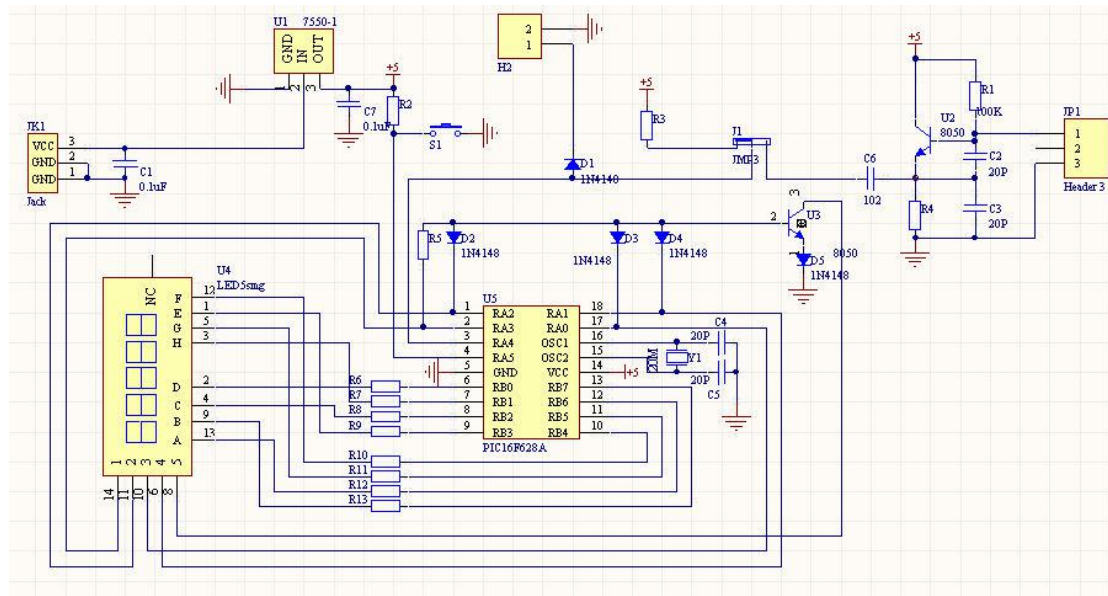


This document describes the construction of small frequency counter with a cheap PIC microcontroller and a few seven-segment LED digits. The main features of the frequency counter are:

- frequency range 1 Hz ... 50 MHz
- five digits resolution (display for example x.xxxx kHz, x.xxxx MHz, or xx.xxx MHz)
- automatic range switching with different gate times
- optional addition or subtraction of a frequency offset (programmable)
- very low component count: a PIC 16F628, 5 7-segment LED displays, a 20MHz crystal and a few resistors
- optional (configurable) power-saving mode which automatically turns the display off if the frequency didn't change significantly within 15seconds
- USB 5V power supply can be used.

main schematic:



Display ranges

The display range is automatically switched to give the maximum readout accuracy (with 4 digits). The gate time is also selected automatically as listed in the following table:

Frequency range	Display	Gate time	Decimal point
0 ... 9.999 kHz	X.XXX	1 second	flashing (which means "kHz")
10 ... 99.99 kHz	XX.XX(X)	1/2 second	flashing
100 ... 999.9 kHz	XXX.X(X)	1/4 second	flashing
1 ... 9.999 MHz	X.XXX(X)	1/4 second	steady (which means "MHz")
10 ... 50.00 MHz	XX.XX(X)	1/4 second	steady

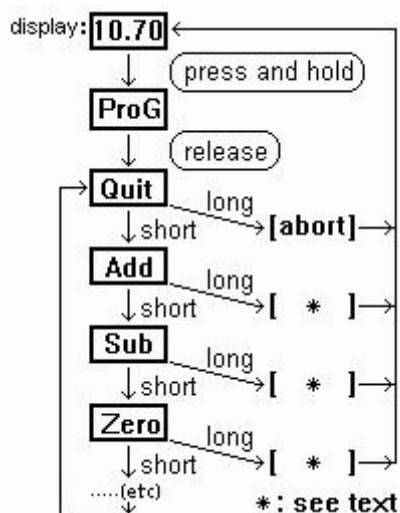
(On this occasion: "MHz" is Mega-Hertz, "mHz" would be milli-Hertz, but that's another story...)

Adding or subtracting an offset frequency

If the counter is used in a shortwave receiver or transceiver, you may want to add or subtract an offset value from the measured frequency. The offset frequency is the same as the intermediate frequency in many cases, because the counter is usually connected to the receivers VFO (variable frequency oscillator). For this purpose, a programming mode (aka "setup mode") has been

implemented in the firmware so you can enter an offset frequency without reprogramming (or even reassembling) the PIC firmware.

The signal RA5 (pin 4 of the PIC 16F628) will is used to switch from normal counter mode into programming mode. Usually the level on RA5 is high because it is connected to the supply voltage via pullup resistor (10k to 22k). If you will never need to add or subtract a frequency offset, connect it permanently with the supply voltage (there must be a defined level on RA5, unfortunately it has no internal pullup resistor). By pulling RA5 low (connect pin 4 and pin 5 of the PIC with a small screwdriver), the firmware will be instructed to use the currently measured frequency as the new offset value. In other words, you must *apply the offset frequency to the counter's input*, wait until the value is displayed correctly, and then enter the programming mode as explained below.



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). Added in May 2006 for battery-powered equipment like QRP transceivers.