K44

CW Keyboard and Reader

User Manual

K1EL
HAM RADIO KITS

www.k1el.com

Introduction

The K44 is the Swiss Army knife of CW keyers, it will provide many hours of CW operation and enjoyment. A CW keyboard interface, CW reader, iambic paddle keyer, backlit LCD display, and optically isolated keying outputs are all presented in one compact box. In addition, the K44 will operate many different modes including QRSS, HSCW, and conventional CW up to 140 WPM.

CW reader (CWR) circuitry is included on the K44 board. It accepts audio from a receiver, filters, demodulates, and then decodes CW characters which are then displayed on the LCD. The CWR provides an LED bar display that is used to tune in CW stations quickly and accurately.

There's a lot to learn, but the following Quick Start section will cover the basics. Later, you can spend some time learning all the commands and what they do. For now let's dive in and get the K44 hooked up.

If you purchased a K44 kit, please refer to the K44 Assembly Guide first.

K44 Quick Start

Interconnection Diagram

The following diagram illustrates a basic K44 set up. The paddle is optional and is not a requirement. A PTT connection would not be required for normal CW keying of a transmitter or transceiver, the PTT output is used primarily in HSCW mode or to key an amplifier or antenna relay. The on-board keying circuit of the K44 PCB is capable of keying virtually any transmitter, positive or negative voltages up to 300 VDC. The keying interface is optically isolated from the K44 chassis for safety.
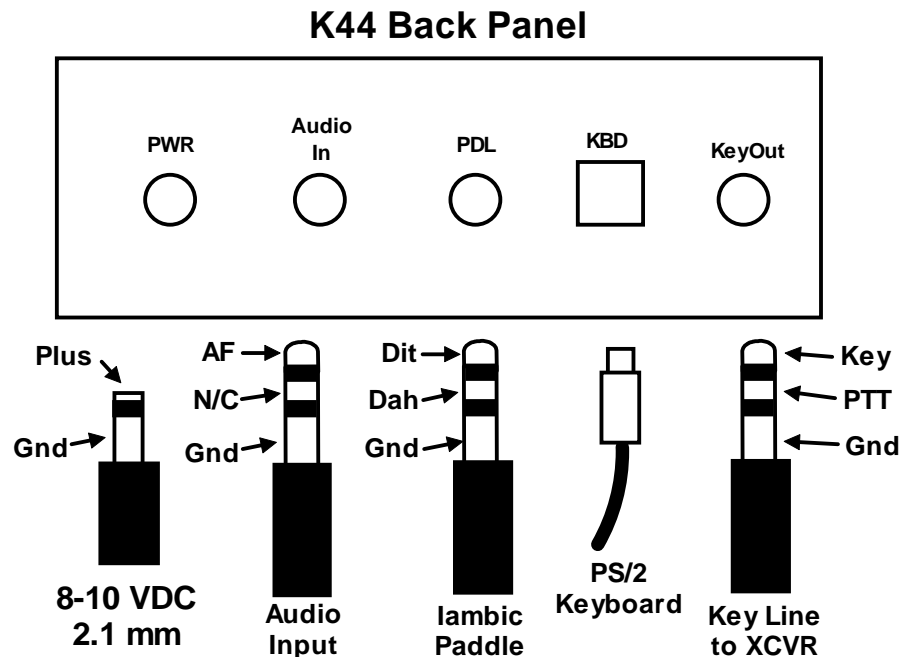

Figure 1 - K44 CW Keyboard Hookup Diagram

What Keyboard to Use

The K44 uses a generic PC keyboard with a PS/2 (mini-DIN) connector. Most PCs have moved to USB keyboards but PS/2 keyboards are still readily available and inexpensive. Try www.ebay.com or www.amazon.com as possible online sources. They are also easy to find at your local thrift store. If you opt for a used keyboard, pick one that is as new as possible, look for the special Windows keys between the CTL and ALT keys. These modern keyboards will have low current draw.

Be wary of USB to PS/2 converters. Only certain keyboards support these adapters. For a short period of time, keyboards were produced that supported both PS/2 and USB interfaces, they were shipped with adapters that converted USB wiring to PS/2 wiring. There is no active protocol conversion happening in the adapter. You need the USB to PS/2 adapter and the keyboard that supports it.

Power Supply

The K44 requires an external power supply in the range 9 to 13.5V, optimal is 9-12 volts. A 2.1 mm power connector is required on the K44 side with center pin positive. A current capability of at least 150 milliamps will be adequate. Exact current requirement depends on the keyboard you use, if the keyboard doesn't draw much you could get away with 100 mA. The K44 by itself draws about 40 mA at 9 volts when idle and peaks up to 80 mA while keying with sidetone enabled. Just to be safe, please test the power connector for correct polarity BEFORE you plug it into the K44.

Power On/Off

Pushing the encoder knob in activates the power on/off switch, it's a toggle function, push it once to turn the K44 on and push it again to turn the K44 off.

Sidetone Speaker

The sidetone speaker in the K44 provides adequate volume for most applications. In most configurations you will turn K44 sidetone off and use the sidetone built into your transceiver. K44 sidetone can be useful for code practice or testing purposes. Note that it is not possible to use the internal speaker for receiver audio.

Transmitter Connection

This is highly transmitter/transceiver dependent. It can be as simple as making up a cable with an 1/8 inch mono jack on each side or as complicated as using stereo jacks and modifying the keying mode in your transceiver's setup menu. Here are the basics: Figure 1 on page 2 shows which pins on a stereo plug do what, your job is to check with your radio's manual and determine what the cable/connector wiring should be. In general, the key line is the tip of the phone jack and the transceiver needs to be configured such that its internal keyer is disabled and set up to run in straight key mode. We recommend using a stereo keying plug and leave the ring unconnected. This will be compatible with almost all modern transceivers. You can plug this directly into the paddle jack of the transceiver. The K44 output is open collector and essentially looks like a switch to ground. You won't measure any voltage on the key output; it is just a passive output. If you want to check it out, use a DVM and measure resistance from tip to sleeve, plus lead on tip, negative lead to sleeve. Keep in mind that the key output jack is isolated from ground so you won't get any readings by measuring tip to chassis ground.

Power it up

Plug a keyboard in and connect the unit to power. Press the encoder button and the K44 will come to life. When the K44 powers up, it will automatically load settings from EEPROM. Messages are preserved from your last session as well as any settings you explicitly saved. (See description of the Shift-F1 command)

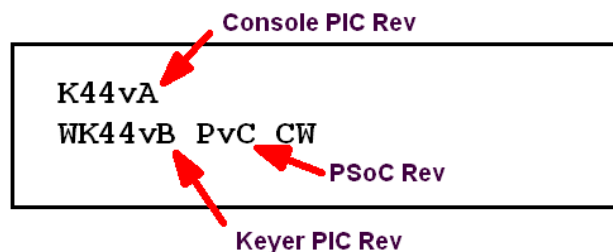A typical sign on display will be shown on the LCD:

Figure 2 – Typical K44 Power On Screen

This display reports the firmware versions of the console, keyer, and CWR microcontrollers.

As shown, Figure 2 reports Console PIC rev A, Keyer PIC rev B, and PSoC rev C. The revisions of your K44 may not match those show. CW means it is running with CWR default off, if CWR was enabled CWR would have been displayed. An N to the right of CW signifies that the EEPROM has just been loaded with factory defaults. This is the signal that the K44 has been turned on for the first time or a CTL-ALT-DEL reboot was

initiated. Normally the N is not displayed. On first time power up, factory defaults will be loaded into the microcontrollers and serial EEPROM. You can modify these settings and customize the K44 to your own preferences and then save these settings in EEPROM. The next time you power up the K44, it will start up the way you like. Initially all message slots are cleared, but as you load your messages they are automatically saved in EEPROM. The K44 supports two keyboard layouts, QWERT and AZERT. The keyboard layout is also reloaded when EEPROM is initialized. The keyboard layout is displayed to the right of the N.

After a few seconds the sign on display will clear and the K44 is then ready to use. Go ahead and type on the keyboard. Whatever you type will be sent in Morse accompanied by internal sidetone. Notice that you can type ahead of the outgoing Morse. There are two display views, the one you are looking at which is the Keyboard Input Window (KIW) and an Echo Window (EW) which you can get to by pressing the TAB key. The KIW immediately shows what you type, the EW shows text as it is sent. You can type into the KIW and then swap over to the EW to check on K44 transmit progress. No matter what window you are looking at, keystrokes always go into the KIW.

You can do two things while the K44 is transmitting, you can pause by hitting the INSERT key or clear the outgoing queue by pressing the ESC key. Now let's load a message: Hold the SHIFT key down while you press F1, release both keys and then hit the F1 key. We are going to load a message into the F1 slot. Type `CQ CQ DE K1EL` and then press the backspace key to erase my callsign and replace it with your callsign. When you are finished, hit ENTER and the message will be stored in EEPROM. Now every time you hit the F1 key your message will be played. You will notice that when you press the F1 key only the token for the F1 message will be shown, in this case a lower case `"a"`, if you want to see the expanded message press the TAB key and watch it in the EW as it is sent.

You can either type on the keyboard or use a set of paddles to enter letters to transmit. While receiving, the K44 supports type ahead allowing you to enter a response while reading an incoming message. Hit the Insert key to pause transmit so you can type ahead. You can quickly toggle between display windows with the TAB key to check what you have typed and use backspace to correct spelling mistakes. The Caps Lock light on the keyboard will flash when there are characters in queue waiting to be sent, this is a reminder that you have paused transmit.

You can adjust the sending speed at any time by turning the rotary encoder, the current WPM will be displayed temporarily in the upper left hand corner of the display.

A handy command is Tune; press SHIFT and F8 and the K44 will hold key and sidetone on until you press either SHIFT F8 again or the ESC key.

The LCD display only shows two lines but you can scroll back and look at previous activity by pressing the PGUP key, this works in both the KIW and the EW. Multiple PGDNs or HOME can be used to get back to the start of a window. The END key will move you to the end of the buffer.

