

MTR-3B - LCD edition

Mountain Topper User Manual



Overview:

The Mountain Topper Rigs are designed to be a very small, light weight, very battery efficient, multi-band CW rig suitable for field operation. The small size and low weight make this rig ideal for SOTA operators and backpackers.

Features:

- 3 band operation – 40/30/20
- Wide power supply operation – 6V to 12V
- Low operating current – 20 ma @ 6V, 15 ma @ 12V
- 5+ Watts out at 12V supply, 2.5-3W at 9V supply
- Easy to read 2 line LCD display with back lighting.
- Push button tuning and audio limiting eliminates protruding knobs.
- Iambic B mode keyer, 9 to 31 WPM range in 1 WPM steps.
- Three, 63 character message memories with beacon mode.
- Optional decoding and display of Morse being sent via paddle. Know your sending good code.
- Built in 24 hour real time clock.
- Battery back up restores last used settings on power up.

Specs:

Receive MDS: ~ 0.2 uV
 Small signal BW ~ 400 Hz
 Audio BPF center ~ 650 Hz

Receive current:

~20 mA at 9.0 V
 ~15 mA at 12.0 V

Typical Transmitter power:

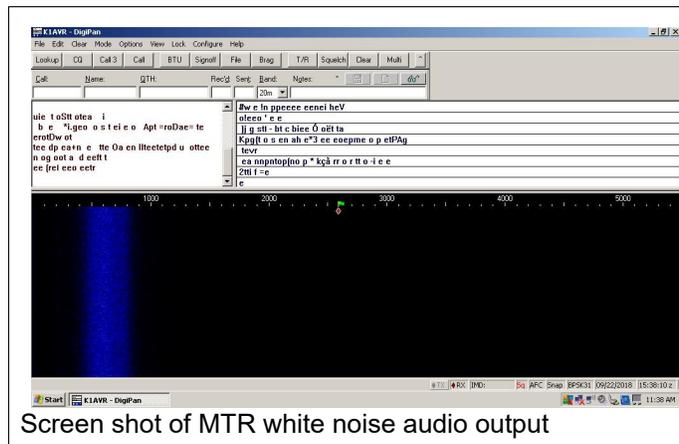
~ 3 watts at 9.0 V, 500 mA
 ~ 5 watts at 12.0 V, 700 mA

Spurious emissions -50 dBc or better

Frequency accuracy : +/- 20 Hz, +/-10 Hz or less typical
 Drift – negligible

DC Jack : 0,7mm X 10mm Center plus
 Antenna jack : BNC

Size: 3.85" X 2.5" X 0.9" LWH
 Weight: 4.8 oz



Screen shot of MTR white noise audio output

Operation:

The rig is controlled by four push buttons and the paddle. Bands are selected using a bank of three slide switches. A power ON/OFF slide switch is also included. Audio level is internally limited so there is no volume control.

Display:

Operating information is displayed on a 2 line, 16 character LCD display with back light. The top line normally displays the operating frequency while the bottom line displays the current keyer code speed, the time and battery voltage in that order. This information will change depending on which of the various functions become enabled.

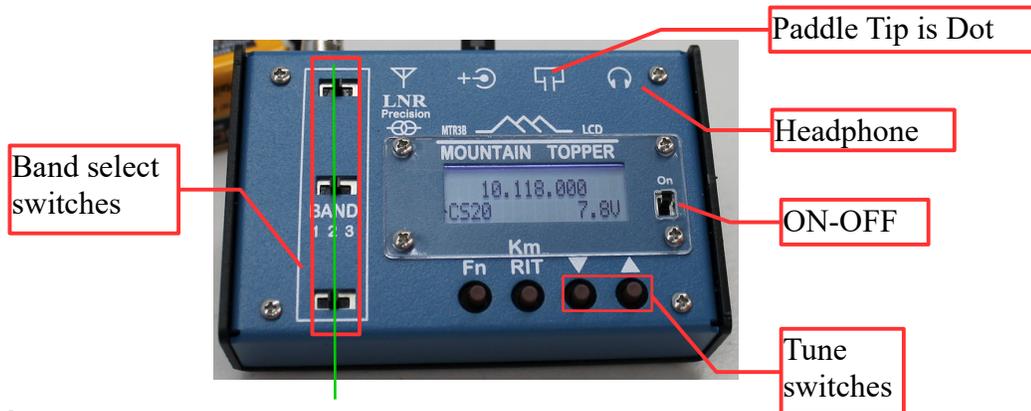


Band selection:

The band is selected by three, three position slide switches. **For proper operation, all three switches must be in the same column**, as highlighted below. It's easy to get into the habit of flipping each switch in sequence from the top down.

