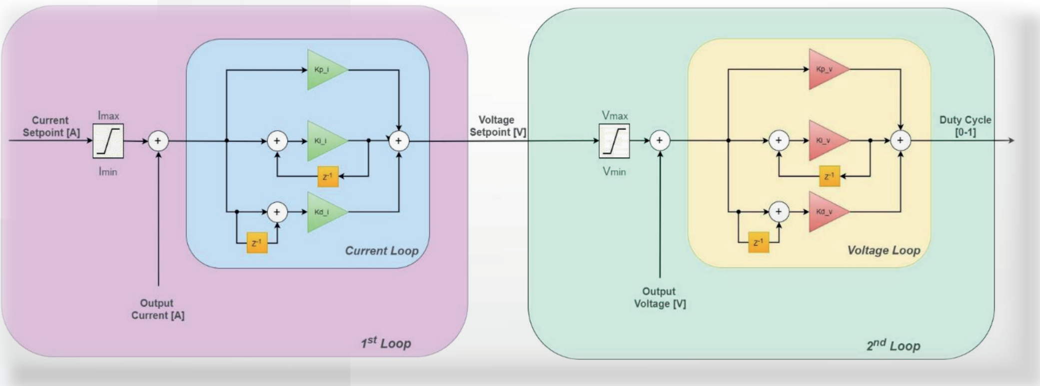
PROCEDURE FOR ADAPTING THE PID PARAMETERS FOR Fast-PS, Fast-PS-1K5, Fast-PS-M, AND NGPS

Pre-Information

All CAEN ELS power sourses are digitally controlled. This means that an adaptation to any load can be achieved simply by changing the Software PID-Parameters.

Fast-PS, Fast-PS-1K5, Fast-PS-M and NGPS power supplies have a double control loop that continously controls output voltage and current. Current Control Loop and Voltage Control Loop diagrams are hereafter presented:



The PID-parameters consist in 12 values that can be input through the web-server interface: 6 values, Kp_v, Ki_v, Kd_v, Kp_i, Ki_i and Kd_i, used when the **CC** (costant current) is selected, and 6 values, Kp_v, Ki_v, Kd_v, Kp_i, Ki_i, and Kd_i, when **CV** (costant voltage) is set:

Constant Current (CC)

Name	Value	Is Editable
Double CC loop *	☐	(RESERVED)
Kp_v (Proportional term - Voltage Loo	0.00012	
Ki_v (Integral term - Voltage Loop) *	0.0028	
Kd_v (Derivative term - Voltage Loop)	0.000	
Kp_i (Proportional term - Current Loop	0.0001	
Ki_i (Integral term - Current Loop) *	0.0001	
Kd_i (Derivative term - Current Loop) *	0.0001	
Max Output Voltage [V] *	22	
Min Output Voltage [V] *	-22	

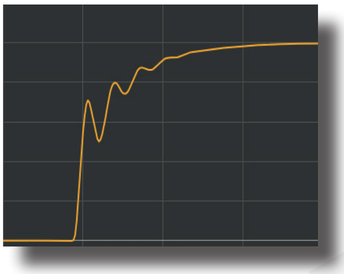
Constant Voltage (CV)

Name	Value	Is Editable
Double CV loop **	☐	(RESERVED)
Kp_v (Proportional term - Voltage Loc	0.00012	
Ki_v (Integral term - Voltage Loop) *	0.0028	
Kd_v (Derivative term - Voltage Loop)	0.000	
Kp_i (Proportional term - Current Loo	0.0001	
Ki_i (Integral term - Current Loop) *	0.0001	
Kd_i (Derivative term - Current Loop)	0.0001	
Max Output Voltage [V] *	22	
Min Output Voltage [V] *	-22	

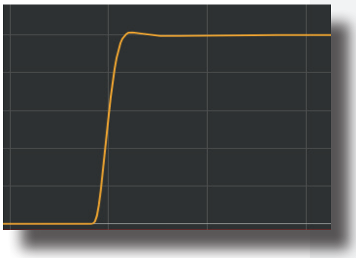
Target

Target is to adapt PID values for a specific load connected to a ELS Instruments power supplies that it is performing in an ideal way: Fast Rise Times, No Overshoot (or small Overshoot), No Oscillations.