One last thing to mention, before we move on, is how to use a set of paddles with the K44. Single lever or dual switch iambic paddles will work fine. Paddle input is accepted at any time. If the K44 is playing a message, it will be cancelled and you can break right in. If you want to exchange the dit and dah paddles, hold the ALT key down and then press the F9 key. The paddles will now be swapped. If you turn the K44 off and then back on again you'll find that your message will have been 'remembered' but not the paddle swap setting. Messages are automatically saved in EEPROM, but all other settings must be saved by command. The command that does this is **SHIFT-F3**; it permanently stores all settings in EEPROM.

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Audio Input for CWR Checkout

Connect audio output from your receiver to the K44 audio input jack. This can be the Line Out of your transceiver (best solution) or you can take audio across an external speaker or headphone jack. The latter is a little tricky since the level will be controlled by the receiver's volume control. We sell an audio splitter that can help if you need to use the radio's external speaker output. Only two wires are needed, ground and audio, hook them up as shown in Figure 1 and you'll be ready to start.

CWR Basics

The K44 design includes a built-in CW Reader. The command to enable/disable CWR mode is ALT-F1. It's fairly easy to operate the CWR but there are just a few things to keep in mind. The filters in the K44 CWR are fixed at 725 Hz. This means that you need to adjust your receiver so that its passband is centered on 725 Hz. When you hear a station, slowly tune the station while watching the five LED display on the K44 front panel. Watch for a peak LED deflection across the array. You will see a peak as you pass though 725 Hz. Once you have the station tuned in properly, CW will be decoded and displayed. Note that during audio overload, the red LED will be lit, on extreme overload, the two opposite green LEDs will light as well. For best results adjust the audio level to avoid overload. The K44 has adjustable gain control so that, in most cases, you can adjust the audio level without changing your receiver's audio level. We will cover this later.

Although AF filtering on the K44 CWR is good, there are two conditions that can be difficult to copy through. The first is a high level of background noise and the second is strong adjacent stations. If either of these is present, you will see a decrease in the quality of copied CW. Another challenge is trying to copy poor sending technique, a bad fist is a bad fist and it's tough to decode. Characters run together, poorly constructed letters, or widely varying code speed is not easy to copy by machine. You will also find that the K44 CWR will occasionally respond to noise or off tuned signals and display garbage characters on the LCD display. It may take the K44 a moment to lock on to a newly tuned in station, it may decode incorrectly at first but after a few letters it will lock on and display correctly. The K44 has three controls that can improve these limitations.

K44 CWR Settings

There are three CWR controls that can be used to improve the quality of copied Morse.

1) Gain can be adjusted to compensate for low or high receiver volume. There are eight gain settings. Gain is adjusted by holding the Shift key down while turning the speed control. As you turn the knob the current setting (01 to 08) is displayed momentarily on the LCD display.
2) The low pass noise filter is also adjustable. There are eight settings from minimal filtering (01) to maximum filtering (08). Filtering is adjusted by holding the ALT key down and turning the speed control. As you turn the knob the current setting is displayed momentarily on the LCD display.
3) Inter-element spacing allowance can be adjusted to help compensate for incorrect spacing between dits and dahs. This can cause letters to be run together or broken apart. There are four settings which are adjusted by holding the CTL key down while turning the speed pot. Zero selects normal spacing. Selecting -1 tightens spacing to pull elements together, for example when an R prints as ETE. Selecting a +1 or +2 loosens spacing to address run together letters, for example the case when ETE prints as R. This adjustment can be too much trouble to manage in most cases. Our recommendation is to leave this at the default and let the K44 compensate on its own.

The upper CWR speed limit is 45 WPM with the upper limit governed mainly by the noise filter setting.

You can display the current receive WPM by hitting ALT-F2. This will momentarily show the approximate speed of the CW currently being copied by the K44 CWR. Note that the speed is determined by the average width of received dits. This means that it can be misled by Farnsworth formatted CW. For example if you copy W1AW code practice at 10 WPM, the K44 CWR will report a faster speed. This is due to the fact that although ARRL code practice is sent at 10 WPM the individual elements are sent at a faster speed.

As mentioned previously, the K44 has two display windows which are selected by the TAB key. In CWR mode, there are additional window display options that are controlled by the ALT-F4 command.

CWR: ASR Window Mode

ASR Mode automatically toggles the display window from Echo Window (EW) to Keyboard Input Window (KIW) when the user types on the keyboard. Pause transmitting output with the INSERT key if you want to type ahead. When Insert is pressed again, transmit is released and what was typed will be sent. When transmit is complete, the K44 will automatically toggle back to the EW.

CWR: TXMON Window Mode

TXMON mode allows both paddled and keyboarded Morse to be shown in the EW as a convenience. Received letters are displayed in upper case while transmitted letters are displayed in lower case.

Both modes can be active at the same time. No matter what mode you are in you can always toggle between the KIW and the EW with the TAB key.

Note: ASR and TXMON modes are controlled by Set Window Mode (ALT-F4), see page 12 for details.

When ASR mode is turned on, the display will toggle to the KIW as soon as you start typing. When you stop or pause, the display will return to the EW. You can tell which display view you are looking at by the underline cursor. The cursor is shown when looking at the KIW and indicates the text entry point. The cursor is turned off in the EW.

You can scroll back though the buffer a line at a time using the PGUP and PGDN keys. The HOME key returns to the start of the buffer .i.e. the text entry point. The END key brings you to the end of the buffer.

CWR Tuning LEDs (Please note that on later K44s, the low and high LED ends are reversed)
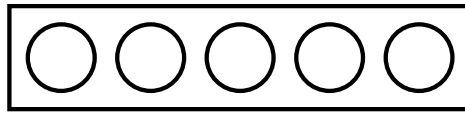
Low Signal Level   High Signal Level

Fig. 3 – CW Level Indicator LEDs

The LED display is a very simple indication of both tuning frequency and signal strength. For this reason, a signal that rapidly changes in signal strength can make tuning more difficult. The accuracy of CW decoding can vary as a signal fades in and out. With very deep fades, the K44 CWR may print an erroneous character or get out of sync for a couple of characters.

Fast Callsign Entry Feature

Pressing the SHIFT-F2 will open up a small window in the upper left corner of the display where you can enter a callsign. When you hit return, the callsign will be copied into the F12 message slot. This is great for contest exchanges. Try entering a message, in slot F1, formatted like this:

^C<F12> DE K1EL 5NN 5NN NH NH QSL ^C<F12> DE K1EL QSL?

Now you can quickly enter different callsigns into the F12 slot using the END key and reuse the above message over and over again. Note that the CALL token ^C (CTL-C) is used to call the message in F12 and then return. *Note: The* **<F12>** *notation means press the F12 key.*

Detailed Command Descriptions

Now that the basics are covered, it's time to dig a little deeper and explore the command set of the K44.

Shift/ALT/CTL Keys

This is basic stuff but let's review. The Shift, Ctrl, and Alt keys allow multiple key functions to be assigned to a single key. If you are not familiar with these keys here's how they are used:

1) Press and hold the CTL key then press the letter A for CTL-A.
2) Press and hold the ALT key then press the letter A for ALT-A.
3) Press and hold the SHIFT key then press the letter A for SHIFT-A.
4) Press the A key by itself for the letter A

In this User Manual:

SHIFT-key	refers to a key pressed with Shift:	**SHIFT-F1** for example
ALT-key	refers to a key pressed with Alt:	**ALT-PGUP** for example
^key	refers to a key pressed with Ctrl:	**^C, ^B** for example

Most commands will display the current setting on the display when entered. If you want to leave the setting as is, press ESC to cancel the command. Some commands are toggle commands which mean they have two states, usually OFF and ON. Each time you press the command key the state is toggled, press it once or twice to arrive at the setting you want.

Keyboard LED indications

When you press a command key that requires additional parameters, the CAPS light on the keyboard will turn on to remind you that more keystrokes are required to finish the command. When recording a message or other stored information the CAPS light will stay on until recording is ended. When the K44 is in pause state (via the INSERT KEY or by the **^P** buffered wait command) the CAPS light will flash to remind you the K44 is paused and waiting for user intervention (press INSERT) to continue. The SCROLL LOCK light is used to indicate a full status of either a message buffer or the type ahead buffer. When Scroll Lock lights that's an almost full indication, when it starts to flash, the buffer is full.

Current Value Status

Most commands modify the value of a K44 Parameter. Two state commands toggle the state, for example, autospace has two states, off and on. Each time you press the Autospace command key (ALT-F7) the state will be changed to the opposite of the current setting. So when you press ALT-F7 and it displays OFF, that is the new Autospace setting. If you wanted it on, just press the key a second time. Other commands have more than two states. For those commands, it is confusing to advance to a new state like the toggle commands do. Instead, on first key press or encoder click, the current value is displayed. You have the option to change the state by pressing the key again or moving the rotary encoder another click. This lets you see what the current state is and if you are happy with it, to leave it as is. The following commands work like this:

ALT-F8 Modify Output Port Setting   ALT-F6 Modify Keyer Mode
Modify Tx WPM Speed (Rotary Encoder)   Shift-F3 Modify ASR/TX Monitor Mode
Modify CWR Gain (Rotary Encoder)   Modify CWR Noise Filter (Rotary Encoder)
Modify CWR I-Space (Rotary Encoder)

Numeric value commands will display the current value and allow you to accept them or enter a new value on the keyboard. An example of this command is Set Tail. The current Tail value will be displayed and if you hit enter or escape, the value is left unchanged. If you go ahead and enter a new numeric value, the value you enter will replace the old value. Both digits of a two digit number must be entered.

Parameter Commands

Several commands are grouped together and accessed using SHIFT-ENTER and SHIFT-BACKSPACE. Successively pressing one of these key combinations will scroll forward or back through the command list. The current value for each item is displayed and nothing will be changed until you stop on an entry and enter a new value. If you want to leave the list without changing anything, press the ESC key.

