# G6LBQ - HF BANDPASS FILTER

## 18th March 2011

### Introduction

The G6LBQ HF Bandpass Filter is a reproducible module based on the 3rd Order Butterworth design using tunable pre wound inductors and covering all 9 of the current HF amateur radio bands.

The individual filters have a flat response in the passband and a steep roll off out of the designed pass bandwidth. As I am not lucky enough to own a spectrum analyser I can not provide plots of the actual filters performance but for those interested in the technicalities I have detailed my calculations used to produce each of the filters.

In the UK where I reside pre-wound tunable inductors have not been so easy to obtain in recent years especially with the demise of component suppliers like Cirkit Distribution who once stocked a whole range of the Toko coils which found there way into most home-brew radio projects. Whilst Toko are still a thriving company producing inductors, filters and transformers they ceased manufacturing the once popular Toko 10mm coil ranges some time ago.

In my quest to source tunable inductors within the UK I was delighted to discover that a UK company Spectrum Communications had arranged the re-manufacture of the most popular 10mm coils commonly used in home-brew radio and magazine projects. The Spectrum Communications 10mm range are identical to the original Toko coils and on the Spectrum web site there is a detailed table outlining all the specifications for the coils.

http://www.spectrumcomms.co.uk/Components.htm

The range of Toko style 10mm coils available from Spectrum Communications is also stocked by the GQRP club.

**TIP:** You can often purchase quantities of surplus 10mm Toko coils on Ebay very cheap. Though the coils may not be the ones you actually require with a little patience and using the chart on Spectrum Communications web site these can be stripped down and rewound to produce the coils needed.

With suitable coils available I set about doing some calculations to see how the Spectrum coils would adapt to the project and the next few pages show the calculations and subsequent node and coupling capacitors required to make the coils resonant and form the wanted filter bandwidths.

If you are not interested in the calculations skip forward to page 11 to see a list of coils and other components required to build the filter module.

**Spectrum TOKO Coils For 3rd Order Butterworth**

- **Spectrum Coils unloaded Q (Qu) = between 70 to 85 for chosen models**
- **3rd Order Butterworth Q = 1.0**
- **3rd Order Butterworth K = 0.7071**

# 160 Mtr Band

160Mtr Band with centre frequency of 1.9 Mhz

BW = 0.35 Mhz (This gives 247 Khz @ -1db bandwidth)

Coil Choice Spectrum 9uh (28 Turns) Qu 70 & AL = 11 (AL value as close as is possible to calc)

Inductive Reactance of the coil at 1.9 Mhz = 107 Ohms
2 x PI x 1.9 x 9 = 107

Node capacitor that will resonate the 9uh coil at 1.9 Mhz = 779.634 Pf
Coupling capacitors between resonant circuits = 101.551 Pf (so use 100 Pf)
Node capacitor therefore 779.634 – 101.551 = 678.038 (so use 680 Pf)

Filter end section Qe = 5.884
(1 x 1.9 x 70) / (0.35 x 70) - (1 x 1.9)
133 24.5 - 1.9
133 divided by 22.6 = 5.884

The optimum I/O resistance with a filter end Q value of 5.884 = 632 ohms
2 x PI x 1.9 x 9 x 5.884 = RP of 632

The IO coupling turns ratio at 632 ohms = 3.55
Square root of (632 / 50) = 3.55

Number of turns for I/O coupling = 7.88
28 (Primary turns) / 3.55

The Link coil for the 9uh therefore needs to be 8 turns (to nearest turn). NOTE the spectrum 9u0h coil has only 5 turns on secondary!

- **Spectrum Coils unloaded Q (Qu) = between 70 to 85 for chosen models**
- **3rd Order Butterworth Q = 1.0**
- **3rd Order Butterworth K = 0.7071**

# 80 Mtr Band

80Mtr Band with centre frequency of 3.650 Mhz

BW = 0.45 Mhz (This gives 318 Khz @ -1db bandwidth)

Coil Choice Spectrum 5u3 (20 Turns) Qu 85 & AL = 11 (AL value as close as is possible to calc)

Inductive Reactance of the coil at 3.650 Mhz = 121 Ohms
2 x PI x 3.650 x 5.3 = 121

Node capacitor that will resonate the 5u3 coil at 3.650 Mhz = 358.739 Pf
Coupling capacitors between resonant circuits = 31.274 Pf (so use 33 Pf)
Node capacitor therefore 358.739 – 31.274 = 327.465 (so use 330 Pf)

Filter end section Qe = 8.959
(1 x 3.65 x 85) / (0.45 x 85) - (1 x 3.65)
310 38.25 - 3.65
310 divided by 34.6 = 8.959

The optimum I/O resistance with a filter end Q value of 8.959 = 1088 ohms
2 x PI x 3.65 x 5.3 x 8.959 = RP of 1088

The IO coupling turns ratio at 1088 ohms = 4.664
Square root of (1088 / 50) = 4.664

Number of turns for I/O coupling = 4.28
20 (Primary turns) / 4.664

The Link coil for the 5u3 therefore needs to be 4 turns (to nearest turn). NOTE the spectrum 5u3H coil has 4 turns so coil is good.

- **Spectrum Coils unloaded Q (Qu) = between 70 to 85 for chosen models**
- **3rd Order Butterworth Q = 1.0**
- **3rd Order Butterworth K = 0.7071**

# 40 Mtr Band

40Mtr Band with centre frequency of 7.100 Mhz

BW = 0.35 Mhz (This gives 247 Khz @ -1db bandwidth)

Coil Choice Spectrum 2u6 (14 Turns) Qu 80 & AL = 11 (AL value as close as is possible to calc)

Inductive Reactance of the coil at 7.1 Mhz = 115 Ohms
2 x PI x 7.1 x 2.6 = 115

Node capacitor that will resonate the 2u6 coil at 7.1 Mhz = 193.264 Pf
Coupling capacitors between resonant circuits = 6.727 Pf (so use 6.8 Pf)
Node capacitor therefore 193.264 – 6.8 = 186.464 (so use 180pf)

Filter end section Qe = 27.177
(1 x 7.1 x 80) / (0.35 x 80) - (1 x 7.1)
568 28 - 7.1
568 divided by 20.9 = 27.177

The optimum I/O resistance with a filter end Q value of 27.177 = 3152 ohms
2 x PI x 7.1 x 2.6 x 27.177 = RP of 3152

The IO coupling turns ratio at 3152 ohms = 7.939
Square root of (3152 / 50) = 7.939

Number of turns for I/O coupling = 1.76
14 (Primary turns) / 7.939

The Link coil for the 2u6 therefore needs to be 2 turns (to nearest turn). NOTE the spectrum 2u6FC coil has 2 turns secondary so coil is good.

