beam current to safe values. If through misadjustment of the brightness control or through application of large signals the beam current increases beyond safe values, enough current is drawn through resistor R321 to reverse bias D503. This opens the DC path from Q304 to the CRT cathode and the signal becomes AC coupled via capacitor C308. This in turn allows the CRT operating point to return to a safe area.

7.2 Vertical Oscillator and Amplifier

An operational amplifier IC601 is utilized as the vertical oscillator. Its operation is as follows:

The output of IC601 pin 6 is connected to the inverting input, pin 2, via two networks – D601, R621, R605 and D602, R606.

When power is applied to the IC pin 6 goes positive, charging capacitor C603 at pin 2 via diode D602 and resistor R606. After the charge on capacitor C603 has reached a certain level (this level being dependent on the bias at pin 3) positive of pin 3, the IC triggers and pin 6 goes negative. Capacitor C603 now discharges via R605, R621 and D601. After the capacitor C603 and pin 2 reaches a level negative of pin 3 the IC triggers again, pin 6 goes positive and the process is repeated. The oscillator frequency is adjusted by control R621. Synchronization is accomplished by applying a positive going pulse to pin 3. This causes pin 3 to go positive of pin 2, thus initiating the cycle in response to the sync pulses.

The sawtooth waveform developed at pin 2 of IC601 is applied via the height control to IC602, amplified and applied to the vertical output stages Q602 and Q603.

Linearity correction is accomplished by applying a sample of the output waveform from the vertical deflection yoke to the inverting input pin 2 of IC602. The network comprised of R622, R618 and C608 which is connected from pin 2 to ground, changes the shape of the waveform dependent on the setting of linearity control R618.

7.3 Synchronization

The sync separator consists of Q501, a linear amplifier, followed by an emitter follower buffer Q502 which feeds a single stage sync stripper Q503. The amplified video signal is applied to the base of Q503 via the coupling network C501, R507 and C502. The positive going sync pulses are clamped to a voltage equal to VBE. Q503 turns on only during the sync pulses. This results in a train of negative going sync pulses at the collector of Q503, which are fed via R901 and C902 to the horizontal AFC network.

Line hum is eliminated by clamping action and time constants in the base of Q503.

For vertical synchronization the horizontal sync pulses must be eliminated. This is accomplished by R510 and C503. The vertical pulses generated across R510 turns on Q601 amplifying the sync pulses, which are then applied to IC601 and synchronize the vertical oscillator. Resistor R603 serves to further reduce the horizontal sync pulses and also attenuates extraneous impulse noise.

7.4 Horizontal Oscillator and Reactance Stage

The horizontal oscillator Q902 has as its tank circuit coil L901 and Capacitor C911 and is arranged in a Hartley configuration. The oscillator tank circuit is shunted by the capacitive reactance stage Q901 and base feedback network C910 and R909. C909 is a coupling capacitor.

The effective capacity "C" on the reactance stage varies with the collector current, which in turn is controlled by the base current. Thus an error voltage, developed by the horizontal phase detector and applied to the base of transistor Q901 varies the base current, consequently the collector current and therefore the effective "C" of the reactance stage. As the "C" of the reactance stage is in parallel with C911 this varies the horizontal oscillator frequency. Effective frequency control is thus achieved.

Resistors R907, R906 and C907 form the main time constant of the horizontal AFC loop. This time constant has been carefully designed to minimize the effects of irregular timing signals and to provide good noise immunity with sufficiently fast recovery time.

7.5 Horizontal Driver

The horizontal oscillator switches the horizontal driver stage Q903. By switching transistor Q903 from cut-off to saturation, a square wave appears in the collector. Step down transformer T901 provides a low voltage high current source to drive the horizontal output transistor Q904.

7.6 Horizontal Deflection

In the shunt efficiency system used in this monitor the horizontal output transistor Q904 and damper diode D904 act as switches.

A cycle may be considered to start when the beam is at the centre of the CRT. At this time output transistor Q904 is driven into saturation by the square wave applied to its base by transformer T901, thus becoming a low impedance path. The yoke is thus placed across a constant voltage of +15V and current in the yoke increases exponentially with time.

At the right extreme of the CRT screen Q904 is driven into cut-off by the square wave applied to its base. The collector current collapses to zero in less than one microsecond.

The yoke current also collapses, causing the magnetic field energy of the yoke to collapse. This returns the beam to the centre of the screen.

The energy stored in the yoke is now transferred to capacitor C916.

C916 and yoke inductance L904A form a resonant circuit and the rapid transfer of energy from yoke to C916 causes it to oscillate.

