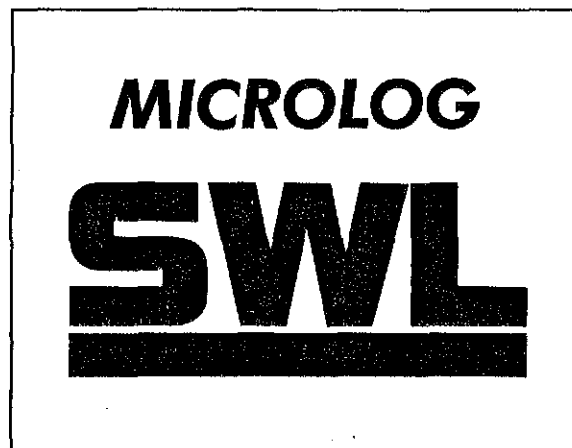# RADIO INTERFACE CARTRIDGE FOR THE COMMODORE 'C-64'

Complete terminal with software in permanent ROM for Receiving RTTY and MORSE Code.

MICROLOG
SWL

INTRODUCTION

0.0   INTRODUCTION

Welcome to the world of digital communications. Your new "SHORT-WAVE-LISTENER" will turn your computer into a complete listening post for those undecipherable coded signals you've heard.

Note, the cassette provided with the SWL is *not* a program — it is to be played on a standard audio type recorder for demo purposes.

If you're new to radioteletype and coded signals, the following information will greatly aid in the enjoyment of your new receiving capability.

0.1   As you know from listening on the short-wave bands, there is a myriad of beeps, squeals and other mysterious sounding signals along with normal voice broadcasts to be heard. A lot of these signals are not MORSE or RTTY (RadioTeleTYpe), and are not copyable with the "SWL." Time code, fax, and navigation signals sound like RTTY, but require specialized equipment designed to process that type of signal. The good news is that the really interesting stuff is transmitted using methods the "SWL" was designed to copy.

You've probably noticed that as you tune your radio in the SSB/CW mode (or with the BFO on) the sound you hear varies in pitch (frequency). The "SWL" detector circuits are listening for tones around 800 Hz (about 1 octave above middle C). By moving the tuning dial on your radio, you can adjust the sound for exactly the right pitch. Simply watch the on screen tuning indicators or use the pitch reference tone heard through your video monitor's audio channel. More on that in Section 4 and 5.

Almost all forms of digital communications in use today involve transmitting a binary pattern of "one's" and "zero's", arranged in such a way as to uniquely represent a number, letter or punctuation. The simplest form of digital communications is of course, MORSE code. Each character has its own pattern of long and short pulses, heard as a dot or dash tone in the radio.

Radioteletype arranges the "one's" and "zero's" a little differently. Instead of "tone/no-tone," it uses two different tones (pitch). Tuning is similar and just as easy. The trick is to tune the radio for the proper pitch sound. As mentioned earlier, a lot of signals "sound" like radioteletype but actually aren't. If you just start tuning the shortwave bands blind, you'll probably be disappointed. Essentially, you have to

know where and when to tune and what to look for. Several good publications are noted in Section 4 that show stations around the world along with time and frequency. A few stations are also listed for you to try. There are several parameters of a RTTY signal that must be known in order to copy it. The information is sent using two tones. You must know also:

1. The code or method of arranging the "1's" and "0's"

2. The speed or rate of information transmission

3. The shift, or separation between the tones

4. The sense, or which tone is the "1" and "0"

Although these look like a lot of variances, there are industry standards for each parameter limiting the number of possibilities to only a few. We'll look at these individually.

0.1.1 Code

There is generally only one code in use on the shortwave bands; the Baudot (pronounced "Baw Dough") code. Occasionally you'll find some ASCII in the amateur radio bands, but even there, Baudot is most prevalent. This is the code that the "SWL" will copy when first turned on.

0.1.2 Speed

There are 5 standard speeds of Baudot (60–66–75–100 and 132 words per minute) only two of which are in common use. Amateur operating is usually 60 wpm. Occasionally you'll find a little 100 wpm. Commercial RTTY is usually either 66 or 100 wpm.

0.1.3 Shift

There are three standard shifts or differences between the tones, 170, 425 and 850 Hz. Amateur operation is almost exclusively "narrow" shift, 170 Hz (width switch on SWL in "narrow" position). Commercial uses "wide" shift either 425 or 850 Hz, (switch in "wide" position).

0.1.4 Sense

This parameter is described as being either "normal" or "inverted" and refers to which tone is defined as the "0" or "1" of the code in use. With your radio in the lower sideband, "normal" will put the tones in the proper sense. If the transmitting station is listed as sending "inverted" you can "invert" your copying logic by a simple keyboard command. See Section 4 for more discussion.

0.2 RADIO FREQUENCY INTERFERENCE

Modern military computerized communications equipment is housed in heavy metal enclosures. Mechanical durability is the primary reason. A secondary but not so obvious reason is to keep radio frequency energy from radiating from within or penetrating to the sensitive internal circuits. With encrypted data, the main concern is radiation and subsequent interception of the "clear" data from the box. Unfortunately, home computer equipment must meet only minimal interference specs to qualify for consumer sale. Simply put, home computers can generate radio frequency signals from their circuitry that may be picked up on a short-wave receiver. They'll sound just like real radio signals and may even have a buzzing "jammer" like quality. We have taken steps in the design of the "SWL" to eliminate these "leakage" signals, but there are certain conditions where you might have some interference. To verify that it really is the computer making the noise, simply shut it off. If the signal is still there, it's not coming from the computer! Here's a list of some hints in setting up your listening post.

1. Don't use the radio's internal whip antenna or a short wire (10–20') tied directly to the external antenna input. The close proximity to the computer and relative inefficiency of the short antenna combine to almost guarantee you'll hear some computer noise. Use coaxial cable (RG-58/U available at Radio Shack) to get the antenna out of the "near field" of the computer. Make the antenna as long as is practical, 25' to 100' or more and orient it away from the computer/radio room. Use a coaxial connector on the radio end and just snip the coaxial cable braid (outer shield wires) up at the antenna feed point. Connect the center conductor only to the antenna wire. Use of a "dipole" type antenna is also quite acceptable.

2. Don't use "amplified" antennas, short whips with integral high gain pre-amps for the same reasons as above, unless the actual antenna is at least 50' from the radio/computer.

3. It's always helpful to provide a good ground for the radio. This may well be accomplished by a 3-wire grounded line cord. If the radio is battery operated, or uses a 2-wire ac line cord, you should run a separate chassis ground wire to a cold water pipe or outside ground rod.

4. Sometimes physically changing the position of the radio, computer and video monitor can signficantly alter extraneous pick-up.

