

HamHUD II

Kit Assembly Instructions & “Quick-Start” Guide

HW Rev E, Firmware Rev 2.8.000 & above

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HamHUD Nichetronix, LLC

www.hamhud.net

656 Ashbrittle Dr.
Rolesville, NC 27571

The HamHUD Team
Steve Bragg KA9MVA, Jason Rausch KE4NYV,
Jürgen Schöpf DB3TB, Dale Seaburg KG5LT

HamHUD Yahoo! Group
<http://www.yahogroups.com/groups/hamhud>

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Thanks for Buying a HamHUD II !

HamHUD II is a versatile APRS-compatible ham radio data terminal designed to be operated mobile. When used with an inexpensive KISS TNC (such as the TNC-X [www.tnc-x.com] or the Argent Data OpenTracker+), a low-cost GPS (such as a Deluo module or a Garmin eTrex) and a low-cost VHF radio, the HamHUD II makes an inexpensive but powerful mobile APRS rig!



NOTE! Please be aware of your state or jurisdiction’s laws on operating electronic equipment while driving. It may be against the law in some jurisdictions to mount HamHUD where it can be operated while driving.

Parts List

Please ensure you have all the parts in your kit. If you find you are short, please email parts@hamhud.net for a replacement. Tell us which kit you have, and the version!

Note that parts with  are POLARIZED, and must be installed correctly. Parts marked with  go on the FRONT size of the PCB.

Capacitors






- | | | |
|-----------------------------------------------------------------------------|----------------------------------------|---------------------------------------------------------------------------------------|
| <input type="checkbox"/> C1 | (1) 10 μ F / 50V electrolytic |  |
| <input type="checkbox"/> C2 | (1) 100 μ F / 35V electrolytic |  |
| <input type="checkbox"/> C3, C5, C6 and
C7, C9, C10 and
C11, C13, C14 | (9) 0.1 μ F (yellow, marked ‘104’) | |
| <input type="checkbox"/> C4 and C8 | (2) 22 pF ceramic disk | |

Resistors

All Resistors are 5% tolerance (GOLD band after the colors listed below).

- | | |
|-----------------------------------------------|-----------------------------------------------------------------------|
| <input type="checkbox"/> R1 | (1) 10 Ω 1-Watt (brown-black-black) |
| <input type="checkbox"/> R2 | (1) 75 Ω 2-Watt (violet-green-black or 75R) |
| <input type="checkbox"/> R3, R4, R6 and
R7 | (4) 1K Ω 1/8-Watt (brown-black-red) |
| <input type="checkbox"/> R5 | (1) 10K Ω 1/8-Watt (brown-black-orange) |
| <input type="checkbox"/> R8,R9 | (2) 220 Ω 1/8-Watt (red-red-brown) (both may be 180 Ω) |

Diodes

- | | | |
|-----------------------------------------------------------------------------------------------------------------|------------------------------|---------------------------------------------------------------------------------------|
| <input type="checkbox"/> D1 | (1) TVS Diode (1.5KE33) |  |
| <input type="checkbox"/> D2  | (1) LED Red/Green 2-lead 5mm |  |
| <input type="checkbox"/> D3  | (1) LED Amber 5mm |  |

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Other

<input type="checkbox"/> T1	(1) Transistor, TO-92 (ZTX651)	+ -
<input type="checkbox"/> Q1	(1) Crystal, 10 MHz, HC-49/US	
<input type="checkbox"/> DSP F	(1) 20x4 extended temp blue LCD	+ -
<input type="checkbox"/>	(1) 16-pin MALE SIP header	
<input type="checkbox"/>	(1) 16-pin FEMALE SIP header	
<input type="checkbox"/>	(4) #4-40 Nylon screws	
<input type="checkbox"/>	(4) #4 x 0.250” Nylon spacers	
<input type="checkbox"/>	(4) #4-40 Nylon Nuts	
<input type="checkbox"/> IC1	(1) LM7805 regulator (or equivalent) TO-220	+ -
<input type="checkbox"/> IC2	(1) PIC18F252 28-DIP w/ firmware pre-loaded	+ -
<input type="checkbox"/>	(1) 28-pin 0.3”-wide IC socket	+ -
<input type="checkbox"/> IC3	(1) ST202 RS232 chip 16-DIP	+ -
<input type="checkbox"/>	(1) 16-pin 0.3”-wide IC socket	+ -
<input type="checkbox"/> S1 F	(1) Momentary switch (‘Beacon Now’)	
	(3) Button caps, Yellow or Blue (stack them)	
<input type="checkbox"/> S2 F	(1) Rotary Encoder	+ -
<input type="checkbox"/>	(1) Knob	
<input type="checkbox"/>	(1) Knob cap (blue)	
<input type="checkbox"/> S3 F	(1) Toggle switch	
<input type="checkbox"/> SG1 F	(1) Piezo Buzzer	
<input type="checkbox"/> PCB	(1) Gold-plated printed circuit board	
<input type="checkbox"/> CASE	(1) Custom anodized aluminum case w/ screws & optional plastic bezels	
<input type="checkbox"/> X2	(1) Male DB15 connector (offset DIP pins)	
<input type="checkbox"/>	(1) Female DB15 mating connector	
<input type="checkbox"/>	(1) DB-15 backshell (plastic)	

IC4 and C12 are pre-installed surface-mount components. They are for the 32K FRAM memory.

X1, X3, and C14A are locations on the board that allow bottom- and side-entry connectors. They are not supplied with this kit, which has a rear-entry connector.

Display & LED Assembly

We’re getting close! We will now install the LCD display and LEDs on the front of the PCB. This has to be done carefully to ensure everything fits properly. Please follow the instructions closely.

