



# HAL COMMUNICATIONS CORP.



DS3100 ASR SYSTEM



CT2200 SYSTEM



CRI-200 COMPUTER  
INTERFACE



PORTABLE CWR6850

# RTTY PRODUCTS CATALOG



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# DS3100 ASR



## AUTOMATIC SEND-RECEIVE TERMINAL

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 received 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*. The DS3100 includes a new green P31 phosphor screen for ease of viewing. Try the DS3100 ASR for yourself and enjoy the operating features and convenience.

### SPECIFICATIONS

#### Input/Output:

Baudot: 18-120 ma / 200 V current loop  
RS232C voltage levels

ASCII: 18-120 ma / 200 V current loop  
RS232C voltage levels  
Full 25 pin Modem connection

Morse: 0.5v p-p (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 199 wpm  
Transmit: preset to 1 to 199 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, -?:\$!&#().,BELL;/' LTRS FIGS CR LF  
ES KN SK

# DS3100 ASR

## 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.

## Local Output:

- Printer Output:** Transmitted and received data is echoed out this port in ASCII code at RS232C voltage levels, regardless of the code being operated. Normally set to 300 baud, the data rate can be slowed internally to 110 baud.
- Sidetone:** Sidetone audio in Morse transmit mode. Also serves as a bell tone. Volume is adjustable at the back panel.

## Programmable Messages:

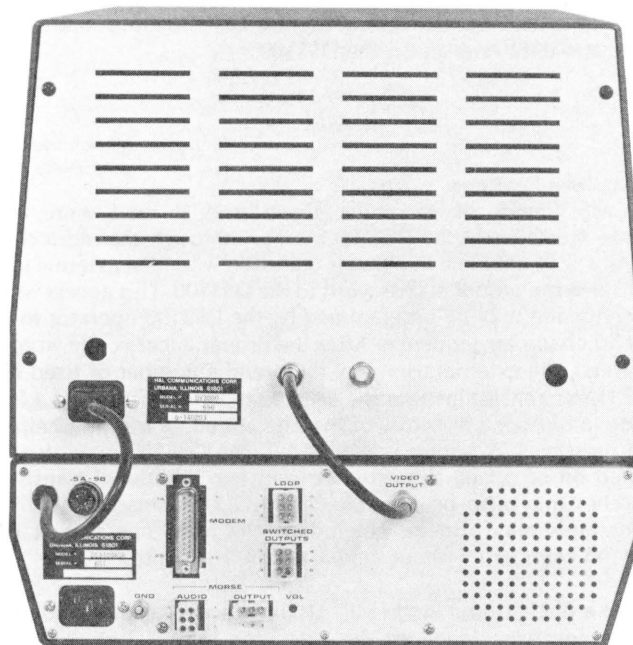
- HERE IS:** Up to 10 different, 32 character HERE IS messages may be programmed and inserted into the transmit text as desired. HERE IS programming may include calls to other HERE IS segments, QBF test message, KY switch control and other features. The contents of HERE IS-1 and HERE IS-0 are permanently saved in the non-volatile EAROM device.
- IDENT:** IDENT key transmits contents of HERE IS-0 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; 0000101) 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-0, 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 USOS:** Full non-overprint; will not split a word at end of line. 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 (00000000) in ASCII, and 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 key-switches and N-key rollover.
- Test Messages:** The standard QBF test message (THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG'S BACK 0123456789) 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 51.2 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



# MPT3100

## MESSAGE PROCESSOR TERMINAL



The MPT3100 Message Processor Terminal is a message handling system that is tailored to the requirements of radio text communications systems. Messages of any length up to 32,000 characters may be stored, edited, and retransmitted. Separate files and directory listings are created for each text message. The MSO (mailbox) allows files to be stored, read, and deleted by external users through a radio communications link. The files may also be entered, edited, and transmitted by local keyboard commands. The TRO (Traffic Relay Option) mode may be used to automatically store all received text in files with the "NNNN" sequence serving as the file separator. Text files may be transmitted singly or in batches. The text editor of the MPT3100 may be used while the terminal is also receiving or transmitting text or while the mailbox is being accessed by an external user. The transmit-receive control line of the radio station may be automatically controlled by the DS3100 when used in mailbox mode. Station identification in both the selected RTTY code and speed and in Morse code may be added automatically to all mailbox transmissions. The MPT3100 is a software (computer program) system that requires the HAL DS3100ASR terminal with MSO3100 circuit board. The Message Storage System may be factory installed with ANY DS3100 equipped with the MSO3100 board. All former features of the DS3100ASR or the DS3100 with MSO3100 are supported by the MPT3100 system.

Extensive use is made of user-programmable features to format messages so that the MPT3100 may be customized to match many different communications format requirements. ALL the requirements of the NAVC MAR COR MARS NTP-8(A) specification can be met with the MPT3100 in both MSO and TRO modes.

## SPECIFICATIONS

### Memory Size:

32 K RAM, 16 K ROM

### Data Codes and Rates:

The MPT3100 receives and transmits through the DS3100ASR terminal and it will operate on text at whatever code and data rates are set on the DS3100. The file handling features are most useful when either the Baudot or ASCII RTTY codes are used at data rates up to 2400 baud. External user transmission must match the code and data rate set on the DS3100.

### MSO Mailbox Features:

The MSO mode of operation allows users to read, write, and delete messages in the DS3100 memory through the radio communications link. The mailbox is activated when the external user transmits the proper access word to the DS3100. This access word or command may be programmed by the DS3100 operator to be any 10 character sequence. After the proper access code word is received, the external user may then send a number of fixed format commands to instruct the DS3100 to store a file, read a file, delete a file, list a directory of the files stored, or transmit help or test messages. A printer connected to the DS3100 may also be turned on or off by the external user; two additional transistor switches may also be controlled by MSO commands. Mailbox commands may also be entered by the local operator at the DS3100 keyboard without activating the transmitter.

When a file is stored in the MPT3100 memory, its name and time of storage are placed in the directory listing. Two different passwords may be assigned to each file; one provides delete protection and the other restricts access for reading a file. If no

password is specified, the file may be read or deleted by any user. A listing of the passwords for a file is not available to external users but is displayed for the local DS3100 operator.

### MSO MAILBOX COMMANDS

- DELETE [filename] Deletes specified file
- DIR Transmits directory of current files
- DIR [filematch] Transmits directory listing for only file names that include characters specified in [filematch]
- ENDFILE Indicates the end of a file being written
- EXIT Terminate mailbox mode
- FILEHELP Shows format of file commands
- HELP Shows list and description of MSO Commands
- KY1ON Turn on switch KY1
- KY1OFF Turn off switch KY1
- KY2ON Turn on switch KY2
- KY2OFF Turn off switch KY2
- PRINTON Turn printer on (KY3)
- PRINTOFF Turn printer off (KY3)
- QBF Send two lines of "QUICK BROWN FOX..."
- READ [filename] Send contents of specified file
- RYS Send two lines of 32 "RY" (U\* in ASCII)
- SDIR Send short-form directory listing
- SDIR [filematch] Send short directory listing for only file names that include [filematch] characters

# MPT3100

## SPECIFICATIONS

- SEND [filename] Send contents of specified file - allows local DS3100 operator to transmit files
- WRITE [filename] Indicates the name and beginning of a new file to be stored

### EDIT COMMANDS:

- |                       |  |
|-----------------------|--|
| EDIT [filename]       | Open named file for editing  |
| CUT [new file name]   | Cut edited file into two segments; give cut segment [new filename] |
| CREATE [new filename] | Open a new text file and compose all text in the editor            |
| QUIT                  | Close editing of file  |

### EDIT KEY COMMANDS:

- | Key Combination    | Operation  |
|--------------------|--|
| FN-H (left arrow)  | Back-up cursor one character                                       |
| SHIFT-FN-H         | Back-up cursor one word  |
| FN-I (right arrow) | Advance cursor one character                                       |
| SHIFT-FN-I         | Advance cursor one word  |
| FN-J (down arrow)  | Move cursor down one line  |
| SHIFT-FN-J         | Move cursor to end of file   |
| FNK (up arrow)     | Move cursor up one line  |
| SHIFT-FN-K         | Move cursor to top of file   |
| RUB OUT            | Erase character preceding cursor                                   |
| SHIFT-RUB OUT      | Erase character at cursor  |
| SHIFT-FN-RUB OUT   | Erase from cursor to end of line                                   |
| NEW LINE           | Insert new line in file  |
| Any Key            | Insert new characters into file                                    |
| FN-NEW LINE        | Stop editing this file and start editing of next file in directory |
| SHIFT-FN-D         | Delete current edit file entirely and edit next file in directory  |

### TRO Traffic Relay Options Features:

The TRO mode of operation is designed to assist the traffic relay station. When automatic recording of messages is used, all text received is stored in the MPT3100 memory. A new storage file is started whenever the standard message separator "NNNN" (4 N's) is received. The entire 32,000 bytes of storage may be used for message recording (approximately 100 messages.) While messages are being stored, the editor may be used to correct and modify files already stored.

Files may be renamed to indicate geographical or other relationships. These related files may then be transmitted in batches. A transmit serial number is assigned to each file as it is transmitted. The transmission of a batch of files may be suspended between files for keyboard-to-keyboard exchanges (e.g., to query the receiving station about reception conditions). Transmission of the batch may then be resumed where stopped, or the batch may be restarted at a previously sent message.

### TRO COMMANDS:

- |  |  |
|--|--|
| RXON                                   | Start recording of received text   |
| RXOFF                                  | Stop recording of received text  |
| DIR                                    | Display directory of stored files  |
| DELETE [filename]                      | Delete name file   |
| SEND [filematch]                       | Transmit all files whose name include the [filematch] character sequence |
| STOP                                   | Suspend transmission of a batch of files                                 |
| RESUME                                 | Resume sending batch after a STOP command                                |
| RESTART [filename]                     | Restart sending of a batch at the named file                             |
| RENAME [new filename] = [old filename] | Rename a file  |
| SEND*                                  | Same as above commands, but the  |
| RESUME*                                | NTP-8(A) test message is sent before                                     |
| RESTART*                               | any messages   |

### MPT3100 GENERAL DATA:

- |                    |   |
|--------------------|---|
| Hardware Required: | DS3100ASR with MSO3100 Circuit Board; may be installed in ANY DS3100ASR with MSO3100. Factory installation REQUIRED. MSO3100 circuit board must be added to DS3100ASR. All new DS3100 with MSO3100 option (serial number 1001 and higher) include MPT3100 software. |
|--------------------|---|

- |             |  |
|-------------|--|
| Mechanical: | No change in DS3100ASR size. 13.5"W x 20.5"D x 15.25"H; 43 lbs net, 61 lbs ship (34.3 c 51.2 x 39.4 cm; 19.5 kg net, 27.7 kg ship) |
|-------------|--|

- |        |  |
|--------|--|
| Power: | 105-130 or 210-250 vac 50-400 Hz; 74 watts |
|--------|--|

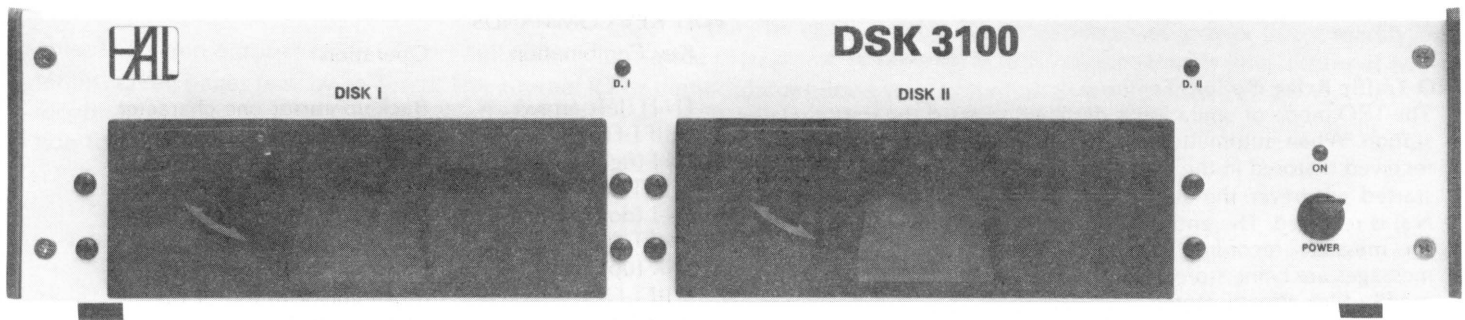
### EDIT Features:

The MPT3100 includes a text editor feature that may be used on all stored files. The editor may be used on files that were created in either MSO mailbox or TRO recording modes. Also, new files may be created in the editor itself. The editor may be used while the DS3100 is also receiving, transmitting, in use as a mailbox, or when storing or transmitting traffic. The editor may also be used to examine any file listed in the directory.