- **Spectrum Coils unloaded Q (Qu) = between 70 to 85 for chosen models**
- **3rd Order Butterworth Q = 1.0**
- **3rd Order Butterworth K = 0.7071**

# 30 Mtr Band

30Mtr Band with centre frequency of 10.125 Mhz

BW = 0.3 Mhz (This gives 212 Khz @ -1db bandwidth)

Coil Choice Spectrum 2u6 (14 Turns) Qu 85

Inductive Reactance of the coil at 10.125 Mhz = 165 Ohms
2 x PI x 10.125 x 2.6 = 165

Node capacitor that will resonate the 2u6 coil at 10.125 Mhz = 95.034 Pf
Coupling capacitors between resonant circuits = 1.524 Pf (so use 1.5 Pf)
Node capacitor therefore 95.034 – 1.5 = 93.53 (so use 100 Pf)

Filter end section Qe = 55.934
(1 x 10.125 x 85) / (0.3 x 85) - (1 x 10.125)
860 25.5 - 10.125
860 divided by 15.375 = 55.934

The optimum I/O resistance with a filter end Q value of 55.934 = 9251 ohms
2 x PI x 10.125 x 2.6 x 55.934 =RP of 9251

The IO coupling turns ratio at 9251 ohms = 13.60
Square root of (9251 / 50) = 13.60

Number of turns for I/O coupling = 1.029
14 (Primary turns) / 13.90

The Link coil for the 2u6 therefore needs to be 1 turns (to nearest turn). NOTE the spectrum 2u6LC coil has 1 turns secondary so is good.

- **Spectrum Coils unloaded Q (Qu) = between 70 to 85 for chosen models**
- **3rd Order Butterworth Q = 1.0**
- **3rd Order Butterworth K = 0.7071**

# 20 Mtr Band

20Mtr Band with centre frequency of 14.150 Mhz

BW = 0.9 Mhz (This gives 636 Khz @ -1db bandwidth)

Coil Choice Spectrum 1u2 (8 Turns) Qu 85 & AL = 15 (AL value as close as is possible to calc)

Inductive Reactance of the coil at 14.150 Mhz = 106 Ohms
2 x PI x 14.125 x 1.2 = 106

Node capacitor that will resonate the 1u2 coil at 14.150 Mhz = 105.426 Pf
Coupling capacitors between resonant circuits = 4.741 Pf (so use 4.7 Pf)
Node capacitor therefore 105.426 – 4.7 = 100.726 (so use 100pf)

Filter end section Qe = 19.246
(1 x 14.150 x 85) / (0.9 x 85) - (1 x 14.150)
1202 76.5 - 14.150
1202 divided by 62.35 = 19.278

The optimum I/O resistance with a filter end Q value of 19.278 = 2056.7 ohms
2 x PI x 14.150 x 1.2 x 19.278 = RP of 2056.7

The IO coupling turns ratio at 2056.7 ohms = 6.41
Square root of (2056.7 / 50) = 6.41

Number of turns for I/O coupling = 2.18
14 (Primary turns) / 6.41

The Link coil for the 1u2 therefore needs to be 2 turns (to nearest turn). NOTE the spectrum 1u2H coil has 2 turns secondary so coil is good.

- **Spectrum Coils unloaded Q (Qu) = between 70 to 85 for chosen models**
- **3rd Order Butterworth Q = 1.0**
- **3rd Order Butterworth K = 0.7071**

# 17 Mtr Band

17Mtr Band with centre frequency of 18.084 Mhz

BW = 0.7 Mhz (This gives 495 Khz @ -1db bandwidth)

Coil Choice Spectrum 1u2 (8 Turns) Qu 85 & AL = 15 (AL value as close as is possible to calc)

Inductive Reactance of the coil at 17.084 Mhz = 128 Ohms
2 x PI x 17.084 x 1.2 = 128

Node capacitor that will resonate the 1u2 coil at 18.084 Mhz = 64.546 Pf
Coupling capacitors between resonant circuits = 1.767 Pf (so use 1.8Pf)
Node capacitor therefore 64.546 – 2.2 = 62.346 (so use 68pf)

Filter end section Qe = 19.246
(1 x 18.084 x 85) / (0.7 x 85) - (1 x 18.084)
1537 59.5 - 18.084
1537 divided by 41.41 = 37.116

The optimum I/O resistance with a filter end Q value of 37.116 = 4410 ohms
2 x PI x 18.084 x 1.2 x 37.116 = RP of 5060

The IO coupling turns ratio at 5060 ohms = 10.06
Square root of (5060 / 50) = 10.06

Number of turns for I/O coupling = 0.79
8 (Primary turns) / 10.06

The Link coil for the 1u2 therefore needs to be 1 turn (to nearest turn). NOTE the spectrum 1u2H coil has 2 turns secondary so not ideal but there is only one 1.2uh coil available.

- **Spectrum Coils unloaded Q (Qu) = between 70 to 85 for chosen models**
- **3rd Order Butterworth Q = 1.0**
- **3rd Order Butterworth K = 0.7071**

# 15 Mtr Band

15Mtr Band with centre frequency of 21.225 Mhz

BW = 1.0 Mhz (This gives 707 Khz @ -1db bandwidth)

Coil Choice Spectrum 1u2 (8 Turns) Qu 85 & AL = 15 (AL value as close as is possible to calc)

Inductive Reactance of the coil at 21.225 Mhz = 160 Ohms
2 x PI x 21.225 x 1.2 = 160

Node capacitor that will resonate the 1u2 coil at 21.225 Mhz = 46.856 Pf
Coupling capacitors between resonant circuits = 1.561 Pf (so use 1.5 Pf)
Node capacitor therefore 46.856 – 2.2 = 44.656 (so use 47pf)

Filter end section Qe = 19.246
(1 x 21.225 x 85) / (1.0 x 85) - (1 x 21.225)
1804 85 - 21.225
1804 divided by 63.775 = 28.228

The optimum I/O resistance with a filter end Q value of 28.286 = 4517 ohms
2 x PI x 21.225 x 1.2 x 28.228 = RP of 4517

The IO coupling turns ratio at 4517 ohms = 9.504
Square root of (4517 / 50) = 9.504

Number of turns for I/O coupling = 0.84
8 (Primary turns) / 9.504

The Link coil for the 1u2 therefore needs to be 1 turns (to nearest turn). NOTE the spectrum 1u2H coil has 2 turns secondary so not ideal but there is only one 1.2uh coil available.

