QUASAR KIT No 1173 - DIGITAL DOWN TIMER 99 MIN WITH PIC

KIT 1173 is a digital countdown timer based on a micro controller, thus securing reliability and excellent operation under any circumstances. It can be programmed to countdown up to 99 minutes and 59 seconds. When the timer starts counting, a relay is activated. When this time reaches zero, the relay is disabled.
This kit can be used for automation and wherever a reliable timer is needed.
The heart of the circuit is a micro controller from the PIC family manufactured by Arizona Microchip, the PIC 16C57.
The time is displayed by 4 large seven-segment displays and it can take any value from 0 to 99 minutes and 59 seconds, or 999.9 seconds.

TECHNICAL CHARACTERISTICS

- Power requirements: 9 - 15V DC, 220 mA
- Time display: 4 seven-segment displays
- Programming controls: 3 pushbuttons: Count/Pause, Start/Select, Reset
- Output: Mains Rated Relay

CIRCUIT DESCRIPTION

Crystal Y1 along with capacitors C1 and C2 form the circuit that produces the 4 MHz reference signal. As you can easily calculate, the 4 MHz frequency leads to a duty cycle of 1μsec. This means that every command (except 5 special commands) is executed in only 1μsec.
The LM7805CV voltage regulator, the D1 diode and the C3, C4, C5 C6 capacitors are supplying the necessary +5 Volts to the micro controller, independent of the input voltage that can vary from 9 to 15 Volts DC. The capacitor C4 makes the regulator capable of responding to fast changes of the load current, making sure that the circuit will be fed with the proper voltage at any time. The diode D1 protects the circuit from any accidental reverse input voltage.
Transistor Q5, resistor R16 and diode D2 drive the relay. Transistor Q5 acts like a switch. Diode D2 protects the transistor from the inductive voltage that occurs at the relay terminals every time t's activated. Resistor R16 limits the base current and is responsible for the switching operation of the transistor.
Resistor R13 and switch S1 are the input network of the microprocessor. When S1 is released, terminal 6 is at logic high (5V), while when S1 is depressed the same terminal is getting a logic low (0V). The same way, resistors R14, R15 and switches S2, S3 form the input networks connected to terminals 17 and 7 (see table 1). All the above mentioned switches are pushbutton type.

BUTTON	FUNCTION	TERMINAL
S1	SELECT/START	6
S2	PRESET/PROGRAMMING	7
S3	COUNT/PAUSE	17

Table 1

Visualization of the microcontroller's output is done through four 7-segments displays. Transistors Q1, Q2, Q3, Q4 and resistors R1 to R12 form the network that is driving the displays. These four transistors act as switches driven by the voltage (0 or 5V) that appears at the microcontroller's pins 10, 11, 12 and 13 that are programmed to operate as outputs. Every time that a transistor is "on" the relevant display is active and displays the contents of its seven segments (A, B, C, D, E, and F). The displays get the data from the PIC and display it in decimal mode e.g. numbers from 0 to 9.
In order to reduce the communication lines from the PIC to the displays from 32 to 12, we have to make sure that when a display is active, the rest three must be set off. This time-sharing is an easy job for a device like the PIC 16C57.
One should expect the brightness of the LEDs to be low using this method of operation, but using the Q1 to Q4 transistors and calculating the value of the R1 to R8 resistors carefully, we achieve the highest brightness possible.

The 9V battery and the D3, D4 diodes form a backup power supply, so in case of main power supply failure, data won't be lost. D5 and R17 detect the presence of the normal supply voltage and when this is off the backup power supply is connected automatically.

NOTE: When the battery voltage drops below 6 Volts the circuit is operating irregularly and data will be lost. At this time you must replace the battery.

ASSEMBLY

The use of the micro controller PIC16C57, the construction of the kit becomes very simple. The only thing that you must pay attention to is the polarity of the transistors, capacitors, diodes and ICs. The placing of the components is already printed on the PCB, making the kit much easier to build.

