505 Transfer Function – Generator Application

Introduction

With this 505 controller based generator application there are two PIDs in effect depending on the implementation; Speed Control PID and Cascade Control PID. The model contains several configurables and analog values that need to be incorporated into the end users model to provide the correct functionality. The following is a summary of the configurables and descriptions of how they function.

Analog Inputs:

Cascade_Spt:	Cascade setpoint for the cascade PID. Configurable in the 505 service headers
Cascade_Input:	Cascade PID input. Usually from a configured analog input
Deadband:	Cascade PID deadband. Configurable in the 505 service headers
Max_Cascade_Spd:	Maximum Speed setpoint of Cascade PID output. Defines range of speed into the speed control setpoint
Min_Cascade_Spd:	Minimum Speed setpoint of Cascade PID output. Defines range of speed into the speed control setpoint
Sync_Spd:	Synchronous speed of the steam turbine. Configurable in the 505 service headers
Ospd:	Overspeed Test Limit. Configurable in the 505 service headers
Droop_Pct:	Droop percentage of the control when the gen and utility breaker are closed. (Ex: 5%=0.05)
Speed:	Actual Speed of Turbine.

Boolean Inputs

GoTo_CascadeControl:	Enables the speed reference to follow the Cascade PID output
Gen_Breaker_Closed:	Generator breaker status
Util_Breaker_Closed:	Utility breaker status

505 Full Transfer Function Model

Figure 1: 505 Transfer Function Model illustrates the total model. The analog and boolean inputs are described in the introduction. The delays that are placed in the model are not true delays but should ideally be simulated with a discrete sample and hold. The delay after the cascade PID simulates the discrete rate group delay of 40msec in the control. This means that the cascade PID should only implement a change to the setpoint of the speed control PID every 40ms. The delay after the speed control PID simulates the rate group delay of the PID which is 10msec. The output of the speed control PID is scaled to its actual mA value that is the signal generated to the steam valve actuator.