CHAPTER 1
'SWL' PRELIMINARY CHECKOUT

After unpacking your unit, make sure that power to the computer is turned off, then plug the 'SHORTWAVE LISTENER' cartridge into the "expansion port" (The same one used for game and memory expansion modules), so that the label is on top, facing up. Turn on the computer and video monitor. The word "MICROLOG" will appear on the screen for several seconds then the following "TOPLINE" display should appear on the video screen.

R   B   060WPM   NOR   U   00:00   UTC

This indicates that the system is set to receive (R) Radio teletype, using Baudot (B) code at 60 WPM, and that the built-in dual tone demodulator is selected in the Normal (NOR) mode, with the "UN-SHIFT on SPACE" feature enabled (U). A four digit HH:MM clock which should start advancing is displayed with flashing colon. UTC is the time zone displayed until you change it.

The "Split Screen" cursor will be displayed in the left center of the screen in white. The receive text cursor will be at the bottom left screen in yellow. If using a monochrome (black and white) TV/monitor, colors will appear as shades of gray.

In the event that the above does not appear on your video monitor's screen, check the cable between the computer and the TV monitor to make sure that it is not shorted or open. You may also have to adjust the TV monitor's various controls such as brightness, contrast, etc. Some monitors provide a switch which selects a low or high impedence input. You should select the low impedence (75 OHM) input. Also, if your monitor has a "PICTURE-DATA" switch it should be in the "DATA" position. Connections to a standard television are exactly the same as when using the computer.

DEMO TAPE NOTES

A standard audio cassette is included with your "SWL" cartridge. It is *not* a program — do not try to "load" this tape. It is a demo of the SWL's receiving capability and should be played on a normal audio cassette player. Connect the earphone or external speaker output of the

recorder to the SWL's "speaker/earphone" jack. Start the tape, gradually increasing the volume until the SWL starts to copy the text from the tape and display at the bottom of the video screen. Don't turn the volume up too high because it will overdrive the SWL's tone detector circuits and make mistakes in the copy. Make sure the nar. wide switch on the SWL is in the wide position.

CHAPTER 2
'SWL' SYSTEM
FAMILIARIZATION

2.1 KEYBOARD:

Your "64" keyboard has a total of 67 keys including all of the familiar Alpha-Numeric keys. In addition there are special symbol keys, and two keys, namely 'SHIFT' and 'CTRL' which are always used in conjunction with another key. The SHIFT key(s) are located on the bottom row and the CTRL key is located on the left side above the RUN/STOP key.

Note that some of the key tops have two symbols. For example, the 4 and the $ symbols are engraved on the same key top. Much the same as in a standard typewriter you must hold the SHIFT key down while pressing the 4 key in order to type the $ symbol. The CTRL key is used in a similar manner.

In the following description, references are made to various control functions or commands. These commands are executed by simultaneously pressing the CTRL (or SHIFT) key plus one other key. For example, a request to press (or type) 'CTRL X' means that you must hold down the CTRL key, and while holding it down, press the X key, then release both keys. Similarly, to type or press 'SHIFT X' means that you should hold down the SHIFT key, and while holding it press X. As soon as the X key has been pressed you can release both keys.

After familiarizing yourself with the location of the various symbols on the keyboard, type some Alpha-Numeric text. Observe that the characters you have typed are displayed on the upper part of the screen above the split-line. The 'INST/DEL' key which is located on the right side of the top row may be used to correct typing errors. Notice that typing 'INST/DEL' erases the previously typed character.

You can go to the "BASIC" computer mode by typing 'CTRL' and Commodore keys. Since you are then under the restraints of "BASIC" language, to go back to SWL communication mode you must type: SYS 32777 then the 'RETURN' key (64 Basic memory shows 30719 bytes free with 'SWL' installed. Some programs that need the full 38911 bytes of memory will require that you unplug the 'SWL'. Be sure to disconnect the cable to your radio first and *always* turn off the computer before unplugging the 'SWL'.)
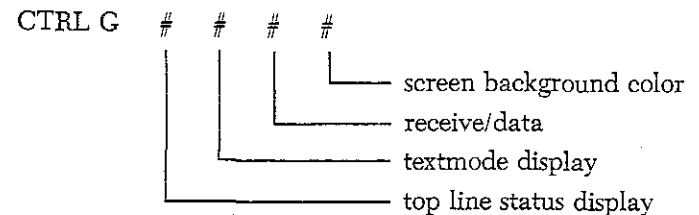
2.2 VIDEO DISPLAY COMMANDS:

The split-screen option is user selectable. The 'CTRL S' command is used to toggle the split-screen screen on and off. To remove the split-screen and use the entire video display for receive text,

TYPE: 'CTRL S'   (HOLD 'CTRL' KEY AND PRESS 'S')

2.2.1 COLOR CHANGES:

The screen and text colors can be changed with a single control command. "CTRL G" followed by a 4 digit number will change the following:

```
CTRL G   #   #   #   #
                     └──── screen background color
                 └──────── receive/data
             └──────────── textmode display
         └──────────────── top line status display
```

The #'s are the same as the 64's color codes as shown on page 139 of the 64 manual with one exception. To utilize a single digit for all 16 colors, you must enter it in "Hexadecimal" that is 0 through F instead of 0 through 15. The colors are as follows:

0 = Black	8 = Orange
1 = White	9 = Brown
2 = Red	A = Light Red
3 = Cyan	B = Dark Gray
4 = Purple	C = Med Gray
5 = Green	D = Light Green
6 = Blue	E = Light Blue
7 = Yellow	F = Light Gray

The colors will change upon typing the forth digit. Note: The default colors are:

(6)	Blue	Top line
(1)	White	Text buffer
(7)	Yellow	Receive data
(E)	Light Blue	Screen

These colors were picked as the best compromise for both color and monochrome display. You can experiment with different color patterns to suit your individual requirements. Suggestions: 0657, 1AE0, 192A, 569D, 062C.

Note also, the tuning indicators and the RX buffer flags are always displayed in red.

You can move the entire video display horizontally with the CTRL H command. This should take care of monitors with limited horizontal sync tracking range.

2.3 TEXT/RCV COMMANDS:

The text mode is useful for inserting your own notes in the printed copy off the air and for familiarizing yourself with the sound of the various codes. It also makes a great "letter writer" too, if you have a printer connected.

Typing 'SHIFT RUN/STOP' or 'SHIFT RETURN' (hold 'SHIFT', press 'RUN/STOP') places the system in the text mode. Observe that the top line display has changed and is now displaying:

T   B   0 6 0 W P M   N O R   C H A R

indicating that the system is now in the Text Mode (T), and that each character will be sent as it is being typed (CHARacter mode). Type some Alpha-Numeric text and observe that the typed text is displayed above the split-line and also below the split line. The text which is displayed below the split-line represents the actual text as it is sent. The text which is displayed above the line represents the entries into the system's text buffer.

Return the system to the receive mode with the RUN/STOP key by itself or by typing 'CTRL CLR/HOME' (hold the 'CTRL' key and press the key labled 'CLR/HOME'). Observe that the top line display has changed indicating that the system is in the Receive mode. Type in some text and note that it is no longer displayed below the split line.

