

CWR-670  
TELEREADER

RECEIVE - ONLY

RTTY/CW TERMINAL

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# INSTRUCTION MANUAL



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*QUALITY COMMUNICATIONS EQUIPMENT*

## CONTENTS

INTRODUCTION .....	3
CHAPTER 1. UNPACKING AND INSPECTION .....	4
CHAPTER 2. RECEIVING WITH THE CWR-670	
2.1 How it works .....	6
2.2 Connecting the CWR-670 to your receiver .....	7
2.3 Receiving RTTY Signals .....	8
2.4 Receiving Morse Code .....	13
CHAPTER 3. CONNECTIONS TO THE CWR-670 .....	15
3.1 Normal Receiver Connections .....	16
3.2 Use of the TTL Data Connection .....	16
3.3 Connection of an ASCII Printer .....	17
3.4 Connection of an Audio Tape Recorder .....	17
3.5 RTTY Tuning Oscilloscope Connections .....	18
3.6 Using a Television Set as a Monitor .....	18
3.7 RF-Induced Problems .....	20
CHAPTER 4. IN CASE OF DIFFICULTY	
4.1 Care and Feeding of Your CWR-670 .....	26
4.2 Typical Operational Problems .....	27
4.3 Repair Procedures .....	27
4.4 User Adjustments .....	28
CHAPTER 5. SPECIFICATIONS .....	31
APPENDIX CWR-670 DISPLAY FORMAT .....	34
LIMITED WARRANTY .....	35
ILLUSTRATIONS:	
Figure 1. The CWR-670 .....	3
Figure 2. Simplified CWR-670 Connections .....	5
Figure 3. Connections to the CWR-670 .....	15
Figure 4. Typical Video Detector .....	19
Figure 5. Modified Video Detector .....	19
Figure 6. RFI Reduction Techniques .....	21
Figure 7. RFI Power Line Filters .....	23
Figure 8. Test Points and User-adjustable Controls .....	29
TABLES:	
TABLE 1. BAUDOT DATA CODE .....	11
TABLE 2. ASCII DATA CODE .....	12
TABLE 3. CONTINENTAL MORSE .....	14

## INTRODUCTION

This manual describes the installation and operation of the HAL CWR-670 Telereader RTTY/CW Terminal. The features of the CWR-670 have been designed for convenient and straightforward customer use; many features are self-explanatory from a close examination of the CWR-670 front panel, rear panel, or screen display. However, like many sophisticated electronic devices, there are some features and operator techniques which you may not understand until you have read this manual. You should plan to devote several hours to becoming familiar with your CWR-670.



Figure 1 The CWR-670

## CHAPTER 1 – UNPACKING AND INSPECTION

When you unpack your CWR-670, carefully inspect the shipping carton and each cabinet for shipping damage. Any evidence of shipping damage should be immediately reported to your supplying dealer or shipping carrier. Be sure to save all packing materials if damage is found – the shipping carrier will want to inspect them for any insurance claim. Before discarding the packing materials check that all parts and accessories are accounted for. Check the accessories against the following list. If any are found missing, double-check the packing for loose parts and then notify either your dealer or HAL Communications Corp. of the shortage. Please specify the HAL part number!

### Accessory parts:

#### Accessories Packed With CWR-670:

2 - 310-35012	Phono Pin Plug
1 - 770-20009	2 Ampere fuse
1 - 870-0670	CWR-670 USER MANUAL
1 - 830-59000	Length coaxial cable

#### Accessory Available for Purchase:

1 -332-12000	12 Pin Printer Connector (\$10.00 postpaid)
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In addition to the accessories listed above, you will need the following items to complete the RTTY/CW receiving station:

1. A shortwave receiver capable of receiving the desired RTTY and CW frequencies. A frequency range of 2 – 30 MHz is desirable. The receiver should be capable of receiving SSB and CW signals using an internal BFO (Beat Frequency Oscillator). Selectable filters with bandwidths of approximately 2.1 kHz and 500 Hz are very desirable; the receiver should have frequency-stable oscillators that have low drift. Most amateur-radio receivers or the receiver section of an amateur transceiver will work well for reception of shortwave RTTY and CW signals, although they may not have the desired frequency range coverage.
2. A good shortwave antenna system. An amateur "all-band" vertical antenna will work well as will a center-fed "doublet" antenna fed with coaxial cable. See the ARRL's Radio Amateur's Handbook for suitable antenna dimensions. An end-fed long wire antenna will also work, but may prove to be susceptible to noise and interference.
3. An external TV monitor. The CWR-670 does NOT include the screen for viewing the received RTTY or Morse characters. A commercial-quality TV monitor is highly recommended over a television set. However, modification of a TV set for use as a display is discussed in detail in section 3.6 of this manual. Your HAL dealer can suggest suitable TV monitors for use with the CWR-670.
4. A source of +13.5 VDC, capable of at least 0.8 Amperes output. The CWR-670 does NOT include a 120 VAC internal power supply. It may be powered either from a "12 V" battery in a portable installation or from an external power supply. The "CB-type" power supplies are quite adequate for powering the CWR-670; your HAL dealer can assist you in selecting a suitable supply. The small, "calculator-type" of wall-plug mounted power supplies will not usually have sufficient current capacity for the CWR-670 and this type of power supply is NOT recommended.

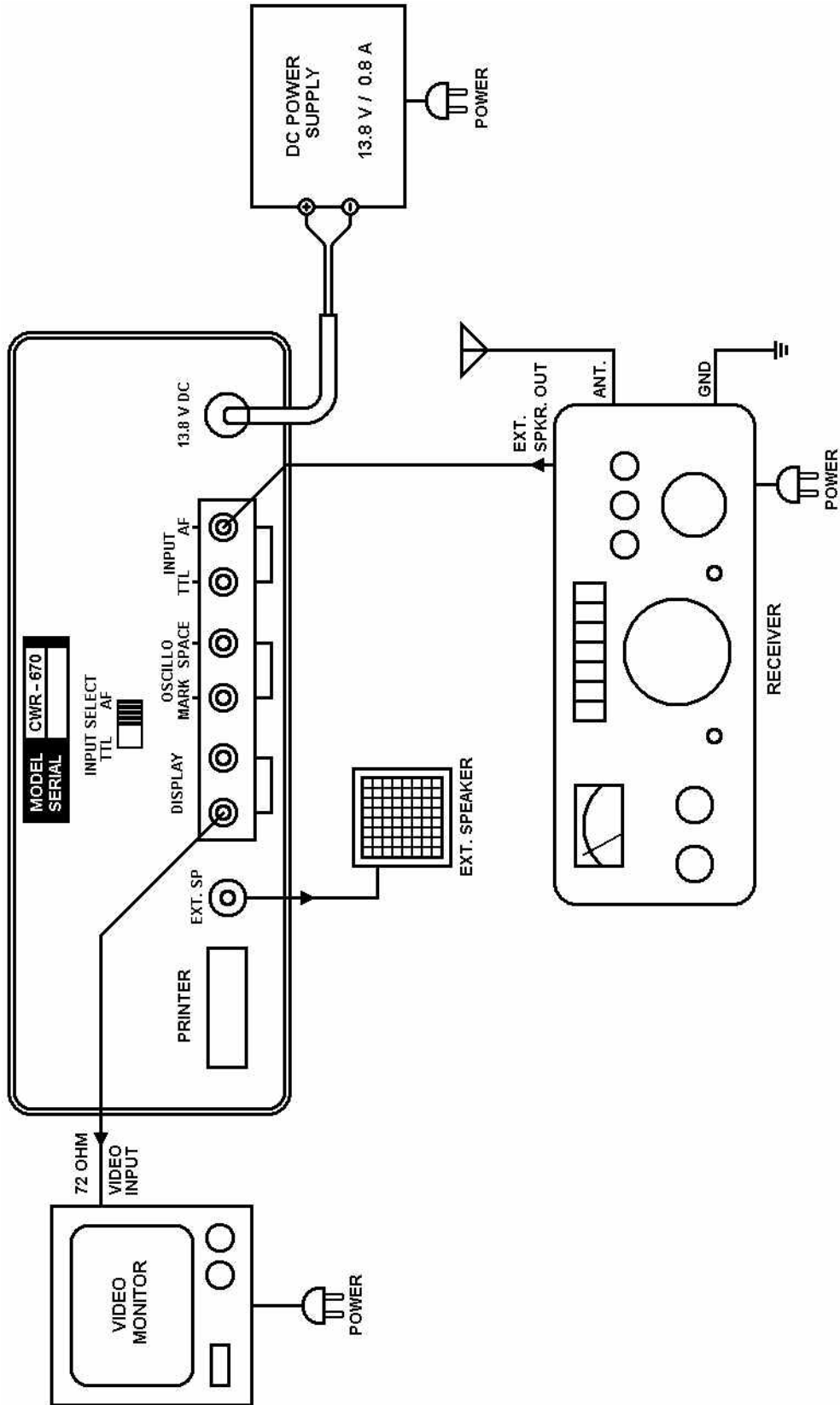


Figure 2 Simplified CWR-670 Connections

## CHAPTER 2 – RECEIVING WITH THE CWR-670

### 2.1 How it Works

While listening to the shortwave frequencies with your receiver, you have probably heard Morse code stations and some other "deedle-deedle" tones that were actually radio teleprinter transmissions (called "RTTY"). The CWR-670 Telereader connects to your receiver and translates or decodes this Morse and RTTY information. An external TV monitor is also connected to the CWR-670 and the decoded characters are shown on the screen as they are received. A computer-type ASCII printer may also be connected to the CWR-670 for a printed copy of the decoded signal (sometimes called "hard copy").

The CWR-670 connects to the audio output of your receiver, usually to the external speaker ("EXT SP") or headphone jack. When receiving Morse or RTTY, turn-on the BFO of the receiver or select the "CW" or "LSB" modes so that audio tones are produced by the desired signal. The Telereader has internal audio filters so that the desired signal is decoded and other, unwanted signals are ignored. Therefore, it is important that the receiver tuning be carefully adjusted so that the resulting Morse code tone or RTTY "deedle-deedle" tones match the filter frequencies of the CWR-670. The tuning LEDs (Light Emitting Diodes) –"CW", "MARK" and "SPACE" show when correct receiver tuning is achieved.

After the desired signal has been selected by the CWR-670's audio filters, the now digital signal is converted to a series of dc pulses that drive the internal microprocessor. The microprocessor (or computer) "reads" the codes of the Morse or RTTY signal and translates them into digital signals that correspond to characters of the alphabet. Another integrated circuit converts these digital signals into a television video signal that is connected to the two DISPLAY output connectors on the CWR-670 rear panel. This video signal may then be connected to your video monitor and the resulting "picture" or character display is then shown on the screen. The microprocessor also sends digital signals to other integrated circuits that then provide the printer output signals to drive an external computer-type ASCII printer.

