

## OPERATING MANUAL

### CMOS SUPER KEYER III (v.2)

designed by KCØQ and NØII

The CMOS Super Keyer III is a compact, full-featured memory keyer combining a CMOS microprocessor and a non-volatile RAM chip for a full-featured, low cost, high reliability design. Unlike other advanced keyers, it needs no myriad of switches and knobs nor complex keypad sequences. Instead, commands are simply sent to the keyer in Morse code using your paddles! Some of its features:

1. Iambic keyer with dot and dash memories
2. Six active messages, plus 12 "banked" messages, 1530 characters total
3. Messages may 'call' others and contain programmed functions
4. Input queue to store multiple message activations
5. Contest serial number - 001 to 9999
6. Digital and linear analog speed control - 5 to 60 WPM
7. Adjustable weighting on code elements - 25% to 75%
8. Built-in adjustable frequency sidetone monitor
9. Tune function for transmitter adjustment
10. Selectable automatic character spacing
11. Timed pauses within messages
12. Message loop capability for continuous replay
13. Messages can allow break-in for paddle-inserted text
14. Emulation available for other keyers, including Curtis "A" timing
15. Ultra Speed mode allows messages at speeds to 990 WPM!
16. Ultra-low power consumption for battery operation
17. Full beacon capability
18. Message editing capability
19. Messages and keyer configuration saved when power is off
20. Keyer can compensate transmitter character shortening

### START-UP

After power is supplied, the keyer responds with "OK" and is ready for operation. It is initialized as follows:

Speed range:	5-40 WPM	Load mode:	character
Weight:	50%	Input queue:	On
Monitor:	On	Serial number:	ØØ1
Auto-space:	Off	Emulation:	Super Keyer III
Function speed:	equals paddle speed		
Monitor tone:	700 Hz		

Note: At start up, the speed knob should be turned fully clockwise and a few dots sent, then turned fully counterclockwise and a few more dots sent. This allows the keyer to calibrate the speed range.

### RESET

A new reset command has been added to the latest version of the firmware. This command erases all settings and messages from the EPROM memory. If the keyer is not acting properly, even on initial start up, try the RE-SET command. The command is implemented by pressing buttons 1,3,4 and 6 all down simultaneously as release. Remember, all stored messages and settings will be lost.

## FUNCTION COMMANDS

Commands to the keyer are entered in Morse code, using your keyer paddle. To alert the keyer that a function is desired, momentarily press buttons 1 and 2 simultaneously. The keyer enables the monitor, disables keying output, and acknowledges your request by sending "F".

After hearing the "F", simply paddle in the desired function character(s) explained below. When the function is complete, the monitor is automatically restored to its previous state, output keying is enabled, and the previous operating speed is restored.

Input command strings and the function performed are as follows:

- A        **Auto-space** - toggles automatic character spacing on or off. The keyer confirms the new state by sending "ON" or "OFF". When on, auto-spacing aids the operator in forming properly spaced characters within a word. Character crowding is prevented by forcing at least 3 elements of space whenever more than 1 space element has been detected. This effect is very noticeable at low speeds can be felt by high-speed operators as well. Without auto-spacing, character spaces are determined by the operator.
  
- B d      **Bank** - Message banking is an option to support multiple operators or preloaded messages for different contest exchanges. In the default mode, there are six messages of 255 characters each. As an option, the available memory can be configured as 3 distinct banks each having 6 messages of 85 characters each. Bank 1 is activated by the "B1" command. Similarly, commands "B2" and "B3" activate banks 2 and 3 respectively. Banking is disabled by the "BØ" command. Bank status can be queried with the "?B" command.
  
- D        **Decrement** - decrements the serial number by one, effectively canceling the automatic increment applied when last played from a message. The decrement function accommodates resending the last serial number, as might be needed when a repeat of a contest exchange is requested, or canceling the exchange with a station that proved to be a "dupe"..
  
- E d      **Edit** - allows the operator to append onto or edit an existing message by entering the "E" command in function mode, followed by the number of the desired message. The keyer will find and play the last word in that message. Then paddle in more text, or use the error symbol (seven or more dots) to erase existing words, just like the delete procedure when loading a message (explained later).
  
