FEATURES

- Two Display Configurations, LED or LCD
- Frequency Range up to 50 MHz
- +/- 1 Hz accuracy
- Single Pushbutton Control
- Beeper output
- LED Mode:
- 9 LED Readout
- 3 Resolution Ranges
- Morse Code Frequency Readout
- LCD Mode:
- Hitachi HD44780 Style Interface
- Single Line 16 Character Format
- Frequency or Difference Readout
- 8 digit readout
- Operating Voltage: 5 VDC
- Power Consumption: < 5 ma

DESCRIPTION

The GS XTAL is a crystal tester that can be used to determine the frequency of a crystal or to screen crystals by comparing them to a stored reference. It is PIC based and can be built with either an LCD or LED readout.

The PIC can be clocked either by an external 4 MHz crystal oscillator module or by attaching a crystal to the PIC directly.

Basic Functionality

This device was designed to provide a quick way of matching crystals for crystal lattice filters. It does this by allowing a reference crystal's frequency to be stored internally and then compared in frequency to other crystals. The difference can be presented to the user either by an array of nine LEDs or by an LCD display. It is the builder's option which to use. A reference crystal frequency is loaded by pressing the normally open pushbutton and holding it until the PIC responds with a beep. That is the signal that the reference will be loaded when the pushbutton is released. The store pushbutton has other functions described below.

LED Mode Functionality

When a test crystal is placed in the oscillator, the PIC will count the frequency and compare it against the reference frequency. One of nine LEDs will be lit to graphically display the deviation value from reference. See the resolution table below to see how the nine LEDs are lit versus frequency delta. Three display resolutions are available and are selected by pressing and holding the push button for 1 second past the single beep. That puts the PIC into resoultion selection mode, and it will advance the resolution through three selections, coarse, medium, and fine modes. A Morse letter is sent through the beeper to report the mode. **F** for fine, **M** for medium, and **C** for coarse. Release the pushbutton after the desired resoultion mode is heard through the beeper.

By quickly pressing and releasing the pushbutton the PIC will be asked to readout the currently sampled frequency in Morse code. The sending speed is fixed at 15 WPM. Leading zeroes are suppressed so for a frequency of 1.344240 MHz, **1 3 4 4 2 4 0** is sent.

LED	Coarse Low	Coarse High	Medium Low	Medium High	Fine Low	Fine High
9	+350	+449	+70	+89	+35	+44
8	+250	+349	+50	+69	+25	+34
7	+150	+249	+30	+49	+15	+24
6	+50	+149	+10	+29	+5	+14
5	-50	+49	-10	+9	-5	+4
4	-150	-51	-30	-11	-15	-6
3	-250	-151	-50	-31	-25	-16
2	-350	-251	-70	-51	-35	-26
1	-450	-351	-90	-71	-45	-36

Led Frequency Delta Table

LCD Mode Functionality

In LCD mode the difference frequency is displayed directly on the 8-digit LCD display. Alternatively the absolute frequency of the crystal can be displayed. The choice is made via the push button. If the push button is quickly pressed and then released, the display will toggle between delta and absolute frequency. Leading zeroes are suppressed to make viewing more convenient. Here is what the display looks like for each mode:

Absolute Mode: `*  12345678 Hz`
Difference Mode: `*  +125 dHz`

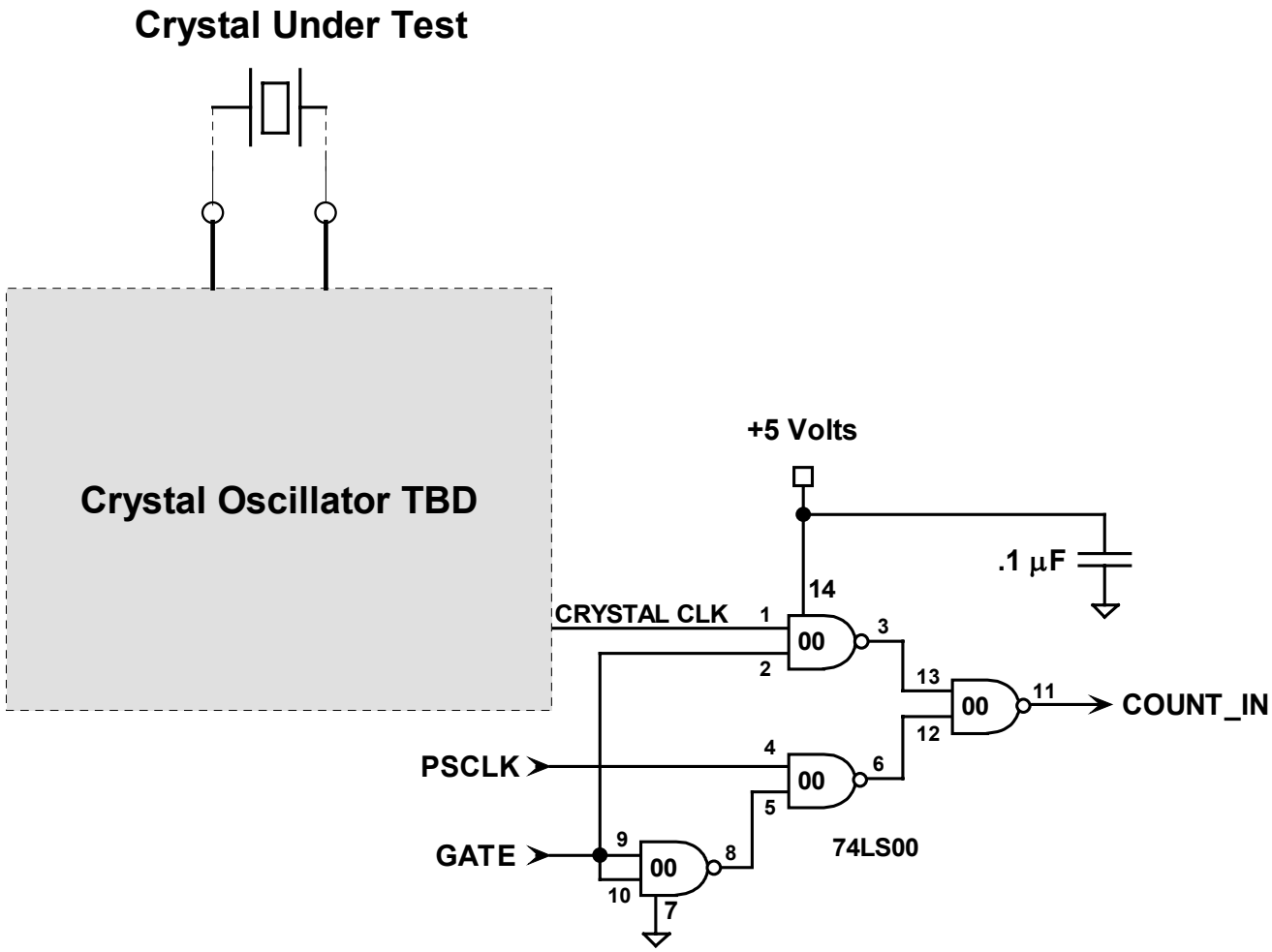
The star character at the left of the display line blinks at the frequency counter gate rate, which is one second. In the difference mode example the + sign signifies that the crystal under test is 125 Hz higher than the reference. If the crystal was below reference frequency a – sign would have been displayed instead.