When a file is edited, the cursor may be advanced or backed-up a character, word, or line at a time. Text may be deleted or inserted at any place within the message being edited. The "dot" MSO commands may be included within an edited message for later transmission to another DS3100 mailbox.

**NEW**

# DSK3100



## DISK STORAGE FOR MPT3100 MESSAGE PROCESSOR TERMINAL

The DSK3100 provides non-volatile mass storage that may be used with the DS3100/MPT3100 Message Processor Terminal. Standard 5.25" floppy diskettes are used to store data in a double-density, single-sided format. Addition of the DSK3100 extends available message storage to more than 326,000 characters. The precise amount of text storage available depends upon how many different files are to be stored. A maximum of 511 different message files may be stored in the system.

The DSK3100 also adds a non-volatile real time clock to the DS3100/MPT3100 system. Clock information is preserved for up to 18 hours after ac power failure. Clock data now includes automatic up-dating of the day and month as well as the hour and minute data.

A parallel printer output port is included on the DSK3100 that echos all received and transmitted data. The output is "Centronics-compatible" and includes standard control signals to prevent printer over-run.

A user serial I/O port is included to allow direct user access to text files stored on the disk. Using this port, the user may read the directory and read, write, and delete files. The user I/O port is RS232C using ASCII data from 300 to 9600 baud (jumper selectable).

Keyboard commands are included so that the contents of all 10 HERE IS messages plus all of the terminal parameters supported by the DS3100 EAROM may also be stored as a disk file for later loading. Thus, various HERE IS and terminal parameter formats may be stored for special uses. The DS3100 still defaults to EAROM-stored conditions when power is first applied.

The DSK3100 is housed in an attractive 3.5" x 17" x 10" cabinet that matches the size and color of the ST6000 demodulator. The DSK3100 may be mounted in a 19" equipment rack with optional rack adapter sides.

# DSK3100

## SPECIFICATIONS

### Disk Parameters:

Media: 5.25" floppy diskettes, soft sectored, certified for 40 track, double-density use. (MAXELL MD1 or equivalent.)

Format: 40 tracks, 16 blocks/track, 256 bytes/block.

Capacity: 163,840 bytes / diskette.

Max Text Storage: 326, 144 bytes less directory.

Max No. Files: 511

Max File Size: 9940 bytes from .WRITE or RXON commands; limited by available RAM in DS3100 with CREATE command (32,768 bytes less directory).

Min File Size: 190 bytes

Directory: Stored on disk 1 and in DS3100 RAM.

### Real Time Clock:

Format: HrHrMinMinZZZ DayDay MoMo YrYr (ZZZ = time zone).

Setting: From DS3100 keyboard as before (FN-TIME).

PWR Protection: 18 hours after failure of AC power.

### Printer Output:

Format: "Centronics-compatible" parallel output.

Code: 7 bit parallel ASCII (bit 8 = "0").

Signals: Data bits 1-8, BUSY, NOT-ACK, NOT STROBE, GND.

Connector: 25 pin female connector ("DB25 style").

### User Serial I/O:

Use: Directly access disks from external device.

User Commands: Read directory; Read, Delete, Store blocks.

Format: Serial 8-bit ASCII; block oriented protocol.

Data Rates: 300, 600, 1200, 1800, 2400, 4800, and 9600 baud (jumper selectable).

Connector: 25 pin male connector ("DB25 style").

### New Commands:

Init: Initialize diskette(s)

Copy: Make back-up copy(s) of diskette(s)

### Dir Commands:

Ext User MSO: Response to an external user MSO .DIR and .SDIR command is same; gives compacted directory list:

FILENAME1 FILENAME2 FILENAME3 FILENAME4  
FILENAME5 FILENAME6 FILENAME7 FILENAME8  
FILENAME9 etc.

Time, size, and password status are NOT given in response to external user .DIR or .SDIR commands. Response to external user .DIR [filematch] or .SDIR [filematch] commands retains MPT3100 format:

.DIR [filematch]:  
FILENAME CREATED SIZE STATUS KY  
.SDIR [filematch]:  
FILENAME STATUS (other than "OPEN")

### Local User:

Response to local TRO DIR command retains MPT3100 full listing format. Directory is displayed in blocks of 20 files with continue display or stop directory display user commands (FN-space to continue; SHIFT-FN-space to stop).

### General:

Size: 3.5" H x 17" W x 9" D  
(8.9 x 43.2 x 22.9 cm)

Weight: 12 lbs (5.5 kg) net; 15 lbs (6.8 kg) shipping.

Color: Castle tan front and rear panels; chocolate brown top, bottom, and sides.

DS3100 Cable: 6 ft. shielded with 15 pin connectors each end.

Power: 105-130 / 210-250 Vac, 50/60 Hz

### Installation:

Required Equip: MPT3100 Terminal with DSK operation modifications.

Modifications: DSK3100 comes with a modification kit and new software for the MPT3100 terminal. This modification kit must be installed for DSK operation. The DSK modification kit can be installed at the factory for a nominal labor charge if desired. Contact the factory for further information.

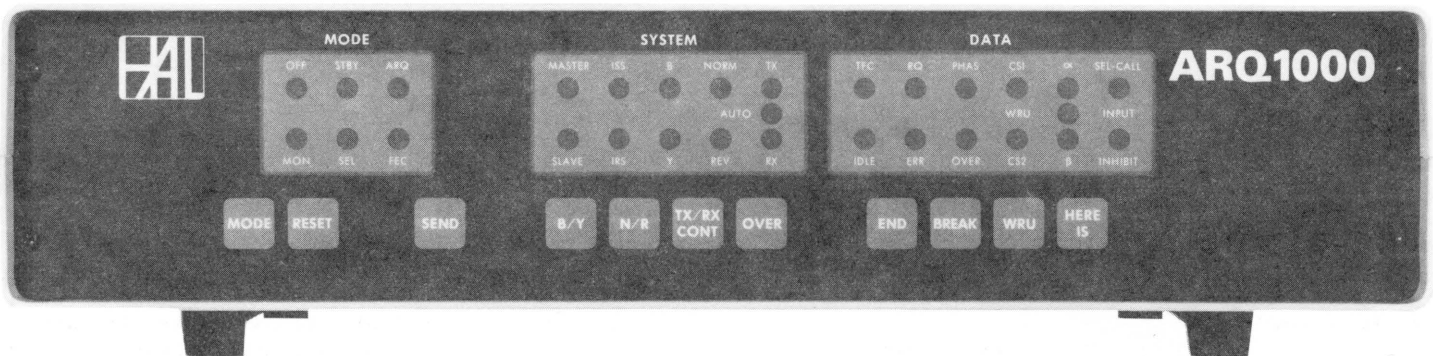
### Accessories:

RM6000—rack mounting side panels for ST6000 and DSK3100 (replace standard table sides).

ST6000 —Companion demodulator for use with DS3100

# NEW

# ARQ1000



## ERROR CORRECTION TERMINAL

The ARQ1000 allows transmission and reception of radio teleprinter signals with the added feature of error correction. The ARQ1000 uses the ITU 7-unit code as defined by CCIR Recommendation 476-2 (1978). This code is also known by the commercial trade names of "TOR," "SITOR," and "AMTOR." All features of 476-2 are supported in the ARQ1000 including "Mode A" (ARQ), "Mode B Collective Broadcast" (FEC/CB), and "Mode B Selective Broadcast" (SEL-FEC/SB). A "monitor" mode is also available so that any of these modes may be received and displayed without requiring transmission of the normal "handshaking" receive station responses. A by-pass mode is also included so that standard Baudot or ASCII encoded signals may be passed directly to the teleprinter without changing wires or using external switches.

When used in the ARQ or "A" mode, the ARQ1000 communicates with another station by exchanging bursts of information. The station originating the message (Information Sending Station or "ISS") sends groups of three characters per data burst. The ARQ code is designed so that errors in reception of any character are easily determined. The receiving station (Information Receiving Station or "IRS") transmits a one character "accept" or "reject" control character back to the ISS to indicate correct or incorrect reception. If the 3-character block was received correctly, the ISS then transmits the next 3-character block; if not, the original block is repeated until it is correctly received. The process continues with repeats as necessary until the complete message has been passed. The direction of communications may be reversed at any time with a control signal so that error corrected text may be relayed in both directions. All ARQ error corrected data uses synchronous 100 baud data as defined by 476-2. The ARQ mode is only used for two-station communications and must originate with digital recognition of the receive station's call sign or access code. This access code is programmed from the terminal keyboard and stored in non-volatile memory.

The FEC (collective broadcast) is used to transmit a message to a number of receiving stations. A two-way accept/reject system is not used in this mode. Rather, the transmitted characters are sent twice, interleaved so that there is a time delay between the two sets of data, providing time diversity protection against reception of errors. The receiving station FEC terminal digitally sorts the interleaved codes, checks each letter for errors and passes the correct text to the printer. The FEC mode also uses 100 baud synchronous data.

The SEL-FEC mode is used for selective broadcast of messages only to stations whose selective-call code corresponds to that transmitted. Data transmitted using the SEL-FEC mode is sent in the same format as that used for FEC mode except that the polarity of the data pulses is inverted. The selective call code is also keyboard programmable and stored in non-volatile memory.

The monitor mode allows the station to receive and decode a message whether it is sent using ARQ, FEC, or SEL-FEC modes. In monitor mode, the ARQ1000 automatically switches to the correct mode and prints received text: reception of either the ARQ access code or SEL-FEC selective call code is not required. Since two-way error correction is not available in ARQ monitor mode, re-synchronizing time delays are reduced and the ARQ1000 quickly synchronizes to an ARQ transmission. The monitor mode is an additional feature of the ARQ1000, not formally defined by 476-2.

The ARQ1000 is a code conversion device and connects between the RTTY demodulator and terminal. A wide selection of I/O interface options are available for connection to the demodulator and terminal. Separate (full duplex) connections are provided for the terminal's keyboard and printer. Handshaking control signals are provided for interfacing with the printer, keyboard, tape transmitter, or video terminal. Either Baudot or ASCII terminals may be used at data rates from 45 to 300 baud. Outputs are also provided for indication of reception of the selective call code and to control the transmit-receive line of the radio system. With the ARQ1000 in off mode, demodulator data is connected directly to the terminal.

The ARQ1000 is designed to interface HAL Communications RTTY terminals such as the DS3100 and ST6000, CT2200, CT2100, and CWR6850 products. A total of 30 LED indicators and 11 front panel switches are provided to give full control and status indications of ARQ1000 operation. The ARQ access code, SEL-CAL code, and WRU/HERE IS response text are keyboard programmable and stored in non-volatile memory. The ARQ1000 is housed in a cabinet matching the HAL CT2200 and CT2100 Communications terminals and may be either rack mounted or placed on the operating table (tilt bail included). The ARQ1000 operates from 105-130 / 210-250 VAC 50/60 Hz power.

Options for the ARQ1000 include a built-in demodulator (M1700), data encryption (ARQX10), dual high voltage loop supply (LP120), and a rack mounting adapter (RM2100).



# ARQ1000

## SPECIFICATIONS

### Controls and Related Indicators:

Control	Indicator
MODE:	OFF: By-pass ARQ conversion; connect TTY to demodulator STBY: "Rest mode" for automatic switching to ARQ, FEC, and SEL transmit-receive modes. ARQ: elect normal ARQ transmit-receive mode. FEC: Select FEC collective broadcast mode. SEL: Select SEL-FEC selective broadcast mode. MON: "Rest mode" for automatic switching to ARQ, FEC, and SEL receive-only modes.
RESET:	Force full reset of ARQ1000 processing.
SEND:	Manual initiation of transmission; may also be made by keyboard control.
B/Y:	Force transmission of alternate 1 second B and Y ARQ code to the demodulator for testing.
N/R:	NORM: Reverse demodulator data sense. REV:
TX/RX CONT:	TX: Transmit continuously until switched off AUTO: Automatic TX/RX control (normal) RX: Receive only until switched off
OVER:	Force change in direction of traffic; also made by keyboard control.
END:	Signal end of message to other station; also made by keyboard control.
BREAK:	Force terminal keyboard continuous space condition; used to indicate entry to program mode for ARQ and SEL-FEC codes; also made by keyboard BREAK key.
WRU:	WRU: Turn on/off WRU response message to reception of WRU ARQ code (FIGS D).
HERE IS:	Manually transmit WRU response message to identify station.

### Indicators:

MASTER:	Station that originated communications.
SLAVE:	Original receiving station.
ISS:	Information Sending Station at a given time.
IRS:	Information Receiving Station at a given time.
TFC:	Normal traffic is being processed.
IDLE:	Idle signals are being sent or received.
RQ:	Repeat request in ARQ mode.
ERR:	A reception error has been detected.
PHAS:	ARQ1000 is synchronizing with remote station.
OVER:	ARQ system is changing direction.

CS1:

CS2: Show reception of indicated ARQ control codes.

alpha:

beta:

SEL-CAL: Indicate reception of programmed SEL-CAL code.

INPUT INHIBIT: Indicate keyboard/TD wait control signal.

