Chapter 7
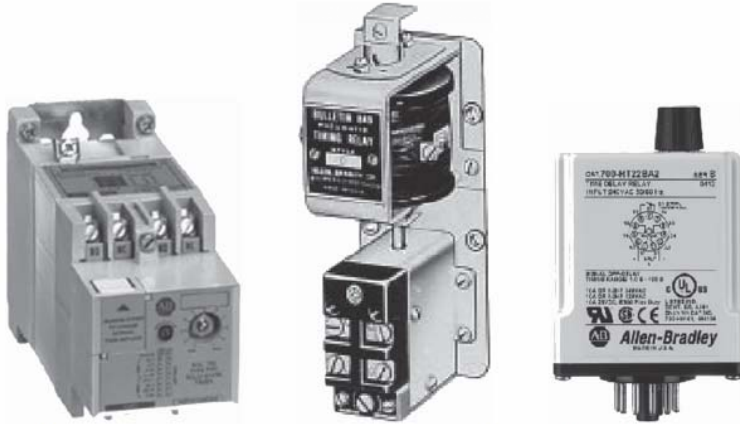
Relays

PART 3 Timing Relays

Timing relays are a variation of a conventional control relay where a **time delay** occurs following a change in the control signal before the switching action occurs.
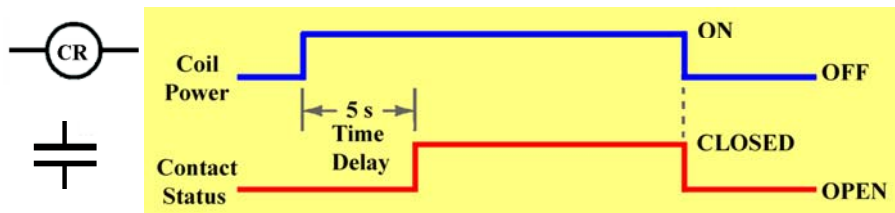
5 Second ON-Delay Timer

Timers allow a multitude of operations in a control circuit to be automatically started and stopped at different time intervals.

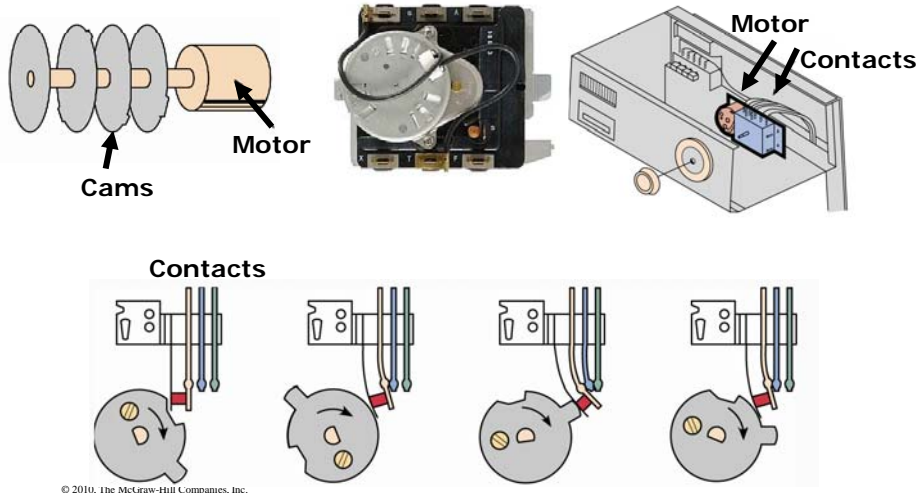Solid-state timing relay   Pneumatic timing relay   Plug-in timing relay

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MOTOR-DRIVEN TIMERS

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## Motor-driven timers are used to time a cycle of operations.

