

# OPEN DRIVE

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*Application n°004  
PID Regulator*

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This OPEN DRIVE application manages a generic PID regulator applicable to the internal drive variables, like speed and torque, but also for external use, with the analog outputs or the fieldbus variables. The great variety of input parameters and the control time scaling allow the use of this regulator in many applications: thermo-control, tension control, speed correction.

## 1.APPLICATION CONFIGURATION

### 1.1.Application parameters

PAR	DESCRIPTION	RANGE	DEFAULT	NORMALIZ. BASE	INT. RAPP
P180	Modbus Set-Point	± 32767	0		32767
P181	Set-Point Linearization Numerator	± 32767	16383		32767
P182	Set-Point Linearization Denominator	± 32767	16383		32767
P183	Modbus Feed-Back	± 32767	0		32767
P184	Feed-Back Linearization Numerator	± 32767	16383		32767
P185	Feed-Back Linearization Denominator	± 32767	16383		32767
P186	KP PID, proportional gain	0.01÷100.00	1.00	%	100
P187	KI PID, lead time constant	0.0 ÷ 3000.0	100.0	ms	10
P188	KD PID, derivative gain	0.0 ÷ 3000.0	0.0	ms	10
P189	TF PID, filter time constant	0.0 ÷ 3000.0	0.0	ms	10
P190	Maximum regulator output	± 32767	16383		32767
P191	Minimum regulator output	± 32767	-16383		32767
P192	PID Output Linearization Numerator	± 32767	100		32767
P193	PID Output Linearization Denominator	± 32767	16383		32767
P194	Set-point rising ramp	0.0 ÷ 3000.0	0.0	ms	0
P195	Set-point falling ramp	0.0 ÷ 3000.0	0.0	ms	0
P196	Maximum PID integral component value	± 32767	16383		32767
P197	Minimum PID integral component value	± 32767	-16383		32767

### 1.2.Application connections

CON	DESCRIPTION	RANGE	DEFAULT	INT. RAPP
C90	Output PID selection: 00 = Disabled (only on INT 52 x test) 01 = Analog output 1 02 = Analog output 2 03 = Speed reference 04 = Torque reference 05 = Torque limit 06 = Add to speed reference 07 = Add to torque reference 08 = Add to Torque limit 09 = Stand-Alone on CAN	0 ÷ 10	0	1
C91	Set-Point selection: 0 = Frequency input 1 = Analog Input 1 2 = Analog Input 2 3 = Analog Input 3 4 = Modbus variable 5 = CAN object	0 ÷ 5	1 =Set-Point ADC 1	1
C92	Feed-Back selection: 0 = Frequency input 1 = Analog Input 1 2 = Analog Input 2 3 = Analog Input 3	0 ÷ 5	2 =Set-Point ADC 2	1

	4 = Modbus variable 5 = CAN object			
C93	Start PID application	0 ÷ 1	0 = OFF	1
C94	A.I.3 selector: 0 = no selection 1 = PID upper limit 2 = PID lower limit 3 = Speed reference upper limit 4 = Speed reference lower limit	0 ÷ 4	No operat.	1

### 1.3.Application output

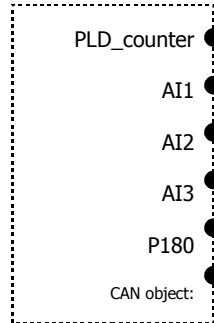
OUT	LOGIC FUNCTION
O21	Selection error Set-Point = Feed-Back

