

Midnight Ultimate Keyer



Quick Reference

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*This Quick Reference contains brief descriptions of the Midnight **Ultimate Keyer** (MUK) displays and operating procedures and controls.*

The product and display images shown herein are current at the time of this writing (MUK_02_00A). Future releases may change appearance and content.

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Revision History:

- | | |
|--------------------|--|
| 2017 MAY 05 | Initial release. Synced with MUK_01_00F |
| 2017 AUG 24 | Revision A. Added encoder mode select and head phone audio.
Synced with MUK_01_01B. |
| 2017 NOV 12 | Revised to include V2 firmware features and Option Card. |

Additional Reference Information

MSNA Tutorial 10 - Audio Filter Testing

1. FEATURE OVERVIEW

Very Compact Design ... *Attractive 4.5"W x 1.5"H x 3" all black enclosure.*

Bright LED Display ... *Four, seven-segment characters with center colon.*

Simple, Intuitive, and Flexible User Interface ...

- *Unique 4-character display guides you using an extended character set, blinking characters, and varying character brightness.*
- *Rotary control with push switch for setup and speed selection.*
- *Eight push-buttons for message selection and setup functions.*
- *Serial interface for optional terminal: for keyer control and keyboard keying; full color display (with touch screen) for keyed text and setup menus.*

Seven Keyer Modes ... *Iambic A, Iambic B, Dot Preferred, Dash Preferred, Ultimatic, Semi Automatic (Bug), and Manual (Straight).*

Keying Rate ... *User selectable from 5 to 50 WPM in 1 WPM steps, current rate is displayed briefly when changed.*

Side Tone Generators ...

- *One for operator alerts (3.0 KHz).*
- *One for keyed text (0.5 - 9.5 KHz, operator selectable).*
- *Built-in, miniature, Piezo speaker (can be muted).*
- *Headphone/external speaker output available.*

Nine Message Memories ...

- *General messages 1 - 7 (non-volatile, 63 characters max).*
- *MY CALL (non-volatile, 15 characters max).*
- *THEIR CALL (volatile, 15 characters max).*
- *Input from CW paddles and/or optional terminal.*
- *Limited editing aids available during input.*

Embedded Message Control Functions ...

- *Unlimited message chaining.*
- *Message nesting to four levels.*
- *Change keying speed.*
- *Insert time delays with displayed countdown (00:00:01 to 18:12:15).*
- *Serial number generation and maintenance.*

Practice Modes ... *Improve your Morse code keying and copying skills.*

- *Keyed text displayed with timing indicators.*
- *Groups of five random characters generated and displayed.*
- *Choose from all alpha, all numeric, alpha-numeric mixed, and sequential alpha.*
- *Optional terminal can capture random text for grading.*

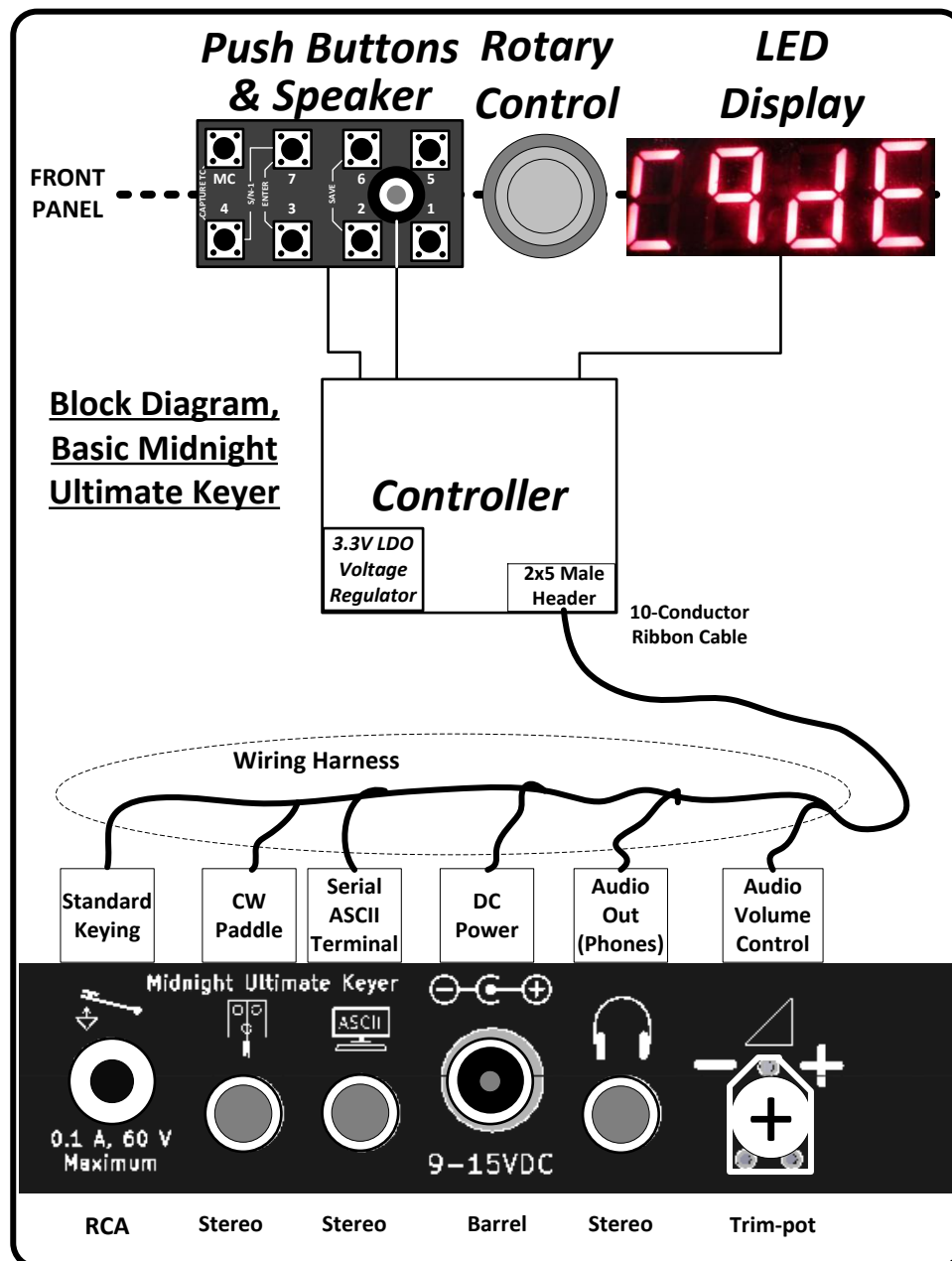
Headphone Audio ... *Audio output for private listening and/or external mixing with receiver audio.*

Tune Function ... *Initiated and terminated using the paddles with a special control code.*

Option Card ... *An optional Option Card adds the following features:*

- *PCB-mounted connectors eliminating the wiring harnesses.*
- *Boat Anchor Keying (grid blocking or cathode)*
- *High-current keying (up to 2A)*
- *An audio channel*
 - *Mixes keyer side tone with transceiver audio.*
 - *Independent volume controls.*
 - *Audio amplifier*
 - *DIP-switch configurator*
- *CW Audio Band-Pass filter.*

2. GENERAL DESCRIPTION



The main components of the basic MUK are shown in the block diagram. The following briefly describe each of them.

1. *Controller*

A 16-bit, 16 MIPS micro controller that processes input from other components and generates Morse Code, displays, and ASCII characters.

- 2. Rotary Control** Rotary control with detents and push-switch. Used to select displays and set parameters.
- 3. Speaker** Small Piezo speaker for sounding Morse code (side tone) and operator alerts (BEEPs).
- 4. Push Buttons** An array of eight pushbuttons organized as two sets (rows) of four. One button from either row is pressed to select messages and other options, two buttons, one from each row, are pushed simultaneously to input commands.
- 5. LED Display** Four-character, seven-segment LED display with center colon. A special font set is used to display a full character set (see Appendix D).

Five connectors mount on the back panel and are connected to the front panel with a wiring harness made from a 10-conductor ribbon cable with a 2x5 pin female connector that mates with a male connector on the back of the front panel. The connectors on the rear panel are as follows:

- 1. Power** 2.1mm coaxial power connector. Power requirements: 9 to 15VDC @ 150 ma.
- 2. CW Paddle** 3.5mm stereo connector for paddle input.
- 3. Serial Int.** 3.5mm stereo connector for Serial interface to an (optional) ASCII terminal. TxD is wired to the tip, Rxd is wired to the ring. The

voltage levels are GND (MARK or 1) and +3 V (SPACE or 0).