2.4 SPEED SELECTION COMMANDS:

NOTE: the right hand bracket] is the symbol for a terminated command sequence which required further keyboard input such as speed select or memory store. When you first initiate these commands, you should not see anything on the screen. If you see the '] ' it means that particular command has been terminated. Hitting 'CTRL X' twice for example will only terminate the command without it taking affect.

The operating speed (RTTY and MORSE) is selected by means of the 'CTRL X' command. The allowable RTTY BAUDOT speeds are 60, 66, 75, 100, and 132 WPM. ASCII code speeds are 110 and 300 baud. For MORSE, speeds from 5 to 99 WPM are permitted. To select an RTTY (BAUDOT) speed of 66 WPM (SAME AS 50 BAUD), first type 'CTRL B' if not in BAUDOT already, then:

TYPE: 'CTRL X'	(SPEED SELECT COMMAND NOTHING SHOWS ON THE SCREEN)
TYPE: 66	(DESIRED SPEED)
TYPE: 'CLR/HOME'	(OR ANY NON-NUMERIC KEY PRINTS])

Observe that the top line displays

R   B   0 6 6 W P M   N O R

To select an RTTY (BAUDOT) speed of 100 WPM (same as 75 baud),

TYPE: 'CTRL X'
TYPE: 100
TYPE: 'CLR/HOME'

Observe the speed display on the top line is now 100 WPM.

To select an RTTY (ASCII) rate of 110 baud,

TYPE: 'CTRL A'

System will automatically go to 110 BAUD when ASCII is selected.

Observe that the top line displays A-110 BD (BAUD) where the 'A' indicates that the selected code is ASCII.

To select an RTTY (ASCII) rate of 300 baud, (no need to type 'CTRL A' since you are already in ASCII)

TYPE: 'CTRL X'
TYPE: 300
TYPE: 'CLR/HOME'

Note, if you are in 300 BAUD ASCII, to change to any other speed or code, you must first go to 110 BAUD ASCII. The jump from 300 BAUD ASCII to MORSE or BAUDOT directely is not allowed.

Go back to RTTY (BAUDOT) speed of 60 WPM (Same as 45 baud),

TYPE: 'CTRL B'
TYPE: 'CTRL X'
TYPE: 60
TYPE: 'CLR/HOME'

(ASCII stands for American Standard Code for Information Inter-

change, whereas 'BAUDOT', pronounced 'BAW DOUGH' is a man's name.)

NOTE, you can omit the 'CLR/HOME' key if you enter the speed with three digits, 110, 066, 075 etc., since the program automatically terminates the command on the third digit.

2.5 MORSE/TTY SELECT COMMANDS:

Enter the MORSE mode by typing 'CTRL M' (hold 'CTRL', press M) and the top display line should read:

R   M   0 2 0 W P M   N O R

indicating MORSE (CW) mode with speed set for 20 wpm. The system will remember the previous MORSE and RTTY speed when changing to and from modes. Go to the text mode by typing 'SHIFT RUN/STOP' and observe that the display has changed and the letter 'T' has replaced the 'R' on the left top display line. Turn up your audio channel volume, and type in some letters and numbers. You will hear the MORSE code as it is displayed below the split-line. To change the speed use the 'CTRL X' command. Also, when the text buffer is empty, if desired, the MORSE equivalent of a "diddle", BT, can be sent. Type 'CTRL D' to toggle the "diddle" mode on/off. To select a MORSE speed of 17 words per minute,

    TYPE: 'CTRL X'
    TYPE: 17   (NEW SPEED)
    TYPE: 'CLR/HOME'   (OR ANY NON-NUMERIC KEY)

Observe that the newly entered MORSE speed is now displayed on the top line. Any MORSE speed from 5 to 99 WPM may be selected.

NOTE: In the receive mode, the displayed MORSE speed will usually be within plus or minus one digit of the speed you set since this is an "averaging" parameter. As you receive some MORSE characters, the receive speed readout will track the incoming speed, (assuming speedlock is not enabled) but will not change the selected text mode transmit speed.

Return the system to BAUDOT TTY mode by typing 'CTRL B'. The top line should display,

R   B   0 6 0 W P M   N O R

2.6 CLOCK COMMANDS:

The SWL includes a real time clock with a 4 digit display of hours and minutes, and a 3 character time zone. When the unit is first turned on the clock is reset to 00:00. You can set the clock to start at any time by means of the 'CTRL K' command. For example, initialize the clock to start at 1758GMT,

    TYPE: 'CTRL K'   (CLOCK SET COMMAND—CLOCK
                           DISPLAY WILL FREEZE)
    TYPE: 1758GMT   (DESIRED TIME AND ZONE)
    TYPE: 'CLR/HOME'   (THIS STARTS THE CLOCK)

The clock will be restarted at 1758GMT as soon as you hit the 'CLR/HOME' key (or any non-numeric key) and the video line will display:

                    17:58   GMT

The clock obtains its timing reference from the CPU Crystal frequency and should maintain good accuracy. The clock will have to be reset if power is lost.

The system's clock time can be inserted in the text buffer by means of the 'CTRL C' command. Type 'CTRL C' and observe that the clock time is displayed on the lower half of the screen if you are in the text mode. If you turn up the monitor volume, you can hear the code being sent.

2.7 MEMORY STORE/RETRIEVE COMMANDS:

The SWL includes a number of user programmable memories. These are useful for storing phrases and comments that are used often. There are 8 message memories of 512 characters each, 2 ID memories of 64 characters each and 2 Selective print memories of 11 characters each. You can store messages at any time, even during a text print.

You can store your name or date into the ID memory by means of the 'CTRL £' command. For example, to store the date, 19 Oct 85,

    TYPE: 'CTRL £'   ('HOLD CTRL' AND PRESS '£' KEY
                           NOTHING SHOWS ON SCREEN)
    TYPE: 'SPACEBAR'   (PUTS A WORD SPACE)
    TYPE: 19 OCT 84
    TYPE: 'CLR/HOME'   (EXITS MESSAGE STORE MODE
                           PRINTS])

As you type the date in, it will be displayed above the split-line. You can correct typing errors by means of the 'INST/DEL' key. To

retrieve and send the stored date simply press the '£' key. The date previously stored will be inserted into the text buffer for transmission and displayed above the split-line.

You can store a second short phrase or call sign by using the CTRL I command. For example, to store the call sign K3ICH/4,

TYPE: 'CTRL I'
TYPE: 'SPACEBAR'
TYPE: K3ICH/4
TYPE: 'CLR/HOME'

This memory will be set by pressing 'SHIFT £' with a "space" preceding it.

