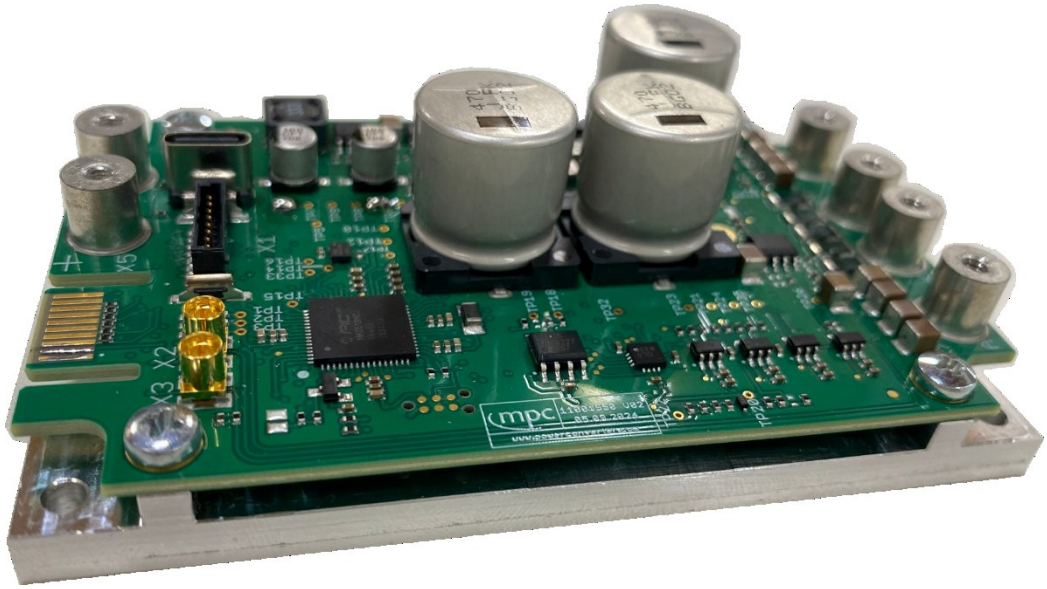


Warning!
Risk of exposure of hazardous laser radiation
in combination with laser light emitting devices!

This Operating Manual is valid for the following Products:

VFS 05-25-U	10100545
VFS 05-25-R	10100546
VFS 05-50-U	10100548
VFS 05-50-R	10100549

Related Documents:

Serial Interface	10100545SI
Control Software	31000057

Content

1. General Description

The VFS driver is a linear modulator that offers improved properties for driving current waveforms into laser diodes. It supports continuous (CW), pulsed, modulated, or mixed signal waveforms with frequencies up to 50 MHz and currents up to 5 A.

To operate the driver only one DC- Power Supply is needed.

The current setpoints can be defined via two analog inputs and/or two software values. It is also possible to use combinations of software and hardware setpoints. The user can switch between Current Setpoint 1 and Current Setpoint 2 via an external trigger signal or an internal pulse generator.

Due to the high modulation speed and the parasitic inductances and capacitances of laser diodes, an individual adaptation of the driver is necessary. This adaptation can be achieved by optimizing two software parameters; hardware modifications to the driver are not required in combination with most laser diodes.

To achieve maximum performance, the modulator should be mounted as close as possible to the laser diode. Additionally, the connection should have an inductance as low as possible. For this purpose, an additional Stripline Set is available. (part number: 13000210)
Individual Stripline kits adapted to customer laser diode can also be ordered.

For detailed information and important hints, please contact our customer support.

2. Power dissipation

The dynamic performance of the VFS driver does normally increase with driver voltage, however the electrical power dissipation increase with the diode voltage, too. To find a compromise between efficiency and performance an driver Voltage 1 to 5 V higher than Diode Voltage is recommended.

Formulas for calculating max. power dissipation:

U_o	Driver Voltage of VFS DC-DC converter
U_D	Diode Voltage (V) = Voltage at diode according to data sheet
$I_{D_{CW}}$	Diode Current CW (A)
$I_{D_{peak}}$	Diode Current peak value (A) (for sinusoidal and rectangle currents)
$I_{D_{Mean}}$	Diode Current Mean Value (A)
t_p	Pulse Duration (s)
f	Pulse Frequency (Hz)
P_L	Power Dissipation (W)

Limits of maximum allowed power dissipations:

For operating with CW current or for pulse length >1ms:

$$P_L = (U_o - U_D) \cdot I_{D_{CW}} < \mathbf{30W}$$

For operating with sinusoidal current:

$$P_L = (U_o - U_D) \cdot I_{D_{Peak}} < \mathbf{30W}$$

For operating with rectangle pulses with pulse length <1 ms:

$$P_{L_{pulse}} = (U_o - U_D) \cdot I_{D_{Peak}} < \mathbf{50W}$$

AND

$$P_{L_{mean}} = (U_o - U_D) \cdot \left(I_{D_{peak}} \cdot t_p \cdot f + I_{D_{CW}}\right) < \mathbf{30W}$$

For operating with rectangle pulses with pulse length <100 µs:

$P_{L_{pulse}} = (U_o - U_D) \cdot I_{D_{Peak}} < \mathbf{100W}$
AND
$P_{L_{mean}} = (U_o - U_D) \cdot \left(I_{D_{peak}} \cdot t_p \cdot f + I_{D_{CW}}\right) < \mathbf{30W}$

The calculation of power dissipation with arbitrary current waveforms is difficult, a good method for estimating power dissipation is to measure the temperature of the modulator. The modulator has a adequate temperature measurement system inside.

3. Power limits

To protect the driver against too high power dissipation the power loss of the VFS driver is monitored in three different ways:

- Monitoring of power stage temperature. If the temperature exceeds 80°C the driver will turn off the output stage. The actual temperature can be monitored via control software or Serial Interface.
- Monitoring of output power loss mean value: If the power dissipation exceeds 30W for more than 1 second the module will turn off the output stage. The actual power loss can be monitored via control software or Serial Interface.
- High speed monitoring of output power loss.
  If the power dissipation exceeds 50W for more than 1ms the module will turn off the output stage
  If the power dissipation exceeds 100W for more than 36us the module will turn off the output stage

4. General instructions

Analog Setpoint Signal

Caution:

Never run a negative current setpoint, this can lead to unwanted current outputs which harm the Laser Diode.

If you use a pulse signal generator or a function generator for the current set point, always disconnect it before you change any ranges. Some generators create high voltages or undefined signals if you change ranges, this may damage diodes and the modulator.

Indicator elements

Green LED: blinking if modulator is ready and no errors exist.

Yellow LED: Blinking when one of the monitored values exceed warning level. The preconfigured warning values can be changed by customer via Serial Interface or using the MPC GUI Software. Warnings do not have any influence to the modulator function. Warnings just monitor that the driver is operating near to an error.

Red LED: Blinking if modulator is disabled after temperature exceeds or another error occurred. Via serial interface or MPC GUI Software the error can be checked. See chapter 6 list of error codes.

The modulator will stop operation until the error is removed and a reset signal is sent to the modulator. (software reset via Serial Interface or hardware reset via X1-4)

5. Block diagram

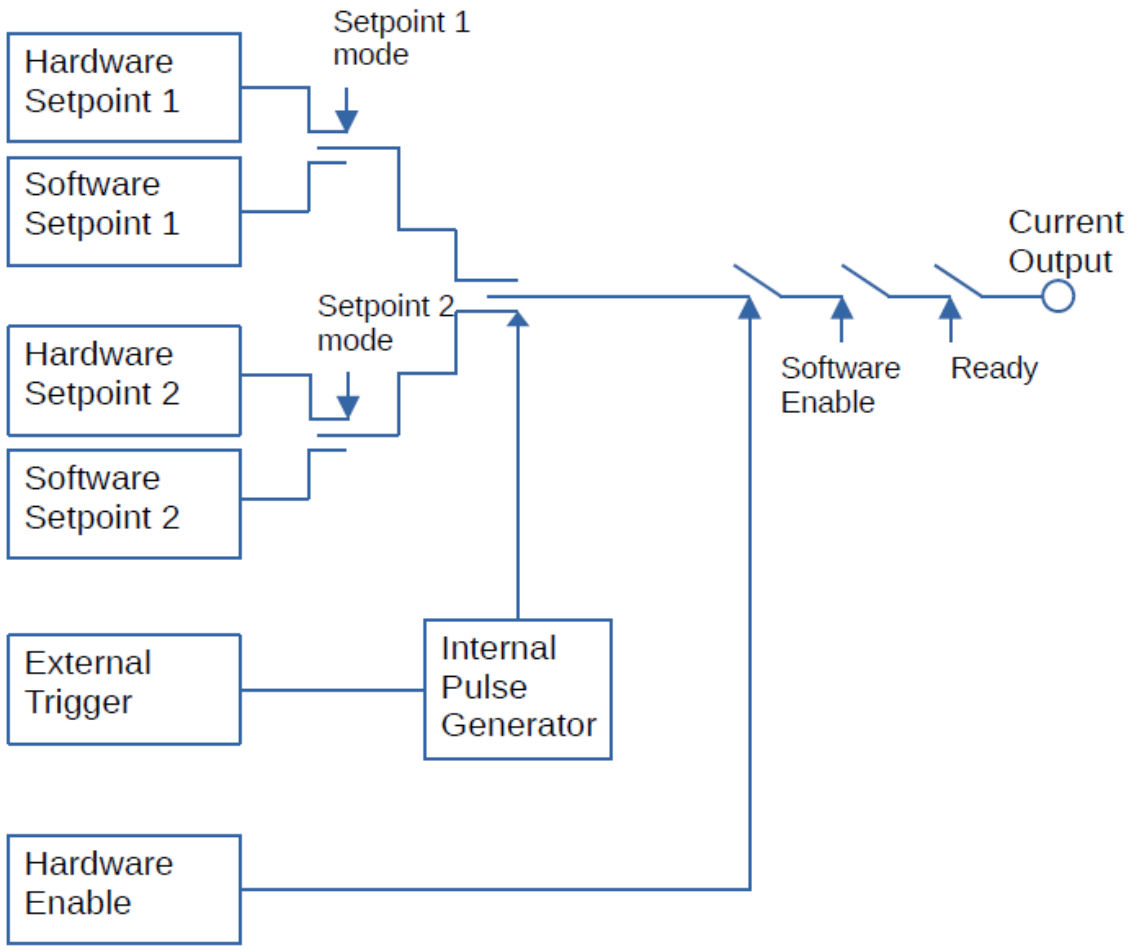
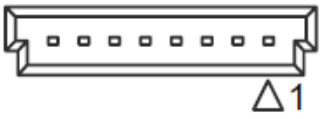