### Interface Specifications:

#### Data To/From Demodulator:

Code, Rate: 100 Baud ARQ code as defined by CCIR 476-2.

Levels: RS232C, TTL.

Control: Tone enable when transmitting.

#### Data To/From Terminal (TTY):

Codes: Baudot (CCITT No. 2) or ASCII.

Rates: 45, 50, 57, 74, 110, 134.5, 150, 300 baud.

Connection: Full duplex (separate printer and keyboard).

Levels: RS232C, TTL, High Voltage Current Loop.

Control: Printer busy input and keyboard wait output; input from terminal KOS control.

#### Data to Transmitter/Receiver:

Control: Transmit/receive control (KOS)

I/O Connections: 21 terminal barrier strip on rear panel. (10 terminal barrier strip provided for optional M1700 installation.)

### General:

Size: 3.5" H x 16.75" W x 10.375" D  
(8.9 x 42.5 x 26.4 cm)

Weight: 16 lbs net; 19 lbs shipping  
(7.3 kg net; 8.6 kg shipping)

Color: Light gray cabinet with black front panel.  
Style: Table mounting with tilt bail or 19" rack mounting with RM2100 option.

Power: 105-130, 210-250 VAC, 50/60 Hz; 30 Watts.

### Options Available:

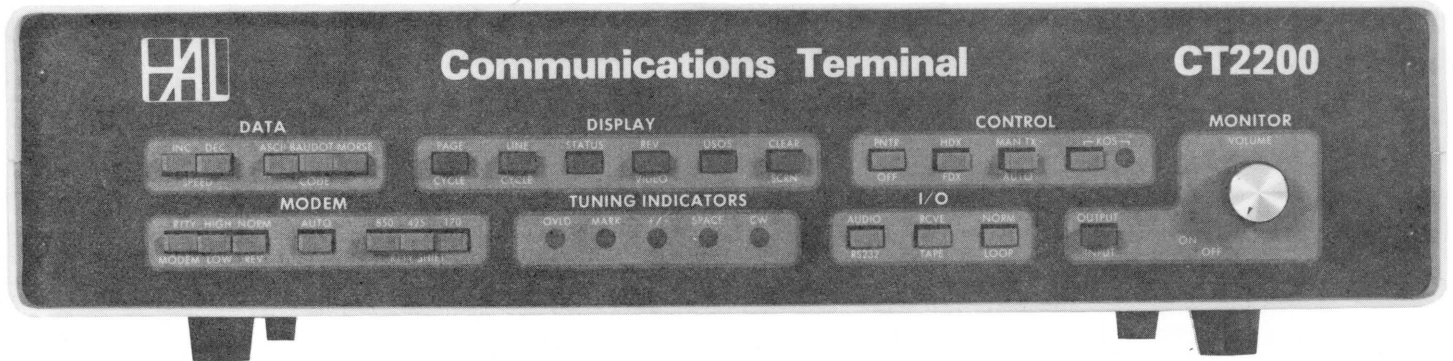
M1700: Receive-transmit demodulator board. Installs in ARQ1000: 1700 Hz +/- 85 Hz standard.

ARQX10: Data encryption option: entry code, exit code, and keyword are keyboard programmable: front panel keyswitch to enable/disable. Factory installed in ARQ1000.

LP120: Dual high voltage loop supply: neutral (0-120V) or polar (-60/+60V), 20 or 60 ma. Optically isolated RS232 I/O. Separate cabinet, same size as ARQ1000, rack or table style.

RM2100: Rack mounting side panels for ARQ1000 or LP120.

# CT2200



The CT2200 is the successor to the popular CT2100 terminal from HAL. It is designed for reception and transmission of Baudot and ASCII Radioteletypewriter (RTTY) signals as well as Morse code signals. The CT2200 incorporates all of the features and conveniences of its predecessor, and has the additional features of selective call, programmable message or "brag tape" storage, and non-volatile memory. These new features are accessed through the optional KB2100 keyboard. A total of five data demodulators are available in the CT2200, including a CW demodulator, both high and low tone RTTY demodulators, and two standard modem tone sets for ASCII and computer use. All demodulator sections use the high performance circuitry for which HAL demodulators are well known. The display of the CT2200 is organized in 24-line pages that can be either 48 lines of 72 characters, or 96 lines of 36 characters. The display features "Smooth Scroll" of the lines rather than a vertical jump each time lines are moved on the screen. The normal display is light characters on a dark background but may be reversed with a front panel switch to present dark characters on a light background. A serial ASCII printer output port provides hard copy capability. This printer output can be controlled manually by a front panel switch, or automatically with a "selective call" code which the user programs in. The CT2200 has been specifically designed so that it may be used as a receive-only device or as a no-compromise send/receive terminal with the KB2100 Keyboard. All CT2200 controls are push-buttons on the front panel. There are no confusing multi-key combinations to remember while operating. Both the keyboard layout and physical design of the KB2100 put user convenience first. The KB2100 is small and light and attaches to the CT2200 with a flexible coil cord, making it ideal for comfortable lap-held use. Since the CT2200 is separate it may be placed on a shelf or rack mounted and only the keyboard need take up limited operating table surface. With the addition of the KB2100 keyboard, split screen transmit/receive operation is available so that transmit text may be composed while receiving. The CT2200 transmits in word mode if half duplex is selected and in continuous mode if full duplex is selected. Split screen may be defeated so that all lines on the screen are devoted to receiving. Eight messages, 7 of 256 characters and 1 of 158 characters, along with two "HERE IS" messages may be stored from the keyboard and recalled at any time. These messages are retained even when power is removed from the CT2200. A status line may be front panel selected to show current operating conditions on the top line of the display. The CT2200 will also interface to a wide variety of external equipment through transmit and receive audio connections, tape recorder audio connections and loop or RS-232 data connections. Tuning is facilitated through 6 LED's on the front panel and a video tuning bar on the screen. The rear panel is set up for fast and simple installation. Most connectors are standard phono connectors and are clearly labeled as to function. The CT2200 also includes I/O connections for operation with the ARQ1000 error correcting terminal.



# CT2200

## SPECIFICATIONS

### Input/Output:

- Audio:** 0.5v. p-p, 600 ohm audio  
Morse: 800 Hz  $\pm$  300 Hz  
RTTY: 1000-3000 Hz, depends on tones chosen.  
Tape: Input and output audio.  
Monitor: Monitor output jack paralleling internal monitor speaker. May be used for headphones.
- RS232:** Full RS232C data levels for RTTY.
- Loop:** 18-120ma/200v maximum current loop.  
External loop supply required to use external loop devices.  
External loop transmit devices will key transmit tones and activate KOS.
- Morse:** Separate transistor switches to key both positive and negative voltage transmitter circuits.

### Data Codes and Rates:

- RTTY:** Baudot (5 unit code) or ASCII (8 unit code): 45, 50, 57, 74, 110, 150, 300, 600, or 1200 baud.
- Morse:** 5 to 100 wpm, with weight control.

### Modem:

- Morse:** Phase-lock loop; 800 Hz nominal center frequency; may be adjusted over 400 - 1200 Hz range; tracks a drifting signal  $\pm$  250 Hz of center frequency.
- RTTY:** US Standard Mark = 2125 Hz  
"High Tones": Space = 2295 Hz (170 Shift)  
= 2550 Hz (425 Shift)  
= 2975 Hz (850 Shift)  
CW ID = 2025 Hz (all shifts)
- IARU Standard Mark = 1275 Hz  
"Low Tones": Space = 1445 Hz (170 Shift)  
= 1700 Hz (425 Shift)  
= 2125 Hz (850 Shift)  
CW ID = 1175 Hz (all shifts)
- "103 Modem" Mark = 1270 Hz  
Standard Space = 1070 Hz  
"202 Modem" Mark = 1200 Hz  
Standard Space 2200 Hz

Transmit audio tone frequencies are automatically set with demodulator switches to correspond to receive tones to assure true transceive frequency matching.

### Display:

- Video:** Standard RS170, 1.0 v. p-p, 72 ohm video output, 6 or 3 MHz BW
- Screen:** 24 Lines of 72 or 36 characters per line
- Page Memory:** 48 lines of 72 characters or 96 lines of 36 characters.
- Polarity:** Normal = white characters on dark screen background  
Reverse = dark characters on white screen background
- Split Screen:** WITH KB2100 ONLY - bottom 12 lines of page 2 may be chosen for display of transmit pretype text. Text may be typed, displayed, and edited while receiving. In split screen mode, transmit text is in reverse video when normal video is selected for receive text and vice versa.
- Status:** Top line of display may be used to indicate CT2100 and KB2100 status; tuning indicator bar, code, rate (speed), USOS, and TX buffer condition are included in status line.
- Scroll:** HAL "Smooth Scroll" of line feeds; inactive when split screen is selected.

### TX/RX Control:

Select transmission in full or half duplex (FDX/HDX) modes, synchronous idle (SYNC), and manual or auto control of transmit/receive status of transceiver, keyboard operated switch (KOS).

### Monitor:

Internal audio monitoring system allows monitoring of either input or output audio signals on the internal monitor speaker (or rear panel headphone jack) with front panel volume control. Input audio switch position allows listening direct to receiver or tape signal. Output audio switch position allows

### Indicators:

listening to 800 Hz sidetone in Morse or to RTTY tones to be transmitted in Baudot or ASCII.

**LEDs:** Six LED indicators show Mark, Space, and center RTTY tuning; Morse center tuning, and KOS on-off status.

**Screen:** Top line of screen may be used for status indicator to show tuning bar for RTTY, code, rate (speed), USOS, and TX buffer condition.

**Scope:** Rear panel connections to vertical and horizontal amplifiers of X-Y RTTY oscilloscope for conventional crossed-loop indication (Oscilloscope NOT included with CT2100).

### Keyboard:

58 keys plus space bar, ASCII keyboard arrangement. Special CW ID (IDENT), two HERE IS, RUB OUT, and BREAK keys included. The HERE IS messages are user programmable. BREAK key sends key-down in Morse and Space condition in RTTY modes. RUB OUT allows error corrections. Highest quality commercial grade keyswitches are used for comfortable and reliable operation.

### Message Storage (with KB2100 only):

Two HERE IS messages and 8 longer user messages may be loaded from the keyboard. Maximum message lengths are: HERE IS 1-16 characters; HERE IS 2-36 or 72 characters; user messages 1 thru 7-256 characters; user message 8-158 characters. All messages retained when power is removed.

### Printer Output:

All received data may be printed on an external printer (available as an option). The printer output is serial ASCII, RS232C standard, at a data rate of 110 to 1200 baud (normally set for 300 baud). Printer operates regardless of received data code (Morse, Baudot, or ASCII), under manual or automatic control.

### Selective Call:

A special code of up to 8 printing characters may be used to automatically activate the printer output if desired. This code is programmed by the user and retained when power is lost.

### Front Panel Controls:

- Data:** Speed Increase, Speed Decrease, Mode selection (ASCII, Baudot, or Morse)
- Display:** Page cycle (to change pages), Line length cycle, Status line control, Normal or Reverse video, Unshift on Space, Clear Screen.
- TX/RX Control:** Full or Half Duplex, Synchronous Idle, Auto or Manual Transmit, KOS control, Printer control.
- Modem:** RTTY or Modem tone select, High or Low tone select, Autostart control, RTTY shift select (170, 425, or 850 Hz).
- I/O:** RS232 or Audio Source select, Receiver or Tape Audio Source select, Normal or Loop control of transmit tones.
- Monitor:** Output or Input audio tone monitoring selection, Volume of monitoring tone, Power on-off switch.

### Rear Panel Connectors:

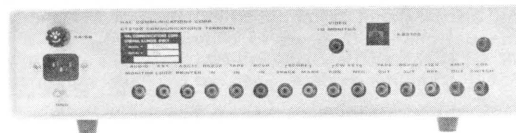
Audio Input from Receiver, Audio Input from Tape, Audio Output to Transmitter, Audio Output to Tape, Monitor Audio Output, Mark and Space Scope Outputs, RS232 Input, RS232 Output, Loop Keyer Output, KOS Output, Negative and Positive CW Key Outputs, Printer Output, Video Output, KB2100 Keyboard connector, AC Power cord connector, ARQ I/O connectors.

### Mechanical Specifications:

- CT2200 Cabinet:** 16.75" x 3.625" x 10.375"  
(17.00" wide with rack mounts)  
42.55cm x 9.21cm x 26.35cm  
(43.18cm wide with rack mounts)  
16.0 lbs net; 19.0 lbs shipping  
7.3 kg net; 8.6 kg shipping  
Color: Light gray top and bottom with black front panel; red and blue push-buttons and front panel trim.
- KB2100 Cabinet:** 14.00" x 2.375" x 7.00"  
35.56cm x 6.03cm x 17.78cm  
4.5 lbs net; 7.0 lbs shipping  
2.0 kg net; 3.2 kg shipping  
Colors: Light gray top, dark gray bottom with black and white keytops.
- Power Requirements:** 110-130vac 50/60Hz; 220-260vac 50/60Hz; 30 watts

## OPTIONS

- CT2200— Standard communications terminal.
- KB2100— Accessory keyboard to allow typing of transmit text.
- Monitor— Recommended 12" green phosphor CRT. Contact your HAL dealer.
- RS2100— RTTY scope and loop supply for accurate tuning of received signals, and to drive mechanical printers.
- RM2100— Rack mounting kit for CT2200. 1.5 lbs. net, 3 lbs. shipping.
- ARQ1000— Automatic error correcting terminal.



