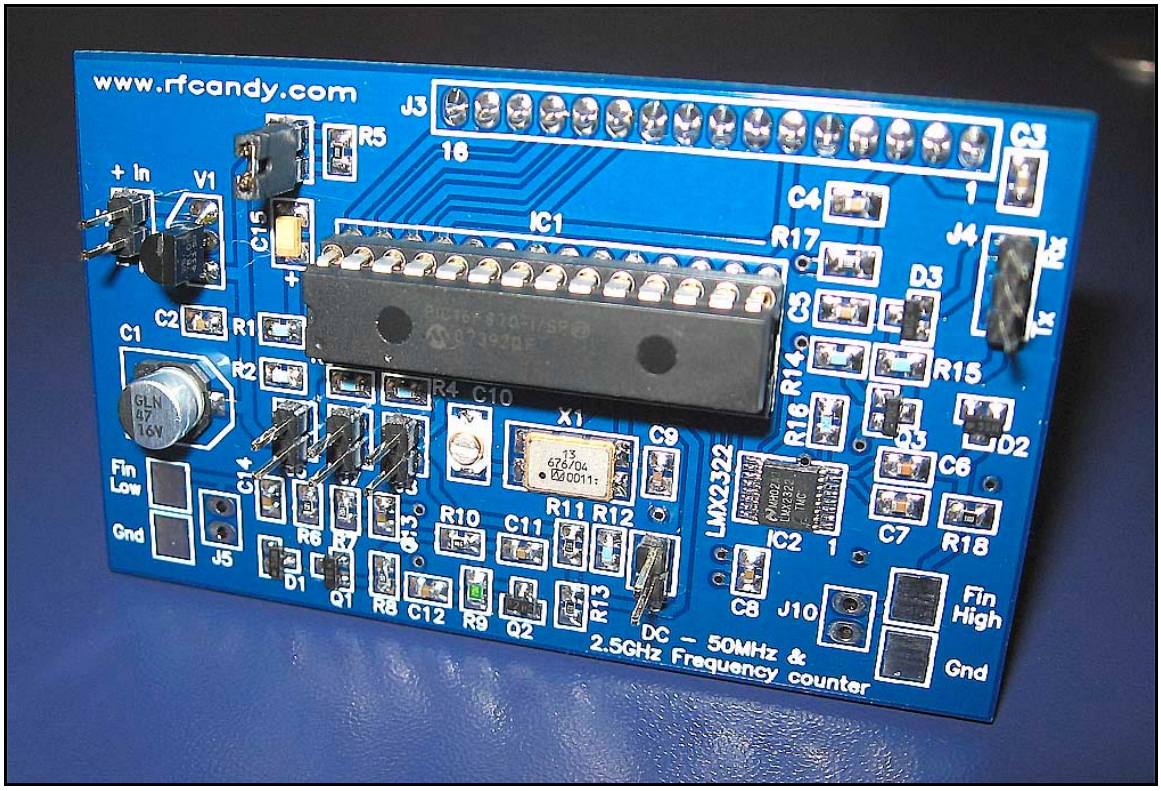
Transcendent Frequency Counter

with blue 2 x 16 LCD display

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



Features:

- The transcendent counter has two input channels
- Channel Fin Low: 1 Hz to 50 MHz with resolution of 1 Hz
- Channel Fin High : 5 MHz to 2.5 GHz with resolution of 100 Hz
- High sensitivity inputs typ -25dBm to -10dBm (12mV to 70mV) both channels
- Channel Fin Low : Input Impedance > 1 M Ohm
- Channel Fin High : Input Impedance 50 Ohm
- Both inputs are protected for transients and ESD over voltage
- Add or subtract seven preset IF frequencies (0 Hz, ±455 kHz , ±10.7 MHz and ±21.4 MHz)
- Add or subtract one self defined IF frequency from -999.9999 MHz to +999.9999 MHz
- Data can easy be transmitted to computer with RS232 cable
- No pre- or post-flank errors
- Power down memory for all menu options and settings
- Three buttons controlled menu system for controlling all options and settings
- Power supply +9 VDC to +18 VDC (+5V possible with minor modification)
- Low current consumption typ 30 mA
- Board size = 3.2" x 1.9" (81 mm x 48 mm)

Assembly instructions

The soldering of this unit is pretty basic if you solder the parts in correct order.
There is six steps for mounting the parts.
Below I describe them with picture and instructions.