Figure 1 Block diagram VFS 05-xx: Generation of Current Output

6. Connectors

X1 – Control Port

8-pole single row male connector



Manufacturer: ERNI Part number 214014

Mating Plug:

8-pole single row female Connector

Manufacturer: ERNI Part number 224396

Inputs		
Pin	*Name*	*Function*
1	AGND	Signal Ground
2	CA-DCSP2	Diode Current Setpoint 2 Input impedance 10 kOhm 0-5V corresponds to a diode current of 0-5 A
3	CD-Enable	Enable
4	CD-Reset	Reset Errors of VFS
Outputs		
Pin	*Name*	*Function*
1	AGND	Signal Ground
5	SA-TEMP	Reflects the actual temperature of the modulator 0-5 V corresponds to 0-100°C
6	SD-READY	High if there are no errors and startup is complete
7	SD EXTEMP	High if internal overtemperature is registered
8	SD-ERROR	High if an error is registered

X2 – CA-DCSP1

Female coaxial jack MMCX

Control Analog – Diode Current Set Point 1

Analog input 0…1000 mV, input impedance 50 Ohm

0..1000mV corresponds to a diode current of 0…5 A

X3 – SA- Diode Current Actual

Female coaxial jack MMCX

Status Analog – Actual Diode Current

Analog output 0…250 mV, input impedance 50 Ohm

0...250 mV corresponds to a diode current of 0…5 A

X4 – GND

M3 screw terminal.

Tightening Torque 0.5 Nm.

thread depth 4 mm

X5 – V+ Supply

M3 screw terminal.

Tightening Torque 0.5 Nm.

thread depth 4 mm

X6 – Laser diode Cathode

Two M3 screw terminals.

Tightening Torque 0.5 Nm.

thread depth 4 mm

X7 – Laser Diode Anode

Two M3 screw terminals.

Tightening Torque 0.5 Nm.

thread depth 4 mm

X8 – Serial Port

USB3.1 Type C connector for USB or RS232 Communication.

7. List of Error States:

If an error occurs the red LED of the modulator will blink. The Signal SD-Ready will switch to a low status and the Signals SD-EXTEMP or SD ERROR will switch to high status.

To analyze the source of the error the serial command “GET ERROR STATE” or the MPC GUI Software can be used.The following Errors are possible:

Error	***Explanation***	***Action***
" V INPUT HIGH"	Input voltage is too high.	Reduce and check input voltage at X4 and X5 and reset the modulator.
" V INPUT LOW"	Input voltage is too low.	Increase and check input voltage at X4 and X5 and reset the modulator.
“OVERTEMPERATURE”	Temperature at driver stage too high.	Check power dissipation or improve cooling of modulator.
“POWER LOSS HIGH 1”	MOSFET power dissipation within 36us is too high.	Check Setpoint 1 and Setpoint 2. Check Configuration of internal pulse generator. Pay attention to power dissipation.
“POWER LOSS HIGH 2”	MOSFET power dissipation within 1ms is too high	Check Setpoint 1 and Setpoint 2. Check Configuration of internal pulse generator. Pay attention to power dissipation.
“POWER LOSS HIGH 3”	MOSFET power dissipation within 1s is too high	Check Setpoint 1 and Setpoint 2. Check Configuration of internal pulse generator. Pay attention to power dissipation.
Output Current	Output current is higher than 12 A	Check Setpoint 1 and Setpoint 2 voltage Reset the modulator, if error persists contact MPC support.
“SENSOR”	ERROR at internal temperature sensor	Check cabling. Reset the Module, if the ERROR persists contact MPC for Support
“MOSFET”	Output Mosfet is defective	Reset the Module, if the ERROR persists contact MPC for Support