Xtal Matching Schematics

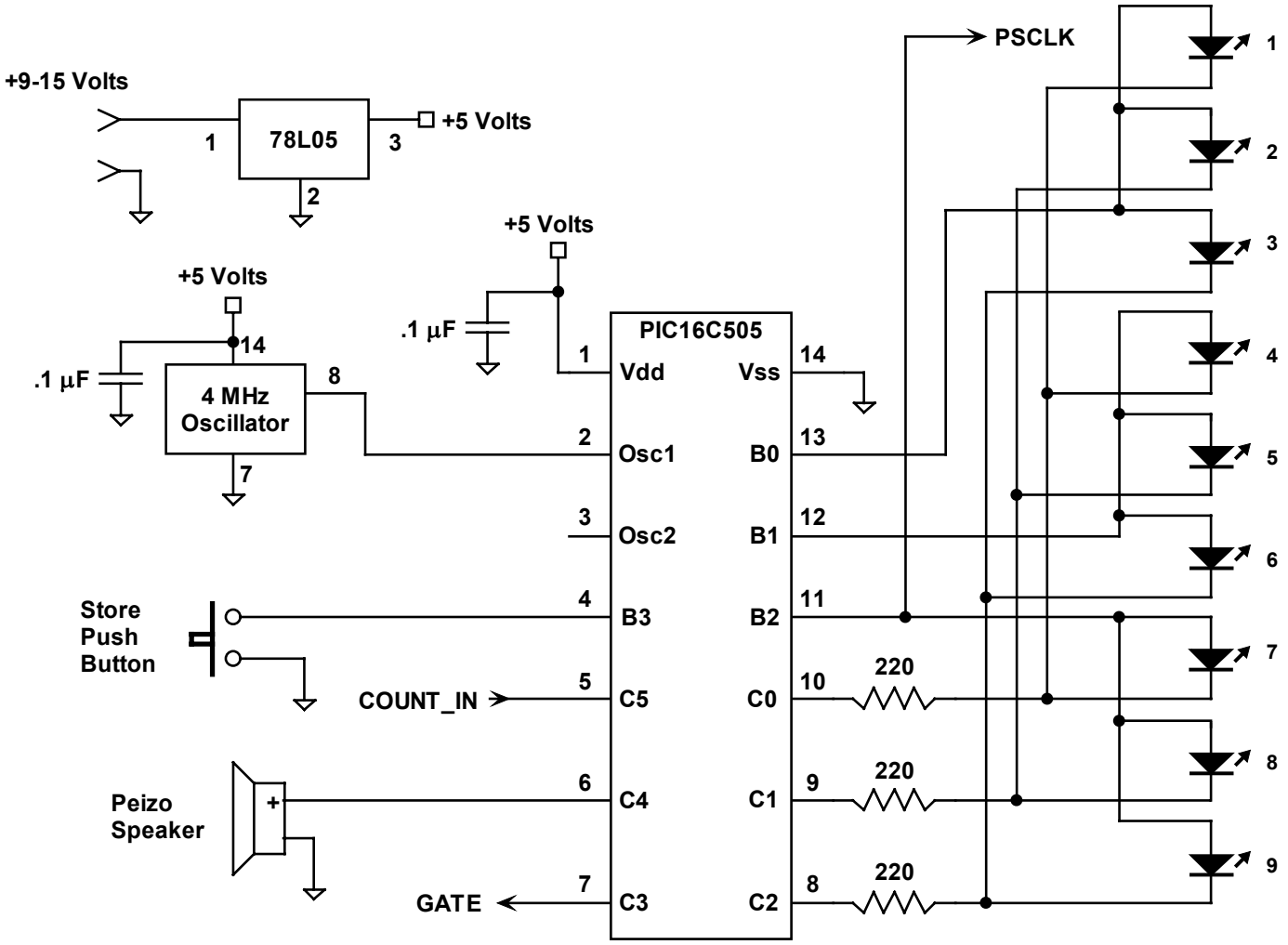
Following are a set of schematics illustrating how to hook up the GSXTAL chip to get it to work. The first schematic is the crystal oscillator and the frequency counter gating circutry. The second schematic is a design utilizing LEDs. Notice that Pin 11 is a multipurpose output shared between LED control and frequency gating. Don't forget the .1 uF cap at the PIC's power pins, it's essential for stable operation. The brightness of the LEDs is controlled by the 220 ohm resistors, smaller values will increase the intensity, larger will decrease intensity.

