



Product	AMD	Type/Series	C/CP2000	Appl. Note Nr.	C-CP2000 PID set-up
Issued by	DEN	Author	Arnoud de Bok	Release Date	April 11, 2016
Title	C/CP2000 PID SET-UP				

Devices and special tools/equipment
N/A

Test setup
N/A

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1 GENERAL

1.1 PID

The PID function can be used to control a process value like pressure, flow, air volume, temperature, etc.

The set point (or target value) is the value that the process should “make”.

The feedback (or process value) is the value that the process actually “makes” and that eventually should become equal to the set point.

A good example of a PID controller is the cruise control in your car:

- The set point is the target speed as set by the driver.
- The feedback is the actual speed of the car.
- The car (the process) maintains the speed by controlling the throttle.

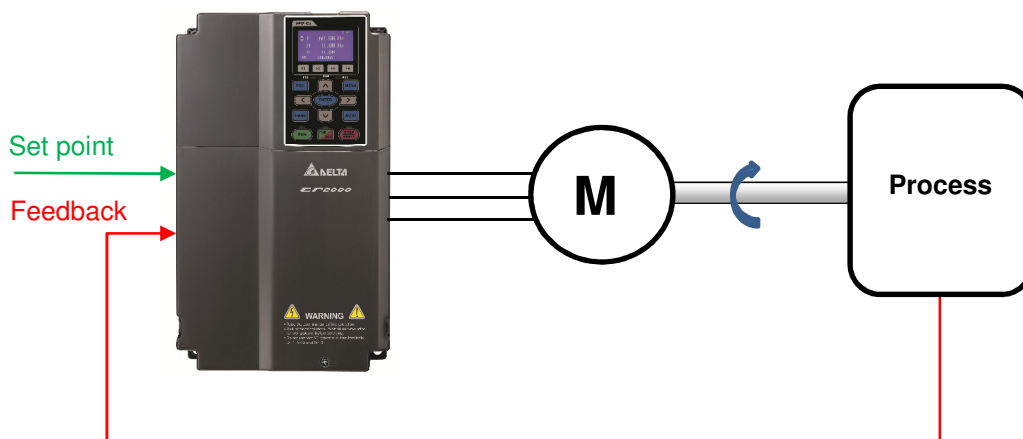
1.2 PID in drives

In Delta drives, the set point is given in the same way as a frequency command (but is not a frequency command).

The feedback (pressure, flow, etc.) comes from a sensor to an analogue input. This sensor usually is 0-10V or 4-20mA.

Depending on set point and feedback the drive outputs a frequency to the motor to achieve equilibrium (feedback = set point).

- When feedback < set point, the output frequency increases.
- When feedback is > set point, the output frequency decreases.
- When feedback is = set point, the output frequency stays constant.



2 PID IN C/CP2000

2.1 Example requirement

- Set-point 0-16bar.
- Feedback 0-16bar.

2.2 Parameter settings

2.2.1 To begin

- Do reset to (50Hz) defaults Pr00-02=9.
- Set motor data, do autotuning, etc. if needed.
- Pr00-21=0 for Start/Stop via keypad.
 - =1 for Start/Stop via RS485.
 - =2 for Start/Stop via digital input.

This setting is not important for the actual PID function.
- Program digital inputs and outputs as required by the application.
- Pr00-04=10 to show PID feedback on display (not necessary but convenient).

2.2.2 Connect the feedback sensor

2.2.2.1 4-20mA sensor

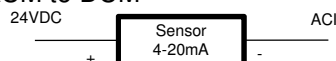
These sensors can be 2-wire or 3-wire.
Always check their specs and supply voltage.

- If a 2-wire 4-20mA sensor is used:

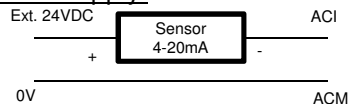
- Connect - to ACI.

- Internal power supply:

Connect ACM to DCM



- External power supply:

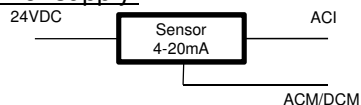


- Generally 2-wire sensors need 8~30VDC over them (at 20mA the ACI input is 5V).

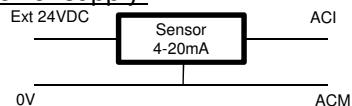
- If a 3-wire 4-20mA sensor is used:

Connect output to ACI.