NOTE! Do NOT solder the LCD headers until Step 24!

- 20. INSERT the largest-diameter pins of the 16-pin single-row header into the 16-pin single-row socket, forming a header-socket mated unit. **DO NOT SOLDER YET!**
- 21. Push the 4 nylon screws through the 4 holes in the LCD (in the side with the glass). They are easy to push in with your fingers. Push them all the way in.
- 22. With the LCD **upside down** (glass down), place a nylon spacer over all (4) nylon screws.
- 23. With the LCD **upside down**, INSERT the header end of the header-socket unit into the 16-position hole pattern on LCD display. **DO NOT SOLDER AT THIS TIME!**
- 24. Continuing with the LCD **upside down**, INSERT the LCD/header-socket/screw/spacer assembly into the 16-position hole pattern on the front side of the PCB (same side as the switches). **DO NOT SOLDER AT THIS TIME!**
- 25. Assemble (4) nylon nuts onto the (4) nylon screws that come through the PCB. Tighten the screws carefully with a screwdriver, using **only your fingers** to hold the nut. These nuts cannot take much torque.
- 26. NOW SOLDER all 32 connections on the PCB and LCD board.
- 27. Install *D3 Amber LED – see NOTE below.

NOTE! To ensure *D3 mounts properly through the front panel, **DO NOT** push the LED all the way down to the PCB. Align the base of the LED (where the leads start) about halfway up the LCD’s black bezel, and hold it there. Solder one lead, keeping the LED in position, then solder the other lead.

- 28. Install *D2 Bi-Color LED – see NOTES below

NOTE! *D2’s silkscreen is **BACKWARD** on the Rev E PCB! Insert D2 into the PCB with the flat **AWAY** from the **FLAT MARK** on the silkscreen.

(If you end up with a HamHUD that shows RED for receiving a packet and GREEN for transmit, then *D2 is installed incorrectly.)

NOTE! To ensure *D2 mounts properly through the front panel, align it to the same height off the PCB as* D3, and hold it there. Solder one lead, keeping the LED in position, then solder the other lead.

Final Assembly

You’re almost ready for mobile APRS! Just a few more steps, and your HamHUD II will be operational.

Take a minute to check the board over and inspect all the solder connections. If any solder joint, looks dull, re-touch it with your iron. Ensure no connections or steps above were missed.

- 27. Install IC2 into socket PIC18F252 microcontroller.

Match the notch on the chip with the one on the socket and silkscreen. You may have to gently bend each row of leads against your table top to get the chip to fit in the socket. This is normal for new ICs.

- 28. Install IC3 into socket ST202 RS232 chip.

Match the notch on the chip with the one on the socket and silkscreen. You may have to gently bend each row of leads against your table top to get the chip to fit in the socket. This is normal for new ICs.

Turn the PCB over now.

- 29. Place front panel over controls. See NOTES below.

NOTE! Remove the case from the its bag, and slide out the front panel. Lay the case on the table with the front side up; you will need it in a little bit.

NOTE! With the rear side of the PCB (and X2) against the table, lay the front panel over the LCD, LEDs, and switches so that everything fits nicely through the holes.

- 30. Assemble HamHUD II into its case. See NOTE below

NOTE! Slide the front panel into the first groove inside the case, **AT THE SAME TIME** as the PCB slides into the 5th groove (counting from the front). It is easier if you start one side and use your other hand to spread the case slightly to allow the other side to start. **MAKE SURE** both edges of the PCB are in the 5th groove, **NOT** one in the 5th and one in the 6th (for example). Continue sliding the PCB and front panel until it is all the way in.

- 31. Assemble the side panels on the case. You may wish to leave two of the screws off the right side panel, just in case you need to take the board back out following the Initial Power-Up Test.

You may or may not wish to use the plastic bezels that came with the side panels; they are a personal preference. KA9MVA and KE4NYV left them off, and we think HamHUD II looks just fine without them. It’s your rig, so it’s your choice!