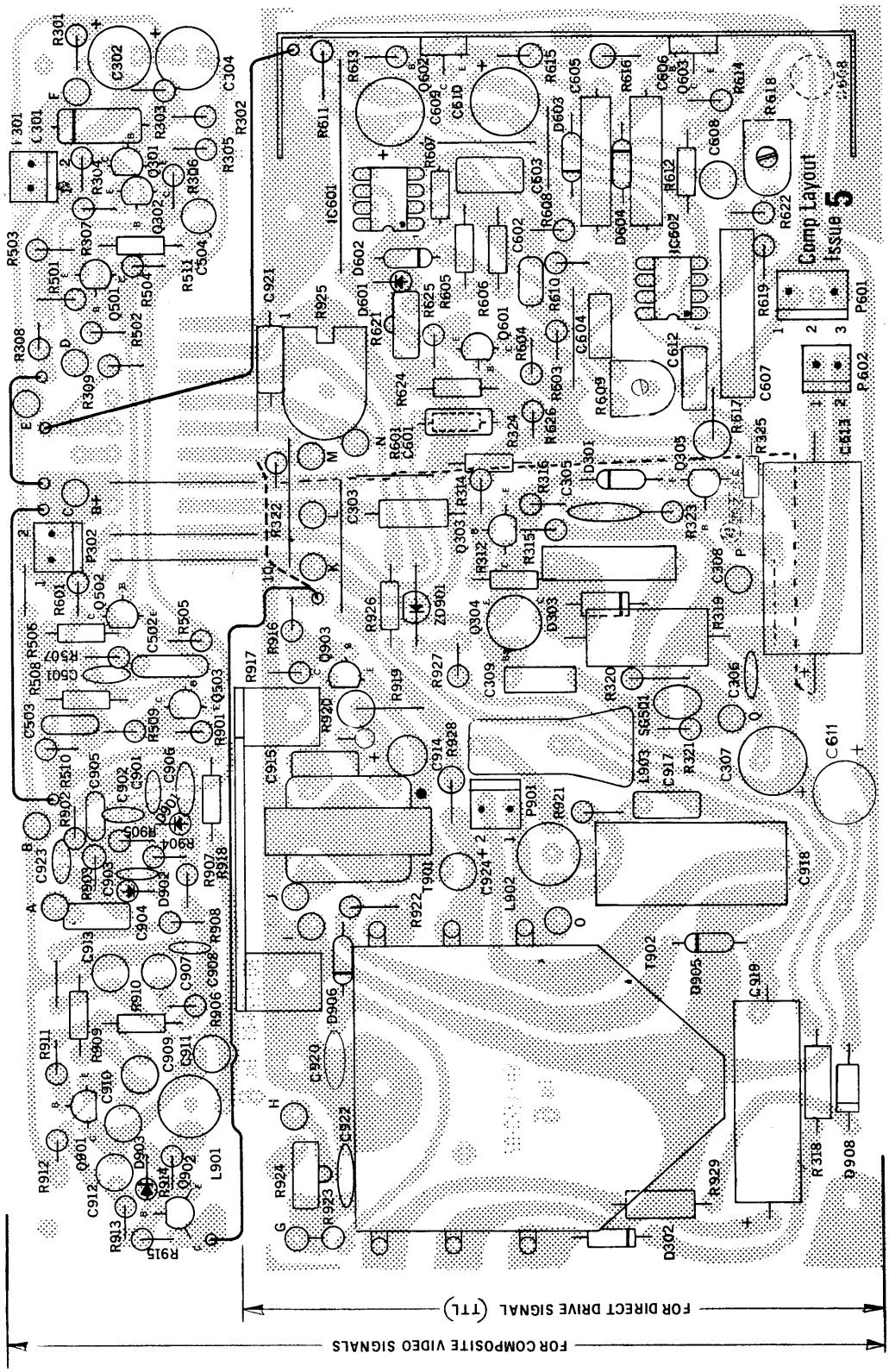
This oscillation is allowed to continue for one half cycle, lasting approximately 10 microseconds. During this half cycle a large voltage pulse is built up across capacitor C916. When the voltage has reached its peak, the yoke current has collapsed to zero. The energy from the capacitor is now transferred back to the yoke causing a current flow in the opposite direction. This deflects the beam to the left side of the CRT.

The transfer of energy from C916 to the yoke causes the voltage across C916 to decrease and, when it reaches a negative value, diode D904 starts to conduct, thus palcing a short across the yoke and C916. This prevents oscillations (or ringing) during the first half of the scan, when the energy stored in the yoke magnetic field collapses, and also allows the transfer of energy from the yoke magnetic field back to the power supply.

The collapse of the yoke magnetic field returns the beam to the centre of the CRT. The cycle repeats itself when Q904 is driven into saturation again.