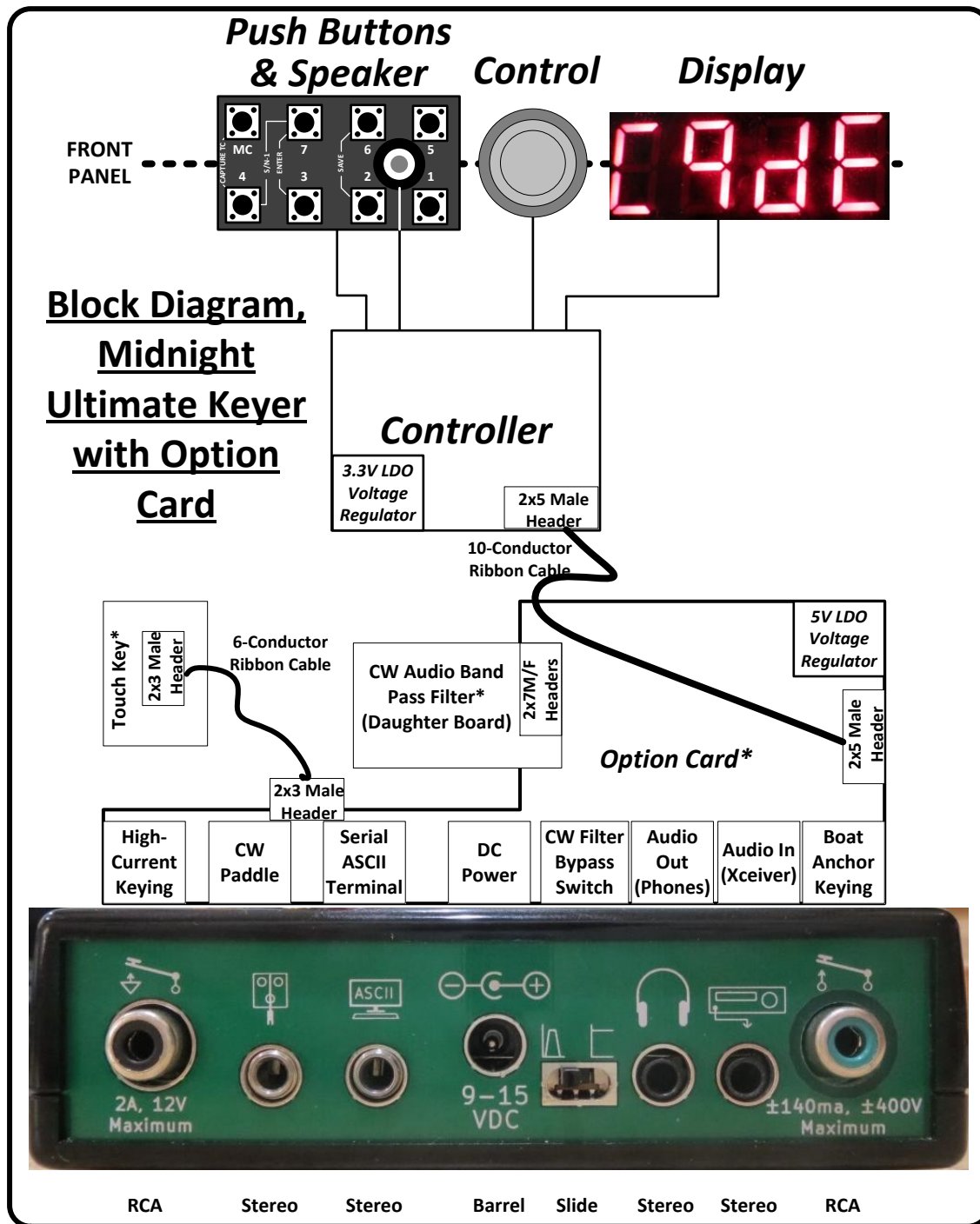
4. KEY

RCA jack for buffered output to key the transmitter. Will key any modern, solid state transmitter, interface converters will be required for cathode and grid-block keying. "Key down" is indicated by GND level (2N7002 is ON).

5. Headphones 3.5mm stereo connector for headphone audio (0 to 3V P-P).

When the Option Card is added, the rear panel is replaced with a new panel that accommodates two additional connectors and a slide switch. The connectors are moved to the option card and are all PC mount connectors. The option card connects to the front panel with a ten-conductor ribbon cable with a 2x5, female IDC connector at each end.

Four of the connectors function the same as those on the basic MUK as described above.



The first three connectors function identical those in the basic MUK. described above. The switch and other five connectors function as follows:

- 4. KEY** RCA jack for buffered output to key the transmitter. A PNP power transistor has been added in series with the key line to up the maximum current rating to 2 amps.
- 5. Headphones** 3.5mm stereo connector for headphone audio (0 to 5V P-P) driven by the audio channel's audio amplifier.
- 6. Filter Bypass** Slide switch to enable and disable the CW audio filter in the audio channel.
- 7. Audio In** 3.5mm stereo connector for audio from the transceiver, fed into the Option Card audio channel.
- 8. Boat Anchor keying** RCA jack for keyer output is optically isolated and can be used for cathode and grid-block keying rated for a maximum of 400 volts.

Note that any of the keyer output options will usually work with modern, commercially available transceivers.

3. QUICK START



This section briefly describes MUK installation and basic operations. Only the minimum operations required to "get on the air" are described, later sections contain detailed descriptions of these and more advanced operations and setup procedures.

1. External Connections

- a. If used, connect the optional ASCII terminal to the serial interface connector. The RxD level (to the keyer) must be restricted to 3.3V or less.
- b. Connect a CW paddle to the CW Paddle connector. By convention, tip is DIT and ring is DAH (a command is provided to reverse this if necessary).
- c. Connect power to the Power connector. Limit voltage range to +9 to +15 VDC.

2. Power On Sequence

- a. If the Optional ASCII terminal is to be used, set its serial port baud rate to be the same as the MUK. (Note, the MUKs default baud rate is 38,400 bps.)

b. Observe a "Splash" screen on the optional ASCII terminal identifying the product, firmware version, and serial interface baud rate.



c. Observe the firmware revision number (e.g., **200a** is Ver 2.00, Rev A) displayed on the MUK display (at full intensity) and "GO" sounded in Morse code (— — • — — —).



d. Without Option Card, observe the display change to **_go_** at half intensity indicating the keyer is ready for normal operation.



With Option Card, observe the display change to **go: A** indicating the audio channel functions are available.




3. Verify the Rotary Encoder Mode

- Turn the control knob counter clockwise (CCW) until you hear BEEPS from the speaker.
- Verify that the display shows **_go_** or "**go: A**". If, instead, it displays the current baud rate (e.g., **b384**), the firmware is interpreting the knob rotation backwards.
- If necessary, follow the procedure under ENCODER MODE (Section 15) to change the encoder mode.


4. Set the Keyer Speed (WPM)

- Press and release the control knob once to switch to normal operating mode. Note the display is now at full intensity.

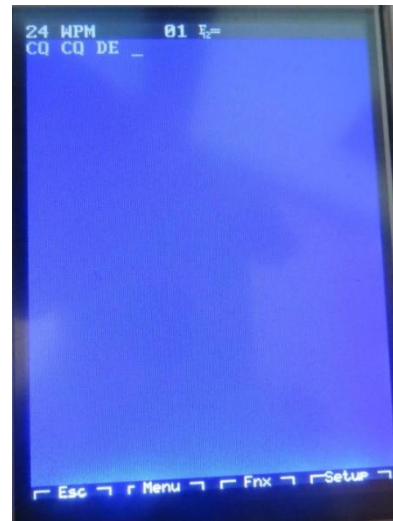
- b. Press and **hold** the control knob in while you rotate it to set the keyer speed to the desired rate (WPM). The default rate is 24 WPM. The keyer speed can be set to any integer WPM from 5 to 50 WPM. 
- c. The default keyer mode is Ultimatic with the paddle NOT reversed. Later sections will describe how to change these selections.

5. Begin Operation

The MUK is now ready to key your transmitter.

- a. Connect the KEY output to the KEY input of your transceiver. Observe the maximum rated voltage and current for the selected key interface.
- b. Enter text with the paddle and observe the text being displayed on the MUK display as the text is keyed. As each character is keyed, the displayed characters are shifted left one position and the new character is displayed in the far right position. Note, in this mode, spaces between words are not displayed, just the "printable" characters. 

c. When the optional ASCII terminal is used, set Caps Lock and enter text from the keyboard. Text will be displayed as it is keyed but will not be transmitted until the end of a word when SPACE or ENTER is entered. You can edit keying mistakes within a word. Spaces between characters will be displayed.



4. CONTROL FUNCTIONS

There are generally more than one way to perform MUK functions. This is to accommodate user preferences and in anticipations of more minimal MUK configurations. For example, it would be possible to configure a MUK with no push buttons and no rotary control and control and operate solely from the optional ASCII terminal.

4.1 ROTARY CONTROL

The single, rotary control knob is used to change displays and enter or select operating parameters such as WPM and keyer mode. Appendix B is a map of the MUK control states listing the functions and displays for each state. This map is navigated using the control knob.

On the map's top row (0) all of the displays are dimmed to half brightness. In this row, rotating the control knob will traverse the row left (CCW) and right (CW). Pressing and releasing the knob will sequentially cycle through the lower rows in the same column. Leaving the last (lowest) function in a column will switch to the top function in the same column.

Many functions below the map's top row are used to make selections and enter operating parameters. The display identifies the current selection by blinking its current value in the display. In these cases, rotating the control knob will change its value. A new selection will be entered the next time the control knob is pressed.

- - - NOTE - - -

The keyer speed (WPM) is adjusted by holding the control knob in while turning it. The speed may be adjusted at any time regardless of the current MUK control state.

The control function map in Appendix B provides basic information about each function and the associated display. Following sections describe the functions in more detail and outline the procedures to activate and use these functions.

