LabVIEW Embedded for ARM Microcontrollers

Digital PI(D)-Controller

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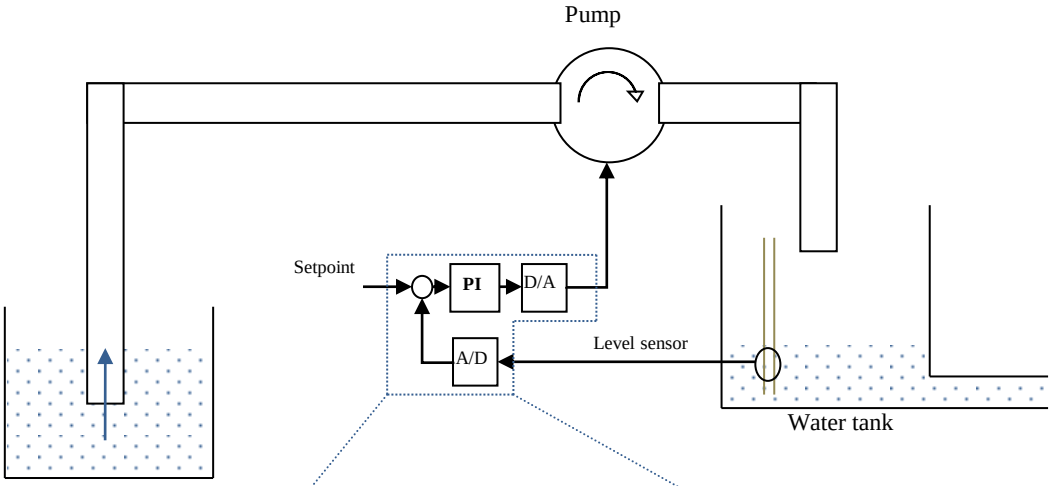
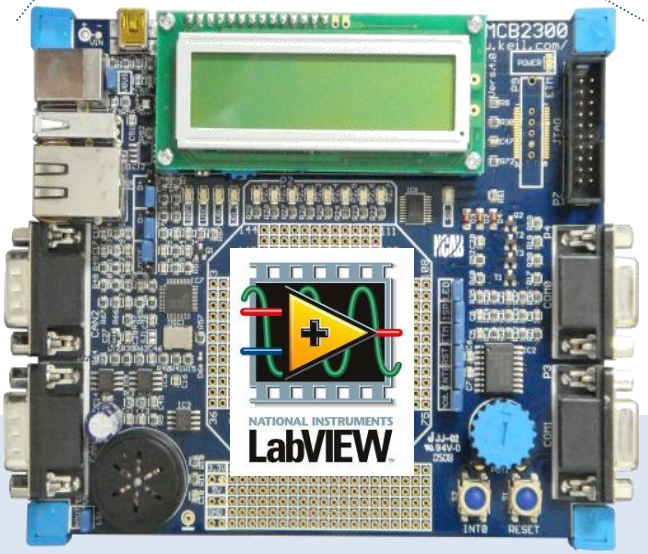
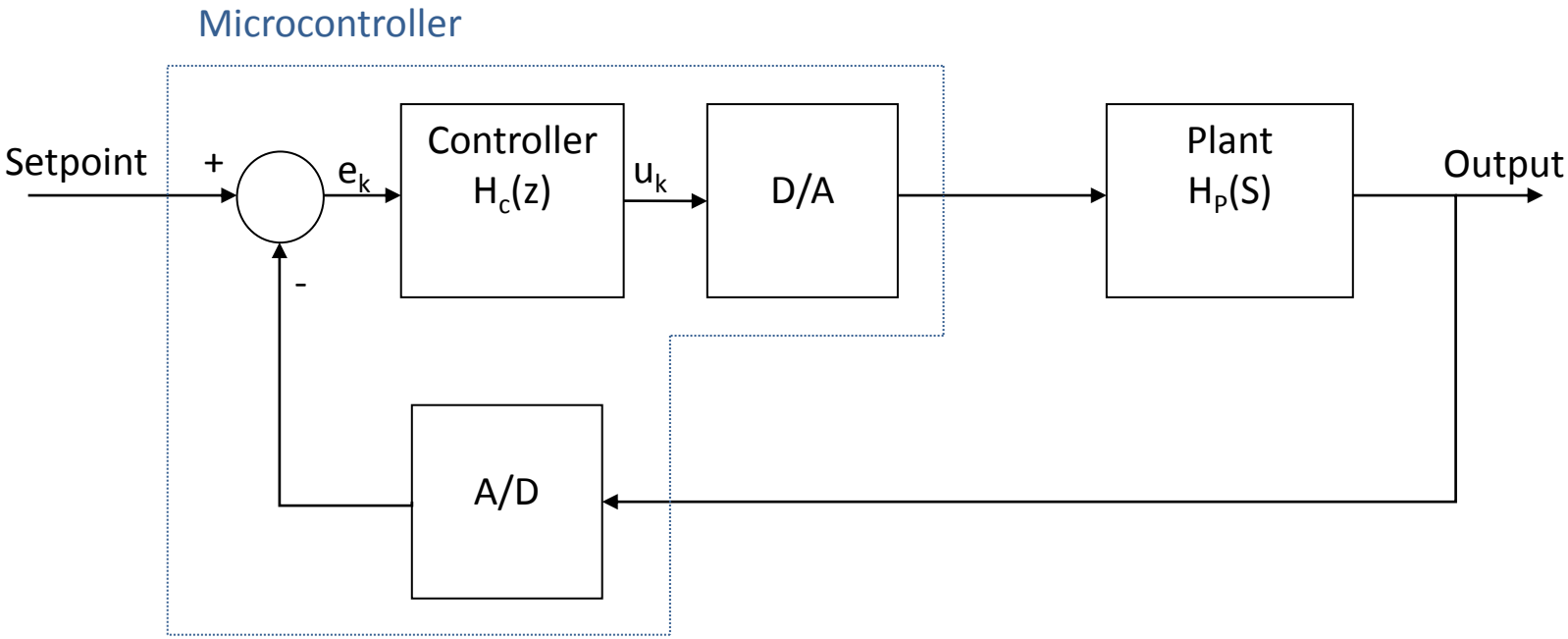
Liquid Level Control System



