HOMEBREW CONSTRUCTION:
AMATEUR RADIO ON A BUDGET

HOMEBREW & KITS : BUILDING A £50 SSB TRANSCEIVER

NEVER BEEN A BETTER TIME TO GET THE SOLDERING IRON OUT

- Component and Module supply; Far East, India

- Easy of acquisition and learning – Ebay, Amazon, Banggood etc.

- Interest Groups – Yahoo Groups and Google Groups

- Always someone to ask – the guru is dead – use of youtube

- Mistakes rarely costly, just frustrating

- Technology leaping ahead
    - Computer assisted – EPROM, Arduino, Raspberry Pi
    - SDR

- Modules – China, India

- Metalwork out of India, Thailand

THE TOOLKIT

- Solder station and small hand tools

- Heated de-solder tool

- Multi-meter – good up to 3A (analogue)

- Component analyser : passive and semi-conductors

- RF sniffer, oscilloscope – SDR spectrum analyser

- Good use of the internet for research . Not being afraid to ask.

- Patience

BUT BUYER BEWARE!

- Component quality is sometime doubtful

- Some components not labelled

- Components occasionally missing – usually they use a 'handful' approach

- Companies have customer service – missing components – it works

- Component boards are good quality but are sometime 'changed' from original
  - Frog kit spoilt by mark V board

- Inexpensive so sometimes ordering two for back up

- Instruction limited - some English , some Chinese

- Some components e.g. PA transistors probably 'not original'
 - Stock of driver transistors and PA transistors

TEST EVERYTHING !

- Test every component thoroughly
- Mark as you go – circuit diagram and component list
- Remember Solder: 2-2-2
- PCB Boards double sided
- Errors are difficult to correct once soldered
- Heat sink the PA transistor
- Don't mix up the key and phones socket
- Remember the dummy load

TEASER PROJECTS (£10)

- XTAL frequency checker/meter (£6)

- QRP Smart dummy load. (£6-9)

- 40m PIXIE kit (£2)
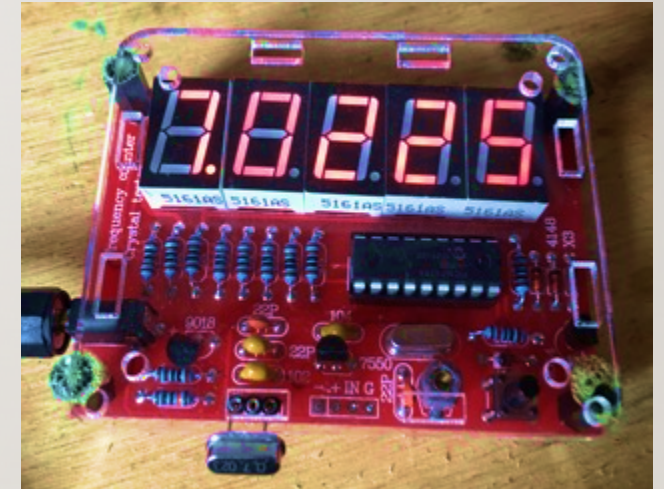
STARTING POINT

THE PIXIE £2.50

- 40m CW Transceiver

- Crystal controlled on RX and TX (7.023)

- No coils/torroids!

- Some bandpass 2-3KHZ

- A couple of watts – variable (0.5W)

- Only drive headphones

- Start up from fresh PP3 but 12V PSU

- Only like to see 50Ω

MOVING FROM THE PIXIE TO 49-ER

- £7.20
- More power 2-3 W (0.5W more typical)
- Still only drives headphones
- Still Xtal controlled
  - One for LO of RX/TX other for receiver front end filter
- CW sidetone
- Works reasonably well
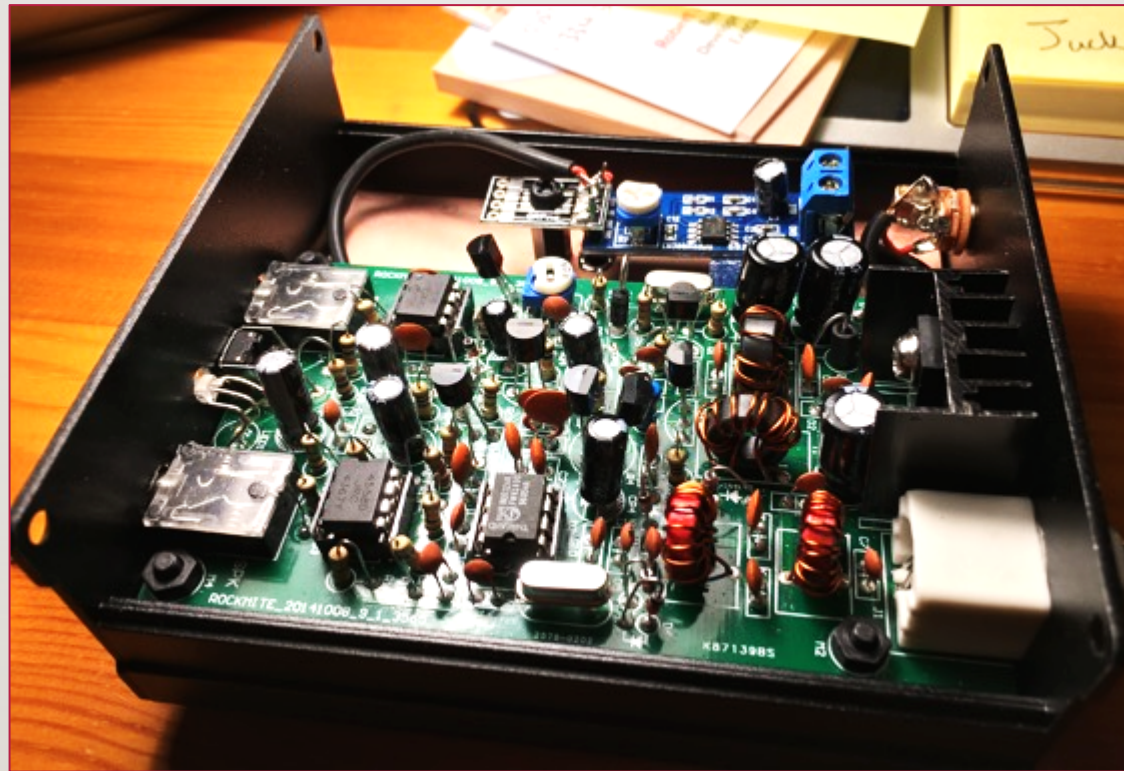- Care with torroids T-37-2 is red!
- Hissy
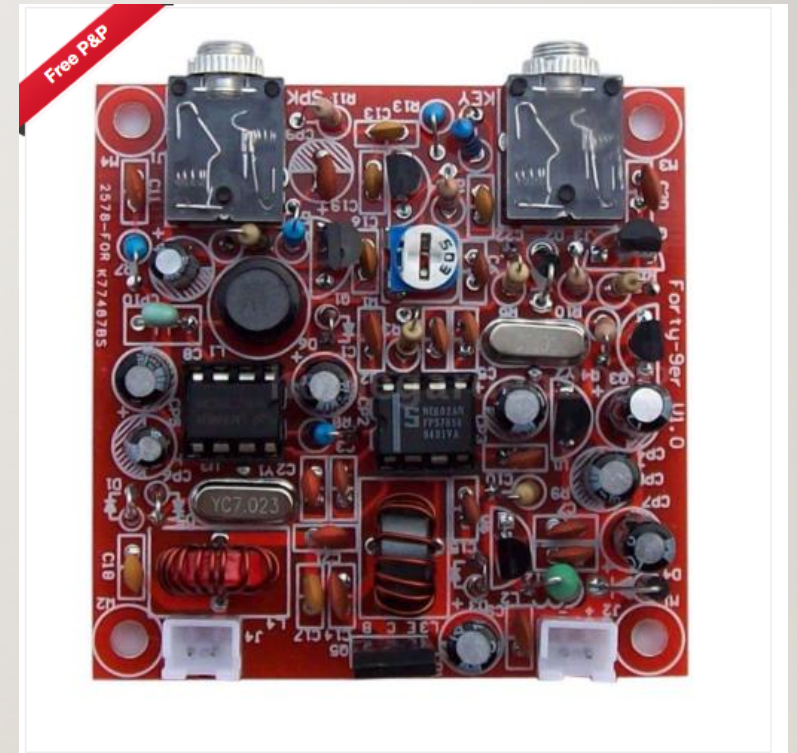
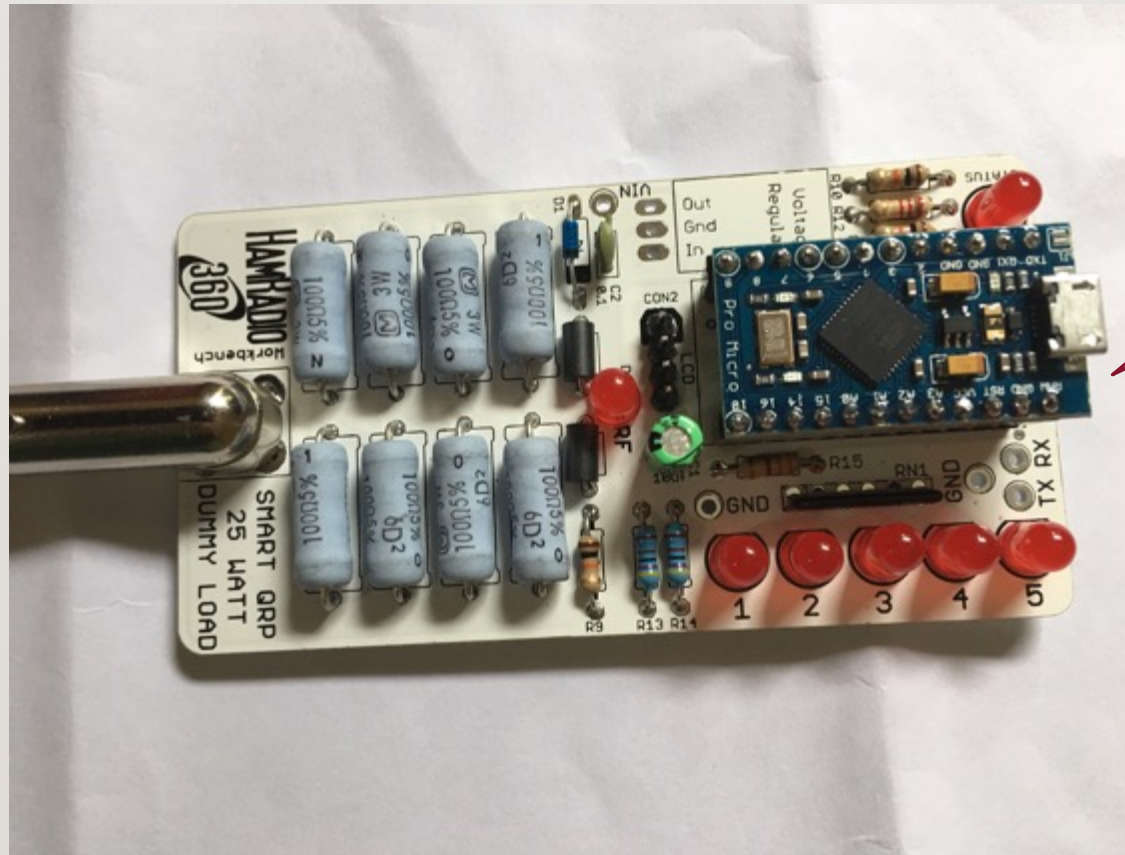# MOVING ON TO RM-80 (SUPER ROCKMITE)