Here is the list of the parameter commands in the group:

Sending Speed in WPM
Weighting
Letterspacing
Keying Compensation
Paddle Hang (dropout delay)
PTT Lead In Delay Time

PTT Tail Delay Time
First Extent
Serial Number
Dit/Dah Ratio
Paddle Sample Delay
Fast WPM F9
Fast WPM F10
Fast WPM F11
Fast WPM F12

Now we will describe each command in detail.

Change Sending Speed
This immediate command will set the current WPM speed to a rate from 05 to 99 WPM. Two digits must be entered or the command will be ignored. Note that you can also change speed in increments of 1 WPM with either the UP and DOWN arrow keys or the rotary encoder. See the section on buffered commands to learn how buffered speed changes are made.

Note that you can set speeds higher than 99 using either the speed control knob or up arrow. These methods will allow you to go all the way to 149 WPM. See page 14.

Set Keying Weight
The keying weight can be adjusted in percentage from 25% to 75%. When set to 50 % the dit time is equal to the inter-element time, which is normal. Values less than 50 reduce weighting while values greater than 50 increase weighting. Note that weighting does not affect sending speed because any increase in keyed time is subtracted from spacing time. Reduction in weighting results in a thinner sound while increased weighting results in a heavier sound. Since weighting will track speed, one weighting setting will sound the same at all speeds.


25 % weighting

50 % weighting

75 % weighting
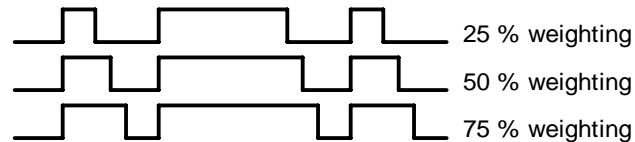
Set Letterspacing
Enter a value from 0 to 31, to specify an additional letterspace to be applied between letters. Multiply the value by two to arrive at the actual adjustment percentage. For example a value of 7 applies 14% additional letterspace between letters. The maximum adjustment is 62%.

Set Key Compensation
Keying Compensation allows a fixed amount of time to be added to the length of all dits and dahs. QSK keying on modern transceivers can cause shortening of these elements which is especially noticeable at high speeds. The K44 allows the length of the elements to be increased uniformly to compensate for this. The adjustments can be made in one-millisecond steps. The maximum adjustment is 31 mSecs. Key compensation is very similar to Weighting in that any adjustment added to the dits and dahs is subtracted from the spacing so the resulting speed is not changed. The difference between weighting and keying compensation is that compensation is independent of speed, so if 10 mSec of key compensation is selected, 10 mSec will be always be added regardless of speed. So be careful at high speeds with large values of keying compensation, dits and dahs may run together with no spacing at all.

Letter R without compensation

Letter R with compensation
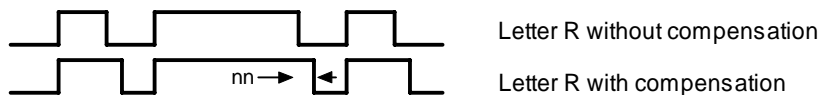
Set Transmit PTT Hang Delay Time (Paddle Hang)
The K44 provides a transmitter PTT output that can be used to switch a transmitter over to transmit mode in advance of actual CW keying. You have control over the time delay between when PTT is asserted and when CW keying will start. Hang is a PTT delay that is proportional to sending speed. The delay begins after paddle sending stops. You can select one of four delays:

HangTime = 0: wait 1 wordspace + 1 dit before ending PTT
HangTime = 2: wait 1 wordspace + 2 dits before ending PTT
HangTime = 4: wait 1 wordspace + 4 dits before ending PTT
HangTime = 8: wait 1 wordspace + 8 dits before ending PTT

Hang delay is different than PTT tail delay in that it is proportional to code speed while PTT delay is a primarily a fixed delay time. This means you don't have to tweak the PTT delay every time you change sending speed. Note that Hang only applies to CW sent by paddle. PTT for CW sent by message is governed only by Tail delay.

PTT Lead In Delay Time

The K44 provides a transmitter PTT output that can be used to switch a transmitter over to transmit mode in advance of actual CW keying. You have control over the time delay between when PTT is asserted and when CW keying will start.

Lead In is entered as a two digit number which sets the delay in 10's of milliseconds.
For example if Lead In is set to 26 the delay will be 260 milliseconds.
The maximum delay that can be set is 99 or 990 milliseconds.

PTT Tail Delay Time

Specifies the delay from the end of CW transmission to PTT deassertion it also is set in units of 10 mSecs.


The letter A
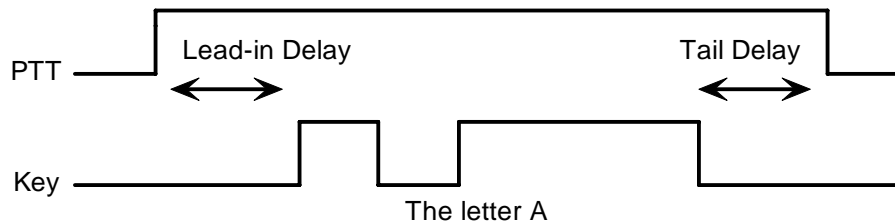
Set 1st Extension

The K42 addresses problems often encountered when keying older transceivers with slow break in response. Due to a slow receive to transmit changeover time, the first dit or dah of a letter sequence can be chopped and reduced in length. Adding a fixed amount to the first element of a sequence can compensate for this. In other words if an R is sent the first dit will be elongated but the subsequent dah-dit is sent normally. The compensation amount is transceiver dependent and is generally independent of sending speed. Note though that this is usually only a noticeable problem at higher CW speeds >25 WPM.

Enter a two digit number (0-99) calling out the delay in milliseconds.

A challenge in this scheme is to determine when sending has stopped long enough to cause the transceiver to switch back to receive. If it has it'll require a new first element correction on the next sequence. The K44 uses the PTT tail timer to determine this, set the tail timer to roughly match the transmit to receive changeover time of the transceiver and things will work fine. It takes some trial and error to get it set up right so make sure you save the values in EEPROM when you're done using the **SHIFT-F1 P** command.
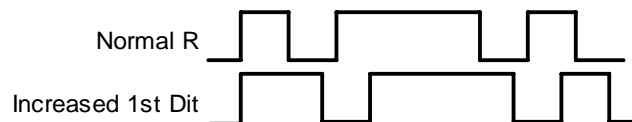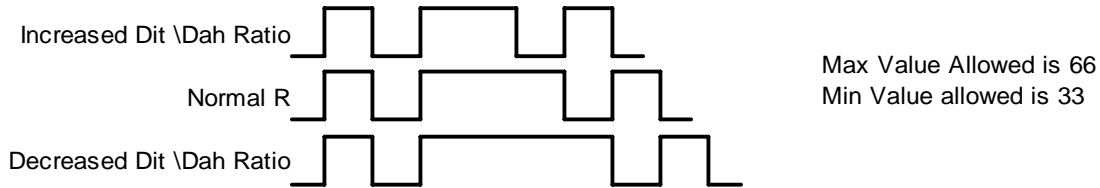

Set Serial Number

For contesting, the ability to send and keep track of a serial number is indispensable. This command allows you to preset the serial number to any 4 digit number from 0000 to 9999. Just hit ALT-F4 and enter four numbers. If you make a mistake hit ESC to cancel and re-enter the number (in other words backspace won't work on this). Any non-numeric entered will cause the K44 to simply abort the command and not change the serial number. Once the serial number is set you can increment, decrement, and send the serial number using buffered commands CTL-I, CTL-D, and CTL-N respectively. The right and left arrow keys can also be used to change the serial number.

Set Dit/Dah Ratio
Default is 50 for standard 1:3. Smaller values decrease the ratio while larger values increase the ratio. This causes an intentional distortion to the Morse waveform. Some ops use this option to make their CW sound less "machine like". Purists (myself included) recommend that you should always leave the ratio set at 1:3 which is the universal standard.

Increased Dit \Dah Ratio

Normal R

Decreased Dit \Dah Ratio

Max Value Allowed is 66
Min Value allowed is 33

Set Paddle Sample Delay   (applies to paddle input only)
This adjusts the delay from the start of a dit or dah to when K44 will start looking for the next paddle press. Normally the K44 waits one dit time before latching a new dit or dah. This delay can be adjusted to be greater or less than one dit time. If the delay is too short the keyer could send extra dits or dahs. If the is too long it slows you down because you have to hold the paddle longer for each dit or dah. Faster operators report a setting slightly less than default is more pleasing.   The delay is calculated with this formula:

DELAY = (SAMPLE ADJUST*DIT_TIME)/50 where Sample Adjust is between 10 and 90

At Sample Adjust = 50   (50 * Dit Time)/50 = One Dit Time (Factory Default)
At Sample Adjust = 25   (25 * Dit Time)/50 = One Half Dit Time
At Sample Adjust = 75   (75 * Dit Time)/50 = One and One Half Dit Time

Special Case: If Sample Adjust is set to zero, the dit and dah latches are disabled.

Fast WPM Keys
Four command keys **SHIFT-F9** through **SHIFT-F12** are assigned as Fast WPM change keys. You can program these keys to any speed of your choice.
NOTE: Fast WPM settings are not automatically saved in EEPROM, to save them you need to enter the "Save Settings" command (**SHIFT-F3**).

F1 through F12: Send Message

Messages are assigned to the twelve function keys. Hitting one of these keys will cause a message to be queued up and sent after the current contents of the FIFO buffer have been sent, in other words messages are buffered. There is no way to send a message immediately except to first clear the FIFO buffer with the **ESC** key and then send the message. If you hit the message key of an empty slot nothing will happen. Reference the next section for instructions on how to load a message.