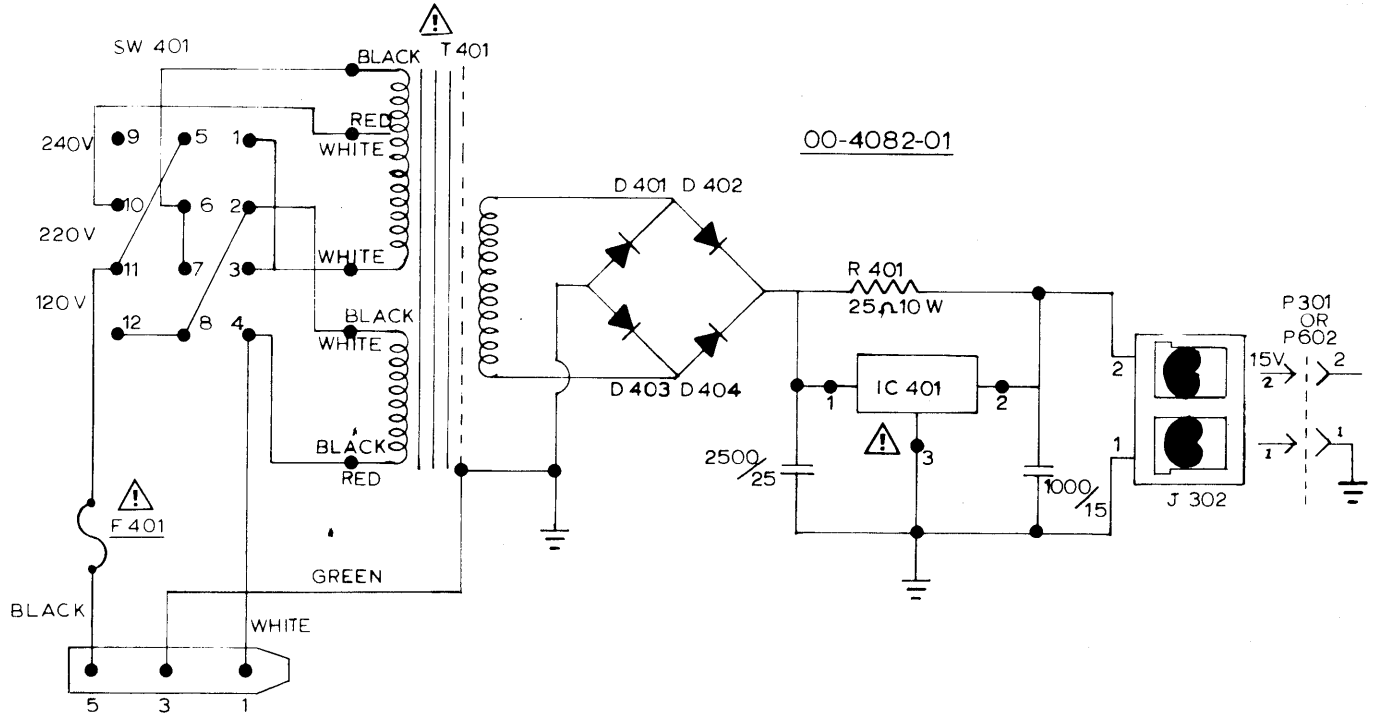
The horizontal output transformer T902, besides providing an impedance match between Q904 and yoke, also serves as voltage source for video +B, EHT, -15V and CRT bias and focus requirements.

COMPONENT LAYOUT



50-1223-00

120/220/240 POWER SUPPLY



SERVICE REPLACEMENT PARTS LIST

Symbol	Description	Part Number
C301	10uF 15/16V Electrolytic	44-110005-03
C302	100uF 15/16V Electrolytic	44-310103-04
C303	2.2uF, 25V Electrolytic N.P.	44-5-21
C305	330pF, 10%, 500V Ceramic	46-333113-06
C306	1nF, 10%, 500V Ceramic	46-310213-06
C307	4.7uF, 150V Electrolytic	44-347509-05
C308	470nF, 20%, 200V Poly Film	48-174742-41
C309	100nF, 20%, 200V Poly Film	48-1710142-21
C501	47nF, 10% 100V Poly Film	48-134731-01
C502	330nF, 10%, 100V Poly Film	48-133341-01
C503	82nF, 10%, 100V Poly Film	48-138231-01
C504	2.2uF, 25V Electrolytic N.P.	44-5-21
C601	1uF, 25V Electrolytic	44-5-23
C602	2nF, 10%, 100V poly Film	48-132022-13
C603	470nF, 10%, 100V Poly Film	48-134741-04
C604	100nF, 10%, 100V Poly Film	44-131041-06
C605	2.2uF, 10V Electrolytic N.P.	44-5-07
C606	2.2uF, 10V Electrolytic N.P.	44-5-07
C607	1uF, 10%, 200V Poly Film	48-171052-42
C608	1uF, 25V Electrolytic N.P.	44-5-23
C609	100uF, 15V Electrolytic	44-310103-04
C610	100uF, 15V Electrolytic	44-310103-04
C611	470uF, 25V Electrolytic	44-347104-07
C612	100nF, 10%, 100V Poly Film	48-131041-06
C901	220pF, 10%, 500V Ceramic	46-322113-06
C902	390pF, 10%, 500V Caramic	46-339113-06
C903	390pF, 10%, 500V Ceramic	46-339113-06
C904	100nF, 10%, 100V Poly Film	48-131041-06
C905	33nF, 10% 100V Poly Film	48-173331-34
C906	3.9nF, 10%, 500V Ceramic	46-339213-05
C907	1uF, 10V Electrolytic	44-310502-03
C908	4.7nF, 10%, 500V Ceramic	46-347213-06
C909	4.7nF, 10%, 160V Polycarbonate	48-304721-11
C910	2.2nF, 10%, 160V Polycarbonate	48-302221-11
C911	4.7nF, 10% 160V Polycarbonate	48-304721-11
C912	2.2nF, 10% 160V Polycarbonate	48-302221-11
C913	10uF, 25V Electrolytic	44-310004-02
C914	10uF, 25V Electrolytic	44-310004-02
C915	10nF, 10% 100V Poly Film	48-171031-22
C916	27nF, 10%, 600V Polypropelene	49-19-22
C917	10nF, 10%, 100V Poly Film	48-171031-22
C918	10uF, 10%, 60V Molded Mylar	48-181065-11
C919	10uF, 150V Electrolytic	44-110013-21
C920	10nF, 20%, 1000V Ceramic	46-510321-35
C304	100uF, 25V Electrolytic	44-310104-04
C921	100nF, 10% 400V Poly Film	48-171044-02
C922	1.2nF, 20%, 1000V Ceramic	46-512221-30
C923	100pF, 10%, 500V Ceramic	46-310113-06
C924	100uF, 25V Electrolytic	44-310104-04
D301	Signal Diode, Si	14-515-14
D302	Silicon Diode	14-514-30
D303	Silicon Diode	14-514-30
D601	Signal Diode, Si	14-514-14
D602	Signal Diode, Si	14-514-14
D603	Signal Diode, Si	14-514-20
D604	Signal Diode, Si	14-514-20
D901	Signal Diode, Si	14-514-14
D902	Signal Diode, Si	14-514-14
D903	Signal Diode, Si	14-514-14
D904	Silicon Diode	14-514-30
D905	Silicon Diode, 1500V	14-514-23
D906	Silicon Diode, 1500V	14-514-23
D907	EHT Rectifier, 20KV	28-38-01
D908	Silicon Diode	14-514-30
ZD901	Zener Diode, 25V, 5% ½W	14-514-28 or -36
IC601	Operational Amplifier MC1741C	14-2020-01
IC602	Operational Amplifier MC1741C	14-2020-01
L901	Horizontal Oscillator Coil	21-1070-02
L902	Width Coil	21-1416-03
L903	Linearity Coil	21-1128-03
L904A, B	Deflection Yoke	21-131-03
P301	PCB Terminal 2 Pin Polarizing	34-548-02
P302	PCB Terminal 2 Pin Polarizing	34-548-02
P601	PCB Terminal 2 Pin Polarizing	34-674-01
P901, P602	PCB Terminal 2 Pin Polarizing	34-548-02
Q301	Small Signal Transistor TIS98	14-802-12
Q302	Small Signal Transistor MPS6518	14-855-32
Q303	Small Signal Transistor TIS98	14-802-12
Q304	Video Output Transistor BF336	14-812-12
Q501	Small Signal Transistor MPS6518	14-855-32

