QUASAR ELECTRONICS PRODUCT No. 1172

Up/Down Counter with two output channels

This product is a construction with unlimited applications. It can be used at production control, providing readings for the quantity of items produced, or at the programming of a repeating production cycle (i.e. for the items contained in a certain package). It can also be used for counting the number of passengers (at ships, buses, etc.) or for counting the number of spectators at a basket game. Its applications are limited only by your imagination!

The 1172 is a cleverly designed two-way counter, easily programmable, with a small volume and high versatility and adaptability to a multitude of applications, which under different conditions would need a counter of a much higher cost.

The heart of the circuit is the PIC 16C57 micro controller, manufactured by Microchip Corp. It is useful to look at some of its characteristics, before discussing the details of the circuit.

The PIC 16C57 Micro controller

Although it is quite difficult to describe within a few lines the PIC 16C57 structure and operation, we will attempt a brief presentation of its workings.

It is an 8 bit micro controller of RISC technology, with a very small instruction set (only 33), most of which are executed during a machine cycle. The program is stored in its memory (EPROM 2KB), and differs according to each specific application. Through its 20 inputs/outputs, the micro controller accepts data from the other components, and by executing the program, it produces the result via the corresponding outputs, through which we can drive relays, displays, etc.

General Description

The 1172 is a simple, small and easy to use counter, which provides its readings via four separate displays. The circuit has two states, “Up” and “Down” respectively.

In the “Up” state, there is an upper limit capability (Preset). The two LEDs signify the “Up” or “Down” state (Red = “Up” and Green = “Down”). The relay in the “Down” state is activated when the counter decreases from “1” to “0”. The relay in the “Up” state is activated when the counter reaches the pre-selected limit (Preset).

Finally, there also exists the capability of storing the current display reading and the pre-selected limit (Preset) in the memory, where they reside even after a power failure, due to the kit’s built-in backup circuit.

“Up” State

The system starts in an “Up” state, and the red LED is lit. Each time we press the <Start> button, we increase the initial display “0” by one. This means that with the first depression the reading displays a “1”, with the second a “2” and so on. This may lead you to believe that if one wants to program the counter at “9.999”, then the button must be pressed 9.000 times, and this is naturally NOT the case! If you continuously press the button for more than 5 seconds, the number increases rapidly until you stop pressing it. In this way you can easily select any number. When the desired upper limit is reached, you can store it by pressing the <Mem> button.

With the <Preset> button we return the counter to zero (re-initialization) without losing the upper bound limit, so that we can repeat the counting procedure. Together with the <Start> button, a bipolar connector enables you to connect a sensor up to a distance of 10m. Thus, you can have a setup that is able to count any incoming or outgoing item, and display it as a four digit decimal number. An example of this utilization is given below.

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Example No1

Let's assume that we must deliver an order for 360 kits, to be packaged in 12 crates of 30 items. This means that we want to count 30 kits by 12 times, without having to pre-adjust the kit number for each and every time we count a crate. As soon as a kit passes by the sensor, the display must report this, increasing its reading by one. The relay will be activated each time the display reaches "30", so that the package may now be sealed. Finally, we want this procedure to be repeated 12 times.

Step 1

We select the "Up" state via the <"Up" / "Down"> button (the red LED is lit, indicating the state selected).

Step 2

We press the <Start> button 30 times, so that the number "30" appears on the display.

Step 3

We press the <Mem> button (storing the upper limit). The display continues to show the number "30".

Step 4

We press the <Reset> button, and the display is re-initialized (showing "0").

Step 5

We press the <Start> button 29 times. At the next depression (the 30th), the relay is activated. If we had connected a micro switch (that could close each time a kit passed through) to the <Start> position, at the end of the procedure we could have an optical or sound reading (through the relay), enabling us to know that the first batch of 30 items (kits) has been completed.

Step 6

We press the <Preset> button. The display shows "0" and the relay is deactivated.

Step 7

We repeat Steps 5 and 6 for 11 more times. In this way, we have counted 12 times 30 kits.

Note

We must note at this point, that in our example we pressed the <Start> button in order to simulate the activations of the sensor (push-on button) that we would have placed on the connector.