UNWANTED STEP RESPONSE:



DESIDERABLE STEP RESPONSE:



PID Adaption-Procedure

Due to safety concerns for both the source and the load, caused by potential dangerous high-frequency oscillations, the PID parameters should be set to very low values at the beginning of each adaptation for an unknown load.

To proceed follow these steps:

1. It is recommended to start with these parameters (safe side):

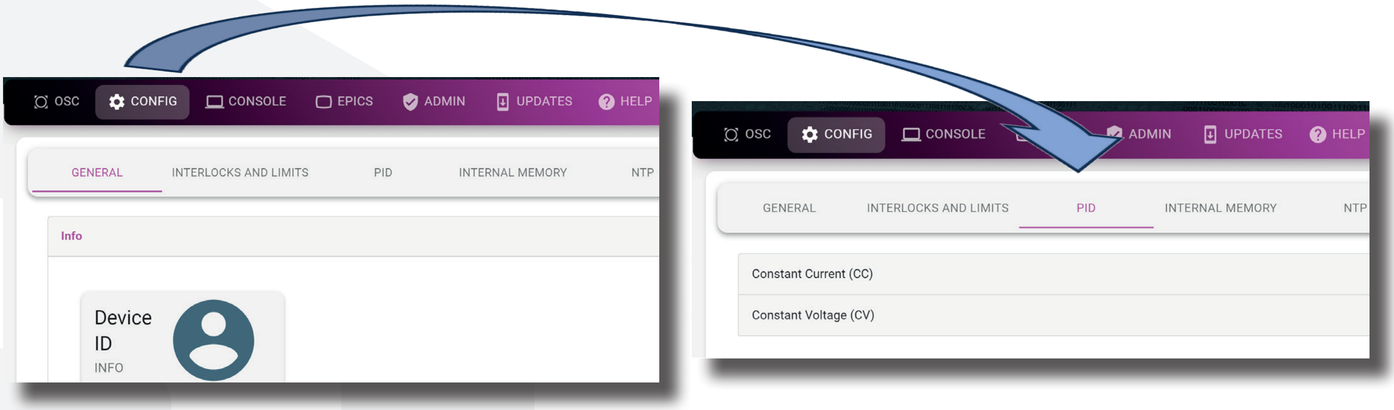
Kp_v = Ki_v = Kp_i = Ki_i = 0.00001 and **Kd_v = Kd_i = 0**

2. Kd typically should not to be changed due to its minor influence on the result. Only in very high-demanding cases , such as superconducting magnets, it might be adjusted.
3. During PID adaptation procedure, set current and voltage to approximately 10% of the nominal rating. (i.e. if the PS is a 20 A - 20 V model set Current and Voltage from 0 to 2A/2V).

ATTENTION: The PID parameters are specific to each power source model. For example, PID parameters for a Fast-Ps 052001 and for a Fast-Ps 058004 can significantly differ.

Open the **GUI** from web server:

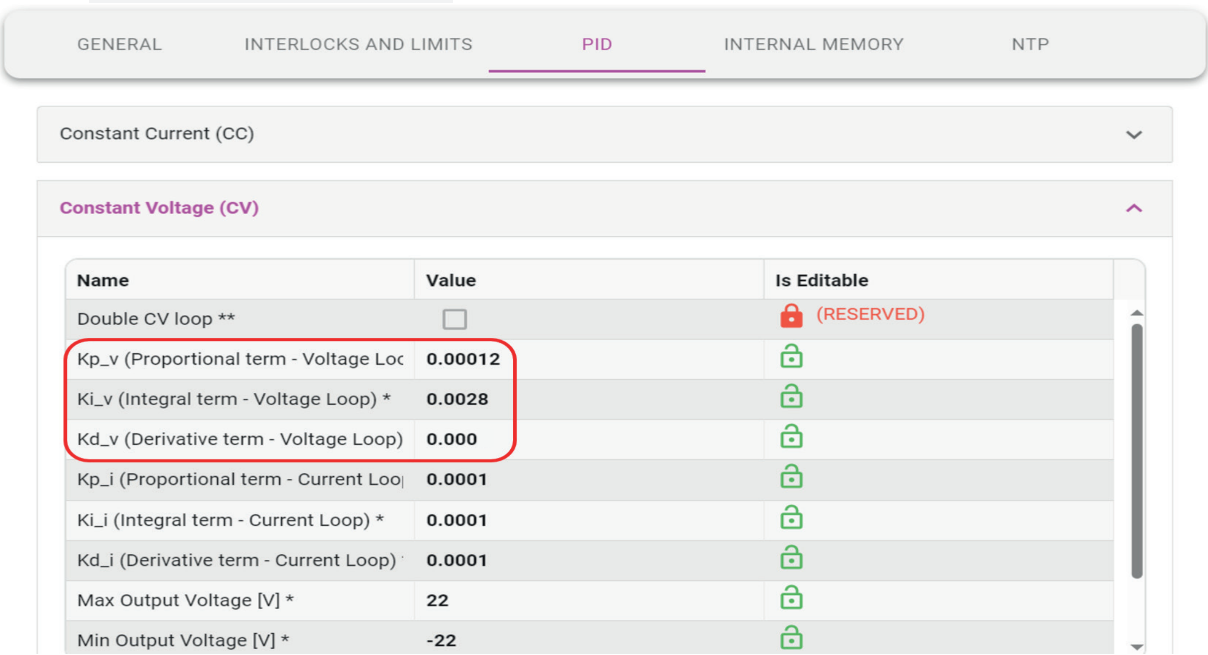
- Enter the Password (ps-admin) to log in with administrator privileges.
- Click on **Config**, then on **PID** to access the **CV** and **CC** modes.
- From the two drop-down menu, start with **CV** mode.



