

SP.710, Spring 2001: "Intro to Microcontrollers"

Handout 1:

1. A schematic of the PIC circuit you will wire up today (due by class Wednesday).
 2. The pinout of the PIC16F876.
 3. A description of the function of each of the PIC's pins.
 4. The pinout of a standard 78L05 5-volt regulator.
 5. How to read resistors.
 6. How to read capacitors.
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References:

web page for this seminar at:

<http://web.mit.edu/rec/seminars/spring01/sp710.html>

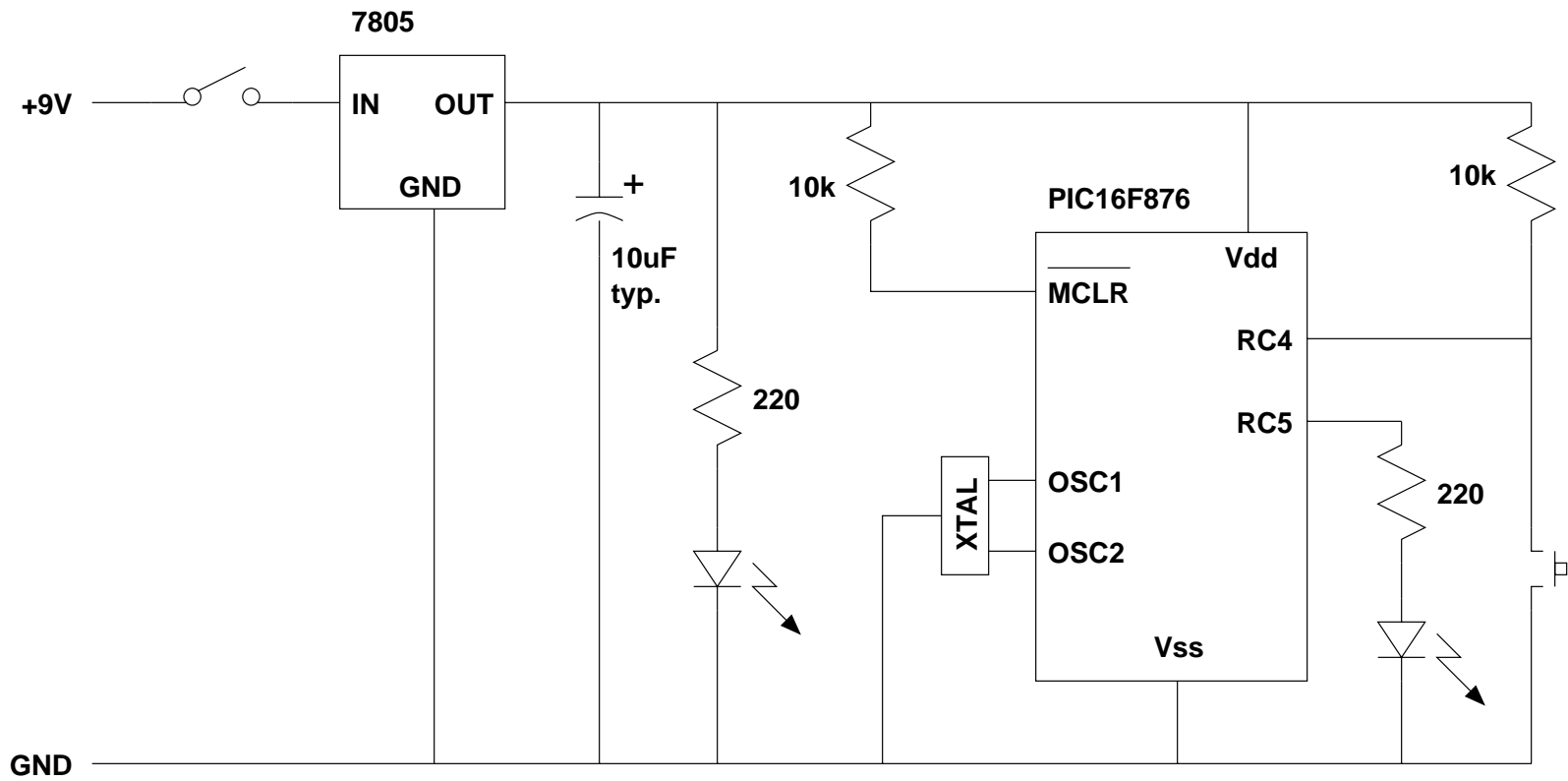
full PIC datasheet available at:

<http://web.mit.edu/rec/datasheets/PIC16F876.pdf>

full 78L05 datasheet available at:

