National University of Singapore

Department of Electrical and Computer Engineering

CG2007 – Microprocessor Systems

AY2011/2012 Semester 2

Introductory Laboratory to Major Projects

1. Objectives

1) To obtain a general picture of micro-processor system

2) To solder surface-mounted components, IC sockets and discrete components onto the printed circuit board (PCB)

3) To learn wire wrapping techniques for connecting IC chips together

2. Components

- ✓ Screw driver and tweezers
- ✓ Wire wrapping wires and solder wire
- ✓ Customized Printed Circuit Board (PCB)
- ✓ IC & IC sockets Set
- ✓ Surface Mounted Devices (SMD resistors and capacitors)
- ✓ LEDs, 5mm diameter, Red and Green
- ✓ 7-segment display (common Anode)
- ✓ Push Button Switches
- ✓ 4-way dip switch
- ✓ Frequency Crystal 16MHz
- ✓ L7805C Fixed Voltage Regulator
- ✓ 74LS14 Hex inverting Schmitt Trigger
- ✓ 74LS47 BCD to 7-segment Decoder
- ✓ Diodes
- ✓ Discrete resistors and capacitors

3. Soldering Procedures

3.1. **Solder the surface mounted resistors and capacitors onto the PCB**, the component values are shown as follows. Component values are also available in the circuit schematic. Capacitor C_1 and C_2 are placed for the crystal, and all the other capacitors are used for decoupling purpose.

$R_1 = R_2 = R_3 = R_4 = R_5 = R_6 = R_7 = R_8 = R_9 = 2.2k\Omega$
$R_{10} = 100\Omega$
$R_{12} = 10k\Omega$

$C_1 = C_2 = 27pF$

$C_4 = C_7 = C_9 = C_{10} = C_{11} = C_{12} = C_{13} = C_{14} = 0.1uF$

Please handle surface mounted components carefully, as they are very small in size. You may read resistance from the label on the resistors, but there are no labels on the capacitors. Do not put C_1 and C_2 with the other capacitors together.

3.2. **Solder the IC sockets for U1, U2, U3, U4, U5 and U6 onto the PCB**. A PLCC 68-pin socket (square shape) is used to hold the 80C188 microprocessor IC (U1). Make sure you place the socket in the correct orientation, according to the special corner of the socket. Take note of the direction of the other sockets as well.

U1: 80C188 Microprocessor
U2: 74HC573 Latch
U3: AT28C64B EEPROM (64K bytes)
U4: HM/UT6264 RAM (64K bytes)
U5: 82C55A PPI (Programmable Peripheral Interface)
U6: 74LS14 Schmitt Trigger

WARNING: Do **NOT** place the ICs onto the sockets when you are soldering the sockets. This may damage the ICs permanently.

Tip: You may use scotch tape or masking tape to secure the sockets before soldering.

3.3. Most digital circuits require a well-regulated +5V DC power supply. The 78'05 fixed voltage regulator provides an economic method to obtain such +5V voltage from a power source that outputs +9V.

Solder the 78'05 IC and corresponding capacitors (EC1 and EC2) and LED (D9) onto the PCB. Circuit diagram of the voltage regulator is shown in Figure 1. Take note of the polarity of the electrolytic capacitors.

After soldering the 9V and GND connectors, you may test the regulator output by connecting the input to a bench power supply unit and set input voltage as approximately +9V. The LED (D9) is able to indicate the on/off status of the power supply. Measure, using digital multi-meter, the output voltage Vcc on the PCB and ensure that it is +5V. You can find several testing points on the PCB for your measurements.

Reminder: Set current limit of the power supply to be less than 500mA to prevent short-circuit damage to the ICs.