To store a message into any one of the 8 available message memories you must first type 'CTRL', and memory number (1 to 8), then enter the message text, and terminate by typing 'CLR/HOME'. For example, to enter: "RECEIVER — DRAKE R7" into memory number 1,

TYPE: 'CTRL 1'(HOLD 'CTRL', PRESS '1')(NO DISPLAY)
TYPE: RECEIVER — DRAKE R7 (TEXT DISPLAYS)
TYPE: 'CLR/HOME' (SHOWS ']' ON SCREEN)

To send this stored message, simply press and release the 'F-1' key (right hand function keys). In a similar fashion you can store and retrieve messages from the other 7 memories.

If your message is longer than the selected number of characters it will simply overflow into the next message memory location. For example, if you store a message that overflows into memory 2, it will be properly retrieved in its entirety by typing 'F1'. If you type 'F2', you will retrieve the last remaining characters of the message, which overflowed into 'F2'.

You must use the 'CLR/HOME' key, or any 'CTRL' key to terminate and exit the message store mode. If you do not, you will continue to store characters until you have filled the entire message buffer.

Normally, each of the user programmable memories in the SWL is 512 characters, which leaves about 28,000 characters for the text buffer. By typing CTRL '< >' (up/down cursor) you can create a receive buffer of 14,000 characters. Typing the same key '< >' by itself will send this new memory.

You can also recall and send two permanently programmed messages. Pressing 'CTRL' followed by the "Q" key, will recall the

"QUICK BROWN FOX . . . " message, and following the "CTRL" by the "R" key, will recall the "RYRYRY . . . " message.

The two selective print memories can store up to 11 characters each. These are entered exactly as for the first 8 memories except that you access these memories by typing 'CTRL 9' and 'CTRL 0 ' respectively.

When the system 'hears' the specific string stored into the "9" memory, the printer port will be enabled, and when it 'hears' the string corresponding to the one stored in "0 " memory, the printer port will be disabled. Manually typing 'CTRL P' or 'CTRL V' also enables/disables the printer port. See Chapter 6 for more info.

To display the current contents of these memories press 'CTRL >' (period key). The contents of the "9" memory are shown next to PON: (printer on), and the contents of the "0 " memory are shown next to POFF: (printer off).

The " = " memory contains the WRU (Who aRe yoU) KEYWORD, shown next to WRU. This function is only used in the transmit/receive version of this program.

See Section 7.2. for information on creating 'OFF-THE-AIR' Receive Memory.

2.8   TEXT MODE COMMANDS:

The program has a number of transmission modes. In the CHARacter mode (this is the system default mode), each character is sent as it is typed. In the WORD mode, an entire string of characters is transmitted as soon as the spacebar key is pressed. In the LINE mode the typed characters are transmitted as soon as the 'RETURN' key is pressed. The WORD and LINE mode are only used in the transmit version of this program.

2.9   TEXT EDITING COMMANDS:

The SPLIT-SCREEN option lets you see what you type, and allows you to correct typing errors before they are sent to the printer. If you are in the text mode, you can enable the WORD or LINE mode as explained above.

You can correct typing mistakes by pressing the 'INST/DEL' key. Pressing this key will cause the previously entered character to be erased and you can correct it. Each press of the 'INST DEL' key will erase one character.

The entire text buffer may be cleared at any time by typing 'CTRL CLR /HOME'. This will also clear the screen and place the system in the receive mode.

You can repeat a segment of text by means of the '←' key. To repeat the printing of a text segment first type 'SHIFT ←' (press the 'SHIFT' and '←' keys). This serves to point to the beginning of your text. Now enter your text, which will be printing if you are in the text mode. Press the '←' key and the text will be repeated. Press it again and it will be repeated for the third time.

CHAPTER 3
'SWL' RADIO
CONNECTIONS

The SWL provides all of the interfaces required for direct hookup to your receiver. For the following description refer to the rear connection diagram below.

3.0   AUDIO INPUT:

Audio from your receiver is connected to the SPKR/EARPHONE AUDIO jack on the SWL. Connect the shielded cable provided between the EARPHONE or external speaker output of your receiver and the SPKR EARPHONE input on the SWL. You will note that there are two "SPKR EARPHONE" phono jacks on the SWL. These are connected internally on the board. This allows you to plug one cable from your radio to the SWL, and one cable out to your external speaker or headphone, eliminating the need for a "Y" connector. Refer to the diagram showing the SWL rear connections.
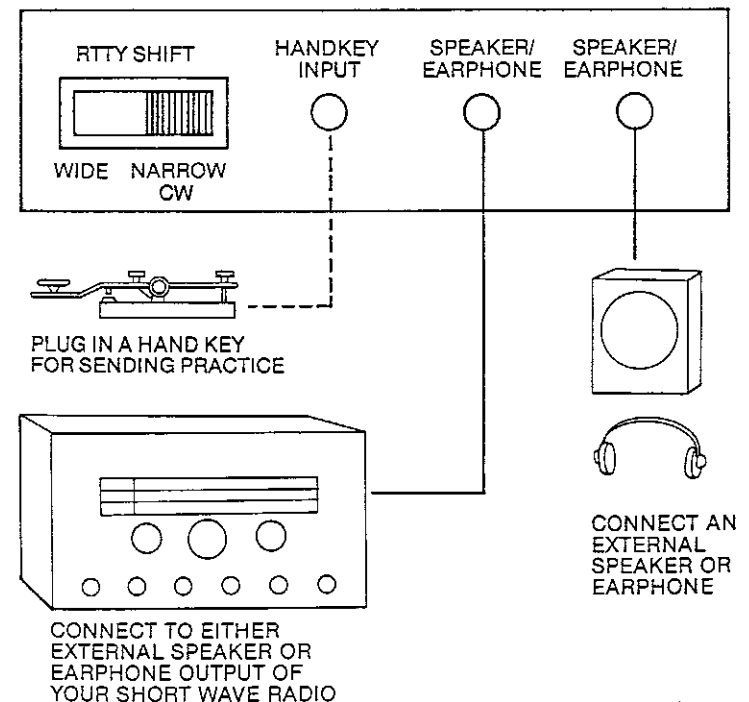
CHAPTER 4
'SWL' RTTY OPERATION

The SWL contains a dual tone demodulator designed to receive both amateur and commercial RTTY signals. The center frequency is around 800 Hz which is compatible with all shortwave receivers in common use.

The "WIDE-NARROW" switch selects between 170HZ "NARROW" shift, and 425/850HZ "WIDE" shift.

At the present time the 170HZ shift is in almost exclusive use by amateur RTTY operators. Whereas most commercial stations use wide (425 or 850 Hz) SHIFT.

Selection of inverted RTTY reception is accomplished by means of the 'CTRL –' (minus) command. 'CTRL +' (plus) selects normal (noninverted) RTTY operation. The selected mode is always displayed on the top video line as NOR or INV.

