

K45 CW Modem

with WinKeyer3 Controller

User Manual



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HAM RADIO KITS

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Introduction

The K45 is the latest member of the K1EL CW Keyboard product line starting with the K20 in 1997 to the most recent K44. The K45 incorporates a CW reader and has both USB keyboard and USB host interfaces. Two separate CW output ports are provided that can key almost any transmitter. This document will describe the features of the K45 including a detailed operation guide.

The K45 is housed in an all-metal chassis with a four line by twenty-character LCD display. A slanted face on the K45 enclosure presents the display for comfortable viewing. A rotary encoder with a push switch provides user input. The unit is powered by connection to a USB power source, this can be a USB charger, USB battery, or the USB port on a PC or laptop. The K45 draws low current, about 140 mA, so a standard phone charger will work fine.

List of K45 features

- WinKeyer mode allows the K45 to connect to a PC host logging or contest application
- 4 Line by 20-character LCD display with adjustable backlight and contrast.
- Multi-function status bar display
- Separate receive and transmit display windows with scrolling and optional word wrap
- Real time transmit progress window can be displayed instantly by hot key
- USB Type A connector for use with a standard wired or wireless USB keyboard
- Mini-USB connector for connection to a host PC or power source
- 1/8-inch audio jack for CW reader input with adjustable gain, spacing, threshold, and noise filter
- 1/8-inch stereo key output jack provides two separate optically isolated outputs
- Keying outputs can be configured as two separate keying outputs or a single output with PTT
- Optically isolated Solid State relay outputs key up to +/- 350 volts at 120 mA
- 1/8-inch iambic or single lever paddle input that also supports straight key input
- Single rotary encoder input with integral push switch
- On board sidetone speaker with adjustable volume and pitch
- ESD input protection and RFI suppression on all connectors
- Transmit keying speed range of 5 to 99 WPM.
- DSP based CW Reader speed operates from 7 to 60 WPM
- Two complete user setups each with message and configuration storage
- Twelve messages of 120 characters each for each of two users
- Iambic A, B, and Ultimatic paddle modes supported
- Adjustable letterspace and wordspace
- Adjustable keying weight, compensation, and dit/dah ratio
- Adjustable PTT lead-in, tail, and paddle hang times
- Firmware can be upgraded over USB

LCD Display

A high quality 20 by 4 LCD character display is used. The characters are large, well lit, and very easy to read. By employing an easy to use scrolling and windowing design, the display is used efficiently, and provides the user with many viewing options.

Status Line

The top line of the display is used for status feedback to the user.

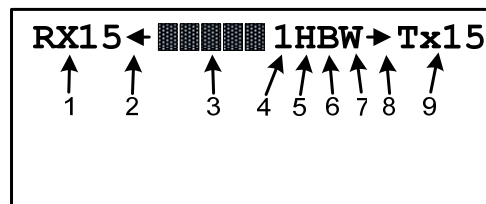


Figure 1 – K45 Display Status Line

Description of the elements contained in the status line:

- 1) Decoded Rx Morse input speed in WPM
- 2) Receive Window selection indicator, active when receive window is viewed
- 3) Real time signal amplitude bar graph with overload indication. Used for CWR tuning
- 4) User number indicator (1 or 2)
- 5) Transmit hold (pause) status indicator (flashing H)
- 6) B=K45 Transmit Busy, P=Paddle Transmit active
- 7) Message wait indicator (flashing W)
- 8) Transmit Window selection indicator, active when transmit window is viewed.
- 9) Transmit speed in WPM

Flash Status indicators

Several important status indicators briefly overwrite the normal status to indicate status or mode changes. The message will automatically be cleared, and normal status will return after a few seconds.

Some of these indicators are:

- 1) Parameter change by hot key
- 2) ESC has been pressed and the K45 is waiting for a command entry
- 3) BEG or END of a scrolled window

The three text lines below the status line are used mainly for receive and transmit character display but are also used for many other functions.

CW Reader Module (CWR)

A very good CW reader function is built into the K45. Morse audio from a receiver is fed into the CWR which then detects, decodes, and displays it on the LCD display. There are four CWR settings available to the user to compensate for receiver audio level, noise, noise filtering, and signal thresholding. These settings can be adjusted in the configuration menu or by special "hot" keys. The CWR is discussed in great deal in the K45 Quick Start section starting on page 32.

K45 Window Modes

There are two main display windows; a transmit window and a receive window. The transmit window shows letters as they are entered on the keyboard to be transmitted. The receive window show letters as they are received by the CWR and decoded. The transmit display holds 16 lines (320 letters) and the receive window holds 64 lines (1024 letters).

In both windows, once entry reaches the end of a line, the display is automatically scrolled up and the cursor is moved to the left of a new line. An optional word wrap mode can be enabled to break the line at word boundaries (this setting is in Configuration Menu #5) If word wrap has been enabled then an entire word will be carried over to the new line. Enabling word wrap applies to both Rx and Tx windows.

It is easy to toggle between receive and transmit windows using the TAB key and it's easy to identify which window is active. There are two arrows displayed on the status line. When the Rx window is displayed, a left arrow will point to Rx WPM on the left side of the status line. When the transmit window is active a right arrow will point to Tx WPM on the right side. Another clue is that only the transmit window has a visible underline cursor marking the text insertion point. In general, the user would keep the display on the receive window to monitor stations and then switch over to the Tx window to enter text to send.

ASR (Automatic Send/Receive)

When ASR mode is active, the display is toggled to the transmit window automatically while typing and then will return to the receive window after a pause. If the user chooses the Tx window with the TAB key, the display will always stay on the transmit regardless of the ASR setting.

Fast Tx View

It is common for the user to type ahead of the current transmit position or to queue up a long message. Since the Transmit window does not show transmit progress, Fast Tx View is provided to display a real time view of what the K45 is transmitting. The user presses the Windows key down (this key is usually located between the CTL and ALT keys) and Tx view is activated. When the key is released, the display goes back to the previous window. Fast Tx View is only available while viewing either the Rx or Tx windows. Fast View is ignored for utility menus such as Configuration, Key mapping, Serial number setip, or during CW practice. To provide maximum screen density, word wrap is disabled in fast view. Fast View only shows the last three transmitted lines, scrolling back is not supported.

Display Window Adjustment Keys

PGDN - Scroll Window Down

The current display window is scrolled down so that older text can be viewed. Even though the active text insertion position may be out of view, it is still being updated in the background so that incoming text is not missed. **BEG** will be flashed on the status line when trying to scroll beyond the start of a window buffer.

PGUP - Scroll Window Up

The current display view is scrolled up so that newer text can be viewed. Attempting to scroll ahead of the start of text will cause **END** to be flashed on the status line.

HOME - Go to the beginning of the text window

This will display the oldest text in the buffer.

END - Go to end of text window

This will return the display the active entry point for new text.

LCD Backlight and Contrast Adjustment

Both the brightness and contrast of the LCD can be adjusted easily. Refer to Configuration Menu #5 on Page 28 for details.

Keyboard Commands

K45 operation is controlled by ESC and/or Control commands. ESC commands are used to start configuration menus while control commands result in an immediate action.

ESC Commands

The user first presses the ESC key, releases it, and then presses the desired command. ESC will be displayed on the status line to let the user know that the K45 is waiting for a command entry.

ESC C – Configuration Mode

System configuration is divided into fine menus, each with eight setting options. The user navigates the menus using the left/right and up/down arrows. Moving extreme right or left will move to the next or previous menu, wrapping from first to last and last to first. An underline cursor indicates the selected item. The ENTER key opens that item up for editing and a submenu will show the current setting. The setting can be changed with the right/left arrows or by entering a new value on the keyboard.

Each menu item leads off with a number. **1:Tx WPM** for example. In this case, entering the number 1 will directly open the TX WPM entry. When finished with an entry, press either the enter key to save the new value or ESC to abort leaving the setting as it was. Values are stored in on board EEPROM so that they are preserved if you happen to disconnect power and are automatically restored on power up.

When the K45 is used without a keyboard, the rotary encoder is used to access configuration by pressing and holding the encoder button down until the menu appears.

Please note that:

- 1) A quick encoder press and release will bring up the message launcher menu which can be cancelled by re-pressing and holding the encoder button.
- 2) If the encoder is held after the configuration menu appears, K45 will go into low power sleep.

Once the configuration menu is up, the user can scroll through the various entries by turning the encoder. Press the encoder quickly to open an entry for editing. Turning the encoder will modify the entry. When finished, press the encoder to save the change return to the main menu. To leave the main menu and return to operational mode, press and hold the encoder button until the menu clears.

Configuration does not interrupt CWR input, all incoming text will continue to be added to the Rx display window in the background.

A full list and description of all the configuration menus is presented in Appendix A starting on Page 23.

ESC D – Dump Display Window(s)

The contents of the Rx and/or Tx windows can be sent (dumped) to a host PC for display or archiving. The following menu is shown and a selection is made using the left and right arrows:

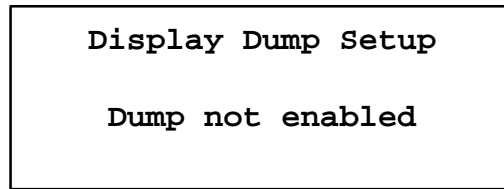


Figure 1a – Display Dump Setup Menu

- 1) Dump not enabled : This selection turns display dump off and is the default.
- 2) Rx Window Only: The contents of the CWR Rx window are sent to the host.
- 3) Tx Window Only: The contents of the K45 transmit window are sent to the host.
- 4) Rx & Tx Left/Right: The contents of both windows are sent, Rx in a left column, Tx right.
- 5) Rx & Tx Top/Bot: The contents of both windows are sent, Rx first then Tx.
- 6) CWR Stream Enabled: This enables a continuous stream of CWR Rx data to the host.

Selections 2 through 5 start when the user presses the Enter key. A message will be displayed while the transfer is underway. When complete, the menu will clear. There will be no further transfer until the user opens the menu again and starts a new one. Selection 1 is the default and is the idle selection.

Decoded Morse from the CWR can be sent to the host as it is received. To start the stream select item 6 and press Enter to start. The stream will continue until the user returns to the menu, picks Item 1 and then presses ENTER.

If there is no host connected, an error message will display and the menu will be cancelled. To leave the menu without making changes press the ESC key. There are several terminal programs that run on a PC and capture the window dumps, display them, and save them to a file. A very popular one is called TeraTerm and is free. The serial data settings are 19200 baud, 8 bit, with no parity.

ESC K - Key mapping Menu

The mapping of K45 keyboard keys to Morse characters can be customized. This feature is primarily used to customize mappings for international character support.

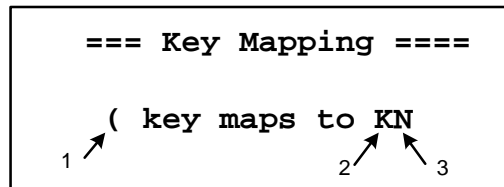


Figure 2 – Key Mapping Menu

As shown, there are three data entry points:

- 1) The character you wish to edit.
- 2) The character you wish to map it to.
- 3) Optional 2nd letter of a prosign.