For the construction of the kit, you just need a small soldering iron (15 – 25 watts) and a small wire cutter. Using an iron soldering with a fine tip prevents heat transferring on the PCB witch can cause damage of the sensitive parts in the circuit.

To solder the components, place the iron's hot tip on the component lead while holding the end of the solder at the point where the lead emerges from the board. The tip must touch the lead slightly above the PCB. When the solder starts to melt and flow, wait until it covers evenly the area around the hole, then remove the iron and wait for the solder to cool naturally, without blowing or moving the component.

If everything is done properly, the surface of the joint must have a bright metallic finish and its edges should be smoothly ended on the component lead and the board track.

If the solder looks dull, cracked or has the shape of a bulb, then you have made a dry joint and you should remove the solder with a pump or a solder wick and do it again.

The first components to solder are the resistors, then the capacitors, the diodes, the DIL base for the PIC and then the transistors. On the silkscreen you will see a thick line on the drawing of IC2 (LM7805CV). This line corresponds to the rear side of the IC that is metallic and can be fitted to a heat sinking plate if desired. The last device to be soldered in place is the relay REL.

On the smaller PCB (1173A) solder the 17 pin terminal block in such a way that you will be able to use the terminals to connect the 1173A & 1173 PCBs together. Proceed by soldering the pushbuttons **and don't forget to solder the 4 jumper leads JP1 to JP4.** If you do forget them, the circuit will be active but you won't be able to see some parts of the displays or their dots.

The four displays will be soldered directly on the PCB if you are going to use the suggested box for the timer, which is the **box No. 2173.** If you don't intend to use this box, it will be better to put the displays on a 40-pin base.

ATTENTION:
- *Don't forget to solder the JP5 and JP6 jumper leads on the 1173 PCB.*
- *The displays should be placed with the dot or the letters facing downwards.*

After finishing the assembly of the PCBs, make a thorough check on both of them and then, using the 17 pins of the terminal block, connect the two PCBs together forming an angle of 90 degrees.

Place carefully the PIC microcontroller on its base, making sure that the gap is facing the Y1 crystal.

The power supply voltage (from 9 to 15 Volts DC) must be connected to the VCC (+) and GND (-) terminals. Make sure that you connect it with the correct polarity.

Connect a 9 Volt battery to the VFF (+) and GND (-) terminals using a clip with cables, so you will have a backup power source. This way no data is lost if the main power supply is off for some reason. Once again, observe the correct polarity of the battery.

If you have followed the instructions carefully, the 4 displays will illuminate and the indication will be "00.00", showing that the timer is working well.

SETUP AND PROGRAMMING

Operation mode

There are two operation modes, defined by the J1 jumper:
- When the jumper is near the Q3 transistor, the timer is working in **minutes** (from 00 to 99) and **seconds** (from 00 to 59). The maximum operating time allowed is **99 min 59"**.
- When the jumper is near the R17 resistor, the timer is working in **seconds** (from 000 to 999) and **tenths of seconds** (from 0 to 9). The maximum operating time allowed is **999.9"**.

ATTENTION: *Don't change the position of the jumper after the power supply is connected. If you want to move the jumper, disconnect both the power supplies first (main and backup).*

PUSHBUTTON OPERATION

S2	***Reset***
	A: Reset to zero
	B: Start programming

S1	***Select/Start***
	A: Set minutes and seconds (Mode1) Set seconds and tenths (Mode2) in the first and second press
	B: Display the full time in the third press
	C: Start time counting in the fourth press

S3	Count/Pause
	A: Increase by one the selected field during setup
	B: Pause/Continue during normal operation

Setting up and operating the timer is easy. After connecting the supply voltage, the displays show "00.00". To input the desired time, follow the next steps:

1. Press and hold S2 for 3 seconds. Now the displays are flashing, indicating the start of the setup procedure.
2. In mode 1, press S1 once to go to the seconds' field or twice to go to the minutes' field. If you are in mode 2, the first press gets you to the seconds' field and the second press gets you to the tenths of seconds field. You can see the field that you are in, observing which LED's dot is illuminated.
3. While you are in the desired field, each time you depress S3, the indication increases by 1.
4. Press S1 to move to the next field and repeat step 3.
5. Press S1 again to see the time that you just entered.
6. Pressing S1 for the last time you activate the countdown procedure. At this moment the relay is activated and it will be off again when the time reaches zero.