<http://web.mit.edu/rec/datasheets/LM78L05.pdf>

(bendavis@alum.mit.edu, 2/12/2001)



PIC16F87X

Pin Diagrams

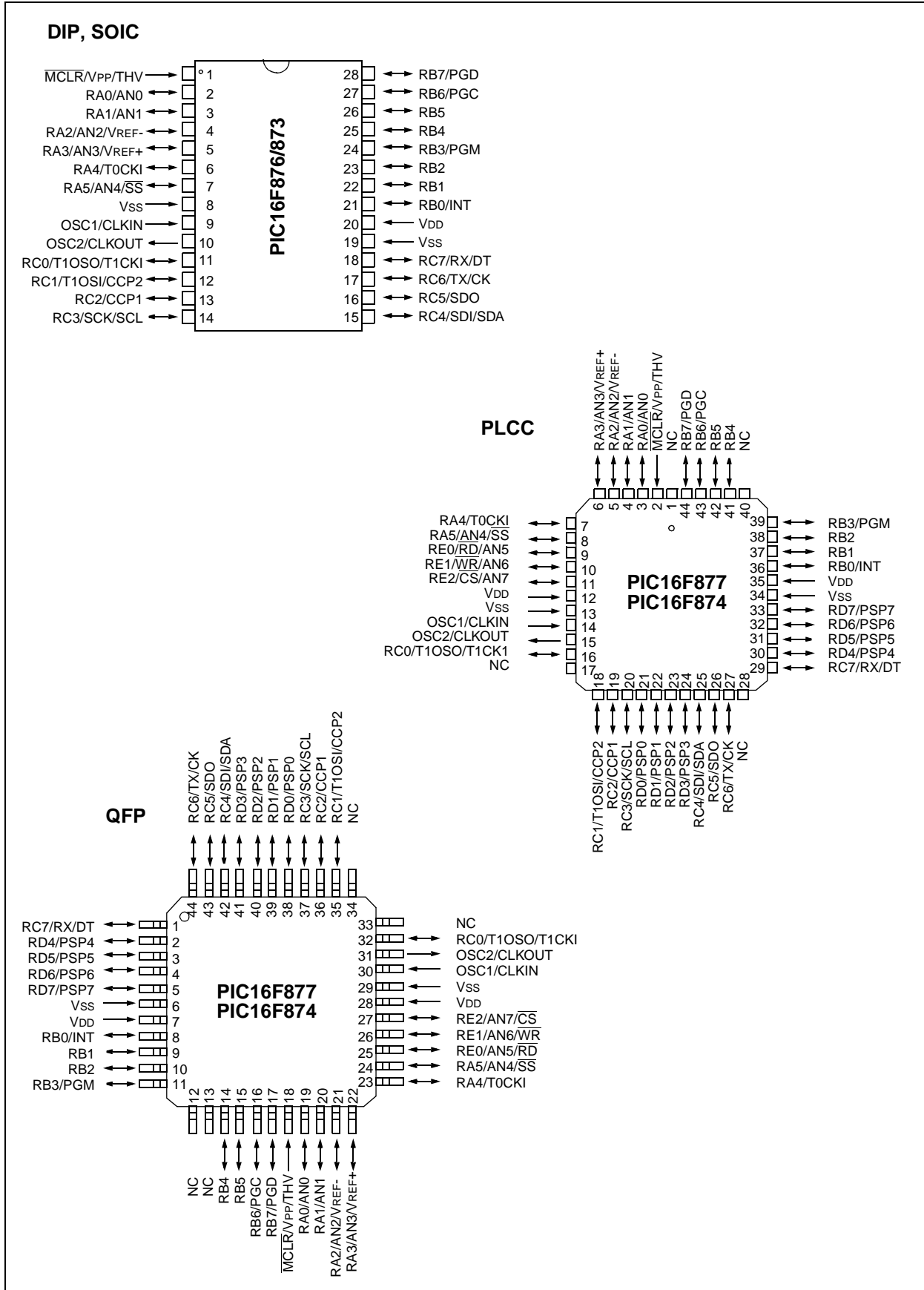


TABLE 1-1: PIC16F873 AND PIC16F876 PINOUT DESCRIPTION

Pin Name	DIP Pin#	SOIC Pin#	I/O/P Type	Buffer Type	Description
OSC1/CLKIN	9	9	I	ST/CMOS ⁽³⁾	Oscillator crystal input/external clock source input.
OSC2/CLKOUT	10	10	O	—	Oscillator crystal output. Connects to crystal or resonator in crystal oscillator mode. In RC mode, the OSC2 pin outputs CLKOUT which has 1/4 the frequency of OSC1, and denotes the instruction cycle rate.
MCLR/VPP/THV	1	1	I/P	ST	Master clear (reset) input or programming voltage input or high voltage test mode control. This pin is an active low reset to the device.
RA0/AN0	2	2	I/O	TTL	<p>PORTA is a bi-directional I/O port.</p> <p>RA0 can also be analog input0</p> <p>RA1 can also be analog input1</p> <p>RA2 can also be analog input2 or negative analog reference voltage</p> <p>RA3 can also be analog input3 or positive analog reference voltage</p> <p>RA4 can also be the clock input to the Timer0 module. Output is open drain type.</p> <p>RA5 can also be analog input4 or the slave select for the synchronous serial port.</p>
RA1/AN1	3	3	I/O	TTL	
RA2/AN2/VREF-	4	4	I/O	TTL	
RA3/AN3/VREF+	5	5	I/O	TTL	
RA4/T0CKI	6	6	I/O	ST	
RA5/SS/AN4	7	7	I/O	TTL	
RB0/INT	21	21	I/O	TTL/ST ⁽¹⁾	<p>PORTB is a bi-directional I/O port. PORTB can be software programmed for internal weak pull-up on all inputs.</p> <p>RB0 can also be the external interrupt pin.</p> <p>RB3 can also be the low voltage programming input</p> <p>Interrupt on change pin.</p> <p>Interrupt on change pin.</p> <p>Interrupt on change pin or In-Circuit Debugger pin. Serial programming clock.</p> <p>Interrupt on change pin or In-Circuit Debugger pin. Serial programming data.</p>
RB1	22	22	I/O	TTL	
RB2	23	23	I/O	TTL	
RB3/PGM	24	24	I/O	TTL	
RB4	25	25	I/O	TTL	
RB5	26	26	I/O	TTL	
RB6/PGC	27	27	I/O	TTL/ST ⁽²⁾	
RB7/PGD	28	28	I/O	TTL/ST ⁽²⁾	