Dryer Motor-Driven Timer

Cams

Motor

Motor

Contacts

Contacts

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Synchronous clock timers use a small electric clock motor driven from the AC power line to maintain sync with standard time.
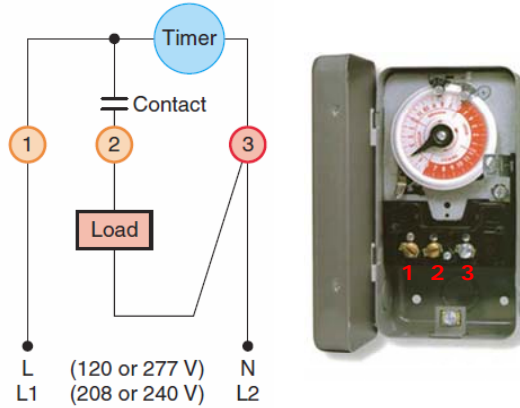
The motor turns the mechanism and actuates normally open or normally closed contacts.
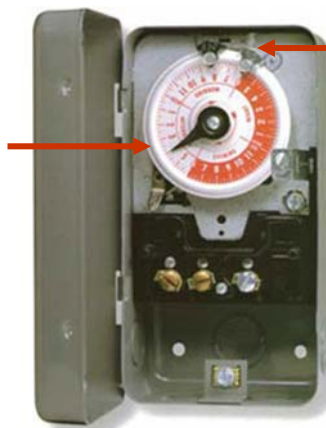
Adjustable ON/OFF tabs set along the clock's timing wheel trip the contact open or closed.

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The timer motor is supplied with continuous power.

L   (120 or 277 V)   N
L1   (208 or 240 V)   L2

These types of timers are used for applications such as lighting and water sprinkler control where precise timing is not critical.

DASHPOT TIMERS
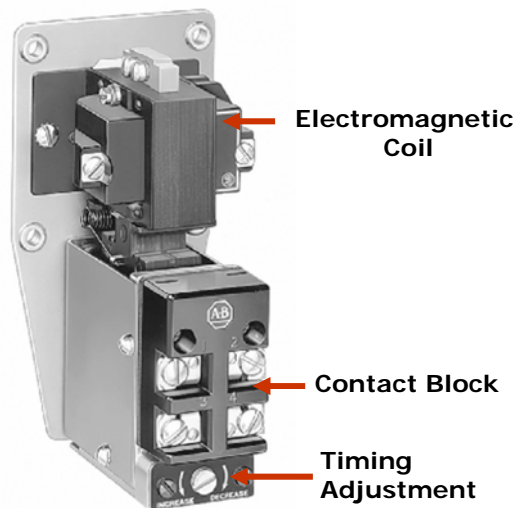
Dashpot timers **mange their timing function by controlling fluid flow or air flow through a small orifice.**

A **pneumatic (air)** timing relay uses an air-bellows system to achieve its timing cycle.

Electromagnetic Coil

Contact Block

Timing Adjustment

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➢The bellows design allows air to enter through an orifice at a predetermined rate to provide the different time-delay increments.
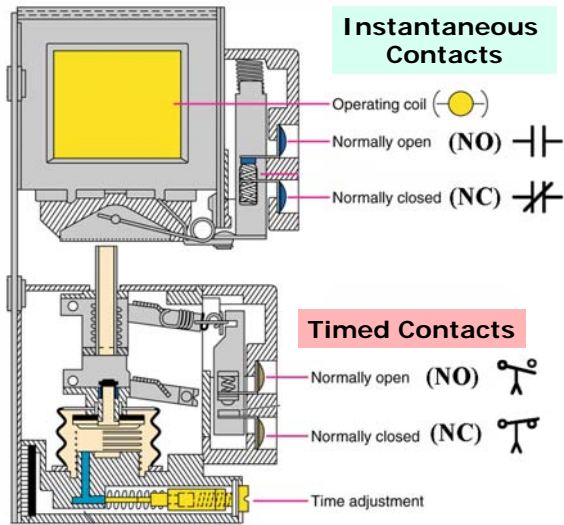
➢As soon as the coil is energized or de-energized, the timing process begins and the rate of airflow determines the length of the time delay.

➢Smaller orifice openings restrict the flow rate resulting in longer time delays.

➢Pneumatic timers have relatively small adjustable range settings. The timing range for the timer shown is adjustable from 0.05 to 180 seconds with an accuracy of approximately +10%.

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Timing And Instantaneous Contacts

Instantaneous Contacts

- Operating coil $(-\bigcirc-)$
- Normally open **(NO)** ⊣⊢
- Normally closed **(NC)** ⊣⊬

Instantaneous contacts, like that of a standard relay, changing their states immediately when the coil is energized or de-energized.