The third schematic is GSXTAL utilized in an LCD design. The chip is designed to be used with a 16x1 LCD display with the standard 14 pin interface. The design supports 16x1 or 16x2 LCD displays. See the display configuartion table to determine how to strap the PIC correctly for your display. Two optional pulldown resistors on pins 13 and 11 are used for strapping, use a 1K resistor as the strap.

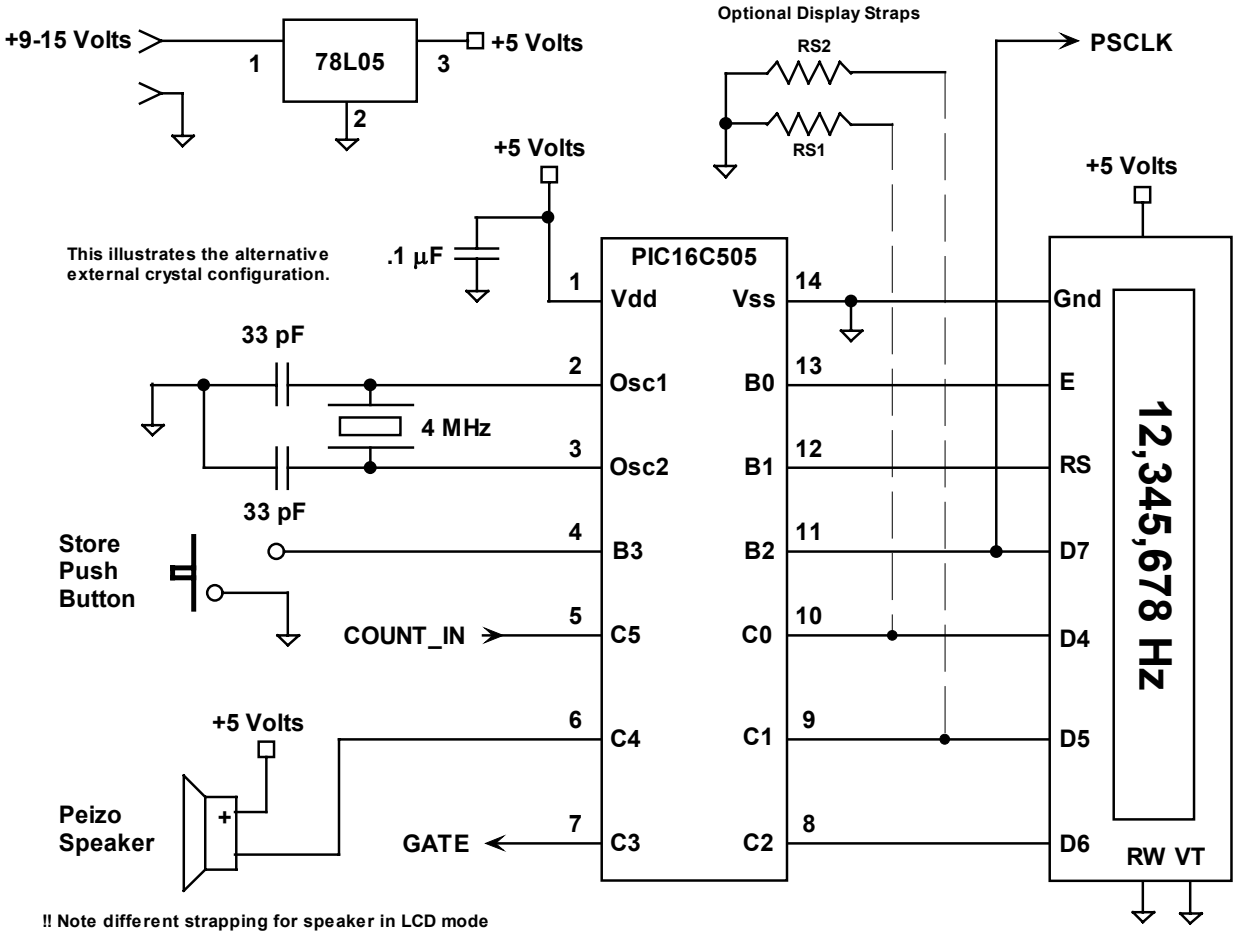
Also note the strapping diference of the speaker between the LED and LCD design. The PIC needs to know at start-up what sort of display it is connected to, LED or LCD. It does this by reading the speaker port as an input. If it finds the port high it knows it's an LCD, if low it's an LED. If you capacitively couple the speaker you will confuse the PIC and the display sensing will not work correctly.