# ANSWERS TO OFTEN-ASKED

## "WHY WORK RTTY?"

RTTY is one of those quickly growing "specialized" forms of amateur communications. The attraction to its devotees is probably a mixture of the magic of modern digital communications coupled with the convenience of written rather than coded or voice communications. If you participate in the popular autostart nets, it's not even necessary to be home when receiving a RTTY message—the printer or display will record the text for you to read at your convenience. RTTY is very popular among "rag-chewers" and "engineers" alike; in fact, you get to do a bit of both. The rapid growth of digital electronics has carried over to both RTTY and the new home computer hobby. ASCII communications between ham computers lacks only final FCC approval. If your "bag" is chasing DX, what could be more satisfying than a DXCC certificate for all RTTY? There are several DX RTTY contests sponsored every year with heavy participation. So, rather than ask "Why?" ask "How?"

## "WHAT DO I NEED TO WORK RTTY?"

A ham RTTY station needs a transmitter, receiver, and antenna just like any RF communications system, in addition to some "special boxes" to make the RTTY part work. Some considerations for the equipment are outlined below:

### 1. RECEIVER - TRANSMITTER

The RTTY receiver and transmitter (or transceiver) should be stable, well calibrated, and capable of *EXTENDED TRANSMITTER OPERATION*. When you are transmitting RTTY, the full carrier is on for longer periods of time than for CW or SSB voice. So, check your manual and manufacturer for RTTY specifications and, if in doubt, reduce transmitter power somewhat. For HF work, a good SSB rig in LSB mode works well with RTTY tones (more on tones, later). Most VHF-FM transmitters work with RTTY, but avoid overloading the transmitter as mentioned above.

### 2. ANTENNA

A good antenna will buy you the same benefits in RTTY as it does in other modes. One caution though, the traps on some antennas may not handle as much power in continuous RTTY operation as they do for CW or SSB voice. This can especially be true of trap yagi antennas for the HF bands.

### 3. RTTY DEMODULATOR

The demodulator connects to the receiver audio output and converts the RTTY tones to keying pulses. The quality of your printed signal is determined more by demodulator performance than by any other portion of the system. Demodulators come in all shapes, sizes, and prices. HAL offers the feature-packed ST-6000 with active filters, scope, autostart, anti-space, ATC, DTH, and KOS, as well as the lower cost ST-5000. The popular ST-5 and ST-6 parts kits are also still available for the skilled technician.

### 4. TONE KEYER

The tone keyer circuitry converts the keying pulses from your keyboard into audio tones to drive the transmitter. Since this circuitry is closely related to that of the demodulator, both are supplied in the same cabinet in all HAL demodulators.

### 5. TERMINAL

The terminal is the device that prints or displays the received signals while allowing you to type your transmitted message. The terminal is sometimes divided into a keyboard and a printer or display section. The terminal can be as simple as an old surplus TTY machine or as exotic as the microprocessor controlled HAL DS3100 ASR terminal. An important feature of HAL Communications terminals is that **ALL HAL RTTY EQUIPMENT IS LOOP COMPATIBLE WITH TTY MACHINES**. This means that you can add HAL electronic equipment to your RTTY system at any time. The advantages of the HAL electronic terminals are many; ranging from lack of noise and oil (keeps the XYL happy and your nerves soothed) to automatic operator features such as real-time editing of typing errors, programmable identification message, and automatic carriage return/line feed operations. Also, the speed of the electronic terminal is easily changed with a front-panel switch. Machines require an expensive gear box or a manual change of gears to change speed. HAL offers the DS3100 ASR, CT2200, and CWR6850. All HAL terminals operate with the standard ASCII computer code as well as with the normal amateur BAUDOT code.

## "HOW DO I HOOK IT UP?"

Probably the most frightening thing to the RTTY beginner is the thought of all those wires that must be connected to make it work. A particularly complicated RTTY station can have a real "rats-nest" of wires, but it didn't start that way. Make connections in a logical and step-by-step manner and all will work well. All transceivers are slightly different, but, in general, you will have to make these connections:

### 1. GROUNDING

Before making any other connections, decide approximately where your equipment will be located and run short, low-inductance ground wires (shield braid recommended) between the cabinet grounds of all equipment AND MACHINES. Do not defeat the AC safety ground on the HAL power cords; run separate RF grounds in addition to the AC safety ground. **LACK OF ADEQUATE RF AND SAFETY GROUNDS CAUSES MORE PROBLEMS IN RTTY INSTALLATION THAN ANY OTHER SOURCE.**

### 2. RECEIVER TO DEMODULATOR

Use shielded cable to connect a 500 ohm audio output of the receiver to the demodulator audio input jack. If you do not have a 500 ohm output, the 4-8 ohm speaker output will work, but not as well; a speaker to 500 ohm line transformer would be a good part to add when possible.

### 3. TONE KEYER TO TRANSMITTER

Use shielded cable to connect the tone keyer output of the demodulator to the transmitter audio input. Often, a rear-panel "phone-patch" or "auxiliary" input is provided. If not, connect directly to the microphone connector.

### 4. DEMODULATOR TO TERMINAL

Use shielded cable to connect the terminal to the demodulator. Use the current loop connection for each. When connecting to a solid-state terminal, be sure to observe the proper polarity as indicated in the operator's manuals. Be extremely careful when wiring the loop circuit—potentially lethal voltages are present when the equipment is turned on (200 VDC @ 60 ma). Also, be sure that no part of the loop circuit is connected to chassis ground in machines or other equipment. All RTTY equipment is connected in series when the current loop output is used.

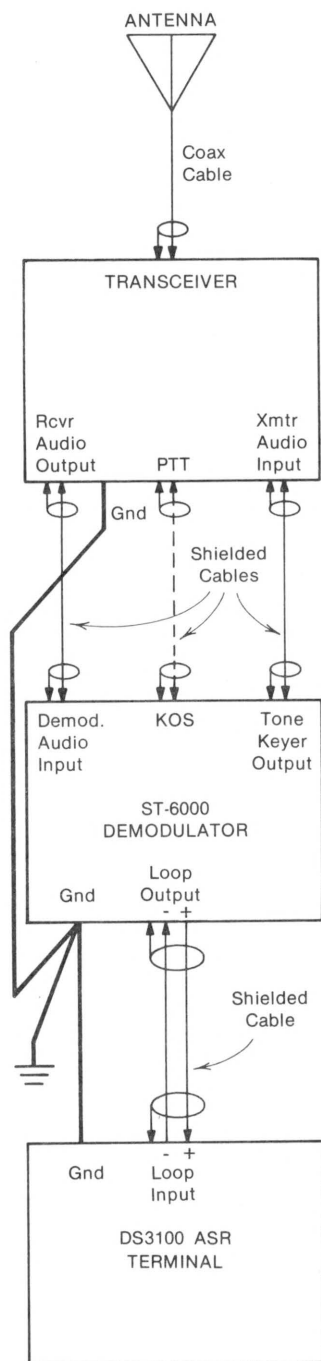
### 5. CONTROL CIRCUITS

Since the control requirements differ with manufacturer, study your transceiver manual carefully to determine how to control the transmit-receiver function. Usually, you can control the push-to-talk (PTT) line through a pin on the microphone connector, a front panel switch, or a rear panel accessory connector. Initially, try to manually switch between transmit and receive until you are familiar with RTTY operation. Eventually, you will probably want to take advantage of the automatic Keyboard Operated Switch (KOS) feature of the DS3100 ASR and ST-6000. KOS is the RTTY equivalent to VOX; typing on the keyboard puts you into transmit mode. If you pause long enough, the KOS "drops-out" putting you back into receive mode. KOS is particularly convenient for short exchanges.

With the CT2200 and CWR6850, since the demodulator and terminal are combined in the same package, the hookup is much simpler. The only cables are audio to and from the transceiver, ground, and KOS to PTT connections.

## "WHAT IS THIS MARK AND SPACE BUSINESS?"

The RTTY signal from the terminal is a series of pulses. The amateur BAUDOT RTTY signal has 7 possible pulses for each character typed or printed, each transmitted one-after-another (serial). Each pulse can be either "ON" (current flow in the RTTY loop) which is called "MARK" or "OFF" (no current flow), the "SPACE" condition. To keep decoders synchronized, the first pulse of a character, the START pulse, is always a SPACE (current off); the last pulse, the STOP pulse, is always a MARK (current on). The 2nd through the 6th pulses can be either MARK or SPACE, depending upon the coding required for a character. The START and all 5 data pulses are the same length; the STOP pulse may be either equal to or longer than the others. The so-called computer ASCII code uses START and STOP pulses but has eight instead of five intermediate data pulses, thus allowing a greater number of characters to be encoded. Although all machines and HAL electronic terminals use pulses, the MARK and SPACE pulse conditions are converted into MARK and SPACE audio tones for easy radio transmission.



# QUESTIONS ABOUT RTTY

## "WHAT IS THE DIFFERENCE BETWEEN FSK AND AFSK?"

Transmitting RTTY signals via radio could be done like Morse code with on-off keying of the transmitter carrier. However, the interference received during off-times would give badly distorted printout. Rather, HF RTTY is transmitted with Frequency Shift Keying (FSK) so that the mark pulse condition corresponds to one radio frequency and the space to another. Amateur radio convention has it that the mark radio frequency is higher than space and that the separation or "shift" of the signal is standardized at 170 Hz or 850 Hz. (425 Hz shift is also used by commercial RTTY stations.) Most present-day amateur RTTY stations use 170 Hz shift exclusively. The FSK signal is received with the BFO turned on, giving two audio frequency tones for the mark and space conditions. The audio tones are, in turn, detected in the demodulator and the resulting pulses drive the display or printer. Note that changing the transmitter or receiver frequency (on purpose or through frequency drift) will change the audio output frequency to the demodulator. The HF system is therefore quite drift sensitive. Present HF equipment frequency stabilities are quite adequate for FSK RTTY, but it is only very recently that VHF equipment was available with similar stability. Therefore, VHF RTTY has traditionally been transmitted by first keying audio tones with the RTTY pulses and then using these tones as the audio modulation of an AM or FM VHF transmitter. This is called AFSK for Audio Frequency Shift Keying. Current amateur convention is to make the mark audio frequency lower than the space frequency by the amount of the shift. Since the RTTY data is audio modulation of the carrier, frequency drift of either transmitter or receiver is a lot less critical. The audio frequency of the tones transmitted is set to be the same as those in the receive demodulator.

The required radio frequency shift keying can be done in two different ways: shift the frequency of a transmitter oscillator directly with the RTTY pulses or use a SSB transmitter with audio tones. Direct FSK keying circuits are described in most amateur journals and are generally simple, but require modification of the equipment; generation of FSK with a SSB transmitter is as follows: If a Lower Sideband Transmitter (LSB) is driven with a 2125 Hz audio tone, the RF output of the transmitter will be at a frequency 2125 Hz *BELOW* the suppressed carrier frequency. A properly adjusted LSB transmitter will have *NO OTHER* output frequencies. If the input tone is changed to 2295 Hz (170 Hz shift), the RF frequency is now 2295 Hz *BELOW* the carrier frequency. Thus, audio tones into the LSB transmitter have produced FSK carriers out of the transmitter. Note that, because the LSB mode was used, the 2125 Hz standard mark tone for VHF AFSK has become the higher radio frequency. Thus, the same demodulator and tone keyer can be used for both VHF AFSK and HF FSK operation. Often, this use of audio tones with a SSB transmitter is mistakenly called "HF AFSK"—actually the resulting output is true FSK, IF the SSB transmitter has no spurious outputs (such as carrier or unwanted side-band). Most HF RTTY amateur radio stations use audio tones with a SSB transmitter. Although "standard" audio tones for VHF amateur operation have long been 2125 Hz for mark and 2975 Hz for space (850 Hz shift), limited audio frequency response of HF SSB transmitters and receivers has recently given rise to a second set of "standard" tones at lower frequencies ("Low-tones").

