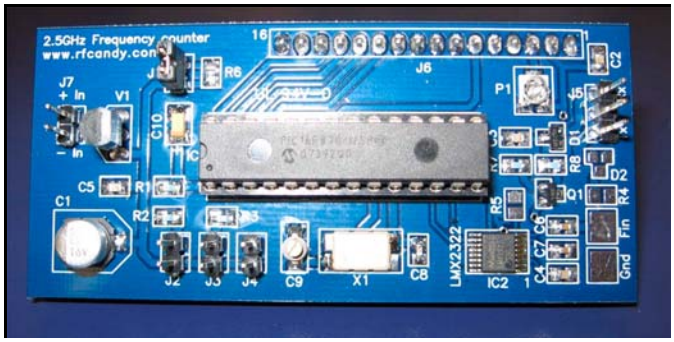
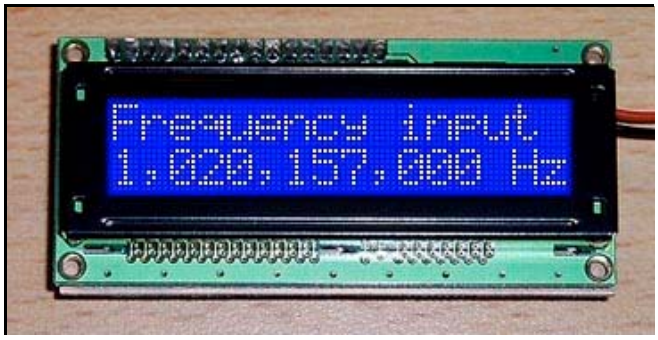
Exclusive 2.5 GHz Frequency Counter with blue 2 x 16 LCD display

This manual will guide you how to assemble,
test and tune this frequency counter KIT.



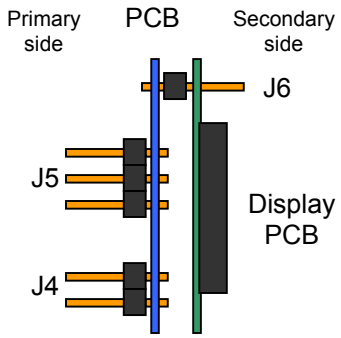


Features:

- Frequency range from 5 MHz to 2.5GHz
- Factory professional made PCB
- High sensitivity input typ 15mV at 150MHz
- ESD protected input
- Two level of resolutions, 1kHz and 100Hz
- On-board oscillator 13MHz or external 10 MHz
- Counter data can easy be transmitted to computer with RS232
- Add or subtract 3 different IF frequencies :
  (±455 kHz ,±10.7 MHz and ±21.4 MHz)
- +7.5 to 35 VDC input power supply
- Low current consumption typ 35 mA
- Extremely simple and the unit is very small

Assembly instructions

Please follow the assembly instruction below.



Hole mounted parts

- ☐ Place J6 on the seconday side of the PCB. The short legs toward the PCB.
- ☐ Place J1, J2, J3, J4, J5 and J7 on the primary side.
- ☐ Place V1 on the primary side.
- ☐ Place IC1 socket on the primary side.

Smd mounted parts

- ☐ Place R1, R2, R3, R6, R7, and R8
- ☐ Place P1
- ☐ Place R4 (this resistor will give 50 ohm match input.
  (If you wish a bit more sensitive input for this counter, you can skip this resistor)
- ☐ Place R5 (this resistor will keep the input stable when no signal is applied)
  (I advice you to wait mounting this resistor until you have tested the counter
  You can find more info below.)
- ☐ Place IC2
- ☐ Place C1, C2, C3, C5, C6, C7, C8, C9, and C10
- ☐ Place X1
- ☐ Place Q1
- ☐ Place D1 and D2

Do **NOT** connect C4, (nc = no connection)

Please check your soldering for no bridges or errors !

- ☐ Place LCD 16x2 on J6, secondary side.
- ☐ Place PIC16F870 into the socket in correct way.

Tuning and testing

Apply power and make sure the LCD gives a blue light.

To set the contrast of the LCD you must trim P1.
Measure the voltage at pin 3 of J6. Trim P1 for 0.7- 1.5V ← **Important!**

To trim the frequency timing you must trim C9.
Connect a well known frequency to your counter input and trim the C9 to exact measurement.

Placement of components primary side.

