AP-11
APB Timer Functions

Introduction

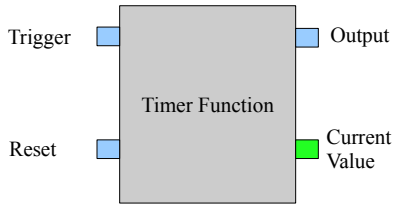
The APB controller offers a rich set of timer functions which may be incorporated into control systems or, in some cases simply used to provide simple multi-timer solutions.

All timers provide time resolutions from 10 msec to 999.59.59.990 msec and support both a 'TRIGGER' and a 'RESET' input signal. The RESET signal takes precedence and will always reset both the internal count and output state to 0. The 'TRIGGER' signal starts the timer functions when it transitions from a 0 to 1 state (on delays) or a 1 to 0 state (off delays).

Each timer has an 'OUTPUT' which will transition to active or inactive depending on the type of timer, the trigger activity and the elapsed time. In advanced applications the current timer 'value' may be accessed and used in comparison or arithmetic functions.

A 'retentive' timer will 'retain' its current time when power is removed and the APB controller supports up to 16 retentive timers (or counters).

Generic Timer Symbol



The differences between the timer types reflect how the timer responds to the Trigger input.

Type	Trigger	Description
ON Delay	↑	When the trigger goes active the timer is reset and starts timing. If the trigger is still active after the timer reaches the preset the timer stops (holds timer value at the preset value) and the output will go active. When the trigger goes inactive timer value is held and the output becomes inactive.
OFF Delay	↓	When the trigger goes active the output becomes active. When the trigger goes inactive the timer is reset and starts timing. If the trigger is still inactive after the timer reaches the preset the timer stops (holds timer value at the preset value) and the output will go inactive. When the trigger goes active timer value is held and the output becomes active.
ON/OFF Delay	↑ ↓	Cascaded ON - OFF delay with individual ON delay time and OFF delay time. The output remains inactive until the ON delay requirement is met. The output will then remain active until the OFF delay requirement is met.
Pulse Delay	↑	When the trigger goes active the timer is reset and starts timing and the output will go active. Further changes to the trigger input will have no affect until the timer reaches the preset, at which point the output will go inactive.
Keep On Delay	↑	When the trigger goes active the timer is reset and starts timing. Further changes to the trigger input will have no affect. When the timer reaches the preset the output will go active. The output and timer value can only be reset to 0 using the RESET input.
Blinker	↑	When the trigger goes active the timer is reset to 0 and starts timing to the ON delay time and the output becomes active. When the timer reaches the ON time it will reset to 0 and start timing to the OFF delay time and the output becomes inactive. This continues until the trigger becomes inactive.

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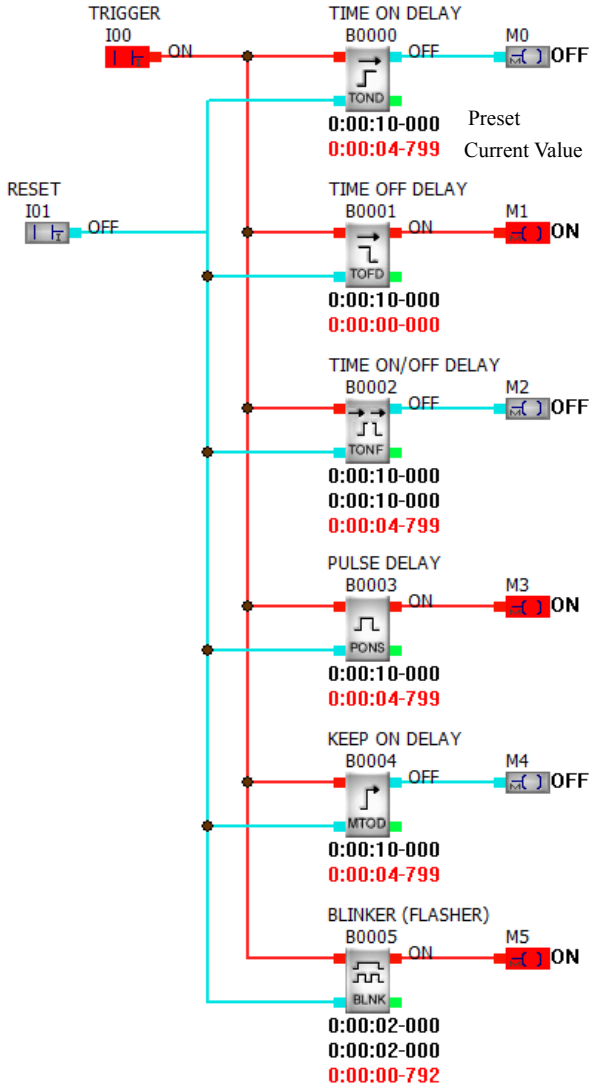
To gain a better appreciation of each of the timers operation the APB programming/simulation software may be used. The following program (AP-11 APB Timer Functions 1.aoc) may be downloaded and run under the APB simulator. The program consists of each of the integral timers connected to an input which may be toggled in the simulator to observe the timer operation. The simulator shows both the timer preset value and the current timer values.