Symbol	Description	Part Number
Q502	Small Signal Transistor TIS98	14-802-12
Q503	Small Signal Transistor TIS98	14-802-12
Q602	Vertical Output Transistor NPN	14-921-23
Q603	Vertical Output Transistor PNP	14-922-23
Q901	Small Signal Transistor TIS98	14-802-12
Q902	Small Signal Transistor MPS6518	14-855-12
Q903	Small Signal Transistor TCS100	14-806-12
Q904	Horizontal Output Transistor 25C681A	14-601-21

All resistors are .25W, 5% film unless otherwise noted

R301	75 ohm	40-127505-21
R302	33K ohm	40-123335-21
R303	150K ohm	40-121545-21
R304	680 ohm	40-126815-21
R305	680 ohm	40-126815-21
R306	2.2K	40-122225-21
R307	22 ohm	40-122205-21
R308	33 ohm	40-123305-21
R309	220 ohm	40-122215-21
R312	150K ohm	40-121545-11
R314	4.7K	40-124725-21
R315	180 ohm	40-121815-21
R316	12 ohm	40-121205-21
R318	10 ohm, ½W, 5% Carbon Composition	40-221005-17
R319	2.2K, 2W, 5% Carbon Composition	40-622225-17
R320	560R, ½W, 5%	40-225615-21
R321	820K, ½W, 5% Carbon Composition	40-228245-27
R322	18 ohm, 1W 5%	40-421805-21
R323	100K ohm	40-121045-21
R324	560 ohm	40-125615-21
R325	6.8K ohm	40-126825-11
R501	15K ohm	40-121535-21
R502	180K ohm	40-121845-21
R503	390 ohm	40-123915-21
R504	3.9K ohm	40-123925-21
R505	2.2K ohm	40-122225-21
R506	100 ohm	40-121015-21
R507	33 ohm	40-123305-21
R508	33K ohm	40-123335-11
R509	3.9K ohm	40-123925-21
R510	150 ohm	40-121515-21
R511	100 ohm	40-121015-21
R601	1K ohm	40-121025-11
R603	4.7K	40-124725-21
R604	10K ohm	40-121035-21
R605	68K ohm	40-126835-11
R606	3.3K ohm	40-123325-11
R607	4.7K ohm	40-124725-11
R608	1K ohm	40-121025-21
R609	220K ohm Trim Pot	41-265-07
R610	100K ohm	40-121045-21
R611	22 ohm	40-122205-21
R612	22 ohm	40-122205-11
R613	2.7K ohm	40-122725-21
R614	2.7K ohm	40-122725-21
R615	1 ohm, ½W, 5%	40-221095-21
R616	1 ohm, ½W, 5%	40-221095-21
R617	4.7 ohm, 1W, 5%	40-424795-21
R618	27K ohm Trim Pot	41-265-34
R619	120K ohm	40-121245-21
R620	180 ohm, ½W, 5%	40-221815-01
R621	100K ohm Trim Pot	41-265-19
R622	3.9K	40-123925-21
R624	15K ohm	40-121535-11
R625	1K ohm	40-121025-21
R626	180K ohm	40-121845-21
R901	2.2K ohm	40-122225-21
R902	22K ohm	40-122235-21
R903	8.2K ohm, ½W, 5%	40-228225-21
R904	100K ohm	40-121045-21
R905	100K ohm	40-121045-21
R906	3.9K ohm	40-123925-21
R907	47K ohm	40-124735-21
R908	1M ohm	40-121055-21
R909	1K ohm	40-121025-11
R910	3.3K ohm	40-123325-11
R911	270 ohm	40-122715-21
R912	150 ohm	40-121515-21
R913	2.2K ohm	40-123325-21
R914	47 ohm	40-124705-21
R915	470K ohm	40-124745-21
R916	820 ohm	40-128215-21