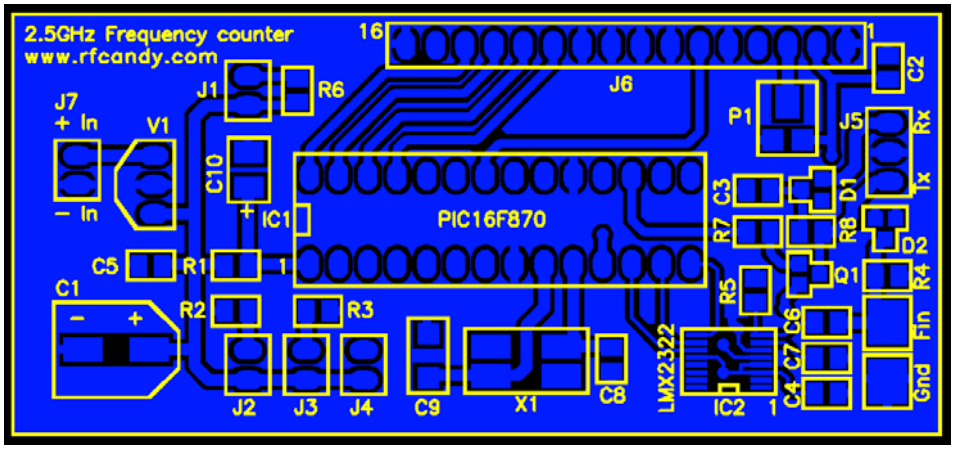


Illustration 1: Primary side of PCB

Component list

PCB

```
===
1 pcs Factory made blue PCB
1 pcs LCD 16x2 Char Blue type
1 pcs 16 pin header 2.54mm pitch (J6)
1 pcs  3 pin header 2.54mm pitch (J5)
5 pcs  2 pin header 2.54mm pitch (J1, J2, J3, J4, J7)
1 pcs  2 pin jumper (J1)
1 pcs 28 pin IC socket for PIC16F870
```

RESISTORS

```
=========
 100  = R4, R6
 20k  = P1
3.3K  = R1, R2, R3, R7, R8
100k  = R5
```

CAPACITORS

```
==========
 22pF = C8
 30pF = C9 (variabel)
  1nF = C6, C7
100nF = C2, C3, C5
2.2uF = C10
 47uF = C1
```