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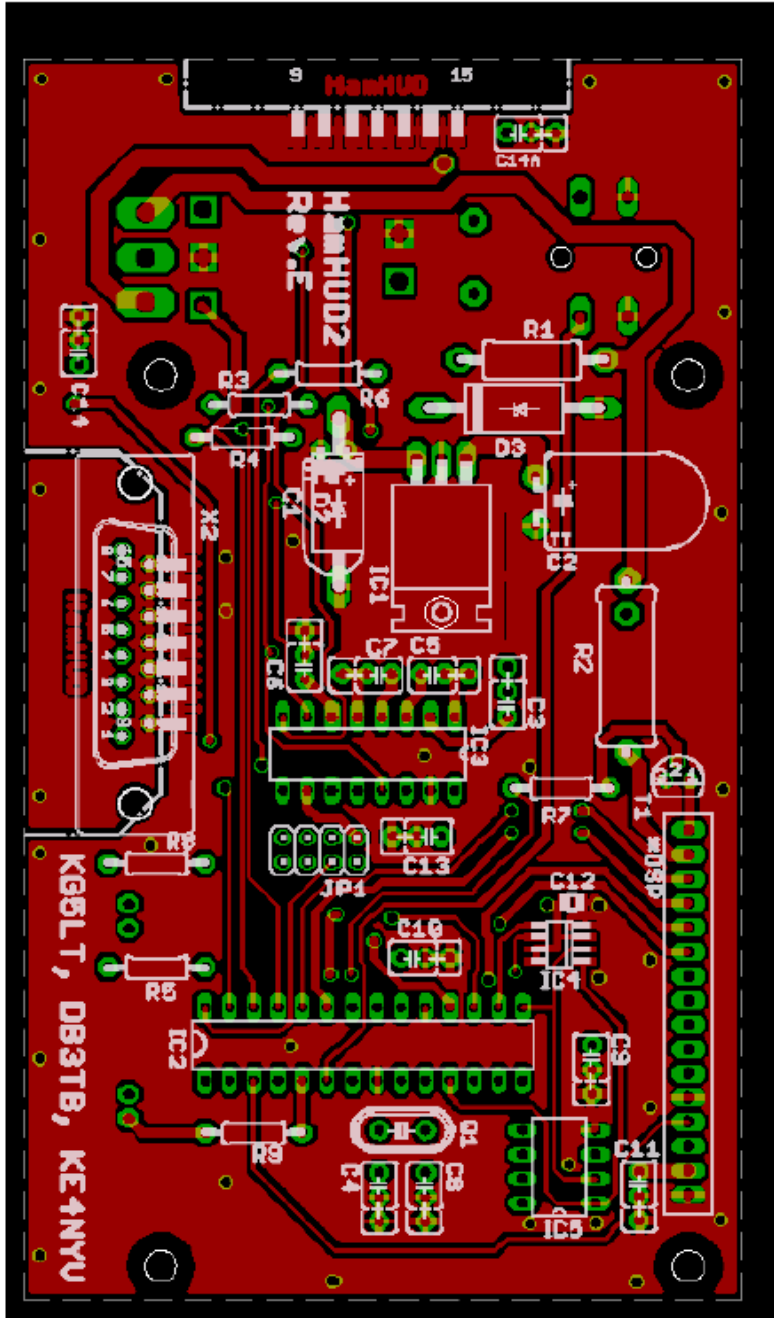
□ 32. Assemble Knob.

Push the knob onto the rotary encoder’s shaft. Use needle-nose pliers to tighten the nut while holding the knob still. Push the blue knob cap on, covering the knob nut and the end of the shaft.

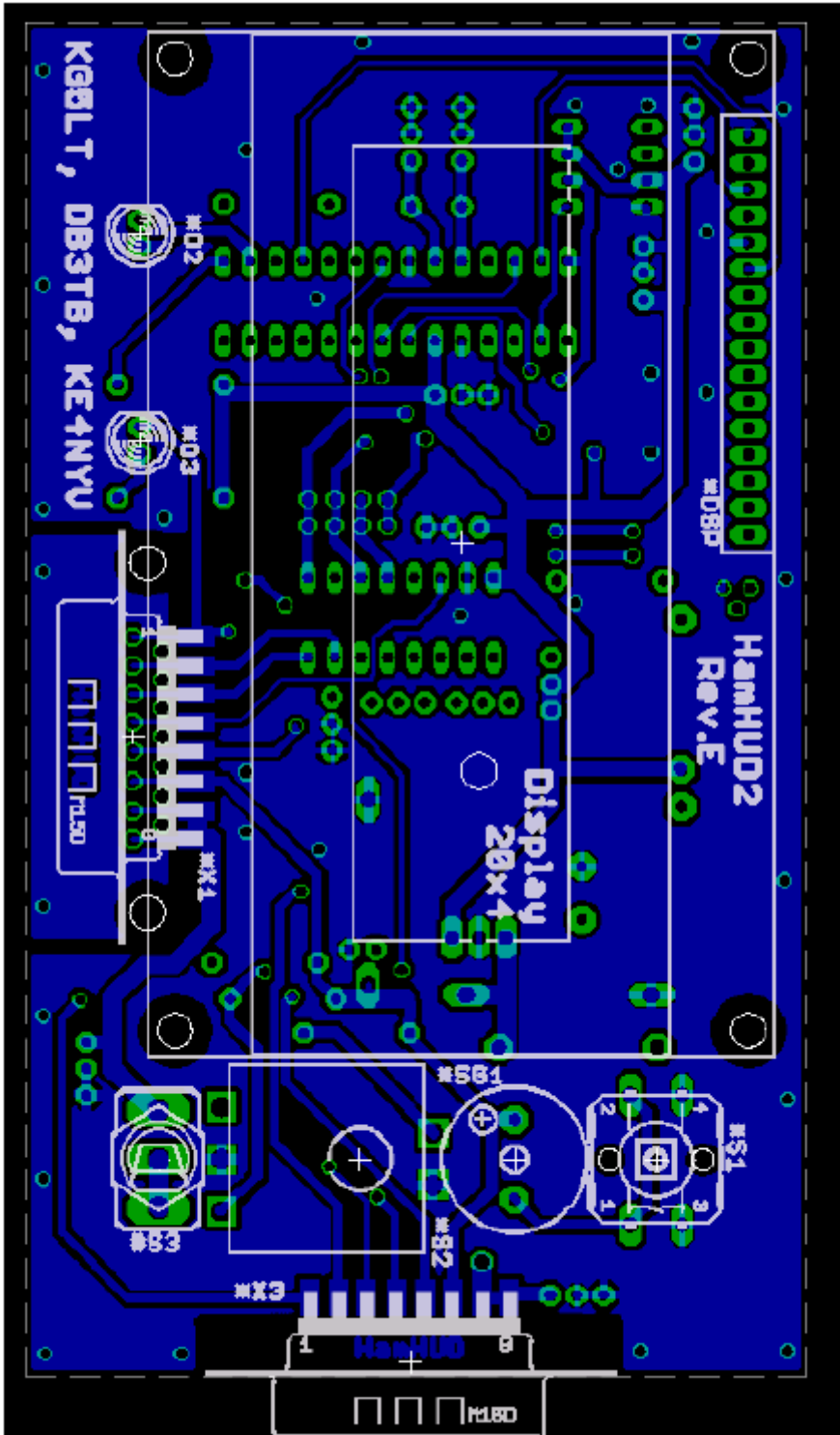
The next few pages contain the schematic diagram and various views of the board and assembly.