- Now up to 8W (5W)

- PIC Keyer

- Dense board

- Circuit at limit (oscillation)

- 4 torroids -2 transformers

- Still only headphones output

- £13

- Could form the basis of transceiver

- Super RM yahoo group
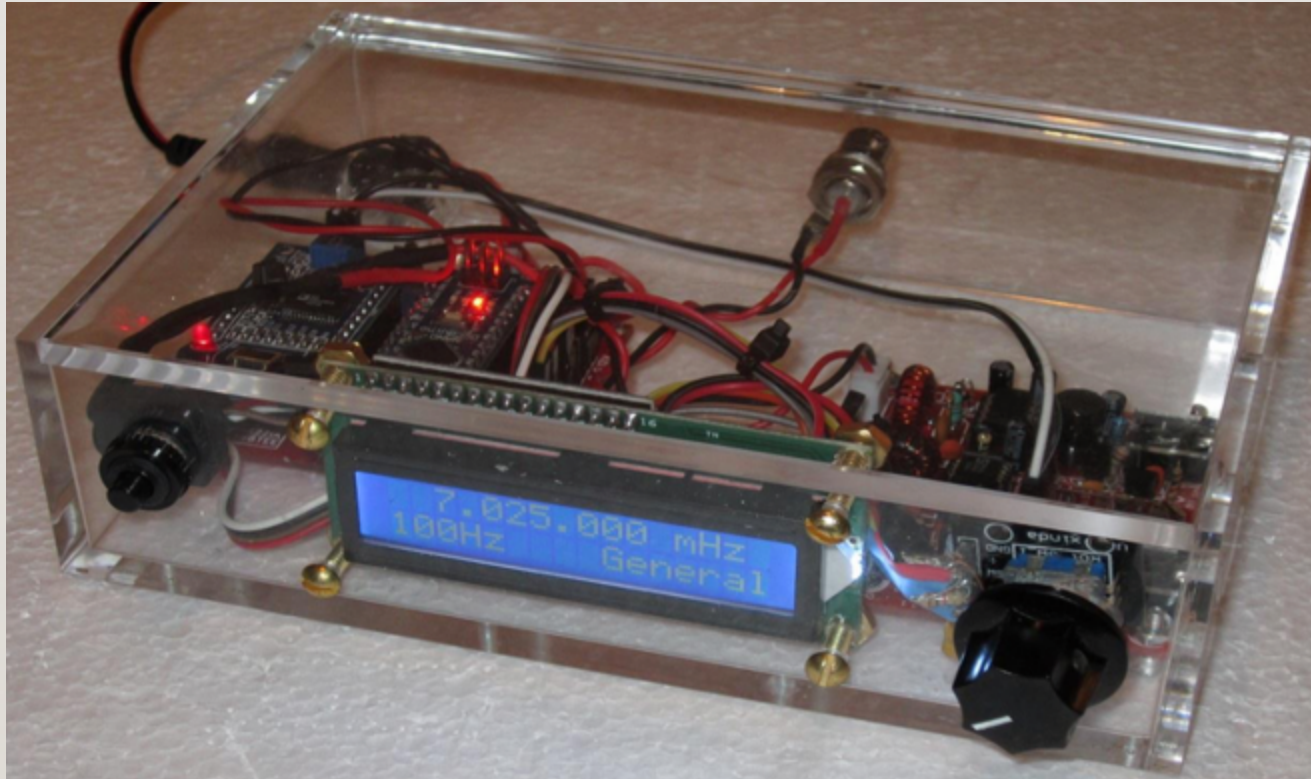
- Can bypass keyer
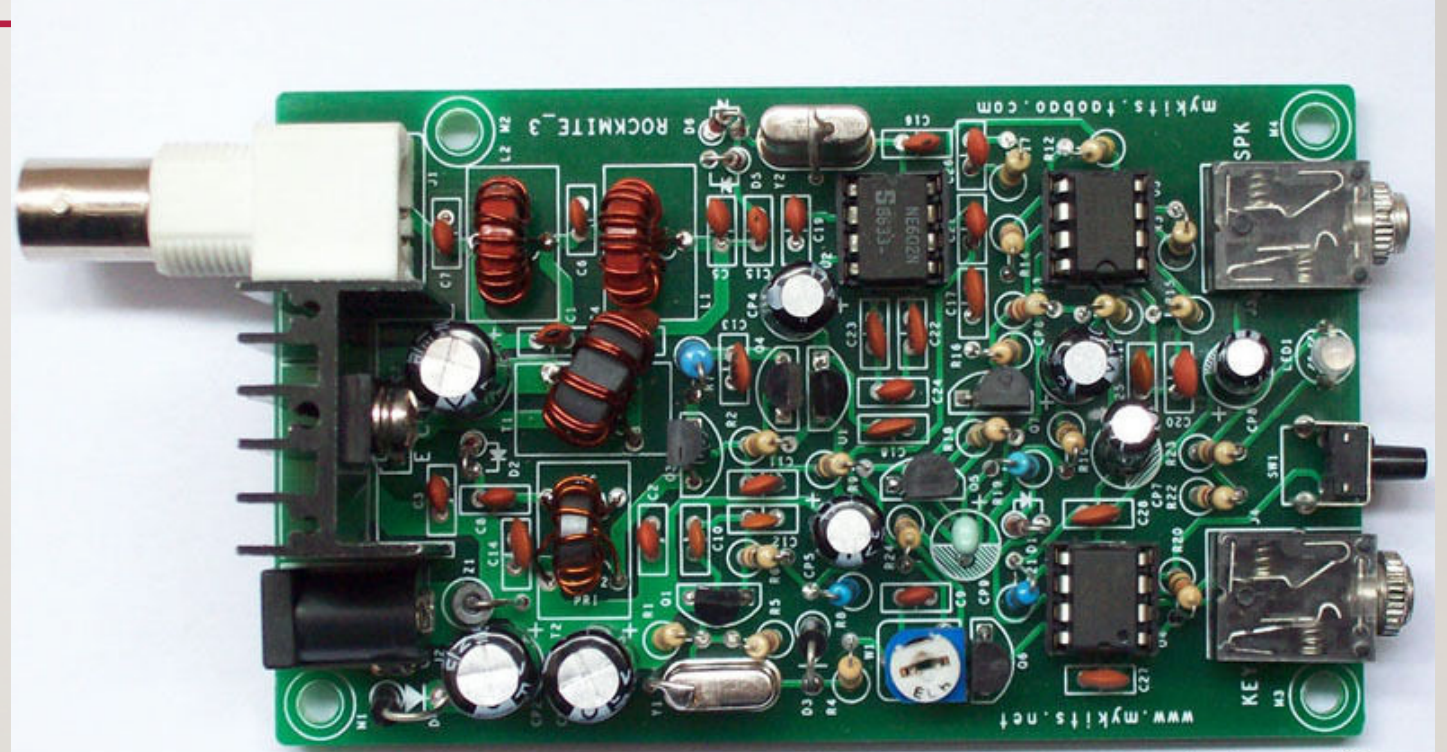
EXAMPLES AT G4FVZ : RM 80

AND THEN MADE MORE SOPHISTICATED.........