The integral timers all provide a timed output signal which is triggered from an input signal transitioning to a particular state. In all cases, when the input signal condition is removed the timer either resets or 'freezes' the output and when the input condition is re-applied the timer value is reset and the sequence repeats. There is no mechanism to 'stop' and 'restart' the timers.

Elapsed Time

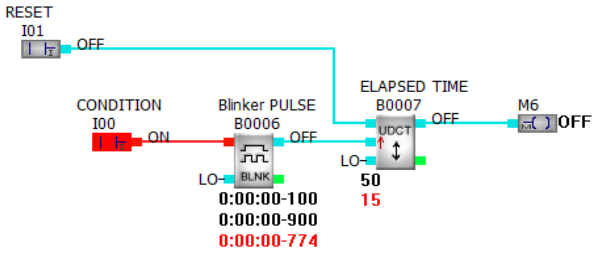
In some applications it is necessary to measure the accumulated 'elapsed' time: when the input condition is removed the timer 'freezes' the time and when the signal is re-applied the timer resumes. The simplest example is a 'hour meter' application that simply measures the accumulated time that a signal has been applied.

The Blinker function may be combined with a counter to easily implement an 'elapsed time' timer. In the circuit shown below the Blinker PULSE is configured to generate a 1 second timing pulse by going active for 100 msec and then timing out for 900 msec (total time = 1 second). This could easily have be configured as generating a 100 msec pulse and then timing out for 59.900 seconds, resulting in one pulse per minute. The output pulses will only be generated when the 'CONDITION' input is active.

In the example the pulses are applied to a counter that has a preset value of 50. After 50 pulses have been counted (50 seconds) the output of the counter will become active. To reset the counter output the RESET input must be made active.

If the input condition is removed the Blinker output pulses will stop and the counter will hold the accumulated time. When the input condition is re-applied the counter will continue to count.

Elapsed Time Circuit

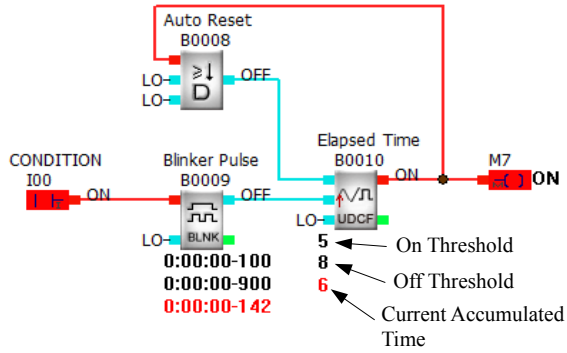


If the 'CONDITION' and 'RESET' inputs are configured to a permanent 'HI' level the Blinker will run whenever power is applied to the APB controller and the current value of the counter will show the total running time of the unit.

In the above example, once the counter has reached its preset value the output becomes active. If further pulses are applied the count value continues to increment but no change will be made to the output. To reset the output the RESET signal must be activated.

Unlike a simple Up/Down counter in which the output will go active if the count equals or exceeds the preset value an Up/Down Threshold Counter output may be configured to go active if the count is within a specific range.

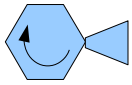
Auto Reset Elapsed Time



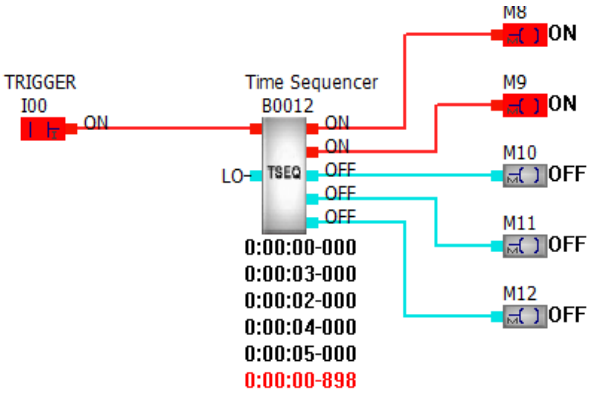
By replacing the simple Up/Down counter with an Up/Down Threshold Counter and adding an edge triggered OR gate the elapsed timer can be expanded to provide an output if the accumulated elapsed time exceeds a specific threshold and maintain the output until the accumulated elapsed time reaches a second threshold value.