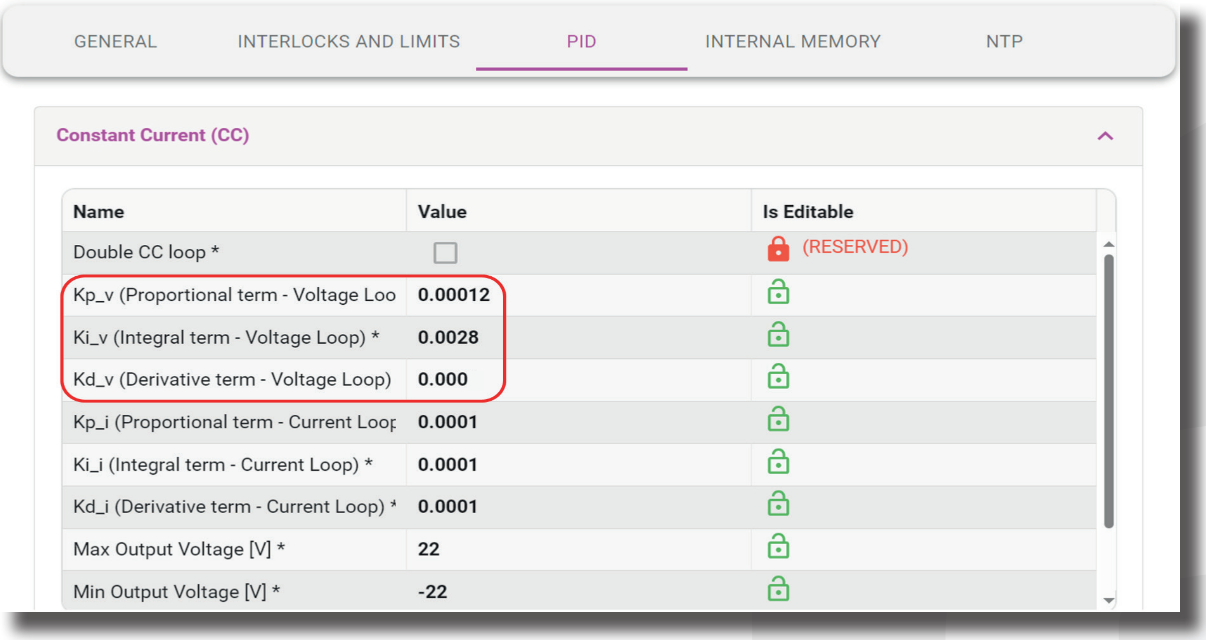
CV-Mode -Voltage Loop

Following the **Voltage Control Loop Adaption** flowchart (see the next pages) :

- Adapt the **Kp_v** parameter for the Voltage Loop.
- Adapt the **Ki_v** parameter for the Voltage Loop.



- Transfer the acquired **CV** Mode - Voltage Loop parameters into the **CC** Mode - Voltage Loop.

