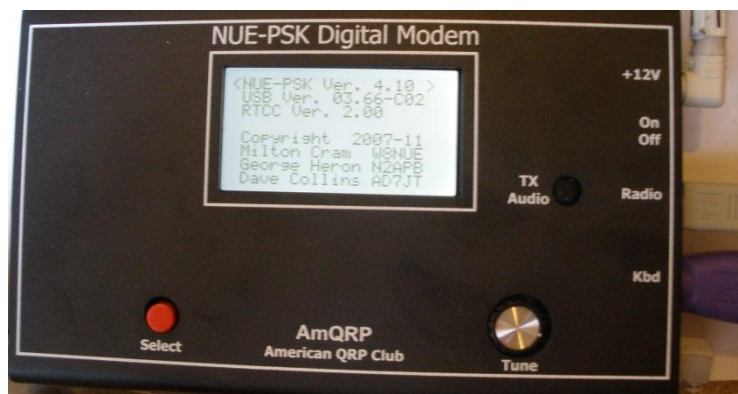


# CW Keyer Manual

*(and other functional enhancements)*

## NUE-PSK Modem

### Version 5.00



David Collins – AD7JT

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## 1.0 Introduction

This document describes the functional enhancements in the NUE-PSK Digital Modem firmware version 5. A major part of these enhancements includes a built in keyer for using CW to enter Tx text and modem commands that can process input from either iambic or single-lever paddles. The built-in keyer implementation makes it possible to operate the modem without requiring a keyboard. This document assumes that the reader is familiar with the CW Mode Operating Section of the NUE-PSK Digital Modem Operating Manual (for firmware version 4).

The firmware will also process input from an external keyer or a straight key in a “practice mode”. Since the firmware processes input from a straight key the same way it processes input from an external keyer, this document will generally refer to either of these simply as an “external keyer”. In practice mode, the external keyer drives the Morse code decoding logic in receive mode and displays the ASCII decode of the Morse characters. This mode was introduced in previous firmware versions and is completely independent of the full-function keyer implemented in this firmware version. In the remainder of this document, the term “keyer” pertains only to the built-in keyer.

The keyer is a new user input device and may be used with or without a keyboard attached to the modem. The keyer can provide all the control and text input functions normally provided by the keyboard. This functionality is available in all operating modes, not just CW mode, thus enabling PSK and RTTY operation without requiring a keyboard. Support for the external keyer and practice modes are only available in CW mode.

To utilize keyer functions, a CW paddle must be interfaced to the modem assembly and wired to two expansion pads on the main modem PCBA. This document recommends a method for adding a connector to the modem assembly but the user may use other methods as long as the required interface connections are provided. A minor modification to the modem chassis may be required to accommodate the connector.

The keyer supports the following keyer operating modes:

- Iambic type A
- Iambic type B
- Dot Preferred
- Dash Preferred
- Ultimatic

Note that semi-automatic (bug) mode is not supported. The keyer operating mode is a Configure Menu selection.

Normally, the left paddle will generate dots and the right paddle will generate dashes. Some left-handed operators prefer to reverse the paddle functions. CW paddle reversal is implemented as a Configuration Menu option

## 2.0 General Description

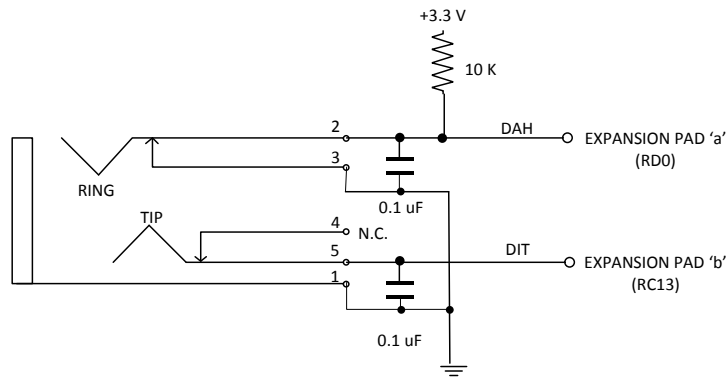
Keyer functions make maximum use of existing CW support functions. Keyer input is always translated to ASCII for processing by the modem firmware. This approach simplifies the keyer implementation and results in a high level of consistency between keyer and keyboard input.

## 2.1 Interface Connections

The major digital modem system components are shown in the following diagram:

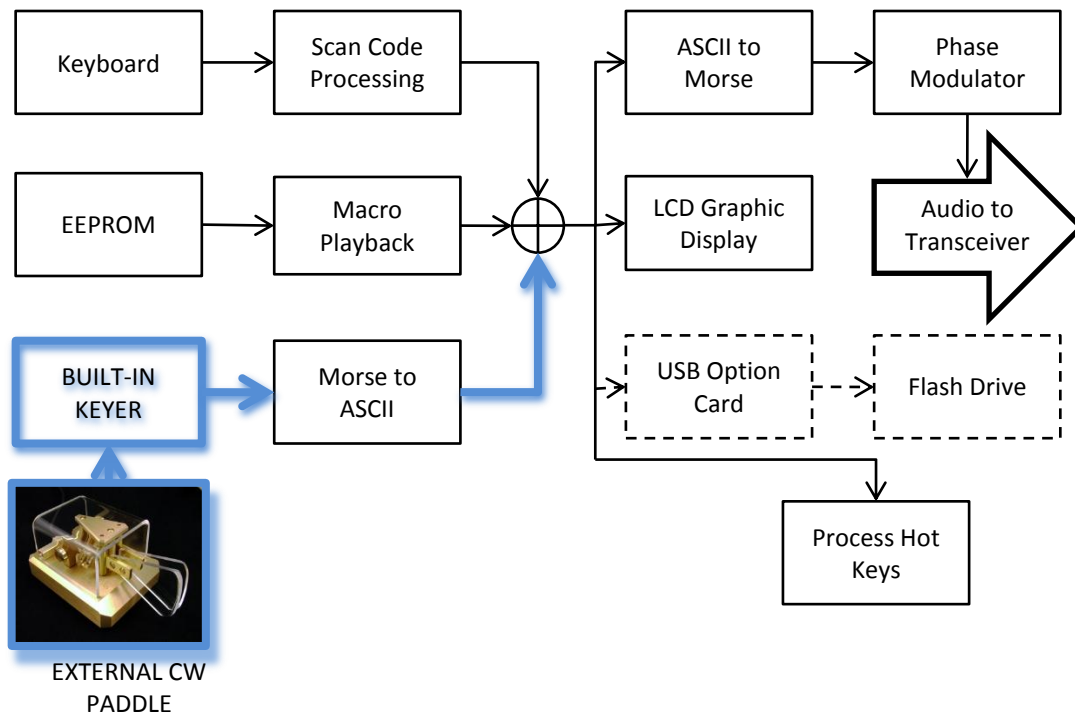


A common interface of two signal lines plus ground is used to interface either a CW paddle or an external keyer to the modem. The signal lines are labeled “DIT” and “DAH” and must be connected to the dsPIC expansion pads ‘b’ (DIT) and ‘a’ (DAH) on the main modem PCBA. Note that there is a conductor from the three-wire cable to the USB option card connected to expansion pad ‘a’. This signal is no longer used so the wire can be disconnected and insulated so it does not cause a short to components or etch on the main modem board. The signal attached to expansion pad ‘a’ also requires a 10 K ohm pull up resistor to 3.3 volts. Expansion pad ‘b’ uses a weak pull up built into the dsPIC I/O pin. The following schematic shows the keyer interface connection using a 3.5 MM stereo connector (Digi-Key P/N SC1464-ND or equivalent).



When the modem is powered up, the signal level on expansion pad ‘a’ (DAH) is checked. If it is at ground level, the firmware assumes a monaural phone plug is plugged into the connector, all keyer functions



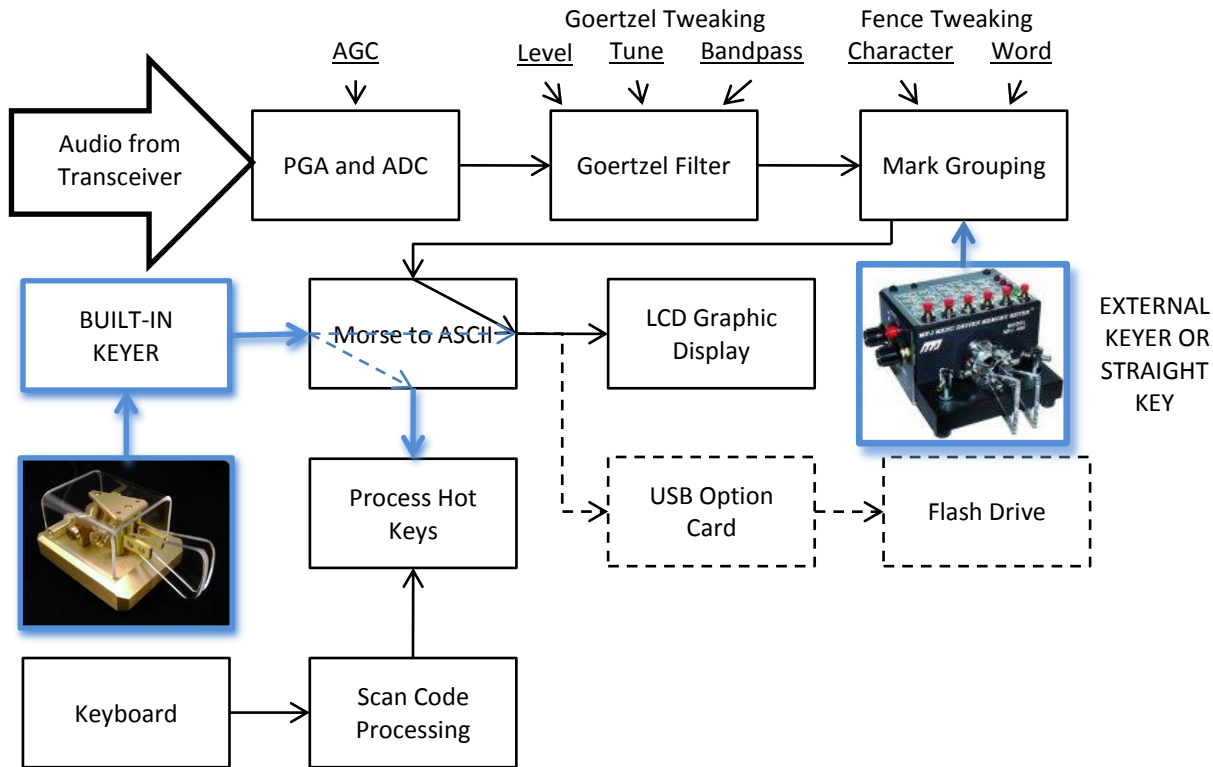


After the firmware determines whether an external CW paddle or an external keyer is plugged into the keyer connector, it sets up the appropriate routing through the functional firmware blocks. When an external CW paddle is connected, inputs (DIT and DAH) from the interface connector are processed by the built-in keyer logic to generate groups of MARKs (dots and dashes) comprising Morse characters. Each group is then translated to ASCII and passed on to the standard firmware functions to display, transmit, record, and/or interpret as hotkey functions.

To facilitate hot-key simulation, an escape character has been defined using a unique Morse code character. This code is only recognized when generated by a CW paddle. It will be treated like an undefined Morse character when decoded in received text. The escape character and its uses are described in detail in later sections.

### 2.3 Receive Operation

The following block diagram shows the major functional elements involved in receive modes. Elements and interconnections with shadows are added to support keyer functions; the non-shadowed elements were included in previous firmware releases. The dashed routing paths through the Morse to ASCII block represent special routing to facilitate keyer-initiated functions.



The same blocks are used to generate MARK character groups in receive mode as are used in transmit mode as described above. The routing through the Morse to ASCII block is modified when the source of the MARK groups is the keyer. Only MARK groups from the keyer are analyzed for hot-key functions and they are not displayed with the received text on the LCD display. A special area of the screen is used to display these control sequences. This display information is not recorded on the flash drive in REC mode, only received text is recorded.

When an external keyer is connected, the single input signal (DIT or key-down) is analyzed to identify the MARK types (dot or dash) to be combined into groups of MARKs comprising Morse characters. This operation is more complicated than the processing of inputs from a CW paddle. In this case, the logic used to generate the MARK groups is the same logic used to analyze received CW signals after processing by the Goertzel filter.