- F dd     **Function speed** - sets the speed used for function entry to 'dd' WPM, where 'dd' are two digits in the range of 06 to 30. This speed is employed for entering commands and loading messages. It is independent of the operating speed and is unaffected by the analog speed control. Alternatively, the function speed can be made to follow the operating speed by using dd = ØØ.
  
- H        **Hand-key** - The keyer enters hand-key mode. Keying output follows closures of either the dot or dash paddle levers, allowing hand-sent code. Normal iambic keyer operation is regained by any button closure.
  
- K dd     **Keying Compensation** - increases keying on-time and decreases keying off-time by 'dd' milliseconds, where 'dd' are two digits in the range of 00 to 25. Although similar to increasing weight, the adjustment is independent of speed. This setting is used primarily to correct keying distortion by certain transceiver.
  
- L        **Load mode** - toggles the load mode between Character and Real-time. The keyer confirms the new mode by sending "C" or "R" as appropriate.
  
- M        **Monitor** - toggles the 700 Hz sidetone monitor on or off. To conserve battery power, the keyer should normally be operated with the monitor off in favor of the rig's sidetone.

- N dddd     **Number** - initializes the contest serial number to 'dddd', where 'dddd' are four digits in the range 0000 to 9999. Note that four digits **MUST** be entered, with leading zeros if needed. Also note that in transmission of a serial number that a 4th place leading zero is never sent.
- Q           **Queue** - toggles the input queue on or off. The keyer confirms the new mode by sending "ON" or "OFF" as appropriate. When off, memory button activations are acted upon immediately, canceling messages in progress. When on, up to 8 button presses are remembered in order and acted upon in succession as each message completes.
- R dd ee     **Range** - programs the keyer speed range within the limits of 5 -60 WPM. "dd" is the low setting, and "ee" is the high setting. A command of R0545 (or R 05 45) would set a range of 5 to 45 WPM. Control via the speed knob is linear and increases speed clockwise. After the range command is entered, a few dots must be sent at each end of the range to allow thekeyer to calibrate itself.
- T dd       **Tone (monitor) frequency** - available range is 500-990 Hz, where "dd" is the first two digits of the desired monitor frequency.
- V dd       **Emulation** - allows the operator to select emulation of the timing characteristics of other keyers. See the section on EMULATION.
- W dd       **Weight** - sets code weight to 'dd' percent, where 'dd' are two digits
- X           **Xmit (tune)** - continuously keys the output for purposes of transmitter tuning and amplifier adjustment. Tuning is stopped by simple tapping either the dot or dash paddle lever.
- Z d        **Zeros and Nines:** controls the way that zeros and nines are sent in a contest style serial number. See SERIAL NUMBER OPTIONS.

## **INQUIRY FUNCTIONS**

Inquiry functions allow the current state of the keyer to be determined. State information is played to the operator in Morse code with the monitor automatically enabled and keying output disabled. Inquiries operate just like command functions: to enter an inquiry, momentarily press the right two buttons (#5 & #6) simultaneously. After receiving the "?" reply, enter the desired inquiry command as follows:

- A           **Inquire Auto-space** - the keyer responds by sending "ON" or "OFF" as appropriate.
- B           **Inquire Bank setting** - the keyer sends the current operational bank number, B0, B1, B2 or B3.
- F           **Inquire Function Speed** - the keyer sends the current function speed setting in WPM as two digits.
- L           **Inquire Load mode** - the keyer responds by sending "C" if in the Character mode or "R" if in the Real-time mode.
- N           **Inquire Serial Number** - the keyer plays the current contest serial number (but does not increment it).
- Q           **Inquire Queue** - the keyer responds with "ON" or "OFF" as appropriate.
- R           **Inquire Speed Range** - the keyer sends the current operation speed range in WPM as four digits with a pause between the slow limit and the fast limit.
- S           **Inquire Speed** - the keyer sends the current speed setting in WPM.
- T           **Inquire Tone setting for the monitor** - the keyer sends the current monitor tone setting.
- V           **Inquire Emulation setting** - the keyer sends the current emulation. See the section on EMULATION.

- W        **Inquire Character Weighting** - the current weight percentage is sent by the keyer as two digits.
- Z        **Inquire Zeros and Nines:** the keyer responds with the option number (Ø-9) currently in effect.
- 1        **Inquire Message 1 (or 2, 3, 4, 5, or 6)** - message 1 (or 2, 3, 4, 5, or 6) is played exactly as it would go over the air, but with the keying output disabled.