Arduino Power Measurement

THE SEARCH FOR A STARTER TRANSCEIVER LINKING A 49-ER TO A DDS VFO : MARCH 2016 QST

THE QST 40M TRANSCEIVER SAGA ....*THE DEVIL'S IN THE DETAIL*

- *From QST April 2016*

- £25 Project

- Use £7 Forty-9er board from Chinese
  - Modify board – XTAL filters

- Use Arduino based DDS for VFO
  - DDS noise
  - Encoder bounce

- Find the limitations
  - Cheap kit from Chinese unreliable
  - Poor audio – overdriven LM386
  - Needs broadcast band filter
  - CW Audio bandwidth filter
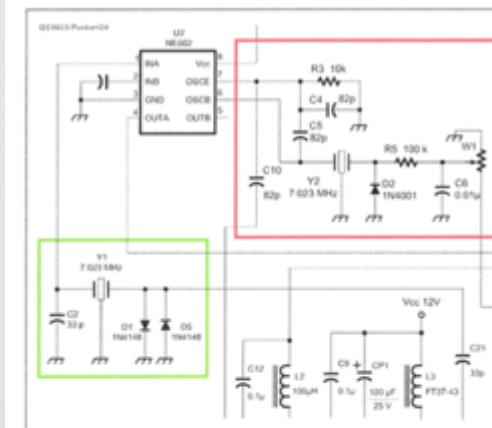 - TX 1W – needs 5W
  - TX LPF

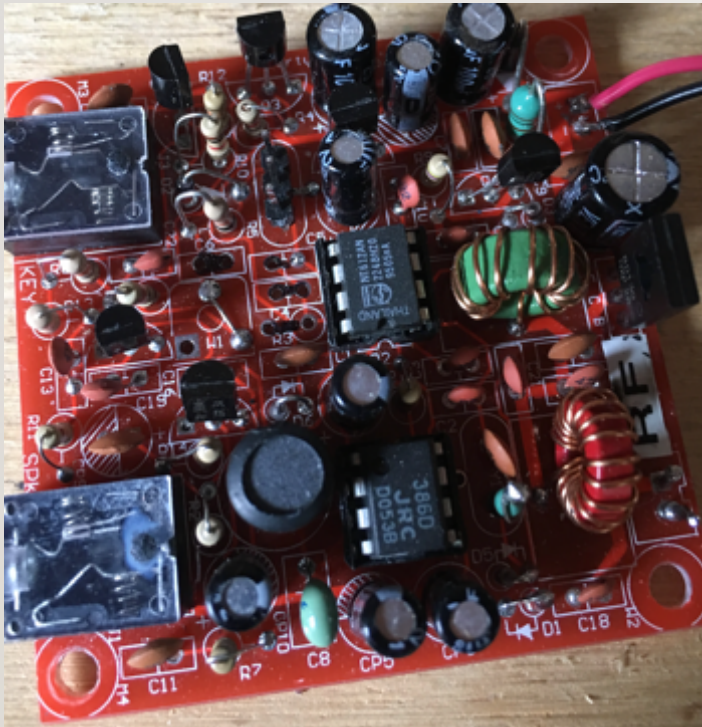# THE STARTING POINT :ADAPTED £6 49-ER KIT

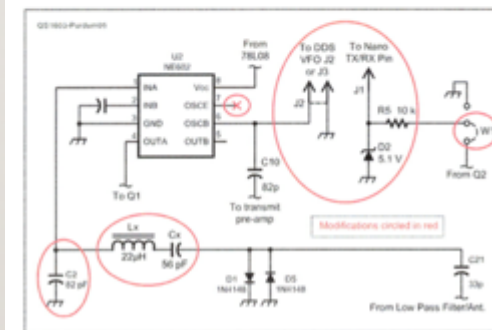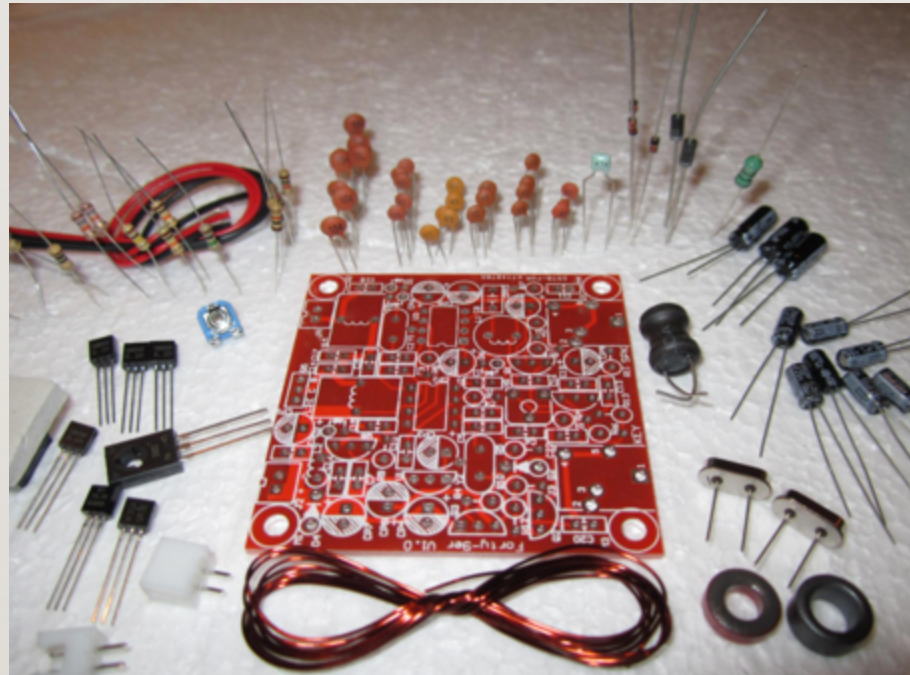Figure 4 — Original Forty-9er frequency control schematic.
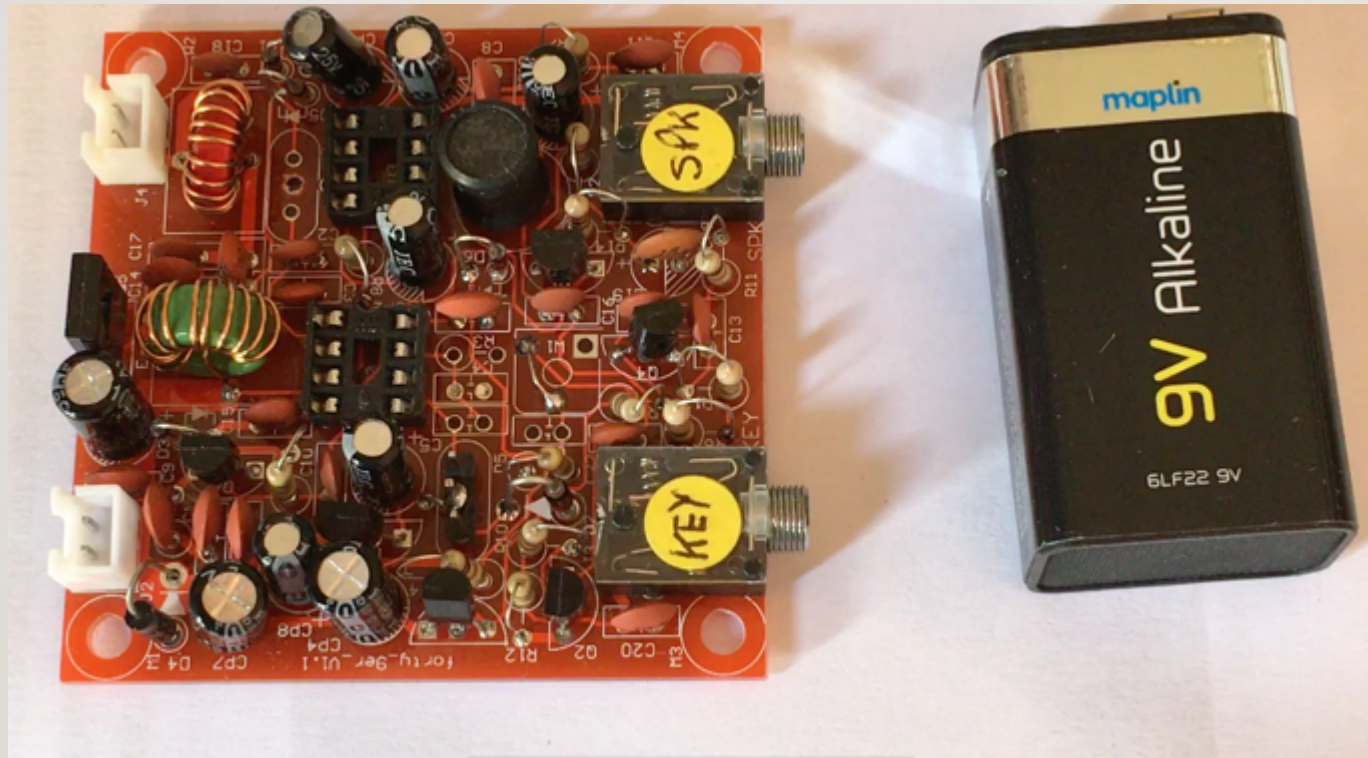
Figure 5 — Modified frequency control for the Forty-9er.