Following that, we will prepare to power up your HamHUD for the first time!

Board Views

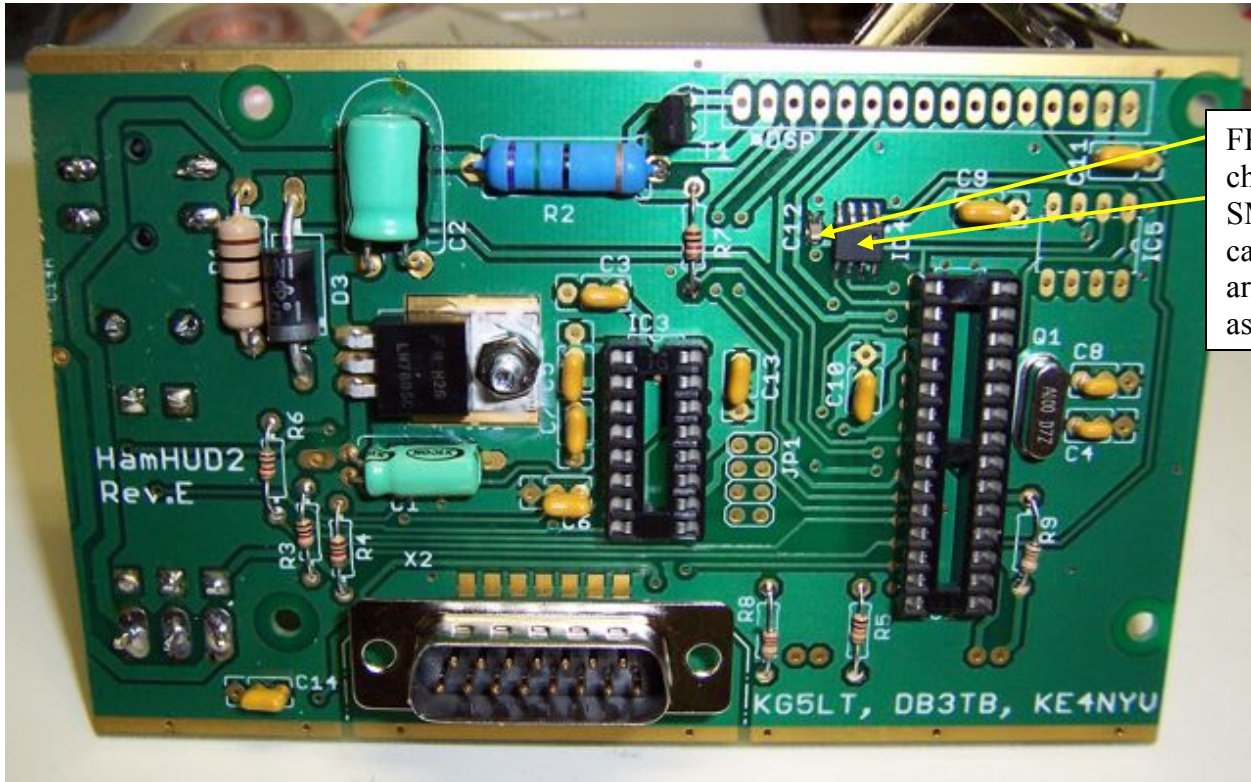


Rear View



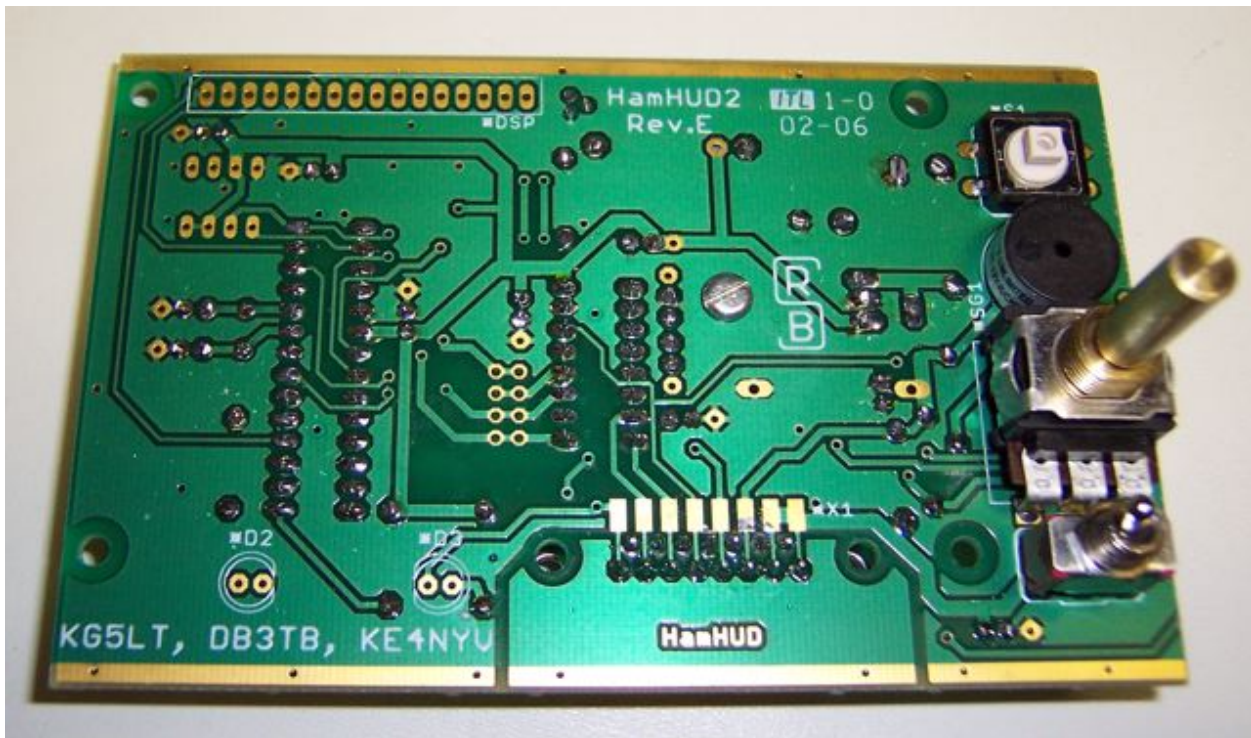
Front View

Assembly and Alignment Photos



FRAM chip & SMT capacitor are pre-assembled.

Rear (connector) side assembly



Front side assembly (LEDs and LCD not assembled yet).

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Front view, assembled (plastic bezels are optional.)



Rear view, assembled (plastic bezels optional).

Initial Power-up Test

We will now power-up your HamHUD for the first time. This accomplishes two things: 1) it provides a basic check of your HamHUD’s functions, and 2) it allows the firmware to initialize all the tables and data in the FRAM memory.

- 1. Set the HamHUD II’s toggle power switch OFF (left, toward LEDs).
- 2. Prepare the female DB-15 connector with a power connection.

Solder one red wire and one black wire to the the female DB-15 connector. Solder the RED to pin 8 of the connector (numbers are on the plastic part of the connector), and the BLACK to pin 10 (other row, almost opposite end of connector). You might want to use heat-shrink tubing on the leads to the connector; you can use this test rig as part of your HamHUD custom cable later.

- 3. Connect the RED to (+) and the BLACK to (-) of a 12V (13.6V nominal) power supply capable of supplying at least 500 mA.
- 4. Plug the DB-15 female connector with the wires into the DB-15 male in the rear of the HamHUD II. Turn on the power supply.
- 5. Set the HamHUD II’s power switch ON (RIGHT), while watching the LCD display.

If all is well, you should see the LCD’s backlight light up, the display show a flurry of activity (you might catch “Initializing FRAM”), and finally it will show:

```
Power-on Reset
Default s in FRAM!
HamHUD-II 2.8.001
FRAM: 32K PIC: 18F252
```

In a few seconds, you’ll see two arrows blinking in the upper left corner of the LCD, and the last line will change to the default callsign:

```
NO GPS
Default s in FRAM!
HamHUD-II 2.8.001
NOCALL
```

(Your DigiMeter™ – the left two characters of Line 1 – may contain random characters at this point. That’s OK, they will clear out as actual network data is displayed there.)