Shift Commands

Note: **SHIFT-F1** means **F1** pressed while the **shift** key is held. For clarity a space is placed between commands and values in the following examples, in reality no spaces are used in any command. Likewise argument values shown enclosed with **<>** are entered without the **<>**. So an example like:

SHIFT-F2 <45> should really be entered as **SHIFT-F2 4 5**

SHIFT-F1: Record Something in Memory
The K44 has the ability to store messages and other items in non-volatile memory. Non-volatile means that the memory contents are preserved even if power is turned off. Recording begins by pressing the **SHIFT-F1** key; the following chart shows all available recording options:

SHIFT-F1 followed by: **F1-F12** - Record a message
                      C - Set a cut number
                      M - Map an abbreviation key to custom prosign

Message Recording
Message recording is easy, let's say you want to put a new message in slot F4, first press **SHIFT-F1** then press **F4**. The CAPS light will come on to let you know that you are in record mode and you can then enter your message. If there is a message already loaded in the slot it will be displayed on the bottom line. If the message is longer than 16 letters, you can use the arrow keys, home and end to move around in the message. If want to edit the message, just move the cursor to the edit point and enter text. **Backspace** and **Delete** work as expected. If you want to clear the message and enter something new, press **SHIFT-TAB**. If you want to abort and leave the message unchanged, press **ESC**. Any alphanumeric key or prosign can be placed into a message as well as buffered commands. When you are all finished and want to save the message, press the **ENTER** key and the **CAPS LOCK** light will go out. Then, if you want to review your message, without actually sending it, hit the Transmit Mute key (**SHIFT-F7**) followed by the desired message key and your message will be played in sidetone only. (Don't forget to turn off transmit mute when you are ready to go "live" again).

The message slots are fixed in size. If, while entering a message, you get to within 8 entries of the slot being full the SCROLL LOCK light will turn on. When you reach the end of the slot (Slot FULL) the SCROLL LOCK light will flash. The following chart shows the sizes of the 12 message buffers in letters/commands:

F1 - 192	F4 - 192	F7 - 192	F10 - 112
F2 - 192	F5 - 192	F8 - 112	F11 - 32
F3 - 192	F6 - 192	F9 - 112	F12 - 32

Cut Number Mapping
Numeric Mapping allows you to substitute a letter for a number when sending a serial number. T is a popular mapping for zero but you can choose what you like for 0 and any other numbers 1-9. To record a mapping press **SHIFT-F1** followed by **C**. After the CAPS light turns on, press the number you want to map followed by what you want it to map to. So to map 0 to T you enter the sequence:

SHIFT-F1 C 0 T

NOTE: Only 0 through 9 can be mapped. Numeric mappings are not automatically saved in EEPROM, to save them you need to enter the Save Settings command (**SHIFT-F3**).

Custom Prosign Mapping
You can permanently assign custom prosigns to any of the abbreviation keys on the keyboard. A "prosign" in this context is simply any two normal characters concatenated into a single character. Several common prosigns such as AR, SK, BT, and DN are already assigned (see page 18) so you don't have to add these. One application of this feature could be adding special European language characters or uncommon prosigns. Note that **.,** and **+** cannot be remapped. To illustrate how the command works let's assign AS to the @ key, just enter the following sequence:

SHIFT-F1 M @ A S

From this time on, anytime you press @, AS will be sent. Custom prosigns are automatically stored in EEPROM after they are entered, you don't have to issue the save settings command to save them.

SHIFT-F2: Fast Callsign Entry
You can quickly and easily enter a message in slot F12 with this command. It's intended to be used to enter a callsign on the fly. Pressing **SHIFT-F2** will bring up a small text entry window in the upper left hand corner of the LCD display. This allows you to see what you are entering while referencing the rest of the display, handy for picking out a callsign. Hit **ESC** to abort this command. Read through the Quick Start section starting on page 2 for some tips on formatting a message to use fast callsign entry.

SHIFT-F3: Store current settings as the power-on default
The K44's operating state is stored in EEPROM and loaded at power up. If change settings such as keying mode, paddle swap, autospace… these changes will stay in force until you power cycle. At that time the EPROM values are reloaded. **Shift-F3** will copy the current state into EEPROM so that it will become the power on default. Answer Y to SAVE DFLTS ? Here's a list of settings that are saved in EEPROM memory:

Speed	Iambic Mode	Sidetone disable
Weight	Autospace Setting	Sidetone Frequency
Character Spacing	Paddle Swap	PTT delays

```
Serial number              Fast WPM keys              CWR Gain/Filter
Paddle Sensitivity         Numeric mapping            Pin Configuration
```

When the K44 is powered on for the first time or is rebooted, a default set of values are loaded into EEPROM. See the CT-ALT-DEL command on page 14 for further details.

SHIFT-F4: Morse Code Practice
A dual mode multi-level code practice program is built into the K44. It's accessed via the `SHIFT-F4` command key. There are two styles of practice, receive only and echo (receive/respond) practice. There are four levels of practice organized by easy to difficult letter groups. The four levels are:

Level 1: **E T A N I M W S G D U K O R**
Level 2: **C Q P J F B V Y H X Z L**   including level 1
Level 3: **1 2 3 4 5 6 7 8 9 0**   including level 1 & 2
Level 4: **? / , . AR SK BT AS**   including level 1 & 2 & 3

The syntax for entering a practice mode is:

SHIFT-F4<style><level> where style is R for receive or E for echo practice

        SHIFT-F4 R2 selects Level 2 receive practice
        SHIFT-F4 E4 selects Level 4 echo practice

Receive Practice Description: Random characters from the selected level are sent in groups of five. Practice will continue until the ESC key is pressed. You can check what was sent by toggling to the Echo Window using TAB.

Echo Receive/Transmit Practice Description: The K44 will send a character from the selected level and you must respond by echoing the character back on either the keyboard or paddle. If you get it right the K44 will repeat the first character followed by a new character. Now you must echo back both characters. The K44 will continue to add characters until it reaches five after which it will start with a new set. If you miss a character the K44 will send 8 dits and then start over with a new sequence of characters. When you want to end practice, hit the ESC key and the K44 will send an SK to let you know it's done. The speed control is disabled in practice mode but you can change speed with the up/down arrows.

SHIFT-F5: Toggle Farnsworth Sending
Farnsworth spacing is useful for CW practice because it encourages you to learn characters by sound not individual dits and dahs. In the K44, Farnsworth is implemented by sending letters at a fixed rate of 18 WPM regardless what the WPM sending rate is. Spacing between characters is determined by the sending rate. When the WPM rate is set above 18 WPM, Farnsworth is automatically disabled. It's a "toggle" command which means if Farnsworth is on when you press `SHIFT-F5` it'll be turned off, if it's off you'll turn it on

SHIFT-F6: Toggle Sidetone
This is how you turn sidetone on and off. If you would rather use the sidetone already provided by your transceiver just disable the K44 sidetone, it's not required. This command is both an immediate and a toggle command. Command response: 'SIDETONE ON' or 'SIDETONE OFF'.

SHIFT-F7: Toggle Transmitter Muting
This command allows you to temporarily disable the Key and PTT outputs. Sidetone is not affected by this command. Transmit muting is useful for verifying a message "off line" or for code practice. This is both an immediate and toggle command. Command response: 'TX MUTE ON' or 'TX MUTE OFF'.

SHIFT-F8: Tune Command
Use this command to force a constant key down condition. If in K1P1 mode both the KEY and PTT outputs are turned on. (See `ALT-F8` command on Page 14) Only one output is turned on in K1 or K2 output modes. Any key press will cancel Tune. CWR is muted while Tune is activated. The display will show "TUNE" to indicate tune is in effect. Tune is automatically turned off after 10 seconds as a safety feature.

SHIFT-F9 through SHIFT-F12: Fast Speed Change Keys
In contesting or just general QSO hunting it's handy to have several preset CW speed settings that you can select with a single key press. You learned how to program these keys in the `SHIFT-F1` section.

ALT Commands

ALT-F1 K44 CWR module On and Off
This toggle command will turn the K44 CWR circuitry on or off. A message is shown on the display that states which one. When the K44 CWR is off, it is in sleep mode and will not respond to audio input.

ALT-F2 Show Current CWR Rx WPM (CWR MODE MUST BE ON)
This is useful to check the speed someone is sending at so you can match their speed. 'CWR WPM nn'

ALT-F3 Match Current CWR Rx WPM (CWR MODE MUST BE ON)
Similar to the previous command, the current CWR WPM is read and then the transmitting speed is set to match. This insures you call someone at their sending speed. Command Response: 'WPM nn'

ALT-F4 Set ASR and TX Monitor Modes (CWR MODE MUST BE ON)
This command controls the setting of both ASR and TXMON. With ASR on, the K44 will toggle back and forth between the Keyboard Entry Window and the Echo Window display views when characters are typed on the keyboard. This frees you from having to hit the **TAB** key to flip the windows back and forth. Actual transmit is still controlled by the **INSERT** key. If you want to type ahead and not transmit, pause the output with the INSERT key. When you are ready to release the buffer, hit **INSERT** again. A blinking CAPS LOCK LED on the keyboard will indicate when output is paused. You can hold the transmit display for a longer period of time by increasing the Tail time.

TXMON mixes receive and transmit activity in the receive view. Letters entered on the keyboard or paddle are displayed in UPPER case while the transmit stream is displayed in lower case after sending.

Each time you press **SHIFT-F4** the selected mode will sequence as shown below.

```
ASR OFF  TXMON OFF
ASR OFF  TXMON ON
ASR ON   TXMON OFF
ASR ON   TXMON ON
```

ALT-F5: Toggle Contest Spacing
When sending by keyboard or by message, default word spacing is 7 dit times, When Contest Spacing is enabled, a word space is shortened to 6 dit times. The idea here is to speed up contest exchanges. This command does not affect paddle keying in any way. The setting is displayed as TIGHT ON and TIGHT OFF. With off meaning the spacing is a normal 7 dit times.

ALT-F6: Select Paddle Keyer Mode (applies to paddle input only)
The K44 supports four keying modes: Iambic A, Iambic B, Ultimate, and Bug keying modes. In iambic and ultimatic modes, the K44 makes dits and dahs automatically based on which paddle you press. In Iambic mode, alternating dits and dahs are sent while both paddles are held closed. In Iambic mode B an extra alternate dit or dah is sent if both paddles had been pressed and then released. In Ultimatic mode, when both paddles are pressed, the keyer will send a continuous stream of whichever paddle was last pressed. For example, if you are holding the dit paddle and then press and hold the dah paddle, the keyer will switch from sending continuous dits to continuous dahs. Note that there are three Ultimatic modes: normal, dit priority and dah priority.