4.2 PUSHBUTTON CONTROL

Many operations can also be performed using only the pushbuttons (see Appendixes C and G). The most basic pushbutton operation is the selection of a stored message (macro) to be played. Each of the pushbuttons is associated with the macro number identified by the legend on the front panel just below or above the pushbutton. Button presses are shown in braces and very bold text. For example **{MC}** indicates pressing and releasing the button labeled "MC".

There are a number of 2-pushbutton combinations that perform the same or similar operations as performed by the rotary control. These are shown in braces and very bold text. For example: **{4-6}** indicates that pushbuttons **4** and **6** are to be simultaneously pushed.

4.3 HOTKEY CONTROL

In many cases an operation can be performed by including the associated hot key in a stored message. In the following descriptions of these operations, the associated hot key/special

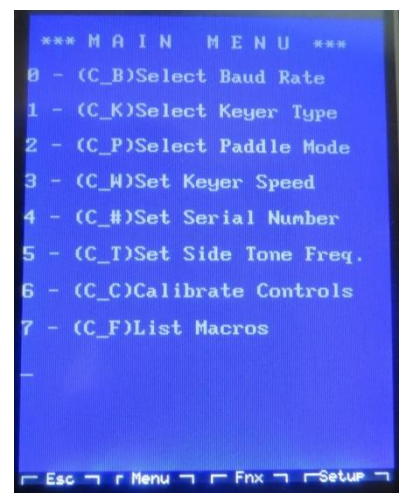
character is shown in square brackets and very bold text. For example: **[F4]** for function key **F4** (special extension code 0x83). Note, special extension codes and hot keys are defined in the appendices.

4.4 ASCII TERMINAL CONTROL

When using the optional ASCII terminal for setup functions, the MUK will generate and display menus in response to requests from the terminal user. These menus use a few special control codes intended to be used with the MSNA operating in Direct Terminal Mode (2). On most any other ASCII terminal (or terminal emulator app running on a PC), many of the functions will still work but the screen format will not be the same and the special control codes will probably be displayed as unknown character codes.

When using the MSNA as the ASCII terminal, many operations can be completed using the touch screen, without needing a keyboard. The menu system implemented in the MSNA is very flexible and most any menu line can generate the character code indicating the selection of that menu line. There are a significant number of other advantages to using the MSNA as the optional ASCII terminal with the MUK. The following sections assume the MSNA is used as the optional ASCII terminal.

Keying **[CTRL-M]** on the keyboard (or touching **Menu** on the fixed buttons at the bottom of the display) will bring up the main menu on the terminal's display. Sub-menus are selected by touching a line or by keying



the number in the first column of the line. Appendix B includes a number of screen shots of sub-menu examples.

5. NORMAL OPERATION

Normal operation was previously covered, this section adds some detail to that brief description.

A. After power on, observe the **_go_** or **go: A** display and sounded "go" in Morse code.

A1:



A2:



B. Observe that the display scrolls left as each character is entered and displayed in the right-most column. Inter-word spaces are not displayed. Press and release the control knob and note the display changes to full intensity indicating we are in the normal operating state.

B1:



B2:



B3:



B4:



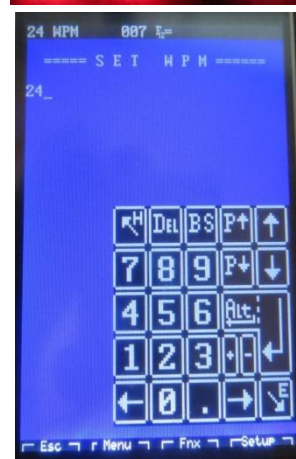
C. Rotate (press and rotate with Option Card installed) the control knob CW to increase the keyer speed **[CTRL-UP]** and CCW to decrease the keyer speed **[CTRL-DOWN]**. New WPM values are displayed for about one second.

C:



D: Touching the top line of the MSNA display brings up a numeric keypad for entering numeric values without a keyboard.

D:



6. SERIAL NUMBERS

Many contests require QSOs to be serialized and the serial number to be sent as part of the required exchange. The MUK has a number of functions to generate and maintain serial numbers.

A. From the normal operating state, press and release the control knob and observe the serial number displayed with the 3-digit serial number blinking. Rotate the control knob to change the serial number **[+]** **{4-6}** and **[-]** **{4-7}**.



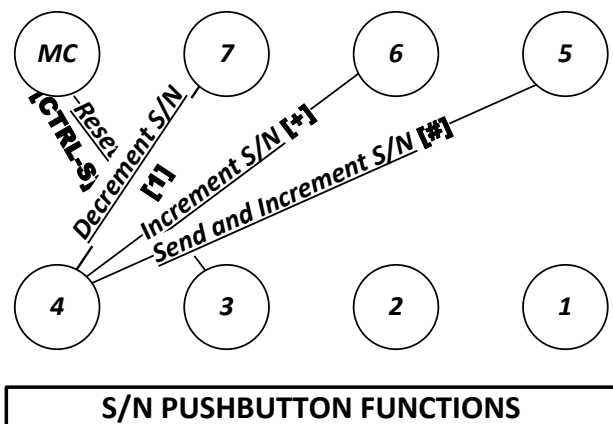
B. Press and release the control knob to set the serial number and return to the top row.

---Or---

Press and hold the control knob down for more than one second to reset the serial number to 001.

C. All together there are four pushbutton combinations to perform S/N operations.

C:

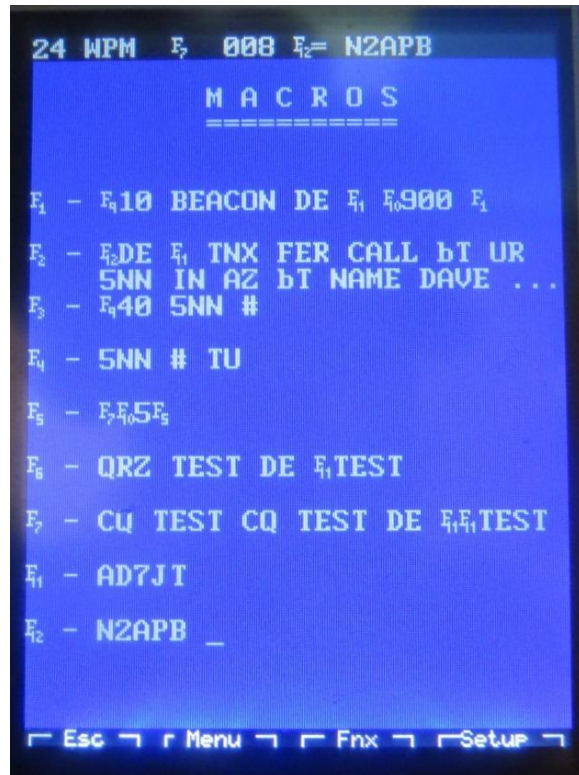
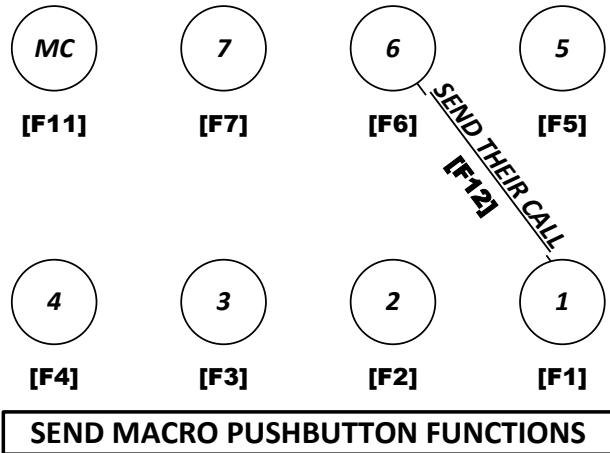


7. SENDING MESSAGES (MACROS)

A. To play a message (macro), stored in non-volatile memory, press and release one of the eight buttons **{1} [F1]** through **{7} [F7]** and **{MC} [F11]**.

B. To play back THEIR CALL stored in volatile memory, simultaneously press and release **{1-6} [F12]**.

A: and B:



[CTRL-F] or touch **Fnx** to list all macros

8. ENTERING MY CALL

A. Rotate the control knob to navigate to the Fn display.



B: Press and release the control knob and observe the macro number blinking.



C. Rotate the control knob CW until the blinking number is **MC [CTRL-F11] {MC}**. Press and release the control knob and observe the blinking stops.



D. Key in your call sign. If you make a mistake, rotate the control knob CCW **[BACKSPACE]** to back up and re-enter.



E. Observe that a space (underline) is added and a "W" (·--·) is sounded indicating the inter-word space.



F. Press and release the control knob **{2-6}** to save the macro in EEPROM. Rotate the control knob to return to operating mode. Press and release **{MC} [F11]** to key your call.

G. Note the display will flash **FnmC** before keying My Call. The keying will scroll the display to the left. If there is no My Call entry, **FnmC** will remain displayed and nothing will be keyed.

9. ENTERING MACROS

A. Rotate the control knob to navigate to the Fn display.

A: and B:
(see above)

B: Press and release the control knob observe the macro number blinking.

C. Rotate the control knob CW until the blinking number is 05 **[CTRL-F5] {3-7} {5}**. Press the control knob and observe the blinking stops.

C: 

D. Key "CQ".

D: 

E: Key "CMA", oops, extra inter-character space.