VOLTAGE REGULATOR

```
=================
V1 = 78L05
```

CRYSTALS

```
========
Xtal = 13.000 MHz
```

SEMICONDUCTORS

```
==============
IC1   = PIC16F870P (pre-programmed)
IC2   = LMX2322
Q1    = BC856 (PNP)
D1,D2 = MMBD7000LT1-D or 1N4148
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SOLDERING TOOLS

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===============
Soldering lead (Extra thin)
Impregnated cleaning wick
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Schematic.

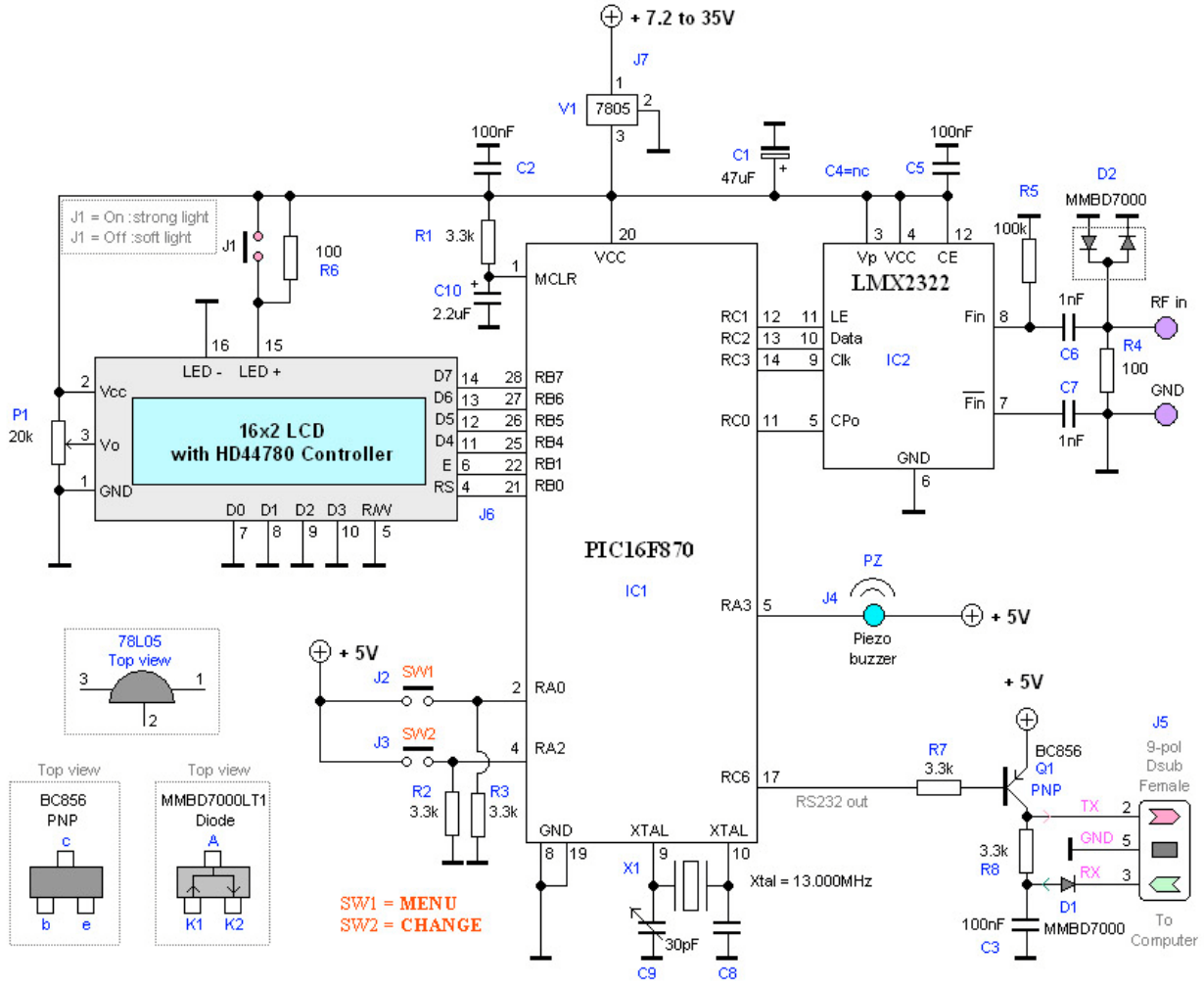

Illustration 2: Schematic

Above you can se the complete schematic of the frequency counter.
I have updated the schematic with a doubble diode D2.
Diode D2 will protect the input of IC2 (LMX2322) from high input power, spikes and ESD discharges.
I have also updated the constrution by grounding $\overline{\text{Fin}}$ (pin 7 of the LMX2322).

Purpose of resistor R5

The input of the LMX2322 (prescaler) is very sensitive.
When the input is not connected to any source, the circuit will pick up any RF noise and start to self oscillate.

This behavior can be used to test the circuit function in a simple way.
When the power is on, the display should show some MHz.

If so, you can be sure that the PLL is soldered correctly and working fine.
To prevent self oscillation, R5 is added to the input stage.
This will make the counter show 0 when no RF signal is applied.
R5 will not affect RF signal or sensitivity of the frequency counter.

PIC Software

All settings are made by the two switches SW1 = **MENU** and SW2 = **CHANGE**.
The unit will always remember the last settings even if power is switched off.

Menu 1 will give the actual frequency.
Menu 2 will add 455 kHz to the frequency.
Menu 3 will subtract 455 kHz to the frequency.
Menu 4 will add 10.7 MHz to the frequency.
Menu 5 will subtract 10.7 MHz to the frequency.
Menu 6 will add 21.4 MHz to the frequency.
Menu 7 will subtract 21.4 MHz to the frequency.
Menu 8 will set the PIC16F870 reference frequency. (On-board 13MHz or External 10 MHz).
Menu 9 will set the gate time. (You can choose fast 1kHz resolution or slow 100Hz resolution).
(*SW2 will toggle choices for you in menu 8 and 9*.)

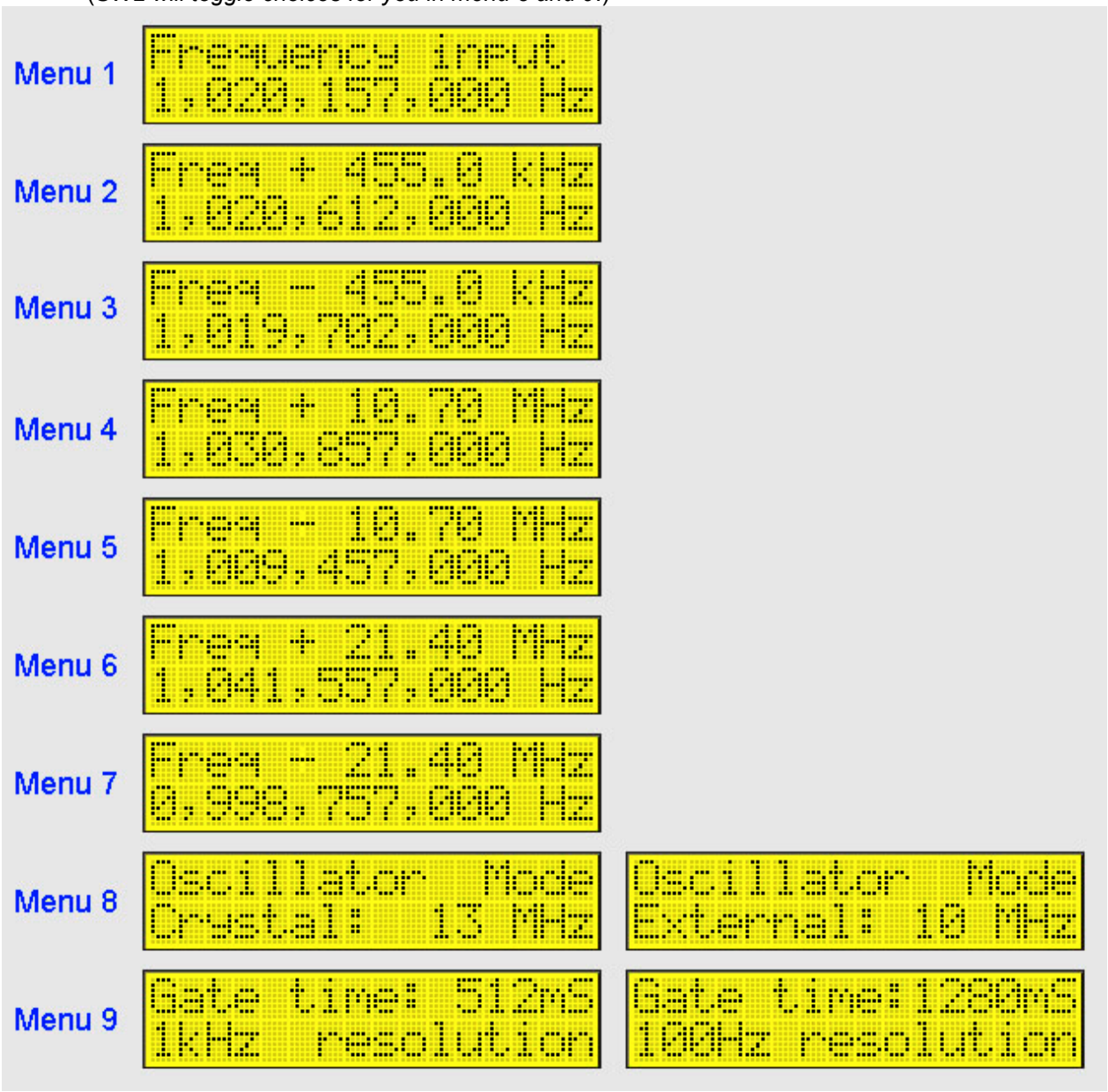

Illustration 3: All the different menu choices

