

Watchdog Timer

Three Circuits: Increasing in Features

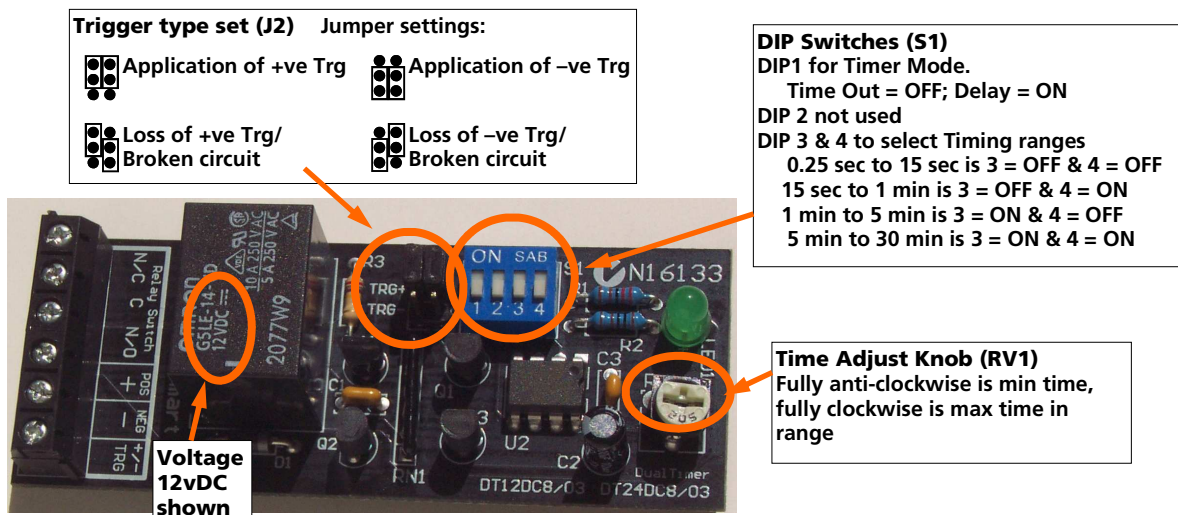
1. OVERVIEW

The DualTimer12 (DT12DC8/03), the 12 vDC version of ULTRAsmart's timer module, is ideal for creating a Watchdog Timer where the minimum watchdog time is 0.25 seconds and the maximum is 30 minutes..

This manual demonstrates how to make three different circuits with an increasing number of features to allow it to be tuned to the widely ranging performances of different systems to be monitored and controlled.

- Monitoring Input. Changing Output While System Failure.** Monitoring an Input signal to ensure it continues as a series of positive pulses (or a continuous positive). Upon failure of this condition for a set time (called the *Watchdog Time*) the Output switches from 12 vDC (system satisfactory) to 0 vDC (system failure). Upon return of the first positive pulse (or the leading edge of a continuous positive), the Output returns to its original system satisfactory condition. Uses One DualTimer (T1). T1 is used to monitor the input signal and provide the output signal.
- Monitoring Input. Output On System Failure Used to Reboot Monitored Unit. Monitoring Turned Off for a Set Time.** Uses Two DualTimers (T1 and T2).
Monitored Unit Power Off Time depends on Which Output is Used:
Output A: Power Off time of monitored unit is very short (time it takes to pulse a relay). Probably fine for simple circuits, but may be too short for some uses.
Output B: Power Off time of monitored unit is extended to almost the same as the Monitoring Off time. This will often be fine if the boot after power on of the monitored unit is faster than the time set in T1 to check for loss of pulses. But if the monitored unit takes longer than the time set in T1 (Watchdog Time) to boot and produce it's first pulse, then it will be interpreted by the watchdog as another system failure and another Reboot would be initiated.
- Monitoring Input. Output On System Failure Used to Reboot Monitored Unit. Monitoring Turned Off for a Set Time. Monitored Unit Power Turned Off for a Set Time.** Uses Three DualTimers (T1, T2, and T3). The third DualTimer is used to control the Power Off time of the Monitored unit. This overcomes the problems outlined in 2 above by being able to separately tune the total reboot time of the Monitored unit and the time that monitoring of the input signal is turned off.

(Sections 3 and 4 also demonstrate an interesting way of minimising power consumption when using two or more Timers, and their timing functions are required one after the other—ie not concurrently.)