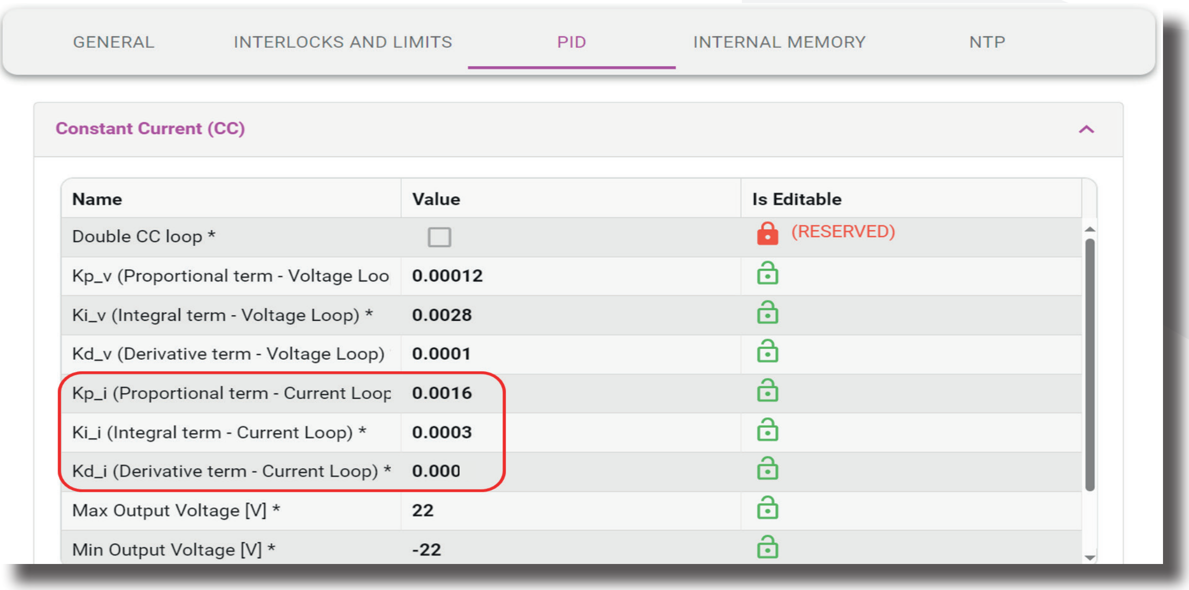


Name	Value	Is Editable
Double CC loop *	☐	(RESERVED)
Kp_v (Proportional term - Voltage Loo	0.00012	
Ki_v (Integral term - Voltage Loop) *	0.0028	
Kd_v (Derivative term - Voltage Loop)	0.000	
Kp_i (Proportional term - Current Loop	0.0001	
Ki_i (Integral term - Current Loop) *	0.0001	
Kd_i (Derivative term - Current Loop) *	0.0001	
Max Output Voltage [V] *	22	
Min Output Voltage [V] *	-22	

CC-Mode -Current Loop

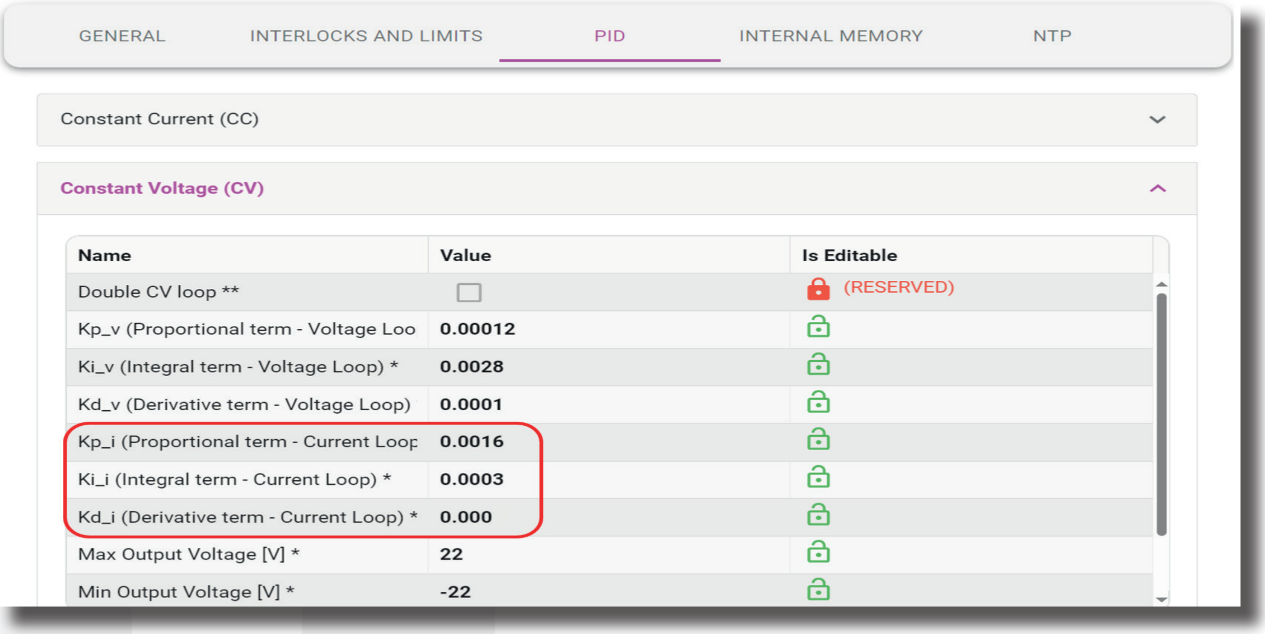
Following the **Current Control Loop Adaption** flowchart (see the next pages):