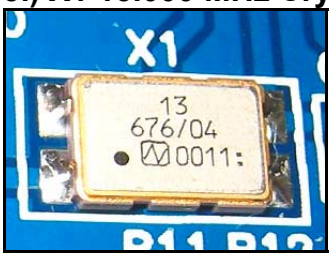
1.) IC2 LMX2322

Place the LMX 2322 to the PCB and by soldering fixate the top right leg and the bottom left leg.
I use a magnifying glass to make sure it is places in line with the PCB pattern.
From the picture above you can see that all legs are placed in line with the PCB pattern, and it looks good.

2.) IC2 LMX2322

When the corner legs are fixed, solder the rest of the legs. If you get lead bridges between legs, you can easy clean it up by using the wick. Place the wick over the bridges and heat the wick with your soldering tool. The wick will absorb all overflow lead. Bridges will be gone and the circuit looks perfect.

3.) X1 13.000 MHz Crystal

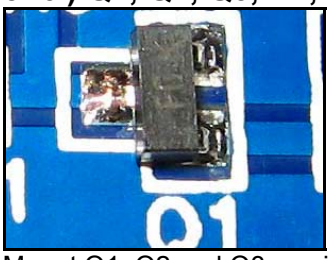


Place the crystal to the PCB and solder all four pads.

4.) C10 Calibration capacitor

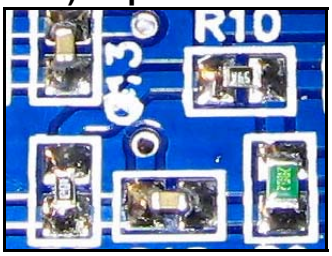
Mount the trimmer capacitor as picture show.

5- 6.) Q1, Q2, Q3, D1, D2, D3



Mount Q1, Q2 and Q3 as picture show.
Mount D1, D2 and D3 as picture show.

7- 8.) Capacitor & Resistor



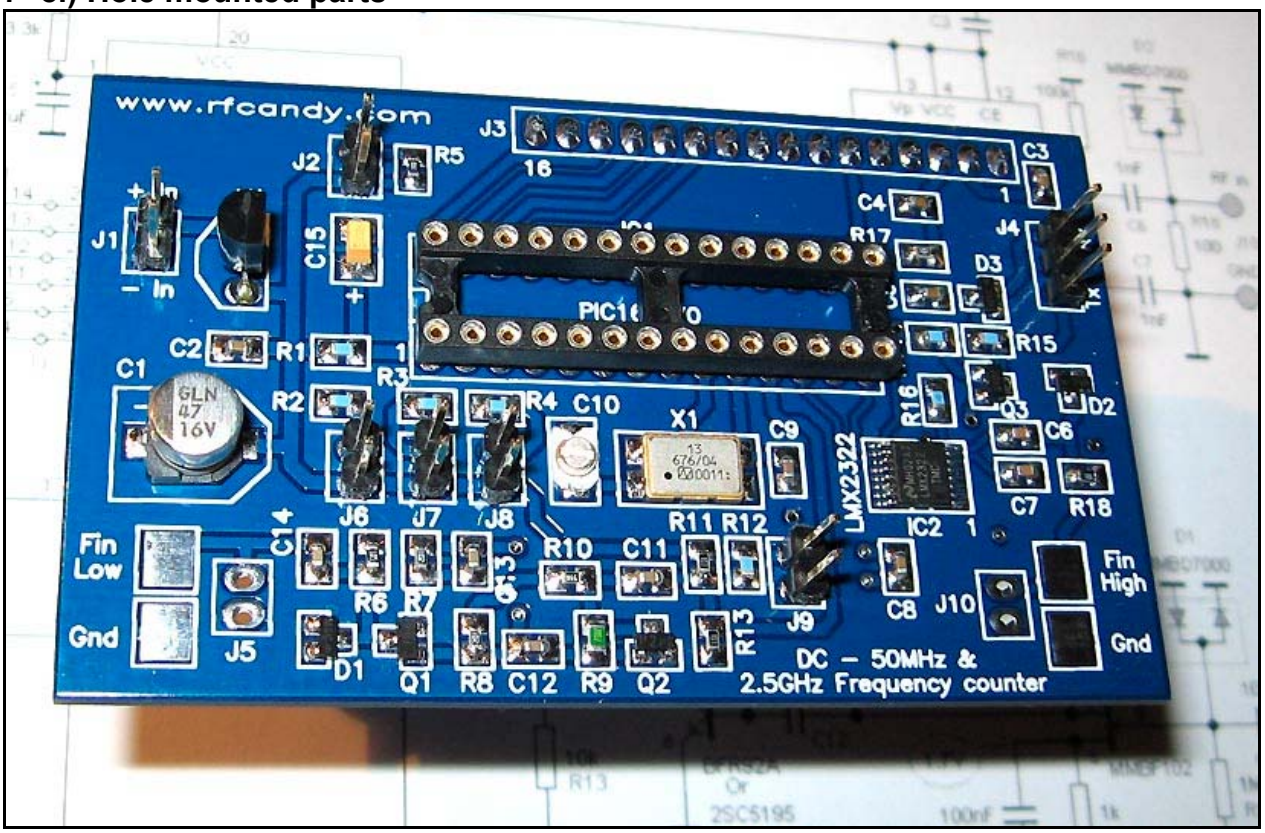
Mount smd capacitors below :