The video output of the CWR-670 is not a radio frequency (RF) signal such as you might, receive from a TV station. Rather, the signal is "direct video", much like what might be obtained from a TV station camera before it is connected to the TV transmitter. Therefore, the video output of the CWR-670 may not be connected directly to the antenna terminals of a television set. Instead, a "video monitor", much like those used for hobby computers or with video security systems should be used. These video monitors are designed to strict specifications and will in general give a much clearer display of the characters than would be seen on a standard television set. Some standard TV sets may, however, be modified for direct video input as is explained in section 3.6 of this manual. However, the quality of the display on a modified TV set will probably not be comparable to that of a good TV monitor, By all means, any modifications should only be done by a qualified TV technician.

The CWR-670 screen is formatted in "pages" of 16 lines per screen "page" with a maximum of 32 characters displayed on each line. Thus, each screen "page" will show up to 512 characters. Two screen "pages" may be selected with the PAGE switch button on the front panel. Newly received characters are always shown on display "page 1" (PAGE button out). After the 16 lines of "page 1" on the display are filled, the "overflow" is passed on to storage in screen "page 2", viewed by pushing the PAGE button in. The most recently received text will always be displayed on "page 1" and older text on "page 2".

## 2.2 Connecting the CWR-670 to Your Receiver

Connecting the CWR-670 to your receiver is extremely simple – just hook a cable between the receiver audio output (external speaker or headphone output jacks) and the "INPUT-AF" connector on the CWR-670 rear panel. Most receivers can be connected with a standard "high-fidelity" phono-to-phono cable, available at all "HI-FI" shops (some receiver external speaker jacks may require an adapter, so check out your receiver before you buy the cable). Or, if you like to make cables, use the phono plugs supplied in the CWR-670 accessories; by all means, use shielded cables. The CWR-670 has been designed to work well directly from the low-impedance speaker output. Refer to Figure 2 for these simple CWR-670 connections.

The CWR-670 includes its own monitor speaker so that you may continue to listen to the receiver output even if the receiver's internal speaker is disconnected when you connect the CWR-670. The left-hand control (VOLUME) on the Telereader front panel controls this monitor volume level. If you wish, an external speaker may also be connected to the "EXT SP" jack on the CWR-670 rear panel.

This is a good time to put in a good ground between the receiver and CWR-670. Use a short, low-inductance wire, preferably a 1/4" or wider piece of shield braid. Make the ground lead as short as convenient, direct from the CWR-670 cabinet to the receiver (or transceiver) ground terminal. This is most important to prevent receive radio frequency interference (RFI) problems (or RFI from the transmitter in a ham-radio station). By all means, if you are using an AC power supply, USE GROUNDING TYPE AC OUTLETS or add a ground wire between the power supply cabinet and good water-pipe ground this is a safety measure that does not replace the need for a good RF ground.

Next, connect the video monitor video input to one of the two connectors on the CWR-670. Both of these connectors have the same video output signal and either may be used. If your TV monitor has a switch for selection of a 75 ohm or high impedance internal termination, select the 75 ohm impedance. A second "high-fidelity" type of phono cable can be used here if it is not more than 10 feet long. For longer lengths (up to 25 ft.), use type RG-59 coaxial cable and phono connectors to make your own video cable; video cables longer than 25 feet may not result in a satisfactory display on the TV monitor.

Connect the CWR-670 to a DC power source capable of supplying +12 V to +14.5 VDC output with a 0.8 Ampere load.

### **CAUTION !**

Be sure that you connect the RED wire to the positive terminal and the BLACK wire to the negative terminal. Reverse power connection may damage both the CWR-670 and the DC power source !

If you use an AC power supply to generate the +12 VDC, use a grounding type of AC connector to provide for a separate power ground return for the power supply to prevent any electrical shock. Finally, connect power to the receiver, and TV monitor but do not turn-on the switches yet. Proper settings for the CWR-670 front panel switches will be discussed in the next section. You may also wish to refer to the APPENDIX at the rear of this manual for an explanation of the display page arrangement of the CWR-670.

## 2.3 Receiving RTTY Signals

As a first step, preset the CWR-670 front panel switches as follows:

CW / RTTY	= RTTY (button-in)
RTTY (BAUDOT-ASCII)	= BAUDOT (Left button in)
SHIFT (170-425-850)	= 850 (Right button in)
BAUD (45 to 300)	= 45.5 (Left button in)
RESET	= Press and release
PRINT	= On (button in)
U.O.S.	= On (button in)
REV.	= Normal (button out)
CASE	= No action at this time
PAGE	= Page 1 (button out)
POWER	= On (button in)
VOLUME	= Mid-position ("12 O'clock")
FINE	= Mid-position ("12 O'clock")
INPUT SELECT(rear panel)	= AF (right position)

Turn on the power switch to the CWR-670 and TV monitor (but not the receiver) and wait for the TV monitor to "warm-up". After the cathode ray tube (CRT) in the TV monitor has "warmed-up", you should see a white square in the upper-left corner of the screen. This square is called the "cursor" – it indicates where the next received character will be displayed on the screen. If you do not see the cursor, try adjusting the TV monitor's brightness and contrast controls. If a cursor is still not seen, be sure that the PAGE button (lower right button on CWR-670) is "out" and that the video cable is making good connection to both the CWR-670 DISPLAY connector and to the monitor's input connector. Also, if your monitor has switchable video inputs, make sure that the correct input connector has been selected. If you see a line of horizontal dots on the screen, adjust the monitor's horizontal hold control; adjust the vertical hold control to eliminate a "rolling" screen or vertical line of squares.

Now, connect an antenna to the receiver, turn-on its power and adjust the receiver volume control for a comfortable listening level out of the CWR-670's internal speaker. You may now see random characters appear on the TV screen. These characters are actually radio noise being interpreted as RTTY characters. Since you are probably not tuned to a valid RTTY station, these characters are meaningless except as an indicator that the system is all connected properly. The MARK and SPACE LEDs may also be flashing, again indicating that the receiver output is indeed connected to the CWR-670.

If all of these indicators are as described, your CWR-670 is functioning properly; if not, recheck your front panel switch settings.

Now, preset your receiver for the following conditions:

FREQUENCY:	14.075 to 14.100 MHz
ANTENNA:	Adequate to receive signals in above range
MODE:	LSB (lower sideband) *
PASSBAND TUNING:	LSB
AGC:	ON - SLOW
SELECTIVITY:	2 kHz - normal SSB voice bandwidth
RF GAIN:	Maximum
AUDIO GAIN:	Comfortable listening level - see following discussion

\* Use RTTY on Drake TR7 or R7; LSB on other equipment



Turn up the volume control of the receiver for a comfortable listening level from the CWR-670 internal monitor speaker. Leave the receiver set for this volume and use the CWR-670's VOLUME control for further speaker volume adjustments.

If your receiver has an internal crystal calibrator, turn it on and tune the receiver to it so that you get a 1 – 3 kHz audio beat note. If you do not have a crystal calibrator, tune the frequency until you get a beat note on a received carrier signal. There are two different types of tuning indicators you may use when tuning RTTY signals on the CWR-670:

1. The MARK and SPACE LEDs on the front panel.
2. A crossed-ellipse indication on an external X-Y oscilloscope (connected to the OSCILLO - MARK and SPACE rear panel connectors).

We will experiment with the first technique at this time; the external scope can be tried at a later time (see Chapter 5).

Tune your receiver frequency and notice that, as the beat note frequency changes, the MARK and SPACE LEDs will alternately turn on as you tune through their filters. You will need to tune slowly and carefully since the mark and space filters differ in frequency by only 850 Hz. Note that the lower frequency audio tone (at 2125 Hz) turns on the MARK light; the higher frequency tone (2975 Hz) turns on the SPACE light. Therefore, a correctly tuned RTTY signal will be indicated by alternate flickering of the MARK and SPACE LEDs.

Next, turn-off the receiver calibrator (or tune away from the carrier) and select 170 shift (170 SHIFT button in). Tune the receiver while listening through the CWR-670 monitor speaker until you find a moderately strong amateur RTTY signal (identified by the characteristic "deedle-deedle" tones). With careful tuning you should be able to tune so that the MARK and SPACE light flicker alternately. You should now see understandable text on the screen. If you don't, try the REV. switch if this corrects the reception, double check your receiver settings to be sure you really are receiving LSB and not USB. If this doesn't give you good "print", try other CWR-670 BAUD switches, trying both REV. switch positions for each speed. If you still can't make sense out of the display, try the ASCII code at 110 baud, either polarity. If all the combinations of MODE, SPEED, and NORM/REV fail, tune to another station, you have probably tuned-in an encrypted signal! Tune around the 20 meter amateur band and get used to tuning-in RTTY signals. It's difficult at first, but becomes much easier with some practice! Most amateur stations will use 45 BAUD (60 WPM), BAUDOT code; some stations may be found using 110 BAUD, ASCII code. Amateur RTTY stations generally use only 170 Hz shift, but a few may still be found using 850 Hz shift. Amateur high-frequency RTTY activity is usually confined to the following frequency ranges:

"80 Meters"	3600 to 3635 kHz
"40 Meters"	7075 to 7100 kHz
"20 Meters"	14,075 to 14,110 kHz
"15 Meters"	21,075 to 21,100 kHz
"10 Meters"	28,075 to 28,100 kHz

If you have a general coverage receiver, you may now wish to try receiving short-wave press RTTY signals. Commercial press RTTY stations can often be found on frequencies around: 5.2 MHz, 5.4 MHz, 5.8 MHz, 6.8 MHz, 7.5 MHz, 7.8 MHz, 8.0 MHz, 9.0 MHz, 9.4 MHz, 9.8 MHz, 10.2 MHz, 10.5 MHz, 10.8 MHz, 11.1 MHz, 11.5 MHz, 12.2 MHz, 13.5 MHz, 14.5 MHz, 14.9 MHz, 15.5 MHz, 15.9 MHz, 16.2 MHz, 16.4 MHz, 17.3 MHz, 17.5 MHz, 18.2 MHz, 18.4 MHz, 18.7 MHz, and 19.0 to 20.5 MHz (plus others!). Commercial RTTY stations will operate with either 850 or 425 Hz shift and may have speeds of 45 (60 wpm) , 50 (67 wpm) , 57 (75 wpm), or 74 (100 wpm) baud, Baudot code. The signals may be of either signal polarity, so try both positions of the REV. switch. There may be

a few commercial press stations operating at 110 baud ASCII, also. Tuning these commercial stations will require some patience due to the wide variety of shifts, speeds, and polarities used.