- Internal power supply:



- External power supply:

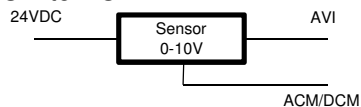


2.2.2.2 0-10V sensor

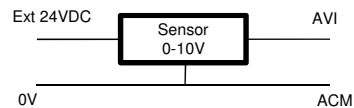
- Connect sensor output to AVI.

- Internal power supply:

Connect ACM to DCM.



- External power supply:



2.2.3 Feedback

- Make sure set-point and feedback are from different inputs.
- Here only negative feedback is considered.
- For positive feedback, please refer to the user manual.
- For feedback via PG (encoder) in C2000, please refer to the user manual.
- Unused analogue inputs should be set to 0 (No Function).
- Please set the relevant switches on the terminal board.

2.2.3.1 Feedback on AVI (CP2000 AVI1)

- Pr08-00=1 for PID enable with negative feedback on AVI (AVI1) acc. to Pr03-00=5.

2.2.3.2 Feedback on ACI

- Pr08-00=1 for PID enable with negative feedback on ACI acc. to Pr03-01=5.

2.2.3.3 Feedback on AUI (C2000)

- Pr08-00=1 for PID enable with negative feedback on AUI acc. to Pr03-02=5.

2.2.3.4 Feedback on AVI2 (CP2000)

- Pr08-00=1 for PID enable with negative feedback on AVI2 acc. to Pr03-02=5.

2.2.3.5 Feedback via communication (C2000)

- Pr08-00=7 for PID enable with negative feedback via communication or Pr08-00=8 for positive feedback via communication.
- The feedback value can be written to Pr08-06 where writing 0~10000 means 0~100.00%.

*When writing very frequently to Pr08-06, please set Mlx=38 to disable writing to EEPROM to prevent exceeding the max. number of write cycles.
This affects all parameters so please do this after setting up the drive and programming all parameters.*

2.2.4 Set-point

- Make sure set-point and feedback are from different inputs.

2.2.4.1 Set-point by keypad

- Pr00-20=0 for frequency command via keypad (therefore also for set-point).

2.2.4.2 Set-point by analogue input

- Pr00-20=2 for frequency command via analogue input (therefore also for set-point).
- Pr03-00=4 for set-point AVI1 (CP2000) or AVI (C2000).
Pr03-01=4 for set-point ACI.
Pr03-02=4 for set-point AVI2 (CP2000) or AUI (C2000).

Unused analogue inputs should be set to 0 (No Function).

2.2.4.3 Set-point by communication

- Pr00-20=1 for frequency command via comm (therefore also for set-point).
- Send 3125d (or 0C35h) to address 2001h (for 31.25Hz or 62.5% of $F_{max}=50\text{Hz}$).

2.2.4.4 Set-point by Preset speeds

- Pr00-20=0 for frequency command via keypad.
- Program the inputs Mlx (Pr02-01 ~ 02-08) and the Preset Speeds (Pr04-00 ~ 04-14) as wanted, see user manual.

The Preset Speeds need to be set as follows:

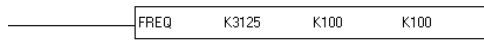
Set point 31.25Hz means $\frac{31.25\text{Hz}}{50.00\text{Hz}} = 62.5\%$ (when Pr01-00=50Hz F_{max}).

Of course it is possible to use PLC for selecting inputs or comm (via Pr02-12).

2.2.4.5 Set-point by PLC (without using PLC PID instruction)

- Pr00-20=0 for frequency command via keypad.
- Use in PLC the instruction **FREQ S1 S2 S3**
where S1=Frequency
S2,S3=Acc/Dec Time. They overwrite Pr01-12/01-13.

WPLSoft:



ISPSOft:



See also user manual.

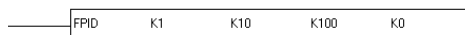
2.2.4.6 Set-point by PLC (with PLC PID instruction)

- Pr00-20=2 for frequency command via analogue input (therefore also for set-point).
- Pr03-00=4 for set-point AVI1 (CP2000) or AVI (C2000).
Pr03-01=4 for set-point ACI.
Pr03-02=4 for set-point AVI2 (CP2000) or AUI (C2000).