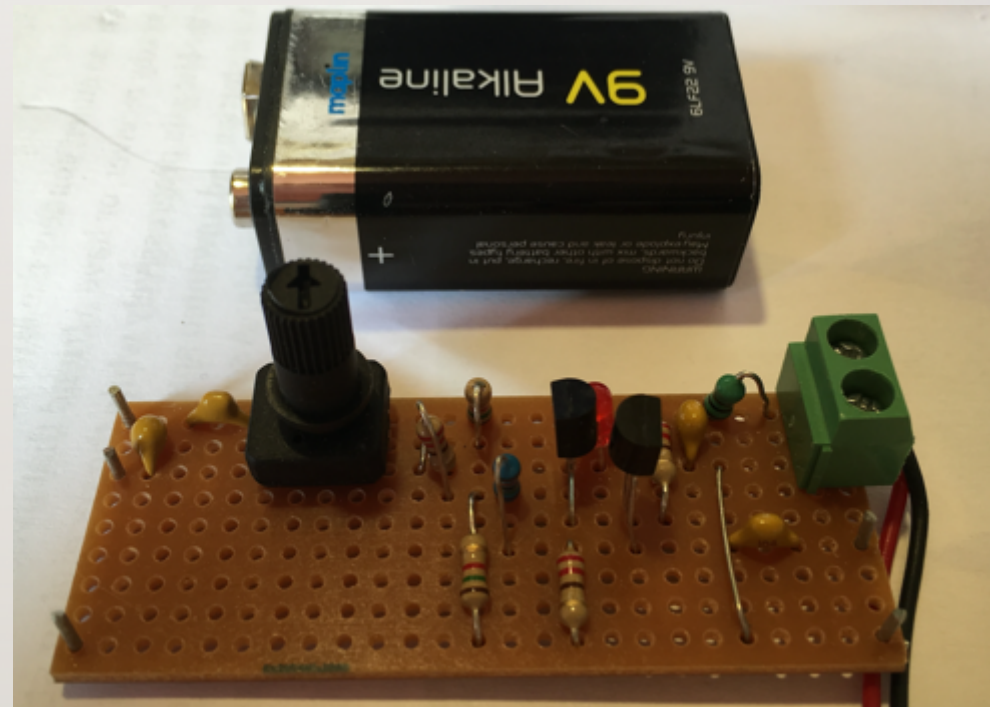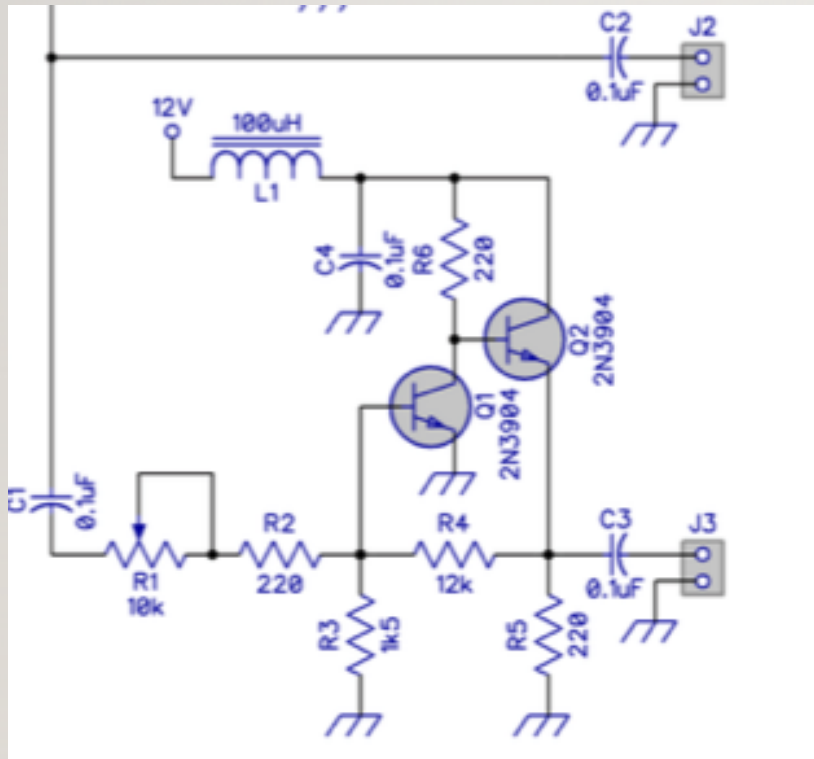# ORIGINAL 49-ER KIT £2.30 (IN BULK)

PCB Board not great quality
Component failures
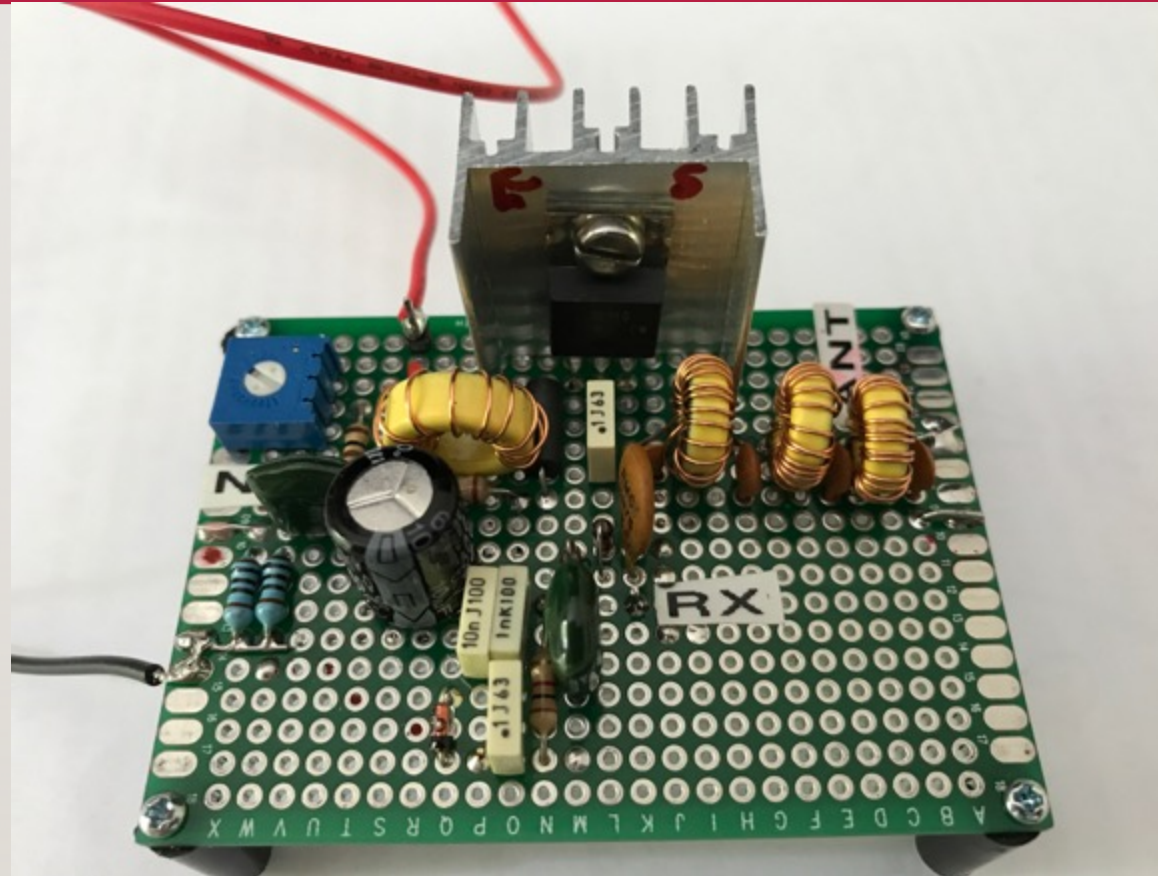
ADAPTED (QST) 49-ER BOARD CONSTRUCTED
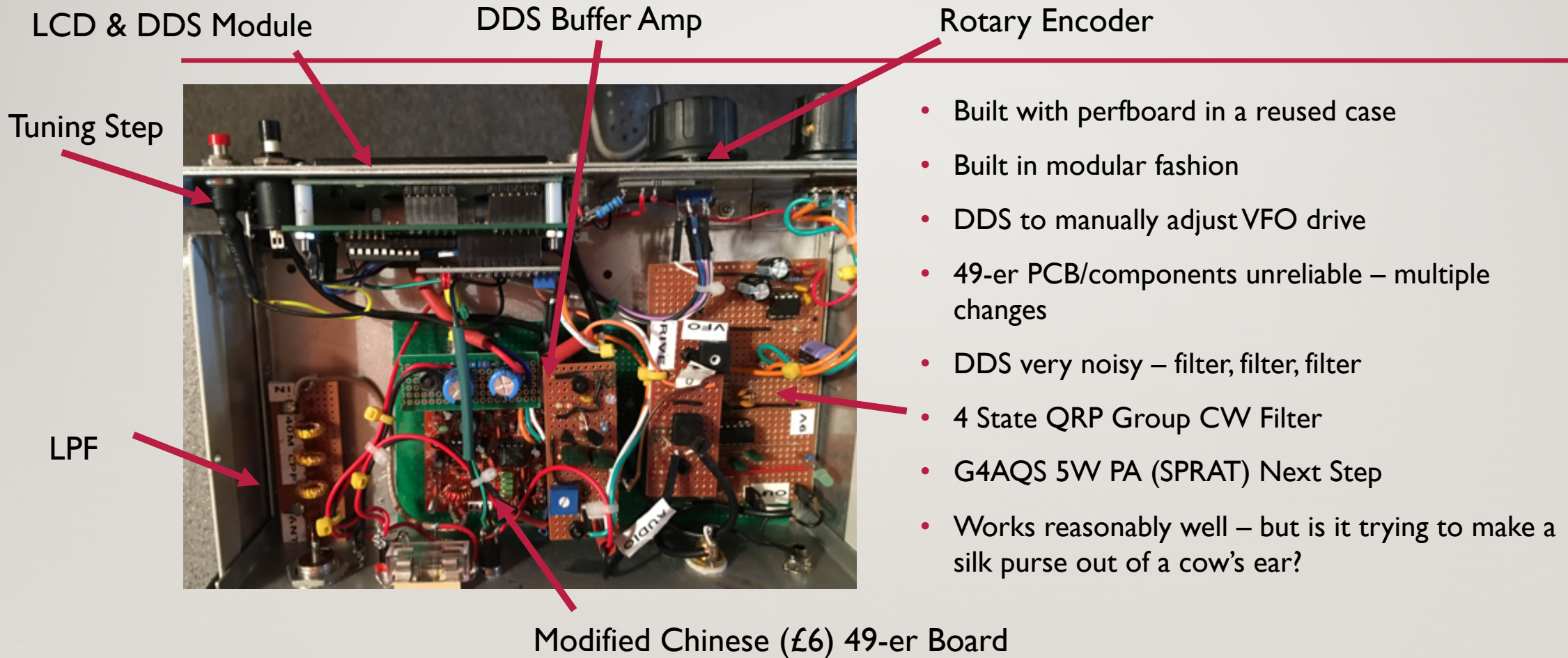
DDS BUFFER AMPLIFIER