### 3.0 Functional Description

Firmware operation with input from a CW paddle or from a keyboard is essentially the same once the CW input has been translated to groups of MARKs representing Morse characters and then to ASCII characters. As the keyer input is processed, a side tone is generated to give the user audio feedback. When using the keyer the user will normally have the transmit side tone turned off.

#### 3.1 External (Practice) Keyer Input Processing

The same firmware used to group MARKs from the Goertzel filter is used to generate MARK groups from an external keyer. In this case, MARK types (dots and dashes) and character and word boundaries are identified by measuring the duration of the MARKs and SPACES in the input stream. The input timing also determines the CW speed (wpm) of the input keying. This same logic is used to process the



output from the Goertzel filter in receive mode which must be processed independently from the external keyer input. This mode of operation is only intended for off-line practice and demonstrations, keyed data is only displayed, and it is never transmitted.

### **3.2 Built-in Keyer Input Processing**

Since the built-in keyer has separate inputs for dots and dashes, it can generate MARK groups without having to determine  $T_{cw}$  from the paddle input. Instead, the operator sets the transmit keying rate which determines  $T_{cw}$ . Training is not required to determine  $T_{cw}$  as is needed to accurately decode received CW text. MARK groups are generated directly from the states of the DIT and DAH inputs at specific time intervals that are multiples of  $T_{cw}$ .

For example, when the DIT input is active, the keyer logic buffers a dot in the current MARK group then monitors the input for two  $T_{cw}$ . If the DIT input is still active, it buffers another dot and waits two more  $T_{cw}$ . If, instead, the DAH input is active, a dash is buffered and the keyer logic waits four  $T_{cw}$  before checking the inputs. If neither the DIT nor the DAH inputs are active, the current MARK group is complete and passed on to be processed as a Morse character and the keyer logic waits two more  $T_{cw}$  before checking the inputs again. If one of the inputs is active at that time, a new MARK group is started otherwise a space (end of word) is inserted in the character stream. After an end of word, the keyer logic goes idle until an input goes active signaling the start of the next MARK group.

When using an iambic (two-lever) paddle, the above sequence is modified to handle the case where both inputs are active. In this case, keyer processing is governed by a Configure Menu option as follows:

IAMBIC KEYSER MODE	PADDLE SQUEEZE ACTION
Iambic-A	Alternate dots and dashes, immediate end
Iambic-B	Alternate dots and dashes, one element added
Dot Preferred	Repeated dots
Dash Preferred	Repeated dashes
Ultimatic	Repeat last selected

In iambic-A mode, the alternate dot - dash generation will terminate as soon as the keyer senses one or both of the inputs are inactive. In iambic-B mode, one more complete element is generated after the keyer senses one or both of the inputs are inactive. The additional element will be the opposite of the last one generated while both inputs were active. Of course, none of these modes apply when a single-lever paddle is used for input.

### 3.3 Keyer Side Tone

A 400 Hz side tone is generated when the keyer is used. The side tone is always enabled and the frequency is fixed. The low frequency was selected to make it easy to distinguish between it and the Rx and Tx side tones. It is recommended that the Tx and Rx side tones be disabled when using the keyer. Multiple tones do not mix well in the modem's piezo noise maker. The rig's receive audio can be on for tuning and signal monitoring.

### 3.4 Keyer Escape Code

In general, the generation of special hotkeys with the keyer requires a mechanism to identify the input as a hot-key sequence. To satisfy this requirement, a special code has been defined for use as an escape character. The code chosen for the escape character is not defined in standard and extended (international) Morse code sets and is relatively easy to key. The chosen code is:

• • - • • -

(prosign uU). This character cannot be generated by the keyboard. It will be represented by and displayed as a backward slash character ('\'). All keyed hotkey sequences must start and end with this character which will be referred to as a "Data Link Escape" or "DLE" character.

When a DLE character is entered, it indicates the start or end of a hotkey sequence. Hotkey sequences consist of the DLE character followed by one or two characters followed by another DLE character. Once the first DLE character is recognized, all inter-word SPACES are ignored. Hotkey sequences never contain space characters. When the ending DLE character is entered, the hotkey sequence is validated and, if valid for the current mode, it is processed and executed immediately. If a hotkey sequence is not valid for the current mode, it is simply ignored; there is no explicit error indication. When entering hotkey sequences, the prosign "hH" (eight or more dots) will be processed as a backspace. The preceding character will be deleted. Note that the starting DLE character cannot be deleted. To cancel a hotkey sequence after it is started, simply key in an illegal character sequence followed by the closing DLE character.

Wherever possible, the characters used for keyed hotkeys are the same as those used for keyboard hotkeys. Leading letters ‘A’ and ‘C’ are used to indicate Alt- and Ctrl- prefixes. For example, to insert THEIRCALL in transmit text from a keyboard enter Alt-T and from the keyer enter “\AT\”. Two consecutive DLE characters perform the same function as the Esc key on the keyboard (i.e., toggle Rx or Tx side tone on and off).

Function keys F1 through F10 are input as just the numbers 1 through 9 and 0. For example, ‘F1’ on the keyboard is entered with the keyer as “\1\”, Ctrl-F5 is entered as “\C5\”, and Alt-F9 is entered as “\A9\”. Function key F10 is entered as “\0\” or “\10\”.

In most cases, keyer input characters not preceded by a DLE character in Rx mode will be ignored. The exceptions are single-letter hot keys used in Rx mode. Since keyboard input is not part of the receive processes, keyboard inputs are always processed as hotkeys. Defined Rx hotkeys are processed, unrecognized keyboard inputs are ignored. The same is true for keyed characters in Rx mode. For example, tweak CW bandwidth may be initiated by keying either “\B\” or the single character “B”. This is only possible for single-character hotkey sequences where the keyboard character is the same as the keyed character. Keyer input characters not preceded by a DLE character in Tx mode will generate ASCII characters to be encoded and transmitted.

