RSC-D250AUTO • April, 2024
Published for the Basler Electric Power Systems Group

Application Note

Automatic PID Tuning of Basler Electric's DECS-250

Basler Electric's digital voltage regulators utilize PID control loop feedback to provide exceptional voltage control and responsiveness to dynamic changes in the generator system. PID or proportional–integral–derivative controllers calculate the error of measured values compared to the desired setpoint and then minimize the error between them by adjusting the amount of excitation to the generator and exciter. Properly tuning a PID controller can often be a time consuming and tedious task. However, the DECS-250 can do this automatically without the need for laborious user interventions.

To understand how the auto-tuning feature tunes a voltage regulator with a PID controller; one must first understand how a PID controller works. PID controllers adjust three gain constants or parameters to manipulate a generator's response. These parameters are proportional gain, integral gain, and derivative gain.

The proportional term adjusts the output at a level proportionate to the amount of error detected by the controller. Simply, the amount of output from the regulator will be directly proportionate to the difference from the setpoint detected by the controller "error" multiplied by the proportional setting (Kp). Therefore, if the error is high, the output of the voltage regulator will also be high. Increasing the Kp term will result in a larger change in output for a given change in the error. In reference to the voltage regulator, the proportional term adjusts the rise time or how quickly the voltage gets to the setpoint.

The integral term (Ki) is somewhat similar to the proportional term in that it is proportional to the amount of error. However, it also makes adjustments based upon the duration of the error. In a proportional only controller, as the error is reduced the amount of correction is also reduced. Therefore, the integral term must be introduced. The integral term adjusts the output based upon the magnitude of the error and also the amount of time the error has been present. When a small error is detected this term will begin to "integrate" and increase the amount of correction based on how long the error is present. The integral gain is adjusted to tune the steady state stability of a digital voltage regulator.

The derivative term setting (Kd) measures the amount of error and the rate at which it is changing. The derivative term then adjusts the output based upon how fast the error is changing. It could be interpreted that the derivative term is adjusting the output based upon anticipating the error signal. In a voltage regulator, the derivative term can be used to minimize voltage overshoot or undershoot.

To achieve a good response, all three PID controller terms must be tuned to work together and also be properly tuned to the generator. The time constants of the exciter and the generator are critical components of this process.

If the time constants are known by the user, Basler Electric provides a PID calculator in their BESTCOMS*Plus*® PC software which can be used to estimate the PID gains

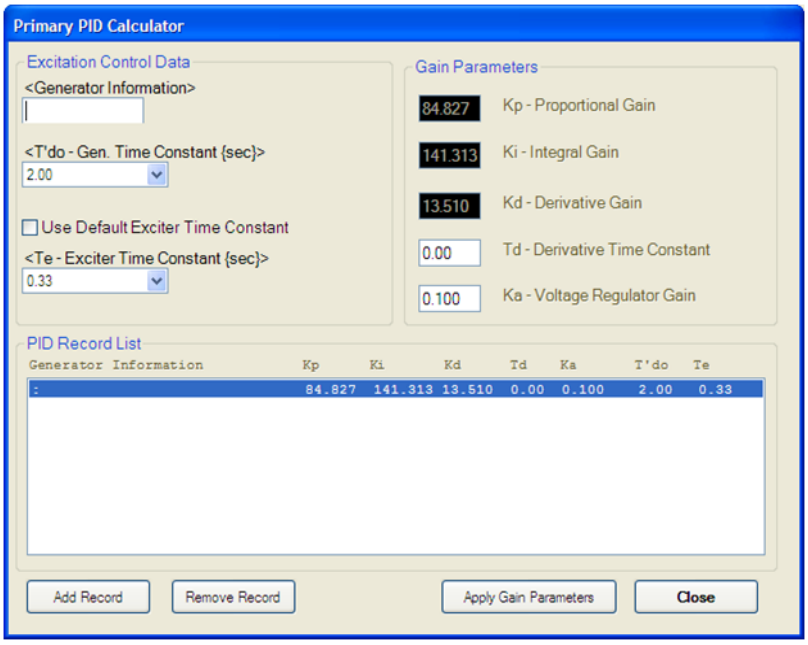

Figure 1: PID calculator in BESTCOMS*Plus*®

required to achieve a stable system response. See Figure 1. However, in many cases this data may not be available. If this is the case, the user is typically required to adjust the voltage regulator's PID gains by trial and error until an acceptable response is achieved. This process of adjusting gains and performing step responses by trial and error often requires a large time investment from the commissioning engineer.