PA IMPROVEMENTS

- Original design working at limits.

- Driver transistor Q6 is really audio device : change to 2N3904

- Output transistor (Q5) is the same – replace with 2SC1971 power transistor; add heatsink. Consider BD139.

- Build Mosfet PA : IRF150?
  - SPRAT 164 : G4AQS Design
  - Uses inexpensive IRF510 Mosfet (15p)
  - Built on PCB with screen
  - Readily available torroids

A REVISED PA : G4AQS DESIGN (SPRAT)
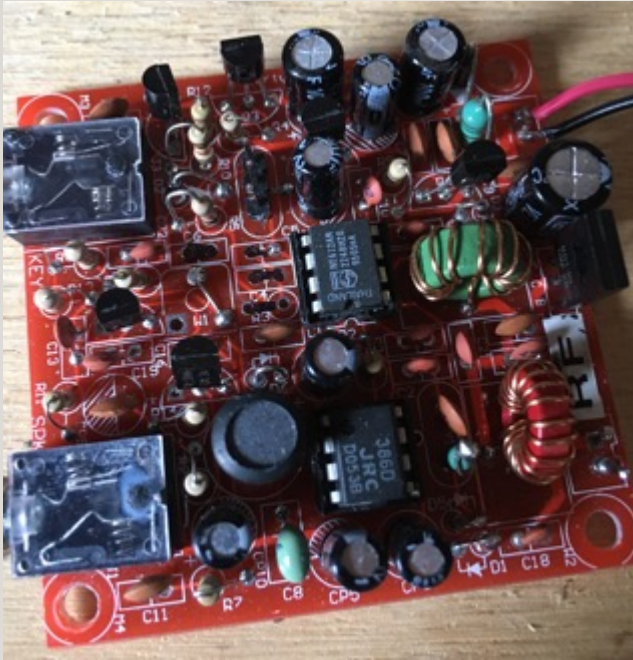# AN EASY 5W OUT USING '510 MOSFET

THE PROTOTYPE : READY FOR MARK II

LCD & DDS Module

DDS Buffer Amp

Rotary Encoder

Tuning Step

LPF

- Built with perfboard in a reused case
- Built in modular fashion
- DDS to manually adjust VFO drive
- 49-er PCB/components unreliable – multiple changes
- DDS very noisy – filter, filter, filter
- 4 State QRP Group CW Filter
- G4AQS 5W PA (SPRAT) Next Step
- Works reasonably well – but is it trying to make a silk purse out of a cow's ear?
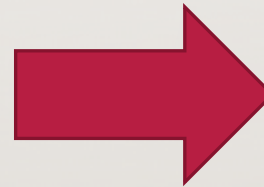
Modified Chinese (£6) 49-er Board

49-ER BOARD : SORTING THE PCB PROBLEM : NEW SOURCE (HK)

China
£2.30 to £6

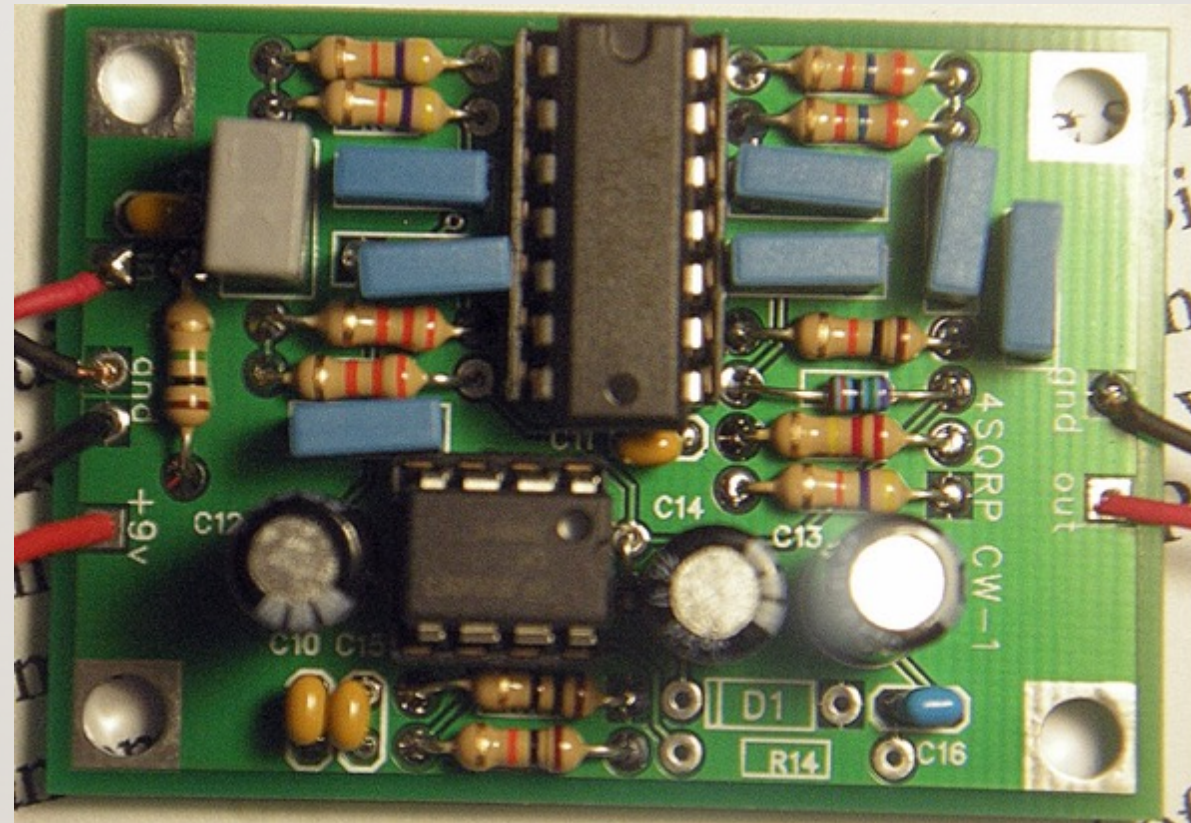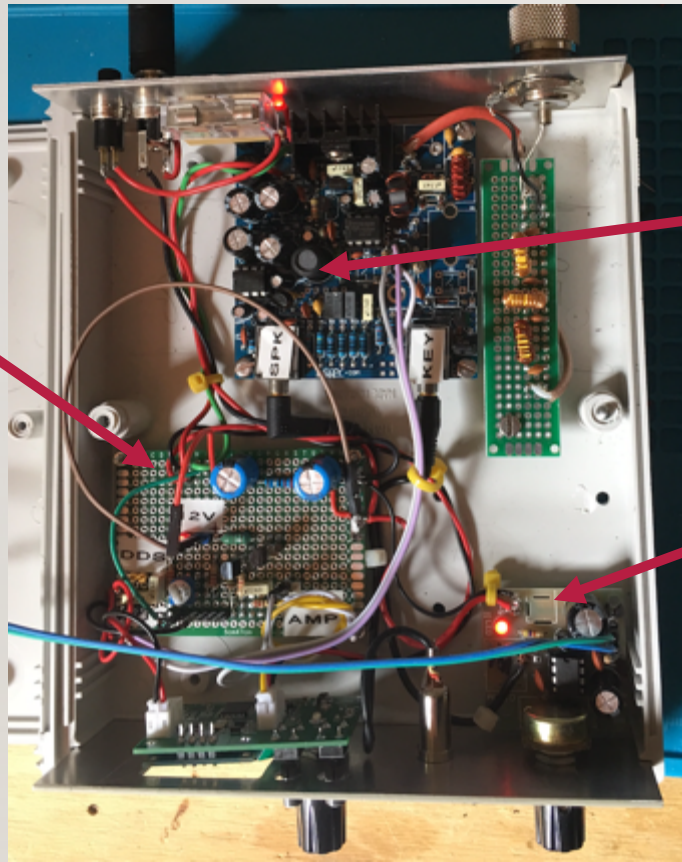Hong Kong
£8