## "HOW ABOUT HIGH- VS LOW-TONES?"

Historically, demodulator tones were set to 2125 Hz for mark and 2975 Hz for space reception of 850 Hz shift. When transmitter stability improved, 170 Hz shift was used and the space frequency changed to 2295 Hz (mark remained at 2125 Hz). These three tones were, and still are, a standard for U.S. Amateur RTTY. However, in the early 1960's, virtually all commercially available transmitters and receivers became filter-type SSB equipment with audio pass-band limited to speech frequencies, sometimes as narrow as 2.1 kHz (300 to 2400 Hz). Obviously, the 2975 Hz (850 Hz shift Space) tone will not pass-through such a filter and 850 Hz shift with these tones is not possible (although the 170 Hz shift is). Therefore, either the SSB equipment must be modified or different, lower-frequency tones must be used if 850 Hz RTTY shift is desired. Both approaches have their advantages and both are currently in use. The so-called "LOW-TONE" standard sets mark at 1275 Hz and space at 1445 Hz (170 Hz shift) or 2125 Hz (850 Hz shift), conforming to the European IARU standard. So, there are now two sets of "standard" tones, LOW and HIGH (as well as a myriad of others), all of which work *INTERCHANGEABLY* on HF RTTY. However, since the actual audio tone is transmitted for VHF AFSK operation, the two sets are *NOT COMPATIBLE IN VHF AFSK* applications. Current U.S. Amateur operation uses the HIGH TONES for VHF. Thus, to use a

demodulator and keyer for both HF and VHF operation, it should be set-up for HIGH-TONE operation. Conversely, you may wish to have separate stations for HF and VHF, simplifying the cabling, and providing simultaneous monitor/operation capability, as well as resolving the tone problem. The HAL ST-6000 and ST-5000 Demodulators are available for either HIGH or LOW-TONE operation.

## "WHAT FREQUENCIES DO I USE FOR RTTY?"

HF RTTY Operation has evolved to heavy operation on the 80 and 20 meter bands (CW segments) with sporadic operation on other HF bands. 80 meter RTTY stations tend to operate between 3600 and 3650 kHz and 20 meter stations between 14.075 and 14.100 MHz. 170 Hz shift is used almost exclusively with mark being the higher radio frequency. 60 wpm (45 baud) is the most popular RTTY speed, but 100 wpm (74 baud) is gaining in popularity.

VHF RTTY operation in most areas is concentrated on 2 meter FM with 146.700 MHz being the popular operating frequency. Virtually all stations are now using the "High-tones," usually with 170 Hz shift. As with HF RTTY, 60 wpm (45 baud) is most popular on VHF. Some areas now have RTTY-only repeaters on 146.10/146.70 MHz.

## "WHO DO I TALK TO ON RTTY?"

RTTY enthusiasts run the full range of ages and interests, but tend to be technically inclined. The typical RTTY'er is always modifying his station, likes to talk, and usually has more ideas than you have printer paper (or display screen)! Some operators are good typists; most aren't. The DS3100 ASR letters-fill and editing modes make even a poor typist look good. Recently, the home computer hobby has become quite popular with RTTY people and you may find a lot of help in debugging your programs if that's your interest. There are an increasing number of DX stations on RTTY.

## "HOW MUCH DOES IT COST?"

RTTY is like any other hobby—it can cost as much or as little as you want it to. If you buy used machines and build kits or your own designs, the total RTTY cost can be quite low. Conversely, the DS3100 ASR and ST-6000 offer an *ULTIMATE* RTTY station that is expensive. Because all of the HAL RTTY products are current loop compatible, you can add devices as your interests (and pocketbook) indicate. For the beginner, HAL has the following recommendations:

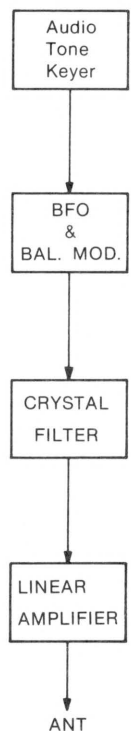
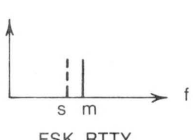
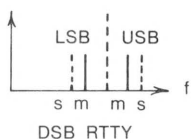
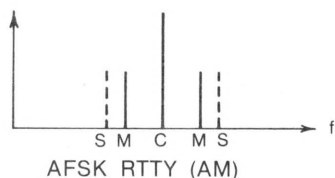
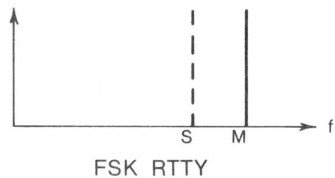
### 1. DEMODULATOR

Assuming you already have a good transceiver and antenna, your first major RTTY purchase should be a good demodulator. The HAL ST-5000 makes a particularly good, cost-effective unit. If you select a high-tone ST-5000, it will be usable for either VHF or HF (170 Shift) RTTY operation; if you are only interested in HF RTTY (for short-wave-listening to press stations, for example), the low-tone unit may be a better choice. Conversely, you may wish to "jump-in" and get the ST-6000 from the first. Either way, put high priority on a *GOOD* demodulator.

### 2. TERMINAL

You can spend very little or a lot on the terminal. A surplus machine can often be acquired at a hamfest for little cash investment. However, by the time you figure out how it works, fix it, and buy parts and manuals the total cost may not be so low. If you do, you'd better be prepared with tools, oil, and patience. Newer machines require less work, but also cost more. On a feature-for-feature basis, either the

TELEREADER, CT2200, or DS3100 ASR are more cost effective than other terminals presently available. Certainly a "solid" beginner's RTTY station would be the CWR6850. For the more serious enthusiast, HAL offers the CT2200 or DS3100 ASR.



**HAL COMMUNICATIONS CORP.**  
 Box 365  
 Urbana, Illinois 61801  
 217-367-7373

# RTTY REFERENCE

## Amateur Radio RTTY Frequencies in the HF Band

80 Meters	3600-3650 KHz
40 Meters	7075-7100 KHz
20 Meters	14075-14110 KHz
15 Meters	21075-21100 KHz
10 Meters	28075-28100 KHz

Regardless of the band in use, Amateur RTTY is normally transmitted with the space tone being the lower frequency on the air. This requires that the transmitter be set for lower sideband with standard U.S. high tone RTTY equipment.

## Some Commercial HF RTTY Frequencies of Interest

8023 KHz	AFP, Paris	425 shift, 50 baud
8105 KHz	Miami WX	850 shift, 74 baud
12223 KHz	VOA, Tangier	425 shift, 74 baud
14638 KHz	USIA, New York	425 shift, 74 baud
14974 KHz	AP, London	425 shift, 50 baud
16440 KHz	Miami WX	850 shift, 74 baud

More complete listings of press service frequencies may be purchased from:  
 Universal Electronics  
 1280 Aida Drive  
 Reynoldsburg, OH 43068  
 Attn: Thomas Harrington

## Amateur RTTY Operations of Special Interest

The ARRL broadcasts bulletins from W1AW by RTTY on 7095 and 14095 KHz. The bulletins are first transmitted in Baudot code at 45 baud, 170 Hz shift. Immediately after the Baudot transmission, the same bulletin is transmitted in ASCII code at 110 baud, 170 Hz shift. The bulletins are transmitted by schedule as announced in QST magazine.

Message storage (MSO) nets are actively operating on 80, 40 and 20 meter frequencies. These nets provide a method of storing messages from one station to another for later retrieval or relay. Quite often general information for any interested operators is stored in these "mailboxes."

RTTY DX operations can be found in the 20-meter band just about any time that band conditions allow.

## Special Considerations When Operating RTTY

We at HAL highly recommend the use of sideband transmission of RTTY signals, with the transceiver in lower sideband position (except of the Drake TR-7, where the RTTY position is used). The operator should remember to keep the mic gain down low enough to prevent overheating the final transmit stage of the transceiver.

Current FCC regulations require that amateur radio transmissions on RTTY be either in ASCII or Baudot code with the following restrictions concerning data rate:

Frequency Range	Maximum data rate
3.500 to 21.250 MHz	300 baud
28.0 to 225 MHz	1200 baud
420 MHz up	19600 baud

Most Amateur RTTY operations are still carried on at 45 baud (60 words per minute) and 170 Hz shift in Baudot code. On the HF bands, the susceptibility to errors caused by noise increases with the data rate.

The FCC still requires that U.S. Amateur Radio stations provide identification in International Morse code. Identification requirements for RTTY operation are the same as those for any other mode of operation.

### The ASCII Data Code

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
4	3	2	1	0	0	0	0	0
0000	NUL	DLE	SPC	Ø	@	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	ENQ	NAK	%	5	E	U	e	u
0110	ACK	SYN	&	6	F	V	f	v
0111	BEL	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	CR	GS	-	=	M	]	m	}
1110	SO	RS	.	>	N	^	n	~
1111	SI	US	/	?	0	_	o	DEL

- |                        |                         |
|------------------------|-------------------------|
| ENQ = acknowledge      | FF = form feed (home)   |
| BEL = signal bell      | FS = file separator     |
| BS = backspace (←)     | GS = group separator    |
| CAN = cancel           | HT = horizontal tab (→) |
| CR = carriage return   | LF = line feed (␣)      |
| DC1 = device control 1 | NAK = not acknowledge   |
| DC2 = device control 2 | NUL = null              |
| DC3 = device control 3 | RS = record separator   |
| DC4 = device control 4 | SI = shift in           |
| DEL = (delete)         | SO = shift out          |
| DLE = data link escape | SOH = start of heading  |
| ENQ = enquiry (WRU)    | SPC = space             |
| EM = end of medium     | STX = start of text     |
| EOT = end of trans.    | SUB = substitute        |
| ESC = escape           | SYN = synchronous idle  |
| ETB = end of block     | US = unit separator     |
| ETX = end of text      | VT = vertical tab (␣)   |

### The Baudot Data Code

Bit Number	Letters	U.S. Figures	CCITT#2 Figures
5			
4			
3			
2			
1			
00000	BLANK	BLANK	BLANK
00001	E	3	3
00010	LF	LF	LF
00011	A	-	-
00100	SPACE	SPACE	SPACE
00101	S	BELL	'
00110	I	8	8
00111	U	7	7
01000	CR	CR	CR
01001	D	\$	WRU
01010	R	4	4
01011	J	'	BELL
01100	N	,	,
01101	F	!	!
01110	C	:	:
01111	K	(	(
10000	T	5	5
10001	Z	"	+
10010	L	)	)
10011	W	2	2
10100	H	#	£
10101	Y	6	6
10110	P	Ø	Ø
10111	Q	1	1
11000	O	9	9
11001	B	?	?
11010	G	&	&
11011	FIGS	FIGS	FIGS
11100	M	.	.
11101	X	/	/
11110	V	;	=
11111	LTRS	LTRS	LTRS

Note: FIGS-H (10100) may also be used for MOTOR STOP function.

Note: "I" = Mark = Hole in punched tape

"I" = Mark = Hole in punched tape

# RS2100



## RTTY SCOPE

The HAL RS2100 RTTY Scope is an accessory that may be used with the HAL CT2100 Communications Terminal as a deluxe RTTY tuning indicator. The RS2100 includes a miniature 1 inch oscilloscope and gives the standard crossed-ellipse RTTY tuning indication. Also included in the RS2100 is a 175 volt, 60 ma dc loop supply that may be used with the CT2100 for direct connection to teleprinter machines. Although the cabinet of the RS2100 is designed to match that of the CT2100, the RS2100 may also be used as an external RTTY scope or loop supply for a number of other RTTY terminals, such as the DS2050, DS2000, CWR685, CWR6850, CWR670, CWR6700, ST5000, ST-5K, and ST-6K.

### SPECIFICATIONS

#### RTTY Scope Input:

Sensitivity:	Approx. 10 v/in to 100 v/in (internally adjustable)
Impedance:	10k ohms or greater (varies with gain control)
Connectors:	Separate phono connections for horizontal (mark) and vertical (space) inputs.

#### RTTY Scope Controls:

Front Panel:	Horizontal Position (H); Vertical Position (V); Intensity (I); Focus (F); Power.
Internal:	X Gain; Y Gain; Astigmatism

#### RTTY Scope CRT:

One inch diameter, green phosphor; 720 VDC maximum cathode to accelerator potential.

#### Loop Supply:

Open Circuit Voltage:	175 VDC, nominal (space)
Closed Circuit Current:	60 mA, nominal (mark)
Loop Key Input:	Switch to ground; compatible with CT2100 "EXT. LOOP" output or DS2050 "RTTY LOOP" output. Other equipment should employ an NPN transistor switch to ground with mark as the "on" state. Transistor must have voltage rating of 300 VDC or more and current rating of 100 mA or more.

#### Loop Outputs:

Two three-conductor ("stereo") jacks wired to accept either "stereo" or "mono" plugs. TTY machine connections must be isolated from ground.

#### Loop Indicators:

Mark and Space pilot lamps.