RC0/T1OSO/T1CKI	11	11	I/O	ST	<p>PORTC is a bi-directional I/O port.</p> <p>RC0 can also be the Timer1 oscillator output or Timer1 clock input.</p> <p>RC1 can also be the Timer1 oscillator input or Capture2 input/Compare2 output/PWM2 output.</p> <p>RC2 can also be the Capture1 input/Compare1 output/PWM1 output.</p> <p>RC3 can also be the synchronous serial clock input/output for both SPI and I²C modes.</p> <p>RC4 can also be the SPI Data In (SPI mode) or data I/O (I²C mode).</p> <p>RC5 can also be the SPI Data Out (SPI mode).</p> <p>RC6 can also be the USART Asynchronous Transmit or Synchronous Clock.</p> <p>RC7 can also be the USART Asynchronous Receive or Synchronous Data.</p>
RC1/T1OSI/CCP2	12	12	I/O	ST	
RC2/CCP1	13	13	I/O	ST	
RC3/SCK/SCL	14	14	I/O	ST	
RC4/SDI/SDA	15	15	I/O	ST	
RC5/SDO	16	16	I/O	ST	
RC6/TX/CK	17	17	I/O	ST	
RC7/RX/DT	18	18	I/O	ST	
Vss	8, 19	8, 19	P	—	Ground reference for logic and I/O pins.
Vdd	20	20	P	—	Positive supply for logic and I/O pins.

Legend: I = input O = output I/O = input/output P = power
 — = Not used TTL = TTL input ST = Schmitt Trigger input

- Note** 1: This buffer is a Schmitt Trigger input when configured as the external interrupt.
 2: This buffer is a Schmitt Trigger input when used in serial programming mode.
 3: This buffer is a Schmitt Trigger input when configured in RC oscillator mode and a CMOS input otherwise.

LM78LXX Series 3-Terminal Positive Regulators

General Description

The LM78LXX series of three terminal positive regulators is available with several fixed output voltages making them useful in a wide range of applications. When used as a zener diode/resistor combination replacement, the LM78LXX usually results in an effective output impedance improvement of two orders of magnitude, and lower quiescent current. These regulators can provide local on card regulation, eliminating the distribution problems associated with single point regulation. The voltages available allow the LM78LXX to be used in logic systems, instrumentation, HiFi, and other solid state electronic equipment.