SERVICE REPLACEMENT PARTS LIST (cont'd)

Symbol	Description	Part Number
R917	560 ohm	40-125615-21
R918	47 ohm	40-124705-11
R919	220 ohm, 2W, 5% Carbon Composition	40-622215-27
R920	220 oh, ½W, 5%	40-222215-21
R921	100 ohm, ½W, 5% Carbon Composition	40-221015-27
R922	560 ohm, ½W, 10% Carbon Composition	40-225615-27
R923	1.5M ohm, ½W, 10%	40-221555-21
R924	2.5M ohm Carbon Trim Pot	41-299-07
R925	100K ohm Carbon Trim Pot	41-323-02
R926	68K ohm	40-126835-11
R927	22K ohm	40-122235-21
R928	0.22 ohm, 2W, 5%	40-622285-98
R929	15 ohm, .5W 5% Carbon Composition	40-221505-17
SG501	Spark Gap 1.2KV	34-395-02
T901	Horizontal Buffer Transformer	24-170003-02
T902	Horizontal Output Transformer	21-240-01

MISCELLANEOUS COMPONENTS

Symbol	Description	Part Number
	IC Socket 8 Pin	34-546-01
J601	Nylon Connector 3 Position	34-549-03
J901	Nylon Connector 2 Position	34-549-02
	Crimp Type Terminal	35-550-01

SAFETY COMPONENTS

Symbol	Description	Part Number

⚠ on schematic.

Critical safety components are designed to "fail save" under abnormal conditions. Replacement with anything other than the identical Electrohome part may present a hazard.

C916	27nF, 10% 600V Polypropelene	49-19-22
D904	Damper Diode	14-514-30
D907	EHT Rectifier	28-38-01
T902	Horizontal Output Transformer	21-240-01
IC401	+15 Volt Regulator	14-2066-01
T401	Power Transformer	24-10190-01
F401	0.375A 250V Slo Blo Fuse	27-5-15

CRT's – Standard Versions (see model data sheets for specific details)

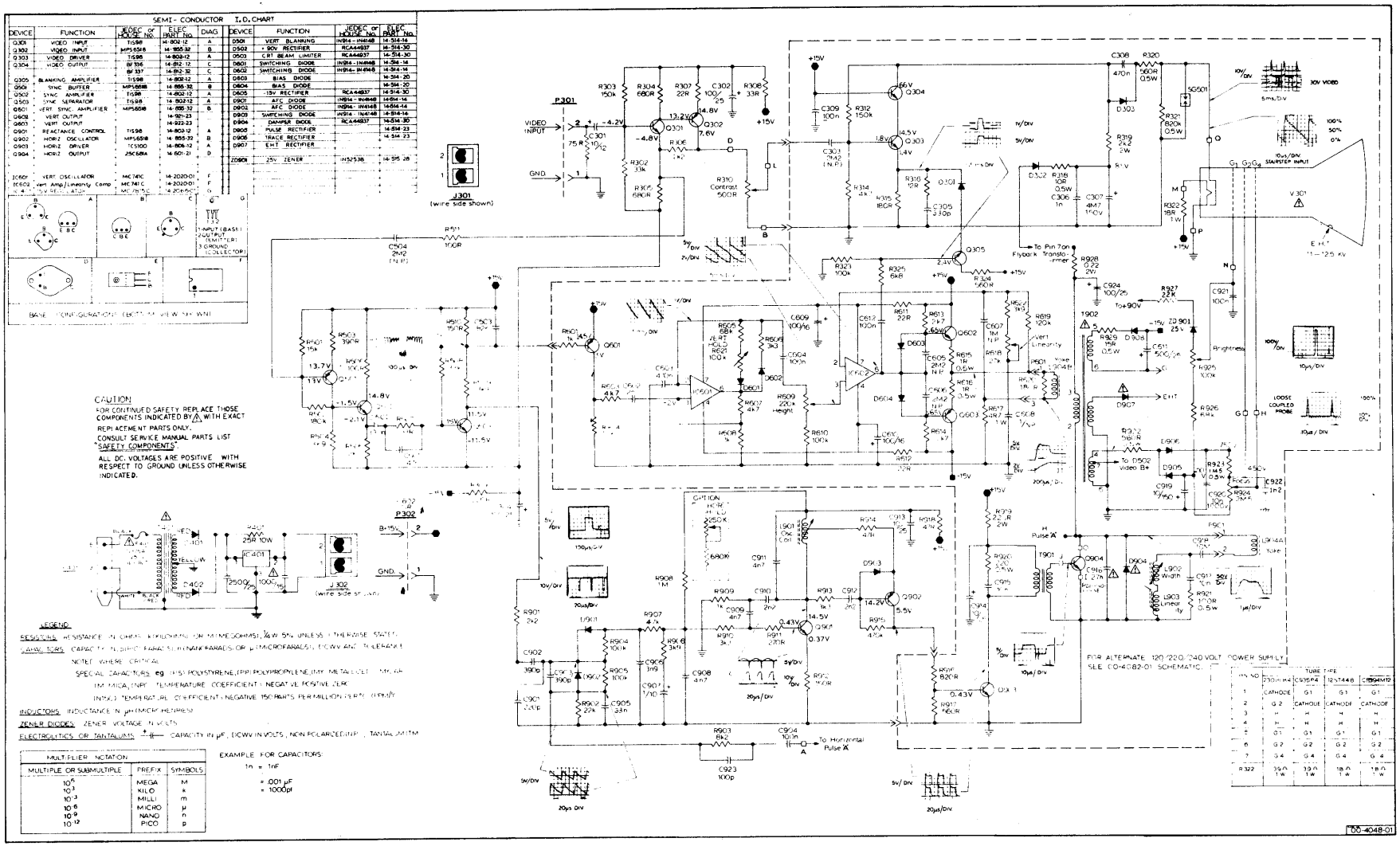
V301	12" 12ST5448P4A	17-6122-02 or -15
	9" 230BLB4	17-6092-01
	C935P4	17-6093-01