### 1.4.Application Internal values

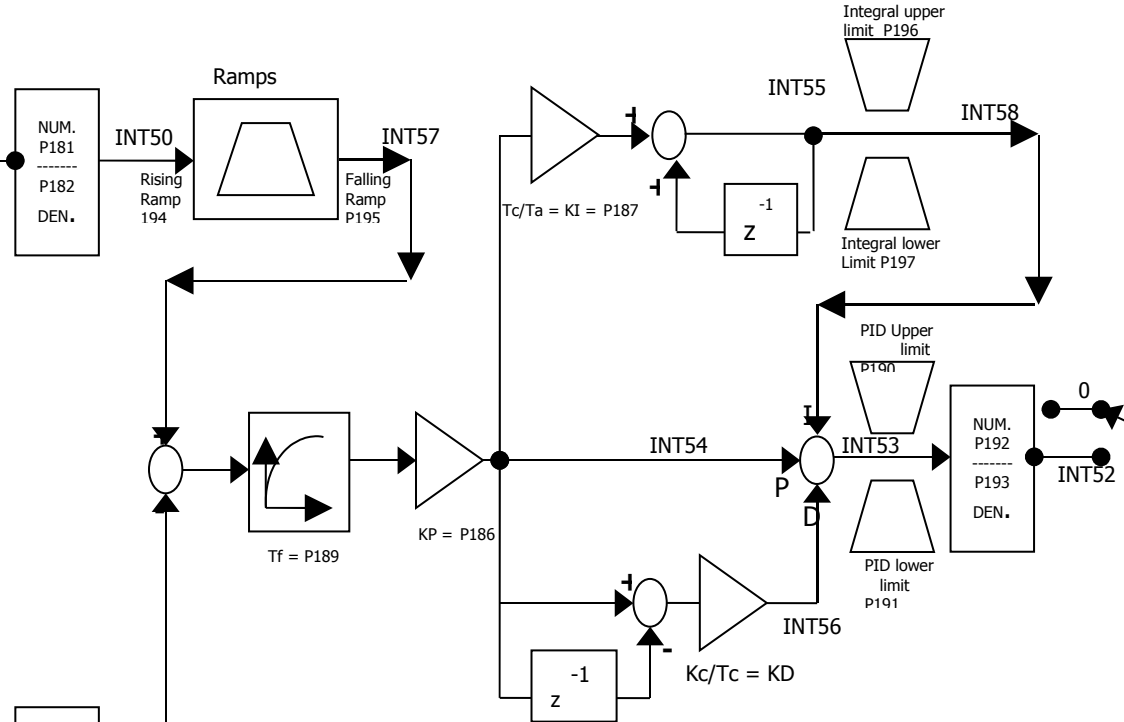
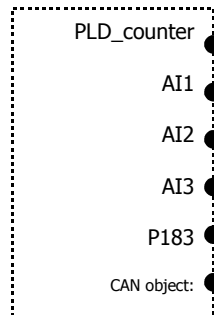
INT	INTERNAL VARIABLE	Normaliz.	Internal rappr.
d50	Selected SetPoint PID	1	32767
d51	Selected Feed-Back PID	1	16383
d52	Output PID	1	16383
d53	Output PID without linearization and limits	1	16383
d54	Proportional output PID	1	32767
d55	Integral output PID	1	32767
d56	Derivative output PID	1	32767
d57	PID Set-point after the ramps	1	16383
d58	PID Integral value after limiter	1	32767

## 2.APPLICATION DIAGRAM

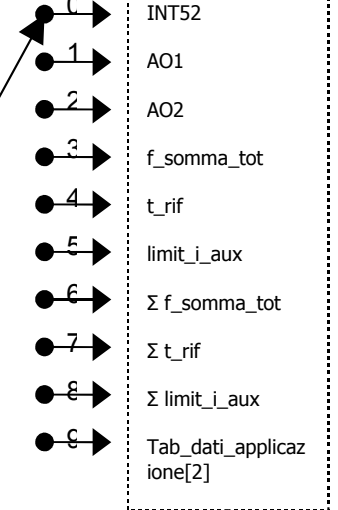
### SET-POINT SELECTION



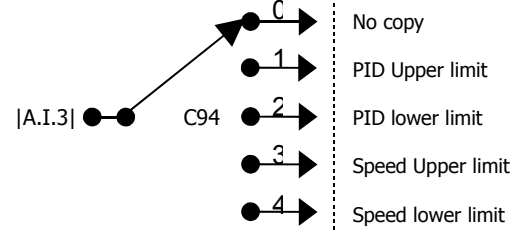
### FEED-BACK SELECTION



### PID OUTPUT SELECTION



### LIMIT SELECTION



**SET-POINT SELECTION:**

With the C91 connection it's possible to select the regulator set-point. This source is scaled with parameters P181 e P182. It's possible to see the result on the internal value d50.

The set-point pass through a ramp generator, P194 define the rise value and P195 the falling value, the ramped value can be viewed on the internal value d57.

**FEED-BACK SELECTION:**

With the C92 connection it's possible to select the regulator feed-back. This source is scaled with parameters P184 e P185. It's possible to see the result on the internal value d51.

There is an internal control to verify that set-point and feedback are different and below to 4, otherwise the output O21 goes high and the regulator cannot be activated.

**ERROR FILTER:**

The difference between set-point and feedback is the error. This value is filtered with a time constant set in P189 and this in the PID input. Setting P189=0 equals disable the filter.

**PID REGULATOR:**

The proportional gain is set with parameter P186, if this value is 0 the regulator is bypassed and the output is equal to the setpoint. The integral part gain can be adjusted with parameter P187, for disable this part set P187=0. The P196 parameter define the maximum upper limit for the integral component and the P197 the lower one. The integral limited value can be viewed on the internal value d58.

The derivative gain is set with P188, for disable this part set P188=0.

The sum of this 3 components is the PID output and it can be seen in the internal value d53.

The PID output can be limited using the parameters P190 and P191.

**PID OUTPUT SELECTION:**

The limited PID output is then scaled with parameters P192 and P193.

The result can be seen in the internal value d52 and the connection C90 selects the desired output.

**SPEED LIMIT COPY SELECTION:**

By this section the absolut analog input 3 value can be used to limit PID output or speed reference.

**P.S.**

The PID regulator is enabled only if the connection C93 is equal to 1, besides, if the PID output is greater than 2, the PID works only when the motor is running.