Hands Electronics

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Thank you for purchasing one of our kits. We hope it will give you many hours of service once built. Our aim is to provide satisfaction and service. If you have any problems with the construction or use of the equipment, please ring, or write to us. We will do all we can to help.If you are new to construction we suggest you read carefully the about part identity and soldering contained in the tools and construction section.

Sheldon Hands

Tools and Construction Practice

We recommend the following tools to make your HANDS kit

15/25w soldering iron
small electrical screwdriver
4inch phillips screwdriver
small side cutters
electricians pliers
snipe nosed pliers
small half round file
multimeter

Below are some notes on construction practice with a heavy emphasis on soldering.

You must use solder with a non-corrosive flux. Acid cored solder MUST NOT be used. A 60/40 type will be ideal. The secret of good soldering is to have the correct temperature at the joint. Make sure the tip of the iron is clean, if necessary clean it on a damp sponge. Do not carry solder on the iron to the joint, by the time you get it there the flux will have burnt or vaporised.

Although it seems to contradict the above, do lightly tin the iron before making a joint. This will aid the heat transfer and lessen the chance of damage to the track or component through prolonged application of the iron.When you are ready to make the joint, apply the iron and the solder at the same time. Do not apply too much solder, a thin gauge helps in this respect. Humps of solder on a joint either means you did not leave the iron on the joint long enough or you used too much solder.

Try to get a medium coating over the track and the component lead. If you use too much heat you may damage the track or the component. We suggest you try some test joint on scrap wire, you will find it inspires confidence! When the board is complete check for solder bridges and dry joints, an Ohmmeter can be used for checks.

Most large parts in the kit are readily identifiable, but value identification systems are varied and may pose a problem. For wire ended resistors (ie not SMD) a colour code chart is included at the back of the manual. Most supplies of resistors are coded with 3 bands for the value , i.e. 1st fig, 2nd fig, 3rd multiplier. But we increasingly receive resistors with a 4 band code this then becomes 1st fig, 2nd fig, 3rd fig, 4th multiplier e.g 1k5 = brown, green, black, brown = 1 5 0 0 .

Capacitor identification for electrolytics is straight forward but ceramic caps may pose a problem. Where n values are used n10 = 100pf and 1n = 1000pf, those with just a 3 digit number use the first 2 numbers as figures and the 3rd indicating the number of zeros, i.e. 102 = 1000pf. For those with a 3 digit number followed by letters treat as a 3 digit number, where only 2 digits and a letter are used this indicates the value is less then 100pf i.e. 82J = 82pf and 4.7C = 4.7pf.

Inductor value systems are as varied as capacitors but generally there are two common types. The first uses coloured bands with the same colour values as resistors, the inductors are the same length as a 0.25w resistor but much thicker with flat ends where the lead exits the body. If

checked with an ohmmeter they will show very low resistance values. The second type have the value marked on them with an alpha-numeric code in uh e.g. 2R2K = 2.2uh and 220J = 22uh.

Circuit Description

The RTX PLL10 is a phase locked loop synthesizer primarily designed to provided local oscillator output for use with the Hands RMX10 and TMX10 mixer boards. PCB1 carries the VCO's, output amp,mixer and comparator with PCB2 providing the mixer xtal oscilltors and buffer amplifier. The reference for the system is an external vfo running at 5-5.5mhz, the stability of the system is dependant on this reference.

TR3 a-j with their associated components form 10 crystal oscillators. The oscillator is resonated by L4/C26 at the wanted output frequency. On some bands capacitive feedback is used from the divider C25/27. D7/R21 damp the output voltage, the output is a series feed through the crystal to obtain a degree of filtering. The oscillators are buffered by TR4 a grounded gate amplifier.

TR2 a-j are the VCO oscillators. The tuned circuit is comprised of L3 resonated by the variable capacitance diode D5, on some bands to obtain the minimum capacitance required the circuit is padded by C19. Feedback is controlled by the capacitive divider C21/22. D6a-j isolates the individual oscillators and are biased on when 12v from the bandswitch is applied to the select line via R19. The DC voltage to the varicap diode is supplied from the loop filter/amp IC3.