Note: You can also play back a message, sounding the embedded function commands. (See below) To do so, momentarily press the right two buttons (#5 & #6) simultaneously. After the "?" reply, press the message memory button you wish to review. the message will be played back with any embedded commands.

## EMBEDDED FUNCTIONS

Certain functions can be embedded within character messages. To distinguish them from normal text, the command strings are prefixed by a "/" and are entered as a separate word. When encountered during a message play, the functions are executed. Note that if "/" is part of a single word, as in W9KNI/ZA2, it is sent as expected and is not interpreted as a command prefix. Embedded command strings and their use are explained below:

- /B        **Break** - message play is suspended to allow insertion of paddle text. The operator may insert one or more words using the paddle. Once input has begun, the break function is canceled when inactivity exceeding a word space is detected. The interrupted message then resumes. A break may also be aborted by pressing a button, causing the corresponding message to play immediately.
- /D        **Decrement** - decrements contest serial number by one.
- /Gd       **Gap** -the normal 7-element inter-word space is modified to 3+d, where 'd' is a digit in the range 0-9. It is used to exaggerate inter-character or inter-word spacing. For example, a call like WØEJ can be entered with slight lengthening of the space between the "E" and the "J" for emphasis, making it easier to copy. /GØ yields normal character space, while /G4 yields a normal word space.
- /N        **Number** - the current value of the contest serial number is played. Its value is then automatically incremented by one. Also see SERIAL NUMBER OPTIONS.
- /Pdd     **Pause** - a speed-independent pause of d.d seconds is inserted, where 'dd' are two digits in the range 00 to 99. For example, /P35 will result on a delay of 3.5 seconds. Pauses longer than 9.9 seconds are obtained by using consecutive commands that total the value desired.
- /R        **Resume** - Stops message play to allow hand-sent entry. When manual keying is completed, press the button for the message being played and the message will resume transmitting from that point on. Multiple "/R" commands are permitted.
- /Sdd     **Speed** - the operating speed is set to dd WPM, where "dd" are two digits in the range 06 to 60.
- /SUdd    **Speed UP** - increases the operating speed by dd WPM, where "dd" is a number in the range 01 and up. Note a leading zero MUST be used for speed increases less than 10 WPM.
- /SDdd    **Speed DOWN** - decreases the operating speed by dd WPM, where "dd" is a number in the range 01 and up. Note a leading zero MUST be used for speed decreases less than 10 WPM.
- /Udd     **Ultra-speed** - sets the ultra-speed speed mode for a message. Range is 70-990 WPM, where "dd" are the two digits representing the first two numbers of the speed setting desired. For example, "07" is 70 WPM, "77" is 770 WPM. This command is used primarily for meteor scatter work. Note that Weighting (W), Compensation (K), and Tone (T) settings are disabled during Ultra-speed message transmission. Also, messages using both regular speeds and ultra speeds can be created. To exit the Ultra-speed mode, (and return to the speed control setting), it is necessary to use a work-around.

At the end of the desired ultra-speed text, send /SUØ1 /SDØ1. This trick tells the keyer that the ultra-speed part is ended, and returns the keyer to the regular speed. Alternately, the message can be returned to a lower range speed by use of the /S command, such as /S20, but this will send text following the ultra-speed text at 20 WPM in this case, rather than the speed set by the panel speed control.

- /1      **Message 1** - message 1 is played in its entirety followed by resumption of the current message. To create a continuous loop, end the message with the number of the message as an embedded command, such as "/1" where the "1" is the message being programmed or played. Also, other messages can be appended. For example, message #2's contents can be appended to the end of message #1 by ending message #1 with a "/2" embedded command. And a loop could then be created by ending message #2 with a "/1" embedded command.

### **MULTIPLE-BUTTON FUNCTIONS**

Single-button closures are reserved for activating messages. As already discussed the 1-2 combination alerts the keyer for paddle-entry functions. Certain keyer functions are duplicated, wholly or in part, by other button combinations.