When the menu is first shown, the cursor will be at position 1. Enter the key to remap here. When a key is entered, the Morse letter it currently maps to is shown at position 2. To change the mapping, use the right arrow key to move the cursor to position 2 and enter a new letter. Position 3 is optional, sometimes the target letter can only be represented as a combination of two existing letters, this is commonly known as a prosign. To create a prosign, simply enter the letter pair at positions 2 and 3. Otherwise just enter a space in position 3. To continue with a new mapping move the cursor back to position 1 and enter a new key to map. When finished, ENTER will save the mapping(s) to EEPROM. ESC will cancel the mapping and revert to the pre-existing mappings. Following the above example, after saving the mapping, the prosign KN (dah-di-dah-dah-dit) will be sent when the (key is pressed.

The K45 follows International Morse convention and defines punctuation as shown in the following prosign table. These are predefined by default in the key mapping table. Any of these can be changed simply by remapping them as described above.

=	is mapped to	BT	/	is mapped to	DN
<	is mapped to	AR	>	is mapped to	SK
;	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	AF	-	is mapped to	DU
`	is mapped to	WG	_	is mapped to	UK
:	is mapped to	OS	+	is mapped to	AR
#	is mapped to	HH	&	is mapped to	AS
*	is mapped to	MM	^	is mapped to	MN

Table 1 – Punctuation to Prosigns Defaults

Several keys are fixed to Q codes, it is not possible to re map these keys:

```
Shift-[ is mapped to QRZ      { is mapped to QRV
Shift-] is mapped to QSL      } is mapped to QSY
```

ESC-L - Clear both display windows

The contents of the receive buffer and transmit buffer will be cleared when this command is entered.

ESC-M - Message Launcher Menu

Since the F1 to F12 keys are not very descriptive, it's easy to forget which key a message is linked to. Message Launcher provides immediate hints for all the message keys in one easy to access menu. When a message is loaded, an eight-letter hint (tag), is entered for each message. Message Launcher formats the message keys and tags together to remind you where the messages are and then allows you to quickly launch a message of choice by entering a single numeric keystroke.

1 : CQX1	2 : RST
3 : NAME	4 : QTH
5 : 73	6 : PSE RPT
7 : RIG	8 : ANT

Figure 3 – Message Launcher Menu Example

Since only eight messages are shown per screen, the up/down arrows are used to view F9, F10, F11, and F12. If a keyboard is not connected, Message Launcher can be opened with a quick press of the encoder button. A cursor is displayed which can be moved by turning the encoder. Once the desired message is selected, press the encoder to start it. The K45 will remember the last selected message so that the next time the menu is brought up, the cursor will be placed there. If the Message Launcher is accessed by mistake, simply press, and hold the encoder button to cancel the launcher.

In the example shown in Fig. 3, simply press 3 to start the NAME message. After the message is selected, the message launcher will clear automatically. To cancel the menu, just press ESC.

ESC-P - Practice Mode

There is an extensive set of Morse practice tools built into the K45. Random Letter Groups, Echo Sending, and QSO simulation are included. A separate section devoted to Practice Modes starts on Page 14.

ESC-R – RTTY Setup Menu

The K45 can be configured to operate in RTTY transmit mode. The format is fixed to Baudot FSK but there are many other options. A separate section on RTTY configuration and operation starts on Page 17.

ESC S - Serial number Setup Menu

The K45 provides a means to send an incrementing serial number either from the keyboard or as part of a message. This menu provides a means to control the way a serial number is sent. Cuts are letters that will be substituted when serial numbers are sent, this reduces transmit time. As illustrated in Fig 4, the most common mappings are T for 0 and N for 9 since they take the longest to send. It's the user's choice as to how far to go with this, usually only one or two numbers are remapped although all of them can be changed if desired. Also included in this menu is leading zero suppression control. This can be turned on and off by hitting the space bar. One or no leading zeroes will be sent as specified by the LZ entry. The serial number can be preset to any value in Configuration Menu #5 (see page 28)

= S/N Cuts & LZZero =			
0:T	1:1	2:2	3:3
4:4	5:5	6:6	7:7
8:8	9:N	LZ =	OFF

Figure 4 – Serial Number Format Menu (LZ is changed by space bar press)

ESC-U - Firmware Upgrade

The 16 bit PIC processor, the WK3 IC, and the CWR's PSoC can all be upgraded in the field. Appendix C starting on page 34 is devoted to upgrading firmware. Please don't experiment with these commands, you could accidentally brick the K45 if you don't follow the update procedures correctly. (**Brick** means put the K45 into an inoperative state).

ESC-W - Start WinKeyer Mode

The K45 has the latest WinKeyer3 IC on-board, and this can be accessed and controlled by a host app running on a PC. If ESC-W is entered, the K45 operating system will be temporarily disabled, and the host USB port will be directly connected to the WK3 IC. The K45 will then operate exactly like a WKUSB or WKmini would in host mode.

In WinKeyer mode, the rotary encoder will function in a similar way to a normal WKUSB speed pot without physical end stops like there are on a potentiometer. The host application's speed pot min and max settings determine what the end stops will be.

Just like WKUSB, the K45 will appear as a serial com port to a host application. Here are the steps to follow to run K45 from a host application.

- 1) K45 must first be plugged into one of the PC's USB ports.
- 2) First enter ESC-W on the K45 to start WinKeyer Mode.
- 3) Determine the USB com port using Device Manager or WKscan.
- 4) The USB com port address is then entered into the application's WinKeyer setup dialog box.
- 5) When WinKeyer mode is started on the K45, a **Port Closed** status is displayed. This status will change to **Port Opened** when a host application is started, and it connected to the K45.
- 6) When the application is shut down it disconnects from the K45 and the status message changes back to **Port Closed**.

Some things to know about K45 WinKeyer mode

- 1) Unlike WKUSB, the K45 does not have any message pushbuttons.
- 2) There is no WKUSB standalone mode, please don't modify settings with WK3tools.
- 3) Upon entering WinKeyer mode, the K45's keyboard (if attached) is disabled and not used.
- 4) Like WKmini, the K45 provides two keying ports without PTT or one port with PTT.
- 5) The K45 encoder emulates a WKUSB speed pot as close as possible. It generates one WPM change per click. If you turn the pot extremely fast, the K45 may miss a step.
- 6) The K45 must be in WinKeyer mode before a USB com port will show up on the PC.
- 7) A *Host Not Found Error* is displayed if WinKeyer mode is started without an active PC host.

To exit WinKeyer mode, close the host application and then press the encoder pushbutton. This will return control of the WK3-IC to the K45 controller.

ESC-H – ESC Help Menu

This brings up a brief list of the ESC commands. Each description is intended to be just enough to jog a user's memory. Use the up/down arrows to view all the selections the menu. If the command letter is entered, it will be run directly. Otherwise press ESC to cancel the menu.

Control Commands

To issue these commands, the user holds the CTL key down while pressing the specified key. Even though the commands are shown in caps, the shift key does not need to be pressed.

CTL-C – Start Fast Callsign Capture

A callsign can be captured and saved while it is being sent on the paddles. A detailed description of this function can be found on page 10.

CTL-E- Send Error Dits

Eight dits will be sent to signify a CW error. This a buffered command causing a # character to be placed in the transmit buffer. Instead of ^E, the user could just enter a # directly.

CTL-D - Decrement Key Weighting**CTL-I - Increment Key Weighting**

^D will decrease weighting by one percent and the ^I will increase weighting by one percent. There are hard stops at 25% min and 75% max. Value changes are flashed on the status line, **W:55** for example, and automatically updated in the User's configuration.

CTL-L Clear currently displayed text window, either Rx or Tx

Only the window in view is cleared. If the transmit window is in view and actively sending text, transmission will stop immediately. Use ESC-L to clear both windows at once.

CTL-M - Match Tx speed to CWR Rx speed

A user usually wants to respond to someone they are copying via the CWR at the same WPM speed. When this command is entered, the transmit speed is immediately changed to the current CWR Rx speed.

CTL-N - Play Serial Number

Use this command to insert the serial number into the text stream. If there is text in the buffer ahead of the command, that text will be sent before the serial number. The serial number is automatically incremented after sending it. For information about inserting a serial number into a message see **IN** in the buffered command section on page 12. The left and right arrows directly adjust the serial number up or down.

CTL-T - Tune

This places the K45 in tune mode which forces a constant key down condition. Sidetone (if enabled) is turned on and the configured output is turned on as well. The user has the option of selecting 50% duty cycle by way of an entry in Configuration Menu #2. Tune remains on until the user presses space, CTL-T, the paddle is pressed, or the 10 second tune watchdog timer expires. If in Key1 & PTT mode, mode both the KEY and PTT outputs are turned on. Only one output is turned on in Key1 or Key2 modes. CWR is muted while Tune is activated. BW will be displayed/flashed on the status line to indicate tune is in effect.

CTL-U - Change User

As mentioned previously, multiple user setups are supported. The current firmware supports two users. The user is toggled between 1 and 2 every time **CTL-U** is pressed. When the user is changed a brief user message is flashed on the status line while the current configuration is changed. Each user has their own settings and message list.

CTL-X – Insert Exchange Message

This will insert the message string <F12:WRKCALL> DE <F11:MYCALL> into the transmitted stream. It is treated as a buffered message and will be sent after any text before it is sent. MYCALL resides in slot F11 and WRKCALL resides in slot F12. WRKCALL can also be entered using the fast capture feature, see pg. 10. A slightly faster way to enter this command is with the ENTER key.

INS - Pause Transmit (Insert Key)

This key is pressed when the user wants to temporarily stop transmitting. Whether the K45 is sending a message or using the type-ahead buffer, transmit is immediately stopped and held until the user presses **INS** (insert) again. A flashing **H** will be displayed on the status line while transmit is held. If the user enters

DEL or text on the paddle, pause will be cancelled and any text that had been held will be cancelled.

DEL - Cancel Transmit Buffer (Delete Key)

When the Delete key is pressed, transmit is immediately stopped and the remaining buffered data is deleted. For example, if the user accidentally starts a message but wants to cancel it, the Delete key should be pressed. The user can also cancel an active buffer by quickly pressing and releasing the paddle.

Other Key Commands

Right & Left Arrow Keys – Increment or Decrement the Serial Number

Since the serial number is automatically incremented when it is sent, the user needs a way to control incrementing and decrementing in a contest situation. Often a serial number is not confirmed and needs to be repeated and the user would need to decrement the serial number before resending it. In a similar case, the user may enter a serial number by paddle or keyboard bypassing the automatic serial number generator. For these reasons, an easy, manual way to modify the serial number is necessary.

Up and Down Arrow Keys - Change Transmit Speed Shortcut

The Up key increases the speed by one WPM and the Down key decreases speed by one WPM. Value changes are automatically updated in the User's configuration settings and status line.

CTL-Left & CTL-Right - CWR Audio Gain Adjustment

While copying a station, it is essential to be able to adjust the CWR gain to bring up a weak station or attenuate a strong station. Hold the Control key down and press the left and right arrows to cycle through eight gain levels. As the gain is being modified, new values will be flashed on the status line as **CG:n** where n is a value between 1 and 8. Changes are automatically stored in configuration memory for the current user. Generally, the best gain setting provides a wide swing in detected amplitude without over-driving. A plus sign (+) in the signal amplitude bar graph indicates overdrive and should be avoided. For best results, adjust the gain so that the loudest signal barely lights the right most LCD bar. The default gain setting is 4.

