

Clansman VRC353 - Modification to operate radio on 10m band

Introduction

The Clansman VRC353 is a vehicle/shack mounted radio with a maximum output power of 50W and an operating frequency range of 30.000 to 75.975MHz in three bands. This frequency range will allow the radio to be operated on the 4m (70MHz) and 6m (50MHz) amateur bands but there are certain useful frequencies slightly outside of this range that the radio can be tweaked to operate on with relatively little technical expertise.



Please note that in writing this modification instruction I have simplified the explanation of the workings of the radio to keep the instructions brief and to avoid getting swamped with details that aren't relevant for carrying out the work in hand. Further detailed technical information can be found from EMER H612 (Technical description)

10m band

The UK 10m amateur band allocation is currently between 28.000MHz and 29.700MHz, the FM portion being 29.100-29.200MHz and 29.600-29.700MHz (using 10kHz channels) with a 29.600MHz calling channel. Due to its unique spot in the spectrum, 10 metres can be interesting to work. At peak times of the solar cycle when sunspots appear on the Sun's surface, 10 metres can be alive with extremely long-distance signals, refracting from the F2 layer in the ionosphere.

ATC/ACF 78.1MHz

The cadets have a certain number of designated spot frequencies across the Clansman range of frequencies, plus access to ATC (Air Training Corps) frequencies, one of which lies just outside of the range of the Clansman VHF radios at 78.1MHz. Use of these frequencies is obviously restricted, so this part of the modification should only be carried out by (or on behalf of) members of the cadet forces authorised to operate on the military radio network.

Technical Overview

Tune Inhibit

The radio creates a tune inhibit signal that prevents synth lock when the frequency dialled goes below 30MHz or above 75.975MHz. This tune inhibit signal needs to be disabled to work outside these frequencies. In this mod the wire is simply disconnected.

Band 1/3 select lines

Band 1 and band 3 select voltages will appear when the frequency dial is set to the relevant frequency ranges for these bands. This signal will be absent when the radio is set outside these ranges, which in turn will also prevent synth lock, so we have to replace it by injecting 0V at the relevant pin for either band 1 or band 3 depending on which frequency we are working on.

20MHz logic voltage (10m mod)

Frequency synthesis is achieved by a series of binary logic voltages created by the frequency dialled up on the frequency setting switch. For the 10 metre mod, once the radio is permitted to tune outside of the designated frequencies and thinks it is on band 1, the logic for x20MHz has to be created. This is simply done by injecting 3V (logic 1) directly onto the synth when the mod switch is set to 10m. Note that no additional logic is required for 78.1MHz as the switch is already capable of dialling up this frequency and creating the correct logic.

Tuning and Oscillator adjustment

The transmit and receive oscillators are designed to work within the permitted range of the radio. Any deviation from this requires some trimming on the receiver and the transmitter modules to ensure synth lock in the final stage of tuning.

Modification instructions

Kit required

Right angled alan key 5mm
Soldering iron
Dual pole Toggle switch on/off (10m) or on/off/on (10m and 78MHz)
Coloured wires
Heatshrink/Hellerman sleeving
Wire snips
Petroleum jelly
Drill
Insulated trimming tools
Small flat point screwdriver

Remove the case

Place radio with the front panel upwards on solid ground and remove the four alan bolts.



Ensure you use the correct tool, sometimes the bolts can be stiff and once you round the edges of the alan bolts, it ruins the look of the radio and makes it more difficult to turn the bolts if you need to remove the case again.

Turn the radio on its face and then remove the central alan bolt at the rear between the two fans





Carefully slide off the case in a smooth upward motion. It is tight fitting and if care is not taken, wires can be snagged or caught. The rubber seal may come off, don't worry too much about that, it will be replaced later.

Remove the retaining block if it is loose enough to do so. If it is tight, leave it where it is, it will not cause a problem.



If available, fit the frame from the 353 test kit to the rear of the radio. This protects the delicate circuit boards and shaft at the end of the radio. If a frame isn't available take great care when turning the radio around on the workbench.