The receive non-overprint feature will automatically place characters on the next line of the screen if more than 32 characters are received between line feed characters. To further prevent overprint, the receive section ignores all received carriage return (CR) characters and always executes a carriage return and line feed (LF) whenever a LF character is received. A space may be displayed when the CR character only is received. The Telereader actually has two "pages" of screen display; after 16 lines of 32 characters have been received, the 17<sup>th</sup> line causes the display to shift-up and the previous top display line shifts off the screen onto the second "page" of display. The second "page" of display will also show up to 16 lines of text, so a total of 32 lines of 32 characters per line may be viewed (1024 total characters). The PAGE button (lower right corner) selects which Page is viewed on the TV monitor, The most recently received text is always shown on display page 1, selected with the PAGE button out; page 2 of the display is selected when the PAGE button is pushed in.

The CWR-670 is factory set to receive the following RTTY audio tone frequencies:

SHIFT	MARK	SPACE
850 Hz	2125 Hz	2975 Hz
425 Hz	2125 Hz	2550 Hz
170 Hz	2125 Hz	2295 Hz

These tone frequencies are what is called the "high-tone" set of RTTY audio tones, the standard tones used for amateur and commercial RTTY operation within the United States. These tones are compatible with those used by U.S. amateurs for 2 Meter FM operation (146.700 MHz is a common 2 meter FM RTTY frequency). These tones are also compatible with reception of all shortwave high-frequency RTTY transmissions from all over the world. The front panel FINE control allows a small adjustment of the internal SPACE filter frequency so that non-standard frequency shifts may also be received.

NOTE: The internal demodulator of the CWR-670 will NOT correctly demodulate RTTY signals using the 300 baud data rate. The low-pass filters in the demodulator section are adjusted to give optimum noise rejection for data rates up to 110 baud and will cause distortion of the faster and wider bandwidth 300 baud signal. An external modem (such as a "Bell Model 103" telephone modem) should be used for reception of 300 baud data. When an external modem is used, it should be connected to the "INPUT-TTL" rear panel connector and the "INPUT SELECT" rear panel switch should be set to the "TTL" position.

A complete listing of the Baudot and ASCII RTTY codes is shown on the following Tables 1 and 2. Note that few of the special ASCII control codes are displayed as they do not apply to "printable text".

BIT NUMBER 5 4 3 2 1	CASE		NOTES:																					
	Letters	Figures																						
0 0 0 0 0	BLANK	BLANK	Mark = "1" = "low" AFSK tone = "low" TTL condition Space = "0" = "high" AFSK tone = "high" TTL condition																					
0 0 0 0 1	E	3																						
0 0 0 1 0	LF	LF																						
0 0 0 1 1	A	-																						
0 0 1 0 0	SPACE	SPACE	LF = Line Feed = CTRL-J CR = Carriage Return = CTRL-M BELL = CTRL-G STOP = # (FIGS case H)																					
0 0 1 0 1	S	BELL																						
0 0 1 1 0	I	8																						
0 0 1 1 1	U	7																						
0 1 0 0 0	CR	CR	Transmission order = Bit 1 to Bit 5 Start Pulse = 1 unit space Stop Pulse = 1.5 unit mark																					
0 1 0 0 1	D	\$																						
0 1 0 1 0	R	4																						
0 1 0 1 1	J	'																						
0 1 1 0 0	N	,	<table border="1"> <thead> <tr> <th>BAUD RATE</th> <th>AVERAGE WPM</th> <th>SELECT PULSE</th> </tr> </thead> <tbody> <tr> <td>45.45</td> <td>60.61</td> <td>22.00 ms</td> </tr> <tr> <td>50.00</td> <td>66.67</td> <td>20.00 ms</td> </tr> <tr> <td>56.92</td> <td>75.89</td> <td>17.57 ms</td> </tr> <tr> <td>74.20</td> <td>98.99</td> <td>13.47 ms</td> </tr> <tr> <td>110.0</td> <td>146.7</td> <td>9.09 ms</td> </tr> <tr> <td>300.0</td> <td>400.0</td> <td>3.33 ms</td> </tr> </tbody> </table>	BAUD RATE	AVERAGE WPM	SELECT PULSE	45.45	60.61	22.00 ms	50.00	66.67	20.00 ms	56.92	75.89	17.57 ms	74.20	98.99	13.47 ms	110.0	146.7	9.09 ms	300.0	400.0	3.33 ms
BAUD RATE	AVERAGE WPM	SELECT PULSE																						
45.45	60.61	22.00 ms																						
50.00	66.67	20.00 ms																						
56.92	75.89	17.57 ms																						
74.20	98.99	13.47 ms																						
110.0	146.7	9.09 ms																						
300.0	400.0	3.33 ms																						
0 1 1 0 1	F	!																						
0 1 1 1 0	C	:																						
0 1 1 1 1	K	(																						
1 0 0 0 0	T	5	Special Baudot Features: Automatic LTRS/FIGS generation when transmitting USOS (Unshift On Space) selectable for reception of noisy signals																					
1 0 0 0 1	Z	"																						
1 0 0 1 0	L	)																						
1 0 0 1 1	W	2																						
1 0 1 0 0	H	#	LTRS = CTRL-O FIGS = CTRL-N																					
1 0 1 0 1	Y	6																						
1 0 1 1 0	P	0																						
1 0 1 1 1	Q	1																						
1 1 0 0 0	O	9	LTRS = CTRL-O FIGS = CTRL-N																					
1 1 0 0 1	B	?																						
1 1 0 1 0	G	&																						
1 1 0 1 1	FIGS	FIGS																						
1 1 1 0 0	M	.	LTRS = CTRL-O FIGS = CTRL-N																					
1 1 1 0 1	X	/																						
1 1 1 1 0	V	;																						
1 1 1 1 1	LTRS	LTRS																						

TABLE 1 BAUDOT DATA CODE

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

NOTES:  
 Mark = "1"  
 = TTL high  
 Space = "0"  
 = TTL low

ACK = acknowledge	HT = horizontal tab	BAUD	CHAR/	SELECT
BEL = signal bell	LF = line feed	RATE	SEC.	PULSE
BS = back space	NAK = not acknowledge			(ms)
CAN = cancel	NUL = null	45.45	4.13	22.00
DC1 = device control 1	RS = record separator	50.00	4.55	20.00
DC2 = device control 2	RTN = carriage return	56.92	5.17	17.57
DC3 = device control 3	RBO = RUB OUT = DEL	74.20	6.75	13.47
DC4 = device control 4	SI = shift in	110.0	10.0	9.09
DLE = data link escape	SO = shift out	300.0	30.0	3.33
EM = end of medium	SOH = start of heading			
EOT = end of trans.	SIX = start of text			
ESC = escape	SUB = substitute			
ETB = end of block	SIN = synchronous idle			
ETX = end of text	US = unit separator			
FF = form feed (home)	VT = vertical tab			
FS = form separator	ENQ = enquiry = WRU			
GS = group separator	SPC = space bar			

Transmission bit order:  
 bit 1 to bit 7  
 bit 8 = even parity

TABLE 2 ASCII DATA CODE

## 2.4 Receiving Morse Code

Morse code reception with the CWR-670 requires very little change in switch settings from those used for RTTY in section 2.3; just change the CW/RTTY to CW from RTTY (button out) and retune the receiver to a CW (Morse code) signal. Refer to the tables in section 2.3 for the rest of the switch settings. Use USB or LSB for CW reception now and do NOT select the narrow CW filter at this time. Tune the receiver to the CW segment of the 14 MHz band, 14.000 to 14.075 MHz.

The CW LED on the CWR-670 front panel is the tuning indicator for reception of Morse code. The CWR-670 receive circuit is designed to lock onto an 800 Hz tone, so tune your receiver until the CW LED flashes in sync with the CW signal (key down = tone on = LED on). Try this on a few signals you will soon find out that Morse tuning can be very easy!

After you have mastered tuning of the Morse code signal, you may notice that what shows up on the screen doesn't always make the best of sense at first glance! This is usually due to the fact that human operators often send imperfect code! When we copy Morse code with our ears and decode in our brains, we can be adaptive and translate what the sending operator "meant to send" instead of what actually was sent. The most blatant examples of this are run-together characters and incorrect spacing between letters and words. It is very easy for the transmitting operator to get in a hurry and run some letters together particularly on something hers transmitted often like "CQ" or his own call. Since we are also good Morse operators who have sent "CQ" and call letters often, we adapt when receiving by ear and interpret what was intended. The microprocessor, on the other hand, is looking for some long CW character (like `-.-.-.-.-.-` for CQ) that doesn't exist: it therefore displays the underline character (`_`) to show that an unintelligible Morse combination has been received.

Similarly, it is a very common thing to insert longer than normal pauses between letters, especially when using a hand key to send Morse. The computer interprets these pauses as spaces between words and puts a space on the screen. When receiving by ear, we tend to group the letters received into recognizable words, ignoring irregularities in spacing.

In these two cases in particular, the computer is a severe critic and "prints 'em as it hears 'em"! On the other hand, the Morse decoding programs are very tolerant of weight variations and will usually correctly decipher a heavy "swing fist" (sometimes called a "Lake Erie swing"). This type of "interface timing" problem will occur with all computer decoding of hand-sent Morse code, much as it will on RTTY if improper or irregular timing is used.

You may notice that sometimes the Morse reception appears to stop or be "locked-up". This is usually caused by reception of a carrier for some period of time. The automatic speed tracking program of the CWR-670 interprets the long carrier as very slow CW and adjusts the speed tracking system for very very slow Morse code. The CWR-670 will readjust the speed tracking back up to the correct signal speed. You will now receive a few "T" and "E" characters as the speed readjusts.

Also, Morse code reception is particularly susceptible to interference when the transmitting station's key is up (between dots and dashes or between letters and words). Comparing RTTY and Morse techniques for the moment, recall that the RTTY signal is sent by frequency shifting a signal (the RF signal for HF, and audio tone for VHF AFSK); for either mark or space RTTY data conditions, there is a definite signal transmitted. On Morse code, the transmitter carrier is turned on when the key is down (mark), but when the key is up (space), there is no signal to be received; your receiver and particularly the automatic Morse detection circuits are now "wide-open" to reception of noise, other signals, etc. This is a basic disadvantage of the on-off A1 type emission we use for Morse versus the F1 or F3 emissions we use for RTTY. If we used F1, frequency shift keying, for Morse transmission (as do many commercial networks), automatic CW reception would be

much improved. Here again, when we copy CW by ear, we are adaptive and "tune-out" interference and noise in the pauses between dots and dashes; the computer looks at all signals!

Therefore, it is not realistic to assume that the computer will do all the work of Morse reception for you, especially when receiving less than perfect CW! On the other hand, if you tune to a station using a keyboard or a professional CW operator (such as on the ship-to-shore frequencies), the CWR-670 will display received Morse with close to RTTY-like perfection.