IC1 an NE602AN mixes a portion of the synth output frequency with one of the on board crystal oscillators. The difference frequency f1-f2 when the system is in lock will be equal to the external VFO. The mixer output is transformer coupled to the low pass filter L1-2/C5,6,7, which attenuates the higher products of the mix process. The wanted output is amplified by TR1 feedback stage.

IC2 is a 74H4046, the phase comparator section of the ic is used to compare the frequency and phase of the external VFO and IC1 mixer output. The comparison generates a voltage at pin 13 of the ic, when the phase of the two signals are the same the circuit is considered to be in 'lock'. The voltage at pin 13 with the system locked will then be the mean of the voltage swing. If the VCO drifts or the VFO frequency is changed the voltage on pin 13 will change and attempt to find a new mean point for 'lock'. The voltage at pin 13 on IC2 is filtered in ICa and buffered by IC3b, the dc voltage is then applied to D6 to vary the VCO frequency.

The control loop operates as a subtractor. If alternative vco outputs are added the xtal oscillator frequency must be higher than the vco frequency.

The Local Oscillator LO for mixer injection will generally be Signal frequency + Intermeadiate Frequency LO = SIG + IF. The frequency of X1 for the crystal oscillator will be LO (lower band edge) + 5.5 mhz.

The synthesizer output frequency is amplified and buffered by a cascade amplifier comprising TR5/6.

Construction

° Fit the Berg headers listed below.

√° PCB1-: 10way select hdr, vfo, 5 way in/out. PCB2 -:10 way select hr, xo out.

° √ Fit and solder R1-R33. DO NOT FIT R15. Check the appendix for the correct way to fit components. Where you see a ground legend on a resistor this end is soldered to the top foil of the pcb termed GROUNDPLANE. The groundplane acts as a large heat sink so always tin the pcb with solder around the area of the connection first. Cut the ground side resistor lead back to about 3mm before

fitting. If the connections are too long and obstruct another pad angle the component to a free area of groundplane.

Fit and solder the ceramic disc capacitors including suffix a-f from the main parts list and the all band list. Many of these capacitors are connected to the ground plane, use the same technique for installation as you did for the resistors.

Fit and solder C11a. This is located adjacent to R9 Fit the + lead through the board ans solder onto the track. Solder the - lead to the top ground plane.

Using a resistor offcut install a ground link as indicated. adjacent to L3a-f, in/out pcb1, xo pcb2.

Fit and solder diodes D1-4, D6a-j. Make sure that the cathode band on the diode agrees with the band on the board component outline.

Fit and solder L1,2

Fit and solder IC1,2 and 3, be careful to observe the correct orientation of the device. The cut out in the component legend indicates the pin 1 end, also pin 1 is further identified by a square pad on the track side. The following pins are soldered to the ground plane side of the pcb-: IC1 pin3, IC2 pin8,9.

Fit and solder IC4,5. Bend the center pin at a right angle and solder to the ground plane. Make sure that the IC outline agrees with the board ledgend.

Fit and solder VR1,2,3. Solder one leg to the ground plane as indicated by the ground ledgend.

Fit and solder TR1,4,5 and 6. . Make sure the transistor shape agrees with the board outline.

Make up T1 on the small ferrite tube bead. Cut 2 x250mm lenths of the 32swg enammeled copper wire and wind on both wires together to give six parrell turns [6 turns bifilar]. Identifiy the two windings and instal one between IC1 pins 4/5 and the other between ground and the junction of C5/L1 [hole adj R2]

Make up T3 on the 2 hole balun core. Dot one tube end with a felt tip marker or paint to indicate the start winding. Cut 13cm of the 32swg copper wire and wind on 6 turns [one turn is up through tube and back down through the other] Remove the enammel from the finish end and tin the wire with solder . Cut another 5 cm of the 32swg wire. Clean and solder one end to the tinned end of the 6 turn winding to form a tail. Wind on a further 2 turns. Clean and tin the start and new finish winding tails.