22 pF = C9
1 nF = C6, C7
100 nF = C2, C3, C4, C5, C8, C11, C12, C13, C14
2.2 uF = C15 (Orange line = plus)
47 uF = C1 (Black line = minus)

Mount smd resistors below :

100 = R5, R18
402 = R10
1 k = R7, R8, R17
3.3 k = R1, R2, R3, R4, R14, R15
10 k = R11, R13
20 k = R9
42 k = R12
100 k = R16
1 M = R6

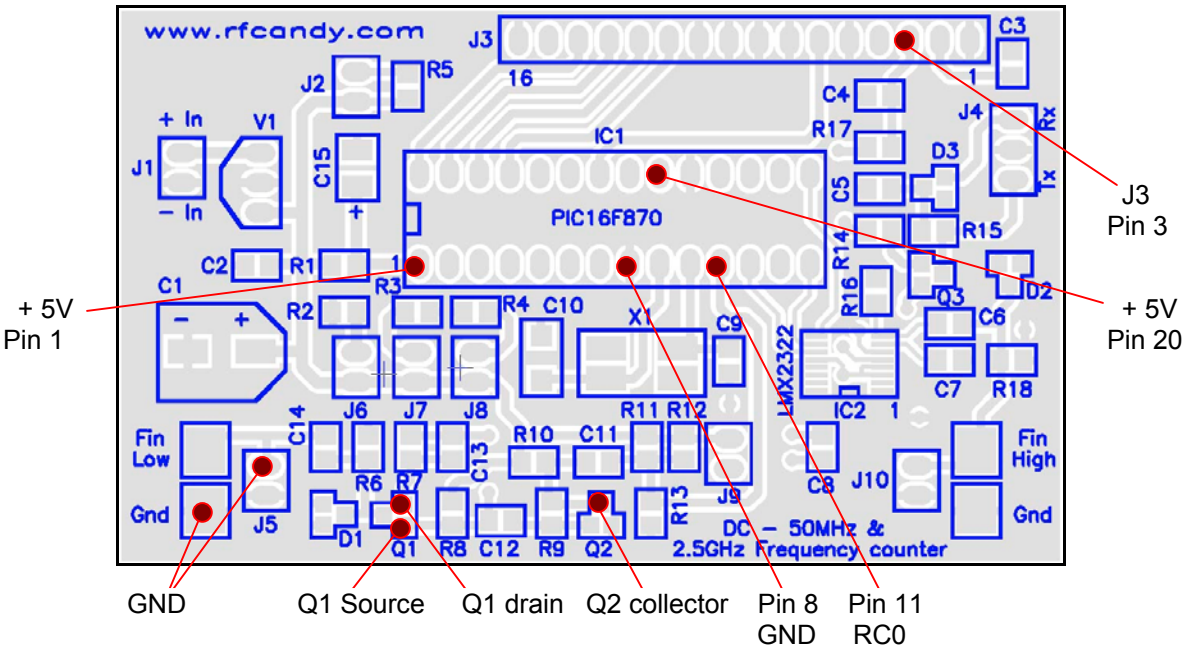
7- 8.) Hole mounted parts



Mount hole mounted parts below :