Timed Contacts

- Normally open **(NO)**
- Normally closed **(NC)**
- Time adjustment

Timed contacts, unlike that of a standard relay, are prevented from immediately opening or closing when the coil is energized or de-energized

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Simulated Timing And Instantaneous Contacts
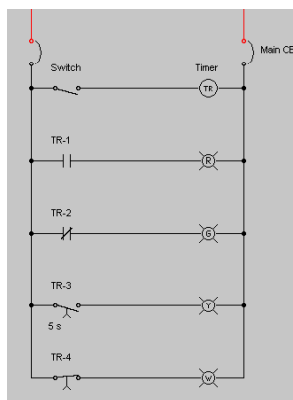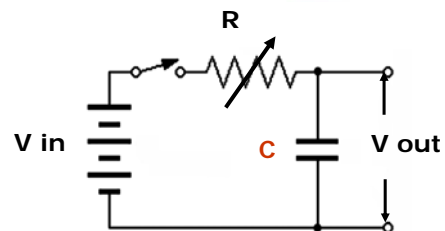

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SOLID STATE TIMING RELAYS

Solid-state timing relays **use electronic circuitry to provide their timing functions.**

Different methods are used to control the time delay period. Some use a resistor/capacitor (RC) time charge and discharge circuit to obtain the time base.

R

V in   C   V out

Gradual build up of voltage across the capacitor used as the basis for timing.

Electronic based timers are much more accurate than their dashpot counterparts and can control timing functions ranging from a fraction of a second to hundreds of hours.
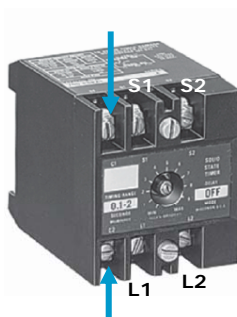
Some are manufactured with fixed, single, and multiple timing ranges. Timers with multiple timing ranges are equipped with two adjustments: one for the timing range and another for the time setting within each range.

Time Setting

Range
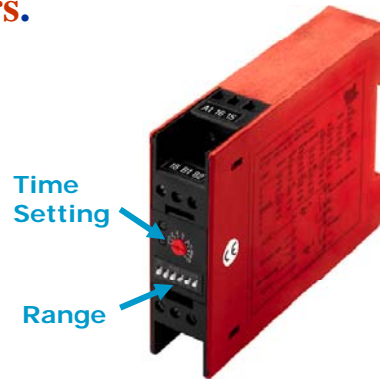
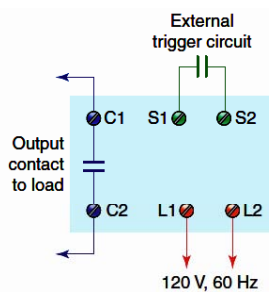In order to maintain their timing operations solid-state timers are normally required to be energized at all times.

Solid-state timing functions are initiated when the electronic circuit of the timer is energized or a triggering signal is received or removed.

External trigger circuit

C1 S1 S2

Output contact to load

C2 L1 L2

120 V, 60 Hz

➢A timing delay period of from 0.1 to 2 seconds is set by the adjustment of an internal potentiometer located on the front panel of the timer.

➢The timer is energized continuously and timing is initiated when the external trigger circuit is closed.

S1   S2

L1   L2

The timed contact is convertible to ON-delay or OFF-delay.

TIMING FUNCTIONS

The on-delay timer is often referred to as DOE, which stands for *Delay On Energize*. The time delay of the contacts begins once the timer is switched ON.

Normally open, timed closed (NOTC)

Normally closed, timed open (NCTO)

➢Once initiated, DOE timed contacts change state after a set period time period has passed.

➢After that time has passed, all normally open timed contacts close and all normally closed contacts open.

➢Once the timed contacts change state, they will remain in this position until the power is removed from the coil or electronic circuit.
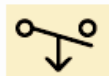
Simulated operation of an on-delay timing relay.
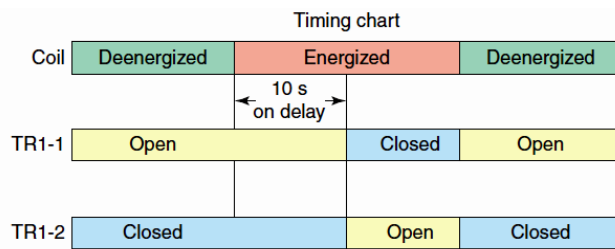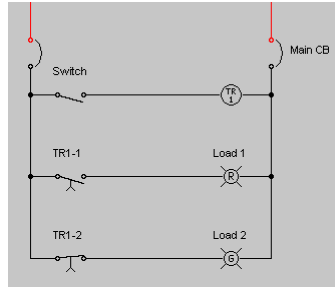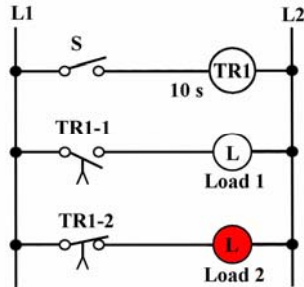
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The off-delay timer is often referred to as DODE, which stands for *Delay On De-Energize*. The time delay of the contacts begins once the timer is switched OFF.
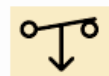