Timed Sequences

Timed sequences consist of a series of outputs activated in a fixed sequence based on time. Traditionally, timing motors would drive a number of cam wheels which would activate switches.



The APB equivalent is implemented as a Time Sequence block.

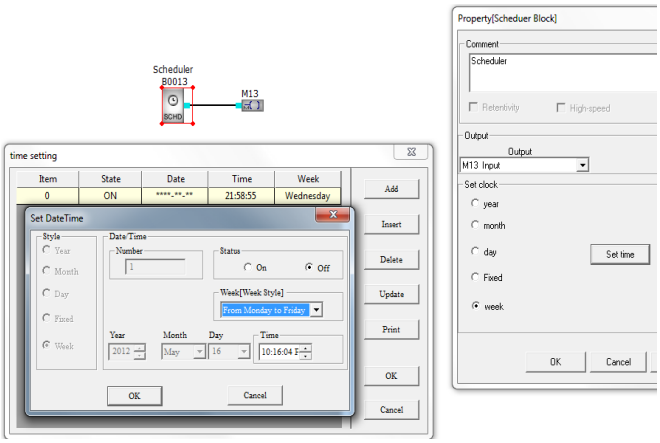


When the TRIGGER input is active the Step Sequencer timer is running. The Step Sequencer may be configured with up to 8 outputs (5 shown) and each output has a preset time. When the timer reaches the first preset the first output will become active and the timer resets to 0 and starts

timing to the next preset value. This continues until all outputs are active. When the trigger input goes inactive all outputs are set inactive.

Time of Day Timers

Similar to Timed Sequencers, a APB Scheduler timer activates its output based on a particular time of day. The scheduler has a single output which will be set active or inactive based on the time of day, the day of the week, the month or the year. Each Scheduler can contain 32 'scheduled' times.



Each time is entered specifying when the event occurs and whether the output should turn ON or OFF.

Special Purpose Timers

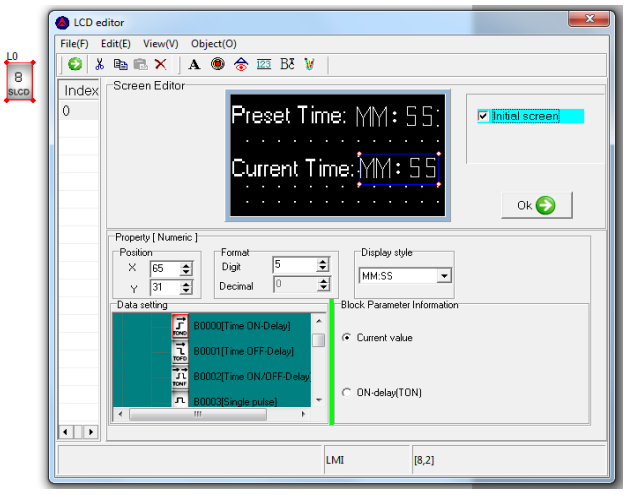
The APB provides 2 additional special purpose timers, the STLT that acts as a 3 stage timer (OFF delay, ON delay, OFF delay) and the MULT block that acts as an OFF delay timer if the trigger input is less than a preset time or a Keep On timer if the trigger input is greater than a preset time.

The Step Sequencer is similar to the Time Sequencer but the outputs are sequenced each time the Trigger transitions from 0 to 1. If a Blinker function is connected to the Trigger input a fixed time sequencer is realized.

Displaying Timer Values

Low cost fixed function timers typically have no display capability – the timer values are set with DIP switches or potentiometers. Many digital timers now offer a display to show the current or preset times.

The APB display supports up to 64 user defined screens, each providing for 4 rows of 10 characters that can display text, function block data, I/O states or graphics.