The top switch tells the processor which band to operate on and connects the Receiver input filter to the first mixer. The middle switch connects the transmitter low pass filter output to the antenna and connects the antenna to the receiver input filter. The bottom switch connects the output of the transmitter PA to the low pass filter.

If you don't get all the switches in the proper position, you will either hear no signals, have no power output, or be transmitting with the wrong low pass filters selected. No damage will occur if this happens, but try not to!



Frequency tuning:

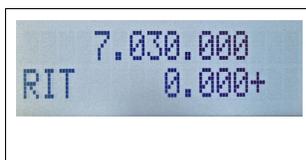
The **<UP arrow>** (Tune Up) and **<DOWN arrow>** (Tune Down) switches change the operating frequency in 50 Hz steps.

- Holding the switch closed for longer than 1 second starts a fast tune mode where the frequency changes in 100 Hz steps at about 10 steps a second.
- If the opposite tuning switch is held closed while in fast tune mode, the step rate will increase to 30 steps/second for very fast tuning.

The Km/RIT switch:

The Km/RIT switch activates the "Transmit Morse Message" selection or RIT depending on the length of time the switch is held closed. A short push activates the Morse Message selection and a long push activates RIT mode.

- To Enter RIT: HOLD **<RIT>** closed for 1 second or longer.
- To Exit RIT : HOLD **<RIT>** closed for 1 second or longer.



The plus (+) or minus (-) difference (delta) between the transmit frequency and the current receive frequency is shown below the main frequency readout on line 2. The delta frequency is limited to +/- 9.950 kHz.

RIT toggle:

RIT can be toggled on and off to check the transmit frequency for activity. Frequency tuning is locked out when R=T, but you can still transmit and use message memories. If you need to move the transmit frequency, RIT must be exited first.

- TAP <Fn> switch to toggle RIT.



Fn (Menu) Functions:

Holding closed the <Fn> switch scrolls through the options at a rate of about once a second. Release the switch when the desired function label appears on the display. A Morse character representing the function is sounded by the side tone for audio feedback. [function label] {Morse character}

- Morse frequency annunciation (optional)
- [ADJ K SPEED] {S} Change Keyer speed
- [DFE] {D} Direct Frequency entry
- [ENTER MSG] {M} keyer Memory entry
- [Tune] {T} toggle carrier on and off.
- [SET TIME] {T} enter current time with paddle
- [CONFIG] {C} Turn on/off options and store current settings and frequencies.
- {E} EXIT

Morse Frequency Annunciation

This function can be turned on or off in the **CONFIG** menu. Default is OFF.

When enabled,

- Tap the <Fn> switch.
- The current frequency is sounded by the side tone at the current keyer speed.
- Format: 000.0 kHz "T" is used for zero's, "R" indicates decimal point.

Change Keyer speed: [ADJ K SPEED]

- Tap the <Fn> switch (or hold closed for 1 second if Morse Freq Annunciation is enabled). The message [ADJ K SPEED] will be displayed to the right of the code speed readout, [CSxx], where xx is current code speed.
- Use <UP/DOWN> arrow switches or DOT/DASH paddle to change speed in 1 WPM steps. Range 9 to 35 WPM.
- Tap the <Fn> switch to exit



Straight key Mode:

Straight key mode can be enabled in one of two ways:

- 1) A mono phone plug in the paddle jack on power up will turn on straight key mode.
 - 2) TAP the <RIT> switch while in [ADJ K SPEED] mode. This will toggle the straight key mode on and off. Straight key mode can not be turned off if a mono plug is in the paddle jack.
- When Straight key mode is active the code speed display will change from [CSxx] to [SKxx].
 - The code speed can be changed using the <UP/DOWN> arrow switches. This allows changing the speed of Morse messages, which can still be sent in Straight Key mode.
 - **DFE, Message Memory entry, Tune and Set Time** modes *are not* available when Straight Key mode is active.
 - Straight key mode is reset on power up unless a mono plug is in the paddle jack.