Install with the six turns between the un-etched ground hole and the center hole of T3 outline.

- Make up T2 on the 6.3mm self colour core. Wind on 5 turns of the 32swg enammeled coppe wire. Clean the enamel from the wire and tin both ends of the winding. Cut another length an wind on 2 turns, remove the enammel but do not tin yet to aid identification.

- Install with 5 turns on TR4 side of the ledgend outline and 2 turns between ground and hole to XO.

- Refer to the band pack parts table and install the suffix A list for the VCO and XTAL OSC.

- Where S18 inductors [2 lead heavy gauge winding with no can] are used the coil should be fitted between the diagnal lines inside the ledgend box outline.

- Fit and solder TR2a,3a. These are static sensitive devices, but in practice are quite robust. However its wise to adopt the standard precautions. Dont wear nylon clothing. Discharge any body static electricity by touching a water or a central heating pipe. Use an insulated soldering iron or fit a ground wire back to the pcb ground track. Dont wave the device about or handle the leads directly. Use insulated pliers to spread the leads. When fiting make sure the transistor outline matches the board ledgend.

- Fit and solder D5a. When fiting make sure the diode outline matches the board ledgend. The grouded lead shouid be bent at a right angle and solderd to the groundplane.

- Fit and solder X1a.

- Install the next band pack following the above procedure.

Test and Alignment

- Check the completed PCB'S for solder splashes, bridged tracks or pads and dry joints. If you suspect a dry joint use a multimeter to carry out a resistance check between the track and the component lead on the ground plane side.

- First check PCB2 the xtal oscillator board. Connect a max 13.8v supply to Berg header via 12VP and GND. Place a jumper from the select header pin E to 12VP to activate the oscillator

- Check with a frequency counter or general coverage receiver that the xtal oscillator is functioning. Adjust the core of L4E for the highest frequency possible . Next adjust adjust C27a to bring the oscilator onto frequency.

- Check the remaining oscillators with the above procedure.

- Connect PCB1 to a max 13.8v supply via the Berg header +12v and GND pins. Check that the current drawen is less than 50ma[typ 10-30ma]

- Make a temporary connection to the R16 side of R15 with a 6 volt supply. [you may use a 13.8v supply via divider formed from a 10k pot and a 10k resistor to ground, te wiper will provide a variable voltage] Fit a jumper from +12v to E pin on the select header

- Check with a frequency counter or general coverage receiver that the VCO oscillator is functioning. The frequency will not be stable but should be close to the required output. Adjust the core of L3E to bring it as close as possible. VR1 will need to be at mid range to get a reliable signal.

- Repeat for the other VCO's

- Disconnect the 6v temporary supply and install and solder R15

- Connect a 5-5.5mhz vfo to the VFO input pin.

- Connect the +12v pin to a maximum of a 13.8v dc supply via a multimeter on its current range . Check that the current drawn is less than 60ma. If the current greatly exceeds this check for an incorrectly fitted diode, transistor or ic.

- Set VR1,2,3 to full range above ground.

- Attach normaly to the 12v pin and now meter the voltage at R15

- Set the VFO to 5.25mhz and adjust the core of L3E for 5v at R15. The output frequency at the SYN pin should in band with the khz portion at 250khz.

- Set the vfo to its upper and lower limits and check that the TP1 voltage is in the range 4-10 volts and that the SYN output tacks the vfo from XX.000khz-XX.500 khz. For best phase noise performance the keep the lower voltge as high as possible by re-adjusting the core of L3 and re-checking the limits.

