Universal Frequency Display for QRP equipment

Frequency Counter based on PIC with minimal-hardware

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Letzte Aktualisierung: 2006-06-03.
The heart of the circuit is an 18 pin PIC 16F628 Microcontroller. With the software of Wolf we get an universal frequency counter.

* Frequenz range 1 Hz to 50 MHz (Most kits work up to 60 MHz which is pretty high above the specification of the Processor).
* Automatic range switch with different gate timimg
* pragrammable offset for superhet receivers (IF shift), either addition or subtraction possible
* Preprogrammed Offsets for common IF e.g. 3.999 MHz for "Miss Mosquita" Transceiver
* Opional power save mode: power of after 15 s with no variation of the frequency.

The actual firmware can be downloaded from Wolfs hompage. If you want to add something, you may use the assembler file which is also available there. The QRPproject kit contains a preprogrammed PIC

Description of the Function

After power on the counter shows "8.8.8.8.8." to test all segments of the Display for a short time.
In the next step the actual measured frequency will be shown.

* flashing decima point: = Display in kHz;
* steady decimal point = Display in MHz.

The range is automatically switched to give maximum resolution and minimum Gate time:

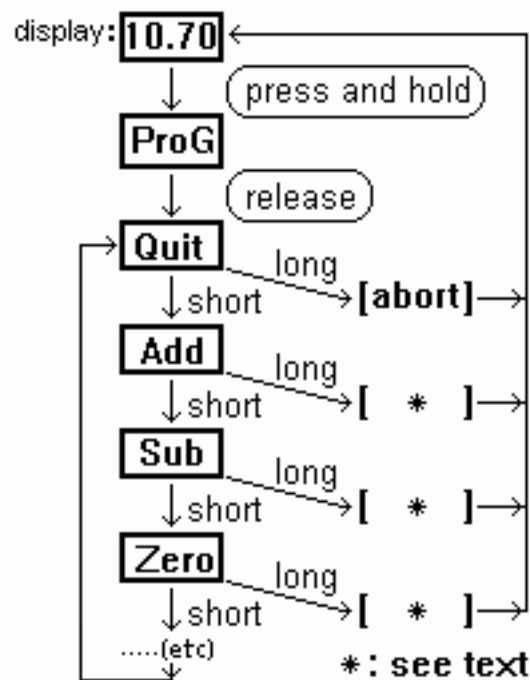| Range	Display	Gate	decimal point
0 … 9.999 kHz	X.XXX	1 second	flashing
10 … 99.99 kHz	XX.XX(X)	0.5 second	flashing
100 … 999.9 kHz	XXX.X(X)	0.25 second	flashing
1 … 9.999 MHz	X.XXX(X)	0.25 second	steady
10 … 50.00 MHz	XX.XX(X)	0.25 second	steady

Programming mode

During 'Programming mode' you can progtramm an frequency offset and the power save mode. To programm the controller you must attach a closing swith to pin 4 of the microprocessor.

Programming mode flow chart
The program flow chart on the left shows how to enter programming mode, how to select a menu, and how to execute the associated function. To enter programming mode, press and hold the programming key (or connect pin 4 and 5 of the PIC with a small screwdriver), until the PIC shows „ProG" on the LED display. Then release the „key". You are now in the first menu of the programming mode.
To select the next menu, press the key for a *short* time (less than a second). To execute the selected function, press the key for a longer time (more than a second). The menu functions are :
· „Quit" : Aborts programming mode without changing anything.

· „Add" : Saves the previously measured frequency permanently, so it will be added in future.
· „Sub" : Saves the previously measured frequency permanently, so it will be subtracted in future.
· „Zero" : Sets the frequency offset to zero, so the display will show the measured frequency without offset. The previously programmed offset will be lost.
· „Table": Allows you to select a predefined offset value from a table. The table itself is also located in the PIC's data EEPROM, so you may find different values in it. When skipping through the table, the frequencies are shown in numeric form, like 455.0 (kHz),

4.1943 (MHz), 4.4336 (MHz), 10.700 (MHz). After selecting an entry (long keypress), you will be taken back to the main menu to select „Add" or „Subtract".