- Adapt the **Kp_i** parameter for the Current Loop.
- Adapt the **Ki_i** parameter for the Current Loop.

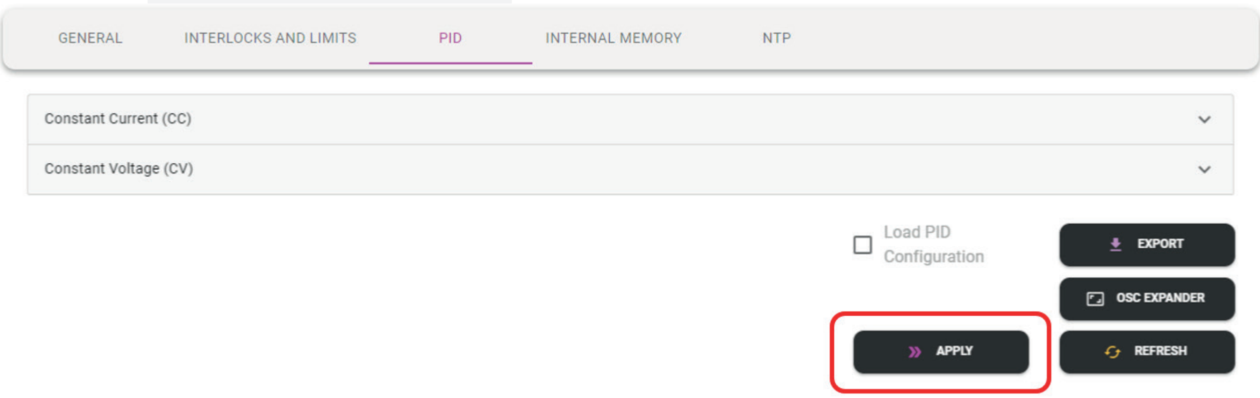


Name	Value	Is Editable
Double CC loop *	☐	(RESERVED)
Kp_v (Proportional term - Voltage Loo	0.00012	
Ki_v (Integral term - Voltage Loop) *	0.0028	
Kd_v (Derivative term - Voltage Loop)	0.0001	
Kp_i (Proportional term - Current Loop	0.0016	
Ki_i (Integral term - Current Loop) *	0.0003	
Kd_i (Derivative term - Current Loop) *	0.000	
Max Output Voltage [V] *	22	
Min Output Voltage [V] *	-22	

- Transfer the acquired **CC** Mode - Current Loop parameters into the **CV** Mode - Current Loop.



- Press the **Apply** button to save the values into the internal memory.