- **Spectrum Coils unloaded Q (Qu) = between 70 to 85 for chosen models**
- **3rd Order Butterworth Q = 1.0**
- **3rd Order Butterworth K = 0.7071**

# 12 Mtr Band

12Mtr Band with centre frequency of 24.940 Mhz

BW = 1.0 Mhz (This gives 707 Khz @ -1db bandwidth)

Coil Choice Spectrum 1u2 (8 Turns) Qu 85 & AL = 15 (AL value as close as is possible to calc)

Inductive Reactance of the coil at 24.940 Mhz = 188 Ohms
2 x PI x 24.940 x 1.2 = 188

Node capacitor that will resonate the 1u2 coil at 24.940 Mhz = 33.936 Pf
Coupling capacitors between resonant circuits = 0.962 Pf (so use 1Pf)
Node capacitor therefore 33.936 – 1 = 32.936 (so use 33pf)

Filter end section Qe = 19.246
(1 x 24.940 x 85) / (1.0 x 85) - (1 x 24.940)
2119.9 85 - 24.940
2119.9 divided by 60.06 = 35.296

The optimum I/O resistance with a filter end Q value of 35.296 = 6247 ohms
2 x PI x 24.940 x 1.2 x 35.296 = RP of 6637

The IO coupling turns ratio at 6637 ohms = 11.177
Square root of (6637 / 50) = 11.521

Number of turns for I/O coupling = 0.69
8 (Primary turns) / 11.521

The Link coil for the 1u2 therefore needs to be 1 turns (to nearest turn). NOTE the spectrum 1u2H coil has 2 turns secondary so not ideal but there is only one 1.2uh coil available..

- **Spectrum Coils unloaded Q (Qu) = between 70 to 85 for chosen models**
- **3rd Order Butterworth Q = 1.0**
- **3rd Order Butterworth K = 0.7071**

# 10 Mtr Band

10Mtr Band with centre frequency of 28.850 Mhz

BW = 3.5 Mhz (This gives 2474 Khz @ -1db bandwidth)

Coil Choice Spectrum 1u2 (8 Turns) Qu 85 & AL = 15 (AL value as close as is possible to calc)

Inductive Reactance of the coil at 28.850 Mhz = 217 Ohms
2 x PI x 28.850 x 1.2 = 217

Node capacitor that will resonate the 1u2 coil at 28.850 Mhz = 25.361 Pf
Coupling capacitors between resonant circuits = 2.176 Pf (so use 2.2 Pf)
Node capacitor therefore 25.361 – 2.2 = 23.161 (so use 22pf)

Filter end section Qe = 19.246
(1 x 28.850 x 85) / (3.5 x 85) - (1 x 28.850)
2452 297.5 - 28.850
2452 divided by 268.65 = 9.132

The optimum I/O resistance with a filter end Q value of 9.132 = 1986 ohms
2 x PI x 28.850 x 1.2 x 9.132 = RP of 1986

The IO coupling turns ratio at 1986 ohms = 6.30
Square root of (1986 / 50) = 6.30

Number of turns for I/O coupling = 1.2
8 (Primary turns) / 6.30

The Link coil for the 1u2 therefore needs to be 2 turns (to nearest turn). NOTE the spectrum 1u2H coil has 2 turns secondary so is good.

| SPECTRUM COMMUNICATIONS/GQRP COIL LIST | | |
|---|---|---|
| COIL VALUE | QUANTITY | PART NUMBER |
| | | |
| 9 Microhenries | 3 | 9u0H |
| 5.3 Microhenries | 3 | 5u3H |
| 2.6 Microhenries | 3 | 2u6Lc |
| 2.6 Microhenries | 3 | 2u6Fc |
| 1.2 Microhenries | 15 | 1u2H |
| | | |

| CAPACITORS All 5mm Pitch (see note at end of component list) | | | |
|---|---|---|---|
| VALUE | QTY | FOR BAND(S) | DESCRIPTION |
| 100nf (0.1uf - 104) | 27 | N/A | Disc or Multi-Layer Ceramic |
| 10nf (0.01uf - 103) | 2 | N/A | Disc or Multi-Layer Ceramic |
| 680PF | 3 | 160 | NPO Ceramic |
| 100PF | 8 | 160, 40, 20 | NPO Ceramic |
| 330PF | 3 | 80 | NPO Ceramic |
| 33PF | 5 | 80, 12 | NPO Ceramic |
| 6.8PF (6P8) | 2 | 40 | NPO Ceramic |
| 10PF | 3 | 30 | NPO Ceramic |
| 1.5PF (1P5) | 4 | 30, 15 | NPO Ceramic |
| 4.7PF (4P7) | 2 | 20 | NPO Ceramic |
| 68PF | 3 | 17 | NPO Ceramic |
| 1.8PF (1P8) | 2 | 17 | NPO Ceramic |
| 47PF | 3 | 15 | NPO Ceramic |
| 1PF | 2 | 12 | NPO Ceramic |
| 22PF | 3 | 10 | NPO ceramic |
| 2.2PF | 2 | 10 | NPO ceramic |

Please note that the Spectrum/GQRP 10mm coils 2u6FC and 2u6LC (as used for 40 & 30Mtrs) are supplied with an internal 82PF capacitor fitted so the actual node capacitors we must add to these coils is the difference required to make up the total node value. Example: Say Node cap needs to be 92PF and coil already has 82PF internal we only need to fit 10PF to our PCB to make up total 92PF value.

| FIXED RF INDUCTORS | | | |
|---|---|---|---|
| COIL VALUE | QUANTITY | | PART NUMBER |
| 10uh or 47uh | 2 | | Small axial chokes |
| | | | |
| **RESISTORS (see note at end of component list)** | | | |
| VALUE | QTY | COLOUR CODE | DESCRIPTION |
| 390 OHMS ¼ Watt | 2 | Orange, White, Brown | Carbon 1/4W Resistor |
| ** 470 OHMS ¼ Watt | 18 | Yellow, Violet, Brown | Carbon 1/4W Resistor |
| ** Only Use 470 Ohms when using BA243 switching diodes | | | |
| * 100 OHMS ¼ Watt | 18 | Brown, Black, Brown | Carbon 1/4W Resistor |
| * Only Use 100 Ohms when using 1N4148 high speed GP diodes | | | |
| | | | |
| **DIODES (see note at end of component list)** | | | |
| VALUE | QTY | | DESCRIPTION |
| BA243 | 18 | | Band Switching Diodes |
| (Or use) 1N4148 | 18 | | GP switching Diode |
| | | | |
| **MISCELLANEOUS** | | | |
| VALUE | QTY | | DESCRIPTION |
| PCB | 1 | | Etch or buy from Sunil Lakhani |
| | | | |
| | | | |

The above component list shows 470 Ohms and 100 Ohm resistors, you do not need both values. These resistors are used to bios the diode switches and depending on your choice of diodes this will dictate which resistor value to use.