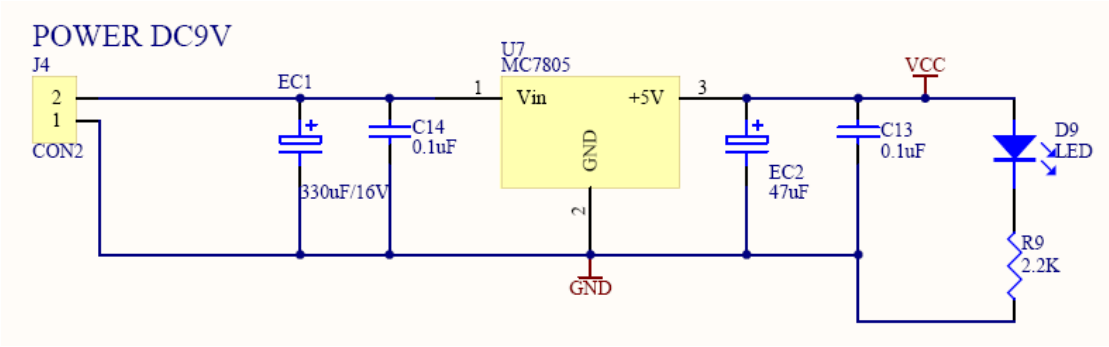

Figure 1 – +5V DC supply using 78'05 fixed voltage regulator.

3.4. The 80C188 microprocessor needs a clock reference to operate properly. Here a 16MHz quartz crystal device is applied to provide such time reference. The crystal circuit diagram is shown in Figure 2. Pin-58 and Pin-59 belong to the 80188C microprocessor. **Solder the crystal IC onto the PCB.**

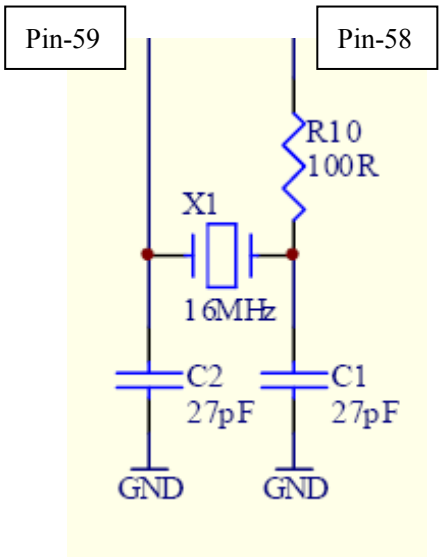

Figure 2 – 16MHz quartz crystal circuit for 80C188 microprocessor

3.5. **Solder the RESET push button and diodes onto the PCB.** The RESET button is to set the microprocessor back to its default status. Take note of the push button orientation and diodes' polarity (the terminal with black label is the negative side of a diode). The RESET circuit is described in Figure 3.

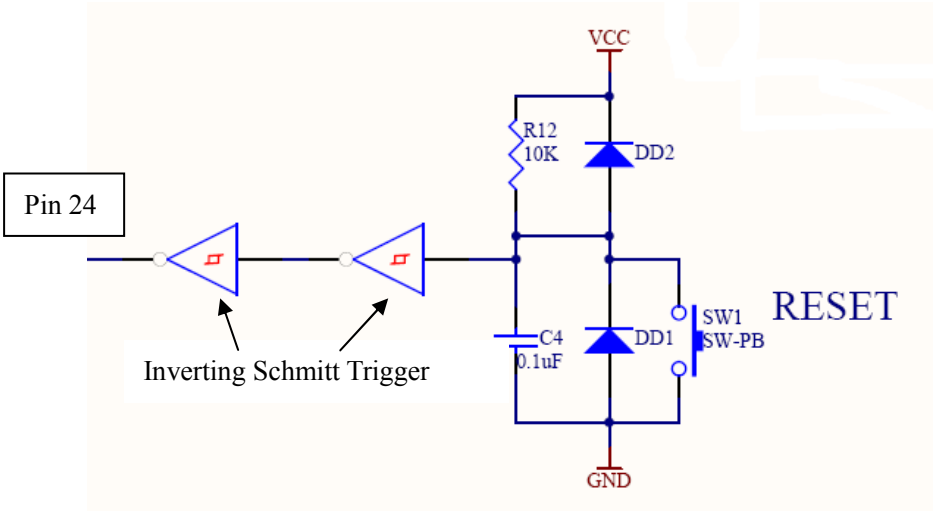

Figure 3 – RESET circuit for 80C188 microprocessor

3.6. **Solder the SIL sockets for LEDs D_1 – D_8.** Make use of scotch tape or masking tape if necessary. You may then place the LEDs on the sockets, according to their polarities.