- 1-2      **Function** - the keyer enters the Function mode, acknowledges with an "F" send in Morse code, and waits for command input. If the mode is entered in error, it may be escaped by sending a string of seven or more dots, which will return the keyer to normal operation.
- 3-4      **Decrement** - the keyer acknowledges with "D" and then decrements the serial number by one.
- 5-6      **Inquiry** - the keyer acknowledges with "?" and then waits for paddle entry of the desired inquiry option.
- 2-3      **Hand-key** - the keyer acknowledges with "H", then enters hand-key mode until another button is pressed.
- 4-5      **Tune** - the keyer acknowledges with "X" and then keys the output continuously until a paddle closure occurs.
- 2-5      **Reverse** - the keyer acknowledges with "RV" and then reverses the paddle sense (left for right, and right for left).
- 1-6      **Speed Range Reset** - the keyer speed range is reset to a range of 5-40 WPM, and the function-entry speed is defaulted to follow the speed knob. After pressing the buttons, the keyer acknowledges with "OK". Important Note: When the keyer speed range is reset, it does not know where the knob is set, and the resulting speed setting may be a random value. It is best to reset with the knob somewhere near midrange. Immediately after you have pressed the reset combination, turn the speed knob fully clockwise and send a few dots, then turn it fully counterclockwise and send a few more dots. This will allow the keyer to calibrate itself.

Note:      To kill a message already transmitting without sending a "dit" over the air, press any two buttons and release.

### **LOADING CHARACTER MESSAGES**

In character mode, each Morse character uses one byte of message memory. Precise 3-element intercharacter and 7-element interword spaces are employed when the message is played (unless modified using the /Gd function). To load a message, first confirm that character- mode loading is in effect using the "L" inquiry function. Then press and hold the desired message button. After 2 seconds, a tone is emitted and the button may be released. The keyer sends "C" to confirm character mode and waits for input.

Morse code text and embedded functions are then entered with the paddles. When each word is complete, simply stop sending. The keyer will detect and insert a word space, and then prompt you for the next word by sending "I". There is no limit to the elapsed time between words, so there is no need to hurry your sending.

The keyer includes an edit feature for immediate correction of errors during message loading. If a mistake occurs, simply send an error indication of 7 or more dots. The keyer will erase the last word sent. It will then play the 'new' last word (if any) so that the position in the message is known exactly. As many words as needed can be erased this way. When the desired position is achieved, continue to enter the remainder of the message.

After the keyer responds with "I" following the final word, close the message by a momentary press of the (same message) button. To completely clear a message from memory, just end the load in this way immediately after the C: prompt is sent. Should message capacity be exhausted during the load, the keyer will send the raspy "error" message and the message will terminate at that point. The operator might wish to then delete the last word with the error string, then have the balance of the message continue in another new message channel, and use the embedded command number command (i.e. "/2" to continue with message #2 after having filled message #1) to tie the two messages together.

### **LOADING REAL-TIME MESSAGES**

Some operators prefer messages containing stretched or compressed spacing rather than perfect timing. Real-time mode stores and replays messages exactly as entered. Along with somewhat reduced message capacity, the primary disadvantage of real-time messages is that they cannot contain embedded functions. Use the Inquiry function "L" command to insure that real-time load mode is in effect. Then press and hold the desired message button. After 2 seconds, a continuous tone will emit, at which time loading is enabled and the button may be released. The keyer then responds by sending "R" to confirm real-time mode and waits for paddle input.

Since the keyer waits until the first paddle closure, there is no need to rush the first entry. Once entry begins, however, the keyer loads continuously - any pauses are stored as spaces in the message. All intercharacter and interword spacing is strictly up to the operator. To end the message, simply press the message button momentarily. Note that the elapsed time from the end of the last character to message termination is stored as space at the end of the message. If room is exhausted during the load, the message is terminated automatically, and the raspy "error" message is sent by the keyer, indicating that the loading has been terminated. The operator will also notice that messages are not as easy to enter in this mode, since the keyer clock is free-running and thus not resynched with paddle closures. However, the stored message will back cleanly.

### **PLAYING MESSAGES**

It couldn't be simpler: just tap the desired message button. Both character-mode and real-time messages can be played regardless of the current load mode.