Test the radio

It is highly recommended that the radio is tested before attempting the modification, to ensure that it transmits and receives on all bands correctly at the top and bottom of each band. The three bands are as follows

- Band 1: 30.000 - 40.975MHz
- Band 2: 41.000 - 55.975MHz
- Band 3: 56.000 - 75.975MHz



In normal working, when selecting a band, the Rx turret (the longer of the two big cylinders) should clunk to the correct position for that band, then the Tx turret will do the same, then the interconnecting shaft should spin quickly before slowing down and inching for a couple of seconds before it stops completely, the frequency dial lights stop flashing and the radio has achieved "synth lock"

Ideally you should use a proper test rig or at least the Clansman test Kit Condition to check the functionality of the radio, but if these aren't available, you can do a quick test by setting the radio to transmit and checking the red



bulb goes on, that sidetone is heard in the handset when you blow, power is in the green on the meter when the system switch (shown on the right) is set to TX O/P, synth is in green when the switch is set to SYNTH and meter reads roughly central when switch is set to AFC TX.



Special care should be taken on testing at 56MHz at all power settings to ensure there is no “squeal” heard in the audio. This is an indication of either a fault in the radio power supply or a power source that is not sufficiently powerful enough to operate the radio. This is especially true when attempting to run the radio from a Widney Aish 14/28V AC Adapter that only has a current capacity of around 7A (even though it is fused at 10A)

It is sensible to check the radio before the modification is attempted to aid in fault finding if a subsequent fault occurs.... If the radio was initially good, then you know the fault was caused by you in the process of attempting the mod, so you can track back and remedy the error easily. If the radio was in an unknown state initially, this fault finding process is a lot more tricky.

Install toggle switch

There are many potential ways to create the switched circuits for this mod – in this version a simple toggle switch is installed on the front panel. If something less visual is required there are ways that the data mode switch could be used or one of the audio sockets could be rewired to accommodate an unobtrusive plug to create the switching. Reed switches with magnets are also a possibility. For simplicity I have stuck with the toggle switch though.

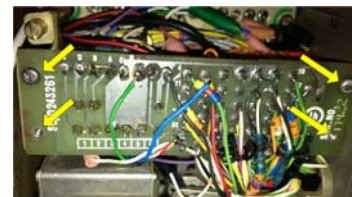


For the 10m only mod, a dual pole on/off switch is required. For the double mode, a dual pole on/off/on switch is required. These switches need to be mini or micro switches as space is very limited on the front panel.



Prepare the switch by connecting four or five wires (depending on which mod you are doing – see schematic in the “wiring” section of the instructions below) approximately 20cm in length and note the specific colours used for the switch poles. It is advisable to heat shrink or hellerman the switch connections to avoid any chance of short circuits in the small space where the switch is to be installed.

Remove the four retaining screws on assembly 1h and pull the circuit card back and out of the way. It may be necessary to cut the string loom to extend the board fully down.



Remove the grey plastic data mode switch knob held in by three small screws.

Be careful not to lose the small metal switch locator that is located in the housing



Remove the switch retaining lug by using a metal ruler or similar flat object

Carefully move the switch body out of the way of the front panel



Drill a hole in the location shown just wide enough for the modification toggle switch to squeeze through (be very careful not to damage any wires when drilling and to remove any burrs and swarf from the hole once done)

Install the toggle switch ensuring it is the right way up and carefully replace the data mode switch at the same time. It may be necessary to do each one a little bit at a time to get them in side by side as it is a very tight fit, especially if the hole isn't quite in the right place.



Replace assembly 1h

Put number two on the frequency setting switch (optional)

This bit is very tricky and is not essential for the modification, however if done right, it can add authenticity to the mod. Unmodified, the radio only has the numbers 3 – 7 printed on the 10 MHz bit of the switch, so “29”MHz will not be visible, just the “9”

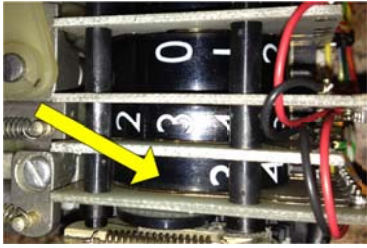


Locate a number 2 on a black background of a similar size and font to the numbers on the frequency dial. I did mine by experimenting with a computer and printing on some sticky labels. If you are lucky you may find a stick on white number from somewhere (but I couldn't)

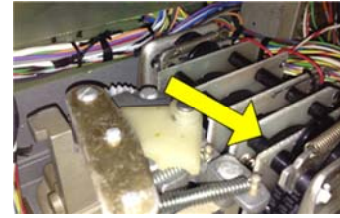


Remove the four alan head screws retaining the IF Amplifier in place with a long handled 3.5mm alan key. Carefully remove the RF lead and the two retaining screws on the plug on top of the Amp to allow the amp to be removed from the radio.