- 28 pin IC socket = IC1 (*only socket, wait with PIC*)
- 2 pin header = J1, J2, J5, J6, J7, J8, J9, J10
- 3 pin header = J4
- 16 pin header = J3 (*mount J3 on backside of PCB*)
- 78L05 = V1
- LCD 16x2 Char Blue type (*backside of PCB*)
- PP3 Connector for 9V battery (J1)
- Jumper (J2)

Testing



I advice you to make a few test before you put the PIC16F870 into its socket.
Perform an visual inspection of the PCB to make sure you have no soldering bridges or misplaced parts.
Make sure the PLL is placed in correct direction. Apply power to J1 and control that the display gives a blue backlight. You will not see any text yet, since the PIC is not connected.
(*Do not forget to remove the clear plastic film which protect the front of the LCD Display.*)

Power to socket
Measure the voltage between pin 8 (GND) and pin 20 (Vcc) of the PIC16F870.
The measurement should show +5 V.
Measure the voltage between pin 8 (GND) and pin 1 (Reset) of the PIC16F870.
The measurement should also show +5 V.

Disconnect power and mount the PIC16F870 into its socket.
Apply power and control that you get some text on the display.
Measure the voltage between GND and pin 3 (J3) of the display.
The measurement should show 0.5 to 1.5 V.

Power to pre-amplifier
Measure the voltage between GND and pin 11 (RC0) of the PIC16F870.
The measurement should show around 2.7 V.
Measure the voltage between GND and collector Q2.
The measurement should show around 2.3 V.

Power to FET-amplifier
Enter menu and set the input to Fin Low (more details under software section).
Measure the voltage between GND and drain Q1. The measurement should show around 3.3 to 3.6 V.
Measure the voltage between GND and source Q1. The measurement should show around 1.2 to 1.7 V.

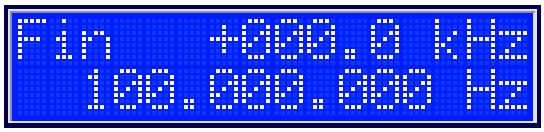
Calibration:
When a 13 MHz crystal is used, the calibration of the counter is made by the variable capacitor C10, which will be able to change the gate time some ppm. The transcendent frequency counter is supposed to be a measuring tool with good accuracy, so a good calibration is needed.

PIC Software

Let's have a look of the different menu systems and choices of the Transcendent frequency counter.
All settings are made by three switches SW1, SW2, and SW3.
The unit will always remember the last settings even if power is switched off.

- **SW1** (J6) guide you through a five steps menu system.
- **SW2** (J7) is used to INC value.
- **SW3** (J8) is used to DEC value.

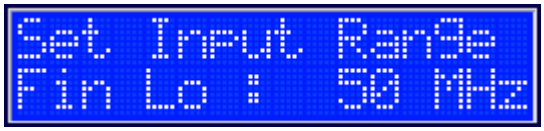
1.) Main menu for presenting frequency measurement



Pressing **SW2** and **SW3** will change Intermediate Frequency (IF) option.

After powerup you will enter the main presentation menu.
Picture above show you the main menu for presenting the frequency measurement. In this case, I have applied a 100 MHz signal to the counter. The Intermediate Frequency (IF) is set to +000.0, and the true measured frequency of 100 MHz is presented on the display.
If you press **SW1** you will enter next menu choice, see info below

2.) Selecting input source

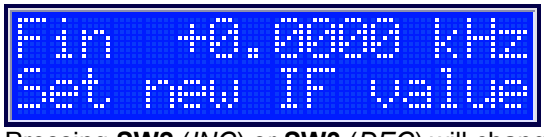


Pressing **SW2** select input Fin Low

Pressing **SW3** select input Fin High

This menu select input signal source.
The display will show you the selected source, see picture above.
By pressing **SW2** you select input **Fin Low**, and by pressing **SW3** you select Input **Fin High**.
If you press **SW1** you will enter next menu choice, see info below.