Direct Frequency Entry: [DFE]

This mode allows you to jump directly to a new frequency which you enter via the paddle.



Line 1: [XX.---.-XX] where (-) is a digit to be entered and (X) is a current frequency digit, which can not be modified.

Line 2: [EXIT Re-Enter LoaD] {Switch function labels}

- Enter four digits, 0 to 9 via Morse, starting with the 100 kHz digit. If a character is not recognized, a "?" will be sent by the side tone. The digits appear on the display as they are entered.
- For 30 Meters the digit "1" has to be entered first to exceed the band limit.
- Short cut: TAP <LD> (**DOWN** Arrow) before entering a digit to reset current frequency to the bottom of the band or to load the remaining decades as "0".
- TAP <LD> (**DOWN** Arrow) to load the new frequency.
- TAP <RE> (**RIT**) to clear entry and start again
- TAP <EXIT> (**Fn**) to exit with no change

Message entry [ENTER MSG]



Line 1 - [ENTER MSG] (Message characters will be displayed here)

Line 2 - [EXIT Check Re-Enter BackSpace] {Switch function labels}

- Messages can be up to 63 characters long (including word spaces)
- There are three (3) message locations, M1, M2 and M3.
- Word spaces are automatically inserted after a word space pause of 7 dot lengths.
- The "ENTER MSG" message on Line 1 will clear once you start to key and the characters you send will be displayed on this line.
- The display will scroll when the message exceeds 16 characters.
- A "Back Space" switch can be used to correct errors or eliminate word spaces. Note: you can not delete the first character entered.
- The symbol <*> indicates a word space has been inserted.
- The symbol <!> indicates the character was not recognized. Most Morse punctuation characters are recognized.

Switch functions:

- <EXIT> (**Fn**) TAP to exit at any time before storing a message.
- <CK> (**RIT**) TAP to check (review) the message and hear how it sounds prior to actually storing the message.
- <RE> (**DOWN** Arrow) TAP to Re-enter (rest) the message entry mode. Only way to clear the first character.
- <BS> (**UP** Arrow) TAP to Back Space one location.



Once the Message has been reviewed after tapping the <CK> switch, Line 2 will change to:[M1 RE M2 M3]

- TAP M1, M2 or M3 to store the message in that memory location.
 - Once tapped, line 2 will change to [**STORING**]. A dot will sound when done and message entry mode will be returned in case you want to enter another message.
 - When done TAP <EXIT> to escape to normal operation.
- TAP <RE> to escape back to message entry mode without storing.

Sending a stored message:

- TAP <Km/RIT>
- With in ½ second, then TAP
 - <Fn> (message 1),
 - <DWN Arrow> (message 2)
 - <UP Arrow> (message 3)

If a message has not been stored in a selected location, nothing will happen.

Pause, terminate and Beacon Mode:

Once started a message can be pause, terminated or set to repeat (beacon mode).

- HOLD <DASH> to pause a message. The message will pause at the first word space after the paddle was closed.
- HOLD <DOT> to terminate the message. The message will terminate at the first word space after the paddle was closed and normal operation restored once the paddle is released.

Beacon (repeat) mode:

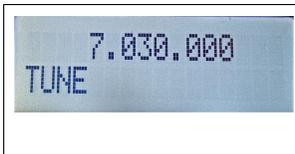
After a message has been started, the message can be set to repeat by **HOLDING** the respective switch for that memory location closed until a word space is detected. For example, if Message 1 was started, hold the <Fn> switch closed, if Message 2, <Down arrow> and if Message 3, <Up arrow>.



Line 2 will now read: [BEACON 2] Where {2} is the repeat delay in seconds.

- During a word space the delay can be set to be up to 9 seconds long using the up and down arrow switches.
- The message can be paused or terminated while being sent using the DOT or Dash paddles. The message must first be terminated before transmitting will begin again.