In bug mode the K44 makes the dits and you make the dahs. The dah paddle essentially operates like a straight key, for a discussion of this see page 20.

Every time you hit **ALT-F6** the K44 will cycle to the next keying mode:

IambicA->IambicB->Ultimatic->Ultimatic Dit->Ultimatic Dah->Bug/SK->IambicA.

Note that a software paddle is mapped to the keyboard, see Page 20 for details.

ALT-F7: Toggle Autospace (applies to paddle input only)
Here is how autospace works: If you pause for more than one dit time between a dit or dah the K44 will interpret this as a letter-space and will not send the next dit or dah until a full letter-space time has been met. The normal letter-space is 3 dit spaces but this can be adjusted by the Letterspace parameter command. (see Page 8) The K44 has a paddle event memory so that you can enter dits or dahs during the inter-letter

space and the K44 will send them as they were entered. With a little practice, autospace will help you to send properly spaced Morse code.

ALT-F8: Modify Output Port
K44's keying port connector can be configured in three different ways. This allows you to ability to key one of two radios if you do not require PTT control.

```
Mode 1:     Tip Output = Key    Ring Output = PTT    LCD Displays: K1P1
Mode 2:     Tip Output = Key    Ring Output Off      LCD Displays: K1
Mode 3:     Tip Output Off      Ring Output = Key    LCD Displays: K2
```

ALT-F9: Swap Paddles (applies to paddle input only)
You can swap paddles with this command. It's a nice feature to have when right and left handed ops want to share the same keyer. Command response:' PDL SWAP ON' or 'PDL SWAP OFF'

ALT-F10: Unassigned
This command is reserved for future use.

ALT-F11: Display Logic Supply Voltage
The K44's main 5 volt bus is read and displayed. Note that the power input voltage is regulated at 5 volts to run the K44 circuitry. In normal operation, this command will display something very close to 5 volts. As the power input voltage drops, the voltage regulator will go out of regulation and the logic supply voltage will fall below 5 volts. For this reason, this command is useful for battery operation. Since the K44 will not operate reliably at a logic voltage less than 4.5 volts, it's important to be able to check it.

ALT-F12: Start Persistent Beacon
When this command is issued, the K44 will send the message in slot 1 (F1) repetitively. A jump to message F1 command is not required at the end of the message. The message can contain buffered commands as well as calls or jumps to other messages. It is called persistent because if power is lost and then restored the beacon will continue to cycle. A persistent beacon is cancelled by hitting the **ESC** (escape key).

CTL-ALT-DEL or Scroll Lock: Force Cold Restart (Clear EEPROM and Restart)
This causes a Master Reset of the K44, clears all of EEPROM, and reloads factory settings. Be careful when using this because it will erase all of your messages, prosigns, and numeric mappings. Factory settings are:

```
Speed = 15 WPM           CWR TXMON off            Shift-F9 = 13 WPM
Autospace off            Extra Space = 0          Shift-F10 = 15 WPM
Iambic B                 1st Extension = 0        Shift-F11 = 18 WPM
PTT Delays = 0           KeyComp/Weighting        Shift-F12 = 20 WPM
CWR Gain = 5             normal                   Paddle Hang = 0
CWR Filter = 6           Dit/Dah Ratio=50 (1:3)   Letterspace = 0
CWR ISPC = 0             PaddleSample=50(1 dit)   Serial Number = 0000
CWR ASR                  Keying=K1P1
CWR off                  Sidetone=800Hz
```

Scroll Lock is a direct way of issuing the restart command. When you hit the **Scroll Lock** key, FCR? (**F**orce **C**old **R**estart) will be displayed, if you want to proceed with the reboot, hit **Scroll Lock** again. Any other key cancels the reboot.

CTL-ALT-INS Select Keyboard Mapping
The K44 supports two keyboard layouts, QWERT and AZERT. This command toggles between the two. After the command is entered, the active mapping is displayed.

UP ARROW: Increase Speed by 1 WPM
DOWN ARROW: Decrease Speed by 1 WPM
This is a quick way to change speed in one WPM increments. The new WPM will be displayed momentarily in the upper left hand corner of the display. Since the speed command only allows a maximum of 99 WPM, this is one way to select WPM speeds greater than 99 WPM. The other way is by the rotary encoder. The maximum WPM allowed by these two methods is 149. See page 8.

ALT-UP: Increase Sidetone Frequency
ALT-DOWN: Decrease Sidetone Frequency
Sidetone frequency is adjusted in fine increments by frequency from 400 Hz to over 3000 Hz. The frequency in Hertz is displayed as it is being adjusted. The factory default frequency is 801 Hz.

HOME: Return Display to Home Position (current entry line)
END: Move Display to Last Position (last line in buffer)

These two commands work in either the Echo Window or Display Window.

SHIFT-TAB: Clear Keyboard Display
Clears both keyboard input and echo display windows. This command will terminate an active message and also clears a pause state.

ESC: Abort/Clear Buffer
This can be pressed at any time to abort a message, abort a command, or to clear the typeahead buffer. If this is pressed during message entry the message buffer will be cleared and you effectively can start over at the beginning.

INSERT: Pause
Sending will halt after the current letter has been sent and will not resume until Insert is pressed again. While the K44 is paused, the keyboards CAPS Lock light will flash.

When the K44 CWR is enabled ,(see ALT-F1 command) the LCD display will default to the Echo Window. This allows you to view received CW that the K44 CWR module is decoding. If desired, you can press insert to pause transmit and type ahead, but the display window will remain in receive. You can view the transmit window at any time by pressing the TAB key. When you are ready to transmit, press the insert key again and PTT will be asserted and text in the transmit buffer will be sent. As long as you continue to type the K44 will transmit until the buffer is empty or you press Insert again.

The CAPS Lock light is a reminder that the K44 is paused. In addition, it's a reminder that there is type ahead text waiting to be sent. Insert is a toggle command, each press will advance from transmit to receive or receive to transmit.

DEL: Send Error Dits

Eight dits will be sent to signify a CW error. This is displayed on the LCD as the token ← .

Right Arrow: Increment Serial Number
Left Arrow: Decrement Serial Number
This is the quick way to modify the serial number, both incrementing and decrementing is supported, Use the Serial Number parameter command to directly set the serial number (see page 9)

Buffered Command Language
A simple set of commands can be used to compose complex CW messages. There are two command types; Message (F1-F12) and Control (control-C for example). Commands are inserted into a message to perform various functions. Each command occupies one character space in a message slot. Refer to the SHIFT-F1 command on page 10 to review message recording. In the following examples a function key is denoted as `<F1>`. In other words `<F4>` is the F4 key.

F1-F12 - Jump to message commands
Message keys can be placed within a message to cause one message to be played from another. Here's a simple example:

Load Slot F1 with: `CQ CQ <F2>`
Load Slot F2 with: `QRZ QRZ <F3>`
Load Slot F3 with: `DE K1EL K`

Message F1 will be sent as: `CQ CQ DE K1EL K`
Message F2 will be sent as: `QRZ QRZ DE K1EL K`

A message can jump back on itself to make a message loop:

Load Slot F1 with: `CQ CQ CQ CQ DE K1EL K1EL K1EL <F1>`

After sending `CQ CQ CQ CQ DE K1EL K1EL K1EL` the K44 will loop back to the beginning and send it again. This will repeat forever until the `ESC` key is pressed.

Message function keys are displayed compactly on the LCD display as single lower case letters as follows:

`F1:a F2:b F3:c F4:d F5:e F6:f F7:g F8:h F9:i F10:j F11:k F12:l`

For example, `CQ CQ K1EL <F1>` would be displayed as: `CQ CQ a`

Control Command Tokens
In addition to messages, there are eight buffered commands that can be placed in a message. They are entered by holding down the control key and then pressing the specified key. Before we get to the actual commands, in the following examples we denote control keys by ^C or ^D for example. Also,in the same way we substituted lower case letters for function keys, we display control keys as tokens:

call msg	load delay	inc s/n	dec s/n	key down	load loop	set speed	decsz
^C	**^D**	**^+**	**^-**	**^K**	**^L**	**^S**	**^Z**
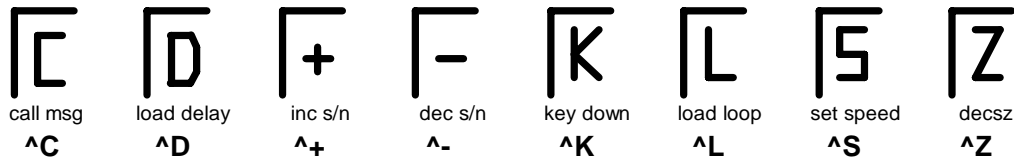
Figure 4 – Command Display Tokens

There are several other message tokens you will encounter; $\rightarrow$ for merge, Ω for pause, and Σ for serial number. These also show up when typing directly into the input buffer window.

CTL-C <F1-F12> - Call a message
Jump to the specified message, send that message and, after the message completes, return to the caller. Here is an example of the call message command:

Load slot F1 with: `^C<F12> ^C<F12> de K1EL K1EL BTU OM KN`
Load slot F12 with: `WA1ABC`

Message F1 will play as: `WA1ABC WA1ABC DE K1EL K1EL BTU OM KN`

This illustrates a powerful feature; you can build up a message that contains other messages. The message can be recycled by substituting a different callsign in slot F12. TO be more efficient, we can quickly enter a callsign into slot F12 by using the Fast Callsign command `SHIFT-F2`.

CTL-D <NN> Delay for NN Seconds (NN = 01 $\rightarrow$ 99)
Insert a fixed pause into a message, it's well suited for building a beacon message:

Load Message Slot F1 with: `v v v ^K05 BCON DE K1EL ^W60 F1`

When you press `F1` three V's will be followed by a key down for 5 seconds, then `BCON DE K1EL` will be sent followed by a wait of 60 seconds after which the whole thing will be repeated. This beacon will repeat until you hit the `ESC` key.