"Down" State

This is a much simpler operation. As soon as we apply a voltage to the circuit, it automatically initializes at the "Up" state and with the <Start> button we increase the display reading, in order to pre-select the desired number. Let's assume that the display shows the number "234". By pressing the "Up" / "Down" button, the counter reverts to the "Down" state and the green LED is lit. Following that, by pressing the "Start" button, the counter starts decreasing the initial reading of "234" by one. We can apply here the previously shown "repeated decrease" capability.

Example No 2

Let's assume that we want to count "30" crates. Each time a crate passes through the counter, the relay must report this by decreasing the reading by one. When all crates have passed through, the display will show "0" and the relay will be activated.

Step 1

With the <"Up" / "Down" button, we select the "Up" state. The red LED is lit.

Step 2

We press 30 times the <Start> button, and the display shows "30".

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Step 3

We press the <“Up” / “Down”> button. The counter reverts to the “Down” state and the green LED is lit.

Step 4

We press 30 times the <Start> button. This simulates the “passing through” of the 30 crates. The display shows “0” and the relay is activated.

Step 5

We press the <Reset> or the <“Up” / “Down”> button and following that, the <Start> button. The relay is deactivated.

The buttons and their operations, together with the technical characteristics of the counter, are shown in the table below.

Table 1

1	«Up» / Down»	Selection of “Up” or “Down” state
2	Start	Selection of “Up” or “Down” state
3	Mem	Storing the boundary value for the “Up” state
4	Preset	Repeated counting with boundary limit
5	Reset	Display initialization (“0”),relay deactivation

Table 2

1	Current	7 - 12 VDC
2	Consumption	220 mA
3	Display	4 Displays -7 Segment.
4	Programming	Five buttons - Push-on button
5	Backup circuit	3 V Battery
6	Input	Connector for sensor connection
7	Outputs	Two channels (relays) - (“Up” and “Down”)

The electronic circuit

The Y1 crystal together with the C1 and C2 capacitors, form the necessary network for the 4 MHz reference oscillation (see fig. 1). With this specific reference oscillation, we obtain a machine cycle of 1ìsec. This means that every instruction (apart from 5 special ones) is executed in 1ìsec.

The LM 7805 power stabilizer, together with the C3, C4 capacitors and the D1 diode, comprise the necessary network for powering the micro controller.

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This network stabilizes the power supply at 5V. The C3 capacitor is essential for power normalization, which may vary from 7V to 12VDC. The C4 capacitor provides the stabilizer with the capability to respond to rapid power variations. The D1 diode protects the circuit from reverse input power.

The Q6 with the R22, R20 resistors and the D3 diode, comprise the driving network for the "Down" relay. The Q6 acts as a switch in a common transmitter, with the transmitter being grounded. The D3 diode is used to protect Q6 from the induction voltage, produced at the ends of the coil when the relay is activated. The diode is placed with reverse polarity.

The R20 resistor narrows the base current. Its value is critical in order to have Q6 working at peak (saturation point). The R22 resistor is placed in order to drive Q6 at peak (saturation point), when the input current at the base is low. With the same way, the grid Q5, R22, R23, D2 drives the relay to the "up" state.

The R18, R19 resistors limit the current at the cathodes of the "Up" and "Down" LEDs. Their values are not critical.

The R15 resistor and the S1 switch comprise the input grid (network) for the micro controller. If the S1 switch is open, pin 15 is on logical "high" (5V). When the S1 switch closes, pin 15 is on logical "low" (0V). In the same way, the R13, R14, R16, R17 and the S2, S3, S4, S5 comprise the input grid (networks) for the pins 17, 16, 14, 13 respectively (see table 3). The values of the R13 to R17 resistors are not critical. The S1 to S5 switches (buttons) must be of the "push on" type.

Table 3

Switch	Select	Pin
S1	Reset	15
S2	«Up»/«Down»	16
S3	Start	17
S4	Mem	14
S5	Preset	10

The visual representation is performed through 4 displays (common cathode). The Q1, Q2, Q3, Q4 and R1 to R12, comprise the necessary output grid (network) for driving the displays.