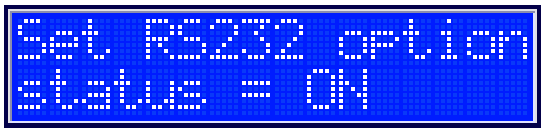
3.) Self defined IF frequency



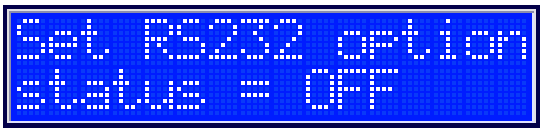
Pressing **SW2** (*INC*) or **SW3** (*DEC*) will change Intermediate Frequency (IF) value.

The picture above show you the Self defined IF frequency menu.
You have one self defined intermediate frequency (IF).
The intermediate frequency can be set from -999.9999 MHz to +999.9999 MHz
By pressing **SW2** the Intermediate Frequency (IF) value will increase with 100 Hz steps, and by pressing **SW3** the Intermediate Frequency (IF) value will decrease 100 Hz steps.
With the two buttons **SW2** and **SW3** you can set any Intermediate Frequency (IF) very easy.
The longer time a button is pushed, the larger increment/decrement you will get.
It takes only a few seconds to sweep over the hole range from -999.9999 MHz to +999.9999 MHz.
All settings of the transcendent counter will be stored during power down.
If you press **SW1** you will enter next menu choice, see info below.

4.) RS232 Option



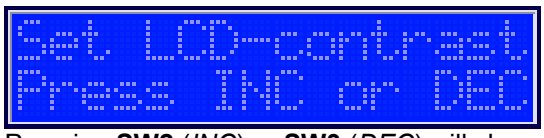
Pressing **SW2** activate RS232 line to ON



Pressing **SW3** deactivate RS232 line OFF

This menu activate or deactivate the transmission of RS232 data to computer.
The display will show you the selected RS232 option, see picture above.
By pressing **SW2** you activate the RS232line to send data, and by pressing **SW3** you deactivate RS232 line which will be silent. Deactivation of RS232 gives an extreme silent counter.
There will be very low noise levels on the input lines and power lines.
If you press **SW1** you will enter next menu choice, see info below.

5.) Display contrast



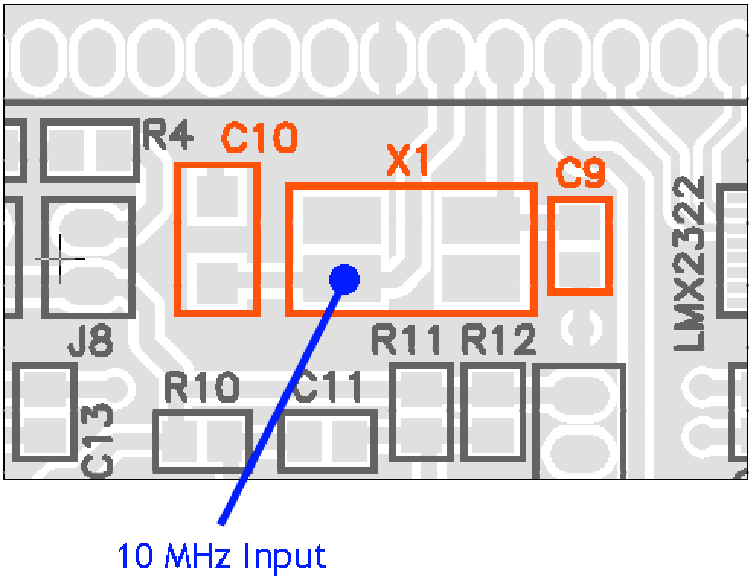
Pressing **SW2** (*INC*) or **SW3** (*DEC*) will change the contrast of the LCD display.

This menu set the contrast of the LCD display.
Picture above show you the menu for changing contrast level
By pressing **SW2** the contrast level will increase, and by pressing **SW3** the contrast level decrease.