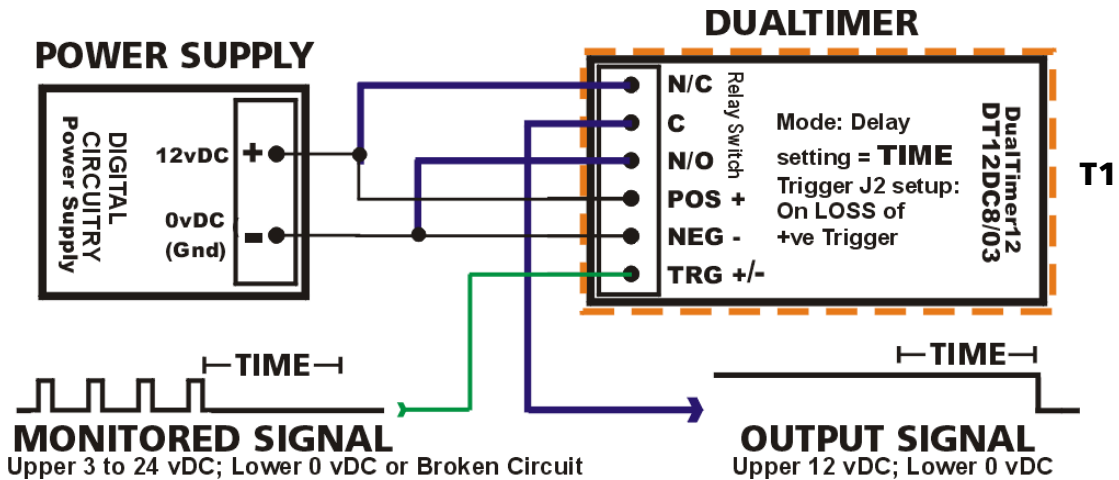
The DualTimer12 (DT12DC8/03) is an ideal module for many 12 v DC timer applications. A 24 volt version, DualTimer24 (DT24DC8/03), is also available.

Notes:

- Refer to the Disclaimer at the bottom of page 2.
- Refer also to Manual: *DualTimer12*.
- Use the relay within OMRON's specifications. A copy can be found on the ULTRAsmart web site.
- Colour and appearance of components may vary from that shown in pictures.

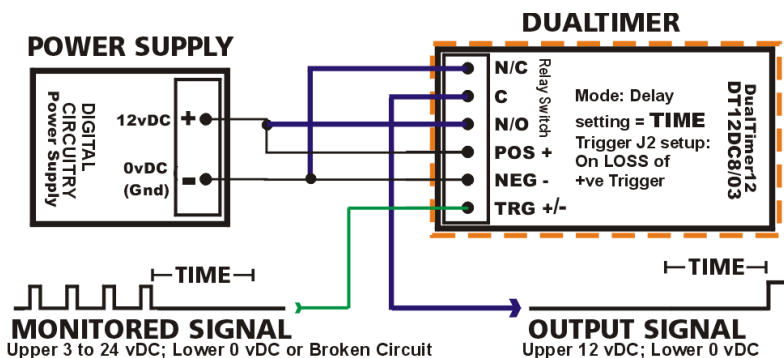
2. MONITORING INPUT. CHANGING OUTPUT WHILE SYSTEM FAILURE.

Monitoring an Input signal to ensure it continues as a series of positive pulses (or a continuous positive). Upon failure of this condition for a set time (the *Watchdog Time*, called **TIME** on the DualTimer in the circuit diagram below,) the Output switches from 12 vDC (system satisfactory) to 0 vDC (system failure). Upon return of the first positive pulse (or the leading edge of a continuous positive), the Output returns to its original system satisfactory condition. Uses One DualTimer (T1). T1 is used to monitor the input signal and provide the output signal.