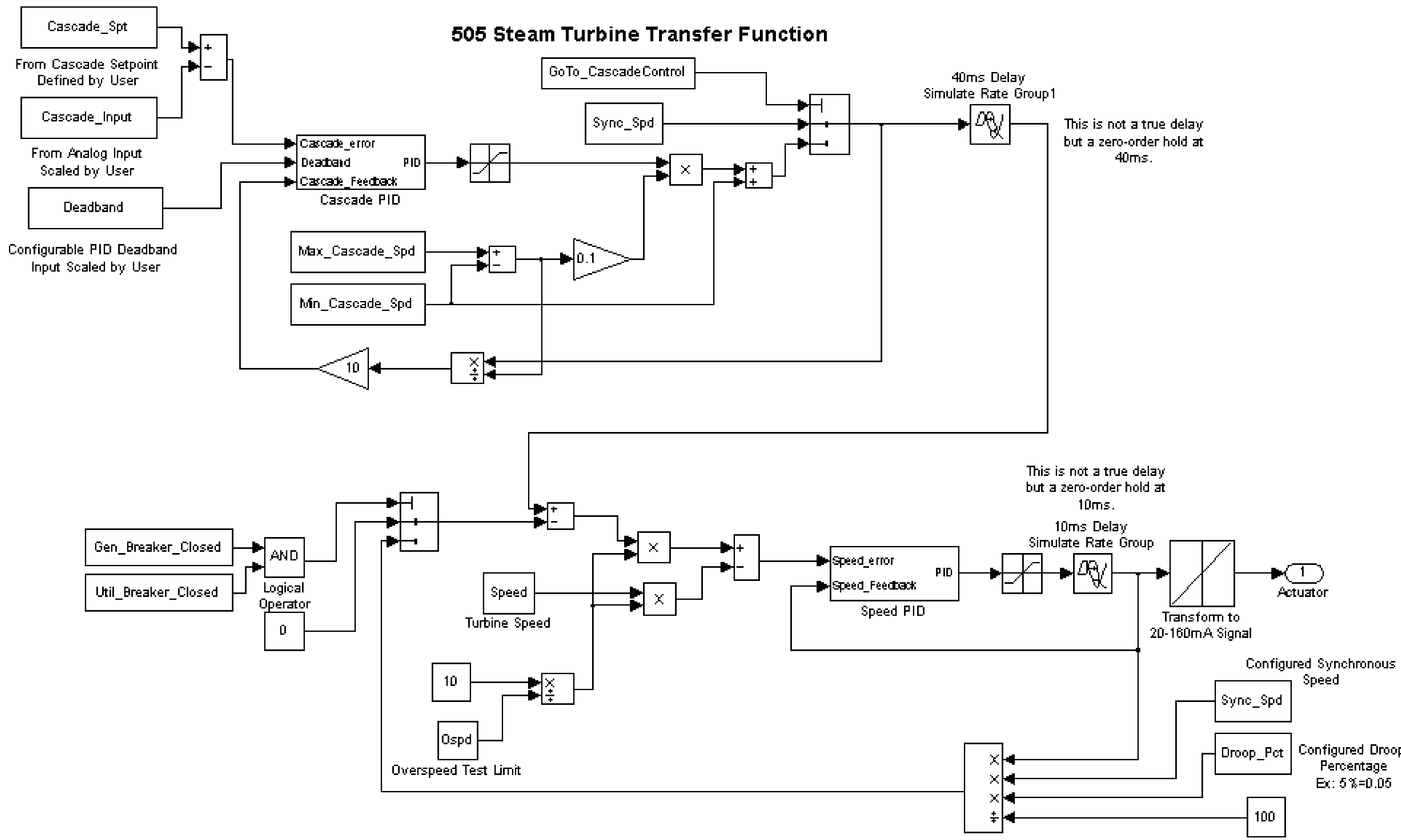

Figure 1: 505 Transfer Function Model

Cascade PID

Figure 2: Cascade Control PID (PID_DB) illustrates the cascade PID. The PID has three gains; Proportional, Integral and SDR. An explanation of the gains and how they are implemented in the model are explained in the figure. If the SDR ratio is greater than 1 then the PID changes dynamics and filtering. The deadband is also important. If the error signal is less than the deadband the cascade feedback is the last value of the feedback. If the error signal is greater than the deadband then the cascade feedback filter is used for control.

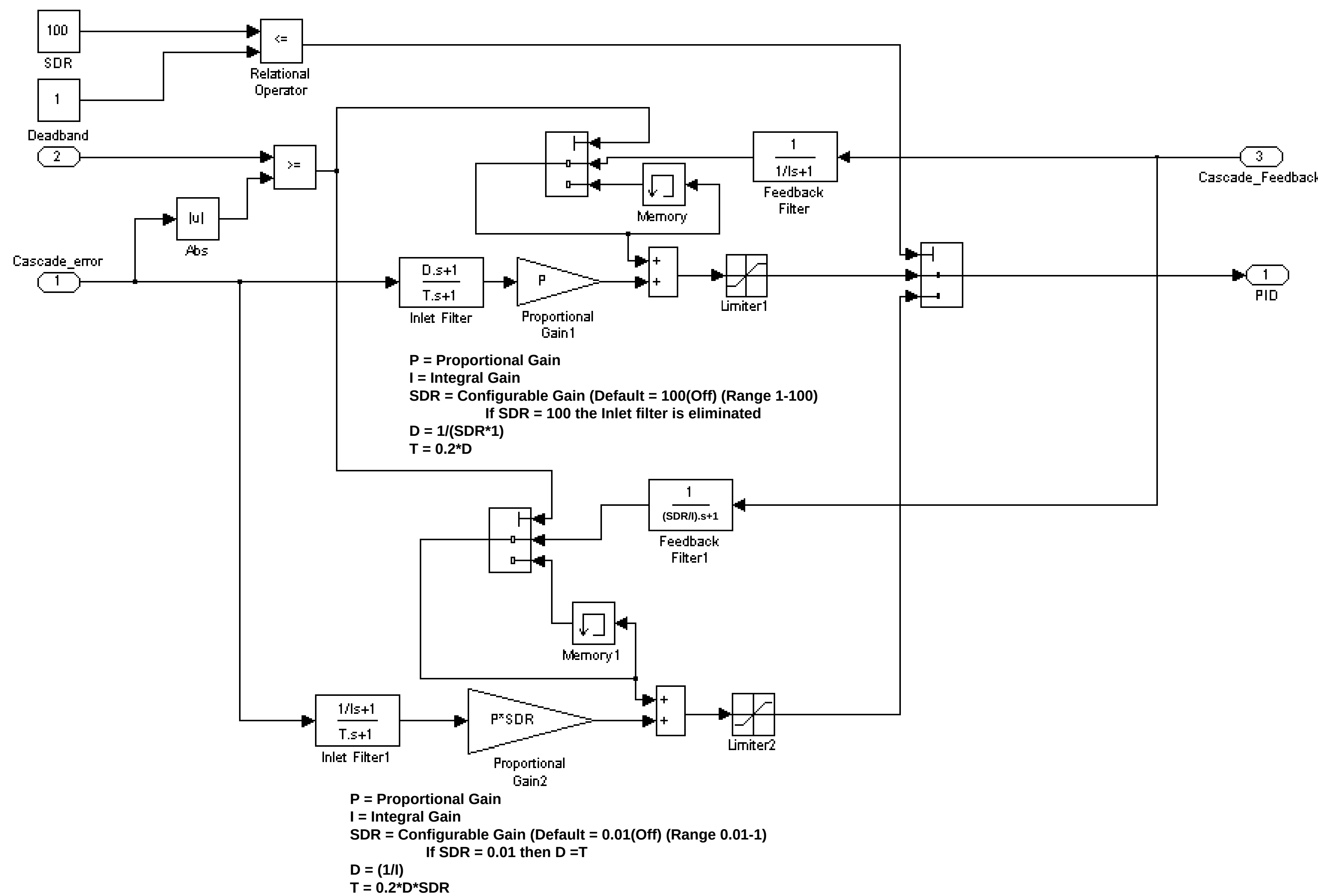

Figure 2: Cascade Control PID (PID_DB)