If you press **SW1** you will go back to main menu.

External 10 MHz reference system

The external 10 MHz reference should be feed to pin 9 at PIC16F870.
Remove (*red marked*) capacitor C10, crystal X1 and capacitor C9.
Feed the external 10 MHz signal to pin 9, which you can find at crystal position, see figure below.



Placement of components primary side.

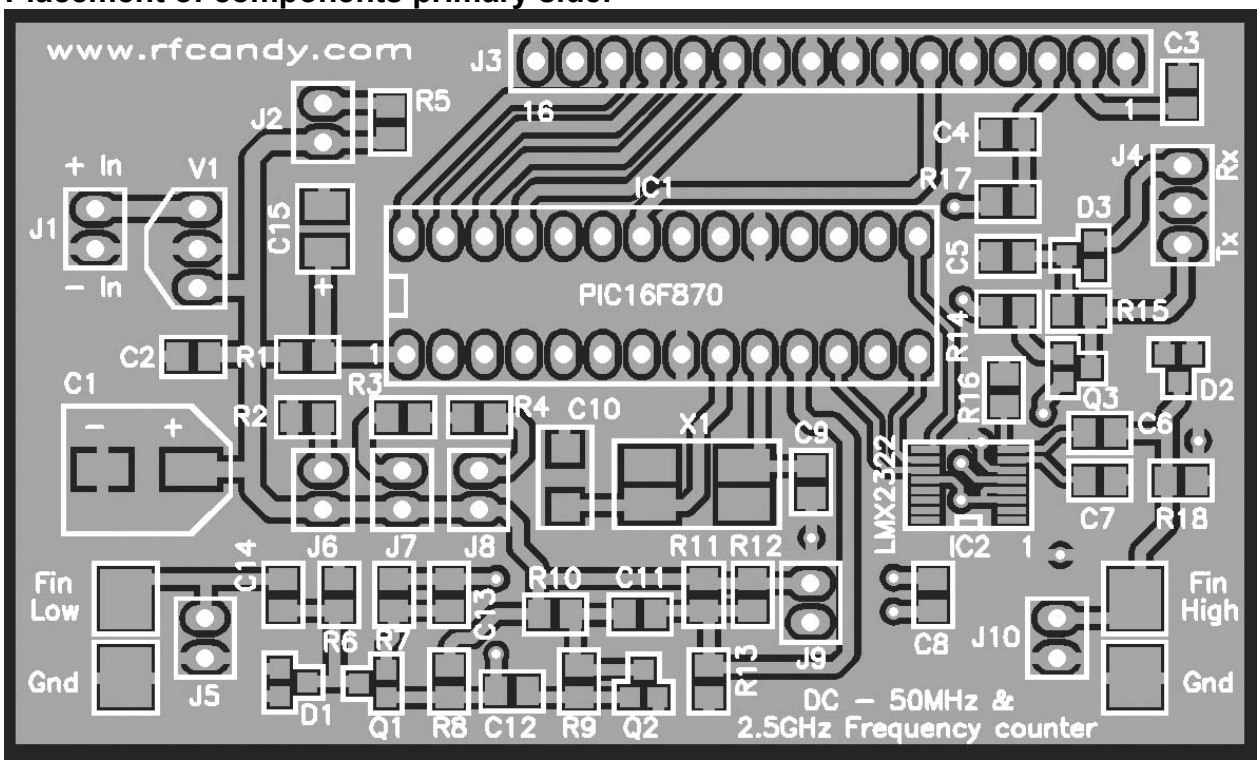


Illustration: Primary side of PCB

Placement of components primary side.

