Feedforward Controller: Gain, Lead–Lag and Dead Time

Static feedforward gain, lead and lag time constants and dead time from first-order-plus-dead-time models of the process and the disturbance path.

Method: Seborg; Edgar; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Process gain (output per % controller output)	2.0000	
Process time constant	120.00	s
Process dead time	20.000	s
Disturbance gain	1.5000	
Disturbance time constant	200.00	s
Disturbance dead time	30.000	s

Calculated results

Parameter	Value	Unit
Feedforward gain	-0.75000	
Lead time	120.00	s
Lag time	200.00	s
Feedforward dead time (0 if not realisable)	10.000	s

Notes for this case

• G_ff = −(K_d/K_p)(τ_ps + 1)/(τ_ds + 1)e^(−(θ_d − θ_p)s). If the disturbance acts faster than the manipulated variable (θ_d < θ_p), perfect compensation is impossible; use the static gain and tune the lead–lag by test. Keep feedback trim in service.

Formula and method

$$G_{ff}(s) = -\frac{K_d}{K_p}\frac{\tau_p s + 1}{\tau_d s + 1} e^{-(\theta_d - \theta_p)s}$$

Variables

K_p	Process gain (output per % controller output)	-
τ_p	Process time constant	s
θ_p	Process dead time	s
K_d	Disturbance gain	-
τ_d	Disturbance time constant	s
θ_d	Disturbance dead time	s
K_{ff}	Feedforward gain	-
T_{lead}	Lead time	s
T_{lag}	Lag time	s
θ_{ff}	Feedforward dead time (0 if not realisable)	s

Method and standards

Ideal feedforward from FOPDT models.

Assumptions and limits

- Linear FOPDT models.
- When θ_d < θ_p the feedforward is not realisable; the dead time is set to zero, with a note.

References

- Seborg
- Edgar
- Mellichamp and Doyle
- Process Dynamics and Control
- 4th ed. (Wiley, 2016)
- ch. 15 (feedforward control design from FOPDT models)

Report details

Report reference	FCC-NK5Q-AHP1 (the same inputs always give the same reference)
Generated	17 November 2026, 19:35 UTC
Calculator	Feedforward Controller: Gain, Lead–Lag and Dead Time
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/feedforward-gain-lead-lag

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.