MOVING AUDIO BAND PASS FILTER TO PCB
HYPERMITE CW FILTER
(BOARD FROM 4 SQUARE GROUP USA)

THE CURRENT BUILD : MK II

New 49-er Board

VFO Buffer
Circuit & Filter
Board

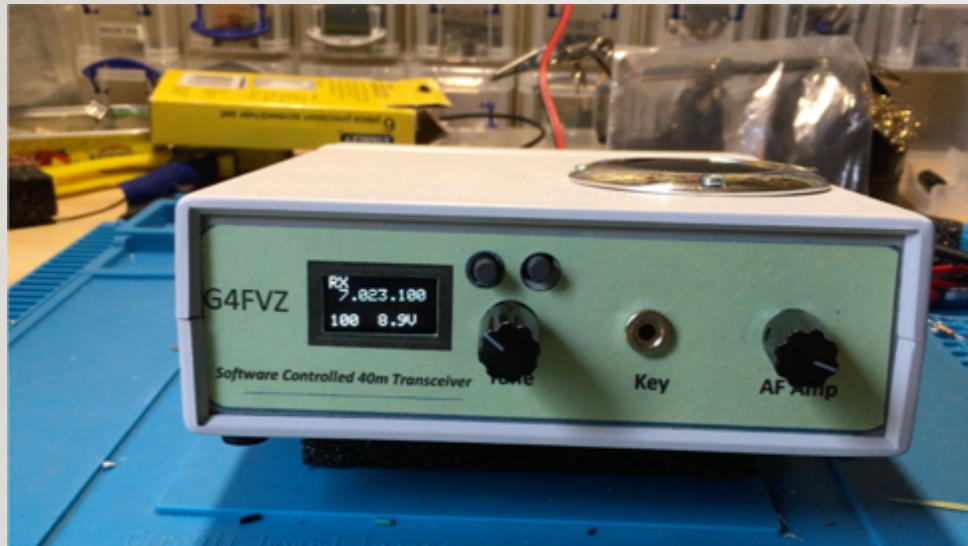Audio Board

OLED DDS

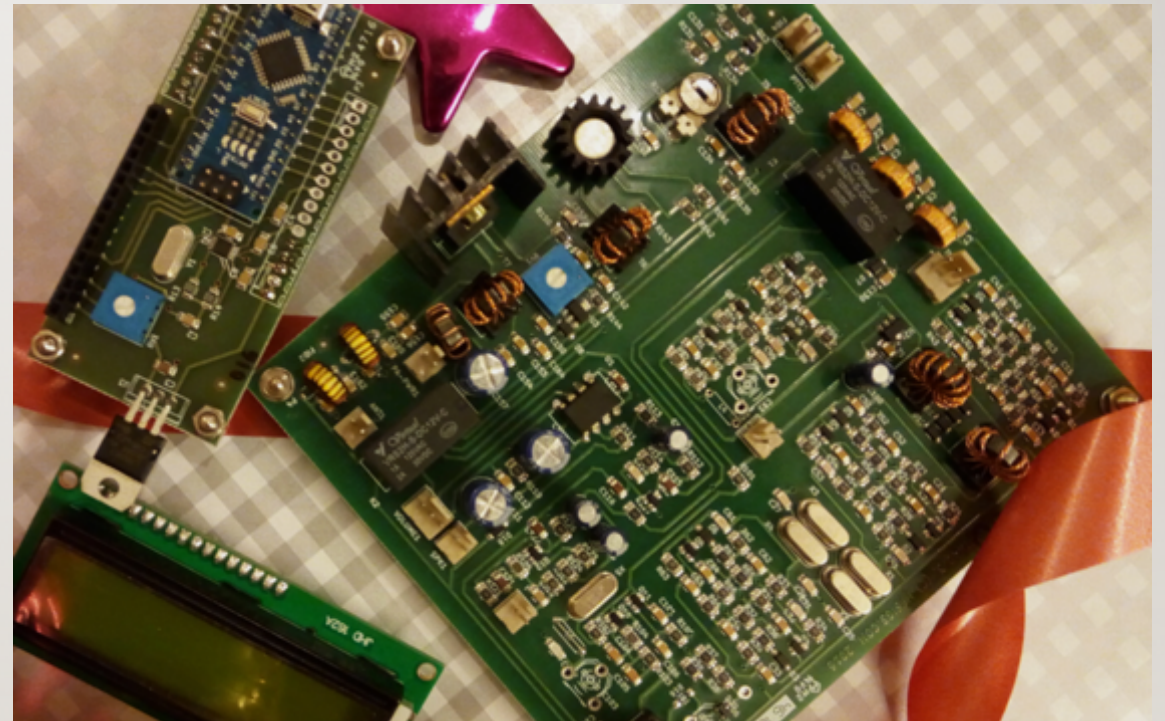# ALMOST THERE ON MKII

AND FINALLY IT'S FINISHED

CW RTX

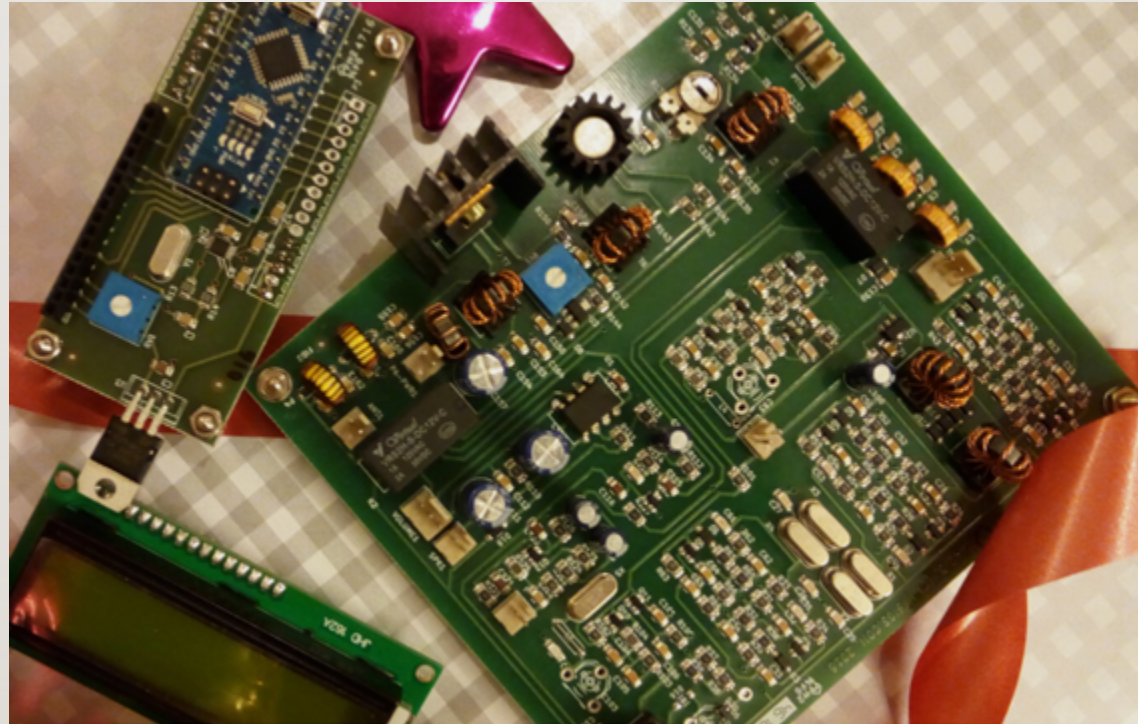AND OK ON SSB

2017 : EVERYTHING IS GATHERING PACE……….
(SSB TRANSCEIVER)