4.1 AMATEUR OPERATION:

Place your receiver in the lower sideband mode, or adjust your BFO for lower sideband and tune in an amateur RTTY signal. A good band to try is the 20 meter amateur band between 14080 and 14100 KHz. Try to locate a relatively strong RTTY signal, and listen to the received audio. Your receiver should be tuned so as to produce tones around 700 – 900 Hz.

When the signal is properly tuned, the on screen tuning indicator will flash in synchronism with the incoming audio tones. The cross hatch tuning aid simulates the pattern observed when using an oscilloscope for tuning. Proper tuning is indicated when a cross is displayed. The Mark displays a horizontal bar and Space displays a vertical bar. You will also note that when properly tuned, the red dot "signal acquisition indicator" is on constantly. If this dot blinks out, it either means the signal is not tuned properly or the audio volume is not high enough. As a further aid in tuning, the computer tone synthesizer is used to generate an 800HZ switched reference tone. This tone is available on your television (monitor's) audio channel through the speaker just as various sound effects are heard when using game programs. Simply turn up the volume on the TV to hear the tone. The tone should sound clean and should be synchronized with the tuning indicator, such that it is "on" during "Mark" (horiz. bar) reception.

Set the system to 60 WPM RTTY operation as this is currently the most popular speed used by amateurs. The mode and operating speed are permanently displayed on the top line of your video screen. To change the operating speed use the 'CTRL X' command to set it directly.

If you are properly tuned, the tuning indicator will alternate between a vertical and horizontal bar at the received bit rate which appears as a cross. If you turn on the reference tone, it should sound clean and be in sync with the received audio.

4.1.1 SELECTABLE OPTIONS:

RTTY reception is further enhanced by means of a number of keyboard selectable options. For a full description of the available RTTY commands see Chapter 7.

You can eliminate the display of most non RTTY signals such as voice or CW by enabling the ANCW (ANTI-CW) option. This option is commanded ON/OFF by means of 'CTRL T' command. When enabled, this ANCW option will inhibit the display of voice and most CW signals. It will also inhibit the display of inverted RTTY signals. There will, however, be a slight delay when you first tune a new RTTY signal before the display is presented on the screen. The letters 'ANCW' will appear on the top line display when in RTTY receive mode.

The actual software (program) operation of the 'ANCW' is to inhibit the video display until 10 properly timed stop bits are received in a row. If two stop bits are missed, the "10" counter is reset and the display is disabled until 10 more stop bits are received in order.

The mechanical teleprinter keyboards that use the Baudot code have fewer keys than a standard typewriter. There are no "lower case" letters in Baudot, only "upper case" caps. Actually the figures and punctuation symbols are the shifted upper case with caps letters as the lower case characters. Hence the terms LTR (letter) and FIG (figure) shifts. The Unshift On Space function when enabled, will cause an automatic shift to the LTR (lower case) mode upon the receipt of a BAUDOT word space code. This option is useful in that it will not get the system "hung-up" in the FIG (upper case) mode in the event of a failure to detect a BAUDOT LTR (down shift) code. This option is enabled and disabled by means of the 'CTRL U' toggle action command. When receiving Weather Reports, turn the 'UNSHIFT' option off, as they do not send a FIG shift after each group of numbers. When not in "UNSHIFT" mode, the SWL will simply react like a mechanical teleprinter. When enabled, the letter 'U' will appear near the right side of the top line. It is initially on at power up, and not displayed during text printing.

The reception of a CR (carriage return) code causes the display to start a new line. The system may be inhibited from starting a new line when the CR code is received. The CTRL F command is used to enable and disable the start of a new display line when the CR code is received.

Many printers automatically insert a line feed after receiving a carriage return. By utilizing the CTRL F command, double spacing can be eliminated on these printers.

4.2 COMMERCIAL RTTY:

Your SWL can be used to copy many commercial RTTY stations transmitting news bulletins and weather data. While the use of a general coverage receiver is most useful, you will find some signals just above the amateur HF bands, in the event you have a HAM-BAND only receiver.

Most of these transmissions will be at 66 WPM (50 baud) with a few, especially weather stations, at 100 WPM (75 baud). These speeds are available to you by means of the 'CTRL X'.

You may also encounter some stations which are utilizing a non Latin alphabet, such as Russian, Arabic, etc. You will of course not be able to decode such transmissions. You should however find numerous stations using the standard Latin character set with transmissions in various languages including English.

Commercial stations in general use a wider shift, with 425HZ as the most typical. Your "NARROW-WIDE" switch should be in the "WIDE" position.

Note that WEATHER bulletins appear in a fixed format. The start of a bulletin is indicated by the 4 letter group ZCZC, and its end by the letter group NNNN. The actual weather information consists mostly of a number of 5 figure groups, interspaced with plain English and abbreviations.

When receiving a Weather bulletin, turn off the unshift on space option in order that you do not shift to letter mode when they send a word space code. If the "UNSHIFT" is on, you will print letter groups instead of figures. You can toggle the "UNSHIFT" option on/off by means of the 'CTRL U' command. If you miss a "FIG" code, you can force the unit to "FIGS" by typing "CTRL Y." This has the same effect as if you received the "FIG" code.

4.3 DEMODULATOR:

The proper demodulator circuit is automatically selected when changing modes. The dual tone (mark and space) is for RTTY and the 800HZ single tone decoder is for CW. You can, however, manually override this selection by typing 'CTRL N' (not recommended), which forces the unit to copy only one tone, mark or space, not both.

The on-screen tuning indicator tells you which circuit has been selected. The cross pattern is displayed for dual tone (blank with no signal) and a red dot is used for single tone. The red dot should stay "on" in RTTY. If it goes out, it is an indication of signal drop out or mistuning. In addition, the copying logic can be inverted by typing 'CTRL −' (minus). Similarly, 'CTRL +' (plus) returns to normal select.

4.4 PUBLICATIONS OF INTEREST

"RTTY TODAY" by Dave Ingram

"World Press Services Frequencies" by Thomas Harrington

"Worldwide Radioteletype Stations" by Klingenfuss

All published by: Universal Electronics, 1280 Aida Drive, Reynoldsburg, Ohio 43068

"Confidential Frequency List" by Oliver Ferrell, published by Gilfer Associates, P.O. Box 239, 52 Park Avenue, Park Ridge, NJ 07656.

4.5 RADIO TELETYPE FREQUENCIES

The following is a short list of some of the more regular and easy to copy RTTY stations around the world along with frequency ranges to explore.

4.5.1 Amateur Radio RTTY

BAND	FREQUENCY	TIME	COMMENTS
80 M	3600 — 3670 KHz	Night	All "narrow" —
40 M	7070 — 7100 KHz	Night	most use 60 wpm
20 M	14070 — 14110 KHz*	Day/Night	with some 100 wpm
15 M	21075 — 21100 KHz	Day/Night	Baudot code

*most popular

4.5.2 Commercial RTTY

Weather information services (use "wide" 100 wpm Baudot code)

8140 KHz and 13625 KHz — KMIA — Miami, FL
13510 KHz — Halifax, N.S.

News and press stations are found in certain areas of the radio spectrum. The following frequency ranges are generally where you'll find them, with the lower frequencies more useful at night.