- Repeat the procedure fo the remaining VCO's

Frequency Table

	Signal	IF	VFO	LO [syn out]	X1
A	1.5-2.0	9	5.5-5.0	10.5-11	16 = 1·5 + 9 + 5·5
B	3.5-4.0			12.5-13	18
C	7-7.5			16-16.5	21.5
D	10-10.5			19-19.5	24.5
E	14-14.5			23-23.5	28.5
F	18-18.5			27-27.5	32.5
G	21-21.5			30-30.5	35.5
H	24.5-25			33.5-34	39
I	28-28.5			37-37.5	42.5
J	28.5-29			37.5-38	43 = 28·5 + 9 + 5·5
NA	29-29.5			38-38.5	43.5
	29.5-30			38.5-39	44

Band Pack Parts List

	BAND	C20	L3	C25	C26	C27	L4	X1	D7
A	1.8	0	9444	0	68P	CTG	KANK3335	16	
B	3.5	0	9445	0	47P	CTG	KANK3335	18	Yes
C	7.0	0	9448	0	47P	CTG	KANK3335	21.5	Yes
D	10	27	9452	0	27P	CTG	KANK3335	24.5	Yes
E	14.0	56P	8.5T WHITE	2P2	18P	CTG	KANK3335	28.5	Yes
F	18	39	7.5T VIOLET	2P2	27	CTG	KANK 3335	32.5	Yes
G	21.0	27	7.5T VIOLET	2P2	33P	CTG	8.5T WHITE	35.5	Yes
H	24.5	22	6.5T BLUE	2P2	27P	CTG	8.5 WHITE	39.0	No
I/J	28.5	22	5.5T GREEN	0	22P	CTG	8.5T WHITE	43.0	No

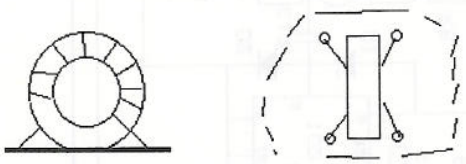
CTG = 30 PF GREEN TRIMMER (NOT REQUIRED ON DDS SYSTEM)

Parts List

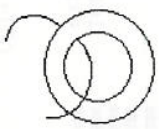
R1,4,5,7,29	100R
R2	3K3
R3	8K2
R6	1K8
R8	1K5
R9,11,13	10K
R10	470K
R12	820RL
R14,15	1K
R22	10R
R23	56R
R24,26	6K8
R25,27	47R
R28	680R
R30	15K
R31	22R
R32	220R
R33	33K
VR1,3	4K7
VR2	1K
C1,2,8,9,12,13,14,,16,18,28[PLL6ONLY]	
30,31,32,33,34,35,36	10N
C3,4,10,11,15	100N
C5,7	22P
C6	68P
C17	1N5
C29	1N
C11A	10MFD
IC1	NE602
1C2	74HCT4046
IC3	TL072
IC4,5	78LO5
TR1	BC183L[or2L,4L]
TR4	J310
TR5,6	BSX20
D1,2,3,4,	1N4148
T1	FX115
T2	KX37830
T3	BLN43002402
L1,2	22uH 7BS