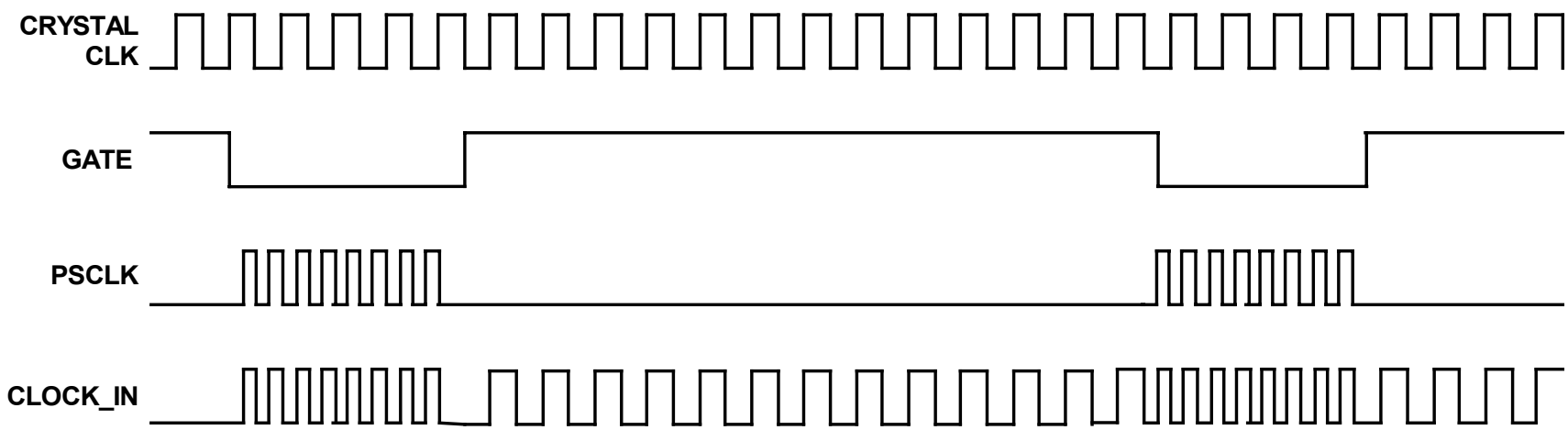
Crystal Matcher Schematic – Input and Gating – Page 1 4/05/01



Crystal Matcher Schematic – PIC and LED Interface – Page 2



Crystal Matcher Schematic – PIC and LCD Interface – Page 2a



GS Xtal Timing Diagram

The PIC counter architecture consists of an 8 bit counter preceded by an 8 bit prescaler. In order to count at high frequencies the prescaler must be used. The counter is readable directly by the PIC while the prescaler is not. In order to implement high-speed counters that utilize the prescaler a means must be provided to indirectly read the prescaler. In this design, incoming count pulses are gated by the GATE signal. Gate is held high for one second. After gating is complete, the PIC counter input is switched over to PSCLK which the PIC clocks until the internal 8 bit counter advances one count. By keeping track of the number of PSCLKs it took to cause the prescaler to overflow and generate a carry to the 8 bit counter we can determine what the count in the prescaler was at the end of the gating interval.

RS1	RS2	Display Type
Installed	Installed	Reserved
Installed	Not Installed	16 x 2
Not Installed	Installed	16 x 1 Linear addressing
Not Installed	Not Installed	16 x 1 Split addressing

Display Strapping Table