If your receiver has a narrow-bandwidth CW filter, you may now wish to try it for CW reception. Tuning the signal will be a lot more critical, but you may improve the "copy" noticeably if interference has been a problem. Conversely, the narrow filter may actually degrade the copy, especially if the narrow filter "rings" on noise! The degree of problems caused by filter ringing varies with the filter, receiver and noise conditions, so you will want to experiment with your own equipment. Often, the effects of noise, both with or without a narrow filter, can be minimized by reducing the RF gain control until the AGC no longer controls the receiver gain, increasing the receiver volume control as required to maintain copy. This technique, of course, makes the receive system more susceptible to fading ("QSB") and will require more active participation on your part in adjustment of the RF gain control. Good Morse reception will require some patience and practice until you "get the hang of it". A listing of the Continental Morse Code as received by the CWR-670 is shown in TABLE 3.

<table border="0"> <tr><td>A</td><td>..</td><td>1</td><td>.....</td></tr> <tr><td>B</td><td>....</td><td>2</td><td>.....</td></tr> <tr><td>C</td><td>....</td><td>3</td><td>.....</td></tr> <tr><td>D</td><td>...</td><td>4</td><td>.....</td></tr> <tr><td>E</td><td>.</td><td>5</td><td>.....</td></tr> <tr><td>F</td><td>....</td><td>6</td><td>.....</td></tr> <tr><td>G</td><td>...</td><td>7</td><td>.....</td></tr> <tr><td>H</td><td>....</td><td>8</td><td>.....</td></tr> <tr><td>I</td><td>..</td><td>9</td><td>.....</td></tr> <tr><td>J</td><td>....</td><td>0</td><td>.....</td></tr> <tr><td>K</td><td>---</td><td>.</td><td>(period) .....</td></tr> <tr><td>L</td><td>....</td><td>,</td><td>(comma) .....</td></tr> <tr><td>M</td><td>--</td><td>:</td><td>(colon) .....</td></tr> <tr><td>N</td><td>..</td><td>-</td><td>(dash) .....</td></tr> <tr><td>O</td><td>---</td><td>'</td><td>(apos) .....</td></tr> <tr><td>P</td><td>....</td><td>/</td><td>(slash) .....</td></tr> <tr><td>Q</td><td>....</td><td>"</td><td>(quote) .....</td></tr> <tr><td>R</td><td>...</td><td>?</td><td>(query) .....</td></tr> <tr><td>S</td><td>...</td><td>AA</td><td>....</td></tr> <tr><td>T</td><td>-</td><td>AR</td><td>.....</td></tr> <tr><td>U</td><td>...</td><td>AS</td><td>.....</td></tr> <tr><td>V</td><td>....</td><td>BK</td><td>.....</td></tr> <tr><td>W</td><td>---</td><td>BT</td><td>.....</td></tr> <tr><td>X</td><td>....</td><td>CL</td><td>.....</td></tr> <tr><td>Y</td><td>....</td><td>HR</td><td>.....</td></tr> <tr><td>Z</td><td>....</td><td>KA</td><td>.....</td></tr> <tr><td></td><td></td><td>SK</td><td>.....</td></tr> <tr><td></td><td></td><td>SX</td><td>.....</td></tr> <tr><td></td><td></td><td>VE</td><td>.....</td></tr> <tr><td></td><td></td><td>error</td><td>.....</td></tr> </table>	A	..	1	.....	B	....	2	.....	C	....	3	.....	D	...	4	.....	E	.	5	.....	F	....	6	.....	G	...	7	.....	H	....	8	.....	I	..	9	.....	J	....	0	.....	K	---	.	(period) .....	L	....	,	(comma) .....	M	--	:	(colon) .....	N	..	-	(dash) .....	O	---	'	(apos) .....	P	....	/	(slash) .....	Q	....	"	(quote) .....	R	...	?	(query) .....	S	...	AA	....	T	-	AR	.....	U	...	AS	.....	V	....	BK	.....	W	---	BT	.....	X	....	CL	.....	Y	....	HR	.....	Z	....	KA	.....			SK	.....			SX	.....			VE	.....			error	.....	<p>NOTES:</p> <p>· = one dot unit of key down time          - = one dash unit of key down time          (space) = three dot units</p> <p>Element space = one dot unit          Letter space = three dot units          Word space = seven dot units</p> <p>Speed in WPM = (dots/min)/25          = 2.4 dots/sec          = no. of 0's repeated in 26 seconds          (1.5 % accuracy).</p> <p>Undefined character displays "_" = underline</p> <table border="0"> <tr><td>AA</td><td>displays</td><td>"@"</td></tr> <tr><td>AR</td><td>displays</td><td>"+"</td></tr> <tr><td>AS</td><td>displays</td><td>"^"</td></tr> <tr><td>BK</td><td>displays</td><td>"]"</td></tr> <tr><td>BT</td><td>displays</td><td>"="</td></tr> <tr><td>CL</td><td>displays</td><td>"%"</td></tr> <tr><td>HR</td><td>displays</td><td>"space"</td></tr> <tr><td>KA</td><td>displays</td><td>"["</td></tr> <tr><td>SK</td><td>displays</td><td>"line feed"</td></tr> <tr><td>SX</td><td>displays</td><td>"\$"</td></tr> <tr><td>VE</td><td>displays</td><td>"&gt;"</td></tr> <tr><td>error</td><td>displays</td><td>"&lt;"</td></tr> </table>	AA	displays	"@"	AR	displays	"+"	AS	displays	"^"	BK	displays	"]"	BT	displays	"="	CL	displays	"%"	HR	displays	"space"	KA	displays	"["	SK	displays	"line feed"	SX	displays	"\$"	VE	displays	">"	error	displays	"<"
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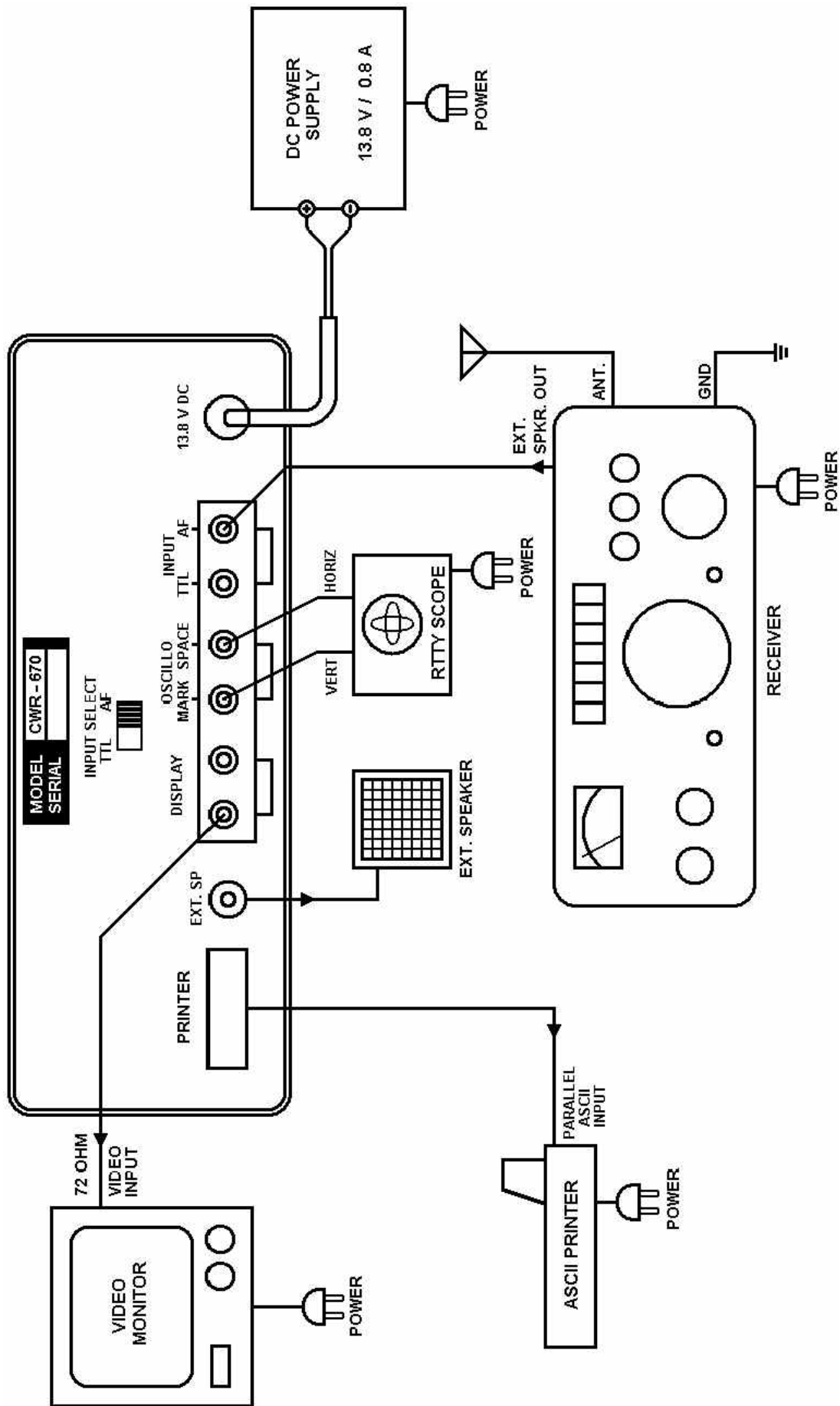


Figure 3 Connections to the CWR-670

## CHAPTER 3 – CONNECTIONS TO THE CWR-670

This section of the CWR-670 manual discusses how to connect the Telereader to your equipment. Section 3.1 will discuss basic connections you may wish to make in a typical receiving station. Later sections of this chapter discuss specialized connections.

### 3.1 Normal Receiving Station Connections

The basic minimum connections required for receiver connection have been shown in Figure 2 in Chapter 2; more elaborate connections are shown in Figure 3. The "basic required connections" of Figure 2 are:

1. A good RF ground between all components of the system. Use heavy wire or 1/4" shield braid.
2. A shielded audio cable between the receiver speaker output and the CWR-670 INPUT-AF connector. A high fidelity phono cable will do nicely.
3. A shielded cable between either of the CWR-670 DISPLAY output connectors and the video input of your video monitor. For short lengths (up to 10 ft. ), this cable can again be a high fidelity type of phono cable. Use a 75 ohm coaxial cable (RG-59 or equivalent) to prepare your own video cable for lengths up to 25 ft. Video cables longer than 25 ft. may not give a satisfactory TV monitor screen display.
4. Connect the CWR-670 to a DC power source capable of +12 to +14.5 VDC output with a 0.8 Ampere load.

#### CAUTION !

Be sure that you connect the RED wire to the positive terminal and the BLACK wire to the negative terminal. Reverse power connection may damage both the CWR-670 and the DC power source !