PID PARAMETER ADAPTATION

Voltage Control Loop Adaption

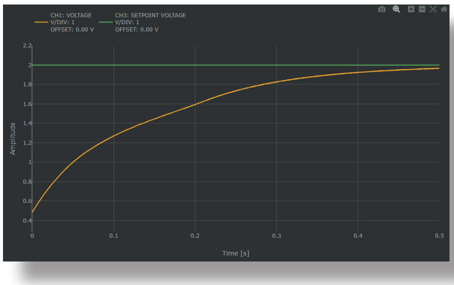


Fig. A

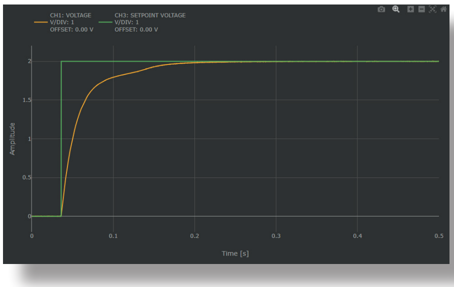


Fig. B

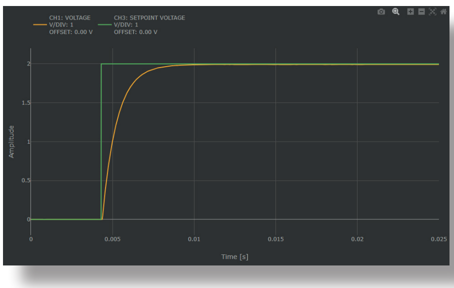
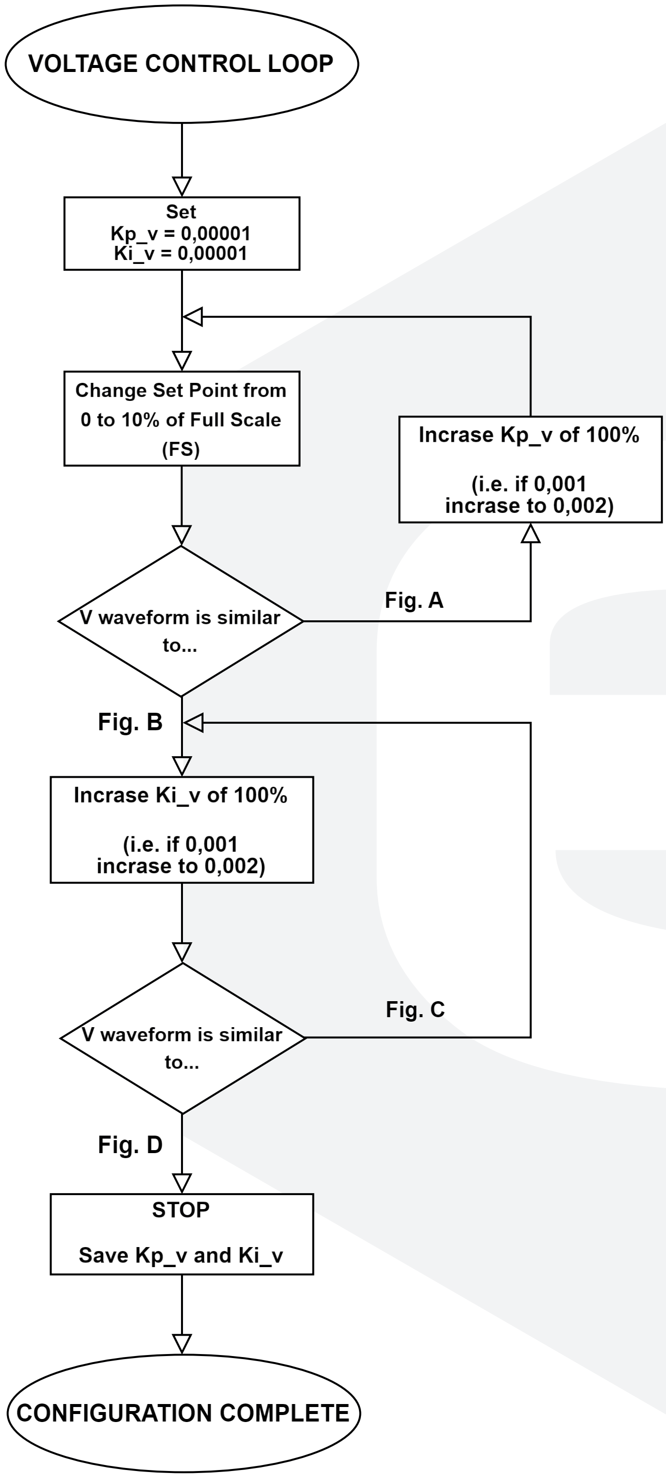


Fig. C

Fig. D



NOTE: In some cases when Fig.D is obtained, a further increase of Kp may reduce the voltage overshoot.