6700 — 7000 KHz	14400 — 16500 KHz
7400 — 8180 KHz	18000 — 21000 KHz
10100 — 14000 KHz	

RTTY stations you can listen for:

Service/Country	Frequencies	Speed	Shift
Tass Relay — Cuba	14901 KHz	66	Wide (INV)
Beijing Press — China	6915	66	Wide
Rueters Press — London	9076.5	66	Wide
Rueters Press — London	10961.5	66	Wide
Rueters Press — London	18686	66	Wide
Tass — USSR	10165	66	Wide
Rueters — Sydney Australia	14944	66	Wide
USIA — News — New York	14638	66	Wide
USIA — News — New York	11456	100	Wide
AP News — New York	11457	66	Wide
Prensa Latina News - Havana Cuba	14928	66	Wide
Czech News — Prague	7328	66	Wide
Kokusai — Osaka Japan	10690	66	Wide
Saporitinews — B.A. Agrentina	10895	66	Wide
UPI — Amsterdam Holland	14843	66	Wide
German News — Berlin	17620	66	Wide
Indian Info — New Delhi	18255	66	Wide

CHAPTER 5
'SWL' CW (MORSE) OPERATION

The SWL is designed to receive MORSE code up to a speed of 99 WPM. The received code will be properly displayed even though not sent by machine. The SWL will properly decode most hand sent MORSE provided sufficient spacing exists between characters.

The decoding algorithm is designed to continuously measure the average length of both dots and inter-element spaces. The decoding decision logic is such that if an observed space is longer than twice this measured inter-element space it is considered to be a character space. If it is longer than 5 inter-element spaces, it is considered to be a word space. Similarly, an observed mark (key down) is considered to represent a dash if it is longer than twice the measured average dot length.

Since for "perfect" code, a dash = 3 dots, an element space = 1 dot, a character space = 3 dots, and a word space = 7 dots, the above algorithm is very suitable. Furthermore, this algorithm will also decode less than perfect code, and is quite tolerant of extreme dash to dot ratios. The more severe restriction is that for inter-character spacing. In order to decode properly, the inter-character spacing must be at least as long as two times the average element spacing.

5.1   HAND KEY:

Before proceeding with "on the air" reception, you may find it useful and instructive to experiment with a hand key, if you know MORSE code, otherwise proceed to 5.2 Receiving. Connect a hand key to the "HAND-KEY" jack on the rear of the SWL. This should be connected to the center pin of the phone plug as shown in the diagram illustrating the rear panel connections. The other hand-key terminal is grounded (sleeve of connecting plug).

Place the system in the MORSE mode by typing 'CTRL M'. Disconnect or turn down the audio from your receiver, and send some V's with the hand-key. If you do not display these V's you must "calibrate". Speed calibration is accomplished by manually telling the system the approximate speed you are asking it to copy. You need not be extremely accurate in your estimation since the SWL allows a ±50% error in actual speed. Also, the "DEFAULT" speed is set to 20 WPM which will be close enough to the typical speeds in common use so as not to need any "RE-CALIBRATION."

Now try sending some code by hand and observe the display. Notice that your sending speed will be displayed on the top line. The displayed speed will change as you speed or slow your sending.

Experimenting in this fashion with hand sent code will assist you in becoming familiar with the MORSE decoding algorithm. You can also listen to your code by turning up the volume on your video monitor's audio channel. This feature will also be very useful in learning to send Morse code should you desire to get an amateur radio license.

Now enable the SPEED-LOCK feature by typing 'CTRL T'. You should still be able to speed up or slow down within the ±50% range and properly display the decoded characters, however the speed display on the top line will no longer be updated. You may still calibrate the system to your fist by pressing 'CTRL X', then the speed. Note that when the SPEED-LOCK is enabled, the word 'LOCK' appears in the status block on the top video line.

Remember that the speed displayed on the top line simply represents the system's internal value of the average dot + element space. For example, consider the case of the perfect code at 20 WPM. Both dot and element space will be equal in length, the actual dot length will be .06 seconds. This is based on the formula,

$$\text{(speed in WPM)} \times \text{(dot length in seconds)} = 1.2$$

Thus, when the top line displays a MORSE speed of 20 WPM it means that the system's current value for the so called "average dot" is 60 milliseconds. All incoming code elements (dots, spaces, dashes) are then compared against this current "average dot" value as part of the decoding algorithm's decision process as previously described. This "average dot" is continuously being updated based on the incoming code elements, and the speed display gets updated periodically.

5.2   RECEIVING:

You should now be ready to copy MORSE signals from your receiver. Entering this mode will automatically enable the single channel detector. To verify simply observe the topline display. The cross hatch is inhibited and the red dot is used as the tuning indicator. Note that "NOR/INV" does not function in MORSE.

Disconnect the hand key input, and reconnect the audio from your receiver to the rear panel of the SWL. Tune the receiver to a MORSE signal, and place your receiver's AGC in the fast position. The "WIDE-NARROW" switch should be in the "NARROW" position resulting in an effective CW copying bandwidth of about 200 to 300HZ.

As you tune the signal across your receiver's pass band you should be able to hear a regenerated signal if you turn up the audio volume on your video monitor (or television). In the single tone mode the system is

designed to "hear" an 800HZ note, and the internal reference oscillator is set to this value. If you are properly tuned, the regenerated tone should sound "clean" and the on-screen indicator will flash in unison with it. A key down (mark) causes the red dot indicator to turn on and the reference tone to be heard. blank = key up   ● = key down.

You will be properly tuned if the audio from your receiver matches, that is, zero beats with the frequency of the internally generated 800HZ note. A little bit of experimentation is all that is required to display good copy on the screen. If the receiver volume is too high, the tone will be raspy all the time and the red indicator will flicker constantly even though there's no input signal. Turn down your radio's audio so that with no input signal, the red indicator does not flicker and only an occasional 'beep' is heard from the monitor's audio channel. Of course, under marginal reception conditions you can expect less than perfect copy even if the code is machine sent. In general it is best if you use a fast AGC in your receiver.

Under noisy conditions you will find it best to use the SPEED-LOCK feature since noise pulses may falsely set the systems's internal "average dot" to value representing a very high speed. Note that even with SPEED-LOCK the system still tolerates reasonable speed variations up to about ±50%. Enable the SPEED-LOCK by typing 'CTRL T'.

You will also find that your receiver's CW filter is helpful in rejecting nearby signals from interfering with the reception of the desired signal. The SWL includes a sharp 300HZ effective bandpass which is sufficient for rejecting undesirable signals. Your receiver's AGC however may act in such a way as to reduce its gain due to a strong signal near the desired one. This is a case where a sharp CW filter in your receiver's IF will be very useful. If you do not have one, you may find it desirable under such conditions to completely turn off your receiver AGC, and backoff on the RF gain.

