**Lab 2: ESOS and the ECE4723/6723 Target Board**

Stuffing, Soldering, and Partial-Build Testing Procedures

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**Purpose**

The purpose of this document is to outline the steps the team took to build and test the target board.

**Process**

The order of the soldering process is as follows:

1. Solder the 64-pin PIC33 microprocessor. Due to the small size of the pins on this chip, it is best to solder this component first in the event of the builder creating accidental solder bridges that cannot be remedied. This limits the amount of work that must be re-done if the soldering process needs to be restarted.
2. Solder the smallest components first: in this case, the resistors.
3. Solder the ceramic capacitors.
4. Identify the color of the LEDs using a multimeter set to “diode” or “continuity.” The two green LEDs go in the 3.3V and LED1 positions. The yellow LED goes with LED2. The red LED goes with LED3. These components should be oriented so that the green dot, which indicates the negative side of the diode, is pointing in the direction of the footprint of the potentiometers.
5. Solder the integrated circuits to the board (U4, IC3, IC2, IC1).
6. Solder the three switches to the board. Ensure that SW1 and SW2 do not bridge their connections.
7. Solder the electrolytic capacitor (C7). The negative stripe of the capacitor should face towards the potentiometers (same rule as step 4).
8. Solder the headers and jumper points.
9. Solder the two potentiometers.
10. Two jumper wires must be soldered to the back of the board: one from the RF0 pin of the H1 header to the RXD pin of the FTDI header, and one from the RTS pin of the FTDI header to the MCLR# pin of the ICSP header.
11. The shunts must be attached to the JP4 jumper and to the JP1 (specifically, between 1 and C).

The LCD is not necessary for this lab and does not need to be attached to the board at this time.

**Testing**

In order to ensure the proper functionality of various subsystems of the board, testing should be done in a cumulative manner. This will require the use of a multimeter and a reliable off-board power supply.

The first test involves ensuring the functionality of the MCU. To do this, the team checked the continuity of the chip by holding the COM probe of a multimeter to the GND pad of the target board and touching the legs of the chip with the other probe until the continuity signal was given by the multimeter.

The second test involves checking the functionality of the output LEDs (the 3.3V green LED should light up once power is supplied to the board). To do this, another continuity test in diode mode can be performed on each LED by applying the COM probe to the cathode (green dot) of the LED and the other probe to the other end. If the LED lights up, then the component is functioning.

Next, the board’s serial connection must be checked. The board, once connected to the computer via USB, can be loaded with the “make it dance” .hex file provided on Canvas. If this file fails to transfer, then BullyCPP will return an error message about a serial timeout. However, if it succeeds in transferring, then the red, green, and yellow LEDs of LED1-3 will light up, flash, and flash when a switch is pressed.

The board’s ability to be programmed over ICSP must also be verified. To do this, MPLAB IPE is loaded and the Advanced Mode is entered. The appropriate chip, the dsPIC33EP512GP806, is selected from the “Device” dropdown. Under the “Power” menu, the topmost checkbox is selected. Then, the bootloader .hex file from Canvas is loaded as the “Source” for the IPE. Once the proper Tool is selected, the device can be programmed. As long as the IPE returns no errors and properly recognizes the PIC, then the ICSP programming is working correctly.

Finally, the MCU inputs must be tested:

* SW1 and SW2 can be checked via the “make it dance” file, as the operation of these switches is required in order for the file to perform the flashing lights correctly.
* To test the potentiometer, a multimeter with an ohmmeter function must be used. The two probes must be placed on two of the legs of the potentiometer. The multimeter should read something within the rating of the potentiometer; in this case, somewhere within the 10 kilo-ohm range. With the probes in place, the potentiometer dial must be turned all the way to one side and the resistance displayed should not change by very much (this will provide a known value for testing the wiper of the potentiometer’s function). Then, one of the probes will be moved to the wiper contact of the potentiometer, and the dial will be slowly turned to the opposite end of its spectrum. As long as the values reported by the multimeter are within the prescribed tolerance of the component (in our case, 20%), then the potentiometer is functional.
* The shaft encoder can also be tested with a multimeter. By slowly rotating the shaft and holding probes against the contacts, one can observe the pulse that’s incurred by the change in connection within the encoder.