The LM78LXX is available in the plastic TO-92 (Z) package, the plastic SO-8 (M) package and a chip sized package (8-Bump micro SMD) using National's micro SMD package technology. With adequate heat sinking the regulator can deliver 100 mA output current. Current limiting is included to limit the peak output current to a safe value. Safe area protection for the output transistors is provided to limit inter-

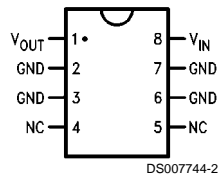
nal power dissipation. If internal power dissipation becomes too high for the heat sinking provided, the thermal shutdown circuit takes over preventing the IC from overheating.

Features

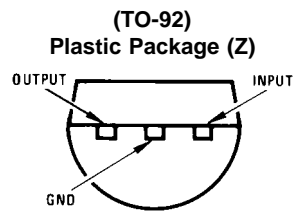
- LM78L05 in micro SMD package
- Output voltage tolerances of $\pm 5\%$ over the temperature range
- Output current of 100 mA
- Internal thermal overload protection
- Output transistor safe area protection
- Internal short circuit current limit
- Available in plastic TO-92 and plastic SO-8 low profile packages
- No external components
- Output voltages of 5.0V, 6.2V, 8.2V, 9.0V, 12V, 15V
- See AN-1112 for micro SMD considerations

Connection Diagrams

**SO-8 Plastic (M)
(Narrow Body)**

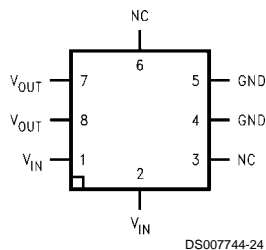


Top View



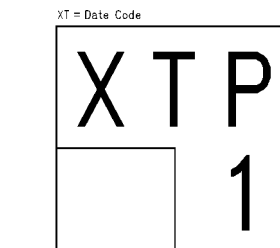
Bottom View

8-Bump micro SMD



**Top View
(Bump Side Down)**

micro SMD Marking Orientation



Pin 1 Corner
Pin 1 is identified by lower left corner with respect to the text.

DS007744-33

Top View

Resistor Color Codes

Most common resistors have four colored bands. The band at one end of the resistor will be a metallic color (gold, silver, or bronze). This indicates the accuracy of the resistor (+/- 5%, 10%, or 20%, respectively).

If you call this the "4th band", the other three bands tell you the resistance in ohms according to the following table:

	Band:		
Color:	1st	2nd	3rd
Black	0	0	* 10^0
Brown	1	1	* 10^1
Red	2	2	* 10^2
Orange	3	3	* 10^3
Yellow	4	4	* 10^4
Green	5	5	* 10^5
Blue	6	6	* 10^6
Purple	7	7	* 10^7
Grey	8	8	* 10^8
White	9	9	* 10^9

To illustrate, the common yellow-purple-orange-gold resistor is $47 * 10^3$ ohms = 47000 ohms (+/- 5%).

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Capacitor Codes

Capacitors are labeled in a wide variety of different ways, but this handout lists the most common markings on capacitors and what they mean.

Electrolytic and Tantalum capacitors often have the capacitance (in uF) and voltage (maximum allowed voltage) printed on them in human-readable form. The capacitance will usually be followed by the letters "uF" to indicate measurement in microfarads, but the voltage may or may not be followed by a V. These capacitors are also often polarized, and typically have a + or a - printed on the case next to one lead (the - may be rotated 90 degrees from the horizontal). Non-polar electrolytics do exist, and often have the letters "NP" printed on them.

Ceramic, Polyester, Metallized Film, and other low-capacitance capacitors are often marked using a different system. Commonly the capacitor will have one or two numbers printed on it. Here are explanations of the most common cases:

- Only one number, which is one or two digits long:

The capacitance is this number of picoFarads (pF).

- Only one number, three digits long:

If we call the digits ABC (with $C < 6$), the capacitance is given by the formula $(AB * 10^C)$ pF. For example, a capacitor that reads 224 is $22 * 10^4$ pF = 220,000 pF = 220 nF = 0.22 uF.

- Only one number, three digits long, followed by a letter:

Same capacitance as in the previous case, but the letter indicates a tolerance:

D = +/- 0.5 pF	F = +/- 1%	G = +/- 2%
H = +/- 3%	J = +/- 5%	K = +/- 10%
M = +/- 20%	P = +100% / -0%	Z = +80% / -20%

- Two numbers, one of them followed by a letter:

The number followed by a letter indicates the capacitance and tolerance of the cap, as in the previous case. The other number is the rated voltage (in volts). For example, a capacitor that reads:

104J
630

Is a 100,000 pF (= 0.1 uF) +/-5% capacitor rated to 630 Volts.