E: 

F: Rotate the control knob three detents CCW **[BACKSPACE]x3**.

F: 

G: Key "Q DE".

G: 

H: Press **{MC} [F11]** twice to insert your call twice.

H: 

I: Key "K".

I: 

J: Press the control knob to end and save the macro **[ENTER] {2-6}**.

F. Rotate the control knob 1 detent CCW **{2-6}**. Press **{5} [F5]** to call **CQ**.

10. CAPTURING THEIR CALL

A: In operating mode, key "N2APB".

B: Press **{4-MC} [ALT-F12]** to capture the last word keyed as Their Call.

C: Rotate the control knob one detent CW, press the control knob once, rotate the control knob to select macro 6, and press the control knob once to start recording **[CTRL-F6] {3-7} {6}**.

D: Press **{1-6} [F12]** to enter Their Call in the macro.

E: Key "DE" and press **{MC} [F11]** to enter My Call in the macro.

F: Press control knob once to end macro entry **{2-6} [ENTER]**.

G: Rotate control knob one detent CCW to go to operating mode. Press **{6} [F6]** to play back the macro.

H: Continue by keying the rest of the exchange.

A: & B:

C:

D:

E:

F:

G:

11. REPEATING MACROS/BEACONS

Inserting **F₁₀** (Appendix F) followed by a decimal number will cause a pause in processing the macro. Doing this in a repeating macro will result in the macro being transmitted repeatedly with a pause after each transmission equal to the value of the number following the **F₁₀** in seconds. The pause duration can be any time from one second to 65,535 seconds (18:12:15). The macro will be terminated by any keying from the paddles or the keyboard.

The **F₁₀** can be generated with **{3-5}** or **[F10]**. The pause duration must immediately follow the **F₁₀**, no spaces. The decimal value accumulation starts immediately after the **F₁₀** and stops with the first non-decimal digit character.

For example, the following macro broadcasts its message at 10 WPM every 15 minutes (900 seconds):

{7} [F1] "F₉10 BEACON DE F₁₁ F₁₀900 F₁"

The **F₁₁** inserts the content of the **MY CALL** macro in the text stream and should contain the station's assigned call sign. The **F₁₁** can be generated with **{MG}** or **[F11]**

The **F₉** sets the keyer speed to 10 WPM until the macro is terminated. The **F₉** can be generated with **{2-7}** or **[F9]**. During the pause, the display will display the time remaining before the end of the pause. Depending on the amount of time remaining, the display will show either "**HH:MM**" or "**MM:SS**".

12. MACROS FOR CONTESTING

The following sample macros perform common functions used during contests (and DX hunting). Note that "#" sends and increments the serial number.

Responding to CQ TEST:

{MC} [F11]:.... "AD7JT"

{4} [F4]: "5NN # TU"

Enter "#" with **{4-5}** or **[#]**.

Calling CQ TEST :

{7} [F7] "CQ TEST CQ TEST DE F₁₁ F₁₁ TEST"

{6} [F6] "QRZ TEST DE F₁₁ TEST"

{3} [F3] "F₉40 5NN #"

Enter "F₉" with **{2-7}** or **[F9]**.

Push **{3}** after keying calling station's call sign. Their call sign will be sent at the then current WPM setting, the RST and S/N will be sent at 40 WPM.

Press **{4-7} [-]** to decrement S/N before responding to a request to repeat the S/N.

Calling CQ TEST during quiet times:

{5} [F5] "F₇F₁₀5F₅"

Enter F₁₀ with **{3-5}** or **[F10]**.

Macro 7 will be transmitted repeatedly every 5 seconds until the operator starts keying which terminates the macro.

13. SIDE TONE

There are two tone generators, one for operator alerts and one for the transmit (Tx) side tone. The alert tone frequency is fixed at 3 KHz, the Tx side tone frequency can be varied in 500 Hz steps. The Tx side tone can also be turned off when using your transmitter-generated side tone.

A. Navigate to the Side Tone functions and observe the current frequency setting (/100).

A: 

B. Press once **[CTRL-T]** and observe the frequency value is blinking. Rotate the control knob CCW to reduce the frequency (minimum = 500 Hz).

B: 

C. Rotate the control knob CW to increase the frequency (maximum = 9500 Hz). Use the paddles to hear the tone, it will not be transmitted.

C: 

D. Press once to display on/off status of the Tx side tone.

D: 

E. Rotate the control knob **[ESC] {1-MC}** to toggle the Tx side tone on and off.

E: 

14. KEYER AND PADDLE MODES

A. Navigate to the keyer mode functions and observe the current settings (Ultimatic and Normal)

B. Press once **[CTRL-K] {3-6}** and observe the keyer mode indicator blinking.

C. Change the mode by rotating the control knob **{1}** through **{7}**. There are seven modes as shown on the right. You can test the keyer mode before finalizing your selection. Press once to save the selection and advance to the paddle mode function. If you hold the press for over one second, the keyer mode reverts to the previous mode before advancing to the paddle mode function.

D. Press once **[CTRL-P] {1-7}** and observe the paddle mode indicator blinking.

E. Rotate the control knob **{1}** and **{2}** to toggle the paddle mode between Normal and Reversed. You can test the paddle mode before finalizing your selection. Press once to save the selection. If you hold the press for over one second, the paddle mode reverts to the previous mode.

A. 

Paddles Normal

B. 

C1. 

Iambic-A

C2. 

Iambic-B

C3. 

Dot-preferred

C4. 

Dash-preferred

C5. 

Ultimatic

C6. 

Semi-auto (bug)

C7. 

Manual (straight)

D. 

E. 

Paddles Reversed

15. ENCODER MODES

The firmware may interpret the direction the control knob is turned differently depending on the encoder used in your MUK. The following procedure may be used to change the way the knob rotation is interpreted.

A. Navigate to the keyer mode functions and observe the current settings

A. 

B. Press once and observe the keyer mode indicator blinking.

B1. 

B2. 

C. Press once again and observe the paddle mode indicator blinking.

C1. 

C2. 

D. Press once again and observe the encoder mode indicator blinking.

D1. 

D2. 

E. Rotate the knob to change the encoder mode (Normal and Reverse).

E1. 

E2. 

F. Press the knob once to save the selection and return to the keyer mode function display.

F. 

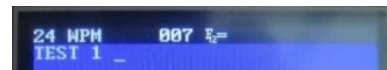
16. PRACTICE MODES

A. Navigate to the Practice function and note the input mode indicator.

A: 

B. Key "TEST 1" and observe that inter-word spaces are displayed as underlines on the MUK display. If the optional MSNA terminal is used, observe the keyed text with inter-word spaces displayed as spaces.

B: 



C. Press once and observe the blinking A indicating all alpha mode.

C: 

D. Press once more and observe the MUK generating groups of five random alpha characters. Observe the generated characters scrolling across the MUK display.

D: 

E. If the MSNA is used as the optional ASCII terminal, the generated text is displayed and can be used to grade your ability to copy Morse code.

E: 

15. PRACTICE MODES (cont.)

F. Press twice and turn the control knob CW to observe the blinking "AN" indicating **alpha-numeric** mode.



G. Press once more and observe the MUK generating groups of five random alpha-numeric characters.



H. Press twice and turn the control knob CW to observe the blinking " N" indicating **numeric** mode.



I. Press once more and observe the MUK generating groups of five random **nu-meric** characters.



J. Press twice and turn the control knob CW to observe the blinking "AB" indicating **sequential alpha** mode.



K. Press once more and observe the MUK generating groups of five sequential alpha characters.



17. BAUD RATE SELECTION

A. In the top row or the state map, rotate the control knob to the baud rate select column.

B. Observe the current baud rate ($\div 100$). Press the control knob once and observe the baud rate blinking.

C. Rotate the control knob and press the control knob to select the desired baud rate.

D. The serial interface's baud rate will be set to the new value. The controller will then reset and restart.

E. The MUK will display **go** and sound it in Morse code.

A: and B:



C:



D:

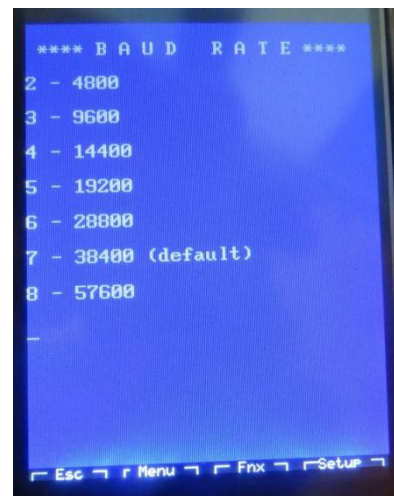


E:



The following baud rates are available:

OFF	Disables the serial interface.
4800	
9600	
14400	
19200	
28800	
38400	(Default)
57600	



18. OPTION CARD

The option card schematic is shown in Appendix I. It mounts in the base of the enclosure and interfaces to the front panel with a short, 10-wire ribbon cable. All rear panel connectors mount on the option card and are accessible through holes in the separate rear panel. The option card adds the following functions to the MUK.