### 3.5 Keyed Common Functions

The following hotkey functions are available in both Tx and Rx modes:

<u>KEYBOARD</u>	<u>KEYER</u>	<u>HOTKEY FUNCTION</u>
Ctrl-Tab	\?\	Display current frequency
F1 - F7	\1\ - \7\	Play macro 1 - 7
F8	\8\	Toggle Tune mode ON/OFF
Shift-F9		
or Ctrl-F9**	\C9\	Turn Beacon mode ON
Alt-F9	\A9\	Turn beacon mode OFF
F11	\11\	Display My Call
F12	\12\	Display/Hide Config
Ctrl-U	\CU\	Toggle RECOrd mode ON / OFF
<i>Ctrl-I</i>	<i>n/a</i>	<i>Enter text to be RECOreded</i>
Ctrl-A	\CA\	Enable AFC
Alt-A	\AA\	Disable AFC
Ctrl-O	\CO\	Toggle LCD display back light ON/OFF
Ctrl-L	\CL\	Clear text display
Ctrl-F	\CF\	Save current frequency in EEPROM
Alt-F	\AF\	Set current frequency from EEPROM
Ctrl-N	n/a	Enter RECOrd file name
Ctrl-Z or F9	\CZ\ or \9\	End \CI\ and \CN\

\*\* New Hotkey assignment

Note that the Ctrl-I hotkey function is not implemented for keyer input. This operation uses the Buffered\_Text\_Capture function which is not capable of accepting keyer input. For more information see Keyer Macro Functions below.

### 3.6 Keyed Transmit Functions

The following hotkey functions are available in Tx mode:

<u>KEYBOARD</u>	<u>KEYER</u>	<u>HOTKEY FUNCTION</u>
Esc	\\	Toggle Tx side tone ON/OFF *
Alt-K	\AK\	Insert Beacon Count
Alt-M	\AM\ or mc	Insert My Call
Alt-S or Alt-X	\AS\ or \AX\	Insert Serial Number
Alt-T	\AT\ of tc	Insert Their Call
F10	\10\ or \0\	
or _K_***	or _K_	
or _kn_ or _KN_	or _kn_ or _KN_	
or _bk_ or _BK_	or _bk_ or _BK_	
or _sk_ or _SK_	or _sk_ or _SK_	Toggle Tx mode OFF

\*\*\* \\_ ' represents a keyboard space character or a CW inter-word SPACE (5+ Tcw)

**Note:** Tx mode is toggled off by a “normal” end of transmission character sequence. These prosigns and one and two character sequences must be preceded and followed by an inter-word SPACE followed by nothing. The end of transmission sequence must be the last thing in the transmit buffer for it to be acted on. The end of transmission characters will be transmitted before toggling Tx mode off.

### 3.7 Keyed Receive Functions

The following hotkey functions are available in Rx mode:

<u>KEYBOARD</u>	<u>KEYER</u>	<u>HOTKEY FUNCTION</u>
Esc	\\<	Toggle Rx side tone ON/OFF *
B	\B\ or B	Tweak CW Bandwidth *
C	\C\ or C	Tweak Character space multiple *
G or T	\G\ or G	Tweak Goertzel Threshold *
S	\S\ or S	Tweak Serial Number
W	\W\ or W	Tweak Word space multiple *
Z	\Z\ or Z	Tweak MARK limit *
+ or U**	\U\ or U****	
	\up\ or up	Tweak Up (Locks \C\, \G\, or \W\)
- or D**	\D\ or D****	
	\do\ or do	Tweak Down (Locks \C\, \G\, or \W\)
Home	\bk\ or bk	Reset Serial Number to 001 (\S\ only)
Enter	\ar\ or ar	End Tweaking (Unlocks \C\, \G\, and \W\)
Alt-D	\AD\	Enter Time
Ctrl-D	\CD\	Enter Date
Ctrl-M	\CM\	Enter/Edit My Call
Ctrl-T	\CT\	Enter/Edit Their Call
X	\X\ or X	Tweak Serial Number and Enter/Edit Their Call
Home	\bk\ or bk	Clear Their Call (\CT\ and \X\) or clear My Call (\CM\)
Ctrl-Z or F9	\CZ\ or \9\	End \AD\, \CD\, \CM\, \CT\, and \X\
Enter	\ar\ or ar	End \AD\, \CD\, \CM\, \CT\, and \X\ (Unlocks \C\, \G\, and \W\)
Page Up	\PU\	Increase PGA Gain
Page Down	\PD\	Decrease PGA Gain
Left Arrow	\LA\	Tune down x 1
Right Arrow	\RA\	Tune up x 1
Down Arrow	\DA\	Tune down x 2
Up Arrow	\UA\	Tune up x 2
End	\AQ\	Acquire (tune to nearby maximum signal level)
F10	\10\ or \0\ or ct	Toggle Tx mode ON

\* CW mode only

\*\* New Hotkey assignment

\*\*\*\* U and D will not tweak Serial Number in \X\, use 'up' and 'do'.

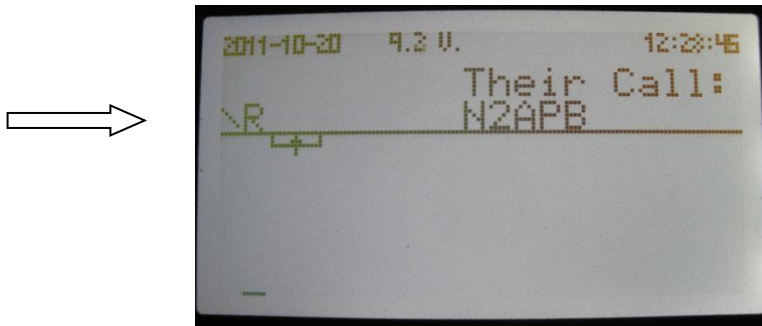
**Note:** Prosigns in DLE sequences can be keyed as discrete characters. Therefore “\bk\” may be keyed as “\BK\”, “\ar\” may be keyed as “\AR\”, and “\do\” may be keyed as “\DO\”. Prosigns not in DLE sequences must be entered without the intra character SPACE.

### 3.8 Keyed Macro Functions

**Entering and deleting macros with the keyer are not supported in this release. It may be considered for a future release but, to do so, will require major changes to basic parts of the firmware.**

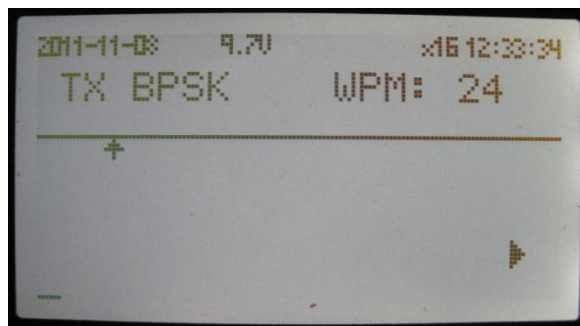
### 4.0 DLE Sequence Display

When a DLE character is keyed, the modem will display a backwards slash (‘\’) character in the first column of the third line of the LCD display screen. The next one or two characters keyed will be displayed after the DLE as they are keyed. When the ending DLE is keyed and the sequence is valid, it will be acted on. If the sequence is not valid it will be ignored. In either case, the DLE display will be cleared. The ending DLE is never displayed.