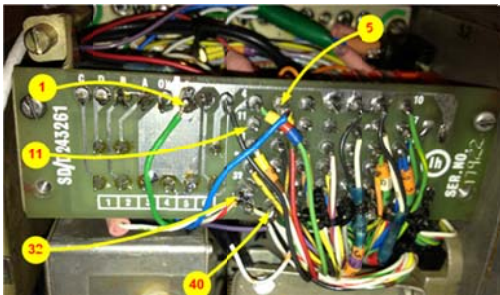


Dial up the frequency setting switch so that the 3 is just visible at the back and with some long tweezers stick on the number two in the space just above the three. (You may need a dentists mirror to see what you are doing) Ensure it is stuck well down!

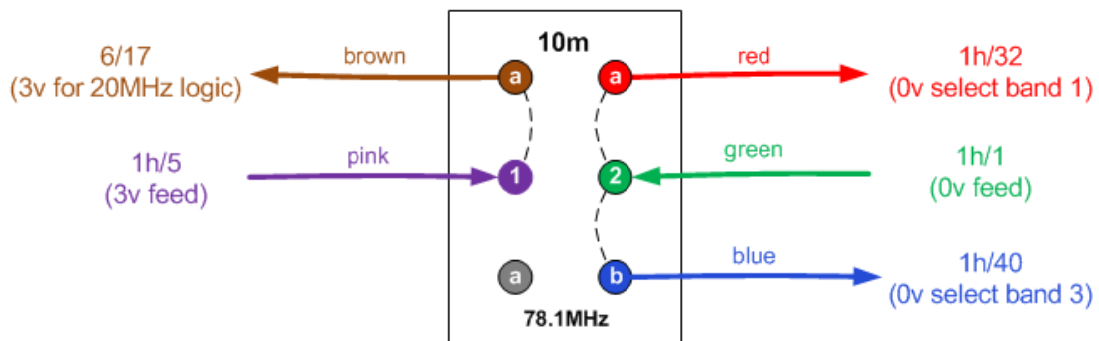


Replace the IF amp

Wiring



Locate the tune inhibit wire on pin 11 of 1h, remove the wire, insulate it somehow and tuck it out of the way within the rest of the bunch of wires



Feed the wires from the toggle switch through the looms and connect them as follows:

Connect the wire from pole 1 to 1h pin 5 (this is the 3V feed for the 20MHz synth logic)

Connect the wire from pole 1a to synth (6) pin 17 (this switches 3V to the synth for the 20MHz logic)

Connect the wire from pole 2 to 1h pin 1 (0V feed for band selection)

Connect the wire from pole 2a to 1h pin 32 (select band 1 for 10m)

Connect the wire from pole 2b to 1h pin 40 (select band 3 for 78.1MHz)



Rx Oscillator alignment (10m)

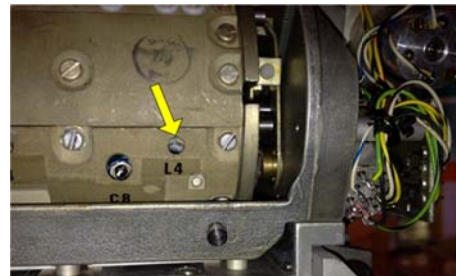
Remove the Rx turret cover by releasing the two catches and sliding it away from the retaining studs

Set the radio to 39.100MHz and let the radio gain synth lock.

Flick the switch to the 10m mod position and then select 29.100MHz. This will either show as 29.100MHz on the frequency dial (if you stuck a "2" on the dial) or as _9.100MHz if you didn't.

The shaft will probably start to inch at this stage for a few seconds before it starts to spin seemingly uncontrollably, unable to obtain synth lock. It will go in cycles of fast spinning, followed by a period of inching, followed by fast spinning etc. This is normal, don't worry.

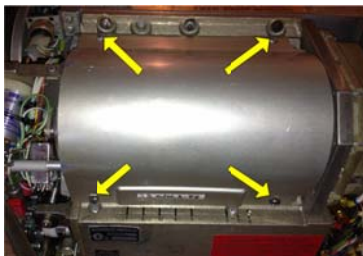
When it is an inching stage, notice which way the shaft is turning, (normally it is anti-clockwise) Insert the trimming tool into the far right inductor marked L4 and slowly, half a turn at a time, turn the trimmer clockwise. The inching should slow down as you do this, but if you haven't done it enough, it will start spinning quickly again. Wait until it inches again and carry on turning the trimmer clock wise. After a few goes you will find that the inching will either stop, or the shaft will start to inch the other way. As long as you get it to stop, that's fine for the purpose of this modification. There are ways to align the Rx shaft very accurately, but this is outside the scope of this instruction and isn't really necessary for what we are trying to achieve. Be very careful adjusting the inductor as it is common for them to disintegrate, especially if using a metal screwdriver that isn't a snug fit.