Error	***Explanation***	***Action***
" V 6"	6 volt onboard is not correct	Check cabling Reset the Module, if the ERROR persists contact MPC for Support
“V MINUS 6”	- 6 volt onboard is not correct	Check cabling. Reset the Module, if the ERROR persists contact MPC for Support
“V DIODE HIGH”	Diode voltage at DC-DC Converter output is higher than configured	Check cabling. Reset the Module, if the ERROR persists contact MPC for Support
“V DIODE LOW”	Diode at DC-DC Converter output is lower than configured	Check cabling. Reset the Module, if the ERROR persists contact MPC for Support
“V DIODE”	Internal error at DC-DC Converter	Reset the Module, if the ERROR persists contact MPC for Support

8. Initial commissioning of unconfigured driver

For the initial setup of the modulator, it is recommended to use the “MPC GUI” software. To understand the software concept and handling, please refer to the documentation of the latest GUI software (part number of GUI Software documentation: 31000057).

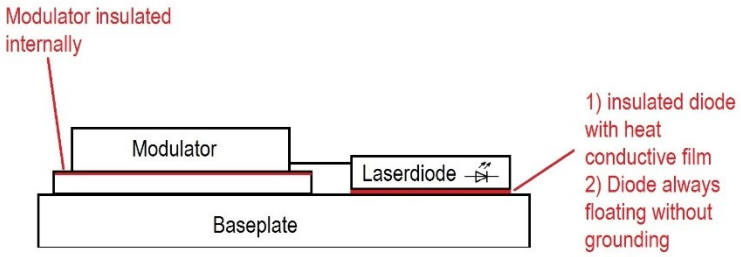
The following steps explain how to setup an unconfigured modulator. If you ordered a modulator with individual adaptation to your laser diode all parameters especially Diode Param 1 and Diode Param 2, are pre-set by MPC.

1. Precaution procedures:

Avoid personal static discharge!

Switch off all power supplies for the Imodulator.

The diode must be mounted floating;
Neither the cathode nor the anode is allowed to be grounded!



2. Install MPC GUI software, connect a USB-C cable between the modulator and the computer and connect a DC power supply to the modulator. Connect X3 to an oscilloscope with an input impedance of 50 Ohm.