If you use an AC power supply to generate the +12 VDC, use a grounding type of AC connector or provide a separate power ground return for the power supply to prevent any electrical shock.

### 3.2 Use of the TTL Data Connection

The CWR-670 includes an input connector for use with TTL data devices ("INPUT - TTL"). This input connection can be used with any TTL compatible device. The TTL voltage standard is as follows:

MARK  $\geq$  +2.7 volts (+5.0 volts maximum)  
SPACE  $\leq$  +0.6 volts (0.0 volts minimum)  
UNDEFINED: +0.6 volts to +2.7 volts

Notice that the voltage levels of the TTL standard are NOT compatible with those of RS232 data connections. Do not be misled by some claims of direct TTL - RS232 compatibility; damage may be caused to one or both units!

The TTL input is selected with the INPUT SELECT - TTL / AF switch on the rear panel. Leave the switch in the "AF" Position whenever you wish to use the internal demodulator for receiving Baudot or ASCII signals. The "TTL" position should be used whenever you are using an external RTTY demodulator, such as a telephone-type modem for reception of 300 baud ASCII data. The TTL input



may also be used for direct connection to a computer data output port. The TTL input is normally used for reception of RTTY (Baudot or ASCII) data but may also be used for Morse code practice.

To practice Morse code, connect the hand key (or keyer positive switch output) to the INPUT-TTL connector and select "TTL" with the INPUT SELECT rear panel switch. Set the front panel CW/RTTY switch to CW (button out). As you send Morse code on the hand key, the decoded characters will be displayed on the screen and the CWR-670's internal tone oscillator will be heard.

### 3.3 Connection of an ASCII Printer

A serial ASCII data printer may be used with the CWR-670 by connection to the PRINTER connector. This output is a parallel, Centronics-compatible interface connection. The specifications of the printer connection are:

Connector: HIROSE P-1612-BAC 12-pin plug (HAL 332-12000)  
Wire: 12 Conductor cable (shielding recommended); 5 ft.

PIN	USE	PIN	USE
1	GND	7	NOT-STROBE
2	BUSY (NOT-RDY)	8	D1 (LSB)
3	NOT-ACK	9	D2
4	D8 (MSB)	10	D3
5	D7	11	D4
6	D6	12	D5

Use a printer that includes a one-line buffer register and will do automatic line feed operations when either the buffer is full or the ASCII line feed character is received (0A HEX). The output of NOT-STROBE is a negative pulse of approximately 1.2  $\mu$ sec. duration. The NOT-ACK input is not read; data is output to the printer when BUSY, (NOT-RDY) is in a "low" TTL state. Data output is latched just before the next NOT-STROBE output pulse. The D8 output condition is set to a TTL "low". The output is parallel 7-bit, ASCII. The contents of the printer output FIFO register are displayed on the top two lines of page 2 of the display.

Data to the printer is turned on and off with the PRINT front panel switch (button out = printer on). The printer provides print-out of data AS IT IS RECEIVED. Since most printers use a line buffer, text will not be physically printed until an entire RECEIVED line is complete (as distinguished from a 32 character display line). Some printers allow modification of the print format when some ASCII control codes are received. All control codes to the printer except LF are normally suppressed to avoid print format changes on received text (or noise).

### 3.4 Connection of an Audio Tape Recorder

An audio tape recorder may be connected to the receiver speaker output and the RTTY signal recorded on tape. The tape recorder may then be connected to the AF-IN connector of the CWR-670 and the recording played back at a later time. It is recommended that you also have the CWR-670 connected to the receiver and working when making tape recordings. Tune the receiver using the CWR-670's tuning LEDs and you will be sure that the recorded tone frequencies are compatible with the filters in the Telereader. The same technique may be used for recording Morse code signals. A phono "Y" adapter is a convenient way to obtain an audio connection for both the CWR-670 and the tape recorder microphone input. When playing-back the tape, connect the tape recorder's audio output (EXT SPKR, usually) to the CWR-670 INPUT-AF connector. In general, use one of the shorter tapes (C30, C45, or C60) in preference to longer playing tapes (C90 or C120) since the long-play tapes tend to stretch after several playings, particularly when used in portable recorders.

Stretching of the tape changes the tone frequency when played-back and may result in unsatisfactory decoding of the RTTY or CW signal.

### 3.5 RTTY Tuning Oscilloscope Connections

In addition to all of the input connections discussed above, you may also wish to use an external monitor scope for a RTTY tuning indicator. The OSCILLO (SPACE and MARK) connectors are provided for tuning indicator use. These output are the filtered signals present at the RTTY demodulator discriminator circuits. The signals are approximately 1 V<sub>PP</sub> in amplitude and have an internal impedance of approximately 200 kΩ. As shown in Figure 3, the standard convention is to use an X-Y oscilloscope with the MARK signal connected to the horizontal scope input and the SPACE to the vertical input. Since these signals have a relatively low output level, it is necessary to use an oscilloscope with amplifier stages in both the vertical and horizontal sections. Use shielded cable for these connections; be sure to include safety power as well as RF ground connections.

The display on the oscilloscope screen for correct receiver tuning will be of the crossed-ellipse type. Correct tuning is indicated when the horizontal ellipse (mark signal) and the vertical ellipse (space) have maximum amplitude (length of the ellipse) and are orthogonal. The 170 Hz shift ellipses will be fairly wide and will not necessarily be at 90 degrees to each other this is normal! The ellipses for the wider shifts (425 and 850) will be noticeably narrower and closer to a full 90 degrees apart. With practice, the tuning scope provides the most accurate tuning indicator available. Properly interpreted, the scope patterns tell which direction to tune the receiver and whether the signal shift matches that of the selected demodulator shift.

### 3.6 Using a Television Set or External Monitor

Although a commercial-quality TV monitor will give the best display, you may wish to use a TV set to display the text. A larger "picture" tube will give a larger character size display but the larger screens will have noticeable distortion, particularly at the corners.

Some good quality black and white TV sets can be easily modified to serve as video monitors. The change does not effect normal operation of the set except that the video cable from the CWR-670 must be removed from the TV when the set is to be used to receive television programs. It is important that the selected TV have adjustments available for both horizontal and vertical size. Normal TV alignment results in "over-scan" of the viewing screen, preventing margin lines but also losing parts of the picture at the edges and corners. To avoid losing characters of the CWR-670 display along the corners and edges, it may be necessary to "shrink" the size of the TV raster with the width and heights controls. These adjustments will be made after the TV set is modified and when you can look at the CWR-670 video output.

#### **CAUTION !**

DO NOT attempt to use as a monitor any television receiver in which one side of the AC line is connected to the chassis or circuit ground of the set unless you supply AC power to the set through an isolation transformer.

The modification is simply a matter of capacitively coupling the external video signal to the input of the first video amplifier stage in the TV set. Figure 4 shows a typical transistor TV video circuit. Although the component values and the biasing scheme may be slightly different in your set,, the circuit should be essentially as shown. The CWR-670 video signal is injected at point A.

The modified circuit is shown in Figure 5. Connect the negative end of a 100 μF, 16 V electrolytic capacitor to the base of the first video amplifier transistor. Mount a UHF (or BNC) video connector on the cabinet as close as possible to the capacitor connection. Connect the center pin of the coax



### 3.7 RF-Induced Problems

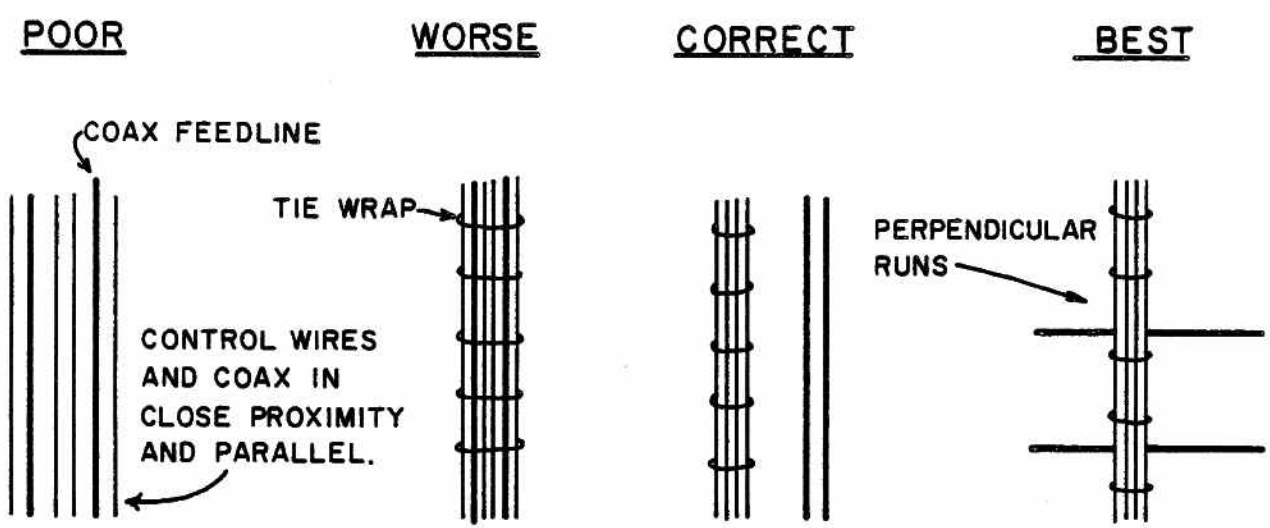
The information in this section is primarily intended for use of the CWR-670 in situations where a radio transmitter is also in use (for example, a radio amateur's station), but many of the techniques also apply if you have interference to reception.

The CWR-670 is designed to operate in close proximity to radio frequency transmitting and receiving equipment. However, under certain conditions in an RF-saturated environment, the CWR-670 may be susceptible to RF-induced interference. This may manifest itself in any of a number of ways, such as partial or complete lack of response to switches or erratic behavior of the video display.

The first thing that should be checked if RF problems are suspected is the GROUND system. The transmitter should be properly grounded for RF (in addition to an electrical safety ground) and all other station equipment grounds should be connected to the transmitter chassis. The RF ground should consist of a short length of heavy copper wire or braid terminated at a good earth ground (ground rod, cold water pipe, etc.). If a water system ground is used, be sure that the pipes are 100 % metal from the connection point to the water mains – plastic plumbing will break the ground path. If the distance between your transmitter and ground connection is more than a quarter wavelength at the highest operating frequency, make the ground wire an integral number of half-wavelengths long. If you plan to operate 10 and 15 meters, you may need to run separate ground wires for each band.