For additional information on CRT options contact Sales Department, Commercial Products.

POWER SUPPLY

Symbol	Description	Part Number
T401	Power Transformer, 120V, 60Hz	24-10190-01
	Power Transformer, 120/220/240V, 50-60Hz	24-10203-01
F401	0.375A, Slo Blo Fuse	27-5-15
C401	2500uF, 30V, 1000uF .15V Electrolytic	44-202-28
D401/ D402	Rectifier	28-22-28
IC401	+15V Regulator I.C.	14-2055-01
P401	Miniature Plug	34-639-05
	Crimp Type Terminal	34-640-02
R401	25 ohm, 10W Resistor	42-142501-01

ALWAYS ORDER PARTS BY PART NUMBER, TO ENSURE FAST DELIVERY AND CORRECT REPLACEMENT


SEMI-CONDUCTOR I.D. CHART
DEVICE | FUNCTION | JEDEC or HOUSE NO. | ELEC PART NO. | DIAG
Q301 | VIDEO INPUT | TIS98 | 14-802-12 | A
Q302 | VIDEO INPUT | MPS6518 | 14-855-32 | B
Q303 | VIDEO DRIVER | TIS98 | 14-802-12 | A
Q304 | VIDEO OUTPUT | BF 336 | 14-812-12 | C
 | | BF 337 | 14-812-32 | C
Q305 | BLANKING AMPLIFIER | TIS98 | 14-802-12 | A
Q501 | SYNC BUFFER | MPS6518 | 14-855-32 | B
Q502 | SYNC AMPLIFIER | TIS98 | 14-802-12 | A
Q503 | SYNC SEPARATOR | TIS98 | 14-802-12 | A
Q601 | VERT SYNC AMPLIFIER | MPS6518 | 14-855-32 | B
Q602 | VERT OUTPUT | | 14-921-23 |
Q603 | VERT OUTPUT | | 14-922-23 |
Q901 | REACTANCE CONTROL | TIS98 | 14-802-12 | A
Q902 | HORIZ OSCILLATOR | MPS6518 | 14-855-32 | B
Q903 | HORIZ DRIVER | TIS100 | 14-806-12 | A
Q904 | HORIZ OUTPUT | 2SC684A | 14-601-21 | D
IC601 | VERT OSCILLATOR | MC14DC | 14-202001 | F
IC602 | Vert Amp/Linearity Comp | MC741C | 14-202001 | F
IC401 | 5V REGULATOR | MC78T05C | 14-205-01 | G
D501 | VERT BLANKING | IN914 - IN4148 | 14-514-14 |
D502 | + 90V RECTIFIER | RCA44937 | 14-514-30 |
D503 | CRT BEAM LIMITER | RCA44937 | 14-514-30 |
D601 | SWITCHING DIODE | IN914 - IN4148 | 14-514-14 |
D602 | SWITCHING DIODE | IN914 - IN4148 | 14-514-14 |
D603 | BIAS DIODE | | 14-514-20 |
D604 | BIAS DIODE | | 14-514-20 |
D605 | -15V RECTIFIER | RCA44937 | 14-514-30 |
D901 | AFC DIODE | IN914 - IN4148 | 14-514-14 |
D902 | AFC DIODE | IN914 - IN4148 | 14-514-14 |
D903 | SWITCHING DIODE | IN914 - IN4148 | 14-514-14 |
D904 | DAMPER DIODE | RCA44937 | 14-514-30 |
D905 | PULSE RECTIFIER | | 14-514-23 |
D906 | TRACE RECTIFIER | | 14-514-23 |
D907 | EHT RECTIFIER | | |
ZD901 | 25V ZENER | IN5253B | 14-515-28 |
BASE CONFIGURATION (BOTTOM VIEW SHOWN)
1=INPUT (BASE) 2=OUTPUT (EMITTER) 3=GROUND (COLLECTOR)
CAUTION
FOR CONTINUED SAFETY REPLACE THOSE COMPONENTS INDICATED BY △ WITH EXACT REPLACEMENT PARTS ONLY.
CONSULT SERVICE MANUAL PARTS LIST "SAFETY COMPONENTS".
ALL DC VOLTAGES ARE POSITIVE WITH RESPECT TO GROUND UNLESS OTHERWISE INDICATED.
LEGEND
RESISTORS: RESISTANCE IN OHMS (KILOHMS) OR MEGOHMS), ¼W 5% UNLESS OTHERWISE STATED.
CAPACITORS: CAPACITY IN DECIMAL FARADS (NANOFARADS OR µMICROFARADS), DCWV AND TOLERANCE NOTED WHERE CRITICAL
SPECIAL CAPACITORS eg: (MS) POLYSTYRENE, (PP) POLYPROPYLENE, (MY) METALLISED MYLAR, (M) MICA, (NP) TEMPERATURE COEFFICIENT NEGATIVE POSITIVE ZERO
(N750) TEMPERATURE COEFFICIENT NEGATIVE 150 PARTS PER MILLION PER °C (150 p/m/°C)
INDUCTORS: INDUCTANCE IN µH (MICROHENRIES)
ZENER DIODES: ZENER VOLTAGE IN VOLTS
ELECTROLYTICS OR TANTALUMS: CAPACITY IN µF, DCWV IN VOLTS, NON POLARISED (NP), TANTALUM (TM)
MULTIPLIER NOTATION
MULTIPLE OR SUBMULTIPLE | PREFIX | SYMBOL
10^6 | MEGA | M
10^3 | KILO | k
10^-3 | MILLI | m
10^-6 | MICRO | µ
10^-9 | NANO | n
10^-12 | PICO | p
EXAMPLE FOR CAPACITORS:
1n = 1nF
= .001 µF
= 1000pf
P301
J301 (wire side shown)
P302
J302 (wire side shown)
VIDEO INPUT
GND
+15V
-15V
+90V
To Pin 7on Flyback Transformer
To D502 Video B+
To Horizontal Pulse 'A'
Pulse 'A'
EHT 11-12.5 KV
V301
SG501
ZD901
T901
T902
T401
IC401
IC501
IC601
IC602
Brightness
Width
Linearity
Vert Linearity
Vert Hold
Height
Focus
Loose Coupled Probe
FOR ALTERNATE 120/220/240 VOLT POWER SUPPLY SEE CDH-CB2-01 SCHEMATIC
TUBE TYPE
PIN NO | C35P4 | 12-TA48 | C19GHM12
1 | CATHODE | G1 | G1 | G1
2 | G2 | CATHODE | CATHODE | CATHODE
3 | H | H | H | H
4 | H | H | H | H
5 | G1 | G1 | G1 | G1
6 | G2 | G2 | G2 | G2
7 | G4 | G4 | G4 | G4
R322 | 39Ω 1W | 33Ω 1W | 18Ω 1W | 18Ω 1W
CDH-4048-01