· „PSave" / „NoPSV": turns the power-saving on/off. In power-saving mode, the display is turned off after 15 seconds of no „significant" change in frequency, and on again as soon as the frequency changes by more than a few dozen Hertz (in the 3..4 MHz measuring range)

RX Frequency = Oscillatorfrequency - IF =14,314 - 4,194 =10120
If you want not the see the 10 MHz use 14,194 instead of 4,194. The 10120 will be shown as 1120.0

Addieren oder Subtrahieren von Frequenzen
If the counter is used in an superhet receiver (or transmitter) you must add or substract the IF frequency (dependig on up or down conversion. In the programming (Setup) Section you can choose a common IF frequency or if your IF cannot be found in the table you can programm any IF.
The following example shows how to programm a tranceiver like our Miss Mosquita with 4MHz IF Quartzfilter (Oscillator of TX at 3,999 MHz)
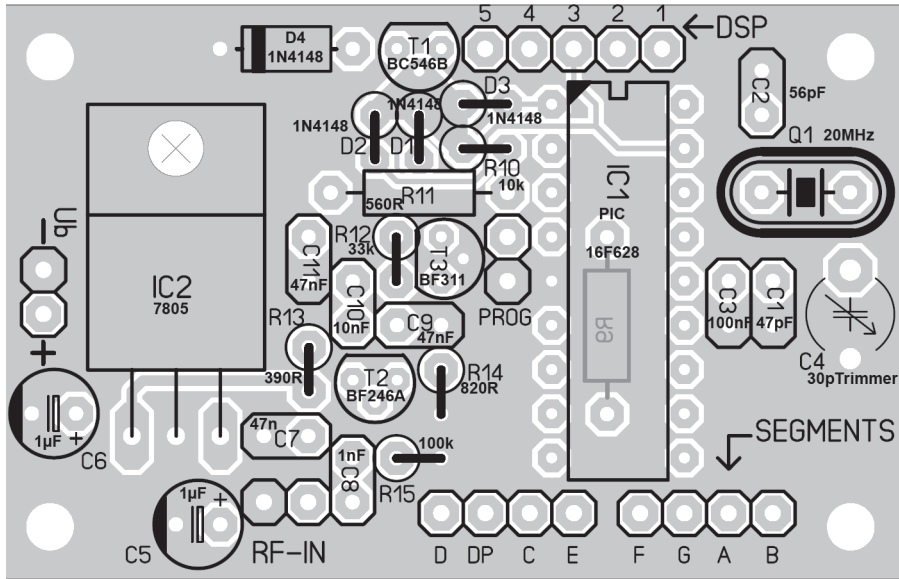
1. counter power on
2. close programming- switch shortly until display shows "PROG"
3. Release the switch
4. Close and open the switch until you see "TABLE" in the display
5. Close and open the switch until you see "TABLE" flashing, release the switch. You are now in a sub menue which shows all preprogrammes offsets.
6. Close and open the switch until the wanted IF (3.999) is shown in the display.
7. Close switch until "3.999" is flashing, release the switch
8. Now you should see "Add" in the display. If not close and release switch until you see "Add"
9. Close switch untill you see "Add" flashing, release switch

Ready. The IF of 3.999 MHz has been written to the EEProm now, it will be added to the actually measured VFO frequency.

Little bit mor tricky is the calculation for the 10MHz and above. Because we have only 5 digits it makes sense not to show the 10 and 1 MHz digits. If we use a negative offset, the display will only show the 1 MHz digit but the 100Hz digit can still be seen. Example for a 30 Meter Transceiver with VCXO:
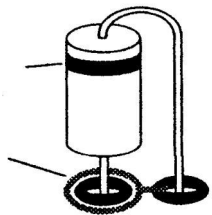
Assembling

Use the PCB as shown in the picture to get some orientation. Don´t install the connectors now, this will be done later on.
Solder Resistor R9 first. You see R9 mirrored inside the outline for the microprocessor IC1 that means it must be mounted at the bottom side (solder side of the PCB.
[ ] R9 10k   Mount at bottom side, solder at part side. cut the remaining pins short above the solder joint.

Now mound other parts to the part side and solder at the bottom side. Start lin the lower left corner. Try to solder each part as low as possible above the PCB. If they are mounted on long legs you will get run into trouble when mounting the Display board.