BA243 diodes require 470 Ohm's and provide a little over 10ma forward bios.

1N4148 diodes require 100 Ohm and provide a little over 20ma forward bios.

The filter can utilise general switching diodes like the 1N4148 but the BA243 is designed as an RF switching diode so will be more linear with less spurious products so therefore a better choice.

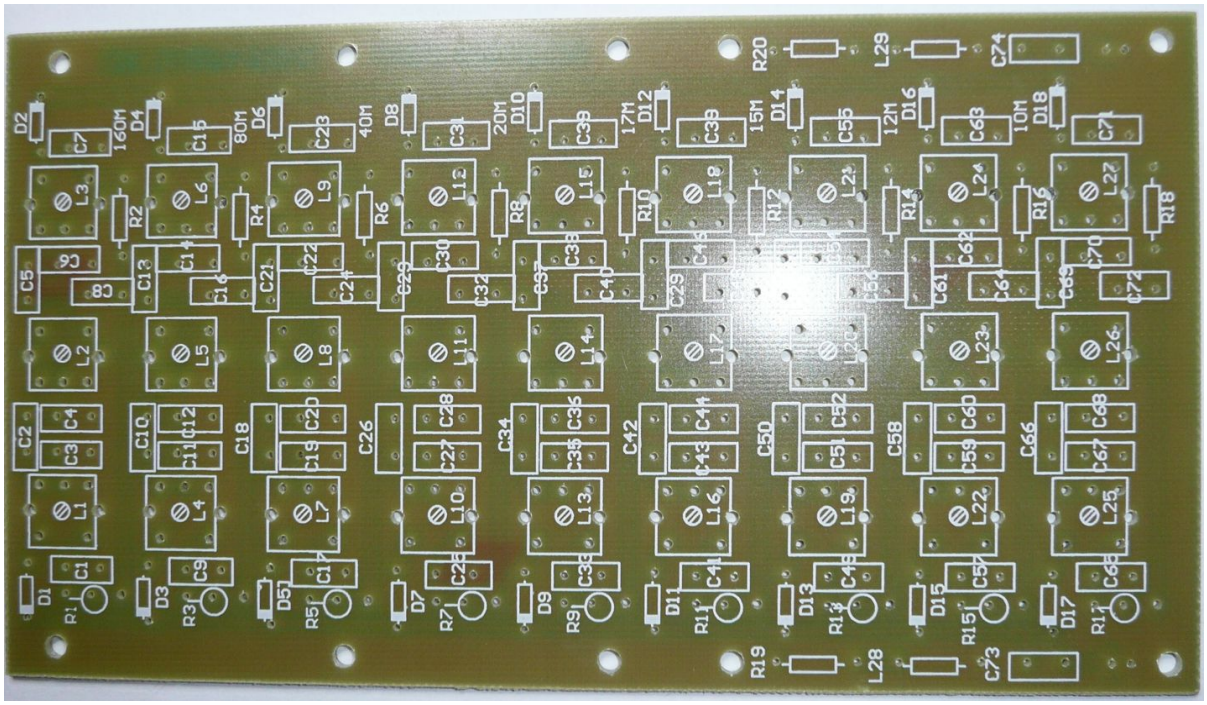
There is a ready etched, screen printed, drilled and tinned PCB available for the bandpass filter from Sunil Lakhani but artwork is provided for those wishing to produce there own PCB.

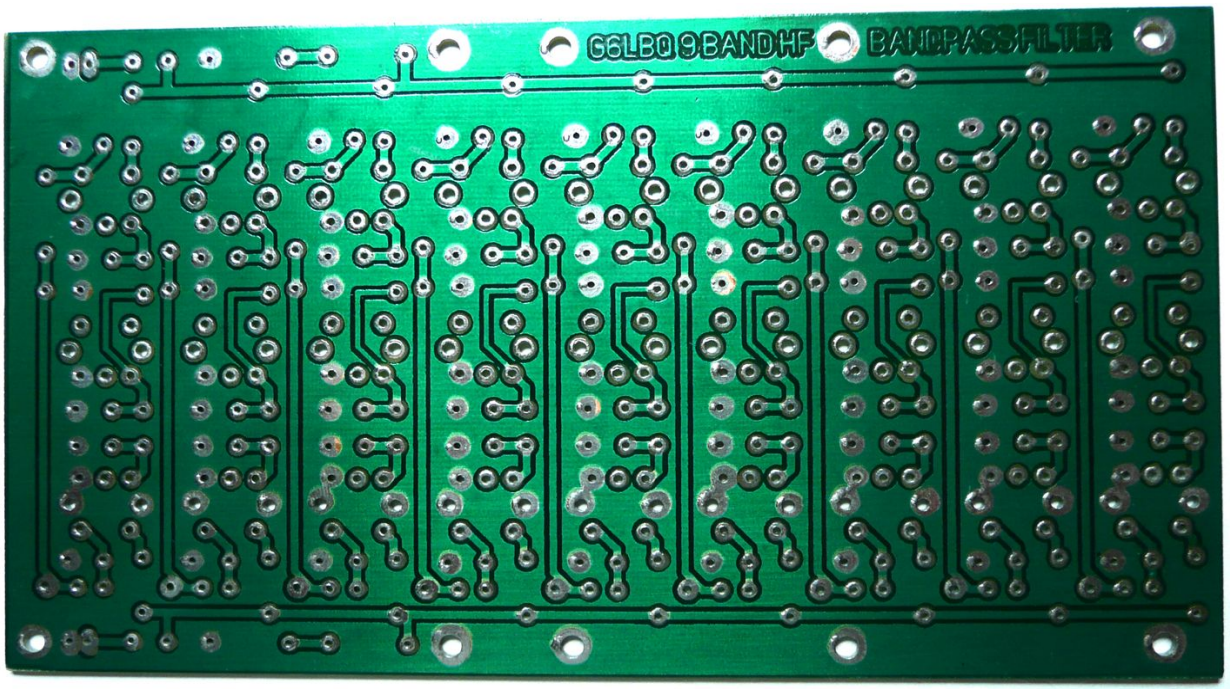
Sunil has a web site with useful radio kits located at http://amateurradiokits.in/ and can also be contacted via email at: vu3sua@gmail.com



