QUASAR PROJECT KIT # 3069 - PIC DICE

This Kit is an introduction to the most popular small micro-controller now on the market the PIC (Peripheral Interface Controller) series of micro-controllers (uC) from Microchip. They are popular because they are fast, are in abundant supply, the code though cryptic on first sight is well thought out, and they have cheap development tools available.

This Kit presents an application using one of the simplest PIC chips available, the 16C54, now available (august, 2000) as the PIC16C54C 04/P. All the code fully commented is available for free download from our website at:

http://www.... Full address supplied with product

One of the most popular electronic kits world-wide is an electronic dice. Our Kit 3003 is an electronic dice using transistors and logic IC's. We have used a PIC chip to completely replace all this external logic. All that remains with the PIC chip is the LED display with a current limiting resistor, an RC oscillator, a voltage regulator and a switch with its pull-up resistor. You could not do the job with much less!

The kit is constructed on a single-sided printed circuit board (PCB). Protel Autotrax and Schematic were used to produce the board.

ASSEMBLY INSTRUCTIONS

Check off the components in the kit against the component listing. Solder in the three resistors, the diode D1 and C2 first. Make sure to get the diode around the correct way; the black bar on the diode corresponds with the bar on the overlay. Next solder in the taller components; the IC socket, the 10uF electrolytic apacitor, voltage regulator, the LED display and the hatkey switch. Make sure the flat side of the switch corresponds to the flat shown on the overlay diagram of the switch. Insert the programmed PIC chip. Make sure the IC notch is towards the top of the PCB corresponding with the overlay.

For the 9V battery snap solder the black wire into the - pad, and the red wire into the +pad.

SOFTWARE SPECIFICATION

We want to generate a random number between 1 and 6 everytime the switch is pressed and to display the number on the LED display for a few seconds. Then we want to be able to press the switch again and get another number. If the switch is not pressed for about a minute then we want it to turn off (that is, use the sleep mode of the PIC) to save power. Pressing the switch for about a second should wake the PIC from sleep mode and be ready to roll the dice again.

Hardware Setup. There are two I/O ports in the 16C54; one 8 bit & the other 4 bit. The 8 bit port, Port B, is connected to the 7 segment display. Only one pin, RA0, of the 4 bit Port A is used. The other 3 pins are all tied high. Pin 4 is also tied high to give a power-on reset.
A single 150R resistor, R1, acts as a current limiting resistor for port B which has a maximum sourcing current of 40mA. (The maximum current for the LED display is 200mA so it is the PIC that R1 is protecting, not the display.)

The PIC uses its internal RC clock oscillator option (with the 10K resistor and the 330pF capacitor) and runs at about 330kHz. The switch is connected to input RA0. Normally this line is pulled high via R3 to +5V, but when the switch is closed the input is pulled low. The software detects the falling edge as a dice roll.

Software Outline. When power is first applied, the PIC does a power-on reset. It goes to Start. The first task is to initialize the various internal options such as the direction of the I/O ports and the status of any outputs (high or low.) The watchdog timer is switched on and the initial value of some RAM locations are set.

The dice now settles down in the main program loop, Start01. It continuously loops hundreds of times a second to see if the switch has been pressed, flash the decimal point, generate the next random number and reset the watchdog timer. Then when a switch press is detected the program jumps out of Start01 to Start02. The dice is rolled. The sleep counter is reset to 50 flashes. Display outputs the random number to the 7 segment LED display by multiplexing to it. At the end of Display the program returns to Start01.

Various subroutines - Delay, Roll, Flash, Random and two look-up tables for the display - are listed in the final part of the program. Note the rand01 code segment in random and why it is there. If there is no keypress for 50 flashes then the PIC goes into sleep mode at the end of the Flash subroutine.The oscillator is turned off and ports A & B are configured as inputs.

Now with the PIC in sleep mode the watchdog timer is not being reset anymore. It was not turned off when the PIC went to sleep. It now times out about every 1.3 seconds to check if the key is being pressed. If no keypress is found then it goes back to sleep. But if it is then the PIC wakes-up, resets the ports, starts to flash the decimal point and it is ready to roll again on the next keypress.

What to Do Now. You should have been able to identify in general terms the various parts of the program mentioned above in the program listing. Now pick out a part of the code and try to understand it in detail. Get the 33 PIC instructions and make sure you understand what is happening. This will immediately lead you into the inner workings of the chip. Remember you will not learn everything in one sitting. Try to find someone you can call on to ask questions & who will mentor you through this task.

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WHAT TO DO IF IT DOES NOT WORK
Poor soldering is the most likely reason that the circuit does not work. Check all solder joints carefully under a good light. Next check that all components are in their correct position on the PCB especially the IC, electrolytic capacitor, the diode and the switch. Is the battery OK?

References
The Internet is where to find References. We have listed some on our links page at

www.quasarelectronics.com/links.htm

There is an active PIC List which you can join and ask questions.

You may email us at

sales@quasarelectronics.com

if you have any questions.

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COMPONENTS	
Resistors 5%, 1/4W	
150R resistor R1	1
10K resistor R2 R3	2
10uF electrolytic C1	1
330pF ceramic C2	1
PIC 16C54C 04/P programmed IC	1
18 pin IC socket	1
LED display	1
78L05	1
1N4148 D1	1
3069 PCB	1
Hatkey switch	1
9V battery snap	1