The de-coding algorithms used in the SWL program provide copying ability as good as a machine is capable and are considered the best in the industry. However, you will probably observe that manually sent code, such as by means of a hand key, will not be properly decoded if it is sent "all bunched together" without sufficient intercharacter spacing. It is a common tendency of many CW operators to suddenly speed up and leave insufficient spacing. This is especially true when the call sign is sent. You can improve on the reception of such senders by selecting a slightly higher speed than he is using. For example, if his average speed is 20 WPM, set the system to a speed of 27 WPM by means of the CTRL X command. Also make sure that the SPEED-LOCK feature is enabled. Use of this technique will enable you to copy the "FAST DOTS" and "SLOW DASHES" typical of semi-automatic key users.

CHAPTER 6
'SWL' PERIPHERAL DEVICES

6.1 PRINTERS:

All Commodore printers will work with the SWL as will a standard Centronics parallel type. The Commodore printer connects as it normally would to the appropriate serial port 'DIN' connector on the 64. The ON/OFF toggle command for the Commodore printer is 'CTRL V' (displays 'V'). The same command for the parallel printer is 'CTRL P' (displays 'P'). If you are using a parallel printer with a Cardco interface, it will be plugged into the serial port and therefore emulates a Commodore printer which requires the "CTRL V" command. Either (not both) can be used. If the Commodore printer is not connected or unable to accept data, the 'V' will not be displayed and the screen will 'freeze' for a few seconds until the SWL decides not to wait any longer for the printer 'HAND-SHAKE.' Note that the SWL expects the Commodore printer to be "DEVICE NUMBER 4".

CTRL F3 (function key 3) causes the Commodore printer to print oversize letters. CTRL F1 resets to normal letter size.

Once the Commodore printer is selected by typing 'CTRL V', either 'CTRL V' or 'CTRL P' will act as the ON/OFF toggle. The last one selected determines which is enabled automatically by the 'P-ON' SEL CAL. If you are using the parallel port with automatic 'SEL-CAL' control, type 'CTRL P' twice, once for enable and once for disable. This tells the SWL that it should write out to the 'user port.'

Both these outputs are code and speed converted and any text appearing on the bottom of the screen will be printed. The parallel output uses the following pins on the '64' 'user's port'.

COMPUTER'S USER PORT		SIGNAL TO PRINTER	
PIN C	PB0	DATA 1	PIN 2
PIN D	PB1	DATA 2	PIN 3
PIN E	PB2	DATA 3	PIN 4
PIN F	PB3	DATA 4	PIN 5
PIN H	PB4	DATA 5	PIN 6
PIN J	PB5	DATA 6	PIN 7
PIN K	PB6	DATA 7	PIN 8
PIN L	PB7	DATA 8	PIN 9

PIN 8	CB-2	STROBE	PIN 1
PIN M	JOY 0	BUSY	PIN 11
A-N-1-12	GND	GROUND	PIN 19 thru 30 AND PINS 14, 16, 17, 33

6.2 SAVING MEMORIES ON TAPE

The eight user memories including the two ID's occupy memory locations $C000 to $CFFF (49152–53247 decimal). You can save these to tape by first going to basic and using the following "SYS" commands to save and load.

First, go to BASIC by typing 'CTRL COMMODORE' (HOLD 'CTRL', and hit the commodore key located on the bottom left row). To save the memories to tape, type:

    SYS 32793   (location of tape save routine)
    RETURN

You will then be requested to press "PLAY" and "RECORD" on your data set. When memory save is finished, the program will automatically jump back to "SWL". You can continue normal operation, or shut down knowing your programmable memories are safe on tape for later.

When loading the memories, go to BASIC, as when "SAVING", then type:

    SYS 32796   (location of tape load routine)
    RETURN

Press "PLAY" on the data set. When finished, the program will jump to SWL as before, ready for communication.

6.3 JUMPS TO/FROM BASIC

The SWL program allows transition to and from BASIC without "POWER-DOWN" or master reset, thus preserving your user programmable memories. This is known as a "WARM-START" as opposed to a "COLD-START" which leaves all memory empty.

When going to BASIC from the SWL program by typing 'CTRL COMMODORE', the memories are preserved. To return to SWL program type:

> SYS 32784
> RETURN

Note also that the "COLD-START" command is

> type:
> SYS 32777
> RETURN

which erases all memory same as master reset or power down.

A program is available from Microlog Corporation that allows saving and recalling the programmable memories and the receive buffer to disk. This can be a big help in archiving various broadcasts you might like to save.

Another practical use of this program is to store often used paragraphs, name/address etc. that you want to include in a letter. Since the 'SWL' can access a printer, it makes a very simple word processor. Even with its limited editing function, the capability to recall whole blocks of text, mixed with direct keyboard input can be very useful at times.

If you would like a copy of this program, send $15 to Microlog Corp. (address on back of manual) and we'll send you a programmed disk. Just ask for the 'AIRDOS' program.

CHAPTER 7
'SWL' KEYBOARD COMMANDS

7.1 ALPHA NUMERIC LISTING

KEYS PRESSED	DESCRIPTION
CTRL A	Go to ASCII code RTTY.
CTRL B	Go to BAUDOT code RTTY.
CTRL C	Send clock time. Sends 4 digits plus zone. Time sent is actual time of transmission — not the time of command entry.
CTRL D	Sync (DIDDLE) ON/OFF. When sync is enabled and system is in transmit mode, an RTTY blank code or MORSE BT code will be transmitted if the text buffer is empty.
CTRL E	Delete receive buffer and return transmit buffer to normal size, erase screen, buffer and go to receive.
CTRL F	Ignore received carriage return code. ON/OFF toggle.
CTRL G	Change screen colors See 2.3
CTRL H	Horizontal screen shift See 2.3
CTRL I	Enter secondary ID text, of up to 64 characters. Follow the 'CTRL I' by the desired text, and terminate by typing 'CLR/HOME' key. Text will be entered into the text buffer for transmission by typing 'SHIFT £'.
CTRL J	No action
CTRL K	Set clock.
CTRL L	Line mode, ON/OFF toggle.
CTRL M	MORSE mode selection. If system is in RTTY it will switch to MORSE.
CTRL N	Use single tone 800HZ detector for RTTY. Mark only is normal. Space only is inverted. No action in MORSE.
CTRL O	No action.
CTRL P	Parallel (Centronics) Printer enable/disable toggle. Displays 'P' when enabled.
CTRL Q	Send "QUICK BROWN FOX" test message
CTRL R	Send "RYRY"