### 5.0 Keyer Speed Control

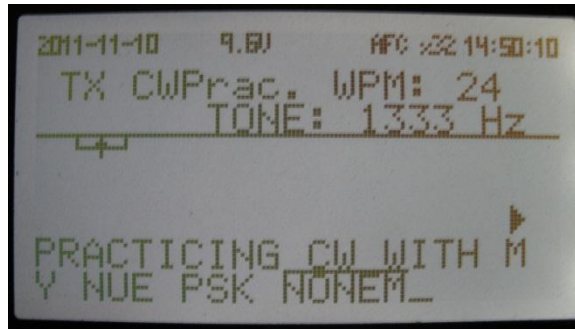
In CW mode, the keyer speed is the same as the CW transmit speed (keying rate). The keying rate can be changed to any value between 5 wpm and 50 wpm when in Tx mode by turning the tune control. Since the keyer can be used in any operating mode, the keying rate control has been included in the Tx display for all modes. In operating modes other than CW, the keying rate can only be adjusted and the rate will only be displayed when the keyer is enabled.



An additional field has also been added to the Tx display to identify the current operating mode. The operating mode is displayed as: “BPSK”, “QPSK”, “QPSK/R”, “RTTY”, “CW”, or “CWD”. When the keyer is not enabled, the TX display line will be truncated immediately after the operating mode field.

## 6.0 CW Practice Mode

Since some of the operating procedures to perform all the modem functions from the keyer are new, a practice mode is included in this firmware release to help the user get familiar with them. Practice mode is selected from the CONFIGURE>MODE menu like any other operating mode. To activate practice mode, select “CW Practice” from the menu. This will activate all the normal CW features and keyer functions except the transceiver’s PTT line will not be keyed and received text will not be displayed on the receive text area of the LCD. CW Practice mode will not be saved with a Save Configuration nor will it be restored on power up. If a Save Configuration is performed in CW Practice mode, the modem will restart in CW mode. The same is true of Upload Config and Download Config.



## 7.0 Other Changes Incorporated in This Release

The following subsections describe those functional changes made in this firmware version other than the CW Keyer support.

### 7.1 Vocabulary Additions

The CW vocabulary has been expanded to include ‘@’ (.-.-.). This character was added to International Morse Code in the 2004 version of Recommendation ITU-R M.1677.

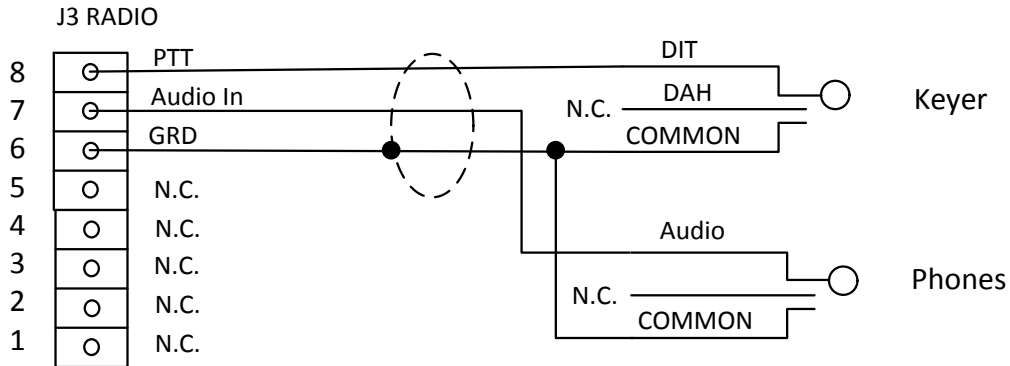
The CW and PSK vocabularies have been expanded to include ‘é’ (. . - . .) . The ASCII code for this character is 0xE9 (233) which exceeds the upper limit for a 7-bit code (0x7F or 127). Internally, the firmware uses ASCII code 0x40 (64) to represent this character. The 0x40 ASCII code is normally assigned to ‘`’ (grave accent) which has little or no use as a stand-alone character in normal text. Some international keyboards use this key to apply the grave accent to the following character.

### 7.2 Direct Keying CW

CW support in previous versions of the modem firmware requires the transceiver be in SSB mode. Rigs that do not support SSB operation could not be used with the modem. This includes many older rigs, QRP rigs, kits, and homebrew rigs. This version of the firmware supports a direct keying CW mode where the rig can be operated in CW mode and the modem keys its PTT interface line. This operating mode is enabled by selecting the “CW DIRECT” mode from the modem configuration menu. CW DIRECT requires a special cable to connect the modem PTT line (J3, pin 8) to the rig’s key-in jack and the modem

audio input interface line to the rig's audio-out jack. This cable will only work in CW DIRECT mode. In some cases, an interface adapter may be required for, circuit isolation, voltage level translation, and/or signal polarity conversion (e.g., for vacuum tube keying).

The following cable (or equivalent) is required for direct keying CW:



This cable can be made as a stand-alone interface or incorporated into a standard modem-to-transceiver cable or as an adaptor between the standard cable and the modem.

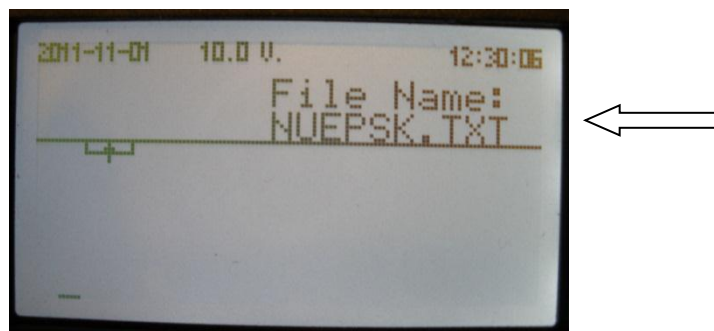
**Note:** Many commercial transceivers have an option that enables transmitter keying using the data interface PTT line in CW mode. In those cases, the standard data mode interface cable can be used. Check your transceiver operating manual.