[ ] D4   1N1448 The diode has a band at the cathode side. Orientation of the band on the PCB as shown in the drawing
[ ] D2   1N4148 -upright If a Diode is mounted upright, there is a circle as an outlin on the PCB. Mount the diode with its body inside the circle, the band (cathode) agt the upper side (see picture left!
[ ] D1   1N4148 upright as D2

[ ] D3   1N4148 upright as D2/D3
[ ] R10   10k, upright
[ ] R11   560R
[ ] C11   47 nF (473)
[ ] C10   10 nF (103)
[ ] R12   33k
[ ] C9   47nF (473)
[ ] R13   390R
[ ] R14   820R
[ ] C7   47nF
[ ] C6   1uF Elko, ATTENTION, polarized. Long leg = PLUS
[ ] C5   1uF Elko, ATTENTION, polarized. Long leg = PLUS
[ ] C8   1nF (102)
[ ] R15   100k
[ ] C2   56pF
[ ] Q1 20 MHz Quartz.Mount the Quartz with a abt 1mm distance between its body and the PCB to avoid a short by solder under it.
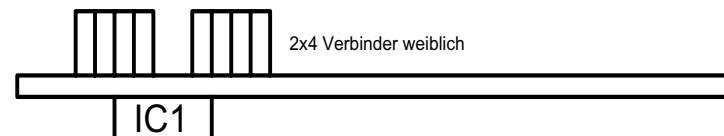[ ] C3   100nF (104)
[ ] C1   47pF   (47p, 47j)
[ ] C4   Foil Trimmcapacitor 30pF
Now the socket for the PIC Take care to mount it exactly as shown in the picture. The GAP at one of the small sides must look to the upper edge of the PCB. They will connect the display PCB to the counter PCB. Best way to mount and solder them is to assemble both PCBs complete with the connectors
[ ] Socket IC1

The following female connectors are mounted on the solder side of the PCB Best way to do is to mount the complete assembly first without soldering. Check if all connectors are absolutely perpendicular. If so, solder them Use the female connectors for the counter PCB and the male connectors for the Display PCB Solder one PIN, check again and if it looks good, solder all

Schnittzeichnung, Bauteile nach unten ,von der Breitseite gesehen

2x4 Verbinder weiblich

IC1

remaining PINs.

Solder at the parts side of counter PCB:
[   ] Connector 5,4,3,2,1 (female)
[   ] Connector D,DP,C.E (female)
[ ] Connector F,G,A,B (female)

Now the other connectors to the outer world. They are mounted on the parts side and soldered on the solder side.

[ ] Wire plus/minus (red/black) as conections to power (+6V bis +12V) at „Ub"
[ ] Koaxcable or a pair of twisted wire at „RF-in" (later connection to VFO, Local Oszillator)
[ ] Programm Switch at „PROG"

Remaining parts are Semiconductors. Some of them, especially the PIC are ESD sensiticve. Discharge yourself by tapping your hand to a blank ground plate or better, use ur ESD sefety equipment.

[ ] T1 BC546B   [ ] T2 BF2546A   [ ] T3 BF311

[   ] IC2 = 7805 (TO220 housing).
Now put the PIC into the socket. Attention: the Gap or Pin 1 marker must look to the upper edge of the PCB / gap in the socket.
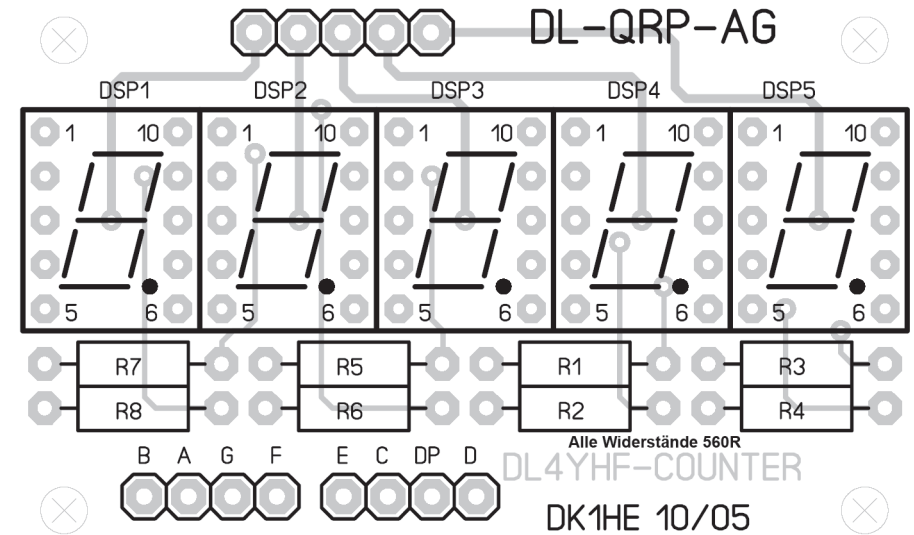
[ ] PIC 16F628