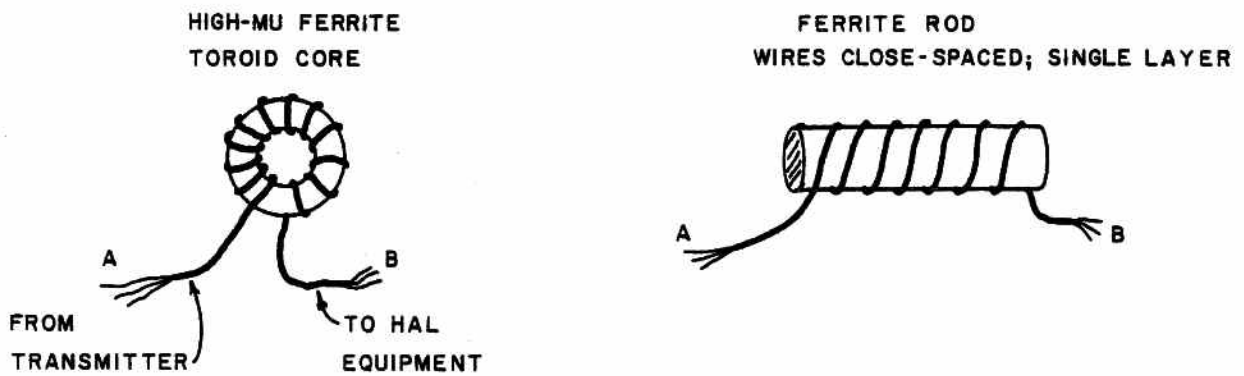
Stations located on the second floor of wood frame houses can present special problems for RF grounding. One technique that has worked well when none of the usual ground returns work is to spread copper screen material on the floor of the room under the operating position. The equipment ground is then attached to the screen with one or more low inductance leads. The screen creates an "artificial" ground plane in the studio. A carpet is usually placed over the screen to improve the appearance of the room! Consult any of the amateur handbooks or antenna books for a more in-depth discussion of grounding techniques.

The best way to confirm that a problem is caused by RF-induction is to temporarily eliminate the source. This may be done in stages, starting with a partial reduction in exciter drive, and ending with transmitter shut-off. Since RF energy may be induced in the CWR-670 through several paths, connecting the transmitter to a dummy load may not eliminate all RF related problems, although this is an excellent first step in verifying RF problems.



(A)

PLACE RF CHOKE CLOSE TO REAR PANEL OF EQUIPMENT



(B)

Figure 6 RFI Reduction Techniques

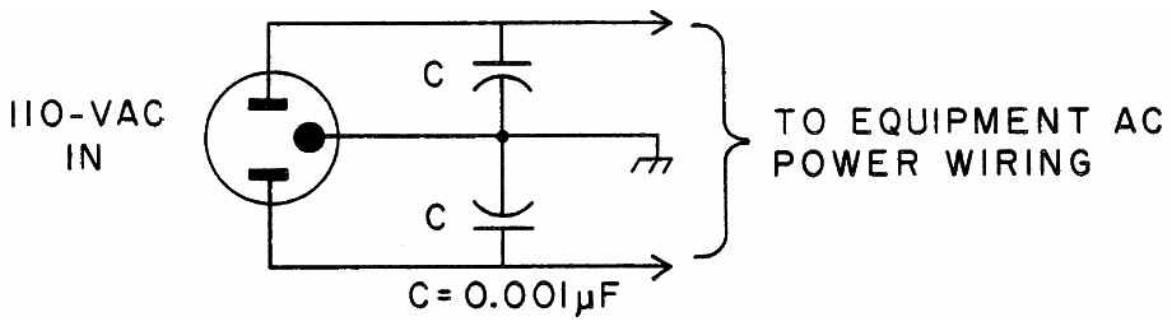
Radiation of RF energy from linear amplifiers, antenna tuners, coaxial switches, monitor scopes and interconnecting coaxial cable jumpers is also possible. In fact, it is this type of radiation that is most likely to be coupled into nearby I/O and power cables of the CWR-670. To locate the point or points of radiation, experiment with different cable arrangements to see if the RF-induced problem can be eliminated by reducing coupling between any of the CWR-670 cables and nearby coaxial lines carrying RF power. Figure 6A shows several cable arrangements, both good and bad, showing how to keep RF coupling to a minimum. Figure 6B shows how to use high- $\mu$  (950–2000) ferrite toroids or rods to choke the flow of RF on audio and control lines.

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

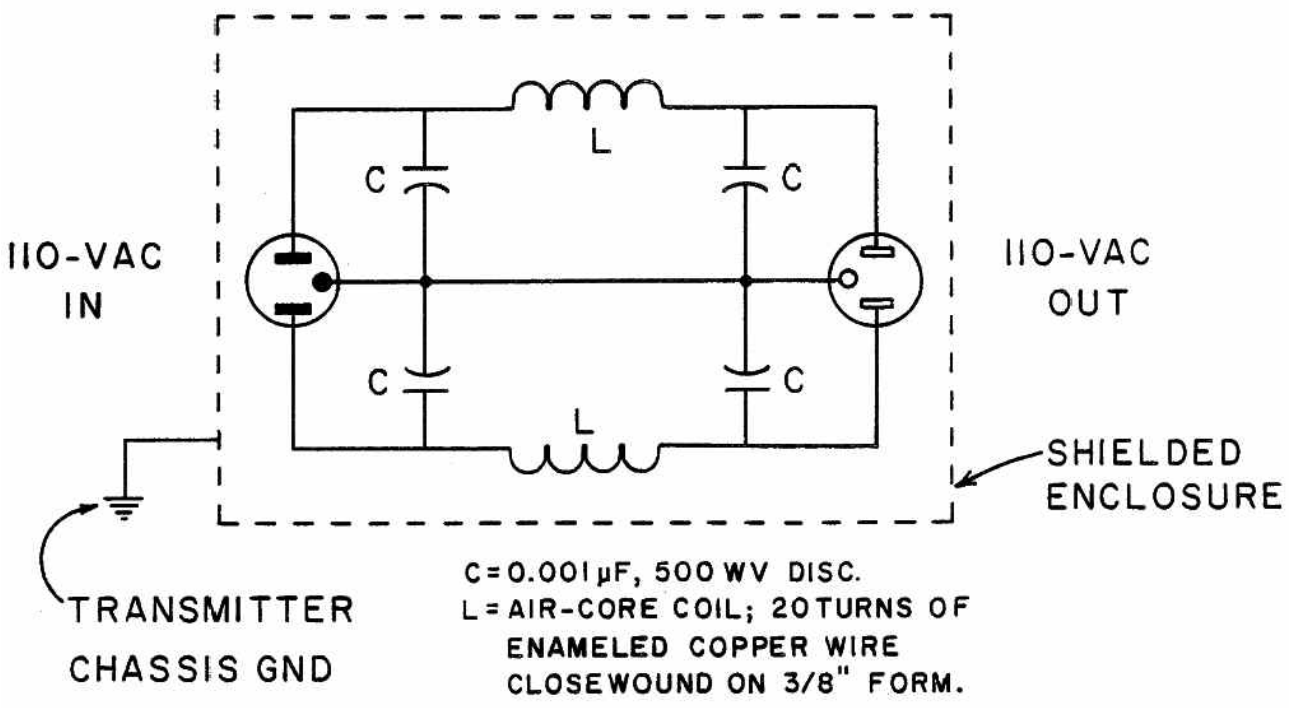
If operation into a dummy load does not significantly reduce the RF-related problems, disconnect all I/O cables from the CWR-670. Test the operation while it is connected only to AC power. At the same time, enable the transmitter so that it sends a CW signal into a dummy load. If RF problems are still present, then RF energy is probably being introduced to the CWR-670 through the power cord by way of the common AC mains power line. This is usually indicative of poor AC-line filtering in the radio transmitter power supply section. Figure 7A shows a common by-pass filter method used in many transmitters. Figure 7B shows a "brute-force" AC line filter that can be added to the transmitter or other equipment to eliminate the flow of RF on the AC power line.

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

The location of the transmitting antenna with respect to the radio room also has an affect on the RF energy that is coupled into interconnecting cables. Apartment dwellers may have the most difficulty achieving a good installation since many times an indoor antenna is the only type allowed. Where outdoor antennas are allowed, they should be placed as high as practical. Not only will this provide for better reception and transmission, but it will also reduce the level of RF in the shack. Also, if possible, avoid bringing an end of a half-wave dipole in close proximity to the operating position; there is a high voltage field at the ends of the dipole that may be hard to shield.



(A)



(B)

Figure 7 RFI Power Line Filter

In general, a shielded, coaxial cable feedline with low SWR is much preferred over open wire, twin-lead, or single wire feed systems. The self-shielding property and lower voltages present act to make the coaxial feedline much less susceptible to radiation of RF energy in the shack rather than at the antenna. RF energy may also be conducted back to the station by conduction down the outside of the coaxial cable shield. This may be a particular problem with half-wave dipoles on 40 and 80 meters that are center-fed with only coaxial cable. A balun at the antenna tends to reduce this problem. Also, dress the coaxial cable from the balun so that it drops perpendicular to the dipole, rather than parallel. In stubborn cases, you may find dropping the coaxial cable clear to the ground and burying it (5 or 6 inches) for the horizontal run to the shack may help reduce RF coupling considerably. This technique has worked particularly well for second-story station installations. As an alternate to the balun construction of an RF choke out of the Coax itself is sometimes

effective; wind six or more turns of the coaxial cable in a six inch diameter coil. Place the coil at the antenna and wrap it with electrical tape to hold its shape. If there is a moderate to high SWR on the line (2:1 or more), you may find that varying the length of the line helps, although this is a poor substitute for a properly matched antenna.

Experience has shown that the TV monitor itself may be a source or conductor of RF interference. Various circuits of the TV monitor (particularly the sweep circuits) can and do generate RF interference which may be heard in the receiver. Also, the video output to the monitor is a wide-bandwidth digital signal with rich harmonic content as is required to produce the crisp character display. If the TV set is poorly shielded (not at all in some plastic-cabinet models) or lacks proper power line by-passing, the RF from the monitor's circuits or from the video output may escape to cause receiver interference. Also, RF from the transmitter may enter the monitor and disrupt the monitor or CWR-670 operation. This may be quickly tested by simply disconnecting the video cable from the CWR-670. There is no substitute for good shielding and by-passing; metal cabinet monitors are highly recommended!

When the CWR-670 is used in a mobile or portable installation, trouble may be experienced from transients caused by the battery-charging system. These transients may be minimized by connecting the CWR-670 power cord directly to the storage battery terminals, avoiding connections to the vehicle's DC terminal block. Any voltage drop between the battery and terminal block may also include the transient spikes. It may be necessary to install additional filtering on the DC leads to the CWR-670 and some on automotive accessories (such as blower and wiper motors) to eliminate such problems. Consult the ARRL Radio Amateur's Handbook for more information.