PID PARAMETER ADAPTATION

Current Control Loop Adaption

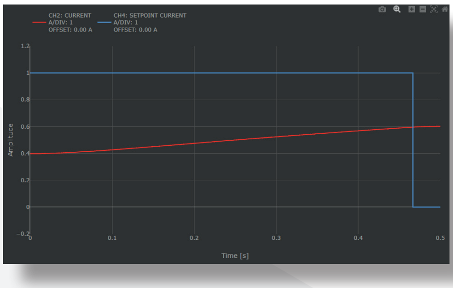


Fig. A

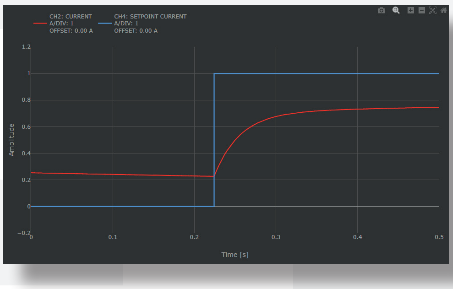


Fig. B

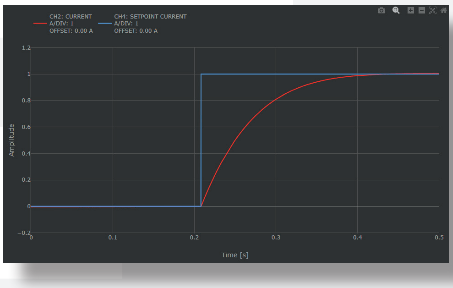


Fig. C

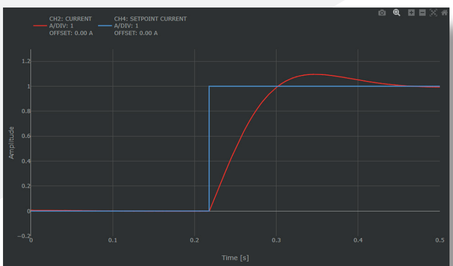
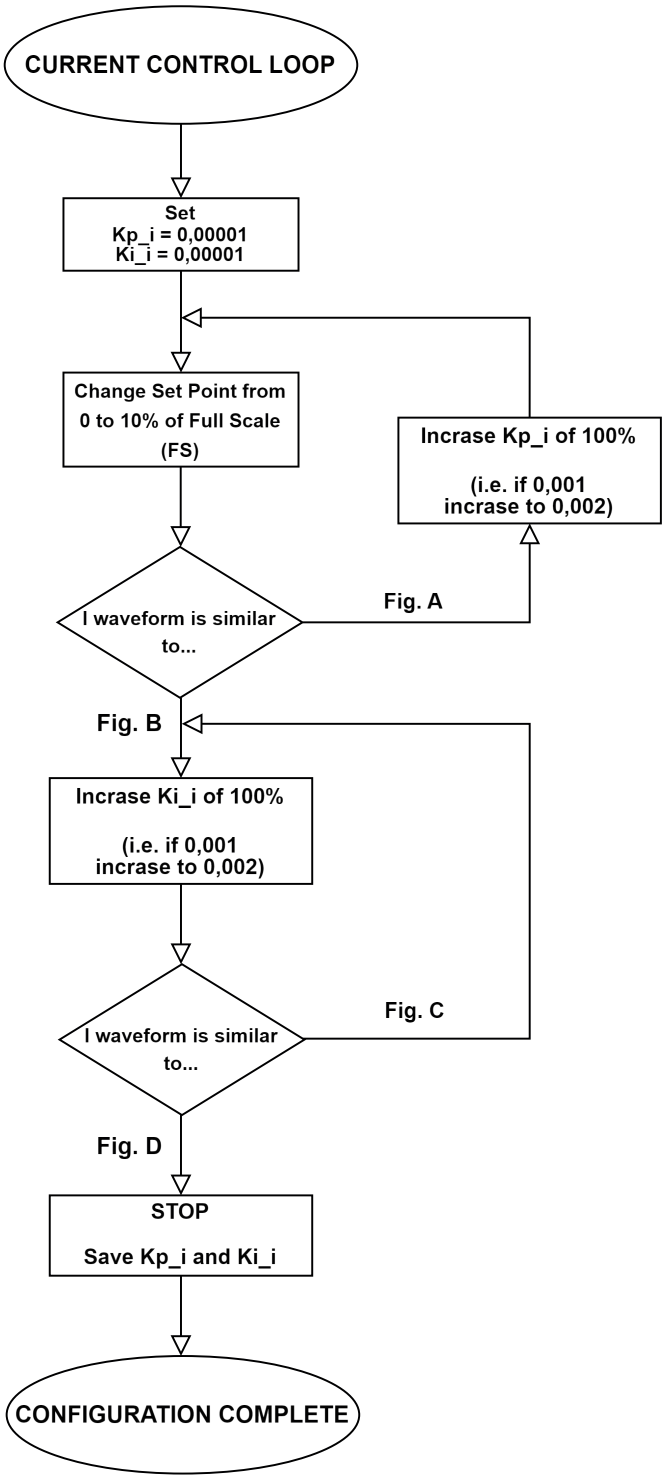