Operation:

1. The DualTimer (T1) monitors the signal from the Monitored Unit via its TRG terminal. An example signal is shown in the diagram above.
2. T1 is set up to detect LOSS of a +ve trigger voltage at its TRG terminal, and is set up in Delay Mode with a time setting of TIME (say 10 seconds, but it can be any time between 0.25 seconds and 30 minutes ie the range of times available on the DualTimer).
3. When T1's relay is NOT activated, there is a connection between the C and N/C terminals, resulting in an Output signal on the C terminal of +12 vDC.
4. Because it is set up to detect LOSS of +ve trigger voltage, T1 starts counting down time the 10 seconds on the falling edge of each pulse. When a rising edge of a pulse arrives before the count down is complete, the Timer resets and does not start another count down until the next falling edge. (Knowing this, it becomes clear that if the monitored unit is outputting pulses, then the time set into T1 should at minimum be greater than the time between 2 pulses. We suggests at least 3 pulses as shown in the above diagram to provide a safety margin in case of a false negative ie should one pulse be "missed"). T1's relay remains unpowered during this time.
5. In the diagram above, after the fourth pulse in the Monitored Signal there is a failure of the monitored unit and no further pulses are produced. So T1 does not get its countdown reset after the fourth pulse, and the countdown finishes after TIME (in our example, 10 seconds) has expired. Because T1 is in Delay Mode, the Timer powers its relay removing the connection between its C and N/C terminals and creating a connection between its C and N/O terminals. This means that the C terminal now outputs a signal of 0 vDC.
6. The relay remains powered (or switched) until it sees a rising edge of a new pulse.



With different wiring of the relay terminals, it is possible to change the output signal around and have 0 vDC on system satisfactory, and 12 vDC on system failure.

3. MONITORING INPUT. ON DETECTION OF SYSTEM FAILURE, OUTPUT "A" OR "B" USED TO REBOOT THE MONITORED UNIT. MONITORING TURNED OFF FOR SET TIME.

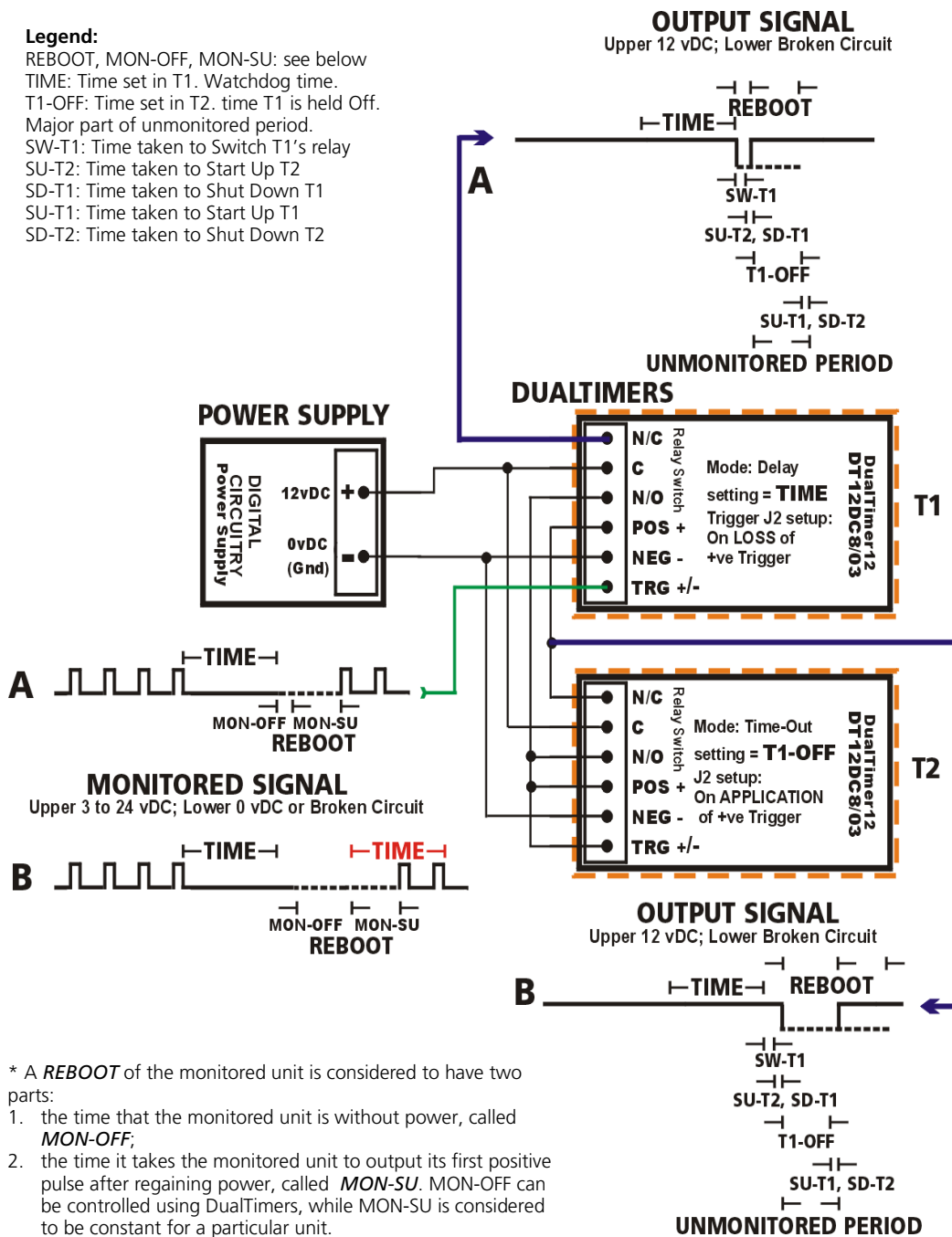
A second DualTimer (T2) has been added to the previous circuit.