If you see this on your LCD, your HamHUD should be functional. If not, please check your connections. You may have to disassemble the HamHUD and check your solder connections.

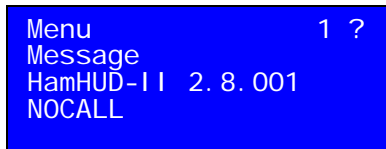
Configuring Basic Settings

If your HamHUD passed the initial power-on test, you’re ready to set up your callsign and other important initial parameters. This will also be a check of your front panel controls.

To use the Whiz Wheel (rotary encoder), you will be “single clicking” and “double-clicking”. A “single-click” is a quick (<0.5 second) push on the Whiz Wheel (S2’s) knob. A “double-click” involves pushing the knob twice quickly, within a time less than a second. You will get used to these actions, because you will do them a lot with HamHUD.

Setting Your Callsign and Learning to Use the Whiz Wheel

- 1. Set the HamHUD II’s power switch ON (RIGHT).
- 2. Single-click the Whiz Wheel knob. You should see the display below:

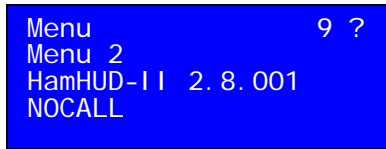


If you don’t see this display, ensure you really pressed the knob. If not, you may have an assembly error, or your PIC may not be seated in its socket properly. Time to disassemble and check.

The display above is telling us that HamHUD has entered its top-level menu (Menu), is waiting for you to select an item (?), and item (1) is being displayed (Message).

- 3. Quickly push the yellow “Beacon Now” button. The “Menu” should disappear. When you’re in the menus, the “Beacon Now” button is a quick way to exit.

- 4. Single-click the Whiz Wheel knob again. Slowly turn the Whiz Wheel knob to the right eight (8) detents. You should see the display below:



If you don’t see that display, your Whiz Wheel may be malfunctioning due to an assembly error. Check also that your PIC is properly seated in its socket.

The display is telling us that HamHUD is waiting for you to select (?) Menu item (9), which will enter the second-level menu (Menu 2). Most of HamHUD’s settings are in the second-level menu (Menu 2).

- 5. Single-click the Whiz Wheel knob. You should see the display below:

```
Menu 2          1 ?
Status
HamHUD-II 2.8.001
NOCALL
```

Now, HamHUD is in Menu 2, at the first item (1), which is Status, awaiting your click (?).