3. Make a low inductive shortcut at the modulator output.

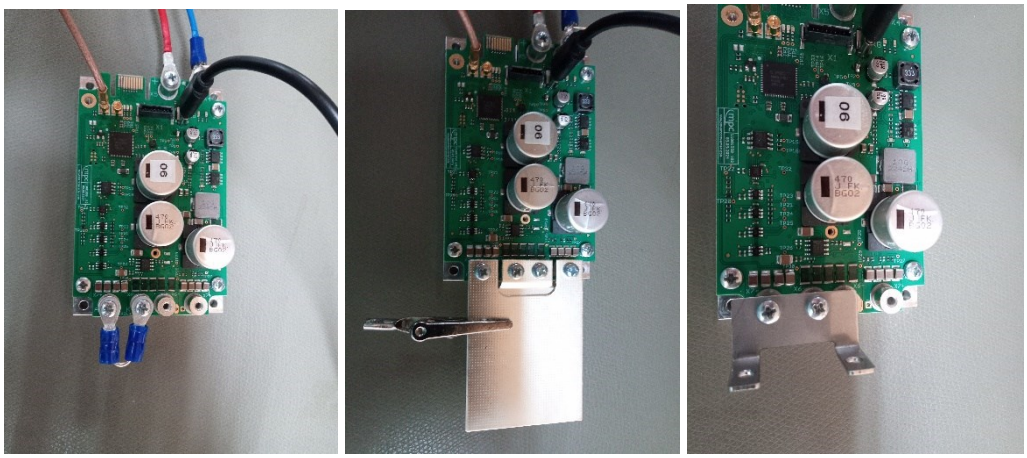
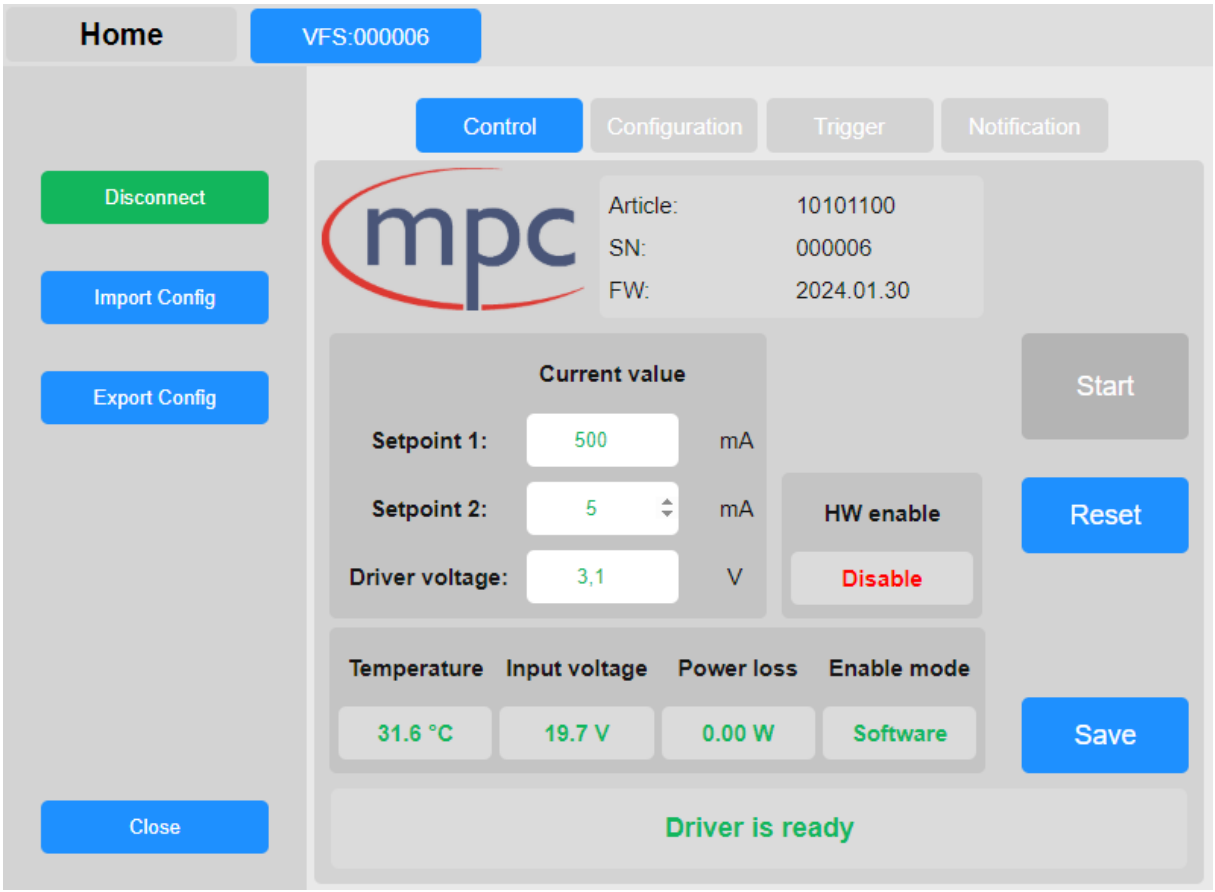


Figure 2: three different methods to realise a low inductive shortcut at modulator Output for the first commissioning