Next the actual PCB

# PCB READY FOR CONSTRUCTION

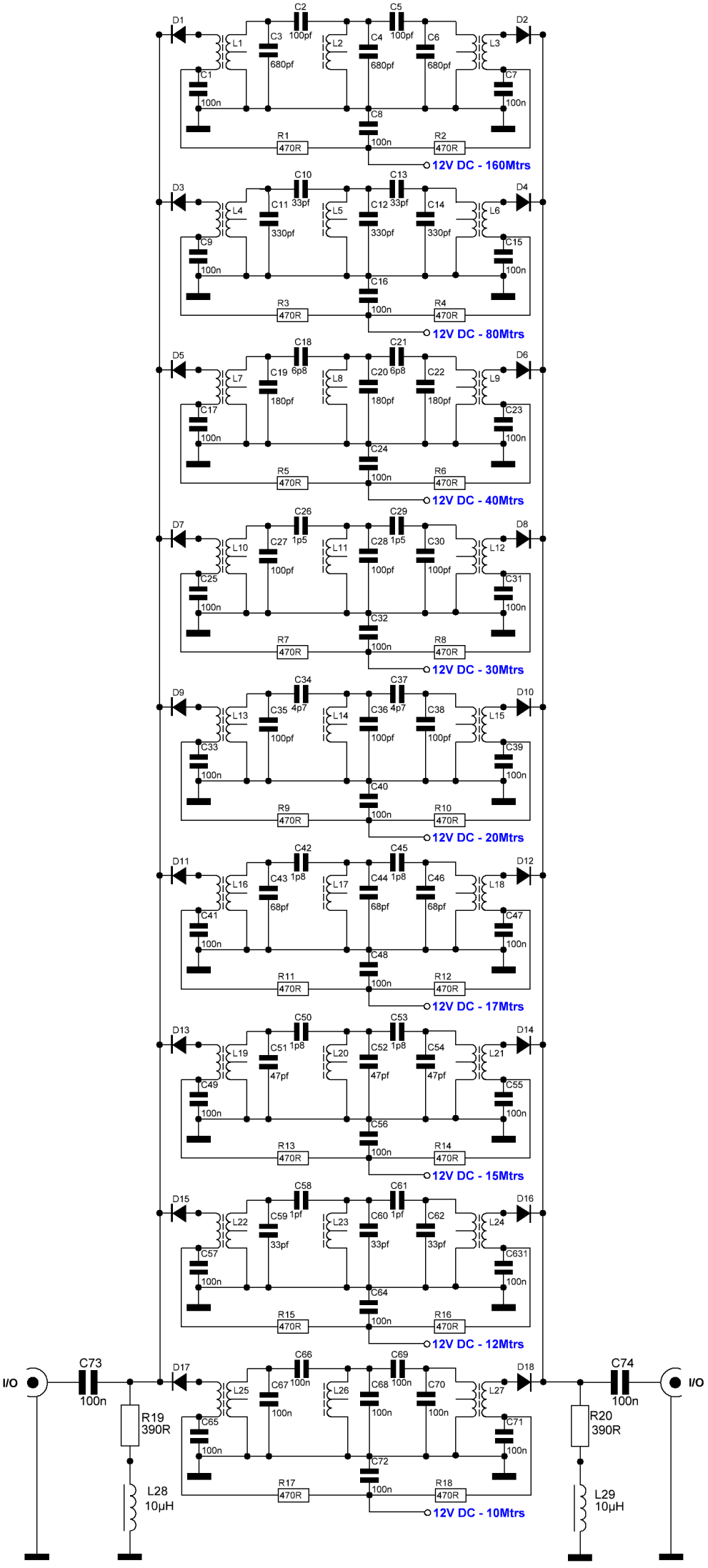




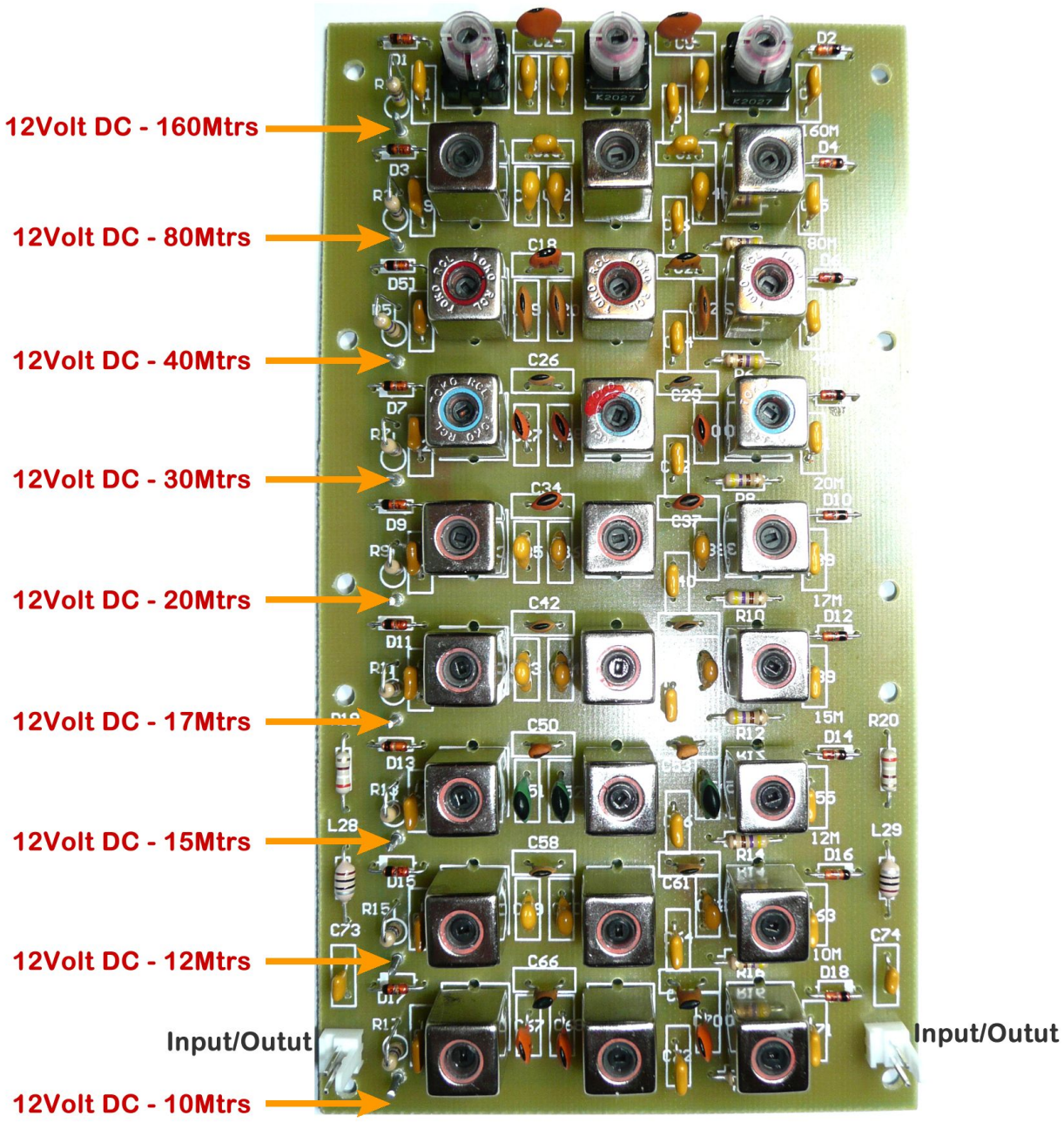

Whilst the PCB is designed to accommodate filters for all 9 HF bands it is not necessary to fit all the filter circuits, you could utilise the PCB to build any number of filters from just one band up to all nine. The PCB has various pre-drilled mounting holes so it is even possible to cut the PCB down in size if building a filter module for fewer bands.



Next the schematic


D1
C2
C5
D2
L1
C3 100pf
L2
C4 100pf
C6
L3
680pf
680pf
680pf
C1
C7
100n
100n
C8
100n
R1
470R
R2
470R
12V DC - 160Mtrs
D3
C10
C13
D4
L4
C11 33pf
L5
C12 33pf
C14
L6
330pf
330pf
330pf
C9
C15
100n
100n
C16
100n
R3
470R
R4
470R
12V DC - 80Mtrs
D5
C18
C21
D6
L7
C19 6p8
L8
C20 6p8
C22
L9
180pf
180pf
180pf
C17
C23
100n
100n
C24
100n
R5
470R
R6
470R
12V DC - 40Mtrs
D7
C26
C29
D8
L10
C27 1p5
L11
C28 1p5
C30
L12
100pf
100pf
100pf
C25
C31
100n
100n
C32
100n
R7
470R
R8
470R
12V DC - 30Mtrs
D9
C34
C37
D10
L13
C35 4p7
L14
C36 4p7
C38
L15
100pf
100pf
100pf