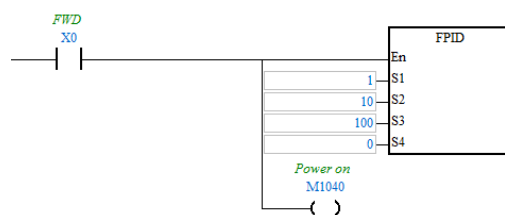
Unused analogue inputs should be set to 0 (No Function).

- Use the instruction **FPID S1 S2 S3 S4**
where S1=Pr08-00 setting (it overwrites Pr08-00)
S2,S3,S4=P, I, D values, they overwrite Pr08-01~08-03.

WPLSoft:



ISPSOft:



S2=10 for P=1.0, S3=100 for I=1.00, S4=10 for D=0.1.

After disabling PLC, always check P,I,D in Pr08-01~08-03.

2.2.5 Trial run

Now your basic PID is ready.

E.g.

- Set-point 0-50Hz = 0-16bar --> 10bar=31.25Hz
- Feedback in % (0-10% = 0-16bar) --> 10bar=62.50% at equilibrium.

You can press RUN to start the drive to check PID.

2.2.6 Scaling

2.2.6.1 Scaling in bar with 2 decimals

Setting and feedback display in bar

- Pr00-25=0162hex to have bar in 2 decimals. Please refer also to the user manual. Here is assumed that 2 decimals are enough.
- Pr00-26=16.00 (to scale setpoint and feedback to 0-16.00bar)

Press RUN and watch the display.

Feedback acc. to 2.2.3.

2.2.6.2 Set-point by keypad and analogue input

Now the setpoint and feedback are in bar with 2 decimals.

2.2.6.3 Set-point by communication

See 2.2.4.3.

- Send 1000d (or 0320h) to address 2001h for set-point 10.00bar. For 8.00bar send 800d, for 6.00bar send 600d. Feedback will go to 10.00bar (or 8.00bar or 6.00bar) in equilibrium.
- The actual output frequency can be read on the display.

2.2.6.4 Set-point by PLC (without using PLC PID instruction)

See 2.2.4.5.

- Instruction:
WPLSoft:



ISPSoft:



The scaling is 16.00bar → K5000 (e.g. 8.00bar → K2500).
See also user manual.

2.2.6.5 Set-point by PLC (without using PLC PID instruction)

See 2.2.4.5.

- Instruction:
WPLSoft:



ISPSoft:



The scaling is 16.00bar → K5000 (e.g. 8.00bar → K2500).
See also user manual.

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2.2.6.6 Feedback by communication

- The scaling for Pr08-06 is 16.00bar → 10000d.
5000d to Pr08-06 (at address 806h) means 8.00bar.
2500d to Pr08-06 (at address 806h) means 4.00bar.

The scaling is always 0~10000 = 0~100.00%.

2.2.6.7 3 decimals

- For 3 decimals, set Pr00-25=0163h and Pr00-26=16.000.
- Communication:
For 9.000bar, send 9000h to 2001h. I noticed the last decimal may be slightly unstable)
- PLC without PID instruction

WPLSoft:



ISPSoft:



The scaling is 16.000bar → K5000 (e.g. 8.000bar → K2500).
See also user manual.

3 GENERAL PID

3.1 General theory

For general theory on PID, please refer to more info in the user manuals but also on the Internet.

3.2 Practice

- P,I,D settings can be changed in Pr08-01 to 08-03. This is really application dependent so we cannot give values. Try first with the default settings.
- In general set Pr01-12/01-13 (Acc/Dec Time) as low as possible without having OC or OV. These times are in the PID loop and cause delays (which can be unwanted). It is not mandatory. Just from experience.
- Set P=1 to have a good starting point for tuning the PID control. Pr08-01=1.0.
- Adjust I to have fast response to changes without overshoot. Pr08-02 value depends on application.
- In case of fan D is not needed because the process is relatively slow. Pr08-03=0
- Set other parameters acc. to application. Best is to leave the default settings and change only when required.
- Increasing P makes the process faster and the static error smaller but makes it more sensitive to changes or disturbances.
- When P is too high the process becomes unstable.
- Small I makes the process faster but also less stable.
- Fast process requires lower I and lower P.
- A slow process (like fan) requires higher P. Too low I gives overshoot.