4. Turn on the power supply, start the “MPC GUI” software, and connect to the modulator.



5. Ensure that HW Enable is set to “Disabled” and Enable mode is set to “Software” in the Control tab.

6. Go to the Configuration tab and ensure that it is set as shown in the following picture.

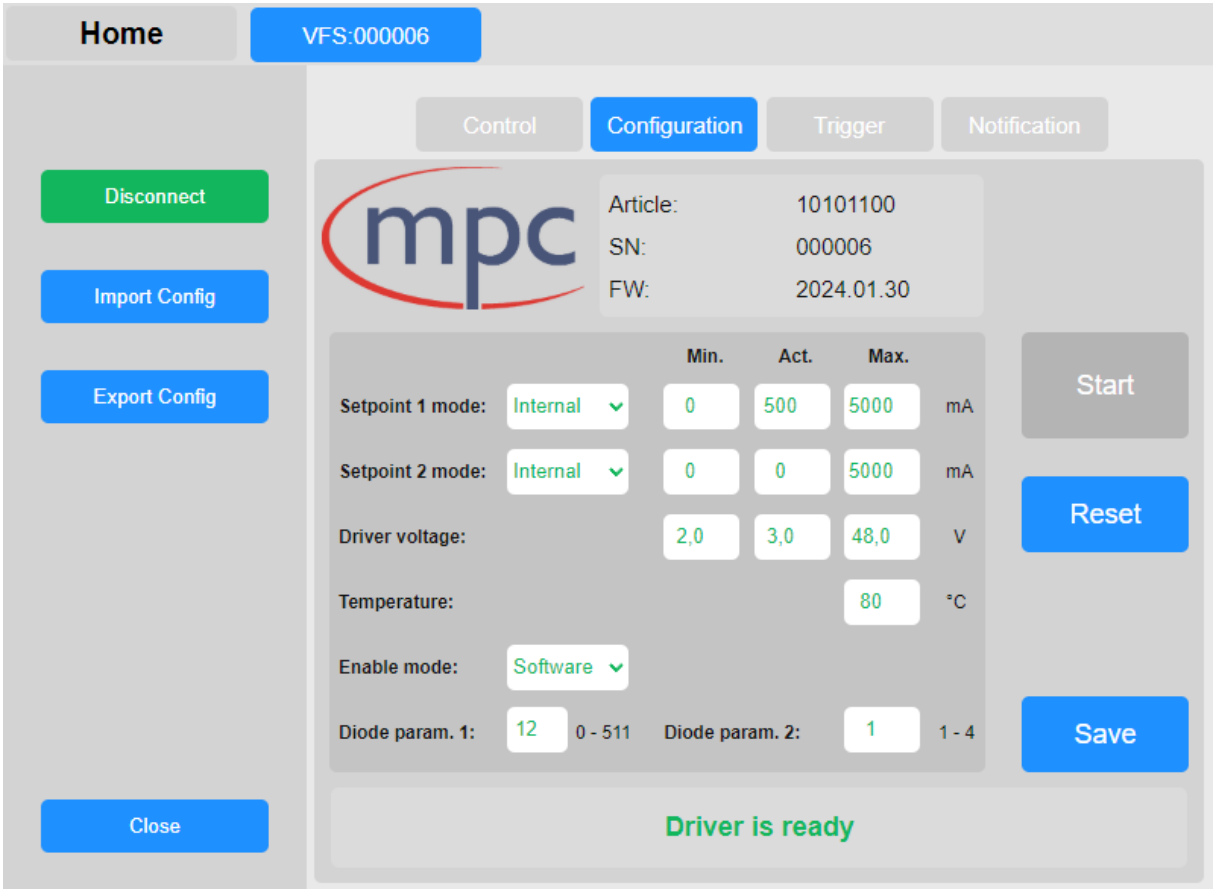


Figure 3 configuration menu of VFS driver at the first time commissioningNavigate to the Trigger tab and ensure that it is configured as shown in the following picture.