The following example will help you understand and set the timer up easily.
Suppose that we want a turn on a light bulb for 8 minutes and 24 seconds.
Step 1: Place the J1 jumper to position 1 (the jumper near Q3) and supply the circuit with the proper voltage.
Step 2: Press and hold for 3 seconds the S2 pushbutton. The displays are flashing, indicating the start of the setup procedure.
Step 3: Press S1 (Select/Start) button to go in the seconds field. The dots of the display for the seconds are illuminated.
Step 4: Press S3 (Count/Pause) repeatedly until the display shows "24".
Step 5: Press S1 (Select/Start) button to go in the minutes field. The dots of the display for the minutes are illuminated.
Step 6: Press S3 (Count/Pause) repeatedly until the display shows "08".
Step 7: Press S1 (Select/Start) button to see the time that you just entered. The displays must show "08.24".
Step 8: Press S1 (Select/Start) button to start the count down. The time is decreasing and the relay is activated. The light bulb is illuminating.
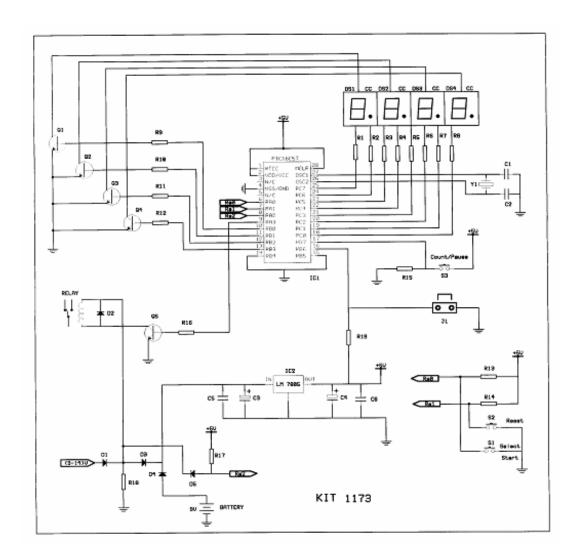After 8 minutes and 24 seconds the bulb is switched off.

ADDITIONAL FEATURES

- Using pushbutton S3 (Count/Pause) to temporarily stop the timer from counting. Press S1 (Select/Start) to start counting again from the time point that was displayed when S3 was pressed.
- You can connect any device you want to the relay's output. Depending on the way that you connect it, the device will be enabled or disabled when the countdown reaches zero.

IF IT DOESN'T WORK

- Make sure that everything is placed and connected properly, especially the jumpers. Check the positions of the components and see that there are no components missing or inserted in wrong place.
- Check your soldering for possible dry joints. Bridges across adjacent tracks or soldering flux residues usually cause problems. Clean the PCB with a cleaning spray or acetone (e.g. PCM 200 from ELECTROLUBE). Cleaning the PCB also helps finding the problem more easily and faster.
- Make sure that the power supply has the correct voltage and polarity.
- Check your project for faulty or damaged components.
- Check the polarity of diodes, electrolytic capacitors, LEDs and the voltage regulator observing the silkscreen and the schematic supplied with the kit.
- Make sure that the programming is done properly.
- Check the position of the jumper that sets the time mode.
- Check the micro controller for correct placing. Also examine its pins for possible damage when inserting it to the base.
- Pull out the micro controller and check that the 5 Volts are present to pin No 1 of the IC's base.
- If everything is checked and your project still does not work, please contact us by email at support@quasarelectronics.com or phone 0870 246 1826.

KIT 1173

PARTS LIST

All components including printed circuit board, assembly instructions including schematics and detailed parts list are supplied when you purchase the kit.

Ordering

For pricing info and online ordering please visit:

http://www.quasarelectronics.com/1173.htm

For further info please contact us by e-mail:

mailto: sales@QuasarElectronics.com