SEMI - CONDUCTOR I.D. CHART

DEVICE	FUNCTION	JEDEC or HOUSE No.	ELEC PART No.	DIAG.
Q303	VIDEO DRIVER	TS98	14-802-12	A
Q304	VIDEO OUTPUT	BF 336	14-812-12	C
		BF 337	14-812-32	C
Q305	BLANKING AMPLIFIER	TS98	14-802-12	A
Q601	VERT. SYNC. AMPLIFIER	MPSE18	14-855-32	B
Q901	LINE OUTPUT		14-920-23	
Q951	VERT. OUTPUT		14-920-23	
	[illegible] AMPLIFIER	TIP 127	14-809-12	A
	[illegible]	2SC1096	14-915-...	D
	[illegible]		14-[illegible]	F
	[illegible]		14-[illegible]	F

DEVICE	FUNCTION	JEDEC or HOUSE No.	ELEC PART No.
D501	VERT. BLANKING	IN914 - IN4148	14-516-14
D502	+ 90V RECTIFIER	RCA40237	14-514-30
D503	CRT BEAM LIMITER	RCA40237	14-514-30
D601	SWITCHING DIODE	IN914 - IN4148	14-516-14
D602	SWITCHING DIODE	IN914 - IN4148	14-516-14
D603	BIAS DIODE		14-516-14
D604	BIAS DIODE		14-516-20
D605	-15V RECTIFIER	RCA40237	14-514-30
D904	DAMPER DIODE	RCA4393	14-514-30
D905	PULSE RECTIFIER		14-516-23
D906	TRACE RECTIFIER		14-516-23
D907	E.H.T. RECTIFIER		
ZD901	25V ZENER	HZ5253A	14-519-28

BASE CONFIGURATIONS (BOTTOM VIEW SHOWN)

DIRECT DRIVE INPUTS

Horizontal Drive

Horizontal Blanking

Vertical Sync.

Vertical Blanking

CAUTION

FOR CONTINUED SAFETY REPLACE THOSE COMPONENTS INDICATED BY ⚠ WITH EXACT REPLACEMENT PART ONLY. CONSULT SERVICE MANUAL PARTS LIST "SAFETY COMPONENTS".

ALL DC VOLTAGES ARE POSITIVE WITH RESPECT TO GROUND UNLESS OTHERWISE INDICATED.

SIGNAL GROUND
VERTICAL SYNC.
VIDEO INPUT
B+ 15V (12V)
HORIZONTAL DRIVE
ARC GROUND
BRIGHTNESS W
BRIGHTNESS CCW
BRIGHTNESS CW
HORIZONTAL GROUND

1 2 3 4 5 6 7 8 9 10

EDGE CONNECTOR INPUTS (FOIL SIDE SHOWN)

FOR ALTERNATE 120/220/240 VOLT POWER SUPPLY SEE 00 4082 01 SCHEMATIC.