- 6. Turn the Whiz-Wheel knob one position to the right, and single-click the Whiz Wheel knob. You should see the display below:

```
Ca l l sgn     1 E
NOCALL
HamHUD-II 2.8.001
NOCALL
```

HamHUD is telling you that you are editing (E) your “Callsgn”, which at present is set to NOCALL. The block cursor (indicating that the cursor can be moved) should be blinking on the last character.

- 7. Turn the Whiz Wheel to the left until the “move” block cursor is over the N. Now single-click. You should see:

```
Ca l l sgn     1 E
NOCALL
HamHUD-II 2.8.001
NOCALL
```

Note that the blinking block “move” cursor has changed to the underline cursor, which means “change”. Turning the Whiz Wheel will change the character above the cursor from its present value to the next or previous ASCII character, depending on the direction of rotation.

- 8. Turn the Whiz Wheel to the left or right until the first UPPERCASE letter of your callsign appears above the “change” cursor. (BE SURE TO ENTER YOUR CALLSIGN IN UPPERCASE.) For KA9MVA’s callsign, we would see;

```
Ca l l sgn     1 E
KOCALL
HamHUD-II 2.8.001
NOCALL
```

- 9. Single-click the knob again. You will see the “change” cursor moved over to the next position, which allows us to quickly edit text data (strings):

```
Ca l l sgn     1 E
KOCALL
HamHUD-II 2.8.001
NOCALL
```

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What if you need to go back to the previous character, or even a different character that you would like to change? No problem, just single-click again, and HamHUD will give you the “move” block cursor back. Now you can move to another character, and by single-clicking there, you will get the “change” cursor back. Make sense?

- 10. Rotate the knob to the second character of your callsign. For KA9MVA’s callsign, we’d see:

```
Call sign      1 E
KACALL
HamHUD-II 2.8.001
NOCALL
```

- 11. Single-click the knob to begin changing the 3rd character of your callsign. You’ll notice that HamHUD “remembers” the letter or character you were just on, and starts changing at that character. This may seem strange at first, but our experience shows this allows lightning-speed edits, because you know where you are in the alphabet/ASCII sequence.

- 12. Go ahead and enter the rest of your callsign. You’re getting the hang of it now. You’ll find you can turn the knob quite rapidly. Remember that the numbers are to the LEFT of the uppercase letters. And of course, callsigns and paths must always be entered in uppercase. For KA9MVA’s callsign, we’d see:

```
Call sign      1 E
KA9MVA
HamHUD-II 2.8.001
NOCALL
```

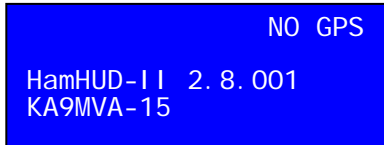
- 13. Now for the station ID (SSID). HamHUD requires that you enter the dash ‘-’ if your SSID is going to be nonzero. KA9MVA’s mobile is a truck, so in APRS tradition, we’ll use -15. Remember that most of the punctuation including the ‘-’ is to the LEFT of the numbers. For KA9MVA’s mobile, we’d see:

```
Call sign      1 E
KA9MVA-15
HamHUD-II 2.8.001
NOCALL
```

- 14. You’ve entered your callsign, and it’s time to confirm it. Single-click to get the “move” block cursor back.

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Turn the knob so that it’s on the LAST character of your callsign. That would be the “5” in the example above. (It’s extremely important to be on the LAST character; HamHUD accepts characters up to the cursor.) For the example above, the block “move” cursor would be over the “5” character. Now, double-click the Whiz-Wheel knob. That’s two single clicks within above a half-second of each other, very much like the double-click on your computer’s mouse. You should see your callsign on Line 4:



NO GPS
HamHUD-I I 2.8.001
KA9MVA-15

Other Basic Settings

Now that you know how to use the Whiz Wheel, we won’t describe every action in such a long-winded way.

Here are some settings you may want to modify right away:

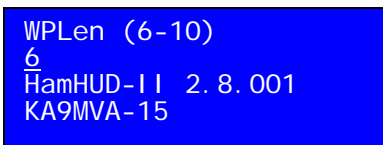
□ 1. Transmit UNPROTO path. That’s in Menu 2, under TXPath. The default is WIDE2-2, which is fine for most mobiles. Some people prefer WIDE1-1, WIDE2-1. This path provides the possibility of digipeating through home digipeaters (supposed to have their RELAY set to WIDE1-1), as well as one hop through a wide-area digipeater (that’s the WIDE2 part). Please keep your path to three hops or less, two hops in metropolitan areas. Be sure to use all uppercase, and double-click on the LAST character of the string.

NOTE! Whenever you enter a string in ANY menu in the HamHUD, you MUST double-click on the last character! This tells HamHUD that the string stops there. This allows shortening or lengthening strings.

□ 2. APRS Icon. The HamHUD allows you to select which icon will appear on other users’ maps when your position is plotted. It’s in Menu 2, under MyIcon. There are 20 different pre-loaded icons that you select by name. Don’t see one that you like? Get on the Web, and look up the symbol table ID and symbol character for another icon, and you can edit any of the icon entries to your liking. Just put the symbol table ID as the first character, and the symbol character as the second character. The rest of the string can be any comment you like.

□ 3. Metric display units. HamHUD defaults to US/Imperial/English units for speed and distance, but can be set to display SI/Metric units. Go to Menu 2, and select SmrtBcn. This menu item adjusts several parameters for the SmartBeaconing algorithm, but the unit selection is also here. Just single-click on each parameter to accept the default until you come to one reading “0=US 1=Metric?”. Rotate the Whiz Wheel to display “1” in Line 2, and single-click. Your HamHUD will now remember to display Metric units.