#### Power Requirements:

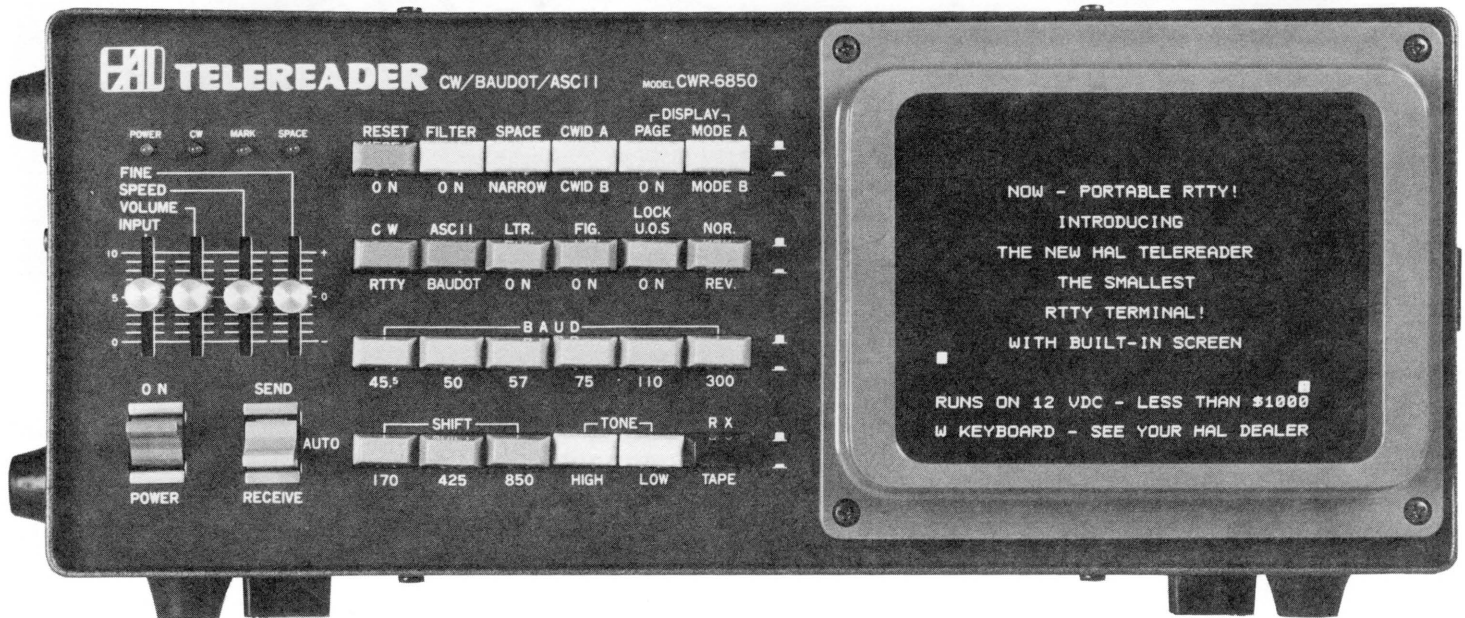
120 or 240 VAC, 50/60 Hz, 18 Watts.

#### Physical Description:

Size:	3.5"H x 8.25"W x 10.156"D (8.9 x 21.0 x 25.8 cm)
Weight:	9 lbs. (4.09 kg) net; 12 lbs. (5.45 kg) shipping
Color:	Light gray textured top and bottom, black front panel; matches appearance of CT2100 and KB2100.



# CWR6850



## TELEREADER KSR TERMINAL

The CWR 6850 is a compact electronic communications terminal designed for reception and transmission of Baudot and ASCII Radio Teleprinter (RTTY) signals as well as Morse code (CW) signals. The CWR 6850 includes a built-in green phosphor CRT display screen and RTTY and Morse demodulators. The very small size of the CWR 6850 makes it particularly ideal for camper, boat, and other portable installations where space for equipment is limited. Since the terminal operates from 12 VDC, it may be easily used in locations where AC power is not readily available. The CWR 6850 comes with a separate full but detachable keyboard. Without the keyboard, it is a convenient and small receive-only terminal; attach the keyboard and add transmitting capabilities. The screen of the CWR 6850 is formatted in 20 lines of 32 characters per line; a total of four different screen pages may be selected. The internal RTTY demodulator allows selection of all three standard shifts (170, 425, 850) for either the "High Tones" (U.S. standard) or "Low Tones" (IARU standard). Transmit AFSK tones match the receive demodulator combination selected. Other transmit features include up to 15 lines of pretype on-screen buffer, automatic transmit/receive control (KOS), and a total of six 64-character programable HERE IS messages. A parallel ASCII printer output is provided for connection to a receive printer.





# CWR6850

## SPECIFICATIONS

### Input/Output:

Audio: 20mV to 2 V rms, 8 ohm audio  
Morse: 800 Hz center frequency  
RTTY: 1000-3000 Hz  
Tape: Input and output audio  
External speaker and headphone jack  
TTL: TTL data input and output jacks  
Morse: Transistor switch for positive or negative voltages

### Data Codes and Rates:

RTTY: Baudot (5-unit) or ASCII (8-unit) codes; 45, 50, 57, 75, 110, or 300 baud  
Morse: 3 to 40 wpm receive  
4 to 33 wpm transmit with weight control

### Modem:

Morse: 800 Hz Active filter or phase-lock loop  
US Standard Mark = 2125 Hz  
"High Tones" Space = 2295 Hz (170 Shift)  
= 2550 Hz (425 Shift)  
= 2975 Hz (850 Shift)  
IARU Standard Mark = 1275 Hz  
"Low Tones" Space = 1445 Hz (170 Shift)  
= 1700 Hz (425 Shift)  
= 2125 Hz (850 Shift)

Transmit audio tone frequencies automatically set with demodulator switches to match receive tones. AFSK CW-ID tone shift available; front panel adjustable receive shift control.

### Display:

Internal: 5 inch diagonal measure (3.25" x 4.25") green CRT;  
Monitor: 20 lines of 32 characters per line; 4 display pages (total of 80 lines of display).  
Page 1: 15 lines Rx data; 3 lines Tx buffer; 2 blank lines;  
Page 2: 3 lines latest Rx; 15 lines Tx buffer; 2 blank lines;  
Page 3: 3 lines latest Rx; 12 lines HERE IS text; 2 blank lines; 3 lines Tx buffer;  
Page 4: 20 lines Rx data.  
Polarity: Green characters on dark screen background.  
External: Composite video, 1.0 V p-p, 75 ohms.

### TX/RX Control:

Automatic Keyboard Operated Switch (KOS) or manual keyboard or manual front panel switch control of station transmit-receive circuitry (plus voltage).

### Indicators:

LED: Four front panel LEDs for power, CW Detect, RTTY mark and RTTY space indication.  
Scope: Rear panel connections to "X-Y" tuning oscilloscope (Tuning oscilloscope NOT included).

### Keyboard:

55 keys plus space bar, ASCII keyboard arrangement.

### Message Storage:

Six 64-character user-programmable HERE IS texts. CW ID may be included within HERE IS text.

### Printer Output:

Parallel, 12-wire Centronics-compatible printer output; 7 bit parallel ASCII code; prints text as it is received for either Baudot, ASCII, or Morse.

### Front Panel Controls:

Switches: CLEAR ON, FILTER ON, SPACE/NARROW, MODE A/MODE B, AUTO ON, PAGE, ASCII/BAUDOT, CW/RTTY, FIG ON, LTR ON, U.S.O. ON, NOR./REV., 45.5, 50, 57, 75, 110, 300 (BAUD), 170, 425, 850 (SHIFT), HIGH TONE, LOW TONE, RX/TAPE, POWER ON, SEND/OFF.

Controls: INPUT (audio level), VOLUME (sidetone monitor), SPEED (CW transmit), SHIFT (RTTY).

Indicators: POWER, CW, MARK, SPACE.

### Rear Panel:

Controls: BRIGHT (CRT intensity), AFSK GAIN (transmit level).

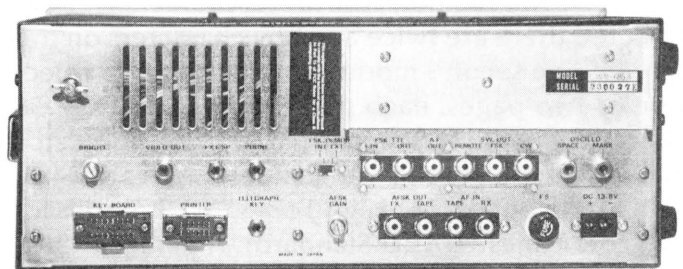
Connectors: KEYBOARD, PRINTER, EXT SP, PHONE, TELEGRAPH KEY, FSK TTL IN, FSK TTL OUT, AF OUT, REMOTE, SW OUT FSK CW, AFSK OUT TX, AFSK OUT TAPE, AF IN TAPE, AF IN RX, OSCILLO SPACE, OSCILLO MARK, DC 13.8V.

### Mechanical Specifications:

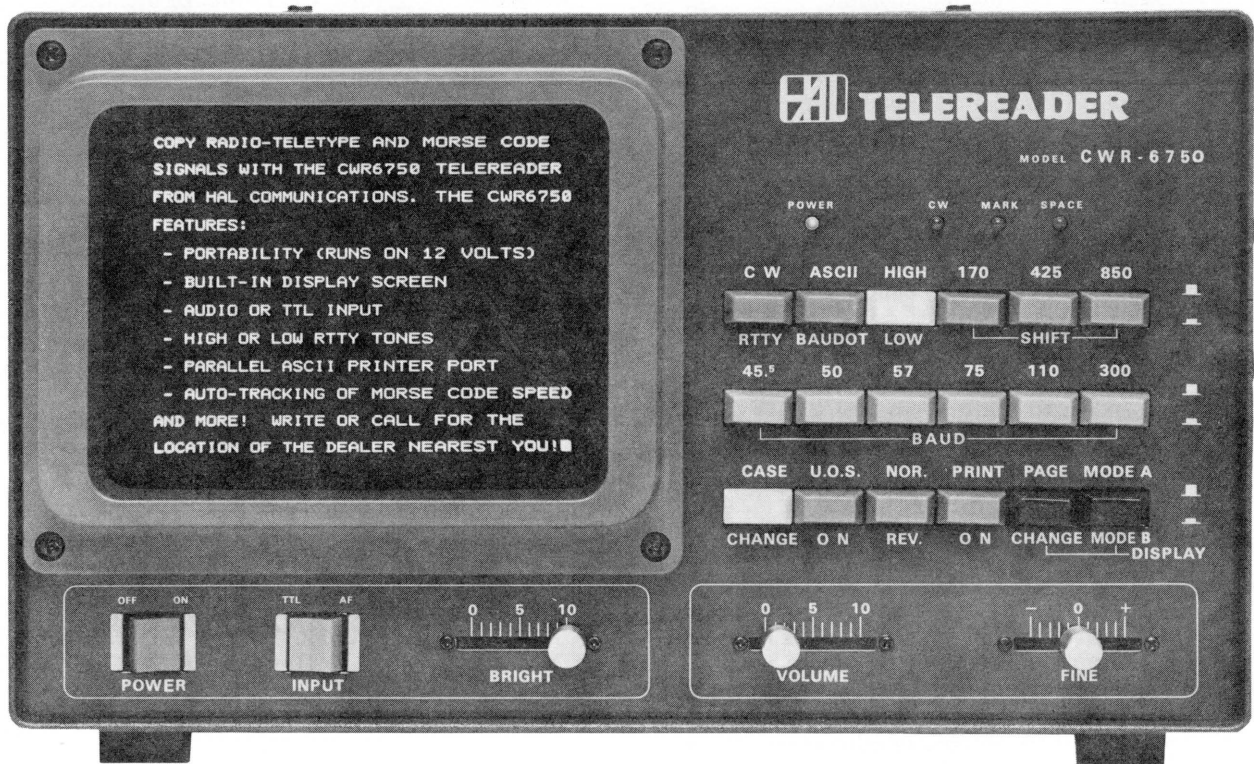
CWR6850: 12.75" x 5" x 11.75" (32.3 x 12.7 x 27.6 cm)  
Keyboard: 13.75" x 2" x 7.25" (34.9 x 5.1 x 18.4 cm)  
16.5 lbs net, 20 lbs shipping (incl. keyboard)  
7.5 kg net, 9.1 kg shipping (incl. keyboard)

### Power:

12 to 14.5 VDC (13.8 VDC nominal), 1.6 Amps.



# CWR6750



## TELEREADER RO TERMINAL

The CWR-6750 is a compact electronic communications terminal designed for reception of Baudot and ASCII Radio Teleprinter (RTTY) signals as well as Morse code (CW) signals. The CWR6750 includes built-in RTTY and Morse demodulators, video generation circuits, and a 5" diagonal measure video screen. The built-in video screen of the CWR-6750 eliminates the need for a separate video monitor in receive-only applications. And, like the other TELEREADER terminals from HAL, the CWR-6750 runs on 12 VDC. This makes the CWR-6750 easily usable in mobile or portable locations where AC power is not available. The video screen of the CWR-6750 has two primary modes of operation. In the first mode, the user may select either 36- or 72-character lines on the display. The display always shows 25 lines, so with 72-character format selected there are twice as many characters on the screen. The second mode allows the user to select one of two pages, each page being 25 lines of 36 characters per line. The internal RTTY demodulator allows selection of all three standard shifts (170, 425, 850) for reception of "High Tones" (U.S. Standard) or "Low Tones" (IARU Standard). A parallel ASCII printer output is provided for connection to a receive printer. TTL level (low voltage) input and output connections are provided in addition to the normal audio input from the receiver.