ALT-Left & ALT-Right - CWR Noise Filter Adjustment

Hold the ALT key down and press the Left and Right arrows to cycle through eight filter levels. As the filter is being modified, new values will be flashed on the status line as **CF:n** where n is a value between 1 and 8. Changes are automatically stored in nonvolatile configuration memory for the current user. The noise filter dictates how the CWR will respond to short impulses of a specified width, Larger filter values lower the response of the filter. A slower filter can reduce the maximum received WPM speed. The default noise filter setting is 4.

CTL-Up & CTL-Down - CWR Threshold Adjustment

The level of background noise can vary from day to day and even hour to hour. The CWR's noise threshold can be easily adjusted to compensate. If the band is very noisy, the threshold should be increased to prevent false letter detection. (This reduces the display of E's, T's, and I's). When the band is very quiet you can lower the threshold to allow better weak signal detection. This isn't without limitations. Raising the threshold too high can cause signals near the noise floor to be ignored. However, a higher threshold will allow strong signals to be decoded well in noisy conditions. New values will be flashed on the status line as **CT:n** where n is a value between 0 and 9. Changes are automatically stored in nonvolatile configuration memory for the current user.

ALT-Up & ALT-Down - CWR Spacing Adjustment

This helps compensate for incorrect spacing between dits and dahs which can cause letters to be run together or words broken apart. There are ten settings which are adjusted by holding the **ALT** key down while pressing the up and down arrows. Zero indicates normal spacing. Selecting values less than zero will tighten spacing. This helps with: U R R S T I S. Spacing adjustment greater than zero will spread letters out. This helps with: URRSTIS5NN. As the value is changed, it is flashed on the status line as **CS+n** or **CS:-n** where n is the adjustment setting. This feature has its limits, you will encounter operators who choose to use very large or small letter spacing which the K45 is not able to correct.

K45 Programmable Messages

There are 12 programmable messages per user, each message can be up to 120 characters long. For very long messages, multiple messages can be chained together. Messages are assigned to the function keys F1 through F12. Pressing one of these keys will play the message. Messages can be stacked, in other words, if you press F2 three times in a row, the message in F2 will be played three times. You can even

stack different messages on top of each other, for example: F2 F2 F3 F1. The K45 allows up to 8 stacked messages, if more than this are added, the last one entered is stored.

Editing messages

Hold the shift key down while pressing a Function key (F1-F12) and that message and tag will be read in for editing. The user edits the message in the familiar way using the Up/Down/Left/Right, Home, End, backspace, and delete keys. In addition, Shift-Left and Shift-Right move the cursor by word, Shift-Home moves to the beginning of a line, and Shift-End move to the end of a line. To quickly clear either an entire message or tag, use Control-C.

```

EDIT F1: CQX3
CQ CQ CQ DE WA1XYZ
WA1XYZ WA1XYZ K_

```

Figure 5 – Message Editor Example

There are six 20 letter lines allocated for each message for a total of 120 characters. Since only three lines are displayed at a time, use the up/down arrow keys to view them all. Word wrap is not enabled in the message editor, this provides the most efficient use of limited display real estate.

Message Tag

The top line of the message edit window shows the current message tag. A tag is an eight-character identifier that is shown in the Message Launch Menu (ESC-M). For F1 to F10, the initial tag is TAGn where n is the message number. The initial tags for F11 and F12 are MYCALL and WRKCALL. Any of these tags can be changed if desired. The most common use of F11 and F12 are with the automatic exchange generator, as discussed in the next section. These slots can be used just like any other slot.

When the cursor is moved up to the top line, the cursor will snap to the tag for editing. Use ^C to delete the current tag or move the cursor to the end of the tag and backspace left to delete letter by letter. Use the down arrow to leave the tag and get back to the message. When message editing is completed, use Enter to save the new message or ESC to cancel the edits and revert to the original message and tag.

Fast Callsign Capture Feature

The K45 can store a callsign as it is entered on the paddles. Press either ^C or the star key on the numeric keypad and CLL will be displayed on the status line. Enter the callsign on the paddles and after a pause of one wordspace, it will be stored in message slot F12. What makes this powerful is that it is saved as it is being transmitted. So when calling someone, first press ^C, enter the callsign, and then continue on. Their callsign will be held in F12. If the user's callsign is loaded into message slot F11, a full exchange will be sent when either ^X or Enter is pressed. For example, if F11 is loaded with K1EL and WA1ABC had been captured into F12, ^X will send the string WA1ABC DE K1EL. Because F11 and F12 are normal message slots, they can be sent individually by pressing F11 or F12. The default tag is MYCALL for F11 and WRKCALL for F12 but these can be modified in the message editor.

Buffered message commands

A simple set of commands can be used to compose complex CW messages. A command is a letter preceded by the \ backward slash. Commands are inserted into a message to perform various functions.

For example, a speed change is implemented like this:

\S05SLOW TEXT **\S30**FAST TEXT**\R** will send SLOW TEXT at 5 WPM and FAST TEXT at 30 WPM

Or a key down as used for testing:

TEST **\K10** DE K1EL will send TEST followed by a 10 second key down followed by DE K1EL

When editing a message, a list of buffered commands can be displayed by entering \?. Scroll through the list using the up and down arrows. When a command is found, enter the command letter and it will be added to the message. This is a fast way to find a buffered command hint and its formatting. To cancel the help

menu, press **ESC** and the command delimiter \ is removed. Some commands, like **Wnn** require a two digit parameter. Don't forget to enter the parameters as this will cause the command to be ignored.

```

< Buffered Commands >
\D Decrement S/N
\Hn Set HSCW Speed
\I Increment S/N
```

Figure 5a – Buffered Command List Menu, use Up/Down to view them all

List of Buffered Commands

Jump to message (Buffered)

\Jn where n is a number 1-9 or letter A,B,C. F1-F9 would be **\1** to **\9**, F10 is **\A**, F11 is **\B**, and F12 is **\C**.

Here are two simple examples:

Load Slot F1 with: **CQ CQ \J3**
 Load Slot F2 with: **QRZ QRZ \J3**
 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**

Jump can be used to make a message loop:

Load Slot F10 with: **CQ CQ CQ DE K1EL K1EL K1EL \JA**

After sending **CQ CQ CQ DE K1EL K1EL K1EL** we loop back to the beginning and send it again. This will repeat forever until either paddle or **DEL** key is pressed. When composing a message like this, be sure to put a space or delay at the end, otherwise the first letter will be sent after the last with no word space.

Call a message (Buffered)

\Cn where n is a number 1-9 or letter A,B,C. F1-F9 would be **\1** to **\9**, F10 is **\A**, F11 is **\B**, and F12 is **\C**. The call command will jump to the specified message, send that message, and after the message completes the stream will return to where it was called from. It is more flexible than a jump to message. An example of this command is:

Load slot F1 with: **\C \C DE \B \B BTU OM KN**
 Load Slot F11 with: **K1EL**
 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. Message can be reused by substituting different callsigns in F11 and F12. By using F11 and F12 this way, the built in exchange feature (^X or ENTER) can be used as well (see "Insert Exchange Message" on page 8).

Set an HSCW Speed (Buffered)

\H<n> n=1 to 6 where n is a number representing the lpm rate divided by 1000. For example, **\H2** selects 2000 lpm and **\H4** selects 4000 lpm. Commonly used rates are 1000, 2000, 4000 and 6000 lpm in the USA and 1000, 3000, 4000 lpm in Europe.

HSCW is mostly used for working stations via Meteor Scatter propagation. This method of operation calls for short bursts of characters to be sent repetitively at high speeds for a predetermined period. The receiving station listens and records the sporadically received bursts and plays them back at a slow speed to decipher the Morse message.

NOTE!!: Remember to put a reset speed command **/R** at the end of a message to restore normal CW

operation when the message is completed.

HSCW Operation Hints: You must enable PTT for this function to work properly. Common practice is to key the transmitter with PTT and feed keyed audio tones into the microphone input. You can use the K45 sidetone output directly as a tone source as this is a keyed 2000 Hz tone in HSCW mode. Alternatively, you can use the K45 key output to key an external tone generator. (note need to look at the outputs, PTT is dropping between chars)

See <http://www.nitehawk.com/rasmit/> for more information about HSCW

/H1 K1EL BCON **\R** (K1EL BCON sent at 1000 lpm followed by WPM reset)

Although it's possible to send HSCW directly from the keyboard by entering the /Hn command before a string, the most efficient use of HSCW is to format a specific HSCW message.

Decrement Serial Number (Buffered)

\D - The five-digit serial number is decremented. If equal to 00000 it is not decremented.

Increment Serial Number (Buffered)

\I - The five-digit serial number is incremented. If equal to 99999 it is not incremented.

Key down for nn seconds (Buffered)

\K<nn> - The transmitter will be held in key down state until either the timer expires or **DEL** is entered. Two digits must be entered, as in 06 for 6 seconds. Maximum key down time is 99 seconds

ON \K05 OFF a 5 second key down will be inserted between ON and OFF.

Merge Two Letters into a Prosign (Buffered)

\M <C1><C2> - You can build "on the fly" prosigns with this command. Just enter **\M** followed by two letters or numbers and they will be merged: **\MAR** is sent as **AR**. If this command is entered on the keyboard, nothing will be sent until both letters have been entered.

Send Serial Number (Buffered)

\N - The current five-digit serial number is sent in Morse. If LZ is on (Serial number menu ESC S) all leading zeroes are suppressed so 00407 would be sent as **407**. The serial number menu is also used to map a number to a cut substitution. If T is mapped to zero, **4T7** would be sent.

Change Output Port (Buffered)

\O<n> - (1 or 2) Select the output port to transmit on. This command will only work when PTT is not enabled. In other words, select either Key1 or Key 2 in Configuration Menu #2:OutPort.

Pause Output (Buffered)

<string> **\P** <string>

K45 message transmission will be paused to allow the user to insert something and then continue. The response can be by keyboard or paddle. If by keyboard, the user must press **ENTER** to signal the end of the string. If by paddle the K45 will continue automatically after paddle entry stops for one wordspace time. The **DEL** key can be pressed to cancel the pause. Here is an example usage of this command :

UR RST IS \P = NAME HR IS STEVE

After playing **UR RST IS**, the K45 will pause to allow an RST report to be sent manually and then continue with the rest of the message. If using the keyboard, be sure to press **ENTER** to continue or **DEL** to cancel because the K45 will hang until that happens.

Set a QRSS Speed (Buffered)

\Q<n> - Where n is a single digit number 1-4 representing the QRSS rate.

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

For example, **\Q1** selects QRSS3 or 3 second dits and **\Q4** selects 60 second dits.

NOTE!!: Remember to put a Reset speed **\R** command at the end of a message that contains a QRSS

command to restore normal CW operation when the message is completed.

/S20/Q1 KEL /RK1EL BCON (*Sends KEL at .4 wpm followed by K1EL BCON at 20 WPM*)

Although it's possible to send QRSS directly from the keyboard by entering the **/Qn** command before a string, the most efficient use of QRSS is to format a specific QRSS message.

Reset Speed (Buffered)

\R – This will cancel a **\S**, **\H**, or **\Q** command and return to the current default WPM speed.