Longer delays than 99 seconds can be derived by looping a wait command in a DECSZ loop. (an example is given in the CTL-Z command description).

CTL-K <nn>- Key down for nn seconds
The transmitter will be keyed for the specified number of seconds. Two digits are required .i.e. 05 for 5 secs.

CTL-L <nn> - Load Loop Count (nn = 01 → 99)
This command works in conjunction with the CTL-Z command. A loop count is entered with this command. The CTL-Z command will decrement this loop count and will repeat a message until the loop count reaches zero. See the CTL-Z description for more info.

CTL-M <C1><C2> - Merge Next Two Letters into a Prosign
You can build "on the fly" prosigns with this command. Just press CTL-M followed by two letters or numbers and they will be merged together: `^MAR` is sent as **AR.** Note that nothing will be sent until both letters have been entered. This merge example would be displayed on the LCD as → **AR**

CTL-N - Send Serial Number
The four digit serial number is sent in Morse. Leading zeroes are suppressed so 0047 is sent as 47. If cut numbers have been mapped using the `SHIFT-F1 C` command, those cuts will be substituted.

CTL+ Increment Serial Number (Control Plus)
The serial number is incremented by 1.

CTL- Decrement Serial Number (Control Minus)
The serial number is decremented by 1.
CTL-P - Pause Output Until Insert Key Pressed
K44 output keying will be paused indefinitely until the `INSERT` key is pressed. While paused, the CAPS LOCK light on the keyboard will flash to let you know that pause is in effect. This command is used to insert a pause into a message to allow you to insert something manually. For example you might make a message up that looks like this:

`UR RST IS ^P NAME HR IS STEVE`

After playing `UR RST IS`, the K44 will pause to allow you to enter an RST after which you hit the `INSERT` key which releases the K44 to continue with the rest of the message. Note that the `ESC` key also cancels a pause, but will kill the remainder of a message in progress.

CTL-S <nn> Change Speed to nn WPM (nn = 05 → 99) or Set HSCW/QRSS Rate
In addition to normal speed changes, the `^S` command is used for HSCW (High Speed CW) and QRSS (Extremely Slow) rate changes.

`^Snn` where nn specifies a new rate between 05 and 99 WPM:

Load Message Slot F1 with: `^S10 CQ CQ DE K1EL K1EL ^S22 CQ CQ DE K1EL F1`
F1 will repeat until ESC: `CQ CQ DE K1EL` (at 10 wpm) `CQ CQ DE K1EL` (at 22 wpm)

`^SHn` where n is a single digit number representing the lpm (letters per minute) HSCW rate divided by 1000:

`^SH2` selects 2000 lpm and `^SH4` selects 4000 lpm. Any rate from 1000 to 8000 can be chosen although only a handful of them are actually used by radio amateurs. In the US, common rates are 1000, 2000, 4000 and 6000 lpm while in Europe 1000, 3000, 4000 lpm are common.

`^SQn` where n is a single digit number 1-4 representing the QRSS rate shown below:

```
1=QRSS3:   3 second dits    2=QRSS6:   6 second dits
3=QRSS30: 30 second dits    4=QRSS60: 60 second dits
```

For example:
`^SQ1` selects QRSS3 (3 second dits) and `^SQ4` selects QRSS60 (60 second dits)

NOTE!!: Remember to put a buffered speed command at the end of a message that contains either a QRSS or HSCW command to restore normal CW operation when the message is completed.

HSCW Operation Hints: In running HSCW mode, a common practice is to key a transmitter and feed audio tones into the microphone input. You can use the K44 sidetone output directly as a tone source. You probably want to choose a sidetone frequency close to 2000 Hz. Preferably, use the K44 key output to key

an external sine wave tone generator. In either case, the PTT output of the K44 should be connected to the PTT input of the transceiver.

You have a choice of either inserting an HSCW/QRSS command into a message or use it on the fly while you are typing. It is not very useful "on the fly" though and is intended to be used in a message. Use **ESC** to leave HSCW/QRSS mode.

There are lots of great websites that cover HSCW and meteor scatter operation, search for HSCW or meteor scatter and you will find lots of information or try: ***www.nitehawk.com/rasmit/ws1_15.html***

CTL-Z <F1-F12> Decrement Loop Count and Skip Message if Zero
Loop a message for a given number of cycles.. The structure of the command consists of the CTL-Z command followed by a message key (F1-F12). There must be a load loop command in the message stream somewhere ahead of the CTL-Z command. When the CTL-Z command is encountered the loop count is decremented by one and if the result is not zero the message is jumped to. If it is zero the message is skipped. The first time the ^L command is encountered the count is loaded and subsequent CTL-L commands are ignored until the loop count expires, this allows a loop count load and loop count test to reside in one message. The best way to describe the command further is with a couple of examples:

Load Message Slot F1 with: **^L02 CQ CQ DE K1EL ^Z<F1> K**
Results when F1 is pressed: **CQ CQ DE K1EL CQ CQ DE K1EL K**

What happens is this: When CTL-L is processed the K44 loads the count and stores it, then it outputs the message. The CTL-Z command tells the K44 to decrement the loop count and test to see if it is zero, if it isn't zero the K44 jumps back to the beginning of F1, If the count is zero the K44 skips over the jump and just outputs the SK. Remember that the CTL-L command is ignored after the initial load.
```
Longer delay example:
```

Load Message Slot F1 with: **BCON DE K1EL <F3>**
Load Message Slot F3 with: **^L10 ^D60 ^Z <F3> <F1>**
Results when F1 is pressed: **BCON DE K1EL** will be repeated every 10 minutes

In this example the message is sent followed by a jump to F3 which waits for 60 seconds 10 times (which gives us 10 minutes). After the 10 minute wait we will jump back to F1 and do it all over again.

More Message Examples:

Send a serial number with an incrementing value:
Load F5 with: **Count is ^N. ^+ ^D05 <F5>**

Assuming the serial number has been preset to 100 the F5 message will be sent in sequence with a delay of 5 seconds in between as:

Count is 100.
Count is 99.
...
Count is 0.   At which point it will wrap around to 255
Count is 255.
Count is 254.

A message that runs at two different speeds.
Load F1 with: **^S10SLOW SPEED ^S20FAST SPEED**

A QRSS beacon message:
Load F3 with: **^SQ2EL ^S18K1EL FN43 ^D60<F3>**

Additional Key Assignments
There are several other key assignments that are treated just like letters and are buffered.

=	is mapped to	**BT**	**[**	is mapped to	**QRZ**
<	is mapped to	**AR**	**]**	is mapped to	**QSL**
>	is mapped to	**SK**	**/**	is mapped to	**DN**

```
;     is mapped to KR              @     is mapped to AC
!     is mapped to CM              $     is mapped to VU
(     is mapped to KN              )     is mapped to KK
"     is mapped to RR              `     is mapped to WG
-     is mapped to DU              _     is mapped to UK
:     is mapped to OS              +     is mapped to AR
```

CWR Settings by Rotary Encoder

These commands are accepted only when the CWR module is enabled.

ALT-SPEED Control (Noise Filter Setting)
If you press and hold the `ALT` key while you turn the Speed Control the K44 CWR noise filter is adjusted. There are eight settings ranging from minimal filtering (1) to maximum filtering (8). This controls the cutoff of the digital low pass filter in the CW demodulator. With higher settings of filtering, the K44 CWR will respond less to shorter bursts of noise. Higher filter settings reduces the K44 CWR's ability to copy very fast CW.

SHIFT-SPEED Control *(Gain Setting)*
If you press and hold the `SHIFT` key while you turn the Speed Control the K44 CWR gain is adjusted. This allows you to tailor the K44 CWR module for differing input levels. Depending on what the source of the audio input is (line out, headphone jack, 600 ohm output, speaker output) the signal level can vary widely. Adjustable gain allows you to compensate for this. For best result, adjust the gain so that the loudest signal just barely lights the end green LED. This insures that you have sufficient gain to copy weak signals while not overdriving the K44 CWR module on strong signals. There are eight gain levels from 1 to 8.

CTL-SPEED Control (Inter-Element Spacing Setting)
If you press and hold the `CTL` key while turning the Speed Control you can adjust the amount of inter-element space the decoder will use when making a decision to end a letter or a word. This can help in situations where ops use too much or too little space between dits and dahs. For example if too much space is used, a dit-dah-dit could be decoded as E T E instead of R. It can also help where faster senders do not allow enough space between letters. For example dit-dah dah-dit is decoded as a P instead of A N. There are four spacing ranges, where the range is represented by -1, 0, +1, +2. Use -1 to tighten up spacing and +1 or +2 to correct for run together letters or words. Use the value 0 for perfectly spaced CW.

LCD Display Interface
The K44 provides an interface to a 16 by 2 line LCD. The display allows the user to see what he is typing when preparing out going text and also monitor transmitting progress. It does this by providing two display windows that can be selected by the `TAB` key. The default view is the keyboard entry window, hitting the `TAB` key will toggle the view over to the outgoing window. The user can type well ahead of outgoing Morse in the entry window, toggle over to monitor outgoing progress and then toggle back. You can tell which buffer is which by the presence of a underline cursor, the cursor is only displayed in the keyboard window. Use the `PGUP` and `PGDN` keys to scroll back and look at previous lines. `Home` returns you to the entry line. Messages appear in the keyboard window as a single token character while the expanded message will be displayed as it is sent in the outgoing window.

LCD Bias Control (Contrast)   ALT-LEFT and ALT-RIGHT

The display bias level is controlled by the holding the `ALT` key down and pressing the right and left arrows. The right arrow increases contrast and the left arrow decreases contrast. The current contrast value is displayed while it's being adjusted.

Using other LCD Displays
The K44 supports the Hitachi HD44780 interface. The format is fixed at 2 lines of 16 characters.

