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International Student Contest

INTERCONNECTION TECHNIQUES IN ELECTRONICS

TIE 2010

Qualification Stage,
Timişoara, November 27th, 2009

Design the printed circuit board for the schematic presented in figure 4.

The circuit is a PWM analyzer able to calculate and display the frequency and duty cycle of a digital signal. It uses a microcontroller from the PIC16F family (**U1**) that acquires the PWM signal through a SMA connector (**FIN**) and displays the frequency and duty cycle on two four-digit LED displays (**DISP1** and **DISP2**). The circuit is powered from three 1.5 [V] AA batteries (**BAT1**-**BAT3**).

Design requirements:

1. Create a schematic symbol for the microcontroller PIC16F877A representing only the used pins. All the pins marked with "X" on the schematic will not be represented on the microcontroller symbol. The datasheet of the PIC16F877A is available as Annex 01.

2. Create the library representation (symbol and footprint) of the four-digit LED display CC56-12SRWA presented in figure 1. The schematic symbol will represent the LED segments and decimal points of each digit, just like in figure 4. The footprint on the other hand, will only represent the outline of the component and a marking of the correct mounting position. The datasheet of the CC56-12SRWA display is available as Annex 02.

Figure 1. The LED display

3. FIN is a SMA connector illustrated by figure 2, designed to be mounted on the edge of the PCB. Create the library representation of this connector, following the mounting guidelines presented in the datasheet. The board thickness is 1,57 [mm] (0,062 [inches]). The datasheet of the SMA connector is available as Annex 03.

Figure 2. The SMA connector

4. The three AA batteries will be mounted in battery holders of type 2460, illustrated by figure 3. The datasheet of the 2460 battery holder is available as Annex 04.

Figure 3. The battery holder

5. Use any components available in the CAD libraries for the rest of the circuit, with the following restrictions:

- The counter 4017 (**U2**) should have a SMD SO-16 footprint.
- The 100nF capacitors should have SMD 0805 footprints.

6. Use three busses on the schematic circuit, just like in figure 4.

7. The board will have rectangular shape with rounded corners and the minimum necessary size. The display and the batteries will be placed on the top side of this board.

8. The board will be double-sided with traces mostly horizontal on top layer and mostly vertical on bottom. The following restrictions must be enforced:

- Signal trace width: 0,25 [mm].
- Power trace width: 0,4 [mm].
- Minimum clearance between traces: 0,25 [mm].
- Minimum clearance between traces and pads: 0,3 [mm].

9. The trace between the SMA connector and the microcontroller will be routed on a single layer of the board and have a length of maximum 30 [mm].

10. Create a guard loop for the quartz crystal (**X1**): a trace connected at GND potential that surrounds the crystal pins and traces.

11. Create a ground plane beneath the microcontroller. Place the decoupling capacitors near its power supply pins and connect them directly to the ground plane.

12. Mark on the solder mask the part number of the SMA connector (ordering code, according to the producer specification)

12. Generate the fabrication (CAM) files for:

- *Top Layer*
- *Bottom Layer*
- *Solder Mask Top*
- *Solder Mask Bottom*
- *Board Outline*
- *NC Drill*

Notes:

(i) The maximum admitted tolerance for footprints is 0,1 [mm]

(ii) This subject also includes the following annexes:

01 Microcontroller PIC16F87x.pdf → *datasheet for the PIC16F877A microcontroller*
02 LED Display CC56-12SRWA.pdf → *datasheet for the four-digit LED display*
03 SMA connector.pdf → *datasheet for the SMA connector*
04 Battery holder.pdf → *datasheet for the 2460 battery holder*

Timişoara,
27.11.2009, 9^{00} – 11^{00}

Qualifications director,
Marius RANGU, PhD

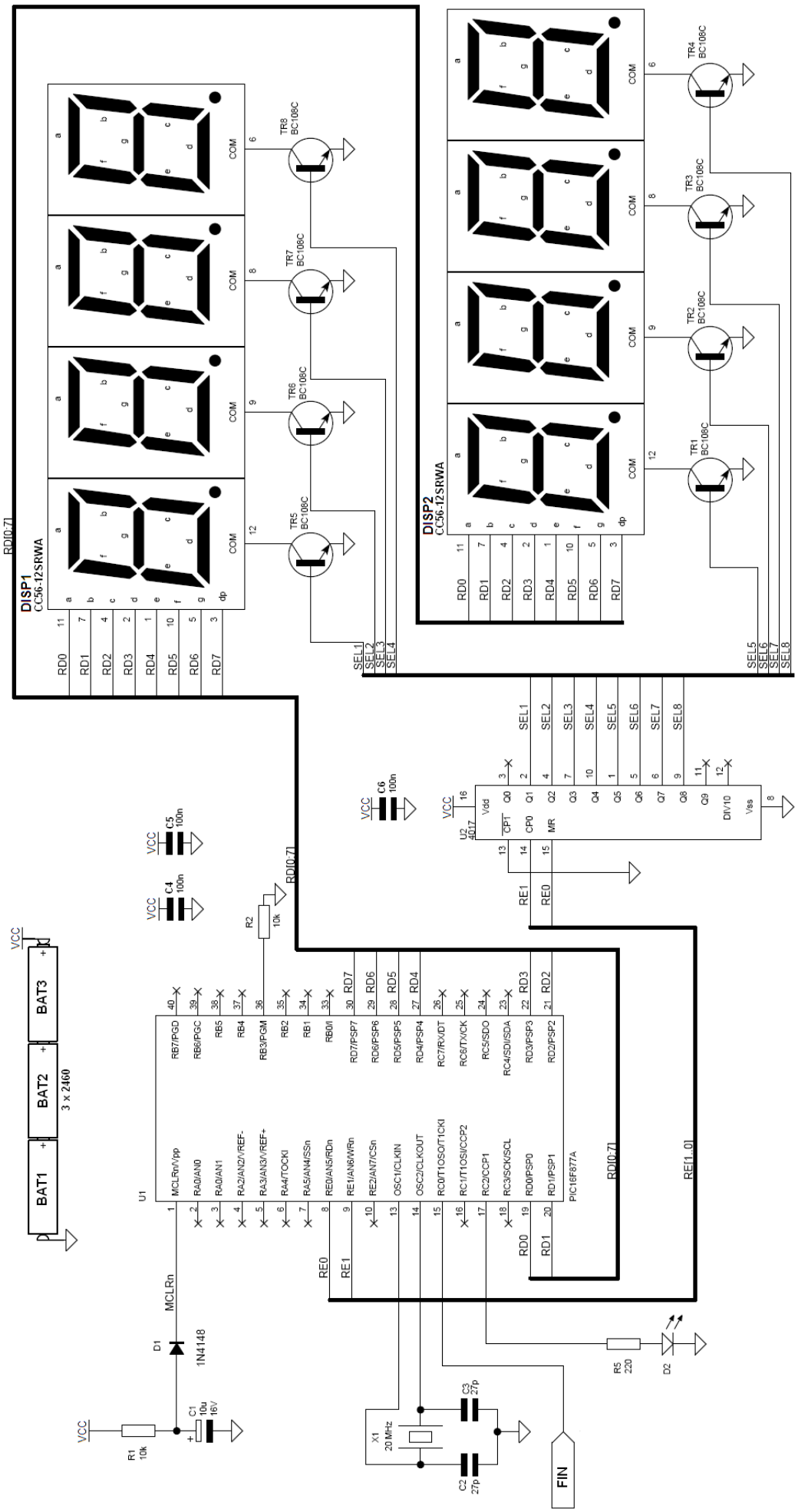

Figure 4. The circuit schematic