T2 is used to shut down T1 and keep it off for a set time (called *T1-OFF* in the diagram below) after T1 has activated its relay on detecting a monitored unit system failure. T1's output (see *A* in the diagram below), can then be used to reboot* the monitored unit (either directly if a digital circuit, or via a relay if a power circuit). However, its output is only a broken circuit (OFF) for a very short time.

T2 provides another output (called *B* in the diagram below) which could also be used to reboot* the monitored unit. This output may overcome the problem above, but introduces another especially if the monitored System has a short Watchdog period. Advantages and disadvantages are discussed in 3.1 and 3.2 on the following pages.

Legend:

- REBOOT, MON-OFF, MON-SU: see below
- TIME: Time set in T1. Watchdog time.
- T1-OFF: Time set in T2. time T1 is held Off.
- Major part of unmonitored period.
- SW-T1: Time taken to Switch T1's relay
- SU-T2: Time taken to Start Up T2
- SD-T1: Time taken to Shut Down T1
- SU-T1: Time taken to Start Up T1
- SD-T2: Time taken to Shut Down T2



3.1 Using the Output Signal on T1 (called "A" in the Diagram)

This setup is likely to meet the needs of monitored units which depower and reboot satisfactorily with the very short OFF then ongoing ON output signal provided by T1.

Circuit Description:

- ❑ **A SHORT reboot signal.** When T1 loses power its relay also loses power. The output on T1 therefore returns to +ve regardless of the state of the monitored signal. (T1 relay's OFF time is the time that it takes after T1 has activated its relay for T2 to power up, detect the signal on its TRG terminal, and then to activate its own relay.)

This **short OFF** then ON is available to turn the monitored unit OFF then ON if output **A** is wired up to control power to the monitored unit (ie to reboot* the monitored unit). The pulsed OFF time is a disadvantage as it may be too short for some applications. Options are discussed in 3.2 below and Section 4.

- ❑ **Ability to turn monitoring Off for a controlled period.** The monitored unit signal is not monitored while T1 is OFF. Monitoring is OFF while T1 is unpowered (called **T1-OFF**, the time set on T2), plus the time it takes for T1 to begin monitoring again once it regains power (**SU-T1**). Because DualTimers power up very quickly, for most purposes it will be satisfactory to consider this time as T1-OFF.

This ability to increase the monitored OFF time is an advantage if the monitored unit takes a lot longer to reboot than does T1.

- ❑ **The combined circuit minimises power consumption.** T2 and T1 are seldom powered at the same time. T2 is generally not powered while T1 is monitoring. T2 is initially powered when T1's relay is activated after T1 has detected an unsatisfactory signal. T2 uses its own relay to "latch" its own power. After T2 has finished its job, it deactivates its own relay, unlatching its own power and powering up T1.