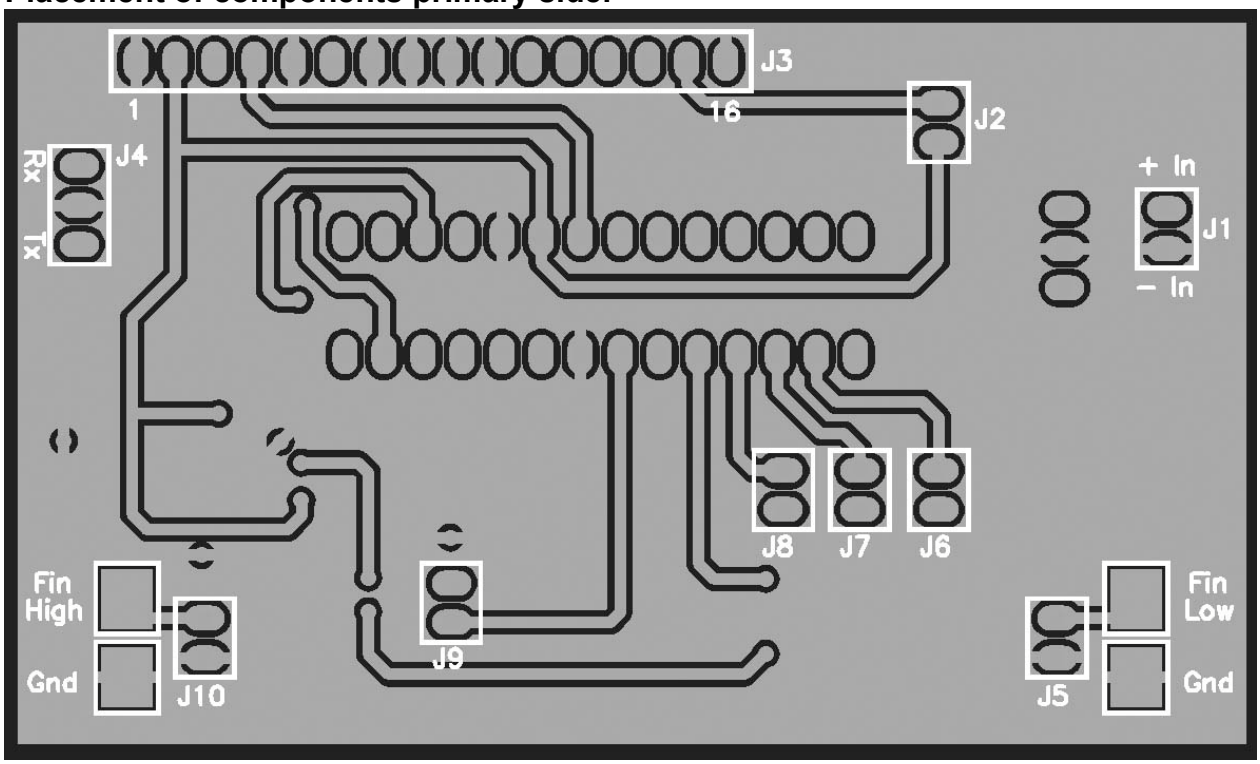


Illustration: Secondary side of PCB

**** PART LIST FOR TRANSCENDENT FREQUENCY COUNTER ****

All parts below are included in the KIT

General parts

1 pcs Factory made PCB
1 pcs LCD 16x2 Char Blue type
1 pcs 16 pin header 2.54mm pitch (J3)
1 pcs 3 pin header 2.54mm pitch (J4)
8 pcs 2 pin header 2.54mm pitch (J1, J2, J5, J6, J7, J8, J9, J10)
1 pcs 2 pin jumper (connected to J2)
1 pcs 28 pin IC socket for PIC16F870
1 pcs PP3 Connector for 9V battery (connected to J1)
1 pcs Buzzer (connected to J9)
1 pcs Soldering lead
1 pcs Wick
1 pcs Instruction manual

RESISTORS

100 = R5, R18
402 = R10
1k = R7, R8, R17
3.3k = R1, R2, R3, R4, R14, R15
10k = R11, R13
20k = R9
42k = R12
100k = R16
1M = R6
(*One extra part will be added for each value, in case you loose one*)

CAPACITORS

22pF = C9
1nF = C6, C7
100nF = C2, C3, C4, C5, C8, C11, C12, C13, C14
2.2uF = C15 (Orange line = plus)
47uF = C1 (Black line = minus)
(*One extra part will be added for each value, in case you loose one*)

VOLTAGE REGULATOR

V1 = 78L05

CRYSTAL

X1 = 13.000 MHz

SEMICONDUCTORS

IC1 = PIC16F870 programmed and tested
IC2 = LMX2322

Q1 = MMBF102
Q2 = BFR92A
Q3 = BC856

D1,D2, D3 = MMBD7000LT1-D

Schematic.