Change Transmit Speed in WPM (Buffered)

\S<nn> - Change Speed to nn WPM (nn = 05 to 99) two digits must be entered as in 08 for 8 WPM

Here is a message with multiple speed changes:

\S25 CQ CQ DE \S15K1EL K1EL *will send CQ CQ DE at 25 WPM and K1EL K1EL at 15 WPM*

Insert a delay (Buffered)

\W<nn> - Wait for nn Seconds (nn = 01 to 99) two digits must be entered as in 05 for 5 seconds

Here is a simple looping message beacon using key down and wait:

VVV \K05 DE K1EL \W60 \J1

Three V's, a 5 second key down, **DE K1EL**, with a wait of 60 seconds will repeat until cancelled with **DEL** or paddle press. Note the placement of spaces around the key down to separate it from the adjacent text.

Delays longer than 99 seconds can be specified by using the **\WM<nn>** variation which will pause for nn minutes. The maximum wait time allowed is 20 minutes.

Easy Beacon with exact timing (Buffered)

\Z<nn><str> - str will be sent at the beacon rate designated by nn in seconds. The time between beacons is set by the value nn and is independent of the time it takes to send str. A **\J** command is not needed at the end of the message. Two digits must be entered, as in 06 for 6 seconds. **DEL** or paddle press cancels.

A disadvantage of formatting a repeating beacon with **\W** and **\J** commands is that the time it takes to send the string is added to the wait time. It takes a lot of trial and error to get an exact beacon interval.

Easy beacon doesn't include the string time, it will repeat at whatever time you enter in the command.

Beacon delays longer than 99 seconds can be set by using the ZM<nn> variation of this command:

ZM<nn> Sets the beacon time to nn minutes. The maximum time allowed is 20 minutes.

Message Key Display

Message function keys are displayed on the LCD display in buffered command format. In other words, pressing F1 will insert **\M1** into the transmit buffer. The expanded message can be viewed in the Fast Tx View window by pressing the Windows key.

More Message Examples:

Send a string with an incrementing value:

Load F5 with: **COUNT IS \N, \W05\J5**

Assuming the serial number has been preset to 100 (by configuration menu), the F5 message will be sent as follows with a 5 second delay after each comma:

COUNT IS 100, COUNT is 101, COUNT IS 102, COUNT IS 103....

A message that runs at two different speeds and then resets to the original speed

\S10SLOW SPEED \S20FAST SPEED\RDEFAULT

A QRSS beacon message:

Load F3 with: \Q2\K05 EL FN43 WJ3

Morse Practice Module

The K45 has three practice modes that are very effective in helping a user improve their Morse skills.

Practice Menu

Press **ESC** followed by **P** to open the practice menu which is the starting point for all three practice modes. There are six options that configure practice operation. Navigate with the up and down arrows and change entries with the left and right arrows.

```

===Practice Setup===
1→Rcv Mode   Level 1 ←4
2→15 WPM     TxOut On←5
3→Show CW    Tone On←6
  
```

Figure 6 – Practice Setup Menu

- 1) Practice mode selection – There are three modes:
Rcv Mode repeatedly sends random 5 letter groups
Echo Mode sends groups of letters which the user echoes back to the K45 by paddle or keyboard
QSO Mode which is a very basic, on air, QSO exchange simulator with a contest option
- 2) Set initial Practice transmit operating speed in WPM. After starting a session, speed can be adjusted either by the rotary control or up and down arrows.
- 3) Show/Hide CW – Text sent during a practice session can be displayed if desired. When first learning Morse, it can be helpful to see letters as they are transmitted. As the user improves, it is more helpful to hide them. Even if the output display is turned off the user can override this by pressing the TAB key to view the transmit window.
- 4) Level – There are five levels of difficulty ranges in Rcv and Echo mode starting with the easiest letters such as E T A N and proceeding up to the full range of letters, numbers, and letters. The levels are shown in Table 2. Keyboard reply should be < for AR, > for SK, = for BT, and & for AS. When QSO practice is selected, this option changes to Contest Mode On/Off.
- 5) TX Out (On/Off) – Transmit output can be disabled during a practice session. This is a good idea to prevent broadcasting if the K45 is connected to a transmitter. Alternatively, the user may want to enable transmit for the purpose of keying an external code practice oscillator (see item 6).
- 6) Tone On/Off – This controls the K45's internal sidetone speaker which should be turned off when using an external code practice oscillator.

Rx and Echo Practice Levels

```

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

Table 2 – Practice Levels

The K45 will remember the last entered practice settings and will reload them when re-starting.

After everything is set up, the next step is to press **ENTER** and the practice session will start. While underway, the user can change the WPM speed with the Up/Down arrow keys or by turning the encoder. The **INSERT** key will pause practice and the **ESC** key will end practice. In modes where the user is entering

text by paddle, the reserved code di-dah-di-di-dit (**AS**) is used to pause and di-dah-dah-dit-dah (**AK**) is used to end the session. To look back and review transmitted text, press **INSERT** to pause the session and then use the **PGDN** and **PGUP** keys to scroll the lines of text. Press **INSERT** again and the display will automatically go back to where the session left off and practice will resume.

Receive Practice Mode

```

RX PRACTICE 15WPM
ASEFO QSMEF ZPOLK
YWMPL UM1MD LZ9BB
LKJNP Q4CXC WWQDF

```

Figure 7 – Receive Practice Display

Random five letter groups are sent continuously until the user either pauses or ends the session. The content of the groups is governed by the level set in the Practice Setup Menu. Test progress by hiding Tx and then copying some number of lines. When done, press **INSERT**, **TAB**, and then **PGDN** to go back and review what was sent and compare to what was copied. Resume by simply pressing **INSERT**.

Echo Practice Mode

```

ECHO PRACTICE 23WPM
A AS ASR ASRG ASRGG
W WZ WZ4 WZ4
W WZ WZ4 WZ4Q WZ4QX

```

Figure 8 – Echo Practice Display

The K45 sends a list of letters from the selected level and the user must repeat them accurately either by keyboard or paddle. Each trial starts with a single letter and progresses to a group of five letters by adding one letter at a time. If the user successfully echoes all five strings, the K45 will send **AR** and then start with a new group. If the user fails, the K45 will send eight dits and repeat that group until the user gets them all correct. **INSERT**, **TAB**, **PGDN** and **PGUP** are very useful here just as they were for Rx practice.

QSO Practice

```

QSO PRACTICE 15WPM
CQ CQ DE K5RF K K5RF
DE K1EL K K1EL DE K5
RF UR RST 5NN_

```

Figure 9 – QSO Practice Display

An interactive QSO experience is presented to the user. The K45 starts off with a CQ which the user responds to. Exchanges will continue back and forth simulating an actual on air QSO.

All callsigns, names, locations, etc. are purely fictitious and generated at random. The K45 is very unforgiving when it comes to letter and word spacing. If words or letters are run together, they will be ignored, and progress will be very slow. The user can choose to use the keyboard or paddles to respond. When using the keyboard, be sure to put a space after the K, KN, SK, or BK at the end of an exchange. This will help the K45 will detect the ending quickly. If this is not done, the K45 will still respond but only after a somewhat long timeout delay. **A full response to the initial CQ is expected** and must include the calling station's callsign followed by DE and your callsign. If you don't get this right the K45 will respond with a QRZ.

For example, in response to **CQ DE W1XYZ K**, I would reply **W1XYZ DE K1EL K<space>**

After the initial exchange, The K45 will respond to **BK** if you don't care to enter a full exchange on every go 'round. To end a QSO early respond with either **73** or **QRT** and that will speed things along; *TIME TO QRT* or *WILL SAY 73* works nicely. The session can be paused with the **INSERT** key or aborted by the **ESC** key. To review a session, press **INSERT** to pause and then use the **PGUP** and **PGDN** keys to scroll around the text. When the **INSERT** key is pressed a second time, the K45 will resume where the session left off. Depending on the timing of the pause, the K45 may ignore the last exchange.

The AI used in QSO Practice is very basic, it responds to certain key words in an exchange and will generate a semi-interesting QSO. It is not able to understand detailed questions. Remember its purpose is to help build speed and skills and is not a substitute for a real online QSO.

Between QSOs, the K45 mixes things up by randomly changing sending characteristics, speed, and even sidetone pitch.

Contest QSO Practice

Contest mode is selected in the QSO Practice Setup menu. It is essentially a simplified contest drill. The user will run a spot and respond to calling stations. The user's response is monitored by the K45 which is very unforgiving and expects the exact format be followed with exact spacing. Any errors will stop the drill.

When Contest is started, the K45 will set up and then print **GO!** on the status line. The user starts things off by sending an initial call. Here's an example response to GO!:

User sends:	TEST K1EL	which will be answered:	W4RTY
User responds:	W4RTY 5NN NH	the calling station answers:	5NN GA
User responds:	TU K1EL	a new station responds:	K3NB
User responds:	K3NB 5NN NH	the new station answers:	5NN MO
User responds:	TU K1EL	a new station responds:	WA5DDC

This continues until the user makes a mistake, the session is paused, or the session is cancelled.

```

GO!   QSO COUNT:27
TEST K1EL W4RTY W4RTY
5NN NH 5NN GA TU K1EL
K3NB K3NB 5NN NH 5NN MO

```

Figure 10 – QSO Contest Drill Display

A QSO counter on the status line will increment on every complete exchange. If the user enters a call wrong, doesn't use proper spacing, or misses an entry the drill will stop. STOP will be then displayed on the status line. If the user hits ENTER, the QSO count will be reset and a new drill will start.

Remember that this is a simple drill to practice accurate and well formed replies in a contest like situation. Many skills can be improved by using this mode of practice. If it starts to get boring, crank the speed up. When you reach 20 WPM, you are ready for real contest conditions.

RTTY Transmit Operation

The K45 provides a very stable and accurate RTTY FSK output which is easier to manage than AFSK interfacing since it directly drives a transceiver's FSK input. When RTTY is first enabled, transmitter FSK output is assigned to the ring of the output jack while transmitter key output is assigned to the tip. There are many options available for tailoring RTTY transmit for a particular radio. These will be described below. Before going any further, please note that the K45 is not capable of receiving and decoding RTTY live off air, it is strictly a transmit only device. An alternate means of decoding RTTY Rx must be supplied by the user. Several transceivers, currently available, decode and display Rx RTTY but do not have an easy way to transmit RTTY, the K45 would be a good match for these.

When the K45 is set to RTTY mode, it will transmit in Baudot only and Morse transmission is disabled. The transmit window acts the same way it does for Morse operation with the exception that Baudot strings must be delimited by square brackets. A starting [keys the transceiver and the user can then send Baudot on the keyboard. When finished, entering a] will unkey the transceiver ending transmission. it. For example:

```

RTTY          1      IDLE
[CQ CQ CQ DE K1EL K1EL
K1EL PSE K][W8RTY W8RTY
DE K1EL K1EL K]

```

Figure 11 – RTTY Operational Display

Using delimiters ensures that the transmitter is keyed and stable before starting FSK, an additional lead in delay time is usually required. Also, to prevent character chopping when transmit is turned off a tail delay is also usually required. PTT is asserted on the leading [and held till the trailing]. Any text keyed outside the brackets will be ignored. For typeahead press INSERT before entering the delimited string and when ready to send, press INSERT a second time. After sending has started, the forward slash character / will clear the transmit buffer and RTTY transmission will stop immediately. The right brace } will force a CRLF sequence: CR CR LF LTRS. (The ENTER key will also generate a CRLF).The left brace { will initiate an RYRYRY test pattern that runs for a line of 45 characters and the stops. All ASCII characters which map to Baudot characters are accepted and printed. The only non-printing Baudot characters acted on are the brackets [], slash \, left brace {, and right brace }. Commands relating to Morse are ignored. Those acted upon are shown below.

- | | |
|--------------------------|----------------------------|
| 1) Tuning command ^T | 2) Transmit Pause (INSERT) |
| 3) Clear Tx buffer (DEL) | 4) Set PTT Lead/Tail |

CRLF handling

While transmitting, a carriage return/line feed ends the current line and starts a new one. This can be handled in one of two ways.

- 1) A CRLF can be inserted manually using either the Enter or } keys.
- 2) Automatic CRLF can be enabled to automatically insert CR LF when the line length exceeds 45 characters.

RYRYRY Test

WK will send a long RYRYRY string automatically in response to a { character. It will automatically send CRLF at the start of the test string.

RTTY Setup

The RTTY Setup Menu is initiated by **ESC-R**. Two menus are accessed using the Up and Down arrows.