The Q1 to Q4 transistors operate under a common transmitter connections, with a grounded transmitter. They transfer from the saturation point to through a logical "high" or "low" respectively, depending on the outputs from the pins 6, 7, 8, 9 of the micro controller. Those pins have been formed as outputs. This means that they convey a logical "high" or "low" at the base of the transistors.

In this way, a momentary "high" at the base of Q4, drives Q4 to the saturation point and thus we have a "0"V at the collector. Consequently, the display is activated and shows the content of the lines (A, B, C, D, E, F, G). These lines contain the visual information, coded in “7 segments” code and recognized by the display, which in turn decodes it into decimal representation, showing numbers from 0 to 9.

However, at the same instant during which the first display is active, the 3 other displays must not be activated. It is a difficult job, undertaken by the PIC 15C57.
You must have realized by now, that the representation of the results is done by slice-time methods, which limit the amount of the cables that drive the displays, from 32 (which should have been used if we haven’t employed this method) to 12, while at the same time the power economization is quite significant.

There could also be a fear of low display luminosity. However, through the aid of the Q1 to Q4 transistors, the luminosity is quite high, even under a low voltage. The R1 to R12 resistors have been calibrated as to offer the greatest possible luminosity and their value is critical.

We could have omitted the Q1 to Q4 and the R9 to R12, but not the R1 to R8. In such a case, the display luminosity would have been much lower and the micro controller could have suffered from overheating after extensive use.

The back up circuit is comprised of D4, D5, D6, D7 and R1. The D5 and D6 are the logical “OR” network, with input voltages the Vff and the battery voltage. D7, which is a zener at 4.7 Volts, keeps the voltage over 3.6V (the backup battery) and under 5V (required for the powering of the micro controller). The D4 and R1 provide the voltage at the one end of the voltage divisor(distributor), formed by the R24, R25. At the other end of the voltage divisor (distributor), the voltage Vff is applied. The output of the voltage divisor (distributor) (middle receipt), is applied at pin 25 of the micro controller, which through this information recognizes the existence (or not) of the central voltage of the circuit. This means that the voltage divisor (distributor) operates as a detection circuit for the central voltage, conveying this information to the micro controller.

Construction - Assembly

Due to the use of the PIC 16C57 micro controller, the construction is greatly simplified. Thus, the only points of attention are the polarity of the transistors, electrolytic capacitor diodes and integrated circuits. The placing of the components is already drawn on the board.

Start the assembly by placing the pins, the resistors and the bases of the micro controller and the displays as follows: At the board 1172, you will place the base of the 28 terminals for the micro controller, and on the board 1172A you will place the base of the 40 terminals, to accept the 4 displays.

After that, place the resistors, the diodes, the zener, the electrolytics and finally the crystal and the relay.
Solder the series of the 20 terminals on the small board, in such a way that its black, plastic support touches the board.
On the small board, solder the button-switches and the LEDS, taking care for them to be at the same height with the displays, so that you can later place the whole assembly in an appropriate box. The ideal solution is to use the Quasar Box No 2172 - TK10. After the completion of the assembly and a thorough check, place first all the displays on their bases.

Solder the pin series to the other board also, in such a way as to the two boards to be connected in a 45 degrees angle. Place very carefully the micro controller on its base, with the notch facing the relays. At the points with the indication “+BAT-”, place a battery case for

two 1,5V (AA) batteries, to ensure a backup operation. Thus, your data will be retained in case of a power interruption.
At the points (+), (-), connect a voltage of 7-12 Vdc.

If all the above steps have been properly followed and everything has been done correctly, as soon as the voltage is applied you will hear the relays close and see the red LED illuminated.

Attention

1. Don't apply to the circuit a voltage greater than 12V.
2. If the backup battery voltage is diminished under 2.3V, the circuit will start behaving erratically. For example, the display 2 or 3 (instead of 1) will light up, or fuzzy numbers will appear on them, and naturally, the circuit will not retain in its memory your current selections. In this case, you must replace the batteries at once.
3. In the interior of the construction, there is a bridge through which we deactivate the backup, saving battery power. However, in this way we deactivate the circuit completely. We propose (in order not to move the bridge inside the box, from the "on" to the "off" position and vice versa), to remove one of the two batteries, to save power when you don't use the counter.

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/1172.htm

For further info please contact us by e-mail:

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