TUNE [TUNE]



Tune mode allows you to toggle the transmitter on and off so you can fiddle with an antenna tuner with both hands. If you have a small tuner, you might have to hold it in one hand while adjusting it with the other. If you don't need both hands just sending a string of dots would be quicker.

NOTE: If the DC supply exceeds 10 volts the output power is reduced by turning the supply to the PA on and off at about a 1:3 ratio. This helps ensure there is no damage to the PA if excessive SWR is encountered while adjusting the antenna tuner. Since this PWM of the PA supply voltage has no feedback, the output power starts out low and slowly builds up until it stabilizes at about 1/3d of it's steady state output. Because of this, do not use TUNE mode for power output measurements. Put the rig into Straight Key mode for power measurements.

- Tap <DOT> paddle to toggle on
- TAP <DASH> paddle to toggle off
- TAP <Fn> switch to exit back to normal operation

SET TIME: [SET TIME]

A 24 hour clock can be enabled and displayed on the bottom line of the LCD. The DFE function is used to enter the time via the paddle. The time is not displayed until the time is set. The "display time" flag is reset on power up if battery back up is not used.



- Enter the current time + 1 minute (24 hr format) using the paddle: hours, then minutes. Leading zero must be entered if the time is before 10:00.
- Tap <Fn> (EXIT) to escape with no action taken.
- Tap <RIT> (RE) to clear and re-enter the time
- Tap <Down Arrow> (LD) to load the time and exit. Do this at the moment the time you entered matches real time.

Configuration: [CONFIG]

This function allows you to turn on or off the Morse Frequency annunciation, the display of Morse while transmitting and storing of the current frequency for all the bands and the current keyer speed to be used as the power on frequency and code speed.



Display Line 2 : [EXIT SToRe DisplayMorse Morse(frequency)Annunciation]

- TAP <Fn> (EXIT) to escape
- TAP <RIT> (ST) to store
- TAP <Down Arrow> (DM) to toggle Display of Morse characters on and off. The side tone will enunciate "ON" or "OFF" to indicate the selected state.
- TAP <UP Arrow> (MA) to toggle the Morse frequency annunciation on and off. The Side tone will enunciate "ON" or "OFF" to indicate the selected state.

Display Morse characters option (DM):

This option decodes and displays the characters you send using the paddle. It will not decode the Straight Key, nor can it decode off air signals.

When this option is enabled, as you start to send, the characters will be displayed on the top line of the display and will start to scroll once the line has filled up. The display will revert back to frequency display after a one second pause in transmitting.

This is a good way to ensure your using proper spacing between letters and words. If the computer can't figure out what your sending, chances are no one else can either!

Volume control:

The MTR uses diode clipping to limit the audio volume. Some users like to use an in-line volume control in series with the headphones to have control of the volume.

Adjusting side tone level:

Side tone level can be adjusted to your tastes using a very small trimmer resistor mounted on the bottom of the circuit board. This will require a small, 2mm screwdriver blade.

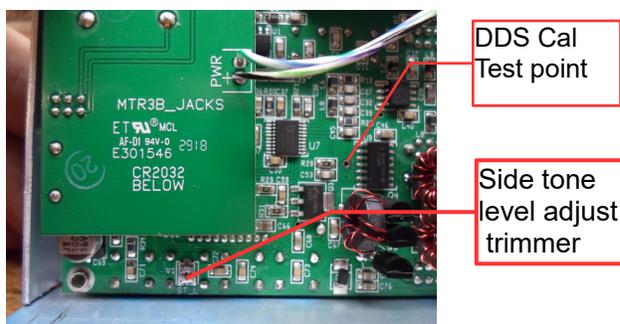
1. Remove the bottom of the enclosure.
2. Locate the trimmer resistor, which is along the bottom edge of the board and directly below the down arrow switch. It is labeled "ST_L"
3. Clockwise increases volume. The control comes set centered from the factory. You'll want to turn it down some.

Note that the side tone frequency is processor generated and may not match the frequency at which the Audio Band pass filter peaks due to component tolerances used in the filter. Therefore, tune for a signal peak. Don't try to match the signal tone with the side tone frequency.