```

RTTY TRANSMIT SETUP1
RTTY On      FSK=KEY
USOS On      Reverse
Auto CRLF    Off

```

Figure 12 – RTTY Setup Menu 1

RTTY On/Off

When RTTY is on, K45 will only transmit RTTY Baudot as configured in the menus presented here. Morse function, including sidetone is disabled. Changes made to Morse related configuration will be recorded but not utilized until RTTY is turned off which will re-enable Morse. CW paddles are ignored when RTTY is on.

FSK Assignment

FSK output can be mapped to either the K45's Key output or the PTT output. The default, FSK=PTT, sets the PTT output to be FSK and the KEY output to transmitter key. This is the way most transceivers with a

separate FSK work and allows a user to run CW or RTTY without changing cables. When FSK=Key, the output is flipped, KEY output is FSK and PTT keys the transmitter. Lead-in and tail delay is applied the same way no matter which way FSKMAP is set. The most common setup on radios today is to allocate both FSK and key to an AUX connector.

USOS (Transmit UOS) On/Off

To improve transmit integrity at the expense of extra FIGS characters, USOS mode will send two FIGS characters whenever a figures character follows a space. This reinforces the operation of UOS at the receiver which forces a letters transition after every space.

Reverse/Normal

This controls the sense of the FSK output. In normal mode (Not Reverse), Mark is signaled when the FSK output is OFF, and Space is signaled when the FSK output is ON. In reverse mode FSK if on during Mark.

AUTO LF/CR On/Off

When Auto CRLF is on, the K45 counts the printable characters in a line and after 45 characters, an automatic CR/LF sequence will be inserted after the next space. The character counter is reset after CR/LF. This is a very valuable feature for conversational RTTY. The operator can type away and not have to worry about running over at the end of a line.

<p>RTTY TRANSMIT SETUP2</p> <p>Baud Rate 45.45</p> <p>Stop Bits 1.5</p> <p>Diddle Ltrs</p>
--

Figure 13 – RTTY Setup Menu 2

Baud Rate

The K45 supports three operational speeds, 45.45 (60 WPM) 50 (66 WPM) and 75 Baud (100 WPM)

STOP Bit Control

There are two possible settings, 1.5 or 2.0 stop bits. This essentially sets the delay between letters sent in Baudot mode.

Diddle Control

If Diddle is enabled, a constant stream of LTRS or blanks will fill idle transmission time as soon as a leading bracket [is entered on the keyboard. It will stay active until a trailing bracket] is entered. A user always starts a stream by starting with a leading bracket. They can then type at leisure knowing that diddle will fill the empty space. Either LTRS or blanks will be sent as specified. There are three choices, Diddle Off, Diddle with LTRS, and Diddle with Blanks). Most ops send a Baudot blank (0x00) for the diddle, but LTRS (0x1F) is often used instead.

Miscellaneous Information

CTL-ALT-Enter Clear EEPROM and Restart

This causes a Master Reset of the K45, clearing EEPROM, and reloading factory settings. Be careful when using this because it will erase all your Messages, Cuts, and Key mappings. Factory settings are:

Speed = 15 WPM	CWR TXMON off	Sidetone=800Hz
Autospace Off	Extra Space = 0	Paddle Hang = 0
Paddle Mode = Iambic B	1 st Extension = 0	Letterspace = 0
PTT Delays = 0	KeyComp/Weighting normal	Word Space = 7 dits
CWR Gain = 5	Dit/Dah Ratio=50 (1:3)	Serial Number = 0001
CWR Filter = 6	PaddleSample=50(1 dit)	Sleep time = 15 mins
CWR Threshold = 5	Keying Output=Key1	Paddle Watchdog = On

Progress messages are displayed as different sections of EEPROM are initialized for each user, there is only one keyboard mapping table shared by both users, so map is only displayed for User1:

```
USR1: MAP KBD MSG
USR2: KBD MSG
```

Preserving Settings

Configuration changes are stored in EEPROM so that they are preserved when power is shut off.

CTL-ALT-DEL Restart

This causes a power on reset of the K45. The current mode is cleared, and all settings are reloaded from EEPROM. This is equivalent to power cycling the K45.

Paddle Watchdog

The K45 has a built-in 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 sound allowing you to detect the condition (sidetone needs to be enabled). Paddle watchdog can be disabled in Configuration Menu #3:PDLwatch.

Running the K45 without a keyboard

The K45 can be operated without a keyboard. It will automatically select the receive window since a transmit window is not required in paddle entry mode. A quick press of the encoder brings up the message launch menu (see page 6).

To make configuration changes, press and hold the encoder button down until the configuration menu appears. Turn the encoder to select a configuration setting and then press the encoder to select that item for editing. Next, turn the encoder to make changes and then press the encoder button to save the new setting. To exit configuration editing, press and hold the encoder button just until the menu clears. If the encoder is held too long it will power down the K45.

Practice and WinKeyer modes are selected from the configuration menu. Practice can be set up using the encoder and operated with the paddles. To leave Practice, enter the prosign KN on the paddles. This will take you back to the normal K45 operational screen. Neither paddle nor keyboard is required for WinKeyer mode. Just select it from the menu and exit WinKeyer Mode by pressing the encoder.

Using a Straight Key with the K45

The K45 can be set up to work with a straight key. Wire the key to an 1/8" stereo plug as shown below. You must use a stereo connector and the ring must be left unconnected. Once the cable is ready, plug it into the K45 paddle input jack and then select **Straight** key mode in Configuration Menu #2:KeyrType.

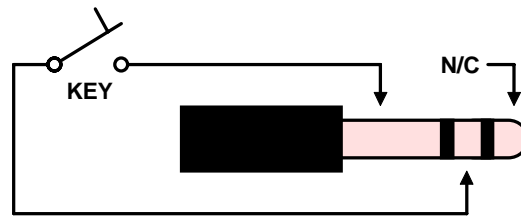


Figure 14 – Straight Key Input Connections

Unlike the K44 and other CW keyboards, the K45 fully supports straight key input for all modes. The user can run Echo and QSO practice from a straight key as well as normal on air transmit. Straight key input will be displayed in the transmit window just like paddle input would be. Neither straight nor iambic input will be shown in the Fast Tx View window since that is reserved for type ahead and messages. It's not possible to buffer anything while entering letters on a paddle so viewing the transmit window is all that is needed. When text is entered on a straight key, the status line TX WPM readout will be updated with the user's straight key speed. This temporarily changes the transmit speed for keyboard entry as well so that if someone changes over from straight key to keyboard, the speed will be appropriate. If the user decides to go back to the default WPM, click the encoder back and forth once, and the keyboard speed will be restored.

Numeric Pad Operation Mode

When desktop space is limited, the K45 can operate with a small numeric keypad. Numeric Keypad operation is enabled by turning NumPad mode on in Configuration Menu #4:NumPad (see page 27). The numeric pad has two sets of key functions as determined by the NumLock key. For example, when NumLock is off pressing 7 will send the number 7, when NumLock is on the Home function is selected. Most pads have an NumLock LED that shows which set is active. In any case, NUML is flashed on the status line when NumLock is set to on.



Figure 15 – Numeric Pad Example

All the numeric pad key mappings, in both NumPad and normal modes, are shown in the following table.

Numeric Pad Key Mapping Table

Key	NumPad Mode Off		NumPad Mode On	
	NumLock Off	NumLock On	NumLock Off	NumLock On
/	/	/	Tab	Tab
*	*	*	Catch call	Catch call
-	-	-	Send Msg 10	Send Msg 10
7/Home	Home	7	Home	Send Msg 7
8/Up	WPM+	8	WPM+	Send Msg 8
9/PgUp	PgUp	9	PgUp	Send Msg 9
+	+	Send Msg 11	Send Msg 11	Send Msg 11
4/Left	S/N -	4	S/N -	Send Msg 4
5	5	5	Toggle Tune	Send Msg 5
6/Right	S/N +	6	S/N +	Send Msg 6
BackSpace	BS	BS	Send Msg 12	Send Msg 12
1/End	End	1	End	Send Msg 1
2/Down	WPM-	2	WPM-	Send Msg 2
3/PgDn	PgDn	3	PgDn	Send Msg 3
Enter	Enter	Enter	Send Exchg	Send Exchg
0/Ins	Pause Msg	0	Pause Msg	Pause Msg
000	Ignored	Ignored	Ignored	Ignored
./Del	Cancel Msg	.	Cancel Msg	Cancel Msg

Table 3 – Numeric Pad Key Mapping Table

With the set of keys available in NumPad mode, the user can send messages and control Pause and Cancel. The fast callsign capture function is activated with the * key as well as send exchange with the Enter key. NumPad mode should only be used with a Numeric Pad attached, since it affects some of the standard keyboard mappings.

PTT Operation

The K45 provides a separate output that is enabled whenever CW transmission takes place. This output is called PTT which is a misnomer since it has nothing to do with Push to Talk. In most cases the K45 PTT output is used to key a linear amplifier or antenna switch. In those cases, it's desirable to assert PTT in advance of keying (Lead In), hold throughout the keying interval, and then deassert it after keying is complete (Tail). Some amount of Tail Time must be set for Lead-In to work. If Tail Time is set to zero, then the lead in delay will activate between every letter. If Tail delay is set to bridge the gap between successive letters, then Lead In will work properly. These delays are customized depending on an individual station requirement to prevent arcing and protect receiver and transmitter inputs and outputs. The PTT output is only available for Port 1 when PTT is enabled. A special PTT delay called Hang is similar to tail but only is used for paddle sending. All of these delays are set in the configuration menus #1 and #2.

Immediate Command Chart

Key	Normal	Shift	CTL	ALT
F1	Play Message 1	Edit Messsge 1		
F2	Play Message 2	Edit Messsge 2		
F3	Play Message 3	Edit Messsge 3		
F4	Play Message 4	Edit Messsge 4		
F5	Play Message 5	Edit Messsge 5		
F6	Play Message 6	Edit Messsge 6		
F7	Play Message 7	Edit Messsge 7		
F8	Play Message 8	Edit Messsge 8		
F9	Play Message 9	Edit Messsge 9		
F10	Play Message 10	Edit Messsge 10		
F11	Play Message 11	Edit Messsge 11		
F12	Play Message 12	Edit Messsge 12		
↑ UP	Speed +1 WPM		CWR Spacing +	CWR Thresh +
↓ DOWN	Speed -1 WPM		CWR Spacing -	CWR Thresh -
← RIGHT	Increment Serial #		CWR Gain +	CWR Filter +
→ LEFT	Decrement Serial #		CWR Gain -	CWR Filter -
ESC		Start command entry		
INSERT		Pause Transmit		
DEL		Cancel Message		
Backspace		Delete letter on left in Tx Window		
PGUP		Scroll display up (View older text)		
PGDN		Scroll display down (View newer text)		
TAB		Toggle display view (swap Rx and Tx)		
HOME		Return display view to input line (BEG)		
END		Move display view to oldest line		
ENTER		Various functions depending on current mode		
Windows Key		Show Tx Progress		
Encoder Clockwise		Increase WPM rate		
Encoder Counterclockwise		Decrease WPM rate		
Encoder Pushbutton Quick Press		Show Message Launch Menu		
Encoder Pushbutton Long Press		Show Configuration Menu		
Encoder Pushbutton Very Long Press		Set K45 Power Down Sleep (power off)		
CTL-ALT-Enter		K45 Restart/Reload Factory Settings		
CTL-ALT-Delete		K45 Power on Reset		

Table 4 – Immediate Key Command Table

Buffered Command Chart

CTL	Command	Syntax
J	Jump to message	\Jn n=1-9, A,B,C
n	Call Message	\n n=1-9, A,B,C
D	Decrement Serial #	\D
I	Increment Serial #	\I
H	Set HSCW rate	\Hn n=rate/1000
Q	Set QRSS Rate	\Qn n=rate (see page 12)
K	Key Down	\Knn nn=seconds
M	Merge Letters	\Mcc
N	Play Serial#	\N
O	Change Output Port	\On n=1 or 2
P	Pause	\Pnn nn=seconds
S	Set Speed	\Snn nn=wpm
W	Insert a Wait	\Wnn nn=seconds
X	Cancel Buffered WPM	\X
Z	Easy beacon	\Znn<string> nn=cycle time

Table 5 – Buffered Command Table

Appendix A – Configuration Menu Layouts and Descriptions

This section will describe the configuration menus and the members of each. Configuration is accessed by pressing ESC followed by C. The various options are divided up into five menus each with eight entries. Use the right and left arrows to move between menu columns and the up and down arrow keys to move between rows. The selection will wrap from one column to the next in right or left directions. The menus will wrap from first to last and last to first which helps in moving from the first menu to the last menu quickly. Each entry in the menu is indexed by number 1 to 8. You can select this entry just by entering the number. Otherwise, the selection cursor is moved to the desired selection and the enter key pressed.

Alternatively, the Configuration menu can be reached by pressing and holding the encoder button down until the menu appears. Entries are navigated by turning the encoder. Once a desired entry is reached press the encoder once quickly to open that entry. The encoder is then turned to scroll through the allowable values. Once the value selection is complete, it is saved by pressing the encoder button again. It is not possible to cancel a selection made by the encoder. Instead the entry must be re-opened and the value set back to what it was. In either case, once the item is saved, control is returned to the main configuration menu. To leave configuration, press and hold the encoder until the menu is replaced by the K45 main window.

Configuration Menu #1

1:TxWPM	5:AutoSpac
2:Weight	6:WordSpac
3:LtrSpc	7:Pdl Samp
4:KeyComp	8:Pdl Hang

Figure 16 – Configuration Menu #1

1:TXWPM - Set the Speed in WPM

Set the transmit WPM speed to a rate from 05 to 99 WPM.

2:Weight - Set Keying Weight

Set the keying weight in a percentage from 50% to 150%. When set to 100 % 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. 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.

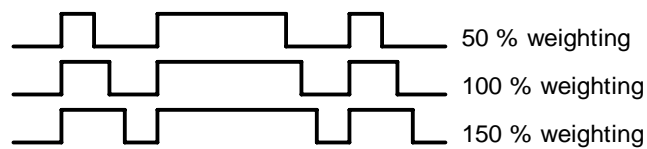


Figure 17 – Weighting Timing

3:LtrSpc - Set Extra Letterspace in Percent

Enter a value from 0 to 62, to specify an additional letterspace as a percentage of the default letterspace (3 dit times) to be applied between letters. The maximum adjustment is 62%.

4:KeyComp - Set Key Compensation

Keying Compensation specifies a fixed amount of time to be added to the length of both dits and dahs. QSK keying on modern transceivers can cause shortening of these elements which is especially noticeable at high speeds. The K45 allows the length of the elements to be increased uniformly to compensate for this. The adjustments are 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.

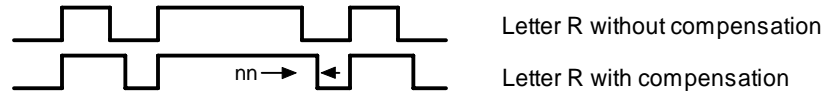


Figure 18 – Compensation Timing

5:AutoSpac - Enable/Disable Autospace Mode (applies to paddle input only)

When autospace is enabled and you pause for more than one dit time between a dit or dah the K45 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. The K45 has a paddle event memory so that you can enter dits or dahs during the inter-letter space and the K45 will send them as they were entered. With a little practice, autospace will help you to send properly spaced Morse code.

6:WordSpac - Word Spacing Control

Normally, the K45 spaces words by seven dit times. This can be adjusted in a range from 6 to 12 dit times. A tighter space speeds up exchanges which is helpful in a contest. Longer word space times aids in copying at very fast speeds where it provides extra space to separate words.

7:PdlSamp - Paddle Sample Time Adjustment (applies to paddle input only)

This adjusts the delay from the start of a dit or dah to when K45 starts looking for the next paddle press. Normally the K45 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 an extra dit or dah. If the delay is too long it slows you down because you must hold the paddle longer. 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 50 and 150%

At Sample Adjust = 50 = One Half Dit Time
 At Sample Adjust = 100 = One Dit Time (Factory Default)
 At Sample Adjust = 150 = One and One Half Dit Time

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

8:PdlHang - Set Transmit PTT Hang Delay Time (Paddle Hang)

The K45 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. Remember that Hang only applies to CW sent by paddle. PTT for CW sent by message is governed only by Tail delay.

Configuration Menu #2

1:PdlTone	5:PTT Lead
2:PdlSwap	6:PTT Tail
3:PdlMute	7:Tune 50%
4:OutPort	8:KeyrType

Figure 19 – Configuration Menu #2

1: PdITone - Sidetone Audio Control

There are many cases when the K45's internal sidetone is not needed or wanted. Using a transceiver's sidetone is one example or using an external code practice oscillator is another.

2: PdISwap - Swap Paddles

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.

3: PdIMute - Paddle Enable (Muting) Control

To prevent unwanted paddle entry, the paddle entry can be turned off. When paddles are turned off the K45 will not respond to any paddle input.

4: OutPort - Modify Output Port

K45's keying port connector can be configured in four different ways. The K45 can key one radio if PTT is required or two if PTT is not required. In addition, the transmit output can be turned off (Mute) if you want to use the K45 for CW practice and prevent transmitter keying. Sidetone is still active when transmit is muted.

The up/down arrows will cycle through four options which are:

- 1) Transmit output muted
- 2) Select Port 1: Tip Output = Key Ring Output = PTT
- 3) Select Port 1: Tip Output = Key Ring Output Off (No PTT)
- 4) Select Port 2: Tip Output Off Ring Output = Key (No PTT)

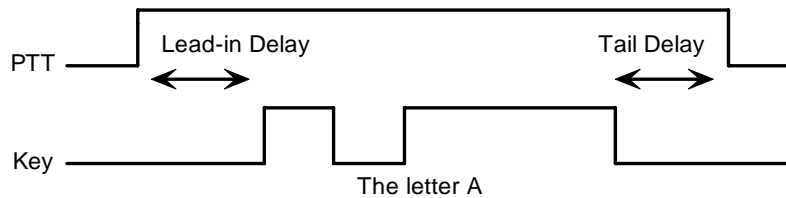


Figure 20 – Lead-In and Tail Timing

5: PTT Lead - Set PTT Lead-In Delay Time (0-99)

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.

6: PTT Tail - Set PTT Off Delay Time (0-99)

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

7: Tune 50% - Set Keying Duty Cycle for Tune Mode

Some Ops prefer to use a 50% duty cycle when keying their transmitter for tuning purposes. This reduces the power dissipation in the transmitter final and can contribute to a longer transmitter life.

8: KeyrType - Select Paddle Mode (applies to paddle input only)

The K45 supports six keying modes: lambic A, lambic B, three Ultimatic versions, and Straight key. In lambic and Ultimatic mode the K45 makes dits and dahs automatically based on which paddle you press. In either lambic mode, alternating dits and dahs are sent while both paddles are held closed. In lambic 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. In Ultimatic Dit mode, dits always take priority while dahs take priority in Ultimatic Dah mode.

In straight key mode the K45 accepts input only on one set of contacts (see fig 14). The user enters dits and dahs manually. The K45 will decode straight key input just like it does for paddle input. This applies to normal sending and for Echo and QSO practice.

Configuration Menu #3

1:DDratio	5:Sidetone
2:1stExtn	6:STvolume
3:Farnsw	7:ST Freq
4:ASRmode	8:PDLwatch

Figure 21 – Configuration Menu #3

1:DDratio - Set Dit/Dah Ratio (33 to 132)

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 (including me) recommend that you should always leave the ratio set at 1:3 which is the universal standard.

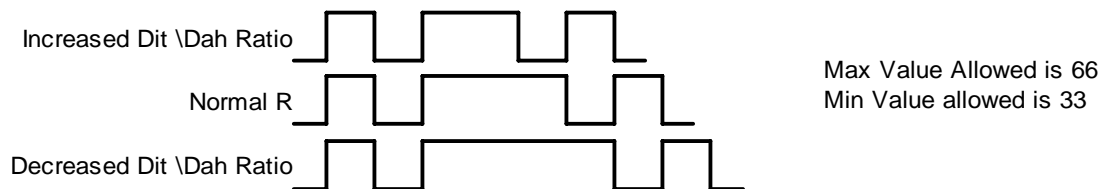


Figure 22 – Dit Dah Ratio Timing

2:1stExtn - Set 1st Element Extension

The K45 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 >30 WPM. The value is set in milliseconds and must be in the range of 0 to 99.

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 K45 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. This can be used for port 1 or port 2 since the PTT output is not required, only the timer is used. Unfortunately, it's not possible to set a different PTT timer for port 1 and port 2.

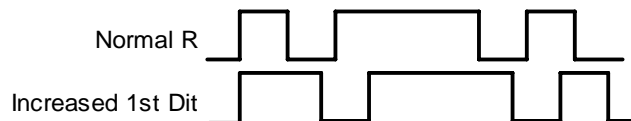


Figure 23 – First Element Timing

3:Farnsw - Toggle Farnsworth Sending

Farnsworth spacing is useful for CW practice because it encourages you to learn characters by sound not individual dits and dahs. Letters are sent at the Farnsworth speed while maintaining the default code speed. For example, if Farnsworth is set to 25 WPM and the operating speed is set to 7 WPM, individual letters will be sent at 25 WPM while spacing between letters is at a 7 WPM rate. To disable Farnsworth mode, set it to zero. Note that Farnsworth is activated only when it is set faster than the current sending speed.

4:ASR - Automatic Send/Receive Window Control

When ASR is enabled, refer to page 3, the display window will automatically change to the transmit window whenever CW text is entered by paddle or keyboard. ASR is active only when viewing the receive window.

5:Sidetone - Turn Sidetone On/Off

If you would rather use the sidetone already provided by your transceiver just disable the K45 sidetone, it's not required.

6:STvolume - Set Sidetone Volume

The K45 provides four different sidetone volume levels. While this isn't a wide range, it's enough to cover most situations. While the K45 sidetone is not extremely loud, users find that adjusting the sidetone frequency can often increase the apparent volume. This is due to two reasons, the sidetone speaker in the K45 has a response that varies greatly with frequency and secondly many hams, including me, find that some frequencies are easier to hear than others due to hearing loss.

7:ST Freq - Set Sidetone Frequency

The K45 sidetone will operate over a wide range of audio frequencies. The user enters a specific frequency and the K45 will match that frequency as close as it can. Usually, the resulting frequency is within a few percent of the request. For example an entry of 840 Hz will result in a setting of 844 Hz.

8:PDLwatch - Paddle Watchdog Control

To prevent a runaway paddle, the K45 has a built-in paddle watchdog that automatically turns keying outputs off after 128 successive dits or dahs, this command allows this to be disabled.

Configuration Menu #4

1:STboard	5:CWR Pwr
2:Sleep	6:CWR Gain
3:NumPad	7:CWR Filt
4:Spare	8:CWR Thrsh

Figure 24 – Configuration Menu #4

1:STboard – Enable Sine Tone Option Board

The ST board is a future accessory for the K45 which will be available from K1EL to generate sinewave side tone audio. Both the volume and pitch will be adjustable. The board will drive a set of stereo headphones or small speaker. This board is not currently available.

2:Sleep – Low Power Sleep Mode options

The K45 has an onboard timer that will start low power sleep after a specified length of time. There are 7 settings: 0, 10, 20, 30, 40, 50, 60-minute power down delay. If a delay has been to a non-zero value set and the K45 is not used during that time, it will go into power down sleep mode. The display backlight will be turned off and a SLEEP MODE message is visible in the display. All the onboard controllers go into low power mode. To wake the K45 up, simply turn the encoder. When Sleep is set to zero, the K45 will not go into low power mode. The K45 can be put into low power mode on demand by pressing ESC Y or holding the encoder button for 5 seconds after the Configuration Menu is displayed.

3:NumPad – Numeric Keypad Mode

The K45 can be set up to use a small numeric keypad for input. This is useful for contests with limited desk space. All twelve message keys can be accessed as well as several function keys. Num Pad mode is covered in detail starting on page 19.

4:Unassigned**5:CWR Pwr - Set CWR Power On/Off**

The CW Receive function is on by default. If the CWR is not going to be used, it's a good idea to turn it off to reduce K45 power consumption.

- 6:CWR Gain - Set CWR Gain Level
- 7:CWR Filt - Set CWR Noise Filter Level
- 8:CWR Thrsh - Set CWR Threshold

These are settings that can improve the quality of the CWR decode. They are discussed in detail in the K45 CWR Adjustments section on page 33.

Configuration Menu #5

