TENET TECHNETRONICS
"Simplifying Technology for Life"

2016

PID Controller

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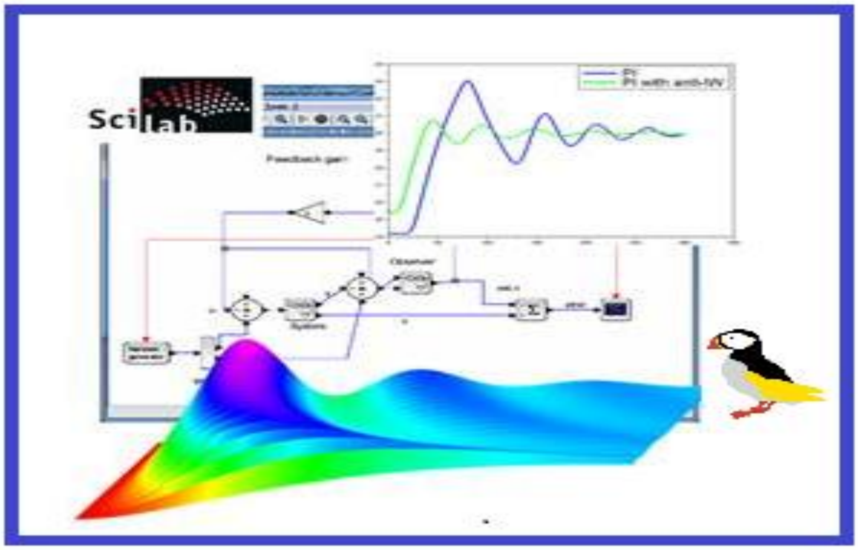

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TENET TECHNETRONICS

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Introduction:

A controller is a device introduced in the system to modify the error signal and to produce a control signal. There are different types of controllers based on the manner in which the controller produces the control signal. The controllers may be electrical, electronic, hydraulic or pneumatic, depending on the nature of signal and the system.

Classification:

Depending on the control actions provided the controllers can be classified as follows,

1. ON-OFF Controllers (or) Two position controllers.
2. Proportional controllers.
3. Integral controllers.
4. Proportional + Integral controllers (PI).
5. Proportional + Derivative controllers (PD).
6. Proportional + Integral + Derivative controllers (PID).

Proportional Term:

The proportional term makes a current error signal multiplied with proportional gain (K_p).

Output signal = K_P * error signal (e_τ)

Integral Term:

The integral term integrates the error signal over a duration multiplied with gain (K_I).

Output signal $= k_I \int_0^t e(\tau)d\tau$

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Derivative Term:

Derivative term makes a rate of change of error signal multiplied with a gain (K_d) as the control signal.

Control signal = $K_d \; d/dt\,(e(t))$

Controller Diagram:

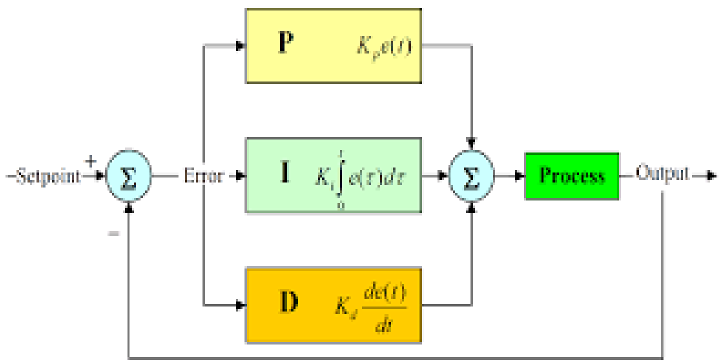
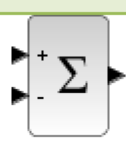


Figure 1: PID Controller

Let us simulate the PID controller,

Step 1: Open XCOS Window, drag & drop the required blocks tabled below.