$$H_p(s) = \frac{e^{-2s}}{1 + 4.7s}$$

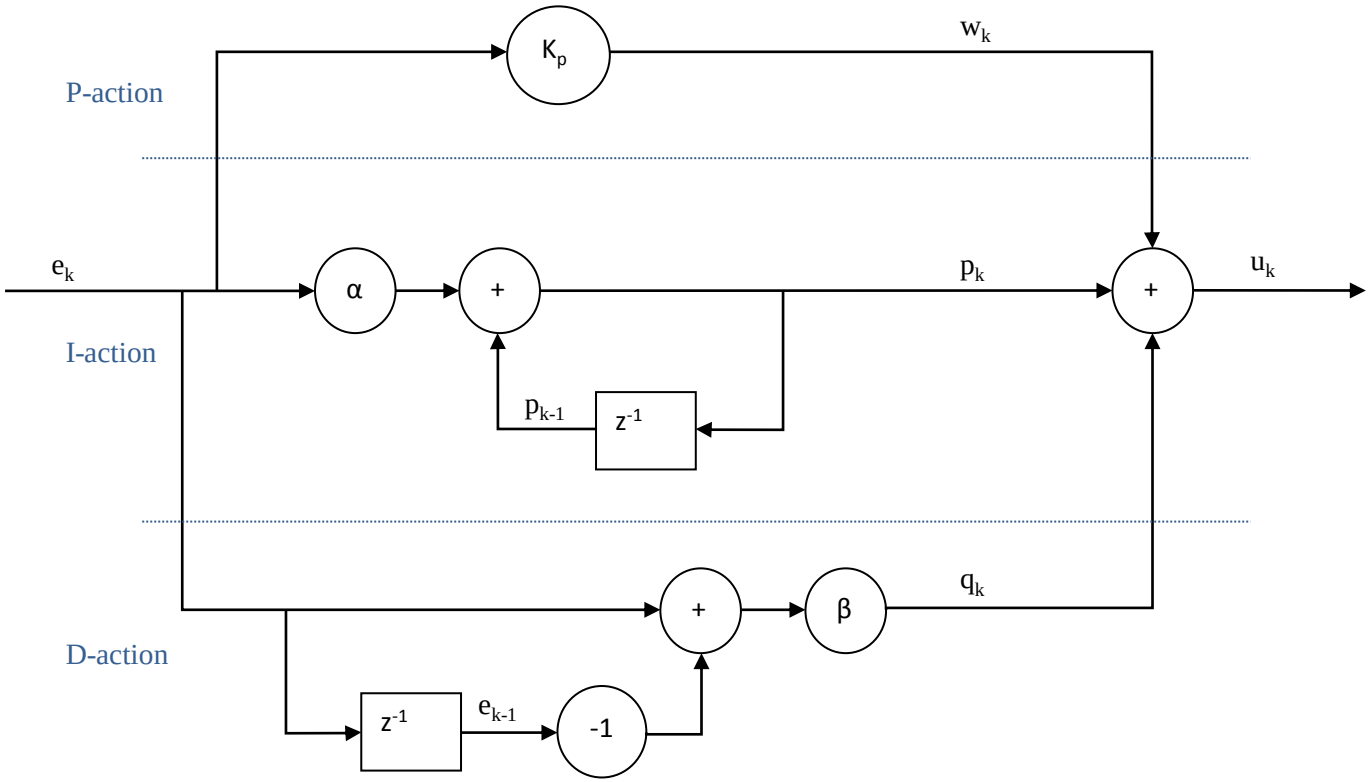


Digital Controller



$$H_C(z) = K_p + \frac{K_p T}{T_i(1 - z^{-1})} + \frac{K_p T_d(1 - z^{-1})}{T}$$

PID-Controller Implementation

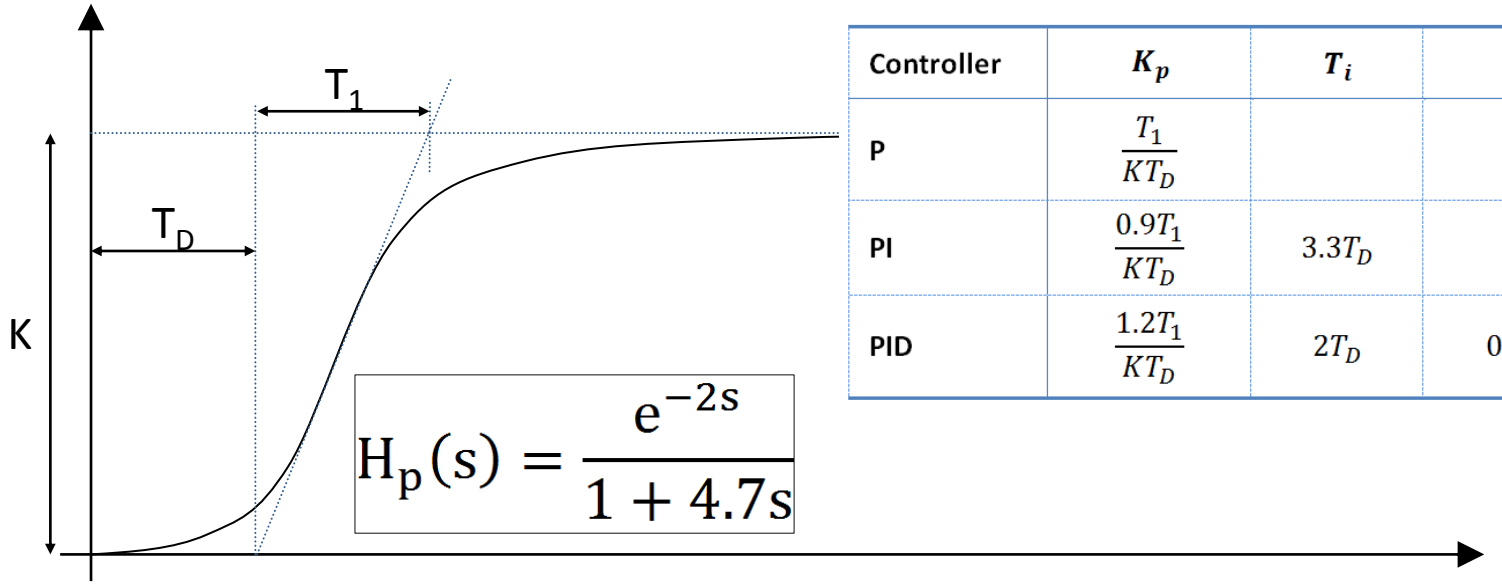