### 7.3 Transmit Side Tone Tweak

Previous versions required the Ctrl key to be held down to adjust the Tx and Rx side tone frequency with the tuning knob. This version allows the frequency adjustment when either the Ctrl key or the Select button is pressed. Note that the side tone frequency applies to both Tx and Rx side tones but the frequency can only be adjusted in Tx mode. This change allows the side tone frequency to be adjusted without a keyboard attached to the modem.

### 7.4 Enter File Name (Ctrl-N) Display Relocation

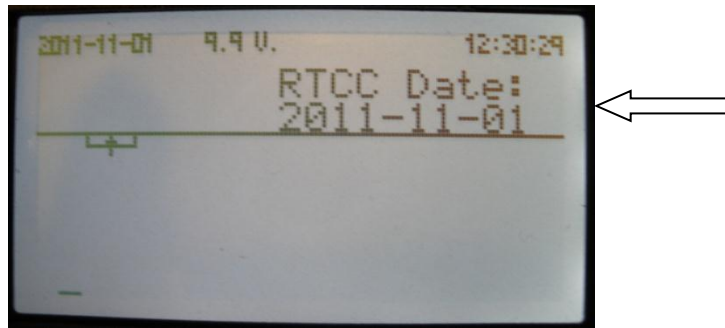
The Enter File Name function display area has been moved to the upper right quadrant of the LCD. This allows the function to be performed without interrupting an in-process Rx operation. It also allows the file name to be entered/edited using either the keyboard or the keyer. Note there is no validation of the input characters other than length.





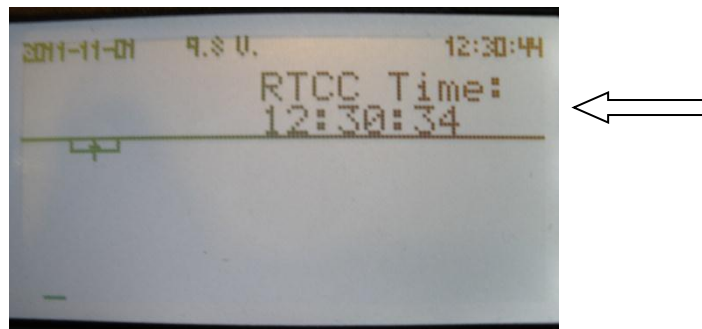
## 7.5 Enter RTCC Date (Ctrl-D) Display Relocation

The Enter RTCC Date function display area has been moved to the upper right quadrant of the LCD. This allows the function to be performed without interrupting an in-process Rx operation. It also allows the RTCC date to be entered/edited using either the keyboard or the keyer. Note that the date separators ('-' and '/') are not verified as long as there is a character in the assigned position. The forward slash may be input with a keyer but the dash cannot. Any character, such as a period or a comma, can be used instead of the dash.



## 7.6 Enter RTCC Time (Alt-D) Display Relocation

The Enter RTCC Time function display area has been moved to the upper right quadrant of the LCD. This allows the function to be performed without interrupting an in-process Rx operation. It also allows the RTCC date to be entered/edited using either the keyboard or the keyer. Note that the time separator (':') is not verified as long as there is a character in the assigned position. Any character, such as a period or a comma, can be used instead of the colon.

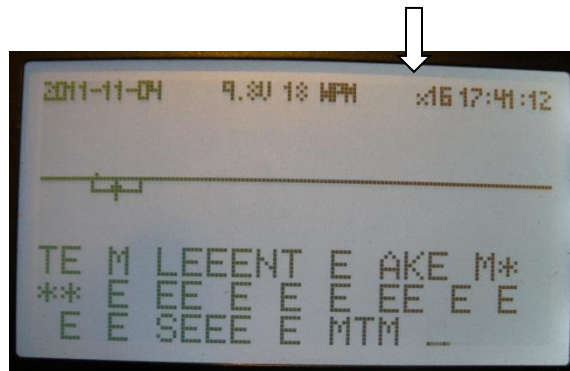


## 7.7 Programmable Gain Amplifier (PGA) Gain Level Display

In receive mode the gain of the input amplifier may be programmed to one of four levels. The gain level is changed using the Page Up (\PU\ ) hot key to increase gain and Page Down (\PD\ ) hotkey to decrease gain. The four levels are as follows:

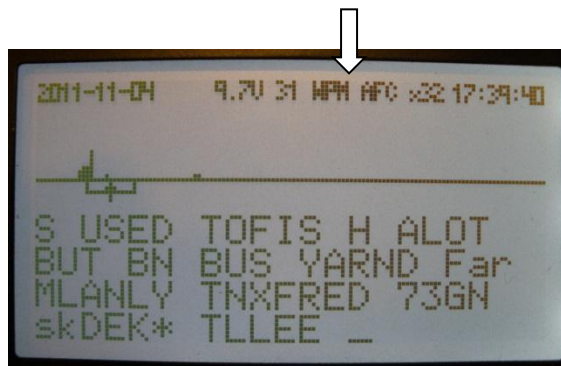
- x1
- x2
- x16
- x32

Repeatedly keying Page Up will raise the gain to x32 and hold it there. Similarly, repeatedly keying Page Down will reduce the gain to x1 and hold it there. To know what the gain level was, the operator had to increase or decrease the gain level to the limit then step the gain in the opposite direction counting the steps. This release displays the current gain level on the top line of the LCD as shown below:



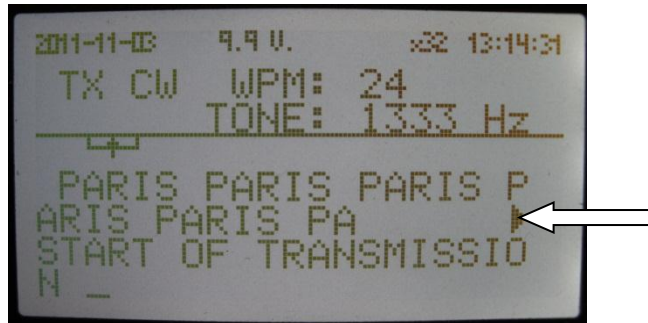
## 7.8 Automatic Frequency Control (AFC) indicator

When the AFC is enabled (Ctrl-A) "AFC" will be displayed on the top line of the LCD. This display area will be blank when AFC is disabled.