Designation	Representation	Sub- palette
Step function		Sources/ STEP_FUNCTION
Summation		Mathematical operation/SUMMATION

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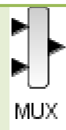
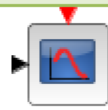
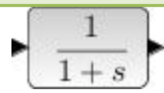
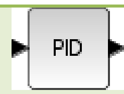
Multiplexer		Signal Routing/MUX
Visualization		Sinks/CSCOPE
Clock		Sources/clock_c
Continuous transfer function		Continuous time systems/CLR
PID regulator		Continuous time system/PID

<u>Purpose of blocks</u>

1. PID Block

The block implements a PID (Proportional-Integral-Derivative) controller. It calculates an **error signal e(T)** as the difference between a measured **process** variable and a desired **setpoint** .

Error signal = set point – Measured process

The PID controller is widely used in feedback control of industrial processes.

The PID controller calculation involves three separate parameters,

I. Proportional Kp,

II. Integral Ki,

III. Derivative Kd

These terms describe three basic mathematical functions applied over the error signal e(T). Kp determines the reaction to the current error, Ki determines the reaction based on the sum of recent errors and Kd determines the reaction to the rate at which the error has been changing.

2. CLR Block

The CLR Block is a continuous transfer function block. This block realizes a SISO linear system represented by its rational transfer function Numerator/Denominator. The rational function must be proper (numerator degree must be less or equal to denominator degree).

3. Step function

In its simpler use this block outputs a step signal between two definable levels Initial Value and Final Value starting at a specified time Step Time.

4. Summation

This block performs addition or subtraction on scalar, vector or matrix inputs.

5. Multiplexer

Multiplexer block is used for the purpose of merging the more than one input into single output.

6. Cscope

The CSCOPE is a single display scope and this Scope block displays its input with respect to simulation time. Both axes have a common range. The Scope allows you to adjust the amount of time and the range of input values displayed.

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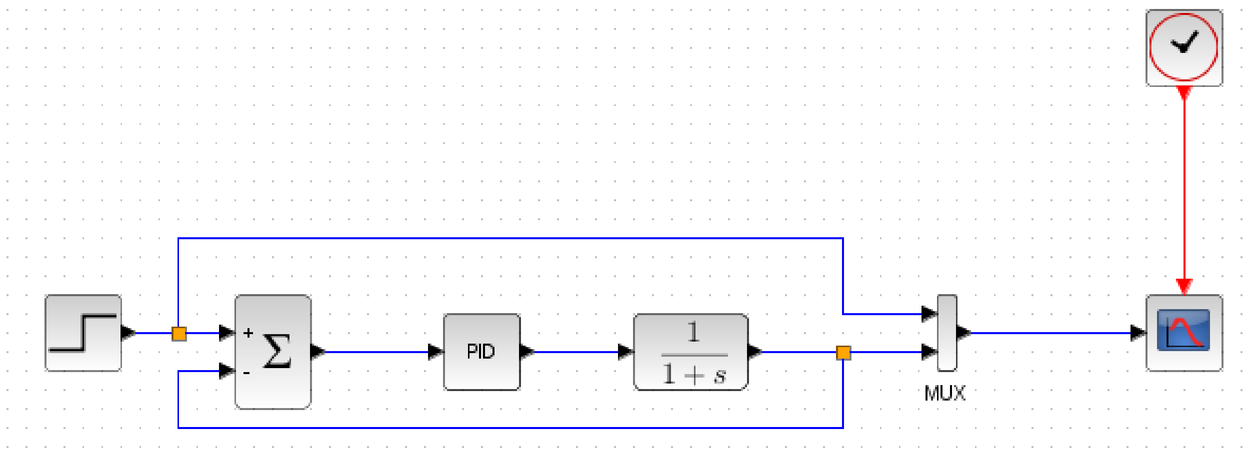
7. Clock