Miscellaneous Information

Paddle Watchdog
The K44 has a built in key output disable that is activated if more than 128 dits or dahs are sent consecutively. This prevents unattended keying. The output is disabled after 128 consecutive events, but the

sidetone continues to report to allow you to detect the condition. If K44 sidetone is disabled there is no indication that the keyer is inactive.

Software Paddle on Keyboard
Two keys on the keyboard are mapped as dit and dah paddles. These keys may not be present on very old keyboards. They are located on the lower right of the layout in the same row as the space bar between the Alt and Ctl keys. The left key is the Windows key, the right key is the listbox select key. Due to slow keyboard response these only work well below 18 WPM, but they are useful in a pinch. Note, it has been reported that some keyboards only have one Windows key, in that case the soft paddle will not work.

Using a Straight Key with the K44
The K44 can be set up to work with a bug or straight key. Wire the key to an 1/8" stereo plug as shown below. You must use a stereo connector and the tip must be left unconnected. Use the **ALT-F6** command to select BUG/SK mode. NOTE: Even though the K44 accepts bug or straight key input for transmitting, it is not able to decode and display these two input types.
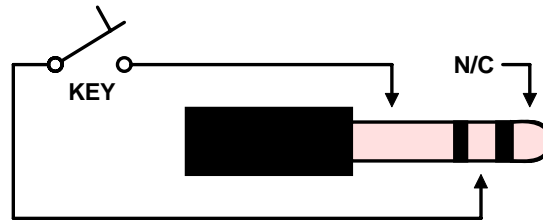
Figure 5 – K44 Straight Key Input Connections

All things considered, it usually works best when the bug or straight key is wired in parallel with the K44's output. Since the K44 outputs are open collector, the external key can pull the keying line to ground with no damage to the K44 output. This allows the external bug or straight key to be used at any time without having to change the K44 keying input mode.

CWR Test Points

There are two optional test points that can be used to verify the operation of the K44 CW PCB. It's not a requirement to view these, they are provided for extra visibility into CWR operation.

TP1: Audio output of the 4 pole active filter before entering the PSoC Controller. By applying a signal generator to the K44 CWR audio input and sweeping this from 600 to 800Hz a peak response will be observed at this test point at approximately 735Hz +/- 20 Hz.

TP2: Logic output of the PSoC's internal tone decoder. When a signal is in the passband this output will assert a logic one output (+5v)

RF Immunity
There are several RF filters included in the K44 circuit design. Caps C4 and C5 on the keying and PTT lines prevent RF from coming back through the keying lines, C2 and C3 shunt any RF arriving over the paddle leads, and C23 and C24 filter the rotary encoder leads. L1 and L2 attenuate RF from coming in on the keyboard data and clock lines to the Console PIC. These components also reduce K44 RF radiation. Some keyboards can produce RF emissions on their own that may cause RFI to your radio receiver. In addition, most keyboards have poor conducted RF emissions immunity and operation can be compromised in high RF environments. To guard against this, additional filtering may be required on the keyboard, usually a ferrite bead on the keyboard cable will address this.

FCC Regulations Compliance
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

Radio and Television Interference
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interferenceto radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful 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 or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

You may also find helpful the following booklet, prepared by the FCC: "How to Identify and Resolve Radio-TV Interference Problems." This booklet is available from the U.S. Government Printing Office, Washington D.C. 20402.

Changes and Modifications not expressly approved by the manufacturer or registrant of this equipment can void your authority to operate this equipment under Federal Communications Commissions rules.

In order to maintain compliance with FCC regulations shielded cables must be used with this equipment. Operation with non-approved equipment or unshielded cables is likely to result in interference to radio & television reception.

Table1: Immediate Command Chart

Key	Normal	Shift	ALT
F1	Play Message 1	Record	CWR On/Off
F2	Play Message 2	Fast F12 Msg Entry	Show CWR WPM
F3	Play Message 3	Save Settings	Match CWR WPM
F4	Play Message 4	CW Practice	Set CWR Display Mode
F5	Play Message 5	Toggle Farnsworth	Toggle Contest Spacing
F6	Play Message 6	Toggle Sidetone	Modify Keyer mode
F7	Play Message 7	Toggle XMIT Mute	Toggle Autospace
F8	Play Message 8	Toggle Tune	Change Output Port
F9	Play Message 9	Fast WPM 1	Swap Paddles
F10	Play Message 10	Fast WPM 2	Not Assigned
F11	Play Message 11	Fast WPM 3	Get Volts
F12	Play Message 12	Fast WPM 4	Persistent Beacon
↑ UP	Speed +1 WPM	Not Assigned	Sidetone Freq Up
↓ DOWN	Speed −1 WPM	Not Assigned	Sidetone Freq Down
← LEFT	Decrement Serial #	Not Assigned	Reduce LCD Contrast
→ RIGHT	Increment Serial #	Not Assigned	Increase LCD Contrast
PGUP	Scroll Display Up	Not Assigned	Not Assigned
PGDN	Scroll Display Down	Not Assigned	Not Assigned
HOME	Return Display to Home	Not Assigned	Toggle Encoder ½ Step
TAB	Toggle Display View	Clear LCD Displays	Not Assigned
ESC	Abort Message	Not Assigned	Not Assigned
INSERT	Pause Transmit	Not Assigned	Not Assigned
END	Move display to end pos.	Not Assigned	Not Assigned
DEL	Send 8 Dits	Not Assigned	Not Assigned
Enter	Not Assigned	Parameter List Up	Not Assigned
Backspace	Delete letter on left	Parameter List Down	Not Assigned
Encoder	Adjust WPM	CWR Gain	CWR Noise Filter
Encoder+CTL	CWR Inter-Element Spacing Allowance		
Encoder Pushbutton	Turn K44 on and off		
Scroll Lock (2x)	Hard Reboot to Defaults (skip keyboard table)		
CTL-ALT-DEL	Soft Reboot to Defaults (master reset)		
CTL-ALT-INS	Select QWERT or AZERT Keyboard Mapping		

Table2: Buffered Command Chart

CTL	Command	Syntax
C	Call Message	^CF1
-	Decrement Serial #	^-
+	Increment Serial	^+
K	Key Down	^Knn nn=seconds
L	Load Loop Count	^Lnn nn=count
M	Merge Letters	^Mcc
N	Play Serial#	^N
P	Pause	^P
S	Set Speed	^Snn nn=wpm
D	Insert a Delay	^Dnn nn=seconds
X	Cancel Buffered WPM	^X
Z	DECSZ Loop	^Z

K44 CW Keyboard Theory of Operation

Block Diagram
As shown in the block diagram below, two PIC processors share the task of converting keystrokes to Morse code. U5, the console PIC, is responsible for retrieving keystrokes from the keyboard and determining what to do with them. U7 is the Keyer PIC which is controlled by the console PIC. Its main task is to generate Morse code, monitor the keyer paddle inputs, and communicate with the PSoC CW reader. The two PICs communicate over a serial interface running at 9600 baud. The Keyer PIC throttles the Console PIC via in-band flow control. A 4-kilobyte EEPROM memory, connected to the Console PIC's I2C interface, stores up to 12 messages, system settings, and holds the keyboard type ahead and LCD display buffers.
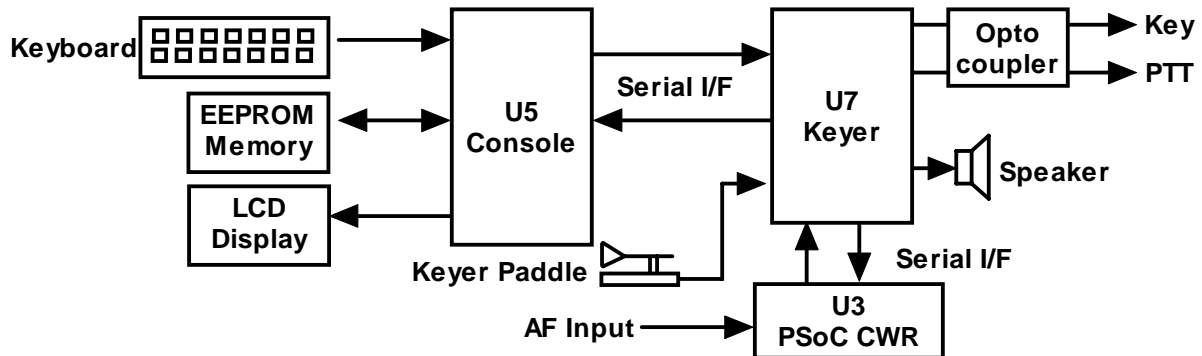
Figure 6 - K44 CW Keyboard Block Diagram

There are two types of data sent from the Console to the Keyer: Commands and Data. Commands modify the K44's operation in some way; changing operating speed, turning off sidetone, recording a message, etc. Data are letters, numbers, or prosigns that are to be sent in Morse. Data is processed differently than commands. Data is put into a type ahead buffer that allows the user to type faster than the Morse is being sent. The size of this buffer is about 200 characters and is a FIFO buffer (First In First Out) meaning that characters are taken out in the order they were put in. Since there can be a considerable delay from keyboard input to Morse output, commands bypass the input FIFO and are sent to the Keyer PIC immediately. This allows changes to be made while sending is underway.

Individual Blocks
The paddle inputs are connected to the Keyer PIC, the paddle takes priority over data coming in from the keyboard. This allows you to cancel a message and start sending by paddle right away. As mentioned before, the keyboard is connected to the Console PIC since its input generally has to be buffered in the EEPROM. The LCD is connected to the Console PIC to allow keyboard data and command prompts to be displayed. The K44 keeps two separate display buffers in EEPROM, one that tracks keystrokes as they are entered and a second which shows data as it is being sent by the Keyer PIC.

The Keyer PIC has three outputs, KEY, PTT, and sidetone. Both the KEY and PTT outputs are optically isolated from K44 power and are implemented with a solid state relay. Full control over PTT is provided to compensate for transmit changeover delay and hold keying between letters and words. The solid state relay will key practically any transmitter, vacuum tube or solid state. Sidetone, generated by the Keyer PIC, is buffered by a 2N2222 buffer transistor which drives an on-board mini-speaker, the volume is set by the on-board resistor R16.