□ 4. GPS Waypoint length. HamHUD will send waypoint strings (\$GPWPL) to the GPS for received stations and objects, and also HamHUD waypoints. The length of the name is selectable, because some GPSs can only handle short names. In the Menu 2, select the GPSWlen item. You’ll see:



Rotate the Whiz Wheel until the name length your GPS can handle is selected, then single-click. The Garmin GPSmap-60c (and indeed most of that series) can handle 10-character names, but some others can only handle 6 characters. For that case, KA9MVA-15 would be displayed on the GPS as “MVA-15”. Not pretty, but that’s what some GPSs require.

Cabling to TNC, GPS, and Power

Since there are so many different GPS’s and TNC’s that can be connected to HamHUD, each installation may require a custom cable. To make things easier, we provide two example cable diagrams in the Appendices: one for the inexpensive Coastal Chipworks TNC-X KISS TNC, and one for the Kantronics KPC-3+ multimode TNC. Both cable diagrams feature a DB-9 male connector for the GPS.

Pinouts vary, so consult your TNC manual for details, and for connection information for your radio. The cable diagram for the TNC-X will also work for other low-cost TNCs, such as Byonics TinyTrak-4, and Argent Data’s OpenTracker 1+. The cable diagram for the KPC-3+ is similar to that required for the KPC-3 and other TAPR clones, such as the MFJ 1270 series, and the PacCom TNCs.

Many GPS modules, such as the Deluo, use pin 4 of the DB-9 as power input, often 5 volts. HamHUD II provides a regulated, switched 5-volt output for this purpose.

We recommend the use of Anderson PowerPoles[®] for connecting 12V to your custom cable. Our partners at RPC Electronics (www.rpc-electronics.com) have PowerPoles[®] and many other cable accessories for your HamHUD and GPS.

Configuring Your GPS and TNC for Use with HamHUD II

HamHUD II supports both modular (no screen) GPSs, as well as those with graphics displays. About the only real requirement is serial communication using NMEA at 4800 or 9600 baud. But, with a GPS such as the Garmin GPSMap, HamHUD II can plot APRS stations on the GPS screen as waypoints

To keep things simple, set your TNC and GPS for 4800 baud; that’s the default.

NOTE! HamHUD’s mode of operation as of firmware version 2.8.000 is KISS mode. If you are using a Kantronics KPC-3+ or other configurable TNC, please use a computer to put it into KISS mode.

More On Operating Your HamHUD II

There’s a lot more to learn about the HamHUD II; we’ve barely scratched the surface here. However, your HamHUD should be configured well enough at this point to monitor the local APRS data stream.

To learn more, visit the HamHUD website:

www.hamhud.net

Download all the latest documentation, release notes, and user manual to learn more about operating your HamHUD.

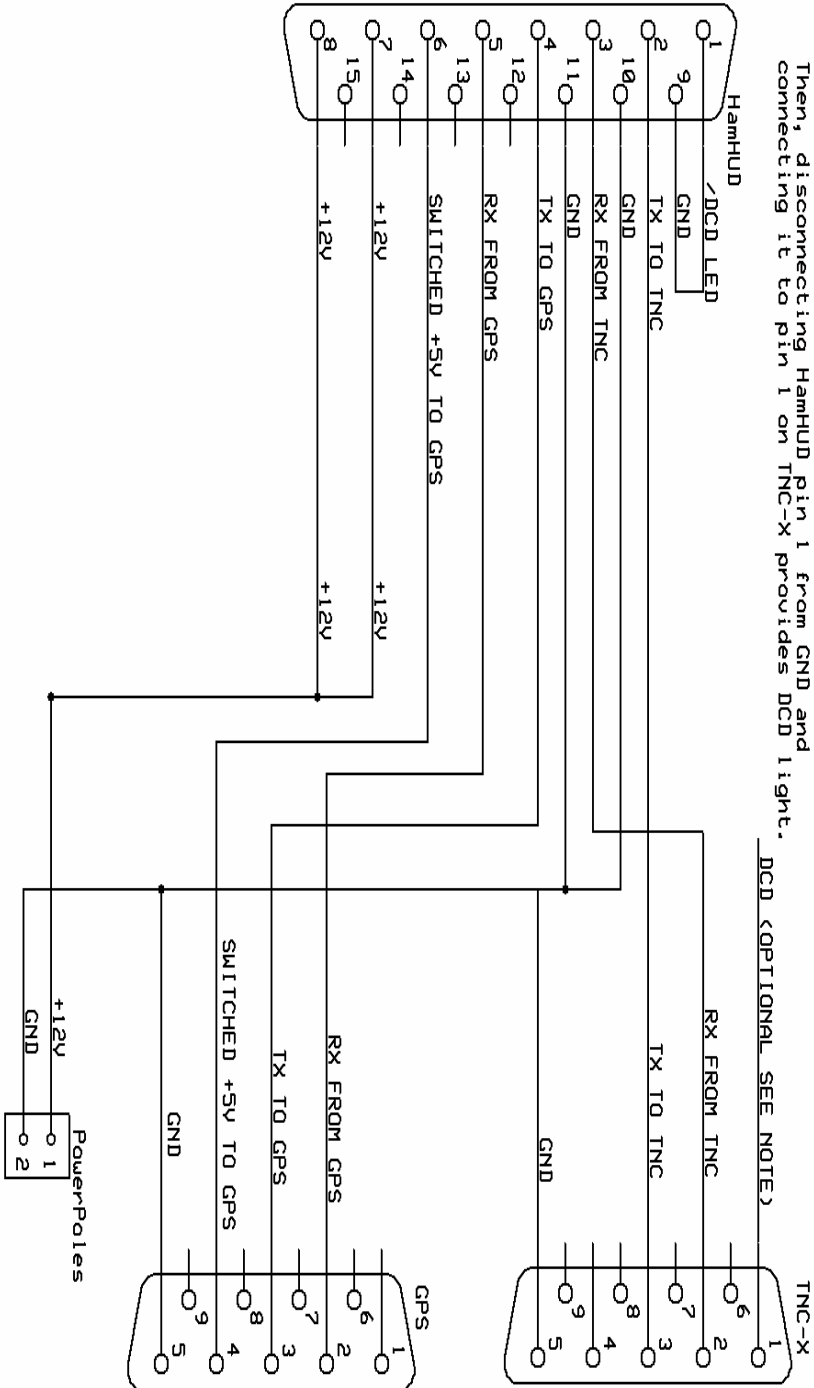
There may also be new firmware upgrades for your HamHUD II, which provide additional functionality and/or bug fixes. Firmware in the HamHUD II can be upgraded with a PC with a serial port; see the website for details, or ask on the HamHUD Yahoo! Group.