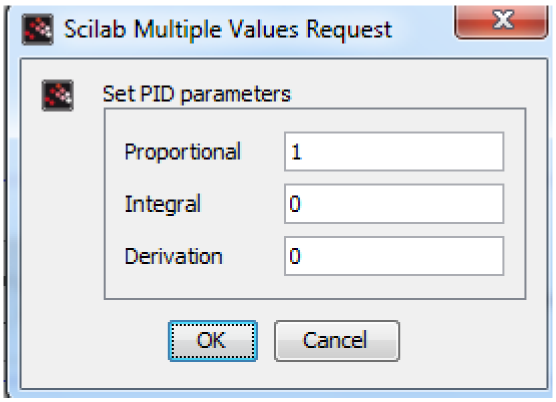
The unique output of this block generates a regular train of events that are scheduled, by parameter Period in seconds. The starting date of events generation can be set in seconds with the Initialization Time parameter.

Step 2: Arrange the blocks in XCOS window and then connect the required ports.



Step 3: To configure the PID block double. Click on it,

Set proportional is equal to 1 and other values are zero.



Note:

- **In proportional only mode, the controller simply multiplies the error by the proportional gain (kp) to get the controller output.**

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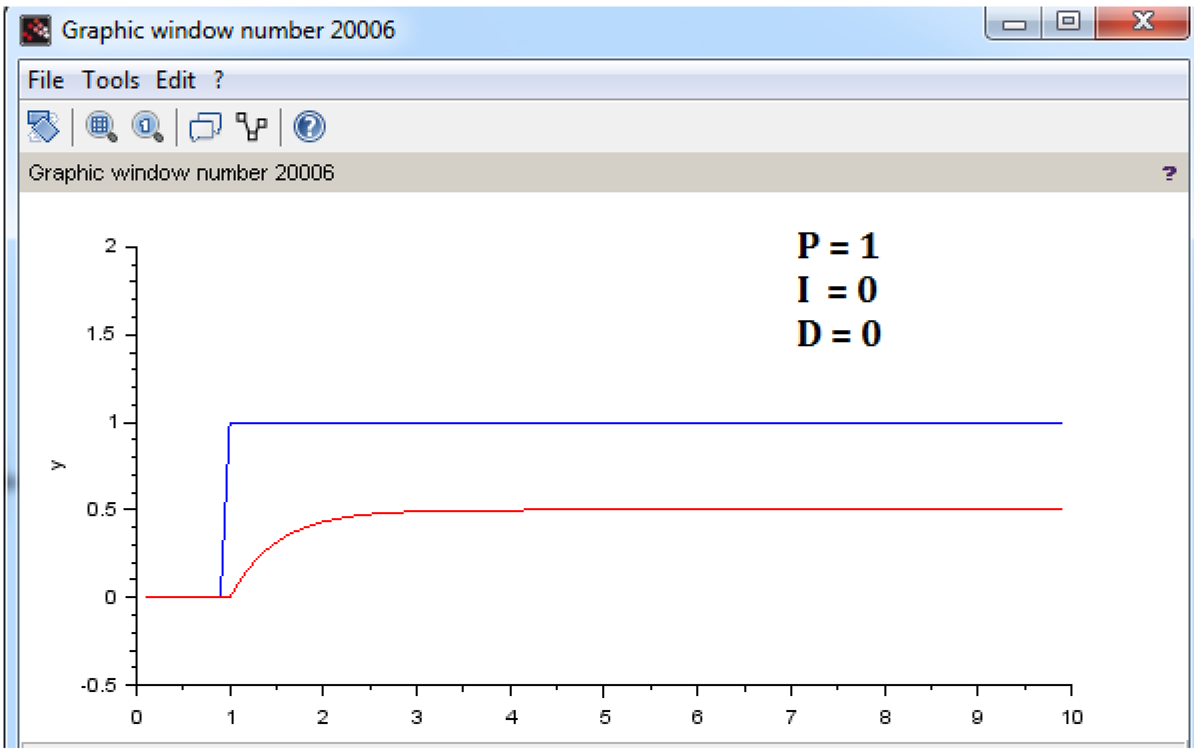
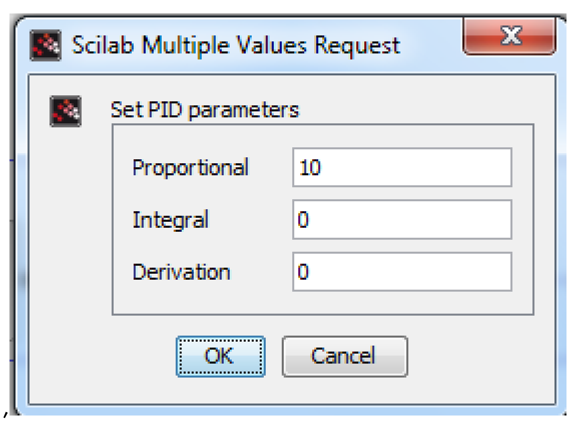
- **Small proportional gain (kp) is the safest way to get to set point, but the controller performance will be slow. If the kp is increased, overshoot in the signal will be present.**