18.1 Boat Anchor Keying

Transmitters using vacuum tubes are commonly referred to as "boat anchors" and usually have different keying requirements than modern, solid-state transceivers. Two common forms of boat anchor keying are cathode keying and grid block keying. As the name implies, cathode keying keys the cathode current of the final RF amplifier which can place a fairly high voltage across the "key". The standard MUK keying output cannot handle these high voltages. Grid block keying applies enough negative bias to the control grid of the final RF amplifier to turn it off. The amplifier is turned on when the keyer shorts the negative bias to a higher potential, normally ground. The keyer must handle a relatively high negative potential.

To handle the demands of boat anchor keying, the option card has a separate key output that is buffered by a solid-state relay. The relay can handle potentials of plus and minus 400V and currents of plus and minus 140 ma. The relay is an AC relay so it can handle negative as well as positive potentials.

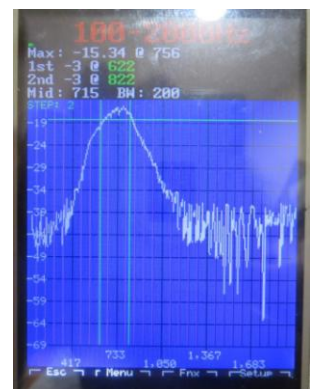
put and output connectors. This switch is normally used for testing with the MSNA which can generate an audio signal on the tip connector and receives the DUT output on the ring connector for signal strength measurements. With this switch on, the MSNA can be used to plot and display the CW audio filter frequency response.

The audio channel includes two digital potentiometers for controlling the MUK side tone volume and the volume of the received audio. The volumes are adjusted using the front panel control knob as described in previous sections.

A slide switch (SW2) on the MUK rear panel can switch the audio filter in and out. The filter band pass is quite narrow (about 200 Hz) and can make tuning somewhat difficult.

18.4 CW Audio Band Pass Filter

The standard CW audio filter (Appendix J) is a clone of the Hi-Per-Mite filter available from the Four State QRP Group (<http://www.4sqrp.com/hipermite.php>) used here with the kind permission of the Hi-Per-Mite designer, Dave Cripe, NMØS. The filter was redesigned using SMT components on a postage stamp-sized PCB. It is a daughter card that plugs into a 2x7 male header on the MUK Option Card. Its specs are as follows:



Center Frequency (Fc).....700 Hz

3 dB Pass Band Width (BW)200 Hz

There are instructions available on line for changing Hi-Per-Mite components to change its Center Frequency and bandwidth. These component changes could also be applied to the MUK filter using the corresponding SMT components.

Other daughter cards are anticipated for use in the audio channel. One possibility is a switched-capacitor audio filter which would enable the operator to tune the center frequency over a small frequency range. Another possibility is an experimenter's board the user could use to prototype and test his/her own audio filter/amplifier designs. MSNA Tutorial 10 describes how to setup and test audio filters using the MSNA with version 6 firmware and an optional audio signal generator test fixture.

18.5 Receive Audio Volume Control

When the option card is installed, receive audio volume control is done using the MUK control knob. In control state **1,1 OP-**



ERATE 1 turning the knob adjusts the receive audio volume. The display will momentarily show the current volume level setting. There are 32 volume settings from **A- 0** (off) through **A-31** (maximum)

18.6 Side Tone Volume Control

When the option card is installed, side tone volume control is done using the MUK control knob. In control state **2,2 SIDE TONE 2** turning the knob controls the MUK speaker and the

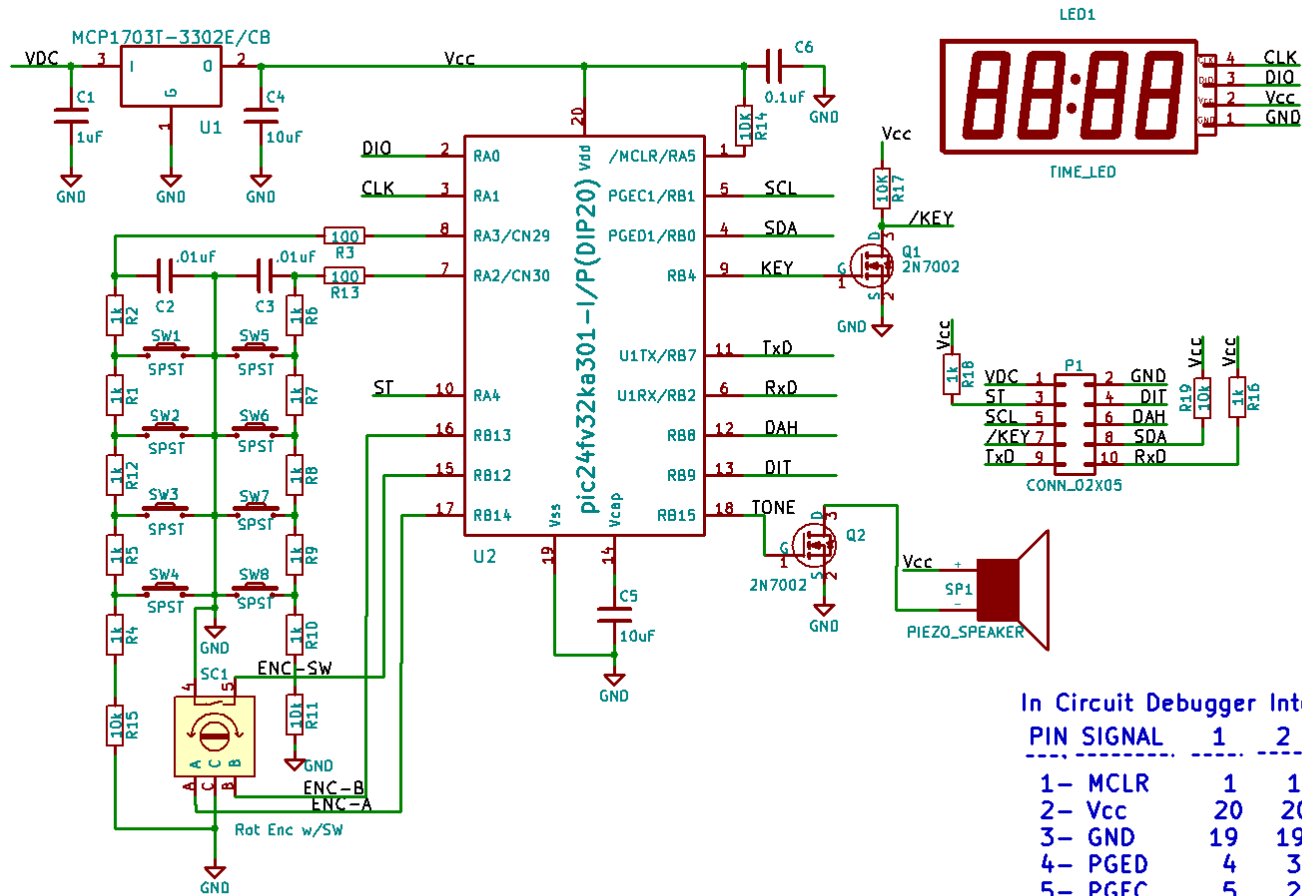
volume of the side tone in the audio channel. The following side tone settings are available:

- **SP:oN** MUK speaker on, Side Tone off **SP:oN**
- **S-:00** MUK speaker off, Side Tone off **S-:00**
- **S-:01** MUK Speaker off, Side Tone minimum vol. **S-:01**
- **- - - -** MUK Speaker off, Side Tone volume levels **02** through **30**
- **S-:31** MUK Speaker off, Side Tone maximum vol. **S-:31**

18.7 Audio Amplifier Gain Control

A separate, gain control for the audio amplifier is provided by a trim-pot (RV1) on the option card. The side tone and receive audio volume control are actually attenuators. The audio amplifier voltage gain can be varied between 20 and 200.

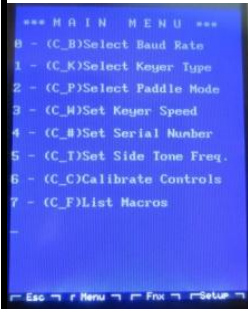
APPENDIX A. MUK SCHEMATIC



In Circuit Debugger Interfaces

PIN	SIGNAL	1	2	3
1-	MCLR	1	1	1
2-	Vcc	20	20	20
3-	GND	19	19	19
4-	PGED	4	3	9
5-	PGEC	5	2	10
6-	N.C.	-	-	-

APPENDIX B1. MUK CONTROL STATES W/O Option Card



90

FN:

ST:20

4n:117

PR:17

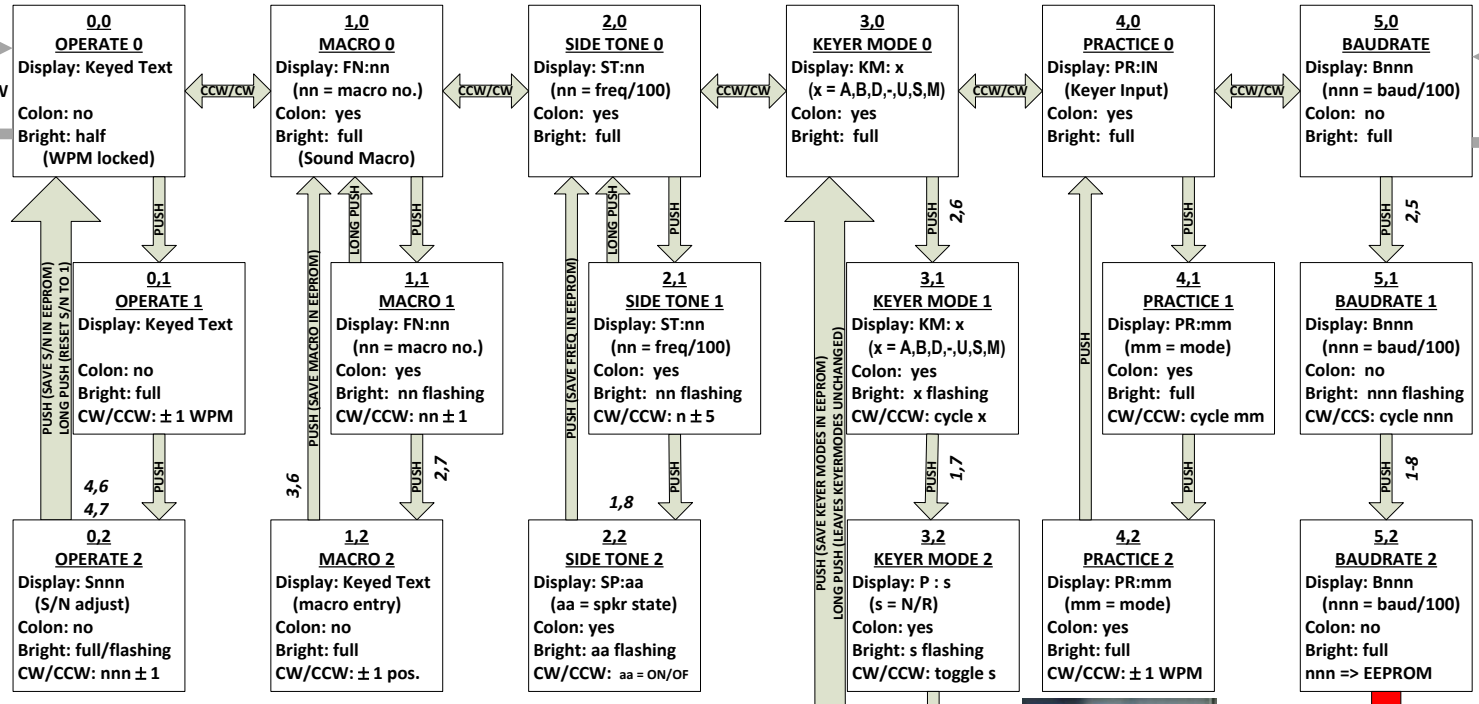
6384

Notes:

1. Flashing rate is four per second.
2. Flashing characters can be modified by rotating the control knob.

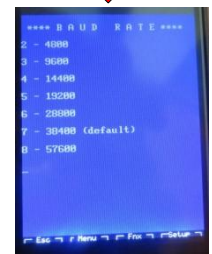
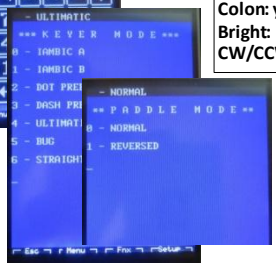
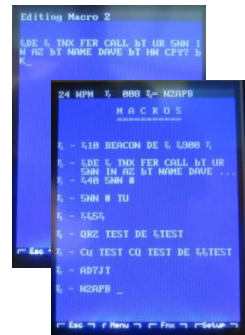
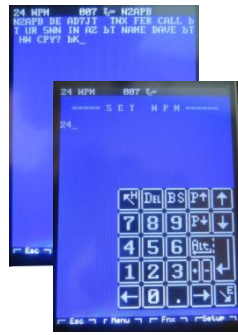
Legend:

1. "PUSH" indicates push and release of control knob.
2. "LONG PUSH" indicates a push of longer than one second before release of the control knob.
3. CW/CCW refer to rotating the control knob Clock Wise or Counter Clock Wise.



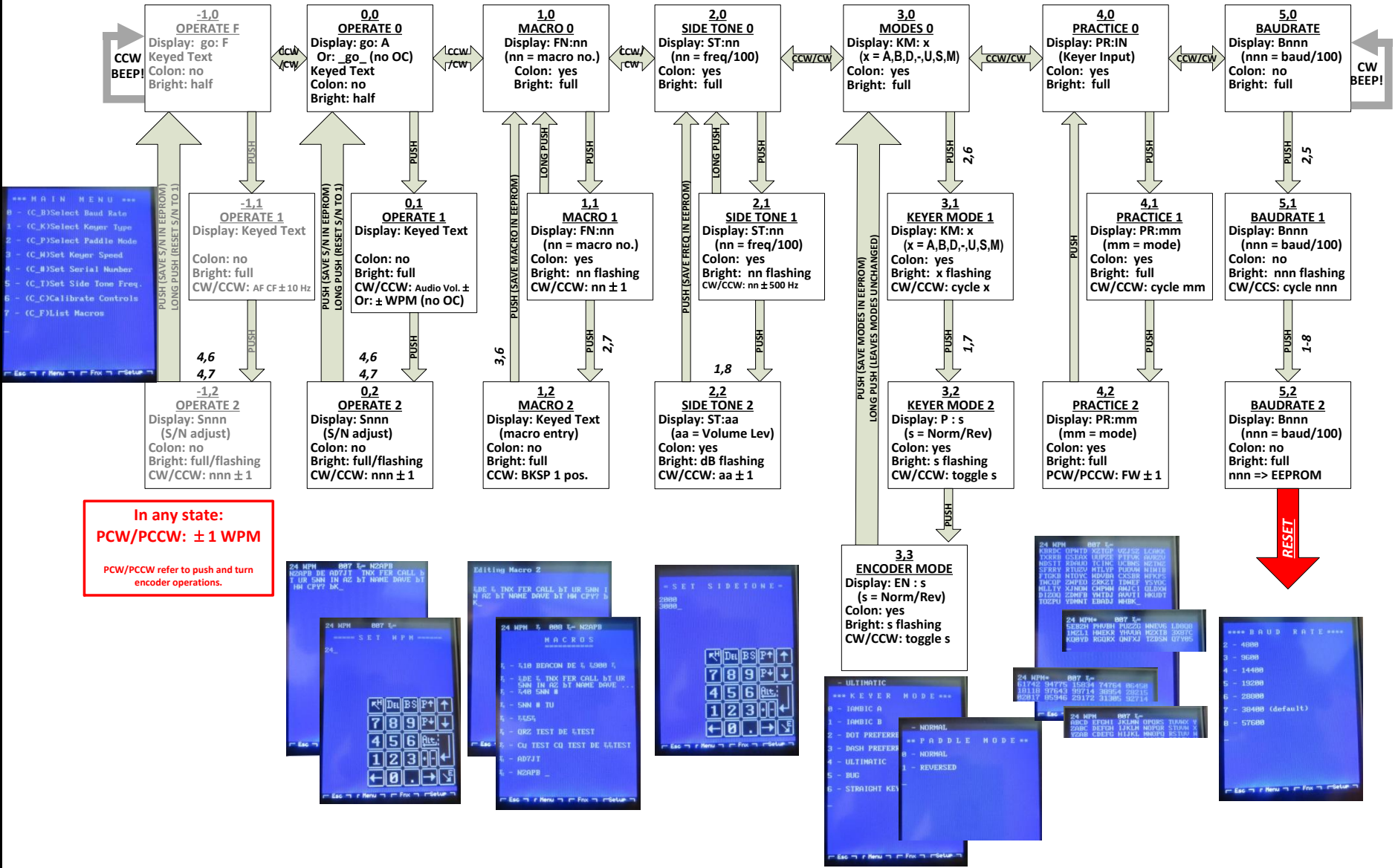
**In any state:
PCW/PCCW: ± 1 WPM**

PCW/PCCW refer to push and turn encoder operations.