Trouble Shooting section

If you get a problem with your unit, you might find this section helpful.

I get no text on my display!

Make sure you have + 5V to pin 2 of the LCD and that the background light is working.
You should now test that the contrast voltage of the LCD is ok.
The voltage at pin 3 of the LCD should be about 0.70V to 1.5V
This will give good contrast!
You should also make sure you have 5, 7, 8, 9, 10 to ground.
Now, you should test that the data signals is arriving to the LCD.
Look at the signal of pin 14, 13, 12, 11, 6 and 4 and make sure you measure on the LCD.
I often use a small speaker or piezo element and listen to the signals.
You should hear clicking sound or beeping tone…
If you don't have any data communication to the LCD the problem is with the PIC16F870, next section.

My PIC16F870 is not working!

Make sure you have + 5V to pin 20 of the PIC.
You should test that the Reset (pin 1) goes high when power is turned on.
The oscillator should be running at 13MHz. (Test with oscilloscope or equal equipment)
Make sure that RA0 (pin 2) and RA2 (pin 4) is low and goes high when SW1 or SW2 is pressed.

The LCD show only zero so my LMX2322 is not working!

Check that the circuit is placed in correct way.
Check that you do not have any soldering bridges between legs or to ground.

My RS232 computer communication is not working!

Make sure you that you have a RS232 digital signal out on RC6 (pin 17).
Transistor Q1 with D1 generate a level shift to + 5V and -12V for communication to computer.
At the collector of Q1 you should have the RS232 signal jumping between -12V and +5V.
(This will only work when the unit is connected to a computer since the -12V comes from the computer.)
If you do not have this, make sure you have connected the TX, RX, and ground on the D-sub connector in correct way.

Any com-port program (terminal program) can be used to test that data enters the comport of the computer.

If you still have problems, you can always mail me and we will work it out.

Final word

I hope you have had a fun time assembly this KIT.
The project may be a small one, but still it is a very powerful frequency counter
with high sensitivity and smart software functions.

Beside all that, it looks pretty cool.

Thanks for your time…
Regard
Daniel