Speed PID

Figure 3: Speed Control PID (PID_2) illustrates the speed control PID. The PID has three gains; Proportional, Integral and SDR. An explanation of the gains and how they are implemented in the model are explained in the figure. If the SDR ratio is greater than 1 then the PID changes dynamics and filtering. If the generator breaker and the utility breaker are closed then the gains change to adjust dynamics. The figure described the gains that are used in isochronous mode and droop mode.

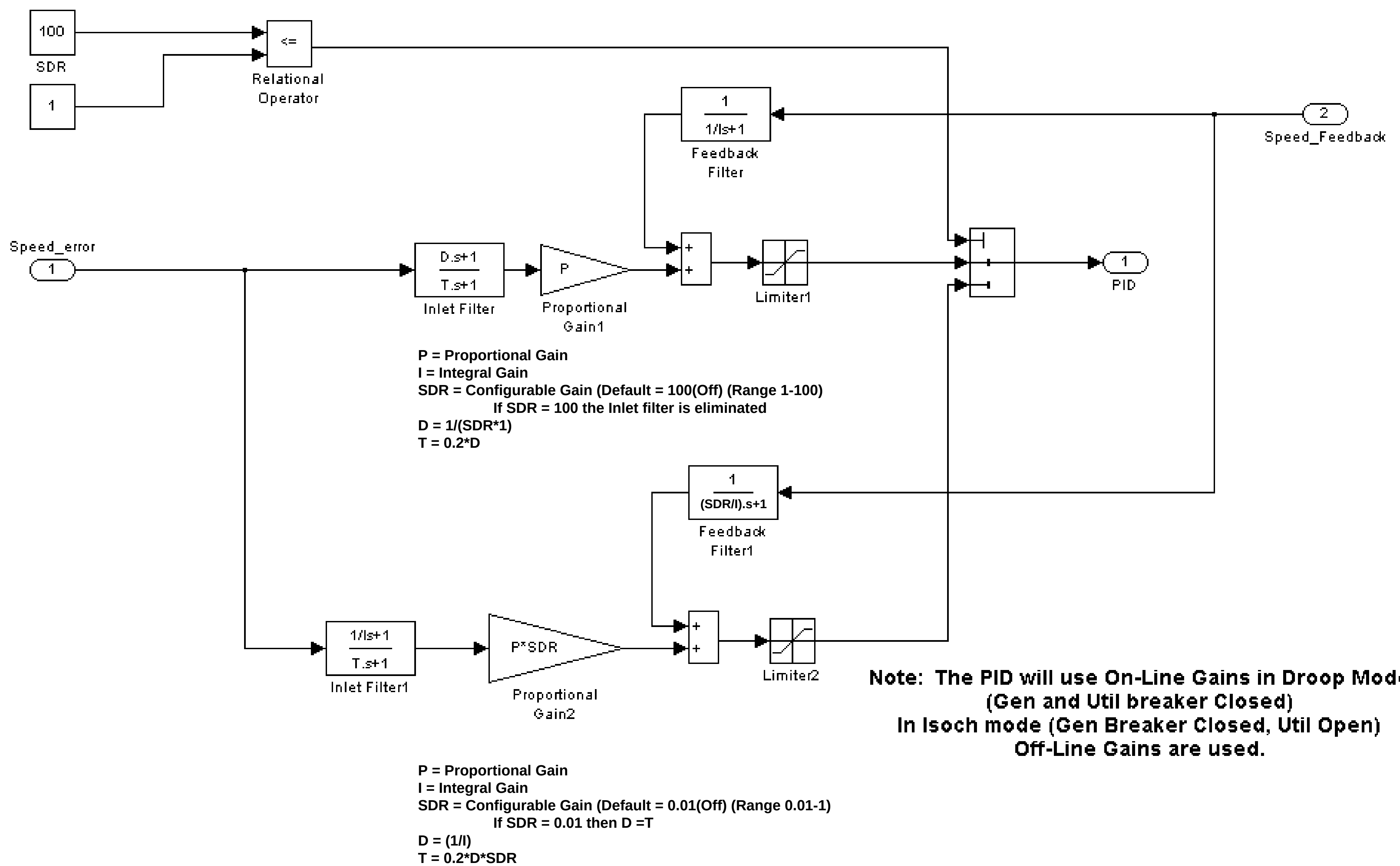

Figure 3: Speed Control PID (PID_2)