APPENDIX B2. MUK CONTROL STATES W/Option Card

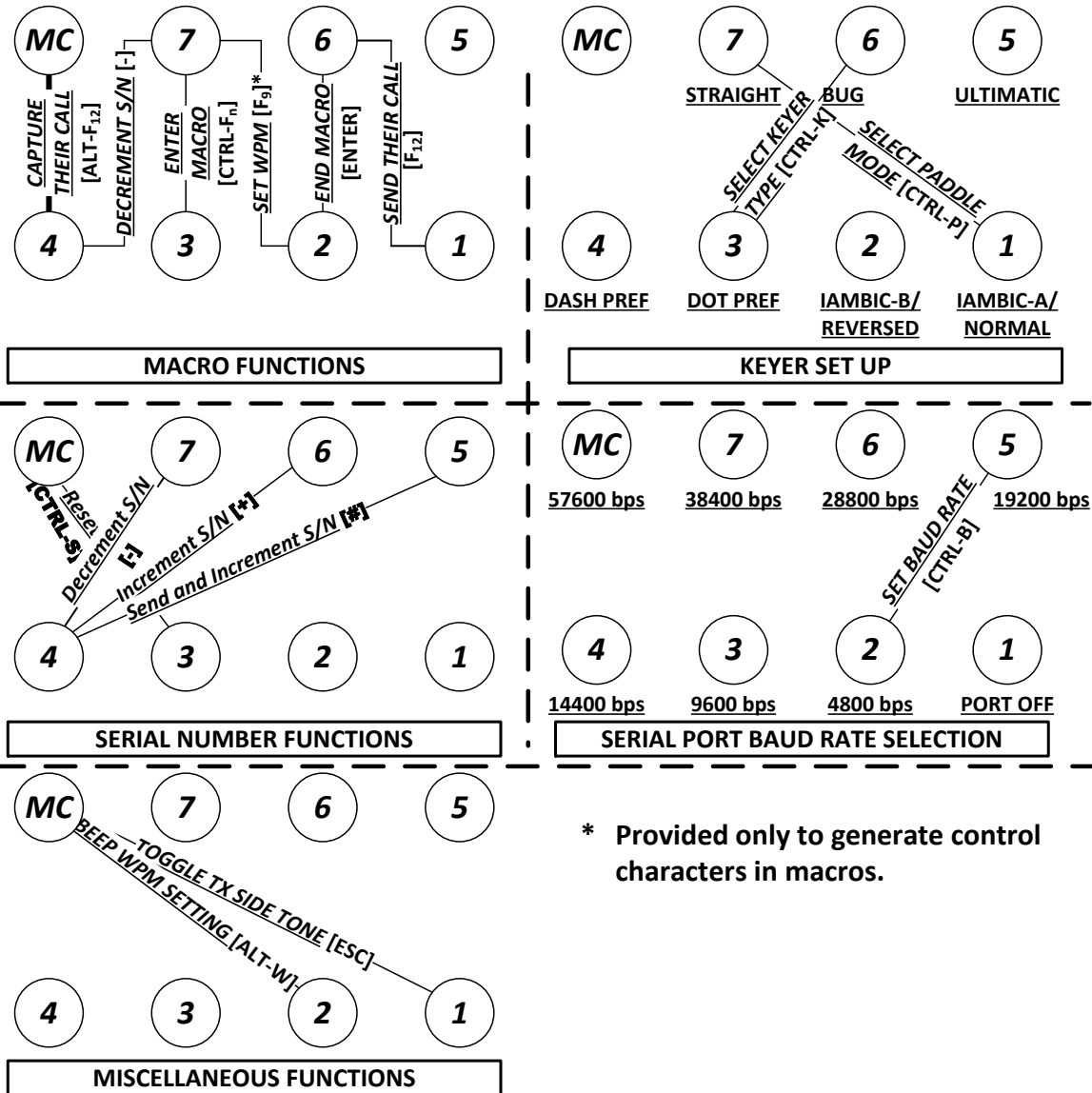
Control State Column
-1 is reserved for future enhancements.



In any state:
PCW/PCCW: ± 1 WPM

PCW/PCCW refer to push and turn encoder operations.

APPENDIX C. SWITCH FUNCTION DIAGRAMS



APPENDIX D. CHARACER FONTS

ABCD



EFGH



IJKL



MNOP



QRST








UVWX



YZ



APPENDIX D. CHARACER FONTS (cont.)

<p>" ' ()</p>	
<p>* , / <</p>	
<p>= > ? @</p>	
<p>[/] ^</p>	
<p>—</p>	

APPENDIX E. MORSE CODE WITH PROSIGNS AND ASCII

STANDARD MORSE ENCODING AND ASCII EQUIVALENTS								
CHAR	DEC	HEX	MORSE	PROSIGN	CHAR	DEC	HEX	MORSE
	32	0x20	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	-.--.	kK	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	96	0x60	..-..
<	60	0x3C						
=	61	0x3D	-.--.-.	bT				
>	62	0x3E						
?	63	0x3F	..-.-.					

Note: The MUK interprets "+ / =" and "-" as commands to increment and decrement the serial number therefore they cannot be transmitted by entering the ASCII character codes. Instead, for transmission, the prosigns " aR / bT" and "kK" must be entered.

APPENDIX E. MORSE CODE WITH PROSIGNS AND ASCII

(cont.)

STANDARD PROSIGNS			
MORSE	PROSIGN	MEANING	DESCRIPTION
.-.-.-	aL		???
.-.-.	aR	All Right (ENTER)	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 (BACK SPACE)	HuH?
..-.-	iQ		???
-.-.-	kN	oK, Named-station	Kalled station only
...-.-	sK	Silent Key	end of contact
...-.	sN	Sho' 'Nuff	understood

NON-STANDARD PROSIGNS RECOGNIZED BY THE MIDNIGHT ULTIMATE KEYSER			
MORSE	PROSIGN	MEANING	DESCRIPTION
..-.-	uU	Start/End DLE Sequence (\)	Keyed modem hot keys
...-.-	uP	UP	Tweak up
-...-.-	dO	DOWn	Tweak down
--.-.	tC	Their Call (F12)	Insert TC in Tx text
---.-.	mC	My Call (F11)	Insert MC in Tx text
--.-.- thru -----	m1 thru m7	Macro 1 (F1) thru Macro 7 (F7)	Play Macro 1 thru Macro 7
----	mM	tune (F8)	Activate Tune mode
.-.-	aA	Tab	Changes pointer in Name and Call display

 = Keyer prosign commands (see text).

APPENDIX F. SPECIAL EXTENSION CODES (SECS)

The standard 7-bit ASCII code set has been extended to 8-bit codes by adding Special Extension Codes (SECS) to the code set. All of these codes are in the range of 128 (0x80) to 255 (0xFF). The following table lists all the SECS and the associated keyboard keys or key combinations and the associated PS2 keyboard scan codes.

SEC	KEY	SCAN CODE	SEC	KEY	SCAN CODE	SEC	KEY	SCAN CODE	SEC	KEY	SCAN CODE
0x80	(not used)	n/a	0xa0	ALT_Q	0X15	0xc0	Home	0X6C	0xe0	CTRL_Q	0X15
0x81	F2	0X06	0xa1	ALT_R	0X2D	0xc1	PgUp	0X7D	0xe1	CTRL_R	0X2D
0x82	F3	0X04	0xa2	ALT_S	0X1B	0xc2	PgDn	0X7A	0xe2	CTRL_S	0X1B
0x83	F4	0X0C	0xa3	ALT_T	0X2C	0xc3	End	0X69	0xe3	CTRL_T	0X2C
0x84	F5	0X03	0xa4	ALT_U	0X3C	0xc4	F1	0X05	0xe4	CTRL_U	0X3C
0x85	F6	0X0B	0xa5	ALT_V	0X2A	0xc5	ALT_UP	0X75	0xe5	CTRL_V	0X2A
0x86	F7	0X83	0xa6	ALT_W	0X1D	0xc6	ALT_DN	0X72	0xe6	CTRL_W	0X1D
0x87	F8	0X0A	0xa7	ALT_X	0X22	0xc7	ALT_LFT	0X6B	0xe7	CTRL_X	0X22
0x88	F9	0X01	0xa8	ALT_Y	0X35	0xc8	ALT_RT	0X74	0xe8	CTRL_Y	0X35
0x89	F10	0X09	0xa9	ALT_Z	0X1A	0xc9	SHFT_Tab	0X0D	0xe9	CTRL_Z	0X1A
0x8a	F11	0X78	0xaa	ALT_0	0X45	0xca	CTRL_LFT	0X6B	0xea	CTRL_0	0X45
0x8b	F12	0X07	0xab	ALT_1	0X16	0xcb	CTRL_DN	0X72	0xeb	CTRL_1	0X16
0x8c	UpArrw	0X75	0xac	ALT_2	0X1E	0xcc	CTRL_RT	0X74	0xec	CTRL_2	0X1E
0x8d	DnArrw	0X72	0xad	ALT_3	0X26	0xcd	CTRL_UP	0X75	0xed	CTRL_3	0X26
0x8e	LftArrw	0X6B	0xae	ALT_4	0X25	0xce	CTRL_TAB	0X0D	0xee	CTRL_4	0X25
0x8f	RtArrw	0X74	0xaf	ALT_5	0X2E	0xcf	CTRL_?	0X4A	0xef	CTRL_5	0X2E
0x90	ALT_A	0X1C	0xb0	ALT_6	0X36	0xd0	CTRL_A	0X1C	0xf0	CTRL_6	0X36
0x91	ALT_B	0X32	0xb1	ALT_7	0X3D	0xd1	CTRL_B	0X32	0xf1	CTRL_7	0X3D
0x92	ALT_C	0X21	0xb2	ALT_8	0X3E	0xd2	CTRL_C	0X21	0xf2	CTRL_8	0X3E
0x93	ALT_D	0X23	0xb3	ALT_9	0X46	0xd3	CTRL_D	0X23	0xf3	CTRL_9	0X46
0x94	ALT_E	0X24	0xb4	ALT_F1	0X05	0xd4	CTRL_E	0X24	0xf4	CTRL_F1	0X05
0x95	ALT_F	0X2B	0xb5	ALT_F2	0X06	0xd5	CTRL_F	0X2B	0xf5	CTRL_F2	0X06
0x96	ALT_G	0X34	0xb6	ALT_F3	0X04	0xd6	CTRL_G	0X34	0xf6	CTRL_F3	0X04
0x97	ALT_H	0X33	0xb7	ALT_F4	0X0C	0xd7	CTRL_H	0X33	0xf7	CTRL_F4	0X0C
0x98	ALT_I	0X43	0xb8	ALT_F5	0X03	0xd8	CTRL_I	0X43	0xf8	CTRL_F5	0X03
0x99	ALT_J	0X3B	0xb9	ALT_F6	0X0B	0xd9	CTRL_J	0X3B	0xf9	CTRL_F6	0X0B
0x9a	ALT_K	0X42	0xba	ALT_F7	0X83	0xda	CTRL_K	0X42	0xfa	CTRL_F7	0X83
0x9b	ALT_L	0X4B	0xbb	ALT_F8	0X0A	0xdb	CTRL_L	0X4B	0xfb	CTRL_F8	0X0A
0x9c	ALT_M	0X3A	0xbc	ALT_F9	0X01	0xdc	CTRL_M	0X3A	0xfc	CTRL_F9	0X01
0x9d	ALT_N	0X31	0xbd	ALT_F10	0X09	0xdd	CTRL_N	0X31	0xfd	CTRL_F10	0X09
0x9e	ALT_O	0X44	0xbe	ALT_F11	0X78	0xde	CTRL_O	0X44	0xfe	CTRL_F11	0X78
0x9f	ALT_P	0X4D	0xbf	ALT_F12	0X07	0xdf	CTRL_P	0X4D	0xff	CTRL_F12	0X07