Fig. D



NOTE: In some cases when Fig.D is obtained, a further increase of Kp may reduce the current overshoot.

About Us

ELS Instruments (formerly CAEN ELS) is a leading company in the design of power supplies and state-of-the-art complete electronic systems for the Physics research world, having its main focus on dedicated solutions for the particle accelerator community and high-end industrial applications.

- Power Supply Systems
- Precision Current Measurements
- Beamline Electronics Instrumentation
- FMC and MicroTCA

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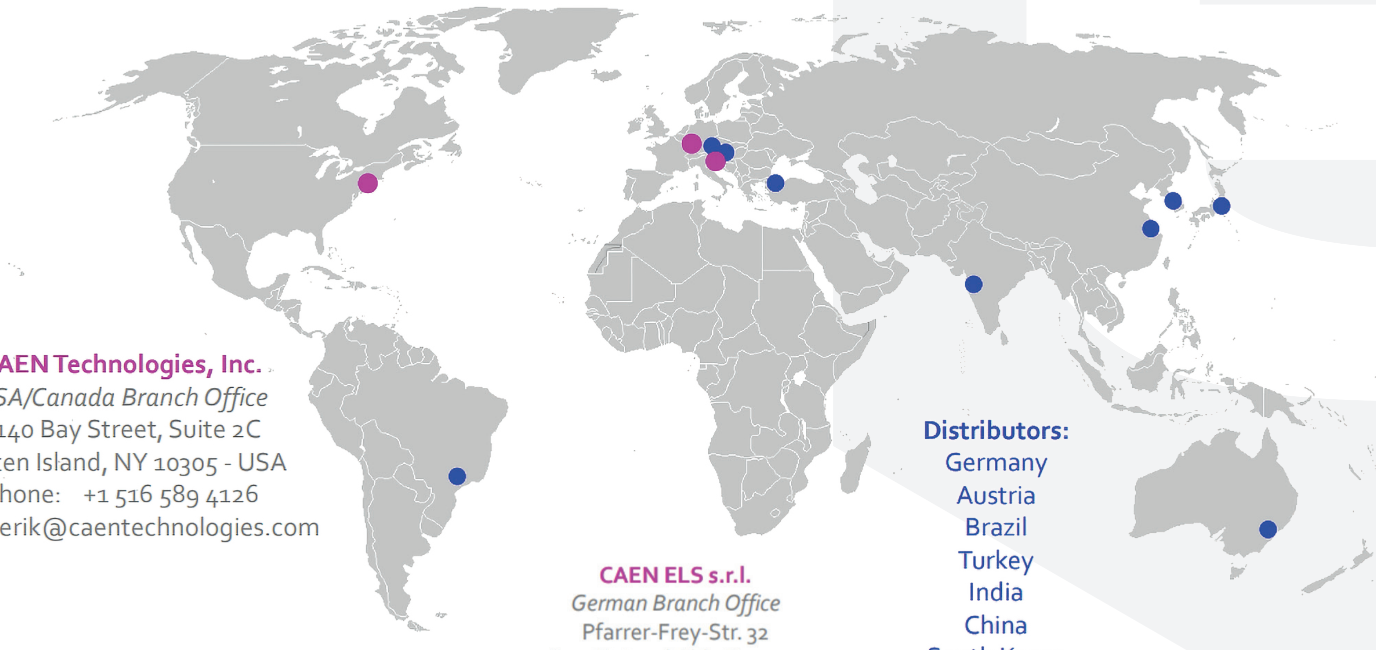

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Rev. 1.2 - Printed in May 2026