OK, the counter is ready, now do the Diplay unit.
This are only a few parts. Mount all parts on the parts side, that´s the side where you find the designers call sign DL4YHF in the lower right corner.
Start with the resistors:
[ ] R1   560R   [ ] R2 560R
[ ] R3   560R   [ ] R4 560R
[ ] R5   560R   [ ] R6 560R
[ ] R7   560R   [ ] R8 560R

Now the 5 Seven Segment Display Chips. Please install them upright witg

the decimal point at the right place. Look at the Picture above to see how they must be installed. Press each Display firmly agaist the PCB and solder 1 pin at a corner first. Check if it is realy sitting flat on the PCB and solder a pin diaginal opposite. Check again if the display is flat on the PCB. If not, reheat and press the display down to the PCB. If it is ok, solder all remaining PINs. Same procedure for all 5 Displays.

[ ] DSP1
[ ] DSP2
[ ] DSP3
[ ] DSP4
[ ] DSP5
Now the connectors, they are mounted on the solder side and soldered at the Parts side. Of course you must use the male connectors at the display PCB. Again assemble the complete unit before soldering. If the PCBs are exactly on eabove the other, solder the PINs carefully without touching the Displays with the hot iron.
[ ] Verbinder 5 pin (männlich)
[ ] Verbinder 4 pin (männlich)
[ ] Verbinder 4 PIN (männlich)
If you now connect Power to the red(black UB line and any signal between 1 and 50 MHz to the RF line (coax or twisted pair of wire) you should see

measured frequency now.
If you use a Receiver / Transceiver as signal source, you will see the local Oscillator frequency. To see the TX/RX frequency you mustr add or subtract the IF frequency as described in the programming section of this manual.

Partlist

D1	1N4148
D2	1N4148
D3	1N4148
D4	1N4148
R1	560R
R2	560R
R3	560R
R4	560R
R5	560R
R6	560R
R7	560R
R8	560R
R9	10k
R10	10k
R11	560R
R12	33k
R13	390R
R14	820R
R15	100k
C1	47pF (47p, 47j)
C2	56pF
C3	100nF (104)
C4	Foiltrimmcapacitor 30pF red 2 pin spacing 5mm
C5	1uF Eléctrolytic cap
C6	1uF Electrolytic cap
C7	47nF
C8	1nF (102)
C9	47nF (473)
C10	10 nF (103)
C11	47 nF (473)

Q1	20 MHz Quartz
T1	BC546B
T2	BF2546A
T3	BF311
IC1	PIC 16F628 -20P programmed (Attention, extrem ESD sensitive)
IC2	7805 TO220 Housing

Socket 18 pin for IC1 (PIC)
7 Segment Display (5)
Connector 13 PIN (female)
Connector 13 PIN (male)
pushbutton switch

DL4YHF-Counter

DSP1 DSP2 DSP3 DSP4 DSP5

a
b
c
d
e
f
g
dp

a f g b e c d (repeated per display)

10k
R10

D2

1N4148

BC546B

D3
1N4148

T1

1N4148
1N4148
D1 C1

D4

1
18

2
17

33k*
R12

3
16

56p **47p**

C2

BF246A

T2

C10

Prog.

4
15

Q1

C4 **30p**

C8

560R

5
14

C3 **100n**

PIC

IC1

von Buffer T2
Mainboard

RF-IN

1n

C9

T3
BF311

R11

d ← R4

6
13

R8 → b

390R

C11
47n

dp ← R3

7
12

R7 → a

R15
100k

R14

R13

c ← R1

8
11

R6 → g

47n

e ← R2

9
10

R5 → f

820R C7 **47n**

R9 **10k**

R1-R8 560R

7805

1uF

+5V

IC2

10V +

C6

C5 **1uF**

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Bei Bedarf mit R12 auf 2,5V Uce justieren 1.01.2006 SOLF

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