The amateur allocation for FM at 10m is only between 29.1MHz and 29.2MHz, so it is not essential to adjust any lower than this, however if you want, you can experiment by turning down the frequency beyond 29.1MHz, but be aware that the further down you go, the harder it will be to maintain alignment at the top and bottom of the band.

Tx oscillator alignment

Turn the system switch to AFC TX and key the transmitter. To be within specification the meter should be within 3 marks left or right of centre, although I always prefer to get it as central as possible when the radio is apart, as ageing/temperature can make the AFC creep and if it is on the edge of spec, it may not be long before it develops a fault, especially when operating for long periods of time or in hot conditions.



To adjust AFC, remove the four retaining screws from the Tx turret cover.

Put the radio to transmit and with care, adjust L1 and/or C1 until the AFC comes in centrally on the meter when the radio is transmitting. If the radio has previously been aligned correctly, use L1 for bottom of the band and C1 for the top of the band, but if this doesn't work, use trial and error with either until you see some movement. If the AFC was way off initially, it is not advisable to adjust to full centrality as this may disturb equilibrium at the other end of the band.



Once you are satisfied that the AFC is ok, turn transmit off and go to the other end of the band to ensure synth lock is still achieved and that AFC Tx is acceptable. (note that by adjusting AFC too much, the shaft could spin and not find a lock position)

78.1MHz Rx oscillator alignments

To adjust the oscillator for 78.1MHz, follow the same method as for 10m as above, but instead of trimming the inductor to stop the shaft spinning, trim the capacitor that is just to the left.

As before, check AFC Tx and the lower end of the band to ensure stability.

Final check

With covers off, turn the mod switch to the off position and check Tx/Rx at the top and bottom of each band.

Replace all internal covers and screws and tidy up any loose wiring before making a final check for any swarf or washers that may have fallen inside

If the retaining block was removed, replace it in position, remove the test frame (if used) and place the radio upside down on it's face.

Inspect the rubber seal on the case – (if it falls off when the case is upside down, use some petroleum jelly to keep it in place) then carefully slide the case back over the radio.



It will only fit one way, so do not force it as it should slide on easily when rotated correctly – notice that there is a slight concave bit on one of the sides, this matches with a slightly raised side on the main body by one of the fans.



Replace the rear alan head bolt – you may need to wiggle it a bit to locate within the retaining block.

Before tightening completely, turn the radio over and replace the four alan head bolts on the front and tighten them. The rear bolt can then be fully tightened and the ready is ready to use!

Operating instructions

Normal operation

To operate radio normally, the toggle switch should be set to the off position and radio will work as normal.

10m operation

1. Flick the toggle switch to the 10m position,
2. Dial up 39.600MHz
3. Take the 10MHz switch down one, so that the dial reads _9.600MHz (29.6MHz FM calling)

*note that if you have stuck a "2" on the switch when doing the mod, the dial will read 29.600MHz

**the 10m allocation currently advises that the channels to be used between 29.100MHz - 29.200MHz and 29.600MHz – 29.700MHz have 10kHz spacing. Due to the fact that the Clansman range of radios use 25kHz steps instead, this means that some channels aren't available for use. Usable channels are 29.100, 29.150, 29.200, 29.650, 29.700 and the 29.600MHz calling channel. This allocation may change in the future, so please check your local licensing conditions.

78.1MHz (ACF) operation

1. Flick the toggle switch to the 78MHz position
2. Dial up 78.100MHz

Disclaimer

When performed correctly this modification should cause no problems to the normal operation of the radio set, however damage can be caused if care is not taken when installing the switch and connecting/disconnecting the wires. If sufficient care is not taken when trimming the oscillators, synth lock may be lost and without proper test equipment could be very difficult to get back. In addition to this, the Clansman range of radios are getting on a bit, some are over 30 years old, and consequently solder joints etc could have deteriorated and if disturbed, could cause faults unrelated to the changes made with this modification. The author cannot be held responsible for any resultant fault or damage caused to the radio when performing this modification.

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September 2012
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