If the input queue is enabled, multiple button closures will be remembered. Each message will be played in succession as the previous message completes. As a simple example, suppose that message 1 contains "CQ" and message 4 contains "DE WB8ZRL". Then pressing button 1 three times and button 4 once, in quick succession, will cause "CQ CQ CQ DE WB8ZRL" to be played. As many as 8 button activations can be remembered in this mode. With the input queue disabled, however, a button closure immediately cancels any current message and starts the commanded one.

When a paddle closure is detected, messages are immediately aborted and the input queue is flushed. The only exception is during execution of a /B break function when paddle input is expected. Otherwise, the paddles always take priority over message playback.

## **EMULATION OPTIONS**

This parameter allows the keyer timing to mimic that of other keyers, making the "feel" of the keyer more comfortable to operators used to different timing patterns. The default setting is VØ, a timing pattern which has proven to be the most user-friendly for many operators. The range of options is as follows:

VØ	Super Keyer II/III timing w/dot and dash memory
V1	Super Keyer II/III timing w/dot memory only
V2	Super Keyer II/III timing w/dash memory only
V3	AccuKeyer timing w/dot and dash memory
V4	AccuKeyer timing w/dot memory only
V5	AccuKeyer timing w/dash memory only
V6	Curtis "A" timing w/dot and dash memory
V7	Curtis "A" timing w/dot memory only
V8	Curtis "A" timing w/dash memory only
V9	Iambic timing w/no dot or dash memory

Note that this makes a full-featured memory keyer finally available to those used to the Curtis "A" timing! Tell your Curtis-equipped friends! To implement a setting different from VØ, enter Function Mode and send "Vd", where "d" is the desired setting. To determine the present setting of the V parameter in your keyer, enter the Inquiry Mode and respond to the "?" prompt by sending a "V". The keyer will announce the "V" setting.

## **ERROR INDICATION**

When an erroneous input or exceptional condition is detected, the operator is notified by a distinctive raucous tone burst (similar to a "Bronx cheer"). Examples include nonexistent functions, invalid numeric parameters, and exhaustion of message capacity during a load.

## **SERIAL NUMBER OPTIONS**

The "Zd" command selects one of 10 options for sending zeros and nines in the contest serial number. Zeros may be replaced by "O" or "T", nines are replaced by "N", and leading zeros are suppressed. The options available are:

Option (d)	Leading Zeros	Other Zeros	Nines
Ø	Ø	Ø	9
1	-	Ø	9
2	O	Ø	9
3	O	O	9
4	-	O	9
5	T	O	9
6	T	T	9
7	-	T	9
8	T	T	N
9	-	T	N

Note: For numbers less than 1000, the first zero is suppressed

## **EMBEDDED FUNCTION EXAMPLES**

Perhaps the most powerful feature of the keyer is its ability to store functions within messages. The stored commands are executed as encountered when the message is played. A consecutive serial number, for example, is needed in several contest exchanges. An ARRL Sweepstakes exchange, for an answering station, could be programmed as exemplified by: "NR /N/GØ A KCØQ 80 1A IA BK". A second message might contain a serial number repeat message. This makes use of the decrement function: "/D NR /N BK".

Speed changes within messages are also permitted, allowing parts of a message to be played at differing speeds. Using relative changes as in "/SU15 QRX DE WØSR/7P UP 5 /SD15" plays the message much faster but then returns to the previous operating speed.

Messages may 'call' other messages. Suppose message 4 contains "WA9CNS/KH7". Then the message "CQ CQ CQ DE /4 /4 K" will, when played, yield "CQ CQ CQ DE WA9CNS/KH7 WA9CNS/KH7 K". Call nesting may be as deep as desired. Thus, message #2 can call message #1 which calls message #4 which calls message #3! In fact, continuous loops can be programmed. A loop will result if a message calls itself (directly or via some other message).

Loops can be very useful. A CQ loop in message 1, using a pause, is a good example: "CQ DX CQ DX DE WØWP WØWP K /P35 /1". The message will play continuously, with 3.5 seconds in between. When an answering station is heard, simply tap the paddle to cancel the loop.

If you are fortunate enough to be able to "run em" in a contest, the break function and looping can be a real advantage. Message 1 might contain: "QRZ TEST DE WØWP /B 599 IA BK /B /1". Here, activating message 1 first causes "QRZ TEST DE WØWP" to be sent. The /B breaks the message and allows the responding station's call to be copied. The call is then sent via the paddles. The message then automatically continues and sends "599 IA BK" followed by another break. The other station's report is then copied while the keyer waits. A simple "TU" or "R" is then sent via the paddles to acknowledge the exchange. This completes the break and causes an automatic loop back, restarting the whole sequence.