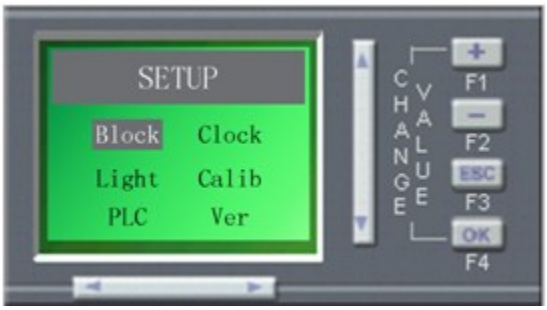


In the HMI configuration screen shown, the text 'Preset Time' and 'Current Time' can be any user defined text to describe the information. The B option allows displaying any block information, in this case block B0000 which is the Time ON delay shown in the first example. The MM:SS characters will be replaced with the actual timer values on the HMI display.

Modifying Timer Presets

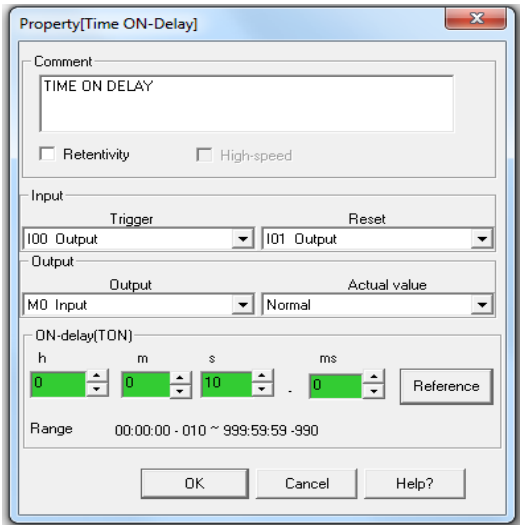
The HMI display allows any timer preset information to be changed by entering the 'Parameter Setup' screen. Pressing the 'ESC' key will return the HMI to the main Interface screen.

The parameter setting screen allows setting the preset information for each function Block and the current Clock value used by the Scheduler as well as other parameters relating to analog input calibration, PLC Modbus address and the LCD back-light control.

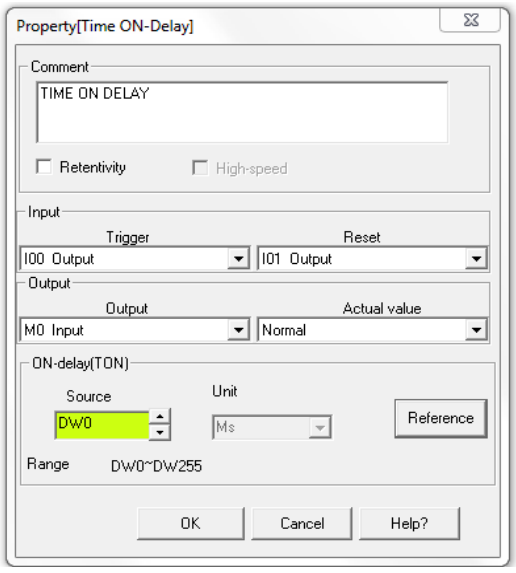


If the Block option is selected each program block may be selected and the preset values may be modified. These changes may be protected using a 4 digit 'password'.

An alternative approach is to use data register references instead of fixed preset values. The first configuration screen shows using the preset value.



By selecting the 'Reference' option the preset may be tied to a Data Register DW0..DW255. Data registers may be directly set by the user from any of the 64 user defined display screens. Refer to AP-8 Run Time Monitoring for further examples.



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Summary

The APB controller provides an excellent solution for applications that require 2 or more conventional timers. The ability to add additional control logic to replace external relay logic, the capability of supporting up to 320 unique timer functions and the integrated HMI display allows the APB controller to act as a universal multi-timer controller.

Up to 16 of the timers may be defined as 'retentive' timers that will retain the timer value in case of a power failure. For 'elapsed time' applications a simple Blinker function may be used to generate a pulse stream that is applied to a counter to form a 'run time' timer that can be started or stopped using an external control signal or run continuously whenever power is applied to the controller. These timers may also be configured to retain the accumulated time during power down.

The APB controller is available with either 4 or 8 outputs and expansion units may be added to support up to 64 outputs. The outputs may be solid state (NPN or PNP) or normally open (NO) relays. Low cost relays may be added to provide NO/NC relay connections if required.

For simple timer replacement applications minimum programming is required. The types of timers required are selected from a list of function blocks and the Trigger, Reset and Output pins are connected to the appropriate Input and Output points. Due to the simplicity of APB Functional Block programming additional control logic typically found in conventional timer applications may be easily added.

References

AP-3 APB Process Timing
AP-8 Run Time Control
YouTube Video Training

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