$$\alpha = K_p \frac{T}{T_i}$$

$$\beta = K_p \frac{T_d}{T}$$

Parameter Estimation

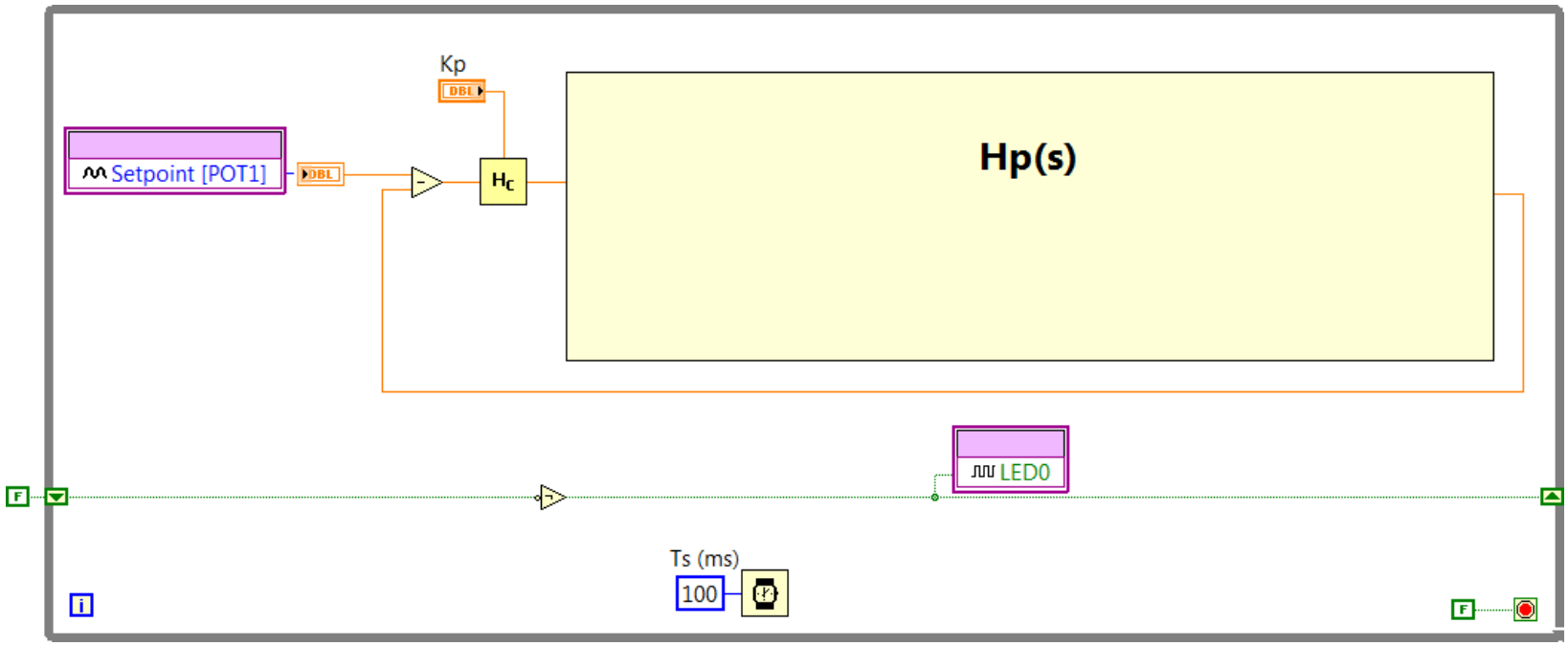
In this case Ziegler-Nichols' open-loop tuning algorithm can be used to estimate the $H_C(z)$ controller parameters.



