PID Tuning Conversion: Series (Interacting) and Ideal Forms

Convert PID settings between the series (interacting) form of many DCS and the ideal ISA form, and check that ideal settings are realisable.

Method: Seborg; Edgar; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Conversion	Series → ideal	
Controller gain	2.0000	
Integral time	60.000	s
Derivative time	10.000	s

Calculated results

Parameter	Value	Unit
Converted gain	2.3333	
Converted integral time	70.000	s
Converted derivative time	8.5714	s
Realisable (1 = yes)	1.0000	

Formula and method

$$K_c' = K_c\left(1+\frac{T_d}{T_i}\right),\ T_i' = T_i + T_d,\ T_d' = \frac{T_i T_d}{T_i + T_d}\ \text{(series → ideal)}$$

$$r = \sqrt{1-\frac{4T_d}{T_i}},\ K_c' = K_c\frac{1+r}{2},\ T_i' = T_i\frac{1+r}{2},\ T_d' = T_i\frac{1-r}{2}\ \text{(ideal → series; needs } T_i \geq 4T_d\text{)}$$

Variables

direction	Conversion	-
K_c	Controller gain	-
T_i	Integral time	s
T_d	Derivative time	s
K_c'	Converted gain	-
T_i'	Converted integral time	s
T_d'	Converted derivative time	s
realisable	Realisable (1 = yes)	-

Method and standards

PID algebra.

Assumptions and limits

- No filter on derivative.
- Ideal settings with T_i < 4T_d have no series equivalent: only "realisable = 0" is shown.

References

- Seborg
- Edgar
- Mellichamp and Doyle
- Process Dynamics and Control

- 4th ed. (Wiley, 2016)
- ch. 8 (PID forms and conversion)

Report details

Report reference	FCC-1D42-Y0NT (the same inputs always give the same reference)
Generated	17 November 2026, 19:48 UTC
Calculator	PID Tuning Conversion: Series (Interacting) and Ideal Forms
Method last reviewed	13 November 2026
Software release	FireCAD Calc, release of 17 November 2026
Release checks	2 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/instrumentation/control-loops/pid-series-ideal-conversion

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.