If no one responds to the QRZ, simply tap button 1 again to resend the QRZ (remembering that a /B is canceled by a button closure). If the responding station's exchange is missed during the second break, use message 2 to ask for a repeat: "AGN? BK /B /1". After getting the repeat, acknowledge with "TU" or "R" as before, and the QRZ loop is automatically resumed.

Setting up a beacon message can be useful for certain functions. Here would be a typical beacon message attached to message #1: "/S20 TEST TEST DE KØHGB KØHGB /X /P5Ø E /1". This would send the message "TEST" twice at a speed of 20 WPM, then sign the call, then send a 5-second carrier. The "E" at the end will not actually go out over the air, but will serve to "break" the key-down condition, then the message will loop back to the start, and recycle ad infinitum ad nauseum.

User note: If the keyer gets excessive RF on the input or output leads it is possible the keyer will lock up, and operate improperly or not at all. In such cases, all the user needs to do is disconnect the power lead to the chip, wait one minute, then reconnect the power. The keyer set up and stored memories should be as before since they are stored in the non-volatile RAM chip.



## CMOS SUPER KEYER 3 COMMAND SUMMARY

### FUNCTION AND INQUIRY COMMAND SUMMARY

Function Command	Operation	Default Setting	Inquiry Mode	Range
A	Autospace - toggle Autospace On/Off	Off	A	-
B d	Bank - select message bank d or disable	Ø	B	-
D	Decrement - subtract 1 from serial #	-	-	-
E d	Edit - begin editing existing message d	-	-	-
F dd	Function Speed - use dd WPM for entry	ØØ	F	05-30
H	Hand Key - Keyer output follows paddle	-	-	-
K dd	Keying compensation (dd ms pre-keying)	ØØ	K	-
L	Load Mode - toggle character/real time	Char	L	C/R
M	Monitor - toggles monitor speaker On/Off	On	-	-
N dddd	Number - set serial number to dddd	ØØ1	N	9999
Q	Queue - toggle input queue On/Off	On	Q	-
R dd ee	Range - limit speed from dd to ee WPM	05-40	R	05-60
S dd	Speed - set to specific dd WPM speed	06-60	S	20
T dd	Tone - set monitor frequency to ddØ Hz.	70	T	50-99
V d	Variant - select keying algorithm d	Ø	V	0-9
W dd	Weight - set weighting to dd percent	50	W	25-75
X	Xmit - continuous key-down for tuning	Off	-	-
Z d	Zeros & nines - use serial # option d	Ø	Z	Ø-9

dØ = Ø Ø 9 d1 = - Ø 9 d8 = T T N d9 = - T N

### MULTIPLE-BUTTON FUNCTIONS

1-2	Function	("F")	4-5	Tune	("X")
3-4	Decrement serial #	("D")	2-5	Reverse paddles	("R")
5-6	Inquiry	("?")	1-6	Reset Speed Range	("OK")
2-3	Hand-key	("H")	1-3-4-6	Reset (complete)	("OK")

### MESSAGE-EMBEDDED FUNCTIONS

/B	Break - suspend msg, wait for paddle input, then continue
/D	Decrement serial number
/Gd	Gap - add inter-character/word spacing, where GØ = normal character space and G4 = normal word space (range 0-9)
/N	Number - serial # played and incremented
/Pdd	Pause - speed-independent pause of d.d seconds
/R	Resume - stop msg, allow hand-sent entry, press msg button ..to resume sending from the stopping point
/Sdd	Speed - set speed to dd WPM. Return to knob-set speed with /SØØ
/Sudd	Speed UP - increase speed by dd WPM
/SDdd	Speed DOWN - decrease speed by dd WPM
/Udd	Ultra-speed - set high-speed mode (70-990 WPM) in 10 WPM increments, where dd = 07-99. Exit = /SUØ1 /SDØ1
/1-6	Send message 1 thru 6

Note: When entering the above embedded commands, the entire command must be entered as one 'word' (e.g. "/Sudd", not "/SU dd").