The CWR-670 has been tested and is verified by HAL Communications Corp. to be in compliance with Part 15, Subpart J of the FCC Rules And Regulations, Class B computing device. The following text is a requirement of that regulation:

"This equipment generates and uses radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class B computing device in accordance with the specifications in Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- reorient the receiving antenna
- relocate the computer with respect to the receiver
- move the computer away from the receiver
- plug the computer into a different outlet so that computer and receiver are on different branch circuits.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful:

"How to Identify and Resolve Radio-TV Interference Problems."

This booklet is available from the US Government Printing Office, Washington, DC 20402, Stock No. 004-000-00345-4."



In addition, the following rear-panel label is located on the CWR-670 rear panel:

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

Also, the following FCC text applies to use of peripherals attached to the CWR-670:

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

## CHAPTER 4 – IN CASE OF DIFFICULTY

This section of your user's manual will discuss in general terms how to keep your CWR-670 in top operating condition and typical operating problems you might encounter (and some solutions).

### 4.1 Care and Feeding of Your CWR-670

Your CWR-670 is the latest of many generations of terminals sold by HAL Communications. In every way, it has been designed, constructed, and tested to assure years of trouble-free operation. However, there are a number of simple procedures that you, the user, can follow to further improve the reliability, performance, and lifetime of the terminal. The following suggestions are offered to help preserve a long operating life for your CWR-670.

#### Environment:

Electric equipment is very susceptible to variations in temperature, relative humidity, and to dust and dirt accumulations. The CWR-670 will operate in normal room-temperature environments and should be as tolerant of temperature extremes as you are while operating it. However, inadvertent blockage of the ventilating holes in the cabinet will cause the INTERNAL temperature of the terminal to rise considerably above the ambient room temperature and may in fact cause circuit failure. Also, accumulations of dust or dirt, particularly when accompanied by high humidity conditions, can also cause overheating and may result in long-term corrosion of the internal circuitry. Therefore, try to position the terminal so that its ventilating holes are not obstructed and try to avoid extremely dusty or dirty environments. On the other hand, the solid-state components in the CWR-670 are designed to operate at considerably higher temperatures than we humans; do not be overly disturbed if the cabinet of the CWR-670 (particularly the rear panel) operates quite warm to the touch. This internal heat often helps to "dry-out" humidity in the cabinet.

In the normal course of operation, the terminal and its display may attract a build-up of dust or smoke "haze". This may be expected even in the cleanest areas, particularly if tobacco smoking is prevalent. The display screen, because of the air flow around it and the high voltage applied to the CRT, actually attracts particulate matter from the air. This causes over a period of time what may appear to be a gradual fading of the screen intensity as well as de-focusing of the characters. Therefore, the face of the CRT should be cleaned often.

Be careful when cleaning any plastic parts as they scratch easily! Cleaning materials available for phonograph records are usually exceeded for cleaning plastic, but may not be strong enough to do the job if too much dirt has accumulated.

#### Electrical Connection:

All electrical connection points of the CWR-670 have maximum voltage and current ratings as given in this manual. If these ratings are exceeded for even a short period of time, considerable damage to the terminal may result. Therefore, be very careful KNOW the ratings of the CWR-670 and the characteristics of any other equipment before making connections. Some common causes of electrical failures have been found to be:

- A. Inadequate grounding, causing RF interference problems as well as sensitivity to AC power line transients.
- B. Damage from lightning, or other transients on the power line or station antenna system. A good lightning protection system may help, as will disconnecting the terminal during electrical storms. However, such things are unpredictable and the CWR-670 is no more susceptible to such problems than other electronic equipment in the station.

- C. Improper connections Co high voltage devices or to equipment with inadequate safety grounds. The CWR-670 does NOT include a high-voltage RTTY loop keying circuit and NONE of its rear panel jacks should be connected to high voltage loop circuits without the use of isolation devices such as optical isolators or relays. Be sure that all devices plugged into the AC mains have safety grounds attached to them. AC line by-pass capacitors in a piece of equipment may cause the cabinet of that equipment to "float" at an AC potential sufficiently high that damage might be done to the CWR-670 when the equipment is connected. **CONNECT THE GROUNDS FIRST – THEN CONNECT TO POWER!**

## 4.2 Typical Operational Problems

Because a large number of features are offered in the CWR-670, it is by nature a complicated device. Therefore, there may be times when it first appears that the terminal has either quit completely or gone off to "do its own thing". If some of the circuitry has failed, you may well get such symptoms. However, most often when a new owner finds the terminal "unresponsive", it is actually doing what it has been instructed to do. Familiarity with the CWR-670 controls will quickly reduce the chances of "cockpit error" during terminal operation.

The front panel switch positions are the best keys to what is happening in the CWR-670. Some of the more confusing conditions you may encounter are:

1. Be sure that the PAGE button is initially in the PAGE 1 position (button out). Newly received text is ONLY displayed on page 1 of the display. If page 2 is accidentally selected when power is first turned oil, no characters will appear on the screen for some time (until page 1 has filled up)!
2. The CWR-670 will only receive correctly if ALL the switches are set correctly. Refer to Chapter 2 for correct starting points for switch selection. The following are general guidelines:
  - a. CW RECEIVE: CW/RTTY - button out
  - b. RTTY RECEIVE: CW/RTTY - button in
  - ASCII/BAUDOT - select code (BAUDOT, usually)
  - LOCK-UOS ON - ON (button in)
  - NOR/REV - NOR (button out; if LSB used)
  - BAUD - select rate (45.5, usually)
  - SHIFT - select shift (170, usually)
  - FINE - "0" (center )
3. The RESET button will clear the entire receive display area, clear the printer output buffer, and clear the tape save buffer. Use this control carefully, but in preference to cycling the power off and back on.

## 4.3 Repair Procedures

In the event that your CWR-670 develops a malfunction, the first step is to carefully note all of the symptoms of the problem. Statements such as "BROKEN" or "DOESN'T WORK" are of little help to the service technician, and usually lead to longer repair times than might other wise be required. Try to provide as much information concerning the failure as you can before you contact your dealer. By all means, consult your dealer before calling the factory; he may be able to fix the unit locally and avoid the shipping and delay times.

The following are some of the things that will concern the dealer or factory:

1. Model number
2. Serial number
3. How long have you owned it?
4. Where did you purchase it (dealer's name)?
5. If purchased used, who was the previous owner? (Used to refer to any previous repair history on that unit.)
6. What terminal modes, rates, codes, and conditions are associated with the failure?
7. Are there extenuating circumstances? (Lightning, spilled liquids, dropped unit?)
8. Is the problem confined to a particular unit? (CWR-670, TV monitor?)
9. Is there anything else you can add to the description that you think might be useful?

AFTER you have determined answers to the above, contact your dealer and discuss the problem with him. If he indicates that he will be unable to assist you, the unit should be returned to the HAL factory for repair. Before returning the unit to the factory, either you or the dealer should call and receive factory return authorization so that we may expect the unit in shipping and be prepared to work on it when it arrives. Whenever possible, return the unit via UPS to the factory address below, insuring it for the full value. The shipping cost to the factory should be paid by you; the return shipping costs from the factory (48 contiguous states only) are paid by HAL (warranty repairs only). The factory "ship-to" address is:

HAL COMMUNICATIONS CORP.  
1201 W. KENYON ROAD  
Box 365  
URBANA, ILLINOIS 61901  
ATTENTION: REPAIR DEPARTMENT

The one-year limited warranty (listed in full at the end of this manual) provides for repair of the CWR-670 for a full year after purchase. The purchase invoice date from your dealer marks the beginning of the warranty period save your copy of the invoice! Please read the warranty carefully to determine the full extent of the privileges and limitations.

#### 4.4 User Adjustments

Because of the complexity of the circuitry used in the CWR-670, we do NOT recommend that you personally undertake repairs of the terminal circuit board. However, there are a number of alignment procedures that you may undertake if you have the test equipment available. DO NOT UNDERTAKE ANY ADJUSTMENTS UNTIL YOU ARE SURE THAT UNDERSTAND THE ENTIRE PROCEDURE! If in doubt, don't do it! (Ask your dealer or the factory for help.) The recommended minimum best equipment is:

1. Audio Frequency Counter high impedance input, 1 V or better sensitivity, count to 1 MHz or higher.
2. Audio Frequency Oscilloscope - high impedance input, 1 V or better sensitivity, 1 MHz or greater bandwidth.
3. Volt-Ohm-Milliammeter (VOM) - 20 k $\Omega$ /Volt or higher.
4. Audio Frequency Oscillator - 500 ohm impedance, 10 mV to 1 V rms output , 500–3000 Hz adjustable frequency.

A simplified layout drawing is shown in Figure E that gives the locations of various variable resistors (VR-*n*), test points (TP-*n*) and user jumper locations (JP-*n*). Note that there are numerous additional jumper locations on the circuit boards that should not be disturbed from their factory settings.

The following adjustments are located on the circuit board; it is NOT necessary to remove the circuit board to make these adjustments. You will, however, have to remove both the top and bottom covers of the CWR-670. Be careful to avoid misplacing any of the sixteen black screws that fasten the covers in place they are metric and not easily replaced! Use a good No. 2 Phillips screw driver (NOT No. 1 or smaller). The diagram in Figure 8 shows the board AS VIEWED FROM THE FRONT PANEL.