vco/xtal osc all band parts suffix A-E

R16	10K
R17,18	100K
R19	100R
R20	220R
R21	33K
C19	1N
C21,22	68P
C23,24	10N
TR 2,3	J310
D5	BB204
D6	BA243
D7	1N4148

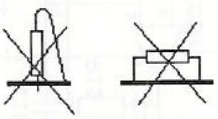


MOUNTING METHOD FOR TRANSFORMERS AND INDUCTORS

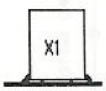


THIS IS 1 TURN ON A TOROID

MOUNT COMPONENTS LIKE THIS



NOT LIKE THIS

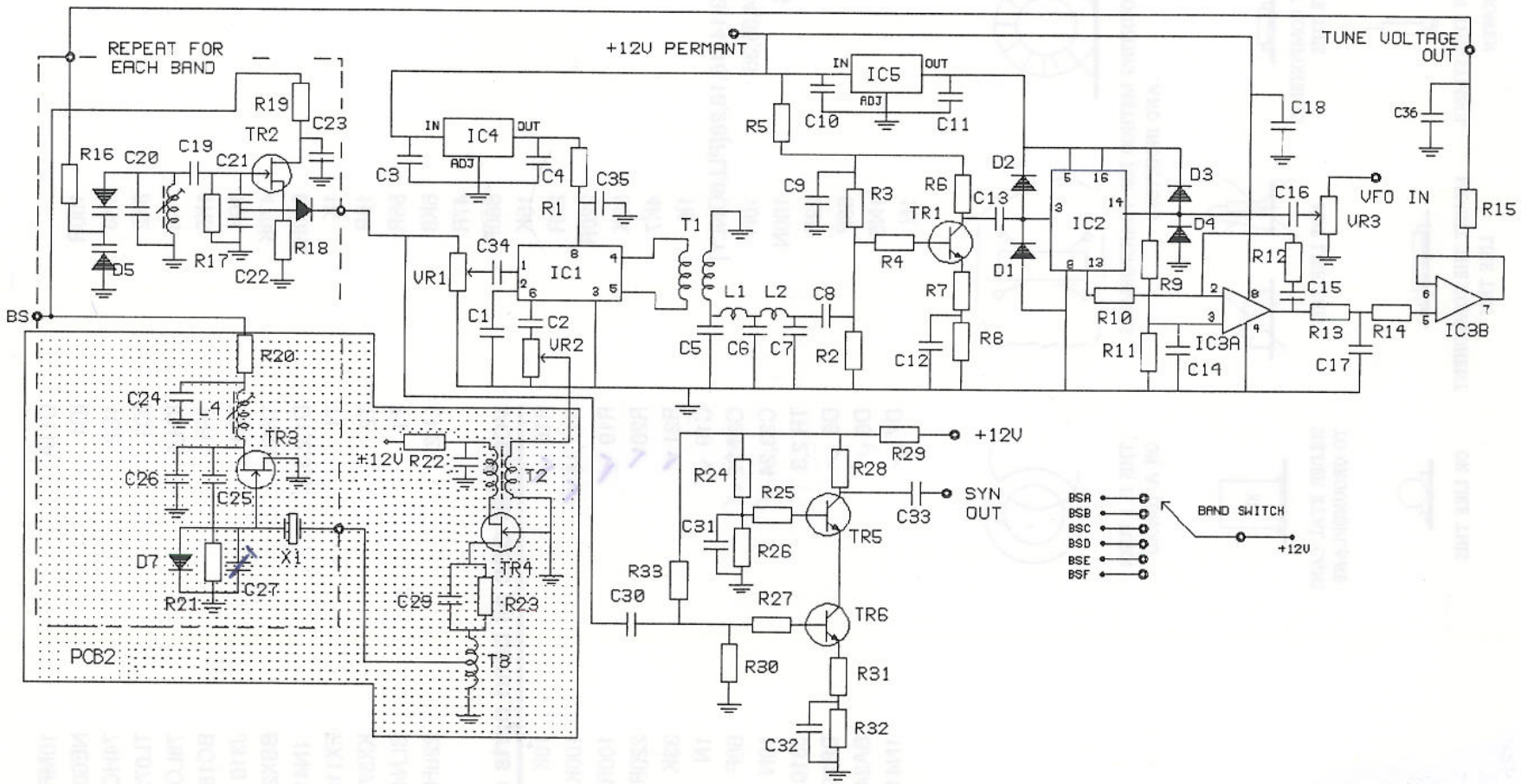


SOLDER XTAL CANS TO GROUNDPLANE

WHEN THIS SYMBOL IS SHOWEN

MOUNT THE COMPONENT LIKE THIS

OR LIKE THIS


REPEAT FOR EACH BAND
+12V PERMANT
TUNE VOLTAGE OUT
VFO IN
BS
PCB2
IC1
IC2
IC3A
IC3B
IC4
IC5
TR1
TR2
TR3
TR4
TR5
TR6