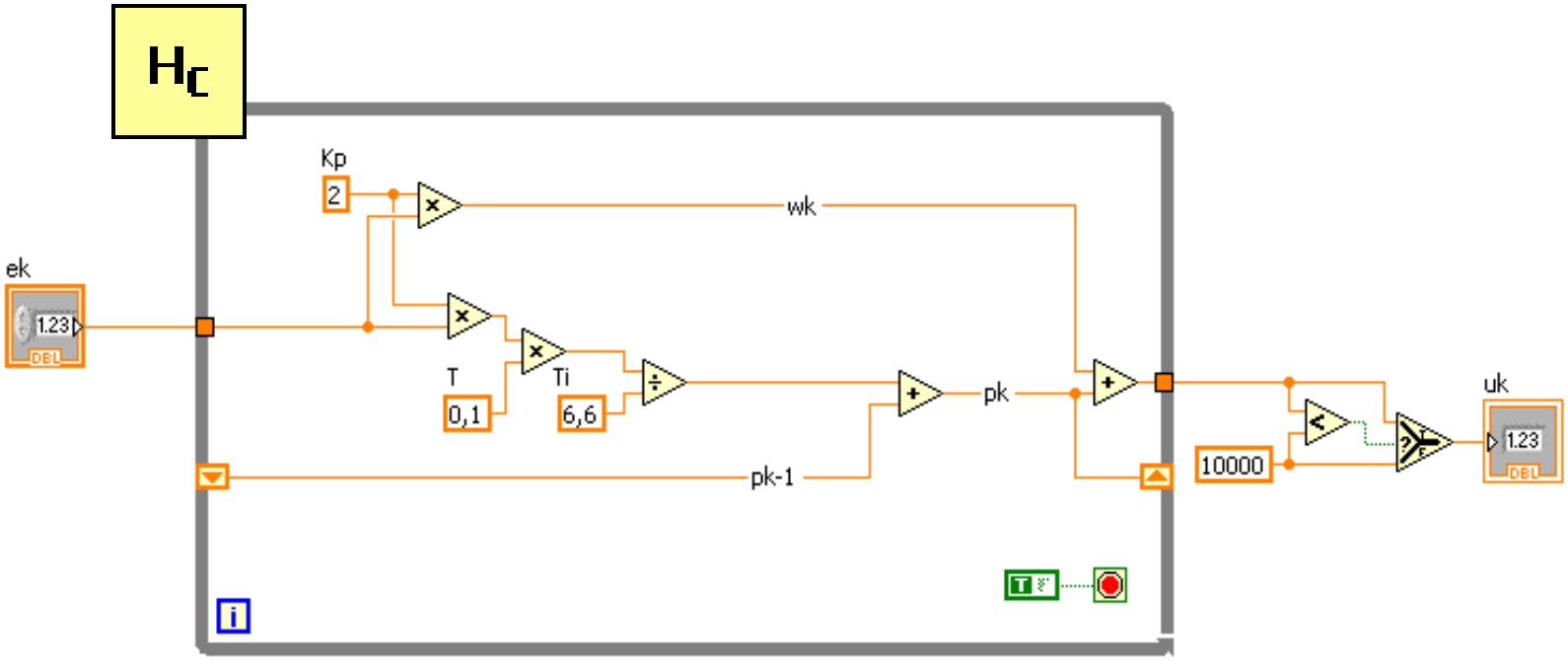
Controller	K_p	T_i	T_d
P	$\frac{T_1}{KT_D}$		
PI	$\frac{0.9T_1}{KT_D}$	$3.3T_D$	
PID	$\frac{1.2T_1}{KT_D}$	$2T_D$	$0.5T_D$