Normally open, timed open
NOTO

Normally closed, timed closed
NCTC

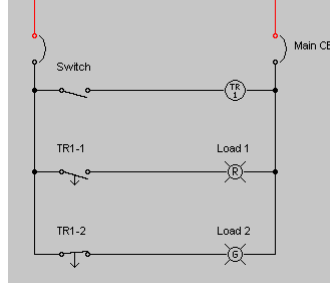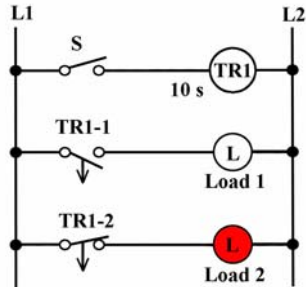➢When power is applied to the coil or electronic circuit the timed contacts will change state immediately.

➢When power is removed however, there is a time delay before the timed contacts change to their normal de-energized positions.

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Simulated operation of an off-delay timing relay.

Timing chart

Coil	Deenergized	Energized	Deenergized	
			10 s off delay	
TR1-1	Open	Closed		Open
TR1-2	Closed	Open		Closed
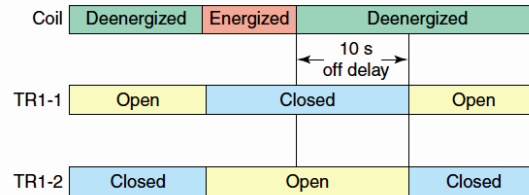
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Sump Pump OFF-Delay Timer Circuit

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Sensor
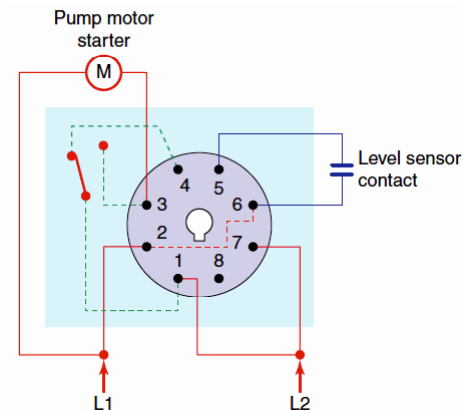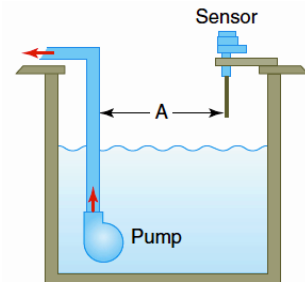
A

Pump

Pump motor starter

M

Level sensor contact

L1   L2

> When the level **rises to point A** the level sensor contact closes to energize the relay timer coil closing its contacts to start the pump.

> When the level **drops below A** the sensor contacts open and timing begins.

> The pump continues to run and empty the tank for the length of the **time delay period**.

> At **time-out** the relay coil de-energizes and the normally open relay contact re-opens turning the pump off.

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With a *one-shot timer* momentary or continuous closure of the initiate circuit results in a single timed pulse being delivered to the output.