Click ok, and start simulation.

Step 4:



Step 5: To Modify the values of Parameters, Click ok, and start simulation



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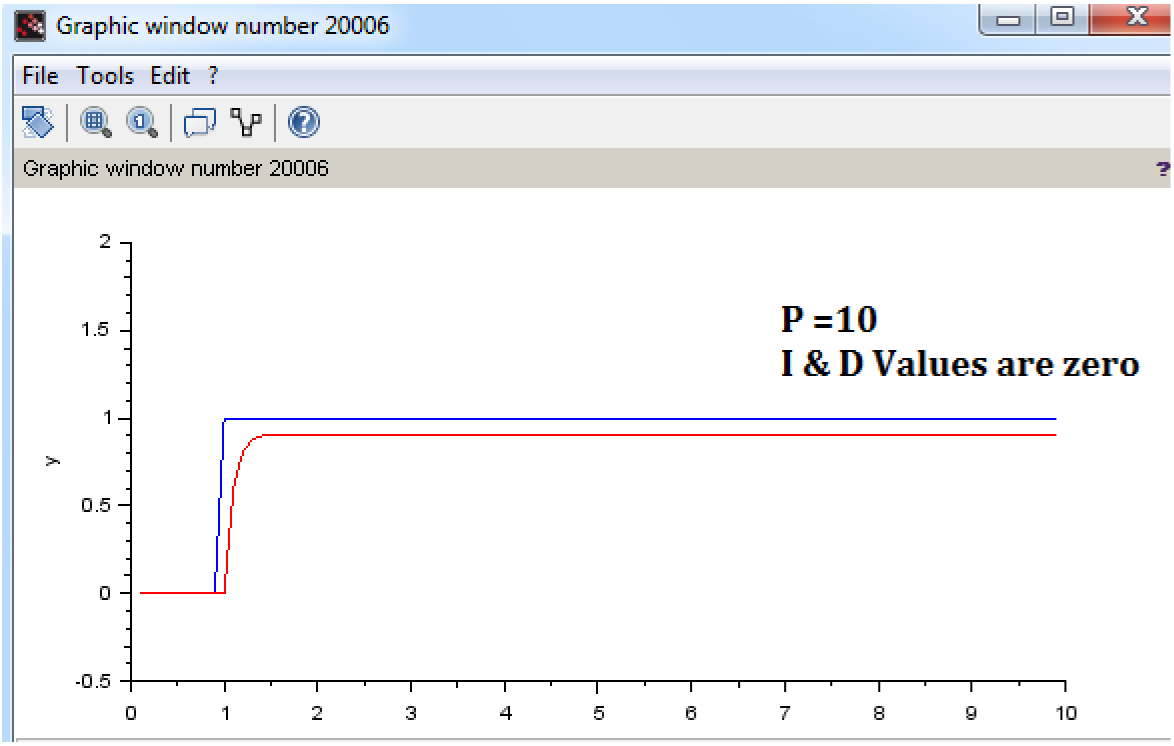
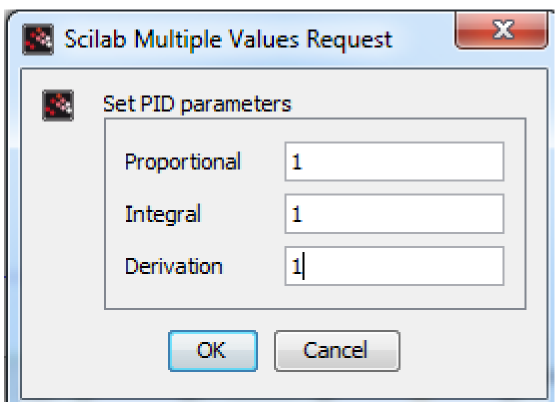