CTRL S	Split screen toggle On/Off.
CTRL T	MORSE speed-lock On/Off. Top line video displays "LOCK" when enabled in speed-lock mode. If "LOCK" is not displayed when in MORSE receive, the automatic speed tracking is enabled.
	RTTY-ANTI-CW ON/OFF TOGGLE. This feature if enabled in RTTY mode will inhibit display of non RTTY SIGNAL. Displays 'ANCW' when enabled.
CTRL U	'UNSHIFT ON SPACE' ON/OFF toggle. When selected, the reception of a baudot space code (11011) will cause automatic shift to lower case letters mode.
CTRL V	Commodore serial printer enable/disable toggle. Displays 'V' when enabled.
CTRL W	Word Mode ON/OFF toggle.
CTRL X	Select operating speed. Follow this command by the desired speed in WPM for MORSE or BAUDOT, and in ASCII, by the baud rate.
CTRL Y	Changes current case during reception. FIG to LTR or LTR to FIG.
CTRL Z	No action.
CTRL 1	Load memory F1
CTRL 2	Load memory F2
CTRL 3	Load memory F3
CTRL 4	Load memory F4
CTRL 5	Load memory F5
CTRL 6	Load memory F6
CTRL 7	Load memory F7
CTRL 8	Load memory F8
CTRL 9	Load printer ON SEL CAL
CTRL 0	Load printer OFF SEL CAL
CTRL <> (cursor up-down)	Creates 14000 character receive buffer message. Clear by typing 'CTRL E'.
CTRL —	Same as repeat function key "—" except that text will be repeated continuously. To stop type 'CTRL CLR/HOME' which will clear the buffer or type

	backspace key (INST/DEL) which removes the infinite repeat command.
CTRL +	Go to "NORMAL" RTTY demodulation (MARK LOW)
CTRL - (minus)	"INVERT" RTTY demodulation (MARK HI)
CTRL £	User's ID of up to 64 characters is entered by means of this command. Follow with the text and terminate by pressing the 'CLR/HOME' key. To send the ID the user presses the £ key.
CRTL CLR/HOME	Halt transmission and go to receive mode. Erase text buffer and entire screen.
CTRL =	Load WRU SEL CAL (transmit program only)
CTRL C = (Commodore key)	Go to "BASIC", normal computer operation. To re-enter AIR-1 communications mode type "SYS" command then 'RETURN' key.
CTRL <	Not used in Receive Program.
CRTL >	Display contents of WRU, print on, print off SEL CALS
CTRL F 1	Restores Commodore printer to normal size print.
CTRL F 3	Causes large character print on Commodore printer.
CTRL F 5	Enables storage into receive memory buffer.
CTRL F 7	Disables (stops) storage into receive memory buffer.
CTRL "SPACEBAR"	The space bar and CTRL keys are pressed to change intercharacter spacing for MORSE code. There are three progressively longer spacings selected with each 'CTRL SPACEBAR' command.
SHIFT —	Pointer for repeat function. This character enters the text buffer and acts as a "BEGIN REPEAT" text pointer.
SHIFT +	Enter 'BREAK BUFFER' mode which halts text entry into normal buffer and saves current text buffer pointers. Typed text is sent directly when

	going to 'TEXT' without its being placed in the text buffer.
SHIFT – (minus)	Exit 'BREAK BUFFER' mode. Normal text buffer is undistributed. (Go to receive first, otherwise transmission of normal text buffer will commence.)
SHIFT £	Place secondary ID text into text buffer. NOTE: ID'S CANNOT BE LOADED INTO "F1-F8" MEMORIES DIRECTLY.
SHIFT *	Blank in RTTY.
SHIFT ↑	Disable text mode (go to receive) if text buffer is empty. Displayed as an up arrow.
SHIFT RUN/STOP	Enable text mode.
SHIFT RETURN	Also enables text mode same as shift run/stop.
SHIFT C = (commodore key)	Random code option selected. System will cause 5 character random code groups to be transmitted. Press any key to deactivate.
SHIFT < ,	Letters code in BAUDOT; < in ASCII (transmit only).
SHIFT >	Sends figures code in RTTY BAUDOT; > in ASCII (trasnmit only).
SHIFT 0 (zero)	Go to MORSE. Action will occur at that point in text. (DO NOT USE with 300 BAUD operation).
SHIFT A	Send . - . - in MORSE. (Ä)
SHIFT W	Send . - - . - in MORSE. (Å)
SHIFT E	Sends . . - . . in MORSE. (Ē)
SHIFT O	Sends - - - . in MORSE. (Ö)
SHIFT U	Sends . . - - in MORSE. (Ü)
SHIFT N	Sends - - . - - in MORSE. (Ñ)
SHIFT H	Sends - - - - in MORSE. (CH)
SHIFT I	Sends . . . . - in MORSE.
—	Repeat command. All text in buffer is repeated once for each "REPEAT" command, starting at the beginning of the buffer, or from last "SHIFT —" entry.

+	Sends BK - . . . . . . - in MORSE:
—	Sends - . . . . . - in MORSE: - 'dash' in RTTY.
£	Places contents of ID memory into text buffer for transmission.
CLR/HOME	Used as command terminator.
INST/DEL	Backspace one character and delete it from the text buffer. Action is visible if split screen is enabled. Once text is transmitted, no further editing is permitted.
@	Send AS . - . . . in MORSE.
*	Send SK . . . - . - in MORSE. Blank in RTTY.
↑	Send AR . - . - . in MORSE. Line feed in RTTY.
< > (Cursor)	Sends carriage return in RTTY.
∧ ∨ (Cursor)	Places contents of receive buffer into transmit buffer.
RUN/STOP	Halt transmission and go to receive but does not erase buffer. Re-enable transmit by typing shift RUN/STOP.
=	Sends - . . . . -BT in MORSE. = in RTTY.
RETURN	Sends . . . - .VE in MORSE. Carriage Return and Line Feed Codes in RTTY.
COMMODORE KEY	Sends CQ__CQ__CQ__DE__ in all codes. (transmit only)
< ,	Sends comma in all codes.
>	Sends period in all codes.

7.2 USING THE RECEIVE BUFFER MEMORY:

The SWL program provides for a 28000 character text buffer. 14000 characters of this can be set aside for a receive buffer that can accept data directly off the air for recall or printing. You must first 'create' this new memory by typing 'CTRL <>' (up-down cursor). A large X will be displayed on the top line. The action of this new receive memory is closely tied to the printer and, like the printer, responds automatically to the 'P-ON/P-OFF' SELCALS even if the printer is not on. Manual control is via the commands: 'CTRL F 5' (right hand "function" key number 5) to enable storage and 'CTRL F 7' to stop or disable storage. Flag up ' ⌐ ' will replace the large X when storing receive text. You can enable/disable storage continuously until the

14000 characters are filled. Typing 'CTRL <>' again, erases the previously stored receive text. Note, CTRL F 5/F 7 do not control the printer, only receive data storage. To send data from this memory, hit the '< >' key by itself. The 'CTRL E' command returns the text buffer to "normal" and disables the receive buffer memory.