- Open Source Hardware

- Open Source Software

- Far East Supply

- Indian sub continent

- Phone/SSB transceiver

(dabbled with DSB)
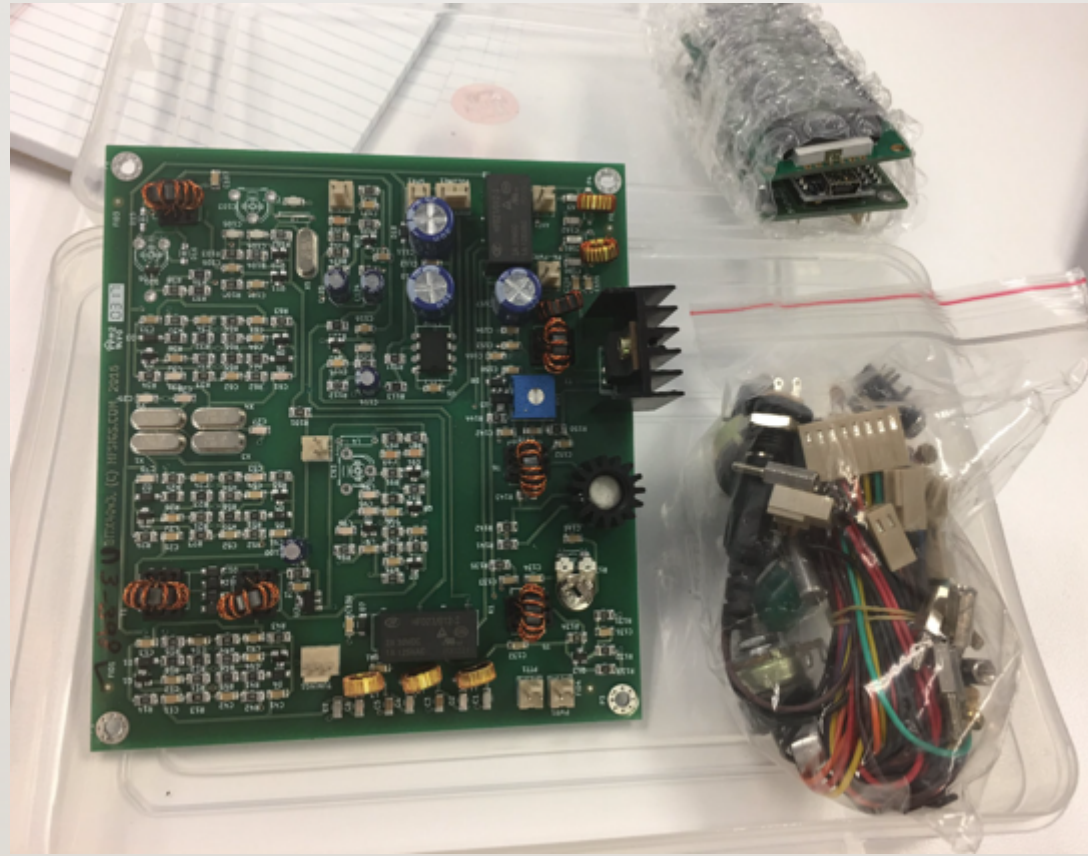
THE BITX $59 PHENOMENON :£45
BITX 40 7W SSB TRANSCEIVER BOARD

BITX 40 : DELIVERED IN A PLASTIC LUNCH BOX (AND ALL THE 'BITS')

BITX : 40M
THE G4FVZ BUILD – MK1

SMD Board

Randuino DDS

THE MK 1 FINISHED UNIT
(ABOUT 8 HRS WORK)

BITX40 MODS

- Metal Punched project case – available from www.amateurradiokits.in

- Change mic audio profile for 'punch' – VK3PYE

- AGC unit -2n7000 design – VU2ESE

- Microphone gain amplifier and mic profile (G3ZPS)

- CW Filter (Hypermite – QRP guys)

- LPF mod; 80m **-** switch

- Data interface – needs USB – with interface

THE MK II VERSION BITX 40 : RED VERSION (SSB)

- Dual Band

- AGC & better control of RF gain

- VOX and compression/AF tailoring

- 10 Turn pot/encoder

- Version 1.17 software (Manual control)
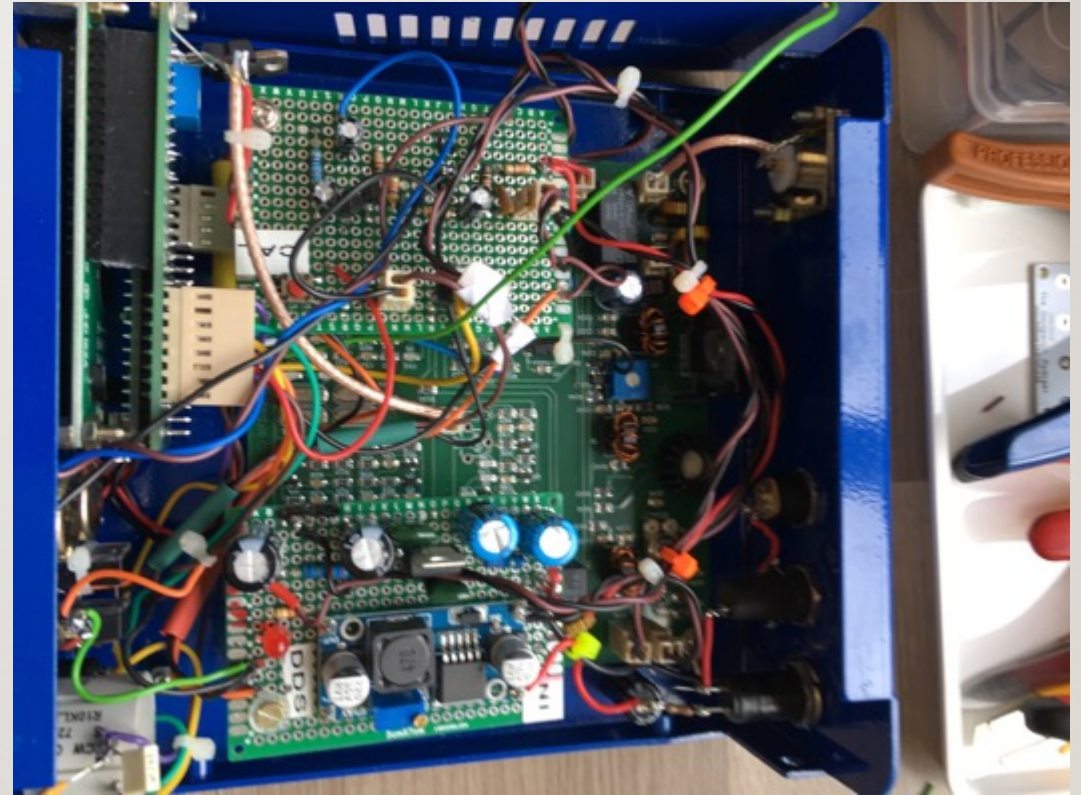 - LSB & USB, RIT etc
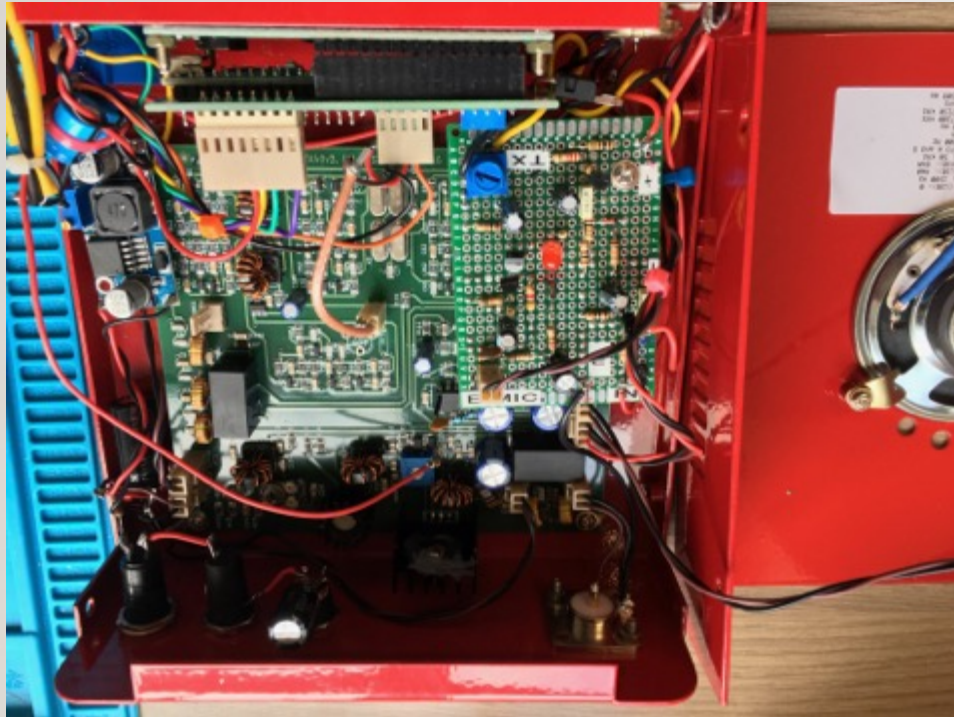
- 10W PA (18V to finals)