Pushbutton

Closed
Open

ON
OFF

Time Delay
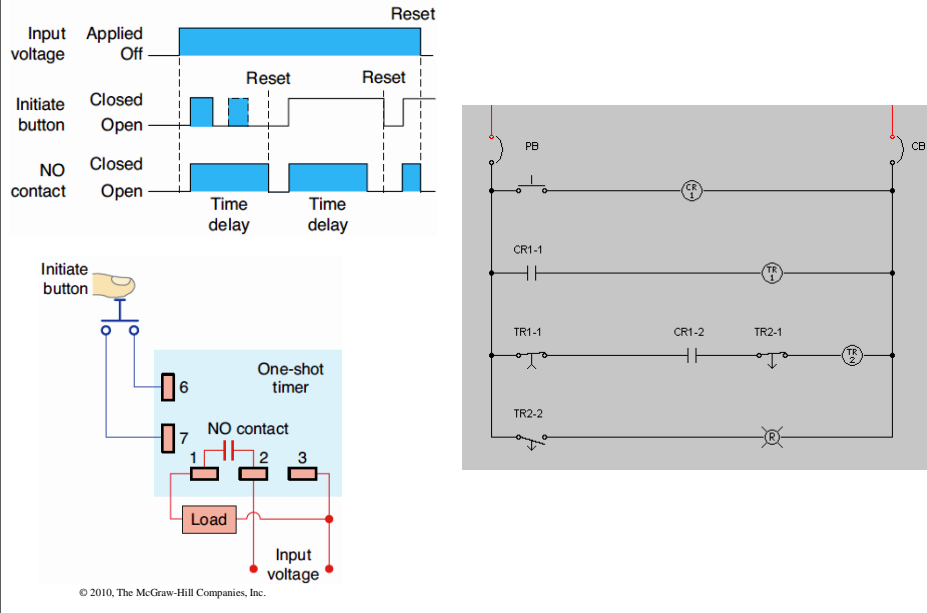
Timed pulse to light
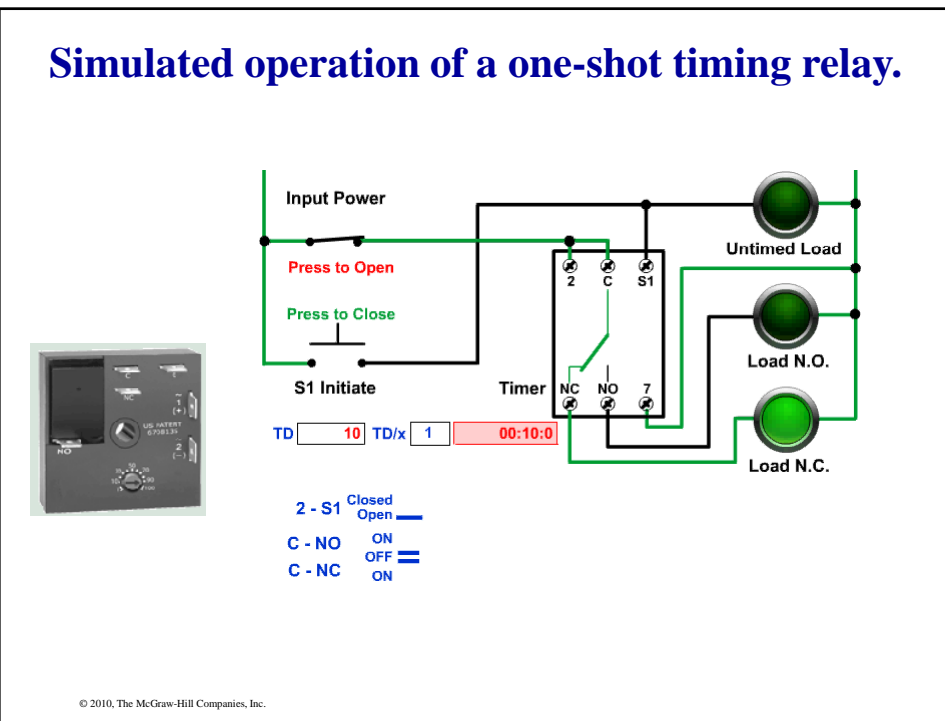
Initiate PB

L1

L2

Light

The one shot causes the timed pulse to happen **only once**, and then must be reinitiated if it is to continue to operate.
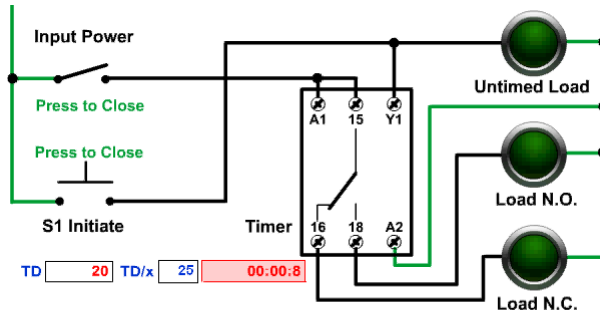
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Simulated operation of a one-shot timing relay.

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Simulated operation of a one-shot timing relay.

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The contacts of a *recycle timer* alternate between an on and off state when the timer is initiated.

Input Power

Press to Close

Press to Close

A1 15 Y1

Untimed Load

S1 Initiate **Timer** 16 18 A2

Load N.O.

TD 20 TD/x 25 00:00:8

Load N.C.

## Recycle timers are available in two configurations; symmetrical and asymmetrical.

In symmetrical timing the on and off periods are **equal**. The length of the timing period is adjustable but the time between the on and off operations remains constant.