TUBE TYPE	230BLH-A	C9QSP4	12S744B	C14-5AP1
1	CATHO	G1	G1	G1
2	G2	CATHODE	CATHODE	CATHODE
3	H	H	H	H
4	H	H	H	H
5	G1	G1	G1	G1
6	G2	G2	G2	G2
7	G4	G-	G4	G4
322	39Ω 1W	39Ω 1W	18Ω 1W	18Ω 1W

LEGEND

RESISTORS: RESISTANCE IN OHMS, k (KILOHMS), OR M (MEGOHMS), ¼W 5% UNLESS OTHERWISE STATED.

CAPACITORS: CAPACITY IN p (PICOFARADS), n (NANOFARADS) OR μ (MICROFARADS), DCWV AND TOLERANCE NOTED WHERE CRITICAL.

SPECIAL CAPACITORS: eg. (PS) POLYSTYRENE, (PP) POLYPROPYLENE, (MY) METALLIZED MYLAR (M) MICA, (NPO) TEMPERATURE COEFFICIENT = NEGATIVE POSITIVE ZERO (N150) TEMPERATURE COEFFICIENT = NEGATIVE 150 PARTS PER MILLION PER °C (PPM/°C.

INDUCTORS: INDUCTANCE IN μH (MICROHENRIES).

ZENER DIODES: ZENER VOLTAGE IN VOLTS.

ELECTROLYTICS OR TANTALUMS: ⁺|— CAPACITY IN μF, DCWV IN VOLTS, NON POLARIZED (NP), TANTALUM (TM).

MULTIPLIER NOTATION		
MULTIPLE OR SUBMULTIPLE	PREFIX	SYMBOLS
10^6	MEGA	M
10^3	KILO	k
10^{-3}	MILLI	m
10^{-6}	MICRO	μ
10^{-9}	NANO	n
10^{-12}	PICO	p

EXAMPLE FOR CAPACITORS:
1n = 1nF
= .001 μF
= 1000pf

00-4047-01

HAL COMMUNICATIONS CORP
P.O. BOX 365
URBANA, IL 61801

LIMITED WARRANTY

HAL Communications Corp of Urbana, Illinois, hereby warrants to the original purchaser only that any new equipment manufactured by HAL Communications Corp shall be free from defects in materials and workmanship for a period of one year from the date of original purchase. In the case of parts kits, this warranty applies only to materials and not to workmanship in kit assembly.

In the event of a defect in materials or workmanship during the warranty period, HAL Communications Corp will, at its own expense, repair the defective unit and replace any defective parts. Costs of shipping the unit to HAL Communications Corp shall be paid by the purchaser, as well as costs of removal and reinstallation of the unit. HAL Communications Corp will bear the shipping costs incurred in returning the unit to the purchaser (48 contiguous states only).

To obtain service under this warranty, the original purchaser should do the following:

1. Notify, as soon as possible, the Customer Service Department at HAL Communications Corp, Urbana, Illinois, either in writing or by telephone, of the existence of a possible defect;
2. At the time of notification, identify the model or serial number, the approximate date of purchase, the place of purchase, and the possible defect;
3. Hold the unit until a written return authorization is received.
4. Return the unit, freight prepaid, upon the receipt of the written return authorization.

Correct installation, use, maintenance, and repair are essential for proper performance of this product. The purchaser should carefully read the technical manual.

This warranty does not apply to any defect which HAL Communications Corp determines is due to any of the following:

1. Improper maintenance or repair, including the installation of parts or accessories that do not conform to the quality and specifications of the original parts;
2. Misuse, abuse, neglect, improper installation, or improper operation (including operation without a proper safety ground connection);
3. Accidental or intentional damage.

All implied warranties, if any, are limited in duration to a period of one year from the date of original purchase. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

HAL Communications Corp disclaims any liability for incidental or consequential damages arising out of the use of, or inability to use, this product. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

The DS3100 has been tested and is verified by HAL Communications Corp. to be in compliance with Part 15, Subpart J of the FCC Rules And Regulations, Class B computing device. The following text is a requirement of that regulation:

> "This equipment generates and uses radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class B computing device in accordance with the specifications in Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
>
> --reorient the receiving antenna
> --relocate the computer with respect to the receiver
> --move the computer away from the receiver
> --plug the computer into a different branch circuit
>
> If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful:
> "How to Identify and Resolve Radio-TV Interference Problems." This booklet is available from the US Government Printing Office, Washington, DC 20402, Stock No. 004-000-00345-4."

In addition, the following rear-panel label is located on the DS3100 ASR and video monitor rear panels:

> "This equipment has been tested and found to comply with the technical specifications in Part 15 of FCC Rules for a Class B computing device."

Also, the following FCC text applies to use of peripherals attached to the DS3100 ASR:

> "WARNING: This equipment has been verified to comply with the limits for a Class B computing device, pursuant to Subpart J of Part 15 of FCC Rules. Only peripherals (computer input/output devices, terminals, printers, etc.) certified to comply with the Class B limits may be attached to this computer. Operation with non-certified peripherals is likely to result in interference to radio and TV reception."