C33
C39
100n
100n
C40
100n
R9
470R
R10
470R
12V DC - 20Mtrs
D11
C42
C45
D12
L16
C43 1p8
L17
C44 1p8
C46
L18
68pf
68pf
68pf
C41
C47
100n
100n
C48
100n
R11
470R
R12
470R
12V DC - 17Mtrs
D13
C50
C53
D14
L19
C51 1p8
L20
C52 1p8
C54
L21
47pf
47pf
47pf
C49
C55
100n
100n
C56
100n
R13
470R
R14
470R
12V DC - 15Mtrs
D15
C58
C61
D16
L22
C59 1pf
L23
C60 1pf
C62
L24
33pf
33pf
33pf
C57
C631
100n
100n
C64
100n
R15
470R
R16
470R
12V DC - 12Mtrs
I/O
C73
100n
D17
C66 100n
C69 100n
D18
C74
100n
I/O
L25
C67 100n
L26
C68 100n
C70 100n
L27
R19
390R
C65
100n
C71
100n
R20
390R
C72
100n
L28
10µH
R17
470R
R18
470R
L29
10µH
12V DC - 10Mtrs

# A FULLY POPULATED PCB



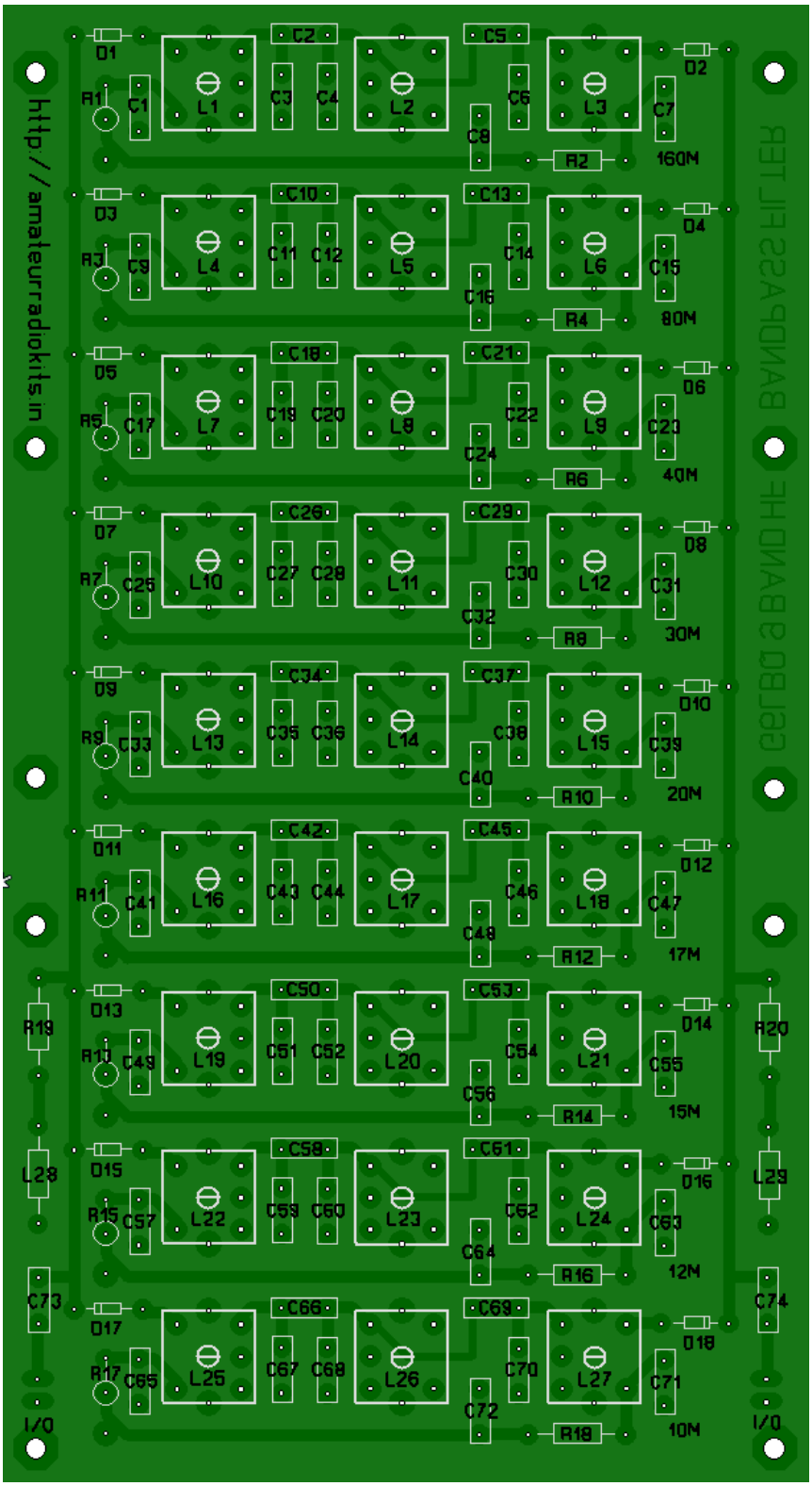

The finished PCB shows the various band switching points and input/output signal connections. Note that the filter is symmetrical so the input/output connections can be wired as either input or output. Whilst not shown on the illustration a separate connection should be made between the filter PCB and the common -ve/ground point of the main receiver/transceiver PCB.