Step 7: Modify the values of PID



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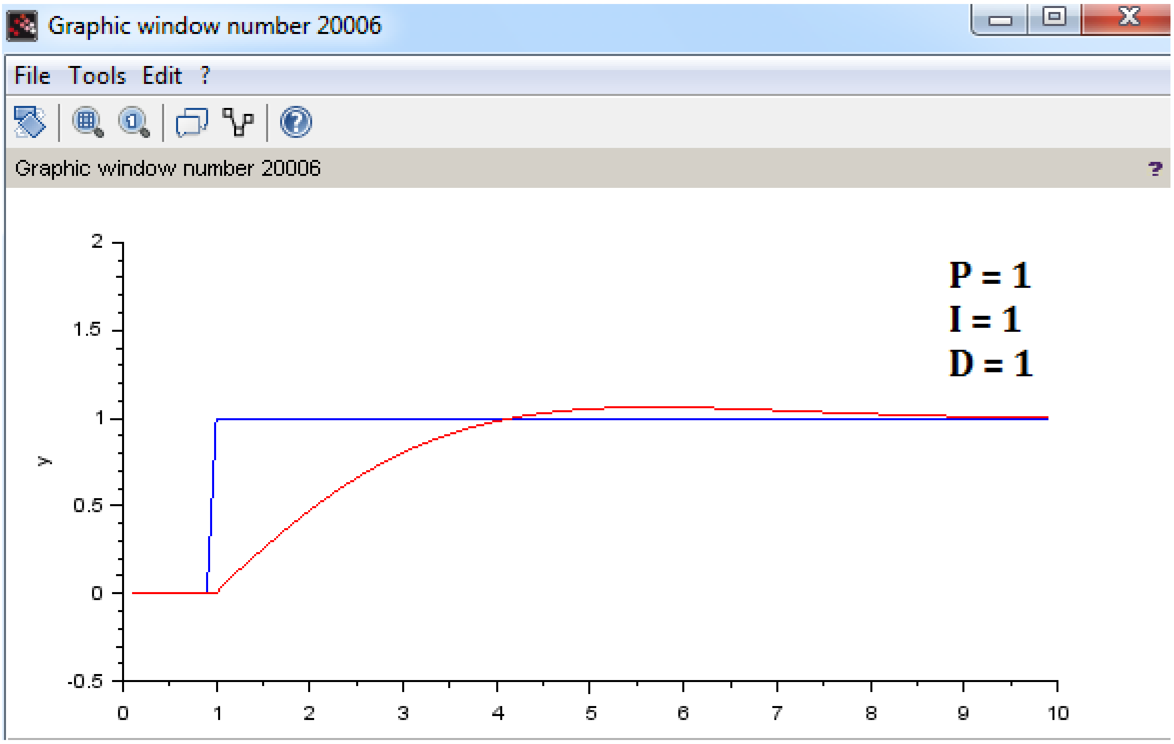

For more information please visit: www.tenettech.com

For technical query please send an e-mail: info@tenettech.com

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