Basler Electric's DECS-250 has the ability to perform this tuning automatically. Utilizing the BESTCOMSPlus software, which is supplied with every DECS-250, the commissioning engineer can now place the DECS-250 in auto-tune mode. While in auto-tune, the DECS-250 takes control of the generator and input signals to the exciter field. At the same time it monitors the generator output voltage changes and automatically calculates the required PID parameters based upon the response of the machine. See Figure 2. When completed, the optimized gains are stored within the DECS-250.

The auto-tuning technology provides many benefits to both the commissioning engineer and the end user. Using this feature of the DECS-250 assures the user that the generator is tuned properly and will provide stable operation and optimal transient performance. Additionally, the auto-tune function reduces the commissioning engineers time and expenses. It also reduces unnecessary fuel consumption used during the conventional "trial and error phase" of PID tuning. All of these reductions provide a cost savings to the end user.

For more information

If you have any questions, consult the Basler factory at +1 618.654.2341 or visit www.basler.com. If you would like additional information about the DECS-250, request a copy of the product bulletin (part no. SZPBULL) or the instruction manual (part no. 9440300990).

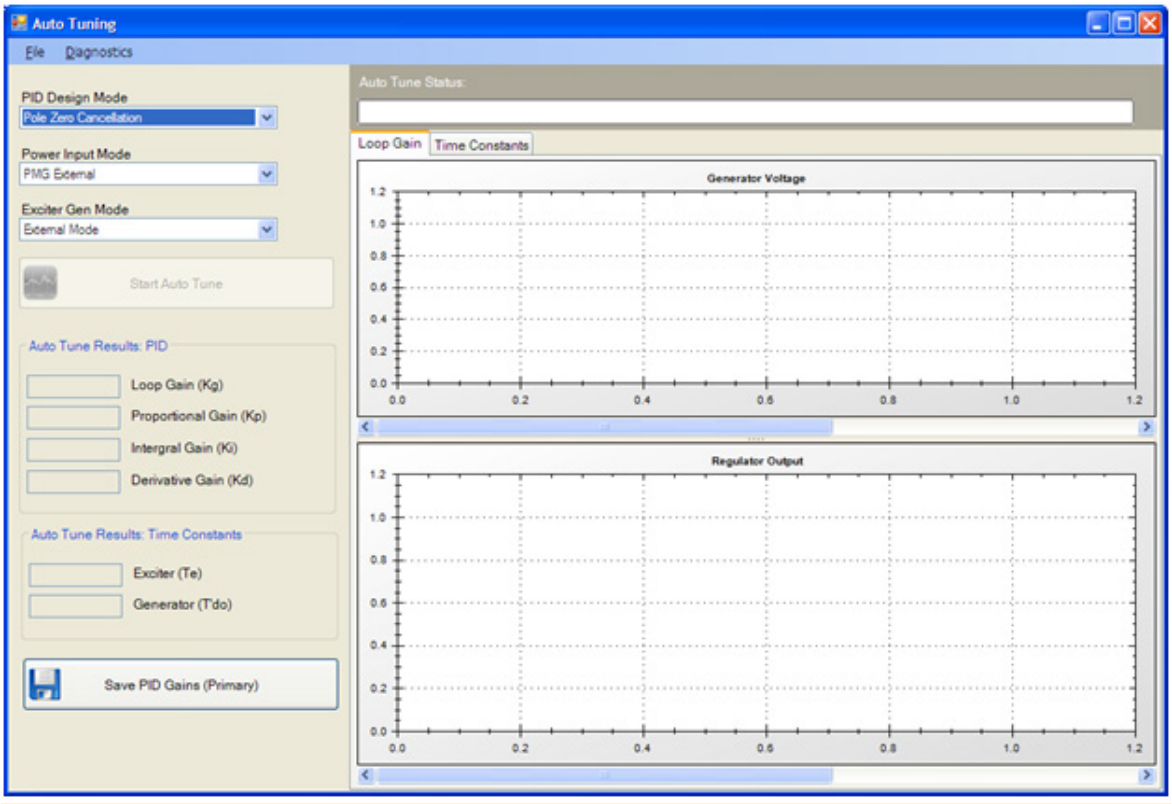

Figure 2: Auto-tune feature from BESTCOMS*Plus*

Basler Electric®

Highland, Illinois USA
Tel +1 618.654.2341
Fax +1 618.654.2351
email: info@basler.com

Suzhou, P.R. China
Tel +86 512.8227.2888
Fax +86 512.8227.2887
email: chinainfo@basler.com

Quality System Certification
Basler
ISO 9001:2015