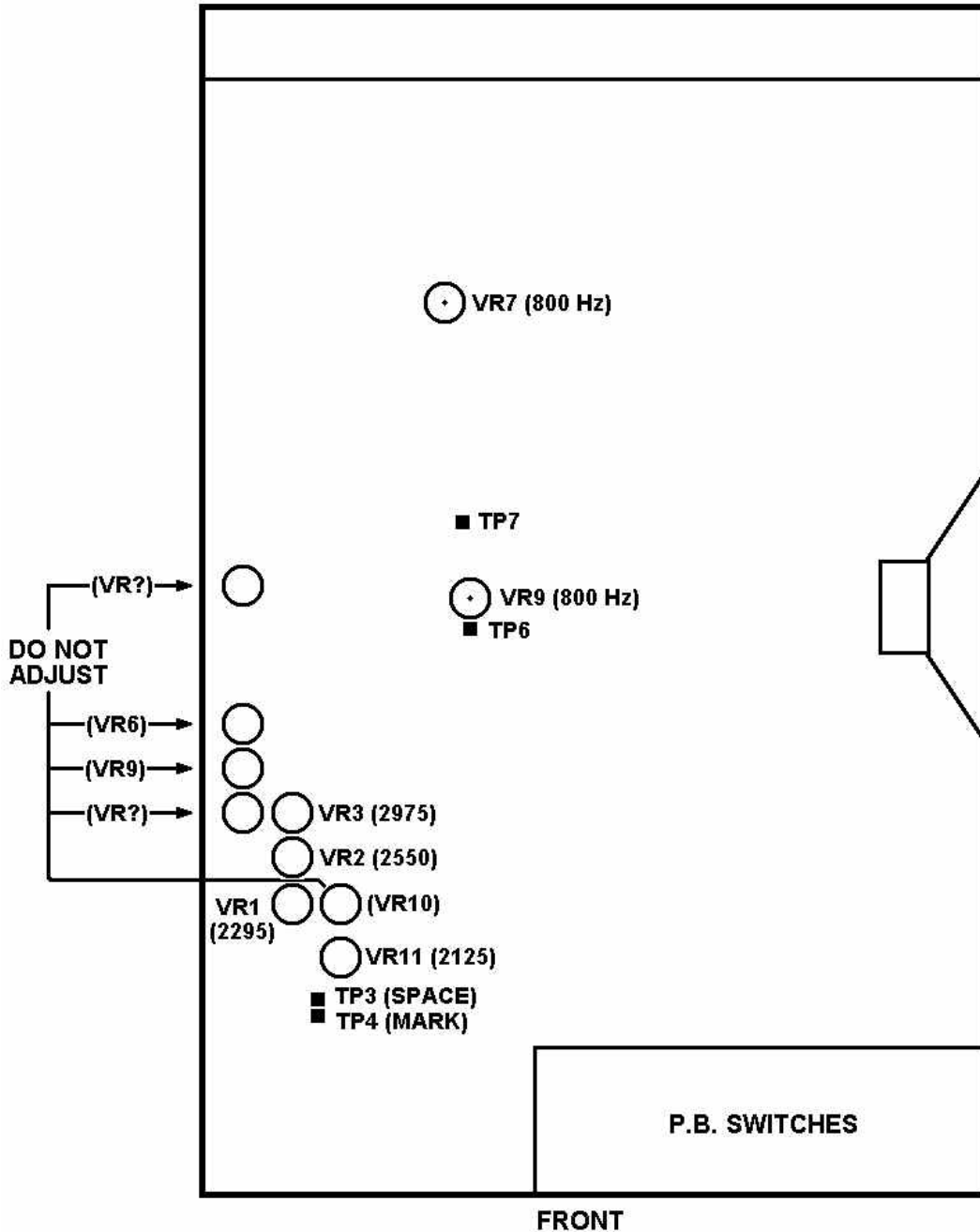


Figure 8 Test Points and User-adjustable Controls

1. Set CW Receive Filters:

Set-up follows:

1. Set the front panel CW/RTTY switch to CW, turn-on the power switch, and do NOT connect any signals to the CWR-670 INPUT connectors.
2. Connect an audio frequency counter to TP-7 and adjust VR-9 for a counter reading of 800 Hz.
3. Disconnect the counter from TP-7 and connect it to the output of the audio frequency test oscillator. Set the oscillator frequency to 800 Hz and amplitude to 1.0 V<sub>PP</sub> (approximately).
4. Connect the test oscillator output to the INPUT-AF connector of the CWR-670.
5. Connect an oscilloscope to TP-6 and adjust it for a stable trace.
6. Adjust VR-7 for a maximum amplitude oscilloscope trace (standard level is 2.5 V<sub>p-p</sub> ±0.3V).
7. This completes the set-up of the CW section of the CWR-670. Disconnect the test equipment from the unit.

2. SET RECEIVE RTTY FILTERS:

Set-up as follows:

1. CW/RTTY switch to RTTY
2. BAUDOT/ASCII switch to either position.
3. FINE control to "0" (center)
4. Connect the audio oscillator output to the counter and to the INPUT-AF connector of the CWR-670. Set the oscillator frequency to the frequency indicated below.
5. Connect oscilloscope to TP-3 or TP-4 as indicated
6. Open or short JP-4 as indicated (as in steps 2 & 3).

OSC. FREQ	SHIFT SWITCH	TEST POINT	JP-4	ADJ FOR MAXIMUM
2125 Hz	any	TP-4	OPEN	VR-11
2295 Hz	170	TP-3	OPEN	VR-1
2550 Hz	425	TP-3	OPEN	VR-2
2975 Hz	850	TP-3	OPEN	VR-3

These are the ONLY user-adjustable controls in the CWR-670. Please do NOT attempt readjustment of any other controls or use of any jumpers not mentioned in the above discussion. If your CWR-670 still exhibits problems or cannot be adjusted as explained, please contact your dealer or the factory for more information. The complete schematic diagram of the CWR-670 is available from HAL Communications Corp. for \$5.00, postage paid in the continental U.S.

**CHAPTER 5 – SPECIFICATIONS**INPUT/OUTPUT:

AUDIO INPUT:	40 mV to 2 V rms, 8 ohm audio 800 Hz for Morse receive 2000–3000 Hz for RTTY
TTL	Standard TTL data interface levels; Mark $\geq +2.7$ V Space $\leq +0.6$ V (= CW key down)
SCOPE OUTPUTS: (OSCILLO)	Separate mark and space connections for crossed ellipse indication on X-Y scope display. Voltage = 1.0 V <sub>PP</sub> typical, 200 k $\Omega$
ASCII PRINTER:	Parallel, Centronics compatible printer output. Received and transmitted text may be printed on the ASCII printer, regardless of code.
VIDEO OUT:	RS170 standard composite video output; 1.0 V <sub>PP</sub> , 72 ohms

DATA CODES AND RATES:

BAUDOT CODE:	U.S. Standard 5-level International Telegraphic Alphabet No. 2 Baudot Code with 1 unit start and 1.5 unit stop bit (CCITT No. 2)
ASCII CODE:	American National Standard Code for Information Interchange (ASCII) as defined by ANSI Standard X3.4-1968. 8 unit code with 1 unit start pulse; 2 unit stop pulse (ISO/CCITT No. 5)
RTTY DATA RATES:	Baudot or ASCII codes may be received at 45.45, 50, 56.88, 74.2, 110 and 300 baud
MORSE CODE:	Continental Morse Code including all letters, numbers, period, comma, colon, dash, apostrophe, parentheses, quote, question mark and AA, AR, AS, BT, KN, SK, and error prosigns. Receive speed automatically tracks from 5 to 40 wpm speeds.

MODEMS:

MORSE:	AF Active filter and Phase-lock loop filler; 800 Hz nominal center frequency
RTTY TONES:	Mark = 2125 Hz Space = 2295 Hz (170 Shift) = 2550 Hz (3425 Shift ) = 2975 Hz (850 Shift)

DISPLAY:

- SCREEN FORMAT: 16 lines of 32 characters per line; two pages may be selected for viewing.
- CHARACTERS: Full upper and lower case letters, all numbers and punctuation of the ASCII character set.
- SCROLL: Received text is displayed on bottom line of receive area of screen; new text scrolls upward.

INDICATORS:

- LED: Four LEDs indicators show MARK, SPACE, Morse center tuning (CW), and Power indicator.
- SCOPE: Rear panel connections to vertical and horizontal amplifier inputs of an X-Y oscilloscope for conventional crossed-loop indication (Oscilloscope NOT included with CWR-670)

FRONT PANEL CONTROLS:

- |                        |  |  |
|------------------------|--|--|
| CONTROLS:              | VOLUME:<br>FINE:   | Volume control for received signals<br>Fine tuning of RTTY space filter center frequency; "0" center for optimum.  |
| PUSHBUTTON<br>SWITCHES | CW/RTTY<br>BAUDOT<br>ASCII<br>SHIFT<br><br>BAUD<br><br>RESET<br><br>PRINT<br>U.O.S.<br><br>REV.<br><br>CASE<br><br>PAGE: | Select between CW or RTTY reception.<br>Select Baudot RTTY code.<br>Select ASCII RTTY code<br>170: Select 170 Hz RTTY shift<br>425: Select 425 Hz RTTY shift<br>850: Select 850 Hz RTTY shift<br>45.5: 45.45 RTTY baud rate (60 wpm)<br>50 : 50.00 RTTY baud rate (66 wpm)<br>57 : 57.00 RTTY baud rate (75 wpm)<br>75 : 74.47 RTTY baud rate (100 wpm)<br>110 : 110 RTTY baud rate (10 cps)<br>300 : 300 RTTY baud rate (30 cps)<br>(wpm = words-per-minute)<br>(cps = characters-per-second)<br>Erase receive screen, return cursor to initial receive position, clear printer output register, reset CW receive<br>Turn external printer on or off<br>Activate Unshift-on-space feature for Baudot RTTY only – no action for CW or ASCII RTTY.<br>Reverses the sense of received RTTY signals – no action for CW.<br>Changes Baudot case from LTRS to FIGS or FIGS to LTRS – no action for CW or ASCII RTTY<br>Select display page 1 or page 2. |



## REAR PANEL CONNECTIONS:

PRINTER, EXT SP, DISPLAY (2 connectors), OSCILLO SPACE, OSCILLO MARK, INPUT TTL, INPUT AF, 13.8 VDC, INPUT SELECT TTL/AF switch.

## MECHANICAL SPECIFICATIONS:

CWR-670:	8.00" W × 2.85" H × 12.6" D 20.3 cm × 7.24 cm × 32.0 cm Color: Tan top and bottom; silver front panel; red, blue, gray, white, and black switch buttons
WEIGHTS	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., 11 Watts

### CWR-670 DISPLAY FORMAT

TOTAL DISPLAY CAPABILITY:

LINE NO.	DISPLAY CONTENT	
32	.....	.....
31	.....	
30	.....	
29	.....	
28	.....	
27	.....	
26	.....	
25	.....	
24	.....	PAGE 2
23	.....	
22	.....	
21	.....	
20	.....	
19	.....	
18	.....	
17	.....	
16	.....	.....
15	.....	
14	.....	
13	.....	
12	.....	
11	.....	
10	.....	
9	.....	
8	.....	PAGE 1
7	.....	
6	.....	
5	.....	
4	.....	
3	.....	
2	.....	
1	■.Receive cursor starts here....	.....

**NOTES:**

1. For clarity of display, when power is first applied, characters are displayed from the top of the screen down for the first 16 lines of display. Thereafter, newly received text is always displayed on the bottom display line of Page 1 and the display is shifted up as each new line is received.
2. The square cursor symbol (■) always shows the screen location at which the next received character will be displayed.

## LIMITED WARRANTY

HAL Communications Corp. of Urbana, Illinois, hereby warrants to the original retail purchaser only that the product herein described and sold shall be free from defects in materials and workmanship for a period of one year from the date of sale to the original retail purchaser.

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

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

1. Notify, as soon as possible, the Customer Service Department of the original selling dealer or HAL Communications Corp., Box 365, Urbana, Illinois, 61801, either in writing or by telephone, of the existence of a possible defect.
2. At the time of notification, identify the model and serial number, date of purchase, place of purchase, and the possible defect.
3. Hold the unit until a written return authorization is received.
4. Return the unit freight prepaid, upon the receipt of the written return authorization with a copy of the original bill of sale for the equipment.

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

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

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

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

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

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