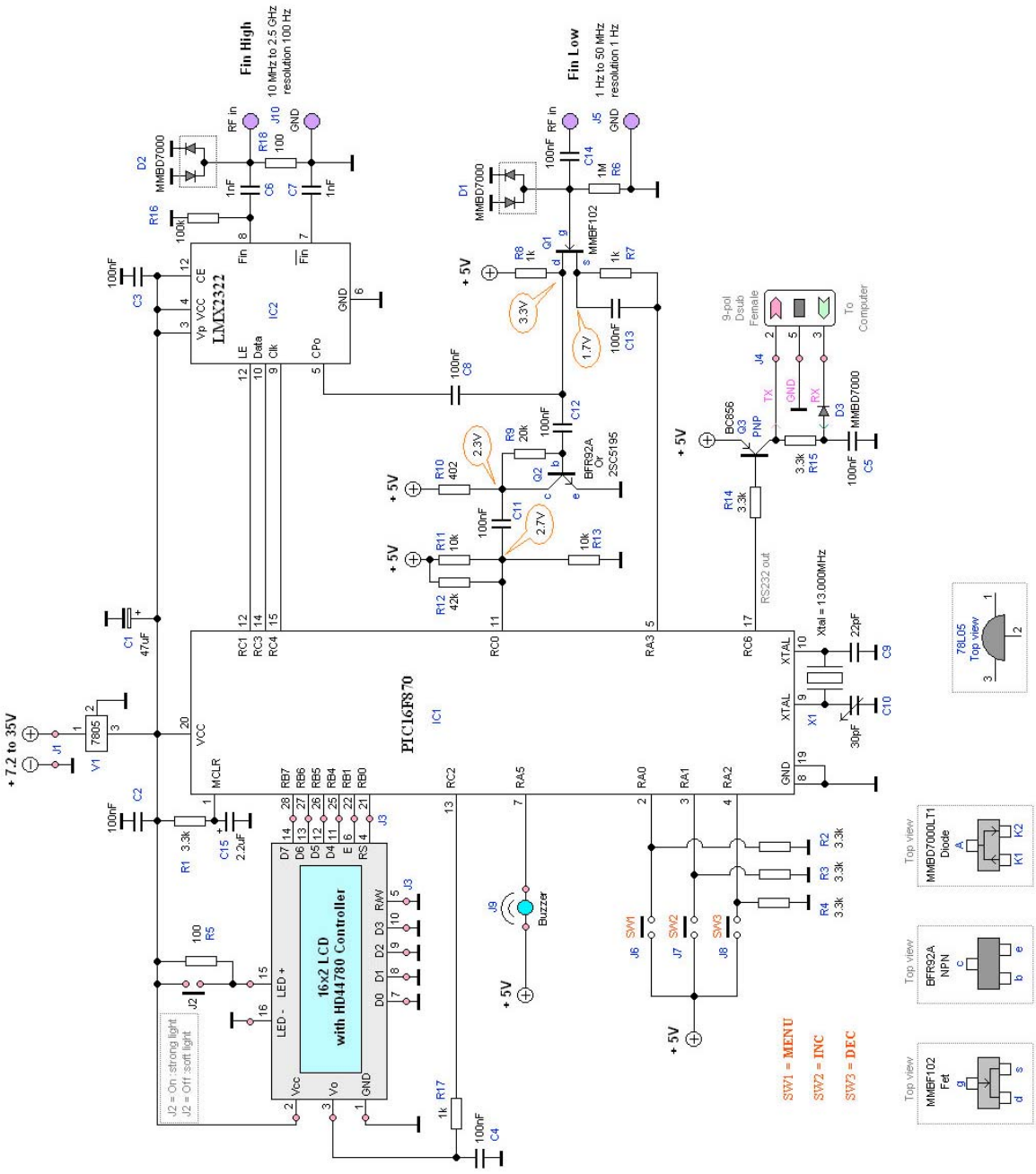


Illustration: Schematic

Final Word

I hope you have had a fun time assembly this KIT.
Thanks for your time…