Calibration:

The frequency reference for the DDS is calibrated at the factory and should never need to be adjusted. But if the need ever does arise to do so, this is how it's done. You will need an accurate frequency counter and an Oscilloscope.

1. To do a complete alignment, the board must be removed from the case to access the trimmer caps. If only the DDS is to be calibrated, this can be done with the board in the case and with just a frequency counter.
2. To enter Cal mode, hold both the <Fn> and <Km/RIT> buttons closed and turn on power. The display will read "CAL REF" on the lower left of the display.
3. Connect the frequency counter to TP3, which is located above the PA choke (the black toroid) This is a 5V square wave. Using a X10 Scope probe might be need to keep from overloading the input to your counter or loading down the test point.
4. The frequency should be pretty close to 10.000,000 MHz. Use the tuning switches to adjust the frequency to exactly 10.000,000 MHz.
5. Tap the <Fn> switch. The display will now read BFO ADJ
6. The DDS will now produce a signal at the center of the IF filter. This signal is used to center the BFO frequency in the audio band pass filter. Connect a Scope to the headphone jack to see the signal.
7. Adjust the BFO trimmer (located on the top of the board, near the top edge above the display) to peak the signal.
8. Tap the <Fn> switch again to store and exit.
9. You can terminate CAL mode at anytime by simply removing power before the final click of the Fn switch.



Using a 3S li-ion battery pack:

Three, 2200 mAh Li-ion batteries would power the MTR-3B for a long time. A fully charged set of these batteries will top out at about 13.5 volts, which exceeds the recommended 12 volt supply. This would result in a transmit power of over 6 watts. Which isn't too big a deal, but at that power level one should ensure a low SWR. It probably isn't going to take too long for the battery pack to settle down to 11- 12 volts. A silicon rectifier diode or two could be added in series with the batteries to drop the voltage closer to 12V. You'd want a way to switch the diodes out when the battery voltage drops.

The minimum operating voltage:

The absolute minimum operating voltage is about 5.5 volts. That is where the 5V regulator drops out of regulation and the audio circuits start to be starved for juice. The digital circuits continue to work down to 3.5 volts, which is when the low voltage cut off kicks in and puts the processor to sleep.

Input voltage reading accuracy:

The input voltage reading displayed isn't calibrated and can be off by a few 100 mV. The error is greatest on the high end of the range and will typically read low. If accuracy is important, check the calibration with a bench DVM to measure your actual input voltage so you have an idea how far off the reading might be.

SWR considerations:

While the PA FETs have proven to be reliable, they can still be damaged by very reactive SWR conditions, especially when operating at higher supply voltages and hence power levels. The use of a resistor bridge SWR meter is recommended as this will ensure the PA sees a reasonable load regardless of the what's on that antenna side. Or use "TUNE" mode when checking SWR or when adjusting an antenna tuner, which reduces the power output if the supply voltage is above 10V.

Internal Fuse

A PTC resettable fuse is located on the Jack board to protect the rig and your power supply from over current. This fuse might trip if operating at above 12V supply and high SWR.

Battery Back up:

A CR2032, 3V lithium coin cell is used to power the processor when external DC power is removed from the rig. When the processor detects that the input voltage has dropped below 3.5 V, the processor is put to sleep, but the 32.768 kHz clock and timer remains active to keep the RTC running. In this mode current from the coin cell is just a few micro-amps. All the current operating settings are retained in RAM so the rig returns to the same settings on power up as it was when power was turned off.

Replacing the battery:

The battery comes installed and should last a very long time. However, there may come a time when it needs replacing. This is easy enough to do. The battery is mounted on a small daughter board which also contains the keyer and headphone jacks.

1. Remove the bottom cover of the enclosure.
2. Remove the nuts on the two 3.5mm phone jacks.
3. You may have to loosen up the main board mounting screws.
4. Unplug the daughter board.
5. Remove the old battery
6. Slide in the new battery, plus side is up.
7. Plug the board back in, making sure the socket lines up properly with the pins.
8. Replace the nuts on the jacks and put the bottom cover back on.

When the board is plugged in, the processor will reset and load the default values. It will then realize there is no external power and go to sleep.

Reading the firmware version:

- Hold closed <FN> and turn on power.
- The firmware version will be displayed for a few seconds [REV1.x]