Next the PCB component overlay

# PCB COMPONENT OVERLAY

Use the following PCB overlay to assist in component locations on the PCB.




 Next table of components for 160Mtr & 80Mtr filters with PCB/Schematic labels

| COMPONENT LIST FOR 160 METER BAND | | |
|---|---|---|
| VALUE | LABEL | DESCRIPTION |
| BA243 or 1N4148 | D1 | Signal switching diode (see notes on page 12) |
| BA243 or 1N4148 | D2 | Signal switching diode (see notes on page 12) |
| 470 Ohm or 100 Ohm | R1 | Carbon 1/4W Resistor (see notes on page 12) |
| 470 Ohm or 100 Ohm | R2 | Carbon 1/4W Resistor (see notes on page 12) |
| 100nf (0.1uf - 104) | C1 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 100nf (0.1uf - 104) | C7 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 100nf (0.1uf - 104) | C8 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 680PF | C3 | NPO Ceramic 5mm Pitch |
| 680PF | C4 | NPO Ceramic 5mm Pitch |
| 680PF | C6 | NPO Ceramic 5mm Pitch |
| 100PF | C2 | NPO Ceramic 5mm Pitch |
| 100PF | C5 | NPO Ceramic 5mm Pitch |
| 9u0h | L1 | 10mm Toko style coil |
| 9u0h | L2 | 10mm Toko style coil |
| 9u0h | L3 | 10mm Toko style coil |

| COMPONENT LIST FOR 80 METER BAND | | |
|---|---|---|
| VALUE | LABEL | DESCRIPTION |
| BA243 or 1N4148 | D3 | Signal switching diode (see notes on page 12) |
| BA243 or 1N4148 | D4 | Signal switching diode (see notes on page 12) |
| 470 Ohm or 100 Ohm | R3 | Carbon 1/4W Resistor (see notes on page 12) |
| 470 Ohm or 100 Ohm | R4 | Carbon 1/4W Resistor (see notes on page 12) |
| 100nf (0.1uf - 104) | C9 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 100nf (0.1uf - 104) | C15 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 100nf (0.1uf - 104) | C16 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 330PF | C11 | NPO Ceramic 5mm Pitch |
| 330PF | C12 | NPO Ceramic 5mm Pitch |
| 330PF | C14 | NPO Ceramic 5mm Pitch |
| 33PF | C10 | NPO Ceramic 5mm Pitch |
| 33PF | C13 | NPO Ceramic 5mm Pitch |
| 5u3h | L4 | 10mm Toko style coil |
| 5u3h | L5 | 10mm Toko style coil |
| 5u3h | L6 | 10mm Toko style coil |

 Next table of components for 40Mtr & 30Mtr filters with PCB/Schematic labels

| COMPONENT LIST FOR 40 METER BAND | | |
|---|---|---|
| VALUE | LABEL | DESCRIPTION |
| BA243 or 1N4148 | D5 | Signal switching diode (see notes on page 12) |
| BA243 or 1N4148 | D6 | Signal switching diode (see notes on page 12) |
| 470 Ohm or 100 Ohm | R5 | Carbon 1/4W Resistor (see notes on page 12) |
| 470 Ohm or 100 Ohm | R6 | Carbon 1/4W Resistor (see notes on page 12) |
| 100nf (0.1uf - 104) | C17 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 100nf (0.1uf - 104) | C23 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 100nf (0.1uf - 104) | C24 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 180PF | C19 | NPO Ceramic 5mm Pitch |
| 180PF | C20 | NPO Ceramic 5mm Pitch |
| 180PF | C22 | NPO Ceramic 5mm Pitch |
| 6.8PF (6P8) | C18 | NPO Ceramic 5mm Pitch |
| 6.8PF (6P8) | C21 | NPO Ceramic 5mm Pitch |
| 2u6FC | L7 | 10mm Toko style coil |
| 2u6FC | L8 | 10mm Toko style coil |
| 2u6FC | L9 | 10mm Toko style coil |

| COMPONENT LIST FOR 30 METER BAND | | |
|---|---|---|
| VALUE | LABEL | DESCRIPTION |
| BA243 or 1N4148 | D7 | Signal switching diode (see notes on page 12) |
| BA243 or 1N4148 | D8 | Signal switching diode (see notes on page 12) |
| 470 Ohm or 100 Ohm | R7 | Carbon 1/4W Resistor (see notes on page 12) |
| 470 Ohm or 100 Ohm | R8 | Carbon 1/4W Resistor (see notes on page 12) |
| 100nf (0.1uf - 104) | C25 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 100nf (0.1uf - 104) | C31 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 100nf (0.1uf - 104) | C32 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 100PF | C27 | NPO Ceramic 5mm Pitch |
| 100PF | C28 | NPO Ceramic 5mm Pitch |
| 100PF | C30 | NPO Ceramic 5mm Pitch |
| 1.5PF (1P5) | C26 | NPO Ceramic 5mm Pitch |
| 1.5PF (1P5) | C29 | NPO Ceramic 5mm Pitch |
| 2u6Lc | L10 | 10mm Toko style coil |
| 2u6Lc | L11 | 10mm Toko style coil |
| 2u6Lc | L12 | 10mm Toko style coil |