Open-loop unit step response

LabVIEW Implementation



LabVIEW PI-Controller

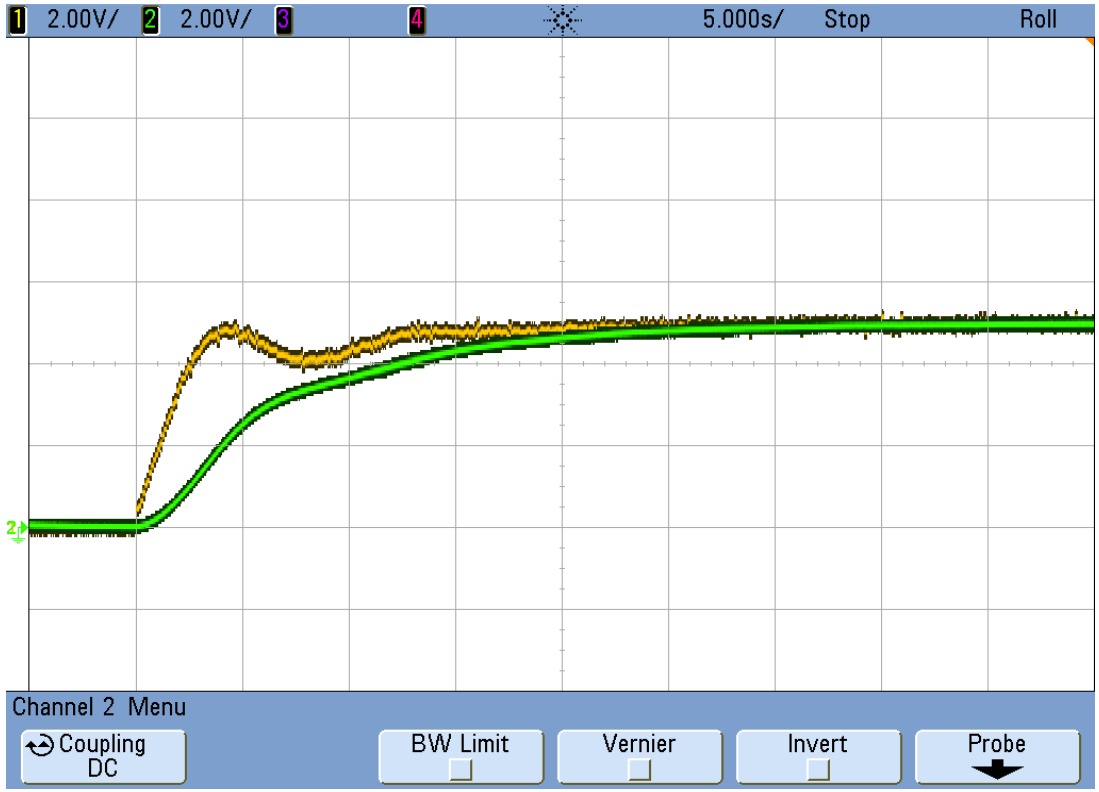


Closed-Loop System Response

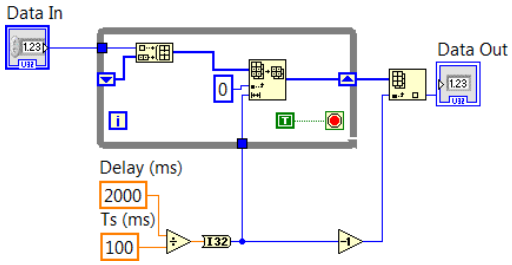
STEP RESPONSE TO A 5 [V] STEP WITH K_p SET TO 2:

Yellow trace: controller effort

Green trace: system response



Software delay:

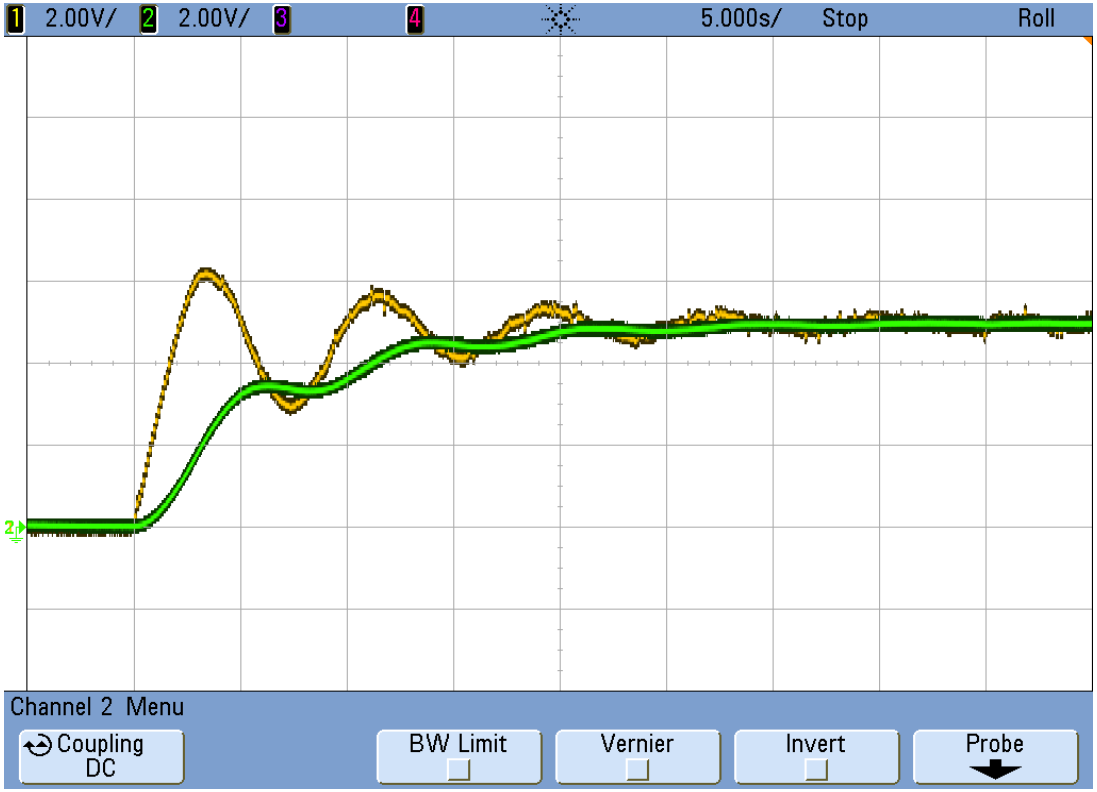


Closed-Loop System Response

STEP RESPONSE TO A 5 [V] STEP WITH K_p SET TO 3:

Yellow trace: controller effort

Green trace: system response

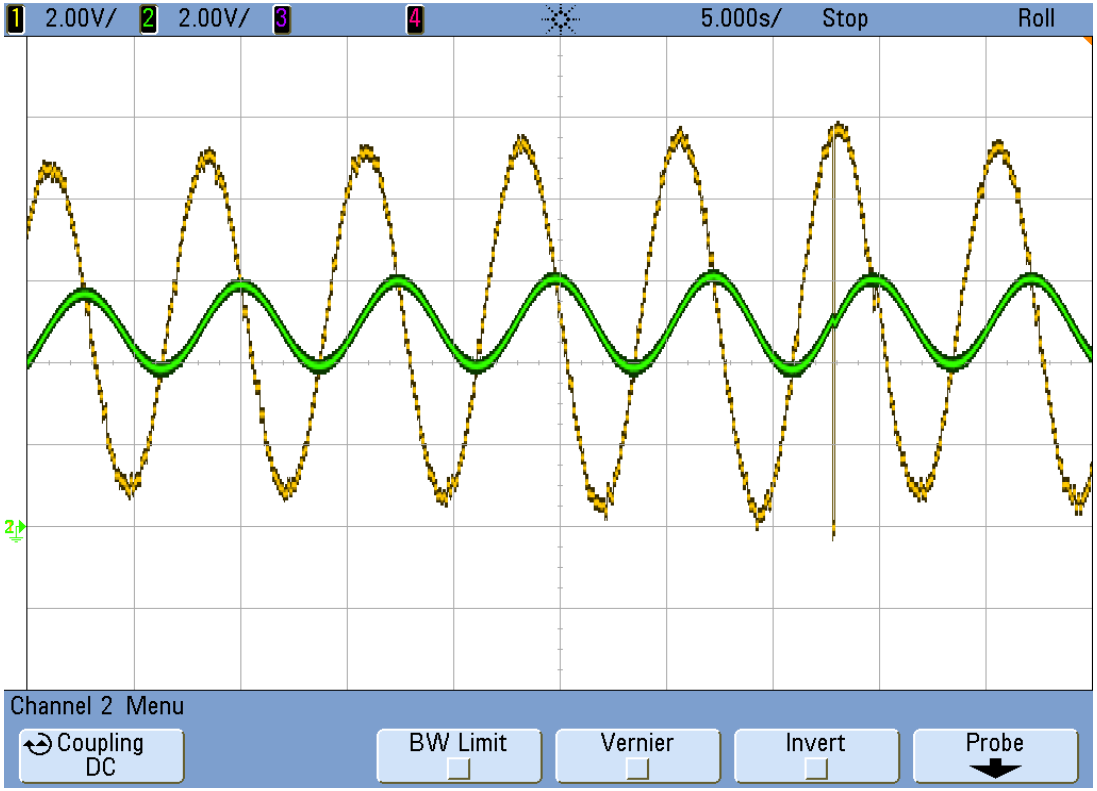


Closed-Loop System Response

STEP RESPONSE TO A 5 [V] STEP WITH K_p SET TO 4:

Yellow trace: controller effort

Green trace: system response

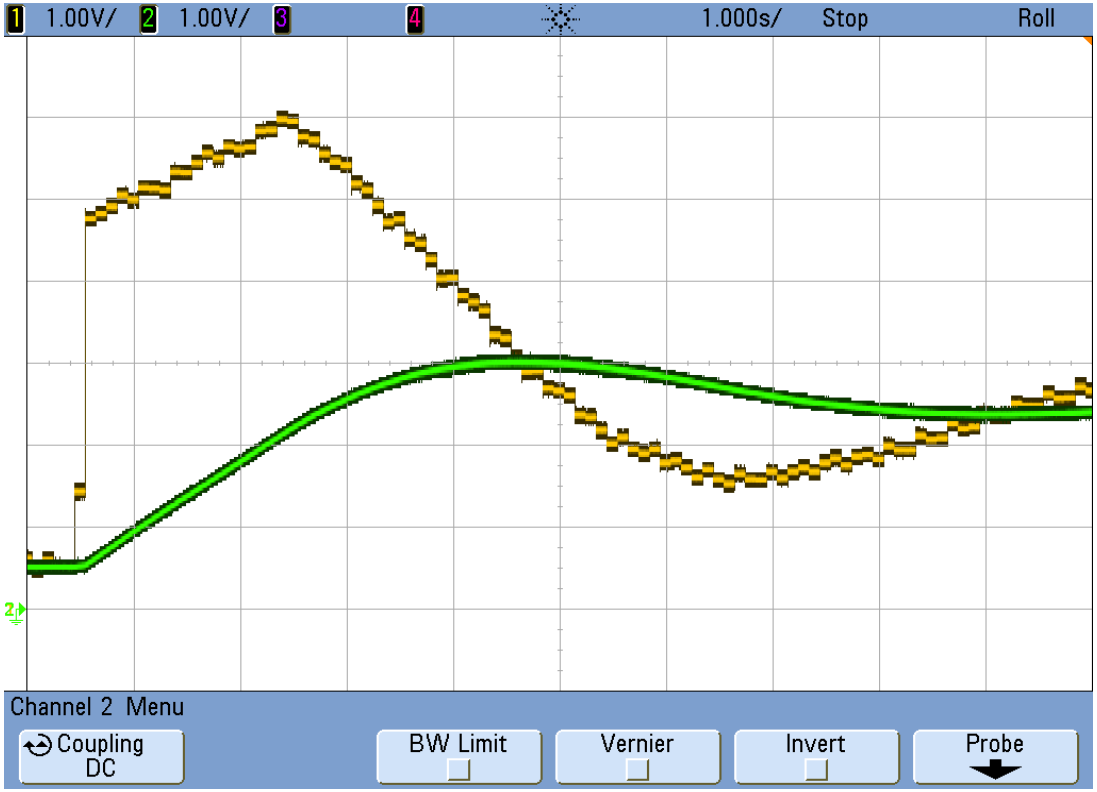


Closed-Loop System Response

Just a close-up to show the discrete controller-output level:

Yellow trace: controller effort

Green trace: system response



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