You did join the Yahoo! Group, right? If not, do so:

www.yahogroups.com/groups/hamhud

You’ll find a warm welcome. The HamHUD community has the true “Elmer” spirit!

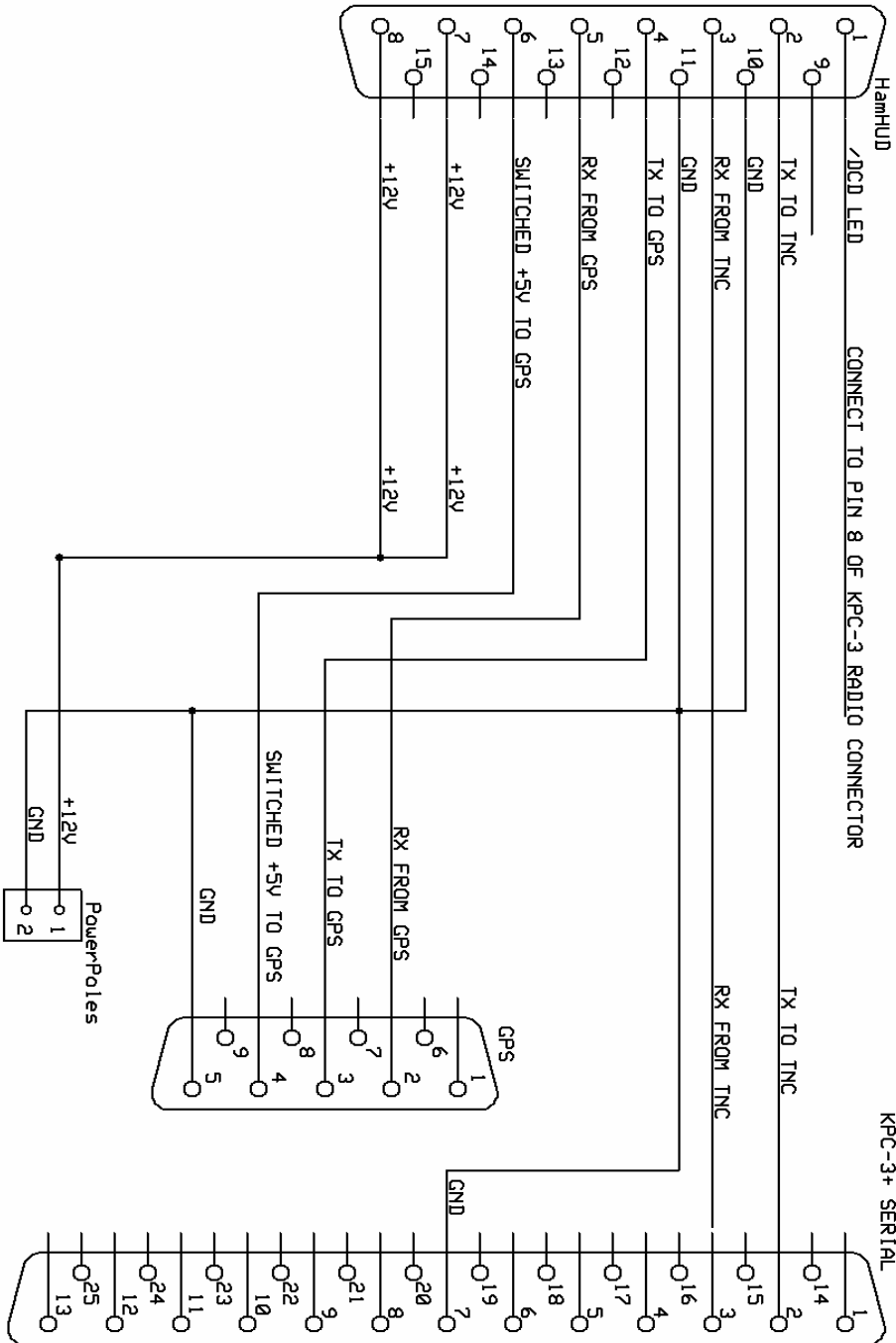
Appendix A: TNC-X/OpenTracker+ and GPS Cable Schematic



Stock TNC-X does not have a CD/DCD output. As shown, the HamHUD's CD LED functions as a power indicator. The TNC-X can be re-wired to connect U3-3 to J2-1. Then, disconnecting HamHUD pin 1 from GND and connecting it to pin 1 on TNC-X provides DCD light.

DCD (OPTIONAL SEE NOTE)

Appendix B: Kantronics KPC-3+ and GPS Cable



LEGAL

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