

Application Note

AN-ODP-32

## ***PID control using Parameter group 3***

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**Revision: 2.21 6 September 2006**

- ***General***

Optidrive Plus has a built-in flexible PID feedback controller that can be used for a variety of process control applications. Typical applications include pressure control, flow rate control, temperature control etc.

***Note that PID controller will function only when P1-12 is set to 3. For Modbus versions of the drive (3GV-M), this parameter group is not available.***

This document describes the setup procedure for each of the operating modes available.

- ***PID controller operating mode selection :***

The PID controller mode is set using parameter P3-04.

In all cases, the P3-04 allows the user to select either direct PID control, where an increase in the speed of the motor increases the feedback value, or to select inverse mode, where an increase in the speed of the motor reduces the feedback value.

Hence,	P3-04 = 0	Direct mode	(eg compressor control)
	P3-04 = 1	Inverse mode	(eg condenser fan control)

- ***PID feedback input :***

The PID feedback can be selected from two different sources: 2<sup>nd</sup> analog input or bipolar analog input. This can be selected by setting 0 or 1 in parameter P3-10.

When using 2<sup>nd</sup> analog input as PID feedback, the PID feedback signal should be connected to the 2<sup>nd</sup> analog input. This will usually originate from a feedback transducer which produces an output proportional to the quantity being controlled. (eg pressure, flow rate etc).

The format of the feedback signal can be configured by setting up P2-33 as required. Most feedback transducers use the 4..20mA format. See AN-ODP-06 for more information about how to select the analog signal input format.

When connecting a 2-wire feedback transducer (eg 4..20mA type), check that the transducer is suitable for 24V operation, then connect the transducer supply to pin 5 and the transducer output to pin 4. Set P2-33 = 4..20mA.

When using the bipolar analog input as PID feedback, the PID feedback signal should be connected to the bipolar analog input (Terminal 6).

The format of the feedback signal can be configured by setting up P2-30 as required. Since there is no current input format option for the bipolar analog input, an external resistor will be needed to support current format signals. See AN-ODP-41 for more information about how to use the bipolar analog input for current input signals.

If the bipolar analog is selected as a feedback signal, digital input 3 (2<sup>nd</sup> analog input) can then be used as an external trip input which enables the user to connect a motor thermistor for motor protection purposes.

This external trip function is not available if 2<sup>nd</sup> analog input is selected as PID feedback input.

- **PID reference select :**

The PID controller reference can be given by an external analog input signal or by digital preset value depending on application requirements. This is set up using P3-05.

P3-05 = 0 : PID control using the digital preset value for the reference input. The digital preset reference value is defined in Parameter P3-06, which will give a 0 to 100% full range of feedback value as reference value.

P3-05 = 1 : PID control using the Optidrive Plus bipolar analog input for the reference input. In PID control mode, the bipolar analog input should be configured as a unipolar input format. Any input value less than zero will be limited to zero.

- **PID output digital preset limit :**

P3-07: PID controller output high limit. This parameter defines the maximum output value of the PID controller. The limit value is calculated as:

$$\text{Limit} = \text{P3-07} * \text{P1-01}$$

A value of 100% limits the maximum speed of the PID controller to the maximum speed limit defined in P1-01.

P3-08: PID controller output low limit. This parameter defines the minimum output value of the PID controller. The limit value is calculated as:

$$\text{Limit} = \text{P3-08} * \text{P1-01}$$

- **PID output limit control :**

P3-09 = 0: Digital preset limit value (P3-07 and P3-08) will be used to limit PID controller output.

P3-09 = 1: Bi-polar analog input will be used as the maximum output limit.

- P3-09 =2: Bi-polar analog input will be used as the minimum output limit.  
P3-09 =3: Bi-polar analog input will be used as an offset value and added to the PID controller output.

- **Note :**

The user has to adjust the PID control parameters (P-gain, I-gain and D-gain) in P3-01, P3-02 and P3-03 respectively to get the best control performance. The values will vary dependent on system inertia and the time constant (rate of change) of the system being controlled.

### **Application Examples:**

- ***Using a condenser fan to control the pressure in a refrigeration system***

1. Set the 2<sup>nd</sup> analog input format to suit the signal from the feedback transducer using parameter P2-33 (typically 4...20mA).
2. For a 2-wire 4...20mA transducer, connect the +ve terminal of the transducer to the +24V supply (usually terminal 5) and the -ve terminal of the transducer to terminal 4 of the Optidrive Plus (2<sup>nd</sup> analog input).
3. Set P3-04 = 1 to select the inverse PID control mode. This ensures that as the feedback signal falls (pressure drops), the speed of the fan also falls.
4. Set P3-05 to determine where the controller reference (set point) comes from. If P3-05 = 1, it means that the reference comes from the preset value (P3-06 value)
5. Set P3-06 to the required level. A value of 100% in P3-06 equates to the rated value from the feedback control transducer (10V or 20mA).
6. Set a suitable value for the P-gain, I-gain and D-gain by giving the correct value into parameters P3-01, P3-02 and P3-03.
7. Set P1-12 to 3. This will active the PID control function automatically. If the enable signal is given on terminal 1 and 2, the Optidrive Plus will run immediately.

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