# CWR6750

## SPECIFICATIONS

### Input/Output:

Audio: 40mV to 2 V rms, 8 ohm audio  
Morse: 800 Hz center frequency  
RTTY: 1000-3000 Hz  
External speaker jack  
TTL: TTL data input jack, TTL data output jack

### Data Codes and Rates:

RTTY: Baudot (5-unit) or ASCII (8-unit) codes; 45, 50, 57, 75, 110, or 300 baud  
Morse: 4 to 50 wpm receive

### Modem:

Morse: 800 Hz Active filter  
RTTY: US Standard Mark = 2125 Hz  
"High Tones" Space = 2295 Hz (170 Shift)  
= 2550 Hz (425 Shift)  
= 2975 Hz (850 Shift)  
IARU Standard Mark = 1275 Hz  
"Low Tones" Space = 1445 Hz (170 Shift)  
= 1700 Hz (425 Shift)  
= 2125 Hz (850 Shift)  
Front panel adjustable shift frequency control.

### Display:

Internal Monitor: 5" diagonal measure  
(3.25" x 4.25") green CRT  
Screen: MODE A—Allows selection of 36- or 72-character lines (25 lines displayed on the screen).  
MODE B—Allows selection of either of 2 pages of 36-character lines (25 lines on each page).  
Output: Composite video, 1.0 V p-p, 75 ohms.

### Indicators:

LED: Four front panel LEDs for power, CW Detect, RTTY mark and RTTY space indication.  
Scope: Rear panel connections to "X-Y" tuning oscilloscope. (Tuning oscilloscope NOT included.)

**Printer Output:** Parallel, 12-wire Centronics — compatible printer output; 7 bit parallel ASCII code; prints text as it is received for either Baudot, ASCII, or Morse.

### Front Panel Controls:

Switches: CW/RTTY, BAUDOT/ASCII, HIGH/LOW, 170, 425, 850 (SHIFT), 45.5, 50, 57, 75, 110, 300 (BAUD), CASE, U.O.S., NOR/REV, PRINT, PAGE, MODE, POWER, INPUT.  
Controls: VOLUME (audio level), FINE (RTTY space filter), BRIGHT (CRT Brightness).  
Indicators: POWER, CW, MARK, SPACE.

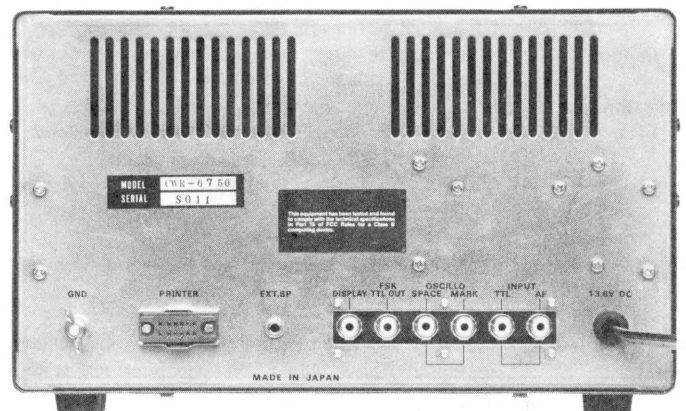
### Rear Panel:

Connectors: PRINTER, EXT SP, DISPLAY, FSK TTL OUT, OSCILLO: SPACE-MARK, INPUT: TTL - AF, 13.8 VDC.

### Mechanical Specifications:

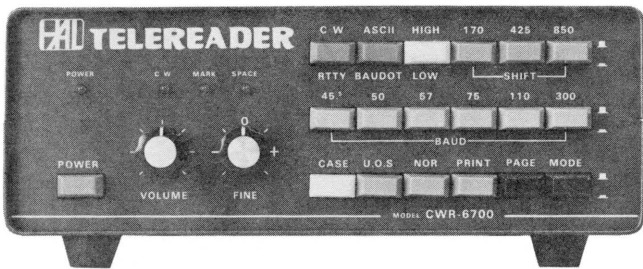
CWR6850: 10.25" W x 6.375" H x 10.75" D  
26.0 cm x 16.2 cm x 27.3 cm  
10 lbs net, 14 lbs shipping  
4.6 kg net, 6.4 kg shipping

**Power:** 12 to 14.5 VDC (13.8 VDC nominal), 1.6 Amps.



# CWR6700

## TELEREADER RO TERMINAL



The CWR-6700 is a compact electronic communications terminal designed for reception of Baudot and ASCII Radio Teleprinter (RTTY) signals as well as Morse code (CW) signals. The CWR-6700 includes built-in RTTY and Morse demodulators and video generation circuits. The very small size of the CWR-6700 makes it ideal for applications where space is limited. Since the terminal operates from 12VDC, it may be easily used in locations where AC power is not readily avail-

able. The video output screen of the CWR-6700 is formatted in pages of 16 lines of 36 or 72 characters per line; a total of two different screen pages may be selected. The internal RTTY demodulator allows selection of all three standard shifts (170, 425, 850) for reception of "High Tones" (U.S. standard) or "Low Tones" (IARU Standard). A parallel ASCII printer output is provided for connection to a receive printer.

## SPECIFICATIONS

### Input/Output:

Audio: 40mV to 2 V rms, 8 ohm audio  
Morse: 800 Hz center frequency  
RTTY: 1000-3000 Hz  
External speaker jack

TTL: TTL data input jack

### Data Codes and Rates:

RTTY: Baudot (5-unit) or ASCII (8-unit) codes; 45, 50, 57, 75, 110, or 300 baud

Morse: 4 to 50 wpm receive

### Modem:

Morse: 800 Hz Active filter

RTTY: US Standard Mark = 2125 Hz  
"High Tones" Space = 2295 Hz (170 Shift)  
= 2550 Hz (425 Shift)  
= 2975 Hz (850 Shift)

IARU Standard Mark = 1275 Hz  
"Low Tones" Space = 1445 Hz (170 Shift)  
= 1700 Hz (425 Shift)  
= 2125 Hz (850 Shift)

Front panel adjustable shift frequency control.

### Display:

Screen: 16 lines of 36 or 72 characters per line, switch selectable; 2 display pages (total of 24 different lines of display in 36 character mode, or 28 lines of display in 72 character mode).  
Page 1: 16 lines Rx data  
Page 2: 16 lines Rx data

Output: Composite video, 1.0 V p-p, 75 ohms.

### Indicators:

LED: Four front panel LEDs for power, CW Detect, RTTY mark and RTTY space indication.

Scope: Rear panel connections to "X-Y" tuning oscilloscope. (Tuning oscilloscope NOT included.)

### Monitor:

Video Monitor required for operation. Contact your HAL dealer for information.

### Printer Output:

Parallel, 12-wire Centronics — compatible printer output; 7 bit parallel ASCII code; prints text as it is received for either Baudot, ASCII, or Morse.

### Front Panel Controls:

Switches: CW/RTTY, BAUDOT/ASCII, HIGH/LOW, 170, 425, 850 (SHIFT), 45.5, 50, 57, 75, 110, 300 (BAUD), CASE, U.O.S., NOR, PRINT, PAGE, MODE, POWER.

Controls: VOLUME (audio level), FINE (RTTY space filter)

Indicators: POWER, CW, MARK, SPACE.

### Rear Panel:

Controls: INPUT SELECT: TTL/AF

Connectors: PRINTER, EXT SP, DISPLAY, OSCILLO: SPACE-MARK, INPUT: TTL - AF, 13.8 VDC.

### Mechanical Specifications:

CWR6700: 8.00"W × 2.85"H × 12.60"D  
(20.3 × 7.24 × 32.0 cm)  
5.5 lbs net, 8 lbs shipping  
2.5 kg net, 3.7 kg shipping

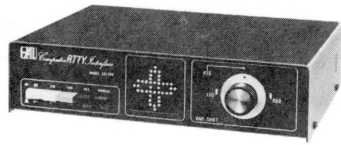
### Power:

12 to 14.5 VDC (13.8 VDC nominal), 0.8 Amps.



Monitor—Recommended 12" green phosphor CRT. Contact your HAL dealer.

# CRI-100 / CRI-200



CRI-200 with LED MATRIX TUNING INDICATOR



CRI-100 with CROSSED LED TUNING INDICATOR

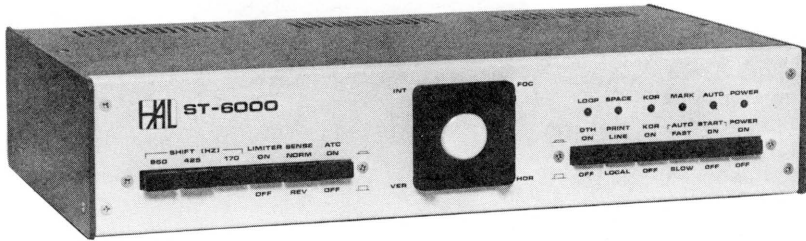
## COMPUTER RTTY INTERFACE

The CRI-100 and CRI-200 are interfaces designed to connect your home computer to a radio receiver and transmitter for copying and sending radio-teleprinter (RTTY) and Morse codes. These units feature LED tuning indicators in the form of 2 crossed lines (CRI-100) or an LED matrix (CRI-200) which simulates the display of an RTTY tuning oscilloscope. As you tune a signal using the CRI-100 cross indicator, the cross grows larger from the center. With the CRI-200 LED matrix, the object is to make the two crossed ellipses as large as possible. The matrix pattern also tells you which way to tune the receiver if you are slightly off frequency by which way the display is tilted. The receive RTTY shift can be fixed at 170 Hz or varied from 80 to 975 Hz. RTTY transmission can be by direct FSK or through the transmitter microphone input using the AFSK transmitter tone keyer. The CW receive filter is centered around 800 Hz (internally adjustable), and the unit will key solid state or tube type radios. The CRI-100/200 will interface to all the popular computers and software programs available. Simply choose your favorite computer and program and the CRI-100/200 will provide the high quality signal input and output which you would expect from a HAL interface.

## SPECIFICATIONS

<b>Audio Input:</b>	50 mV to 2 V p-p, 8 to 600 ohms 800 Hz for Morse Receive (700-1000 Hz with internal adjustment) (2000-3000 Hz for RTTY)	<b>Data Codes:</b>	Set by computer and computer program.
<b>Computer I/O:</b>	TTL data levels for: <ul style="list-style-type: none"><li>• PTT IN (TX = low)</li><li>• RTTY DATA IN (Mark = high)</li><li>• CW DATA IN (TX on = low)</li><li>• Signal Ground to Computer</li><li>• DEMOD RTTY OUT (Mark = high)</li></ul>	<b>Data Rates:</b>	110 baud maximum.
<b>AUX 1-4 I/O:</b>	Four Phono connectors that may be jumpered to the following signals: <ul style="list-style-type: none"><li>• Mark for RTTY Scope</li><li>• Space for RTTY Scope</li><li>• RS232 RTTY DATA IN (Mark = -V)</li><li>• RS232 DEMOD DATA OUT (Mark = -V)</li><li>• RS232 PTT INPUT (TX = +V)</li><li>• TTL RTTY DATA IN (Mark = high)</li><li>• TTL DEMOD DATA OUT (Mark = high)</li><li>• TTL PTT INPUT (TX = low)</li><li>• FSK OUTPUT, set with jumpers F1 &amp; F2 Maximum = +180 V; 50 ma</li></ul>	<b>Modems:</b>	Morse: AF Active filter; 800 Hz nominal center frequency. RTTY Tones: TX Mark = 2125 Hz TX Space = 2295 Hz RX Mark = 2125 Hz (all shifts) RX Space = 2295 Hz (170 shift) = 2200 - 3100 Hz (VAR shift)
<b>CW KEY I/O:</b>	INPUT - TTL or switch contact input (TX ON = low or closed circuit) OUTPUT - Positive or negative voltages as set by internal jumper (P or N). Maximum = 180 V; 50 ma	<b>Indicators:</b>	CRI-100: Two crossed lines of LEDs; mark on horizontal and space on vertical. Power on indicated by center LED; CW receive indicated by both crossed lines. CRI-200: Matrix of LEDs to show scope-type ellipse pattern. Mark on horizontal matrix and space on vertical matrix. Power on indicated by center LED. CW receive indicated by vertical line.
<b>AFSK Out:</b>	4-pin microphone jack with: <ul style="list-style-type: none"><li>• Transmit audio output, 1000 ohms; 300 mV maximum; adjustable; DC isolation with 4.7 uF capacitor</li><li>• PTT output, relay isolated.</li><li>• PTT ground return</li><li>• Transmit audio ground</li></ul>	<b>Front Panel Controls:</b>	Switches: ON/OFF Power to unit. CW/RTTY Select receive modem. VAR/170 Select variable or fixed (170) RTTY receive shift. REV/NORM Select RTTY polarity. MANUAL/AUTO Select manual TX PTT ON or automatic control by computer Controls: VAR SHIFT Set receive modem shift from approximately 75 to 975 Hz.
<b>Score Outputs:</b>	Maximum 1.0 v p-p; 100 k ohms	<b>Rear Panel Connectors:</b>	RX IN, EXT SP, CW KEY IN, CW KEY OUT, COMPUTER I/O, AUX 1, AUX 2, AUX 3, AUX 4, AFSK OUT, POWER IN
<b>TTL I/O:</b>	Standard TTL data interface levels: Mark = +2.4 V Space = +0.8 V (= CW key down)	<b>Mechanical:</b>	(CRI-100 and CRI-200) 9.75"W x 2.75"H x 7.75"D 24.8cm x 7.0cm x 19.7cm Color: Dark Gray cover and front panel; red, gray, and black switch buttons. Weight: 3 lbs. net, 4.5 lbs. shipping 1.3 kg net, 2.1 kg shipping
<b>RS232 I/O:</b>	Standard RS232-C data interface level. Mark < -5 V Space > +5 V	<b>Power:</b>	120 VAC, 60 Hz, 5 watts (with AC adapter) 12 to 14 VDC, 200ma DC input