4. Testing hardware

4.1. You may now plug the ICs into the sockets. Take note of the IC orientation.

4.2. Power up the board using +9V DC supply. Make sure the regulator circuit outputs a clear +5V DC voltage. The output current should be less than 100mA.

4.3. Check the crystal oscillator's functionality by using the oscilloscope. From Pin-58 and Pin-59, you should see the respective waveforms in Figure 4 and Figure 5.

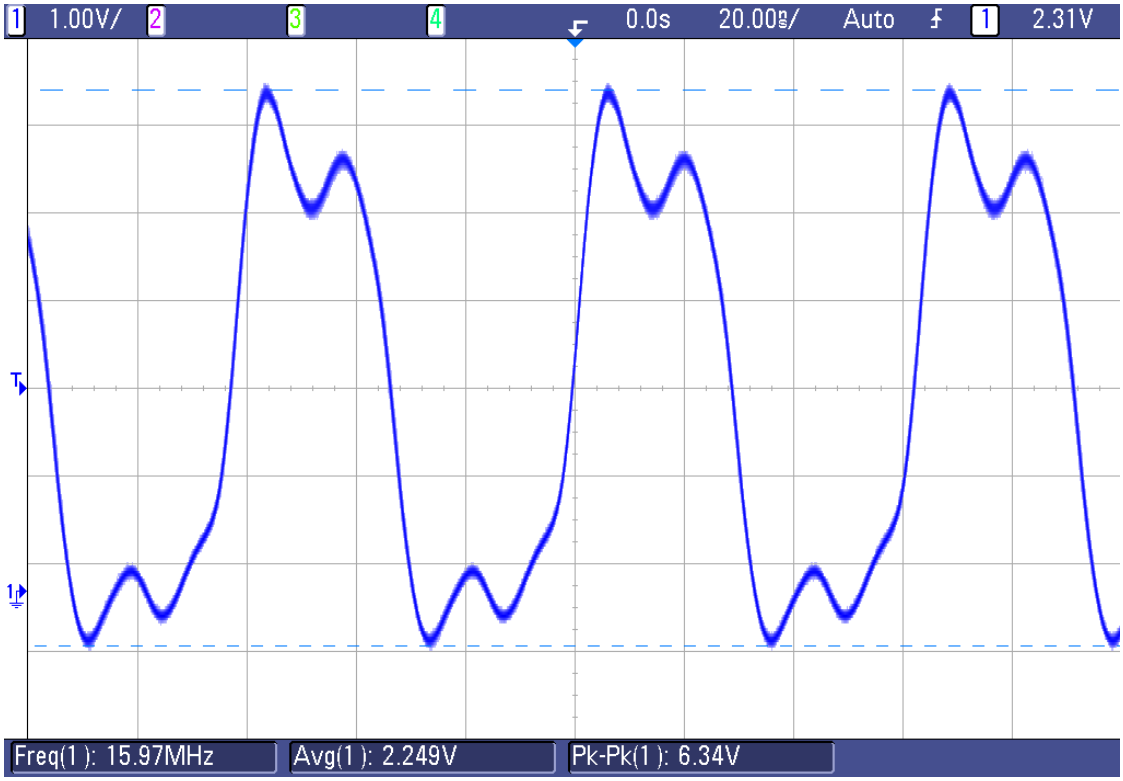

Figure 4 – Proper oscilloscope waveform for Pin-58

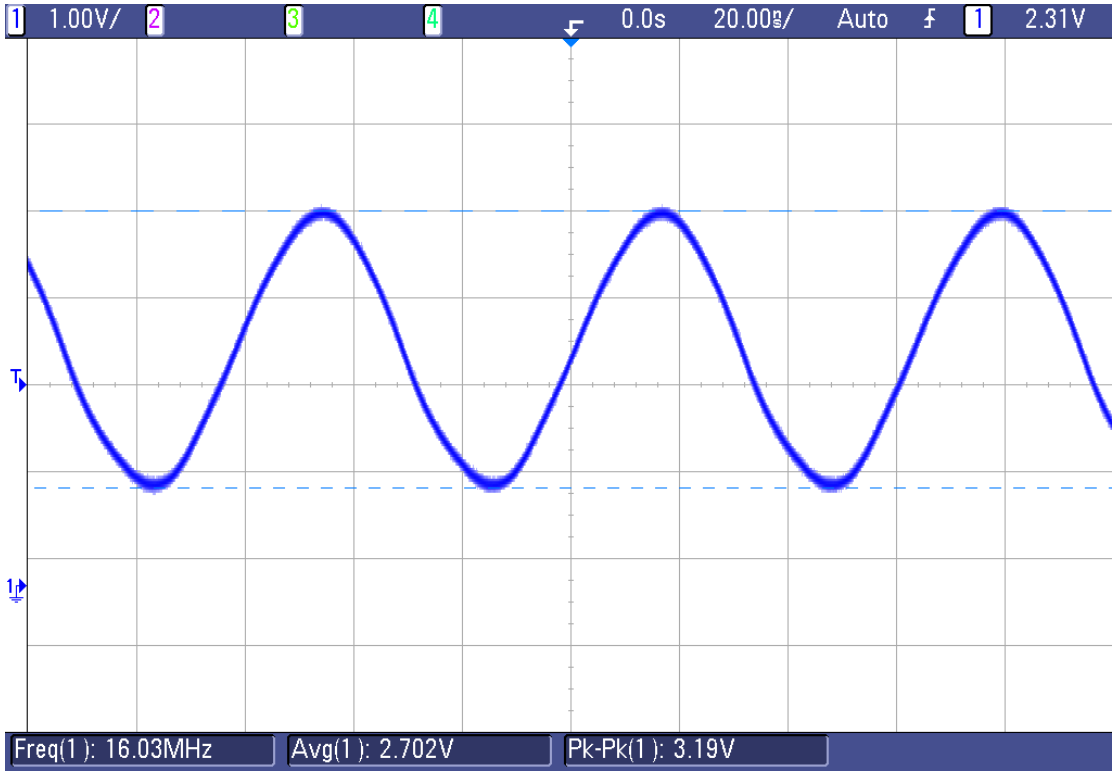

Figure 5 – Proper oscilloscope waveform for Pin-59

4.4. **Test your board's functionality using the sample program "Demo.BIN"**. Take out your EEPROM from the PCB and place it in the SuperPro500P programmer located in the lab. Load the sample file "Demo.BIN" and press "Auto" to burn your EEPROM with the loaded code.

Plug your EEPROM back to the PCB, and then power up your circuit. After pressing the RESET button, the LEDs D_1 – D_8 will light up alternately. If the system does not function properly, it implies that the board has hardware problems, possibly caused by soldering, malfunctioning chips, or other errors. Try to debug your board first. If problems still exist, you may go to your respective GA for assistance.

5. Hardware Assessment

Demonstration Date: Week 7 (starts from 27th Feb).
You need to demonstrate your board with "Demo.BIN" (Section 4.4) to your respective GA during the lab session in Week 7. Late demonstration will be penalized.

Note: Copying should be strictly avoided. If any circuit/report is found copied, then the candidate must face the disciplinary action from the Department/University.

THE END