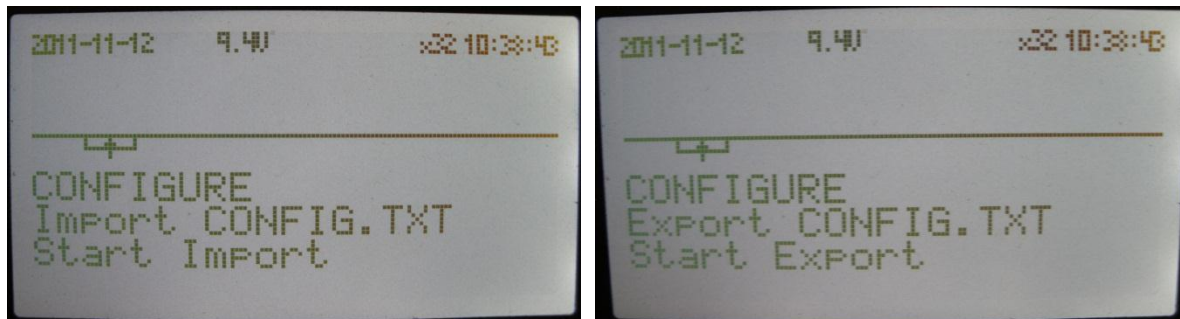
## 7.9 Save Text on Switch from Rx to Tx

Previous firmware versions clear the text area of the LCD on any change between Rx and Tx modes. This version preserves the last three lines of the Rx screen when changing from Rx mode to Tx mode. Instead of clearing the text area of the screen, a marker (a right pointing triangle) is placed at the end of the current line and the text is scrolled up one line. This allows to operator to see up to three lines of Rx text as he/she starts to key a response. The text area is still cleared on a change from Tx mode to Rx mode.



## 7.10 Configure Menu Terminology

The “Upload” and “Download” terminology formerly used to select reading and writing the CONFIG.TXT file was confusing to some users. This terminology has been changed to “Export” and “Import” to be more definitive.



## 8.0 Keyer Configuration Menu Options

This release adds the following selections to the configuration menu.

### 8.1 Keyer Mode Selection

The following keyer modes are supported:

CONFIGURE menu selection: Keyer Mode

- Iambic A
- Iambic B
- Dot Preferred
- Dash Preferred
- Ultimatic

A Save Config operation will save the current keyer mode in the EEPROM so it will be restored the when modem power is turned on. The keyer mode is not saved in the config.txt file.

## 8.2 CW Paddle Reverse

The CW paddle dot-dash designations may be interchanged as follows:

CONFIGURE menu selection: CW Paddle Reverse

- Normal (DOT: left paddle, DASH: right paddle)
- Reverse (DOT: right paddle, DASH: left paddle)

A Save Config operation will save the current CW Paddle Reverse selection in the EEPROM so it will be restored the when modem power is turned on. The CW Paddle Reverse selection is not saved in the config.txt file.

**APPENDIX A. Morse Code Encoding with Prosigns and ASCII Equivalents.**

STANDARD MORSE ENCODING AND ASCII EQUIVALENTS								
CHAR	DEC	HEX	MORSE	PROSIGN	CHAR	DEC	HEX	MORSE
	32	0x20	W SPACE		@	64	0x40	.-.-.-.
!	33	0x21			A	65	0x41	.-
"	34	0x22	.-.-.-.		B	66	0x42	-...-
#	35	0x23			C	67	0x43	-.-.-
\$	36	0x24			D	68	0x44	-..-
%	37	0x25			E	69	0x45	.
&	38	0x26			F	70	0x46	...-
'	39	0x27			G	71	0x47	--.
(	40	0x28	-.-.-.	kn	H	72	0x48	....
)	41	0x29			I	73	0x49	..
*	42	0x2A	...-.-	sk	J	74	0x4A	..---
+	43	0x2B	.-.-.	ar	K	75	0x4B	-.-
,	44	0x2C	--...-		L	76	0x4C	...-
-	45	0x2D	-.-.-.-		M	77	0x4D	--
.	46	0x2E	.-.-.-.-		N	78	0x4E	-.-
/	47	0x2F	-.-.-.-		O	79	0x4F	---
0	48	0x30	-----		P	80	0x50	...-
1	49	0x31	.------		Q	81	0x51	---.-
2	50	0x32	..-----		R	82	0x52	...-
3	51	0x33	...-----		S	83	0x53	...-
4	52	0x34	....-----		T	84	0x54	-
5	53	0x35	.....-----		U	85	0x55	...-
6	54	0x36	-.....-----		V	86	0x56	...-
7	55	0x37	--.....-----		W	87	0x57	...-
8	56	0x38	---.....-----		X	88	0x58	...-
9	57	0x39	----.....-----		Y	89	0x59	...-
:	58	0x3A	-----.....		Z	90	0x5A	...-
;	59	0x3B	-.-.-.-.-		é	64	0x60	...-
<	60	0x3C						
=	61	0x3D	-....-	bt				
>	62	0x3E						
?	63	0x3F	..-.-.-					

**APPENDIX A. Morse Code Encoding with Prosigns and ASCII  
Equivalents (cont.)**

STANDARD PROSIGNS			
MORSE	PROSIGN	MEANING	DESCRIPTION
.-.-..	al		???
.-.-.	ar	All Right	end of message
.-...	as	wait A Sec	stand by
-...-.-	bk	Back-to-you	BreaK
-...-	bt		Separator
-.-.-..	cl	Clear	CLosing down
-.-.-.-	cq		Calling
-.-.-	ct	Commence Transmission	start of message
.....	hh	error	HuH?
..-.-	iq		???
-.--.	kn	oK, Named-station	Kalled station only
...-.-	sk	Silent Key	end of contact
...-.	sn	Sho' 'Nuff	understood

NON-STANDARD PROSIGNS USED BY THE NUE-PSK DIGITAL MODEM			
MORSE	PROSIGN	MEANING	DESCRIPTION
..-.-	uu	Start/End DLE Sequence	Keyed modem hot keys
..-.-.	up	UP	Tweak up
-.-.-	do	DOWn	Tweak down
--.-.	tc	Their Call	Insert TC in Tx text
---.-.	mc	My Call	Insert MC in Tx text