THE MK III BITX40M : BLUE VERSION (SSM/CW/DATA)

- Push button tuning jumps
- Dual Band
- CW
- AGC & better control of RF gain
- VOX and compression/AF tailoring
- 10 Turn pot/encoder
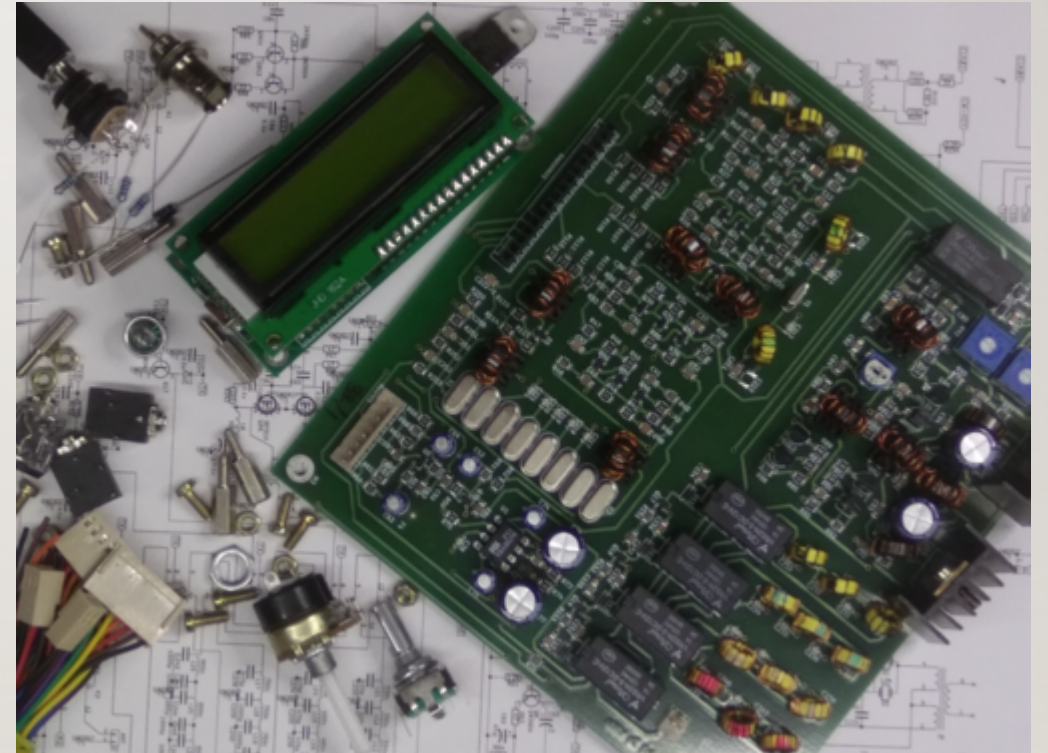- Version 1.19 software (Manual control)
- 16W PA

WHAT'S IN SIDE THE BOX? ....

2018 : INTRODUCTION OF UBITX

- All band Transceiver

- £80 Entry Point : India ; 4 week lead time

- Comes as single board plus all components

- Smooth encoder – little digital noise

- More sophisticated DDS – USB, LSB, CW, RIT etc

- CW sensing

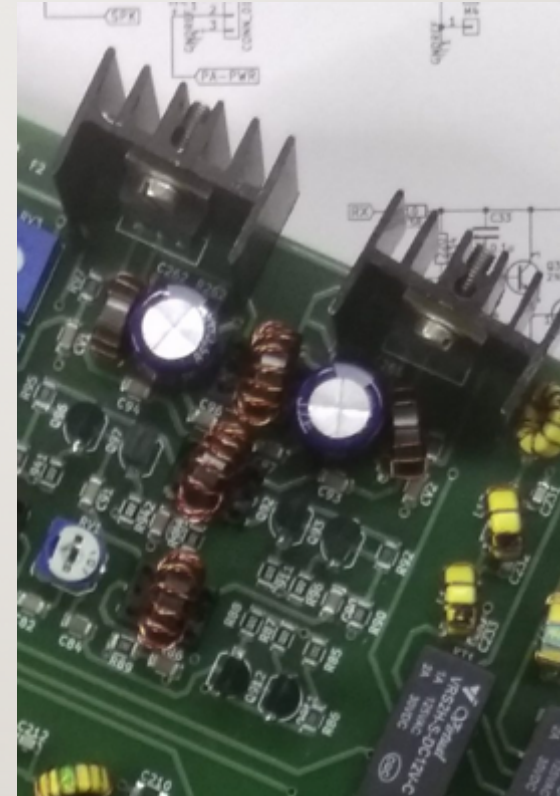- Huge support/hack/mods ecosystem

UBITX FIRST PROTOTYPE

TO CONTINUE BUILD OF PROTOTYPE

- AGC Board and S meter – G3ZPS

- Mic gain board - Adafruit

- Fan for PA

- Switchable CW 500Hz filter

- Tune button

- PA, Power Management board

Circuit differences push pull PA

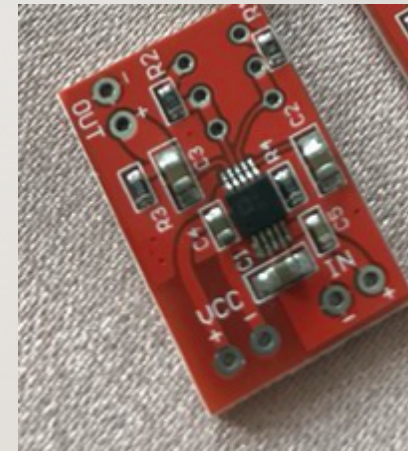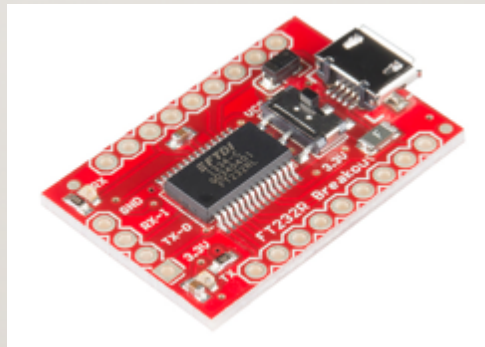Power good at 80,40m, OK on 20m – not great on 10 and 15m

A WORD ON THE MIC BOARD AND DATA MODE UNIT

BITX Digital Modes

Sparkfun USB to Serial Break Out Board

Sound digital interface card for computer

Signal inverter

Adafruit Mic Gain/AGC Board

SOME OF THE GROUP SELF BUILD UBITX SITES

Keep an eye on VU3SUA ; www.amateurradiokits.in

http://www.phonestack.com/farhan/bitx.html The original BITX
http://www.hfsignals.com/index.php/bitx40/ BITX40 by HFSignals
http://www.hfsignals.com/index.php/ubitx/ uBITX by HFSignals
https://amateurradiokits.in/store/ BITX Store by Sunil
http://ubitx.net/ BITX Web Site of Mike ZL1AXG
https://groups.io/g/BITX20/wiki/home Wiki

NEW OPPORTUNITIES…………
A PARADIGM SHIFT IN HOMEBREW CAPABILITY

- Test equipment is relatively inexpensive

- 3D Printing of instrument cases and project parts

- A4 Flat bed router for PCD design/board etching/drilling

- More and more powerful processors/controllers for more sophisticated projects

  - The magic will be in the software

- Linkages to the mushrooming technology 'maker' movement

  - Component supply, technology innovation,

FINAL THOUGHTS

- Home brewing fun and can really be done on a budget – BITX is phenomenal value

- Support network is huge once you get into it

- Component/module supply

- Kits a good way to go to get into it

- Doesn't have to be QRP – 25/100W BITX

- Help available at our club

- Get ready for the new wave of home/club capability

- MKARS Competition !

CONSTRUCTION COMPETITION

- September 2018

- Two Categories
  - Introductory – newly licensed amateurs (2 years)
  - Senior Category

- Prizes

- Can be homebrew, modules, kits and software – no antennas