```

1:BackLt  5:Serial #
2:Contrst 6:ShowRevs
3:Volts   7:WordWrap
4:CW Prac 8:WinKeyer

```

Figure 25 – Configuration Menu #5

1:BackLt - Set the LCD Backlight Intensity

The brightness of the LCD backlight can be adjusted from 10% to 99%. The higher the percentage the brighter the display.

2:Contrst - Set the LCD Contrast Level

Adjusting the contrast will tune display appearance to compensate for individual display differences.

3:Volts - Show Logic Supply Voltage

For diagnostic purposes, the K45's main logic supply voltage can be displayed. For proper operation, this voltage should be 3.3V plus or minus 5%.

4:CW Prac - Practice Launcher

CW Practice can be started from the Configuration Menu #5. This allows Practice to be started when no keyboard is attached to the K45. Move the cursor to this entry and simply press the encoder. The practice menu will be displayed, and all options can be set using the encoder. When everything is ready, press the encoder until the Practice Menu disappears and a practice session will start.

5:Serial # - 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 5-digit number from 00001 to 99999. Any non-numeric value entered will be ignored. Once the serial number is set you can increment, decrement, and send the serial number using buffered commands CTL-G, CTL-D, and CTL-N respectively.

6:ShowRevs - Display Firmware Revisions

For informational purposes all the system firmware revisions are displayed:

```
CA2 LC W312 PB0 (Console A2, LCD C, WinKeyer 3.12, PSoC B0)
```

7:Word Wrap - Set Word Wrap On/Off

When word wrap is on, new lines will be carried over on word instead of letter boundaries.

```

HERE IS AN          HERE IS AN ILLUSTRATION OF WORD WR
ILLUSTRATION OF    AP CONFIGURED OFF
WORD WRAP
CONFIGURED ON

```

8:WinKeyer - WinKeyer Mode Launcher

WinKeyer Host Mode can be started from Configuration Menu #5. This allows WK mode to be started when no keyboard is attached to the K45. Move the cursor to this entry and simply press the encoder. The WinKeyer menu will be displayed and the K45 can then be connected to a host application on a PC. To exit WK host mode, press the encoder. The launcher will abort if no host is attached. This prevents a hang condition if the K45 tries to connect to a host that isn't connected.

Appendix B - K45 Modem Quick Start

Interconnection Diagram

The following diagram illustrates a basic K45 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 RTTY mode, HSCW mode, or to key an amplifier or antenna relay. The keying output of the K45 is capable of keying virtually any solid state or grid block transmitter and is optically isolated from the K45 chassis for safety.

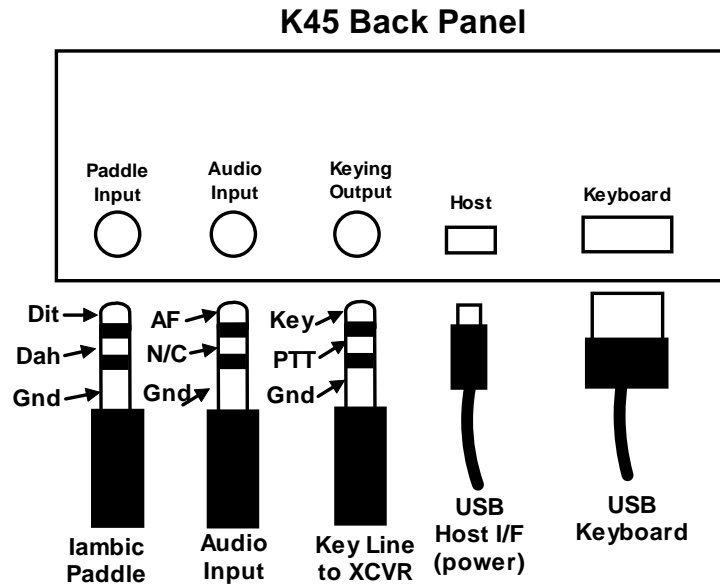


Figure 26 - K45 CW Keyboard Hookup Diagram

Which Keyboard to Use

The K45 will accept just about any wired or wireless USB keyboard. Surprisingly, most wireless USB dongles draw significantly more current than a standard wired keyboard. This may be a consideration for portable battery operations.

Power Supply

The K45 is powered through the host USB connector. This means it can be powered by connecting it to a host PC, a USB charger, or battery pack. The current draw of the K45 is low, about 120-150 mA so even a small USB charger will work fine. Please use a good quality USB charger, one for a dollar might not be a good choice.

Power On/Off

The K45 will power up as soon as it is plugged into a USB power source and will remain on. It can be put into a low power sleep mode by pressing the ESC-Y command or by holding the encoder button down for 3 seconds after the configuration menu appears. In sleep mode, the display backlight is turned off and other electronics set to a low power state. To wake the K45 up, simply turn the encoder one or two clicks. The K45 can be configured to automatically go into sleep after a specified time of inactivity. This option can be found in Configuration Menu #4:Sleep.

Sidetone Speaker

The sidetone speaker on the K45 provides audio feedback as Morse is transmitted. There are four sidetone volume levels that can be set via an entry in Configuration Menu #3:STvolume. In most configurations, the K45's sidetone should be turned off and the sidetone built into your transceiver will be used instead. However, K45 sidetone is useful for code practice or testing purposes. Please note that the internal speaker can't be used for receiver audio. (This was a common question from K42 and K44 owners)

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 26 above shows which pins on a stereo output 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 can be easily accomplished by selecting Key1 without PTT in Configuration Menu#2:OutPort). This will be compatible with almost all modern transceivers. The K45 output is open drain 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, with the plus (red) lead on tip, negative (black) 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 K45's metal enclosure.

Power it up

When the K45 powers up, the WK3 IC sends a R in sidetone which is followed by the system splash display. As shown below, the firmware revisions of each of three microcontrollers and LCD driver are displayed. If any of the controllers failed self-test, a warning message will be displayed. After about four seconds, the splash will clear and be replaced by the main display window. The K45 will install settings from EEPROM and attempt to attach a USB keyboard. The keyboard can be plugged or unplugged at any time, the K45 will detect the change and handle it properly.