## APPENDIX B. EEPROM Content Map

(HEX)	CONTENT	ENTER	CHARS
00000	's' (indicates saved config is valid)	-	1
00001	CFG1 (PGA + mMode)		1
00002	CFG2 (BL + SQTH + AFC + CWID)		1
00003	CFG3 (CW side tone enables and RTCC display enable flags)	<b>Esc</b>	1
00004	CW TX Speed (05 – 50 WPM)	CW Mode + Tuning	1
00005	CW Side-Tone Period (2 – 10, 400 – 2000 Hz)	CW Mode + Ctrl-Tuning	1
00006	CW RX inter-char Tcw x 10 (20 – 40)	'C' +/-	1
00007	CW RX inter-word Tcw x10 (25 – 70)	'W' +/-	1
00008	CW RX skew limit (2 – 6)	'S' +/-	1
00009	Date Display Format (0: Y-M-D, 1: M-D-Y, 2:M/D/Y)	Config option	1
0000A-0000B	Serial Number (001 - 999)	'N'/'X' +/-/Home	2
0000C-0001F	Reserved		20
00020	'd'	-	1
00021	'e'	-	1
00022	' '	-	1
00023-0002F	My Call Sign (11 char max, null terminated)	Ctrl+M	13
00030-0003F	Saved Frequency	Ctrl+F	4
00040 - 0004F	(unassigned)	-	16
00050	' '	-	1
00051-00059	Log File Name (8.3)	Ctrl+N	12
0005A-0005F	(unassigned)	-	6
0005A-000FF	(unassigned)	-	166
00100-001FF	Macro 1	Ctrl+F1	255
00200-002FF	Macro 2	Ctrl+F2	255
00300-003FF	Macro 3	Ctrl+F3	255
00400-004FF	Macro 4	Ctrl+F4	255
00500-005FF	Macro 5	Ctrl+F5	255
00600-006FF	Macro 6	Ctrl+F6	255
00700-007FF	Macro 7	Ctrl+F7	255
00800-03FFF	(unassigned)	-	14336
04000-040FF	(unassigned)	-	256
04100-041FF	CW Macro 1	Ctrl+F1	255
04200-042FF	CW Macro 2	Ctrl+F2	255
04300-043FF	CW Macro 3	Ctrl+F3	255
04400-043FF	CW Macro 4	Ctrl+F4	255
04500-045FF	CW Macro 5	Ctrl+F5	255
04600-046FF	CW Macro 6	Ctrl+F6	255
04700-047FF	CW Macro 7	Ctrl+F7	255
04800-07FFF	(unassigned)	-	14336

Note: Address range is shown for 24AA256. Some modems use 24AA1025 which has four times the capacity but the modem only uses the first quarter.

## APPENDIX B. EEPROM Content Map (cont.)

Configuration byte bit and field definitions:

ADRS	BYTE	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
00001	CFG1	X	PGA		OPERATING MODE				
00002	CFG2	X	X	BL	X	SQTH		AFC	CWID
00003	CFG3	X	K Swap	CW RX ST	CW TX ST	Keyer Mode			RTCC

<b>Keyer Mode</b>	
VALUE	MODE
0	lambic A
1	lambic B
2	Dot Preferred
3	Dash Preferred
4	Ultimatic
5	
6	
7	

<b>OPERATING MODE</b>	
VALUE	MODE
0	BPSK_MODE
1	QPSKU_MODE
2	QPSKL_MODE
3	<i>(TUNE_MODE)</i>
4	<i>(TUNE_MODE_WID)</i>
5	<i>(CWID_MODE)</i>
6	RTTY_MODE
7	CW_MODE
8	<i>(PSK63_MODE)</i>
9	CW_DIR_MODE
A	<i>(CW_PRACTICE)</i>

Note: Modes shown in parentheses are used internally and are not entered in the EEPROM. They are shown here for reference only.



## APPENDIX C. Hot Key Assignments

KEY	---	Ctrl-	Alt-	Shift-
A		Enable AFC	Disable AFC	
B	CW Goertzel Bandwidth	Clear internal buffers		
C	CW Char SPACE fence	Toggle RTTY FIGS		
D	<b><i>Tweak Down</i></b>	Enter date	Enter Time	
E				
F	-	Save freq in EEPROM	Retrieve saved freq	
G	CW Goertzel threshold			
H	Reset Entry (CANCEL, DLE only)			
I		Enter text to be REcd		
J				
K	<b>Toggle Tx mode ON</b>	Clear keyboard buffer	Insert beacon count	
L		Clear text display		
M		Enter My Call	Insert My Call	
N		Enter REC file name		
O		Toggle back light		
P		<i>Keyboard to Tx buffer</i>		
Q		Insert Tx OFF in macro		
R		Reverse RTTY Mark & Space		
S	Serial Number	Insert Tx ON in macro	Insert Serial No.	
T	CW Goertzel threshold	Enter Their Call	Insert Their Call	
U	<b><i>Tweak Up</i></b>	Toggle REC mode		
V				
W	CW Word SPACE fence			
X	Serial Number/Their Call		Insert Serial No.	
Y				
Z	CW Skew count	Input string terminator		
F1	Play macro 1	Record macro 1	Delete macro 1	
F2	Play macro 2	Record macro 2	Delete macro 2	
F3	Play macro 3	Record macro 3	Delete macro 3	
F4	Play macro 4	Record macro 4	Delete macro 4	
F5	Play macro 5	Record macro 5	Delete macro 5	
F6	Play macro 6	Record macro 6	Delete macro 6	
F7	Play macro 7	Record macro 7	Delete macro 7	
F8	Toggle TUNE mode			
F9	Save_Macro (0x1A)	<b><i>Beacon ON</i></b>	Beacon OFF	Beacon ON
F10	Toggle Rx & Tx			
F11	Display My Call			

KEY	---	Ctrl-	Alt-	Shift-
F12	Toggle settings display			
Tab		Display current freq		
Pg-Up	Increase PGA gain			
Pg-Dn	Decrease PGA gain			
End	Acquire			
Home	Reset Entry (CANCEL)			
L-Arrow	Tune down x 1		Tune down x 5	
R-Arrow	Tune up x 1		Tune up x 5	
D-Arrow	Tune down x 2		Tune down x 10	
U-Arrow	Tune up x 2		Tune up x 10	
ESC	Toggle CW Side Tone (TX or RX)			