A rotary digital encoder is connected to the Keyer PIC, this control is used primarily for speed control but it is also used for real time control of CW Reader settings such as gain and noise filtering.

The K44's LCD interface is a fixed format at 16 characters by 2 lines. The display allows the user to see what is being typed in while sending and also do basic editing. It is also possible to scroll back to view the last 14 lines typed in. The outgoing viewport can be selected by hitting the TAB key which allows the user to see outgoing Morse as it is being sent. The outgoing buffer is much larger at 125 lines. A cursor is shown when viewing the edit buffer, the cursor is not shown when viewing the outgoing buffer.

LCD Display Window Architecture
Display windowing data flow is best described by the following diagram:
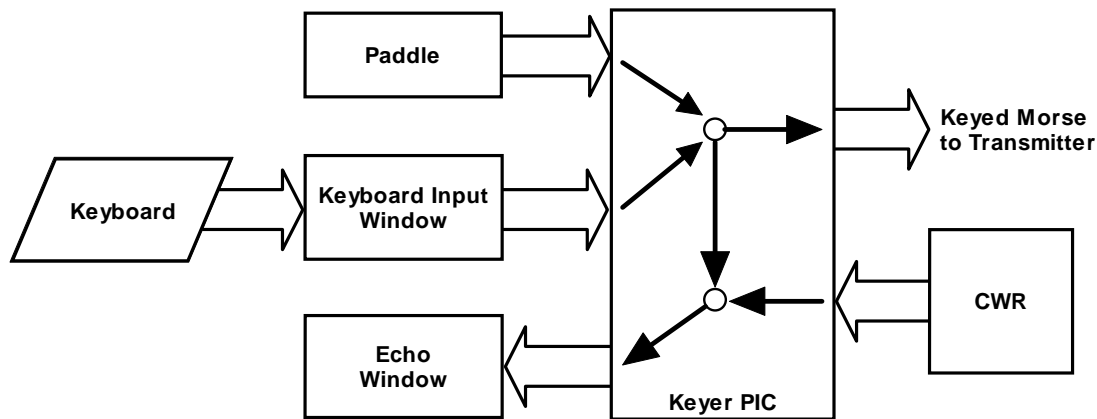
Figure 7 - K44 Display Window Diagram

Letters entered on the keyboard are placed directly into the Keyboard Input Window (KIW) this window has a direct correspondence to the input buffer described previously, In other words it shows what is placed in the input buffer. The console PIC takes data out of the input buffer and transfers it to the Keyer PIC where it is merged with letters entered on the paddles and then sent off to key the transmitter. As data is sent to the keying output it is echoed back to be displayed in the Echo Window (EW). When not in CWR mode this is easy to understand, the KIW shows what is being entered on the keyboard and the EW shows what is being sent in real time. The EW also shows what is being entered on the paddles. The default window is the KIW since you want to see what you are typing and occasionally look at the EW to monitor sending progress.

In CWR mode it gets more complicated since there are three different view modes. The normal mode is similar to above in that keyboard letters go into the KIW but the EW only shows what is being received by the CWR. The EW is the default view. In this mode it's not possible to see what is being sent because the KIW only shows keyboard entry and the EW only shows CWR reception. For some folks this is ok but most of us want to be able to monitor transmit progress, There are two ways to do this. In TX Monitor Mode (TXMON) outgoing letters are displayed in the EW along with CWR reception. CWR letters are in upper case while TXM is in lower case. If you just want to see the KIW, just TAB over to that and you can watch what you are typing in real time. (The EW only shows letters as they are being sent so it's not too helpful for those who like to type ahead. ASR mode automatically toggles to the KIW when you start typing on the keyboard, the EW is still the default. Now you can see the keyboard as you type and monitor the CWR when you stop typing. In ASR mode the outgoing letters are not displayed in either window. Now for those who want both, both TXM and ASR mode can both be active at the same time. This combined mode will toggle you to the KIW automatically as you type and show what is being sent in the KIW in lower case. Two notes about these modes, when running ASR it's useful to set a longer tail time to prevent the window from toggling between every letter. Also note that in ASR mode the window will toggle to the KIW when you use the paddles even though the paddle entry is not shown in the KIW.

K44 CW Reader Theory of Operation
The following block diagram shows the main sections of the K44 CW Reader. Audio from a receiver is filtered through an initial two pole, active bandpass, filter stage. The bandwidth of this stage is approx. 400 Hz which provides coarse out of band signal rejection. This stage also isolates and protects the PSoC processor from the large input levels. The rail to rail op amp handles large input amplitudes well and clips cleanly. Filtered audio is fed directly to the PSoC processor. This is a mixed signal device containing both analog and digital function blocks. These blocks, as well as the connections between the blocks, are programmable. This allows a very sophisticated design to be implemented in a tiny package. The clock that runs the PSoC is contained within the device and is set at 24 MHz. The signal chain inside the PSoC is described next. First the signal is passed through an adjustable gain amplifier to allow a boost for low level signal levels. Next, the signal is fed through a two stage 4 pole bandpass filter that is implemented with an SCAF filter. The center frequency of this filter is set to 725 Hz with a bandwidth of about 400 Hz. The filtered signal is then fed to a tone detector which is implemented in a DSP function block. The recovered dit and dah intervals are then timed and translated into ASCII letters which are sent to the Keyer PIC which in turn passes it directly to the Console PIC for display on the LCD. As part of the detection process, the amplitude

of the filtered CW signal is determined in the PSoC. This amplitude information is transmitted serially to the display PIC U6 which lights a five LED bar graph display.
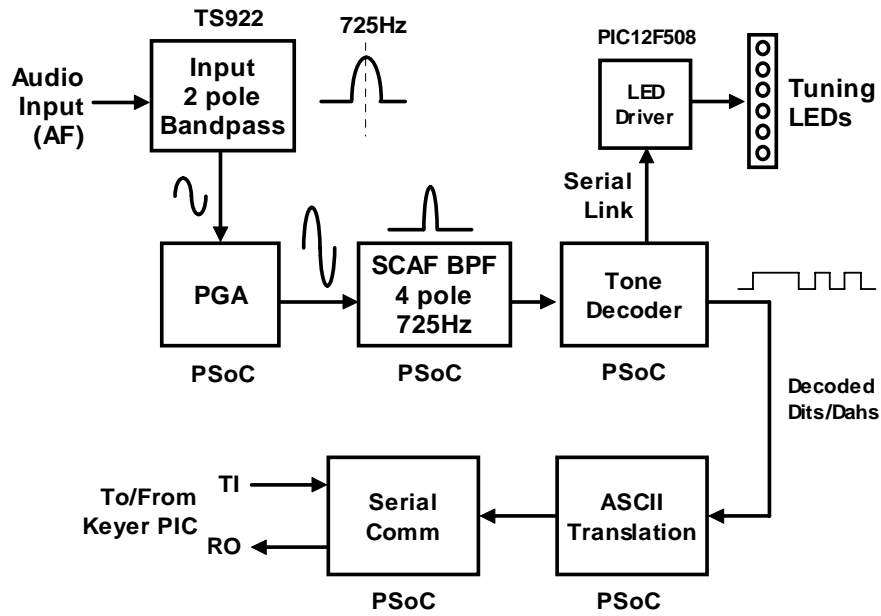

Figure 8 - K44 CW Reader Block Diagram

K44 Specifications

- Built-In PS/2 AT Keyboard Interface
- Iambic CW Paddle Interface
- PTT Output: Solid state relay +/- 300VDC
- Key Output: Solid state relay +/- 300VDC
- Outputs are optically isolated
- Adjustable lead in and tail delays
- Adjustable Speed 5-149 WPM
- Adjustable Weighting
- Adjustable Keying Compensation
- Built-In Sidetone Generator
- On Board Sidetone Speaker
- 16 Char by 2 Row LCD Display
- Rotary Encoder for fast WPM change
- 12 Message memories
- On/Off Pushbutton Switch
- Operating Voltage: 8-10 VDC

- On board regulated 5 volt supply
- Current: < 40 ma (less keyboard)
- Embedded commands in messages
- Iambic A, B, Ultimatic, SK, and "Bug" modes
- Built in CW practice modes
- Autospace
- Rx/Tx Speed Matching
- Automatic paddle watchdog
- Flexible Beacon Modes
- HSCW/QRSS Output Capability
- Farnsworth speed mode
- Extensive RFI filtering
- Keyboard Paddle
- On/Off Switch on Encoder
- Firmware controlled LCD Contrast adjustment

CWR Specifications

AF Input Level	100 mV minimum to 5V maximum peak to peak.
Input Audio Filter	2 Pole
PSoC Based Audio Filter	4 Pole
Tone Decode Frequency	725 Hz
Decode Method	Quadrature Correlation Demodulation
Decode Speed Range	10 to 45 WPM
Tuning Indication	Five LEDs frequency bar graph, auto squelch
Gain Settings	Eight gain levels
Noise Filtering	Eight Digital low pass filter settings
Inter-element Spacing	Four spacing intervals, narrow to wide
WPM Speed Read Back	Displayed upon command key press
ASR Mode	Automatic display buffer toggle
Console and Keyer PICs	PIC16F1825
CWR Processor	Cypress CY8C27143-24 PSoC Processor
LED Controller	PIC12F508 Microcontroller

Support and Warranty

The K-44 is fully warranted to the original purchaser by K1EL Systems against defects in materials and workmanship for one year after purchase. This warranty does not cover damage caused by accident, improper care, or lightning damage. Please contact us before returning your K44 for repair and we will issue an RMA. Please submit questions by e-mail to k1el.kitsinfo@gmail.com

Watch our website for latest updates and new products: http://www.k1el.com

While every effort has been made to insure that the K44 design is as complete and safe as possible, it is still possible to cause equipment damage or incur personal injury if:

1) **The K44 kit is not used as intended.**
2) **Is connected incorrectly.**
3) **Safety guidelines outlined in this document are not followed.**
4) **The K44 kit is modified in any way.**

K1EL Systems cannot be held responsible in these or other similar events.