```

K1EL K45 CW MODEM A2
LCD Driver Rev C
WK Rev 31.2
PSoC Rev B0

```

Figure 27 – Typical K45 Power On Screen

The power on display reports the firmware versions of the Console, WinKeyer, and PSoC microcontrollers. As shown, Figure 27 reports Console PIC revision A2, LCD driver revision C, WinKeyer PIC revision 31.2, and PSoC revision B0. If the K45 had been turned on after a system reboot (CTL-ALT-ENTER), Some additional messages will be displayed as the system data structures are rebuilt.

On first time power up or after CTL-ALT_ENTER, K45 configuration is reset to default values. Some of these you may like, others not so much. All settings are stored in EEPROM and can be modified easily through the Configuration Menus (press **ESC** followed by **C**). A detailed description of all the entries in the menu is provided in Appendix A. Since all changes made in Configuration as stored in EEPROM, the next time you power up the K45, it will start up the way you like. Initially all message slots are cleared, but as you load messages, they are automatically saved in EEPROM.

There are two display views that must be understood before we go any further. The initial view is the receive display which will show characters decoded by the built in CW decoder. If you press the TAB key, the display will toggle over to the transmit view. What is typed on the keyboard or enter on the paddles will be displayed in the transmit window. Whatever you type will be accompanied by internal sidetone. Notice that you can type ahead of the outgoing Morse. The Transmit window immediately shows what you type and what will be transmitted. If you want to see what is being sent in real time, press the Windows key and a third display will come up showing transmit progress. When you release the Windows key, the previous display will be shown. When you have finished and want to monitor what the other station is sending, Press the TAB key to swap back to the receive window and see what the CWR is decoding. If you want to type ahead while they are sending, press INSERT to pause transmit and then you can go ahead and type ahead. When the other station is done, press INSERT again and the transmit buffer will be sent. While it is sending you can continue to add more to transmit.

If you get tired of pressing the TAB key to go back and forth between the receive and transmit windows, enable ASR mode. This will automatically flip you to the transmit window when you type. Ref. page 27.

When you pause transmit with the INSERT key, a flashing H will be displayed on the status line. This is a reminder that you have paused transmit. If you want to cancel transmit that is underway, press the DELETE key. If your keyboard has LED lights, hold status will be displayed there as well.

Now let's load a message: Hold the SHIFT key down while you press F1, release both keys and the Edit Message window will appear. We will 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 **M1** will be shown. If you want to see the expanded message, press the Windows key, and watch it in the Fast Tx View window as it is sent.

You can adjust the sending speed at any time by turning the rotary encoder or pressing the up/down arrow keys. The new transmit speed will be displayed on the right side of the status line.

A handy command is Tune; press Control-T and the K45 will hold key and sidetone on until you press either any key on the keyboard or press a paddle. A 50% tune duty cycle can be selected by an entry in the Configuration Menu #2:Tune 50%.

One last thing to mention before we move on is how to use a set of paddles with the K45. You can enter Morse on the paddles at any time. If the K45 is sending a message or something from the outgoing queue, it will be cancelled by the first paddle press and you can break right in. If you want to exchange the dit and dah paddles, there is a setting in Configuration Menu #2 for that as well as other Paddle settings.

Audio Input for CWR Checkout

The K45 has a built in Morse Reader (CWR) that demodulates, decodes, and displays Morse from audio input that is connected to the K45's audio input. There are several guidelines for audio input that if followed will optimize the performance of the reader. The AF input is both low level and high impedance. It is intended to be driven by the audio line out from a radio receiver. It takes a little bit of work to accomplish this, but it is well worth the effort. Unlike a speaker output (which is both low impedance and high level) the line output provides a fixed audio level that is not affected by the radio's AF gain setting.

A radio's speaker output is not suitable for driving the K45 since in most cases when you plug a connector into the radio's speaker jack, the radio's internal speaker is disabled. The K45 does not have an internal speaker so there will be no audio to listen to. An option is to use a splitter cable and feed one side to a speaker and the other side to the K45. This will work to some degree but since the level is dependent on the AF gain control, you may have to adjust the CWR gain every time you change the radio's AF gain. So bottom line, use line out if possible.

SignalLink or similar devices that plug into the radio's AUX connector can provide an easy way to get at the line out signal. Most of these devices bring line out to a separate 1/8" monitor jack that can easily be connected to the K45.

CWR Basics

It's easy to operate the CWR but there are just a few things to keep in mind. First, make sure you are looking at the receive window. The filters in the K45 CWR are fixed at 725 Hz. For best results, adjust your receiver so that its passband is centered on 725 Hz. When you hear a station, slowly tune through it while watching the five bar LCD display on the status line. Watch for a peak movement to the right. You will see a peak as you pass through 725 Hz. Once you have the station tuned in properly, CW will be decoded and displayed. When audio overload happens, the right most bar will display a +. For best results adjust the audio level to avoid overload. The K45 has adjustable gain control so that you can adjust the audio level without changing your receiver's audio level. (see CWR Adjustments on page 33)

CWR Tuning Display

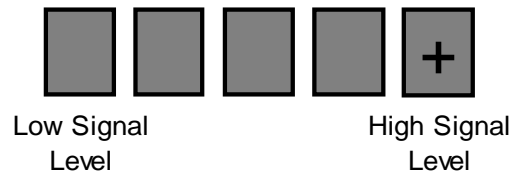


Figure 28 – CW Level Indicator

The LCD bar 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 slightly more difficult. The accuracy of CW decoding can vary as a signal fades in and out. With very deep fades, the K45 CWR may print an erroneous character or get out of sync for a couple of characters.

CWR Adjustments

There are four adjustments that can be made to the CWR decoder's signal path that can compensate for poor decoding conditions. Gain, low pass filtering, noise floor thresholding, and inter-letter spacing can all be adjusted to improve copy.

CWR Gain Adjustment

Signal gain is adjustable to compensate for low or high receiver level. The gain should be set to a point that is high enough to provide sufficient signal level to run the CWR without causing overload on very strong signals. Ten different gain levels are provided. A fast way to adjust CWR gain is to hold down the **CTL** key and press the left and right arrow keys. New values of gain are flashed on the status line: **CG:n** where n is a gain level between 0 and 9. There are ten gain settings. CWR gain can also be adjusted in Configuration Menu #4:CWR Gain.

CWR Low Pass Filtering

There is a digital low pass filter in the CWR DSP processing path. This essentially controls how very short impulses are processed. It can effectively heal elements that are broken up by very fast noise impulses. Ten levels of low pass filtering are provided. A fast way to adjust the CWR filter is to hold down the **ALT** key and press the left and right arrow keys. New values of filtering are flashed on the status line: **CF:n** where n is a filter level between 0 and 9. Filtering can also be adjusted in Configuration Menu #R Filt.

CWR Noise Floor Threshold Adjustment

Although low pass filtering on the K45 CWR will help decode a noisy signal, a very high level of background noise can degrade copy quality. Threshold adjustment can help with background noise by raising the signal threshold so that the CWR will ignore any signal below the threshold. This can help greatly when copying a station just above the noise level. Thresholding is adjusted by holding the ALT key down while pressing the up and down arrows. The updated threshold level is flashed on the status line as **CT:n** where n will be the threshold level setting. For best results, set the threshold just above the point where random band noise triggers the letter decoding. Threshold can also be adjusted in Configuration Menu #4:CWR Thrsh.

CWR Inter-letter Spacing Allowance

Another challenge is trying to copy poor sending technique; letters that are run together, poorly constructed, or varying widely in speed are not easy to copy by ear or machine. Adjusting the spacing allowance helps compensate for incorrect spacing between dits and dahs which can cause letters to be run together or words broken apart. There are ten settings which are adjusted by holding the CTL key down while pressing the up and down arrows. The updated spacing adjustment is flashed on the status line as **CS+n** or **CS:-n** where n will be the adjustment setting. Zero selects normal spacing. Selecting negative values tightens spacing to address run together letters, for example the case when UR RST prints as URRST. Positive values pull elements together, for example when an UR RST prints as U R R S T. Because this setting varies greatly depending on conditions, it is not stored in EEPROM but defaults to zero on power up.

CWR Rx WPM Rate

The current received WPM rate is displayed on the left of status line. 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 K45 CWR will report a faster speed. Although ARRL code practice is sent at 10 WPM the individual elements are sent at a faster speed.

CWR Rx Display

Morse decoded by the CWR is added to the receive text buffer and displayed in the RX display window. Since this is only three-line display, it is often necessary to scroll back to "review the log". The CWR always runs in the background decoding and buffering incoming Morse. So even if the display is scrolled back many lines, new incoming text is not missed. There are times when the CWR is not running:

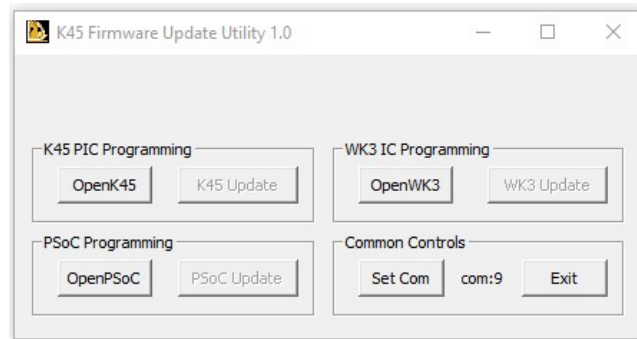
- 1) When the K45 is transmitting
- 2) The CWR is powered down
- 3) RTTY mode is active
- 4) During practice
- 5) During WinKeyer mode

Appendix C Firmware Upgrade

There are three programmed microcontrollers in the K45 that can be updated in the field. This menu presents the options for updating. The three controllers are the K45 Console PIC, the WinKeyer3 controller, and the PSoC mixed signal controller. To start the upgrade menu, press **ESC** followed by **U**. Then press the number of the controller to be upgraded. If you then wish to continue, verify the selection by pressing a capital **Y**.

DO NOT PRESS Y UNLESS YOU REALLY WANT TO UPGRADE !!

All three devices are upgraded using one application on the PC namely, K45pgm.



The app is divided into three groups, one for each controller. There are three different upgrade files, one for each controller. The K45 controller has the file type .K45, the WK3 IC has the file type .WK3 and the PSoC controller has the file type .PSC.

The procedures are slightly different for each controller and are described below.

K45 PIC Upgrade

On the PC, Start K45pgm and set the com port
On the K45 enter: ESC U, 2, Y (must be capital Y)

On K45pgm, click open K45 and the current F/W revision is displayed.
Click K45 Update
Enter file name
Click program

WK3 Upgrade

On the PC, Start K45pgm and set the com port
On the K45 enter: ESC U, 2, Y (must be capital Y)

On K45pgm click Open WK3 and it will report WK3's version
Click WK3 Update
Enter file name
Click program
When programming is done, WK will send an R
Then press encoder to reboot WK
It is now ready to go, no power cycle is needed

PSoC Upgrade

On the PC, Start K45pgm and set the com port
On the K45 enter: ESC U, 3, Y (must be capital Y)

On K45pgm, click Open PSoC , the current PSoC rev will be displayed
Click PSoC Update
Click file and open the PSoC programming file
Click Program
When programming is done press the encoder on K45
This will reboot the PSoC
It is ready to go, no power cycle needed

K45 Specifications

- Built-In USB 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 with
- On Board Speaker
- 20 Char by 4 Row LCD Display
- Rotary Encoder for fast WPM change
- 12 Message memories
- Message Pushbutton
- Operating Voltage: 5-volt USB
- WinKeyer Mode through
- USB Host interface
- Current: < 140 ma (less keyboard)
- Embedded commands in messages
- Iambic A, B, Ultimatic, and Straight Key
- Built in CW practice modes
- Autospace
- First Dit/Dah adjustable correction
- Automatic paddle watchdog
- Flexible Beacon Modes
- HSCW/QRSS Output Capability
- Farnsworth speed mode
- Extensive RFI and ESD filtering
- Keyboard Paddle
- Fast Callsign Capture
- LCD contrast and backlight 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	10 Level LCD frequency bar graph, auto squelch
Gain Settings	Eight gain levels
Noise Filtering	Eight Digital low pass filter settings
Inter-element Spacing	10 Noise threshold levels
ASR Mode	Automatic display buffer toggle
CWR Processor	Cypress CY8C27243-24 PSoC Processor

Support and Warranty

The K-45 is fully warranted to the original purchaser 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 K45 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 ensure that the K45 design is as complete and accurate as possible it is still possible to cause equipment damage or incur personal injury if:

- 1) The K45 is not used as intended.
- 2) Is connected incorrectly.
- 3) Safety guidelines outlined in this document are not followed.
- 4) The K45 is modified in any way.

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

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