Switch TR1 CB

TR1-1 ®

Single Time Setting

Input Voltage	ON	
	OFF	
N.O. Relay Contacts	ON	TD1 TD2 TD1 TD2
	OFF	

14
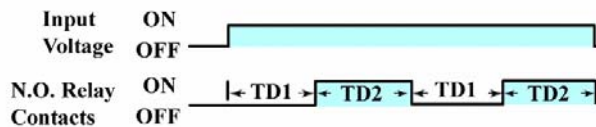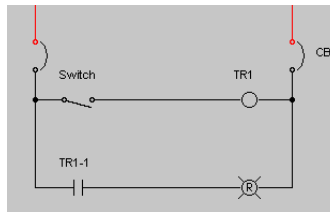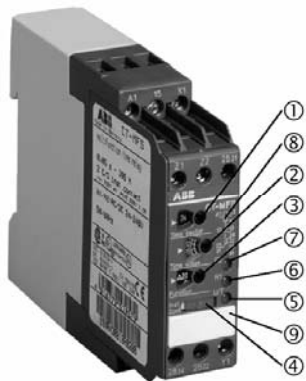
Asymmetrical timers **allow independent adjustments for the** **on** **and** **off** **period.**

They come
equipped with
individual ON and
OFF time
adjustment knobs.
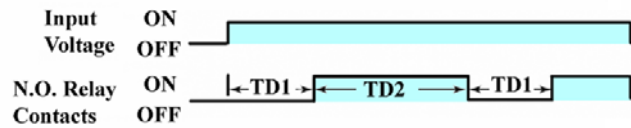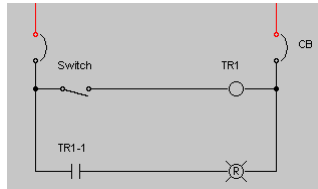
**MULTIFUNCTION
AND PLC TIMERS**

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**The term multifunction timer refers to timers that perform more than one timing function.**

Multifunction timers are more versatile and common in that they can perform **many different timing functions.**

Timing functions and special features provided include:

➢ **ON-delay**
➢ **OFF-delay**
➢ **impulse-ON**
➢**impulse-OFF**
➢ **flasher starting with ON**
➢**flasher starting with OFF**
➢**10 time ranges from 0.05 s to 300 h**
➢**Remote potentiometer connection**
➢**2 SPDT contacts**
➢**2nd SPDT contact can be selected as instantaneous contact (front-face sliding switch)**
➢**Volt-free (dry) control contact**
➢**Starting the time delay is possible**
      -via an external control contact or
      -via the supply voltage
➢**Pause timing /time storage is possible via an external control contact**
➢**3 LEDs for status indication**
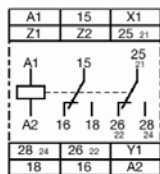
Programmable Logic Controllers (PLCs) can be programmed to operate in a manner similar to conventional timing relays.
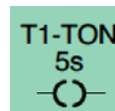
Ladder Logic Program
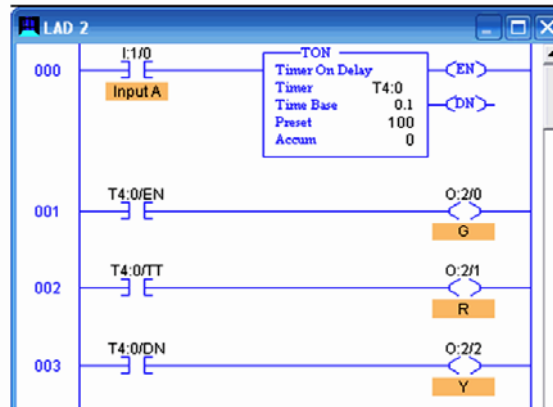
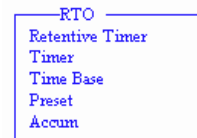**Hardware**

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➢**A PLC timer instruction** can be used to active or deactivate a device after a preset interval of time.

➢**One advantage of the PLC timer is that its timer accuracy and repeatability are extremely high.**

TON	TOF	RTO
Timer On Delay	Timer Off Delay	Retentive Timer
Timer	Timer	Timer
Time Base	Time Base	Time Base
Preset	Preset	Preset
Accum	Accum	Accum

The most common types of PLC timer instruction are the on-delay timer , off-delay timer, and retentive timer.

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This application calls for the pilot light to turn ON any time the pressure switch closes for a sustained period of 5 seconds or more.

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Simulated PLC ON-Delay Timer Program

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