 Next table of components for 20Mtr & 17Mtr filters with PCB/Schematic labels

| COMPONENT LIST FOR 20 METER BAND | | |
|---|---|---|
| VALUE | LABEL | DESCRIPTION |
| BA243 or 1N4148 | D9 | Signal switching diode (see notes on page 12) |
| BA243 or 1N4148 | D10 | Signal switching diode (see notes on page 12) |
| 470 Ohm or 100 Ohm | R9 | Carbon 1/4W Resistor (see notes on page 12) |
| 470 Ohm or 100 Ohm | R10 | Carbon 1/4W Resistor (see notes on page 12) |
| 100nf (0.1uf - 104) | C33 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 100nf (0.1uf - 104) | C39 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 100nf (0.1uf - 104) | C40 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 100PF | C35 | NPO Ceramic 5mm Pitch |
| 100PF | C36 | NPO Ceramic 5mm Pitch |
| 100PF | C38 | NPO Ceramic 5mm Pitch |
| 4.7PF (4P7) | C34 | NPO Ceramic 5mm Pitch |
| 4.7PF (4P7) | C37 | NPO Ceramic 5mm Pitch |
| 1u2H | L13 | 10mm Toko style coil |
| 1u2H | L14 | 10mm Toko style coil |
| 1u2H | L15 | 10mm Toko style coil |

| COMPONENT LIST FOR 17 METER BAND | | |
|---|---|---|
| VALUE | LABEL | DESCRIPTION |
| BA243 or 1N4148 | D11 | Signal switching diode (see notes on page 12) |
| BA243 or 1N4148 | D12 | Signal switching diode (see notes on page 12) |
| 470 Ohm or 100 Ohm | R11 | Carbon 1/4W Resistor (see notes on page 12) |
| 470 Ohm or 100 Ohm | R12 | Carbon 1/4W Resistor (see notes on page 12) |
| 100nf (0.1uf - 104) | C41 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 100nf (0.1uf - 104) | C47 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 100nf (0.1uf - 104) | C48 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 68PF | C43 | NPO Ceramic 5mm Pitch |
| 68PF | C44 | NPO Ceramic 5mm Pitch |
| 68PF | C46 | NPO Ceramic 5mm Pitch |
| 1.8PF (1P8) | C42 | NPO Ceramic 5mm Pitch |
| 1.8PF (1P8) | C45 | NPO Ceramic 5mm Pitch |
| 1u2H | L16 | 10mm Toko style coil |
| 1u2H | L17 | 10mm Toko style coil |
| 1u2H | L18 | 10mm Toko style coil |

 Next table of components for 15Mtr & 12Mtr filters with PCB/Schematic labels

| COMPONENT LIST FOR 15 METER BAND | | |
|---|---|---|
| VALUE | LABEL | DESCRIPTION |
| BA243 or 1N4148 | D13 | Signal switching diode (see notes on page 12) |
| BA243 or 1N4148 | D14 | Signal switching diode (see notes on page 12) |
| 470 Ohm or 100 Ohm | R13 | Carbon 1/4W Resistor (see notes on page 12) |
| 470 Ohm or 100 Ohm | R14 | Carbon 1/4W Resistor (see notes on page 12) |
| 100nf (0.1uf - 104) | C49 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 100nf (0.1uf - 104) | C55 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 100nf (0.1uf - 104) | C56 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 47PF | C51 | NPO Ceramic 5mm Pitch |
| 47PF | C52 | NPO Ceramic 5mm Pitch |
| 47PF | C54 | NPO Ceramic 5mm Pitch |
| 1.5PF (1P5) | C50 | NPO Ceramic 5mm Pitch |
| 1.5PF (1P5) | C53 | NPO Ceramic 5mm Pitch |
| 1u2H | L19 | 10mm Toko style coil |
| 1u2H | L20 | 10mm Toko style coil |
| 1u2H | L21 | 10mm Toko style coil |

| COMPONENT LIST FOR 12 METER BAND | | |
|---|---|---|
| VALUE | LABEL | DESCRIPTION |
| BA243 or 1N4148 | D15 | Signal switching diode (see notes on page 12) |
| BA243 or 1N4148 | D16 | Signal switching diode (see notes on page 12) |
| 470 Ohm or 100 Ohm | R15 | Carbon 1/4W Resistor (see notes on page 12) |
| 470 Ohm or 100 Ohm | R16 | Carbon 1/4W Resistor (see notes on page 12) |
| 100nf (0.1uf - 104) | C57 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 100nf (0.1uf - 104) | C63 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 100nf (0.1uf - 104) | C64 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 33PF | C59 | NPO Ceramic 5mm Pitch |
| 33PF | C60 | NPO Ceramic 5mm Pitch |
| 33PF | C62 | NPO Ceramic 5mm Pitch |
| 1PF | C58 | NPO Ceramic 5mm Pitch |
| 1PF | C61 | NPO Ceramic 5mm Pitch |
| 1u2H | L22 | 10mm Toko style coil |
| 1u2H | L23 | 10mm Toko style coil |
| 1u2H | L24 | 10mm Toko style coil |



Next table of components for the10 Mtr filter with PCB/Schematic labels

| COMPONENT LIST FOR 10 METER BAND | | |
|---|---|---|
| VALUE | LABEL | DESCRIPTION |
| BA243 or 1N4148 | D17 | Signal switching diode (see notes on page 12) |
| BA243 or 1N4148 | D18 | Signal switching diode (see notes on page 12) |
| 470 Ohm or 100 Ohm | R17 | Carbon 1/4W Resistor (see notes on page 12) |
| 470 Ohm or 100 Ohm | R18 | Carbon 1/4W Resistor (see notes on page 12) |
| 100nf (0.1uf - 104) | C65 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 100nf (0.1uf - 104) | C71 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 100nf (0.1uf - 104) | C72 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 22PF | C67 | NPO Ceramic 5mm Pitch |
| 22PF | C68 | NPO Ceramic 5mm Pitch |
| 22PF | C70 | NPO Ceramic 5mm Pitch |
| 2.2PF (2P2) | C66 | NPO Ceramic 5mm Pitch |
| 2.2PF (2P2) | C69 | NPO Ceramic 5mm Pitch |
| 1u2H | L25 | 10mm Toko style coil |
| 1u2H | L26 | 10mm Toko style coil |
| 1u2H | L27 | 10mm Toko style coil |

| COMMON COMPONENTS USED FOR ALL BANDS | | |
|---|---|---|
| VALUE | LABEL | DESCRIPTION |
| 390 Ohm | R19 | Carbon 1/4W Resistor |
| 390 Ohm | R20 | Carbon 1/4W Resistor |
| 10nf (0.01uf - 103) | C73 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 10nf (0.01uf - 103) | C74 | Disc or Multi-Layer Ceramic 5mm Pitch |
| 10uh | L28 | Small axial chokes |
| 10uh | L29 | Small axial chokes |

## Conclusion

Using the documentation and illustrations provided construction should present no issues. The prototype worked as expected and all coils adjusted with nice peaks and all the tuning slugs sit nicely within there cores. It is worth mentioning that the ferrite slugs in the coils break easily if not adjusted with a suitable trimming tool!

The PCB artwork is available as a separate download in my Yahoo Group BitX folder.