Operation:

1. The DualTimer (T1) monitors the signal from the Monitored Unit via its TRG terminal. An example monitored signal is shown in the diagram on the previous page, and is labelled **A**.
2. T1 is set up to detect LOSS of a +ve trigger voltage at its TRG terminal, and is set up in Delay Mode with a time setting of TIME (the **Watchdog** period, say 10 seconds, but it can be any time between 0.25 seconds and 30 minutes ie the range of times available on the DualTimer).
3. When T1's relay is NOT activated, there is a connection between the C and N/C terminals, resulting in an Output signal on the N/C terminal of +12 vDC.
4. Because it is set up to detect LOSS of +ve trigger voltage, T1 starts counting down TIME (10 seconds in this example) on the falling edge of each pulse. When a rising edge of a pulse arrives before the count down is complete, the Timer resets and does not start another count down until the next falling edge. (Knowing this, it becomes clear that if the monitored unit is outputting pulses, then the time set into T1 should at minimum be greater than the time between 2 pulses. We suggest at least 3 pulses as shown in the above diagram to provide a safety margin in case of a false negative ie should one pulse be "missed"). T1's relay remains unpowered during this time.
5. In the diagram, after the fourth pulse in the Monitored Signal **A** there is a failure of the monitored unit and no further pulses are produced within the Watchdog period. So T1 does not get its countdown reset after the fourth pulse, and the countdown of the Watchdog period completes. Because T1 is in Delay Mode, the Timer powers its relay removing the connection between its C and N/C terminals and creating a connection between its C and N/O terminals. This causes two changes:
 - ❑ the N/C terminal's connection to the power supply is broken which means that Output Signal **A** can be used to depower the monitored unit
 - ❑ the N/O terminal is now connected to the 12vDC on the power supply which means that T2 is powered up and sees a +ve on its TRG terminal
6. Because T2 is in Time Out mode, and it powers up very quickly, T2 activates its relay almost immediately and keeps it activated for the Time Out period (called **T1-OFF** in the diagram, say 8 seconds in this example).
7. While T2's relay is activated, T1 is OFF.
 - ❑ There is no monitoring of the input signal **A** during this time
 - ❑ T1's relay is unpowered, so its N/C terminal is again connected to 12vDC, and the monitored unit's power is on again. So the monitored unit can boot up after being unpowered during the time T1's relay was activated/powerd.
 - ❑ T2's POS and TRG terminals are connected to T2's N/O terminal which is connected to 12 vDC. T2 effectively "latches" itself while counting down its Time Out period.
8. T2 deactivates its relay after the Time Out period has expired. T2 loses power and shuts down. T1 regains power, starts up and starts monitoring the signal on its TRG terminal again.

3.2 Using the Output Signal on T2 (called "B" in the Diagram)

This setup *may* meet the needs of monitored units that require a longer period of no power (than is available from Output A) to reboot satisfactorily.

Suits systems with a long Watchdog period (the delay period *TIME* used by T1). Systems with a short Watchdog period *may* not be suited because this circuit uses the same timer, T2, which is used to control the time that *monitoring is Off* to also control the time that the *monitored system* is Off.

See Section 4 for those systems which need separate timers for the *monitored system* Off and *monitoring* Off functions.

Circuit Operation:

- ❑ **A longer power OFF signal than Available from Output A.** Because T2's output is used instead of T1 to control the monitored system. An advantage if a longer period is needed than available from Output A.
- ❑ **Monitoring Off period and Monitored Unit Off period are the Same.** The disadvantages of this are discussed above.
- ❑ **The combined circuit minimises power consumption.** T2 and T1 are seldom powered at the same time. T2 is generally not powered while T1 is monitoring. T2 is initially powered when T1's relay is activated after T1 has detected an unsatisfactory signal. T2 uses its own relay to "latch" its own power. After T2 has finished its job, it deactivates its own relay, unlatching its own power and powering up T1.

Operation of the circuit is the same as for Section 3.1 discussed previously.

4. MONITORING INPUT. ON DETECTION OF SYSTEM FAILURE, OUTPUT "C" USED TO REBOOT THE MONITORED UNIT. REBOOT AND MONITORING TURNED OFF BOTH SET SEPARATELY.

A third DualTimer (T3) has been added to the previous circuit. Three Timers means that it is possible to control the 3 major time events inherent in this Watchdog Timer / Reboot of Monitored Unit control system:

1. Watchdog Time (TIME on T1)
2. Power Off Time of the Monitored System to ensure it shuts down fully (MON-OFF on T3).
3. Monitoring Off Time while the Monitored System reboots (T1-OFF on T2)

Via Output C, T3 is used to control how long *power is off* to the *monitored system*. The addition of T3 overcomes the disadvantage of Output B described in 3.2 previously. T3 would normally be set to the minimum time required to successfully force a reboot of the monitored system. T2 would normally be set to a time longer than T3 ie something like MON-OFF plus MON-SU (See reboot* explanation in the diagram below).