T1
T2
T3
L1
L2
L4
X1
VR1
VR2
VR3
D1
D2
D3
D4
D5
D7
R1
R2
R3
R4
R5
R6
R7
R8
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R10
R11
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C21
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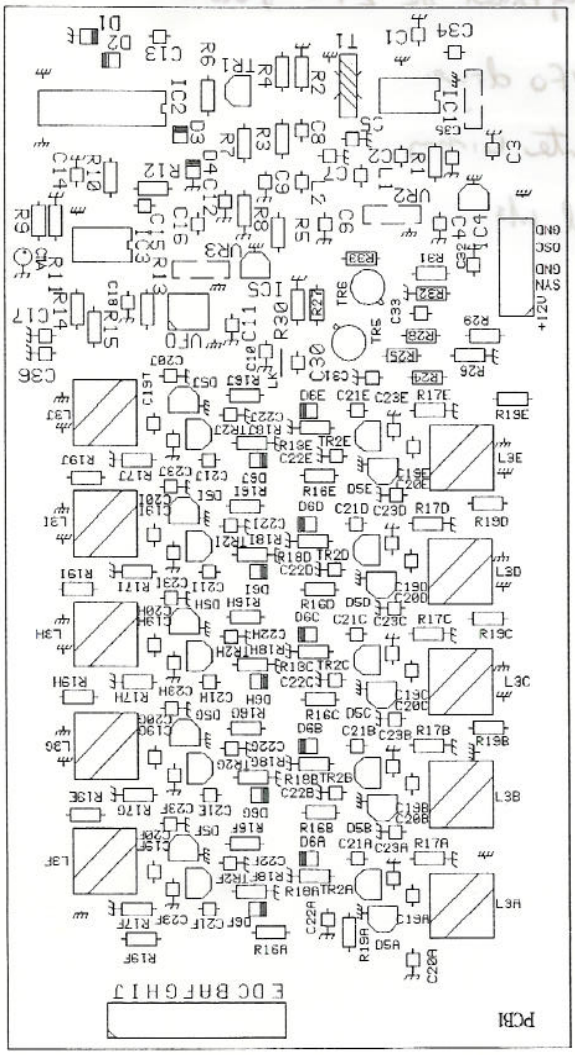
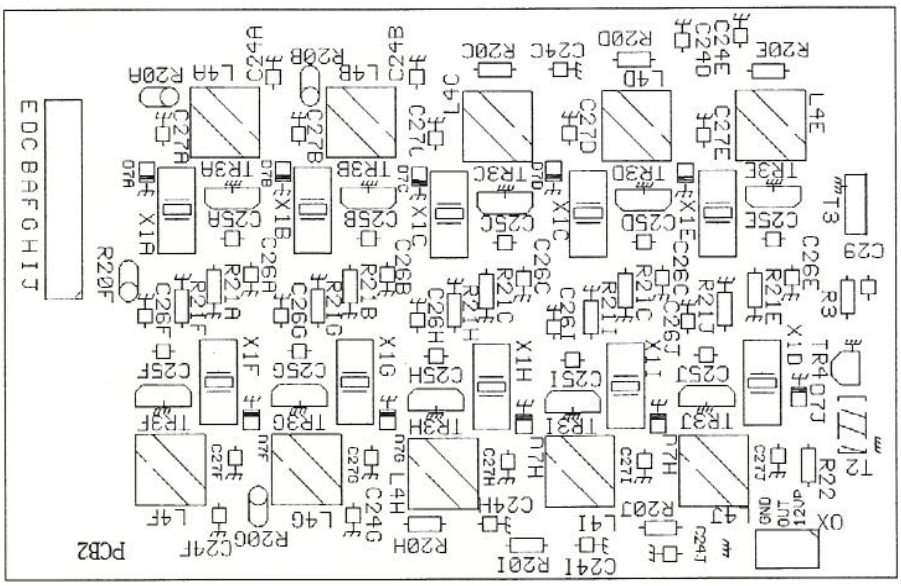
C23
C24
C25
C26
C27
C29
C30
C31
C32
C33
C34
C35
C36
+12V
SYN OUT
BAND SWITCH
BSA
BSB
BSC
BSD
BSE
BSF


PCB1
E D C B A F G H I J


PCB2
E D C B A F G H I J

Things to do.

① W/S Rx/Freq count on 29 MHz band.

② Tidy up VFO drive

③ [illegible] [illegible] [illegible]

④ [illegible] band [illegible]