APPENDIX G. SWITCH FUNCTIONS

ROW A	ROW B	GENERATED HOT KEY*		FOLLOWED BY
X	X	(none)	Normal Operation	
X	5	F5	Send Macro 5	
X	6	F6	Send Macro 6	
X	7	F7	Send Macro 7	
X	MC	F11	Send MY CALL	
1	X	F1	Send Macro 1	
1	5		Reserved	
1	6	F12	Send THEIR CALL	
1	7	CTRL-P	Select Paddle Mode	1-7 enters 0 - 6**
1	MC	ESC	Toggle Side tone ON/OFF	
2	X	F2	Send Macro 2	
2	5	CTRL-B	Select Baud Rate	1-MC enters 1 - 8**
2	6	ENTER	End and Save Macro	
2	7	F9	Set WPM to following N	Decimal digits (5 - 50)
2	MC	ALT-W	Beep WPM***	
3	X	F3	Send Macro 3	
3	5	F10	Set Delay Timer to N	Decimal digits in Seconds
3	6	CTRL-K	Select Keyer Type	1-F7 enters 0 - 6**
3	7	CTRL-F _n	Enter Macro	1-MC enters 1 - 8 for n**
3	MC	CTRL-S	Reset S/N to 001	
4	X	F4	Send Macro 4	
4	5	#	Send and increment S/N	
4	6	+	Increment S/N	
4	7	-	Decrement S/N	
4	MC	ALT-F12	Capture THEIR CALL	

X = No switch pressed in this switch row

NOTES:

- * When a switch is pressed in row A and/or Row B, the associated HOT KEY code is generated as if received from the serial interface (MSNA or PC).
- ** Pressing a switch after hearing prompt makes selection and ends function.
- *** Switch-only function.

APPENDIX H. KEYBOARD HOT KEYS

MENUS	
CTRL_M	Main Menu
0	(C_B)Select Baud Rate
1	(C_K)Select Keyer Type
2	(C_P)Select Paddle Mode
3	(C_W)Set Keyer Speed
4	(C_#)Set Serial Number
5	(C_T)Set Side Tone Freq.
6	(C_F)List Macros

CTRL_B	Select BPS
2	4800
3	9600
4	14400
5	19200
6	28800
7	38400 (default)
8	57600

CTRL_K	Select Keyer Type
0	IAMBIC A
1	IAMBIC B
2	DOT PREFERRED
3	DASH PREFERRED
4	ULTIMATIC
5	BUG
6	STRAIGHT KEY

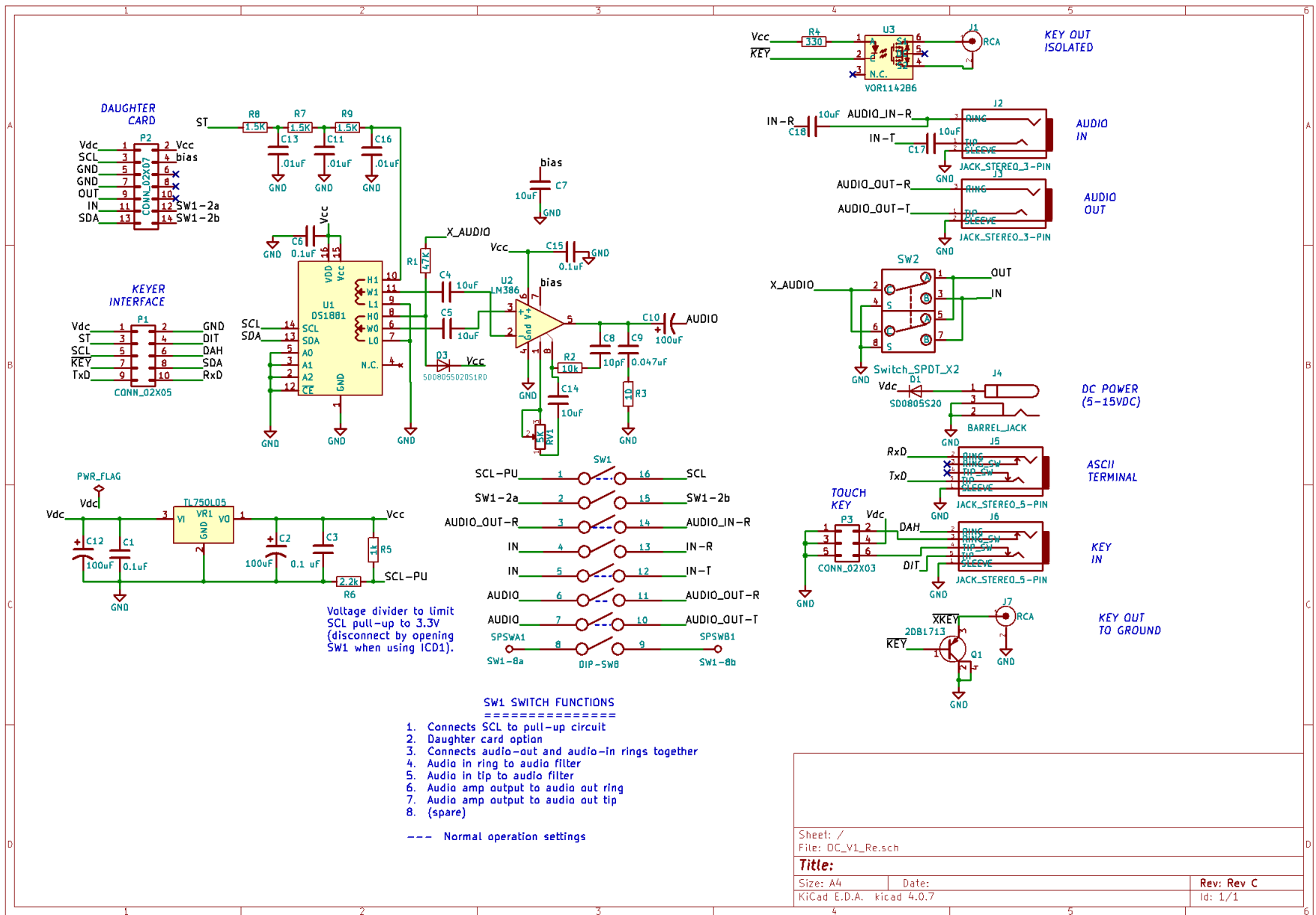
CTRL_P	Select Paddle Mode
0	NORMAL
1	REVERSED

CTRL_F	List Macros
--------	-------------

HOT KEYS	
CTRL_M	Show Main Menu
CTRL_B	Show Select Baud Rate Menu
CTRL_K	Show Select Keyer Type Menu
CTRL_P	Show Select Paddle Mode Menu
CTRL_W	Show Select Keyer Speed Prompt
CTRL_#	Show Set Serial Number Prompt
CTRL_S	Reset Serial Number to 001
CTRL_T	Show Set Side Tone Freq. Prompt
CTRL_F	Show Select Macro Menu
F1 to F7	Play EEPROM Macro 1 - 7 (63 char max)
F11	Play EEPROM Macro 11 (MY CALL, 15 char max)
F12	Play RAM Macro 12 (THEIR CALL, 15 char max)
CTRL-F1 to -F7	Enter EEPROM Macro 1 - 7
CTRL-F11	Enter EEPROM Macro 11 (MY CALL)
CTRL-F12	Enter RAM Macro 12 (THEIR CALL)
ALT-F12	Capture THEIR CALL in Macro 12
CTRL-F8	Toggle Tune On and Off
CTRL-UP	Increment Keyer Speed (WPM)
CTRL-DOWN	Decrement Keyer Speed(WPM)
#	Insert Serial Number in Transmission
+	Increment Serial Number
-	Decrement Serial Number
INSERT	Toggle Keyboard Tx on/off
ESC	Toggle Tx Side Tone on/off
CTRL_TAB	Reinitialize EEPROM

=> Keyboard only functions
 => Keyboard and Switch functions

APPENDIX I. OPTION CARD SCHEMATIC



APPENDIX J. CW AUDIO BAND PASS FILTER SCHEMATIC