# ST6000 RTTY Demodulator



## TOP OF THE LINE RTTY DEMODULATOR

Connect the ST-6000 between your transceiver and a HAL DS3100 ASR terminal and join in the fun of amateur RTTY. The ST-6000 provides outstanding recovery of HF RTTY signals, despite noise, interference, or weak signals. Deluxe features of the ST-6000 include a multi-pole active filter front-end, wide dynamic range limiter, either FM (hardlimiting) or AM reception, active filter discriminator and low-pass filters, and internal crystal-controlled AFSK tone keyer. The ATC (Automatic Threshold Control) and DTH (Decision Threshold Hysteresis) features minimize effects of selective fading and multi-path distortion of the RTTY signal. The ST-6000, available with either "Low" or "High" frequency tone sets, receives and transmits 170, 425, and 850 Hz shifts. Other features include internal loop supply, KOS (Keyboard Operated Switch) circuit, autostart, antispacer, oscilloscope tuning indicator, and a rear panel with I/O connections for super-flexible interfacing to all data handling equipment. All in all, the ST-6000 is everything you could want in a demodulator.

### SPECIFICATIONS

#### Electrical

**Input Data and Rate:** Serial Baudot or ASCII code, up to 110 baud.

**Input Impedance:** 600 ohms, balanced, transformer coupled.

**Output Signals:** 60 ma @ 175 VDC loop or low-level RS-232C.

Note: An auxiliary loop keyer is available to key a second loop with an external loop supply.

#### Miscellaneous Output:

Discriminator output to external scope, pre-autostart and post-autostart data, keyboard operated switch (KOS), printer motor AC power.

**Autostart Response Time:** Slow, 3.5 sec. Fast, 1.5 sec.

**Printer motor Dropout Time:** 20 sec.  $\pm$  10 sec.

**Tuning Indicator:** 1" scope.

#### Keyboard Operated Switch (KOS):

Transistor switch to actuate external circuits  
Rated + 25 VDC, 500 ma.

#### Frequency of "Low-tone" pairs.

Shift:	850 Hz	425 Hz	170 Hz
Mark:	1275 Hz	1275 Hz	1275 Hz
Space:	2125 Hz	1700 Hz	1445 Hz

#### Frequency of "High-tone" pairs.

Shift:	850 Hz	425 Hz	170 Hz
Mark:	2125 Hz	2125 Hz	2125 Hz
Space:	2975 Hz	2550 Hz	2295 Hz

CW ID shifts frequency of tone keyer down by 100 Hz.

#### Audio Tone Keyer

**Input Signal:** Dry contacts, EIA-RS-232C levels, or internal current loop, CW ID hand key.

#### Output Signal:

**Levels:** variable from -40 dbm to 0 dbm

**Impedance:** 600 ohm nominal, balanced.

**Distortion:** All harmonics below the 9th harmonic are greater than 40 db down.

**Stability:** Crystal controlled to  $\pm .05\%$

#### Physical

**Cabinet Finish:** Castle tan front and rear panel.

Textured chocolate brown top, bottom and side panels.

**Cabinet Style:** Table or 19" rack mount.

**Size:** Table: 3.50 H  $\times$  9D  $\times$  17 W (inches)

8,9 H  $\times$  22,8 D  $\times$  43,2 W (cm)

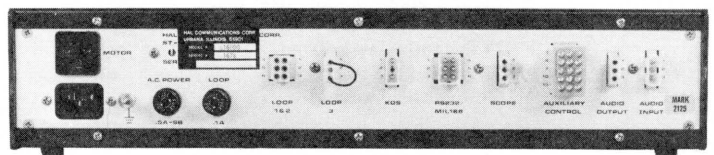
Rack: 3.50 H  $\times$  9D  $\times$  19 W (inches)

8,9 H  $\times$  22,8 D  $\times$  43,3 W (cm)

**Weight:** 12.0 lbs (5,45 kg) net, 15.0 lbs. (6,82 kg) shipping.

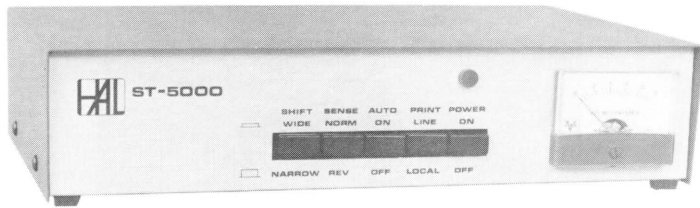
**Power:** 105-125 VAC (210-250 VAC optional)

50-60 Hz, 20 Watts.



(Specify table or rack and high- or low-tones when ordering.)

# ST5000 RTTY Demodulator



The HAL ST5000 Demodulator provides reliable RTTY performance on both HF and VHF bands. A hard limiting front end, active discriminator, and active detector make this unit a big value. Standard features include 170 and 850 Hz shifts, normal or reverse sense, autostart, built-in loop supply, an audio tone keyer, and RS-232 input and output for connection to computer I/O ports.

## SPECIFICATIONS

**Input:** Audio tones, serial Baudot or ASCII code to 110 baud, Impedance 600 ohms - unbalanced, or RS-232C.

**Output Signals:** 60 ma, 175 VDC loop or low-level RS-232C, scope outputs, printer motor power, remote standby line.

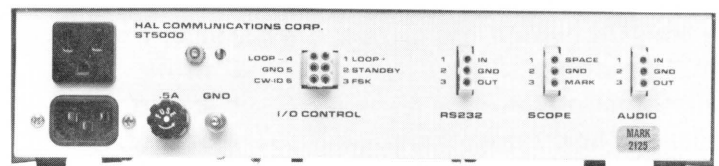
**Tuning Indicator:** Front panel meter.

**Tone Keyer Output:** Internally adjustable output level (preset to -32 dbm), Impedance 600 ohms - unbalanced. CW ID shifts frequency down by 100 Hz. All harmonics below the 9th harmonic are more than 30 db down. Tone keyer is equipped for the same tone pairs as the demodulator.

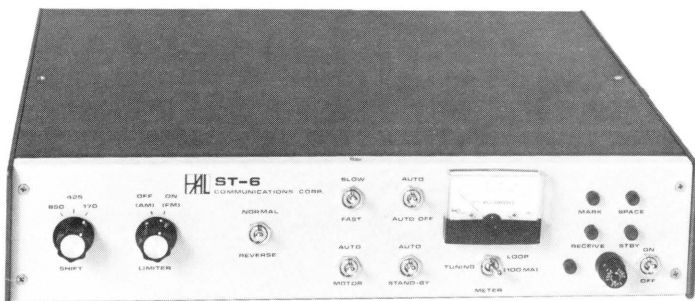
**Physical:** Castle tan front, bottom and rear. Chocolate brown top and sides. Size: 2.75H x 8D x 12W (inches); 7, 0H x 20, 3D x 30, 5W (cm). Weight: 6.0 lbs (2.73 kg) net, 9.0 lbs (4.10 kg) shipping.

**Power:** 105-125 VAC (210-250 VAC optional), 50-60 Hz, 20 watts.

(NOTE: Specify high or low tones when ordering.)



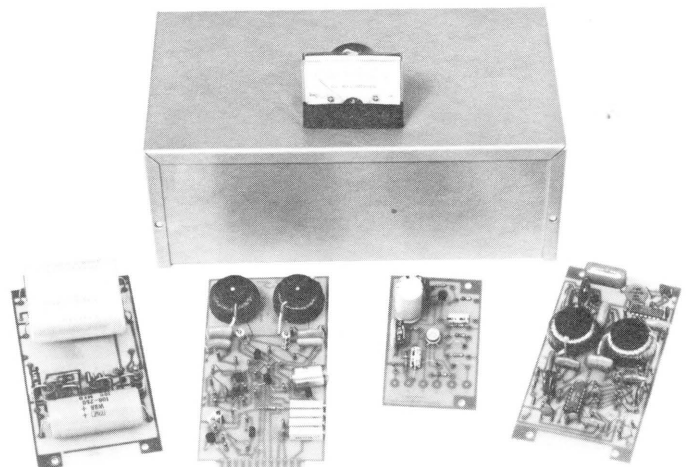
# Demodulator Kits



ST-6K

HAL still offers the famous ST-6 demodulator in kit form for the experienced technician. The ST-6K features input bandpass filters, wide dynamic range limiter, balanced discriminator, active low-pass filter, ATC, autostart, and anti-space. In addition, the output tone keyer is crystal controlled for high stability. The ST-6K provides an extremely good demodulator value for the experienced builder.

**SPECIFICATIONS:** Input - audio tones (RTTY "high" tones for 170, 425, or 850 Hz shifts), 600 ohms, unbalanced input. Output signals - 60 ma/175 VDC loop or low level (RS-232 compatible). Front panel tuning meter. Crystal controlled tone keyer for 170 and 850 Hz shifts. CW ID tone is 100 Hz down from mark. Size: 3.5 H x 12 D x 17 W (19 W for rack mount) inches. Weight 14 lbs. net, 16 lbs. shipping. SPECIFY TABLE OR RACK MOUNT.



ST-5K

The ST-5K is a good first demodulator for the experienced kit builder. The ST-5K package features a wide dynamic range limiter, balanced discriminator, solid state loop switch, autostart, tuning meter, and AFSK oscillator. An unscreened and undrilled Bud 2110 minibox is provided to be tailored to the user's requirements. The ST-5K is the lowest cost method for becoming active in RTTY with HAL equipment.

**SPECIFICATIONS:** Input - audio tones (RTTY "high" tones for 170 and 850 Hz shifts), 600 ohms, unbalanced input. Output signals - 60 ma/175 VDC loop or low level (RS-232 compatible). Tuning meter. Audio tone keyer for 170 and 850 Hz shifts. Size: 10 x 6 x 3.5 inches. Weight 7 lbs net, 8 lbs. shipping.

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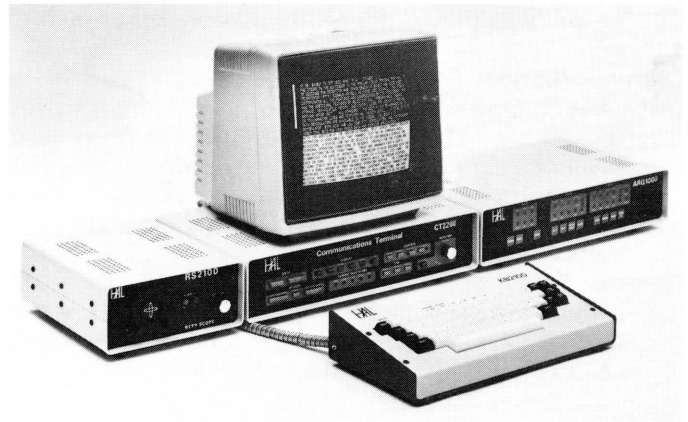
## SYSTEM I

This is the top-of-the-line HAL combination for the serious RTTY enthusiast. It is composed of the MPT3100, ST6000, DSK3100, and optional printer. HAL can supply cable set C-1 to connect this system to your transceiver. Put System I in your shack for the finest in RTTY operation. The ARQ1000 may be added for use in AMTOR or ARQ applications.



## SYSTEM II

This is the attractive and versatile CT2200 system from HAL which includes the ARQ1000, KB2100, KG12 monitor, RS2100, and optional printer. This combination offers a unique set of features at a reasonable price for the radio amateur or shortwave enthusiast. Cable set C-2 interfaces this system to your transceiver. Complement your shack with this extremely versatile system from HAL.



Prices and specifications are subject to change without advance notice.

#484



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