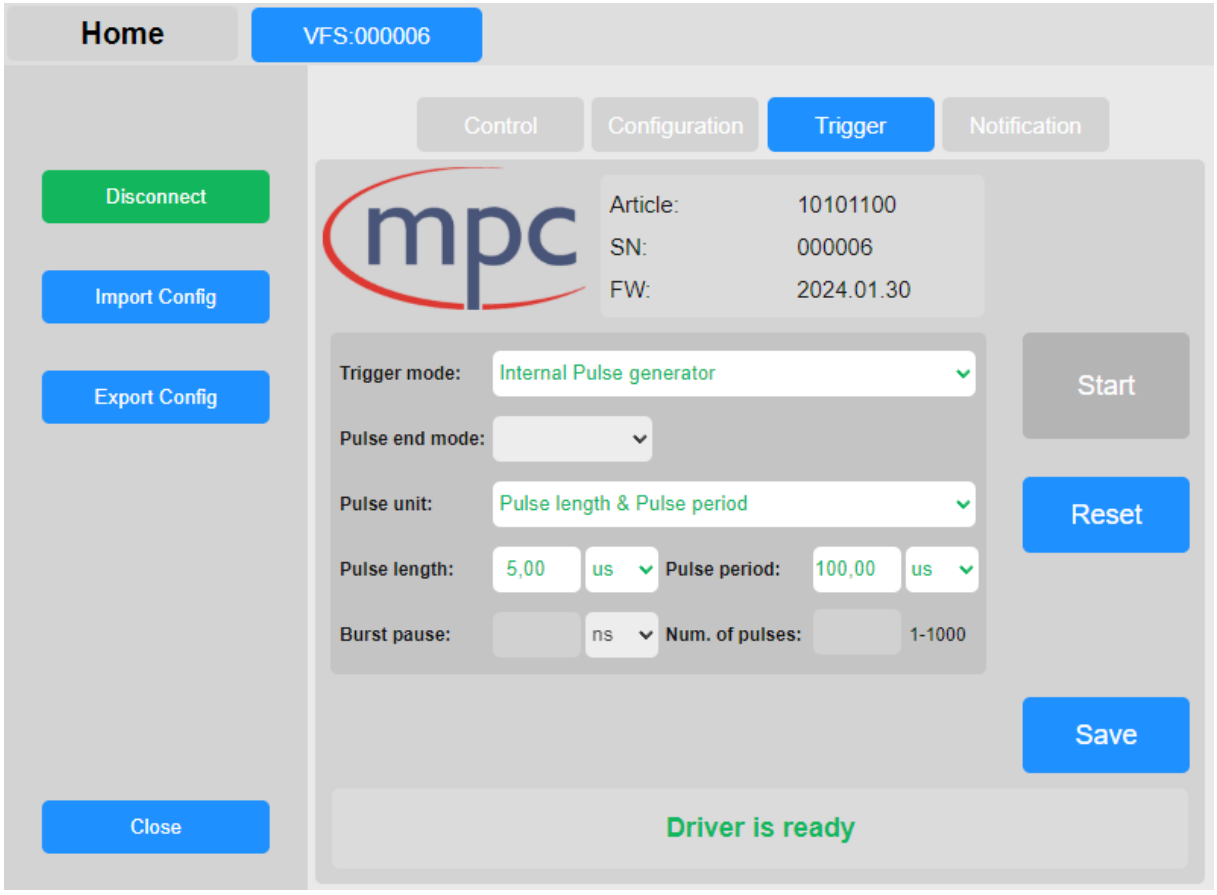
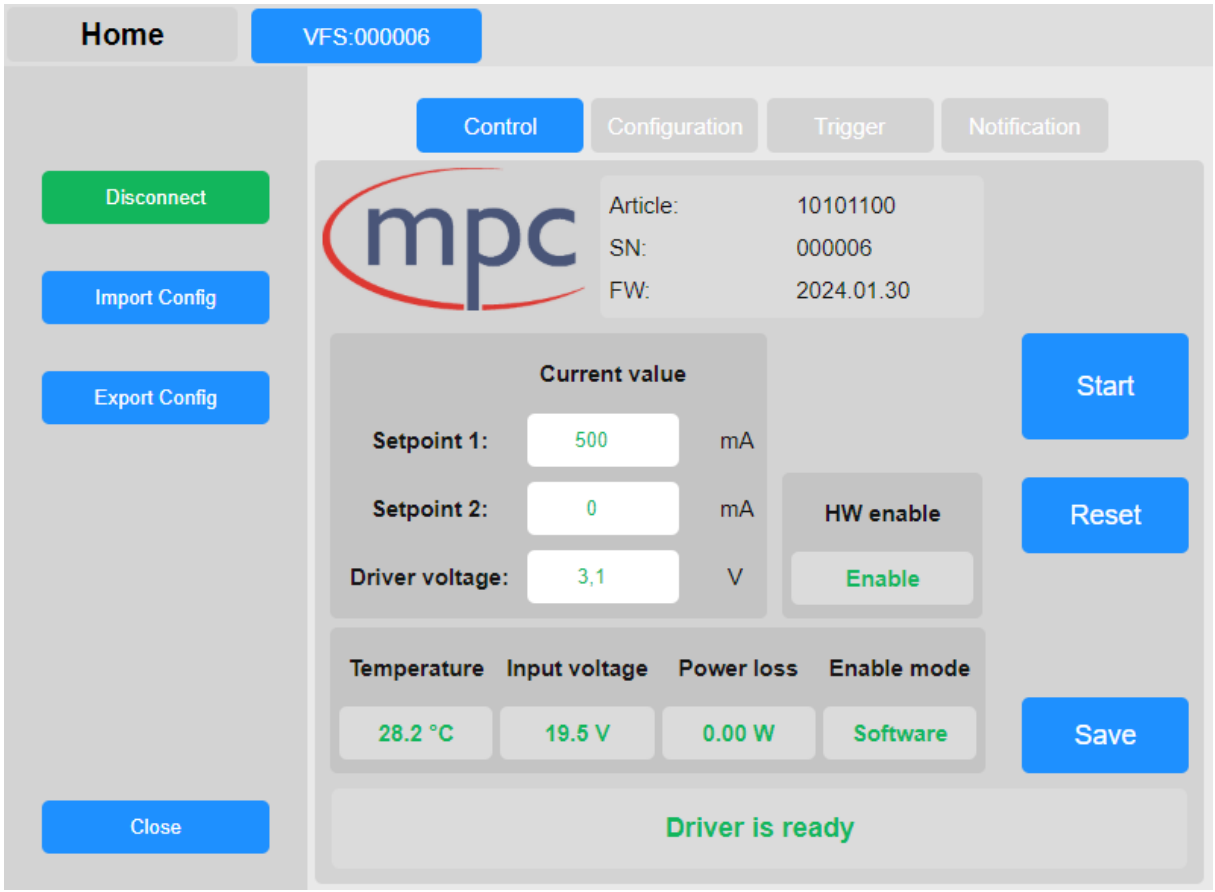
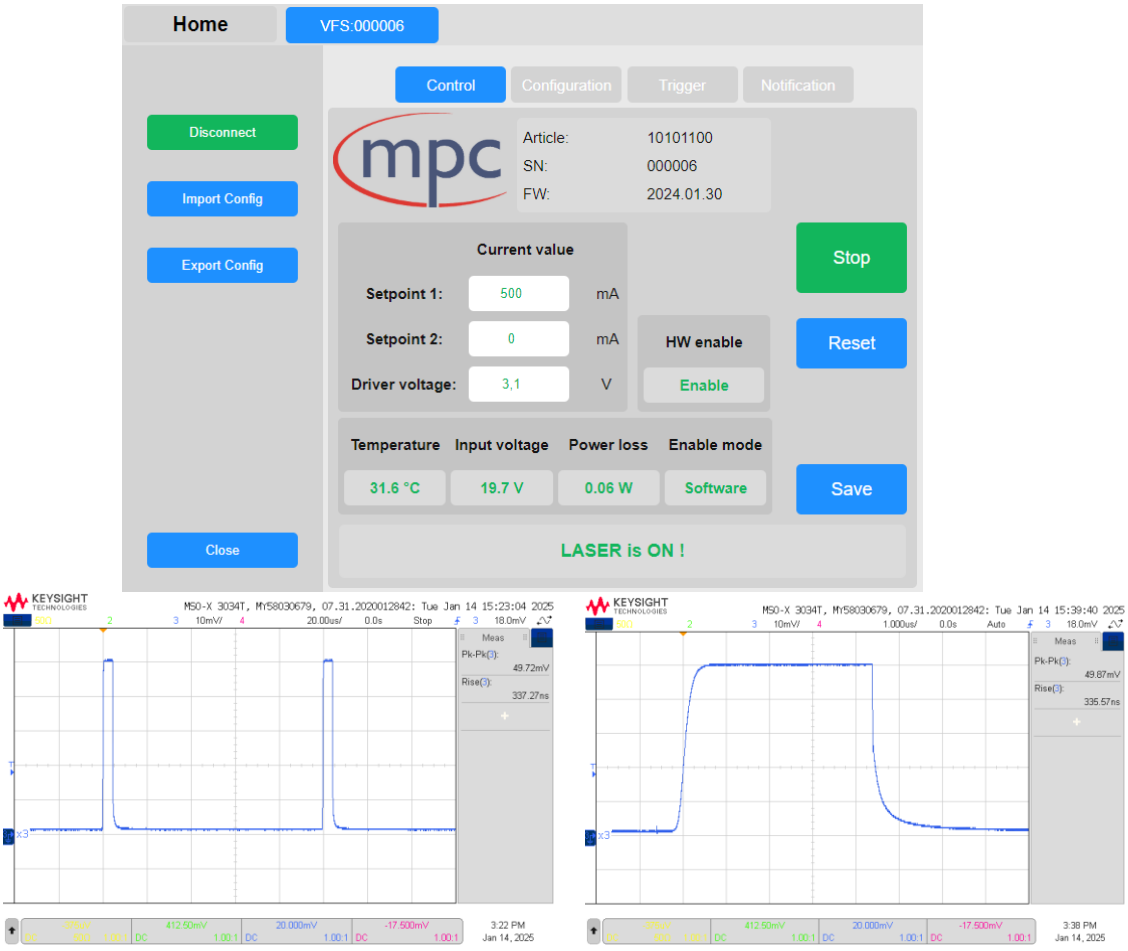


Figure 4: configuration of Trigger tab at the first setup

7. Connect the enable pin to GND to set the hardware enable of the driver. Check that Hardware Enable is correctly set in the Control tab:



8. Press the Start button to generate output current. Verify the X3 signal on the oscilloscope.



9. Press the Stop button to turn off the driver, remove the Hardware Enable and turn off the power supply. Remove the shortcut and connect your laser diode.

Caution! Pay attention to Laser Safety. In the following steps, laser light may be emitted.

10. Ensure Hardware Enable is removed. Turn on the power supply.

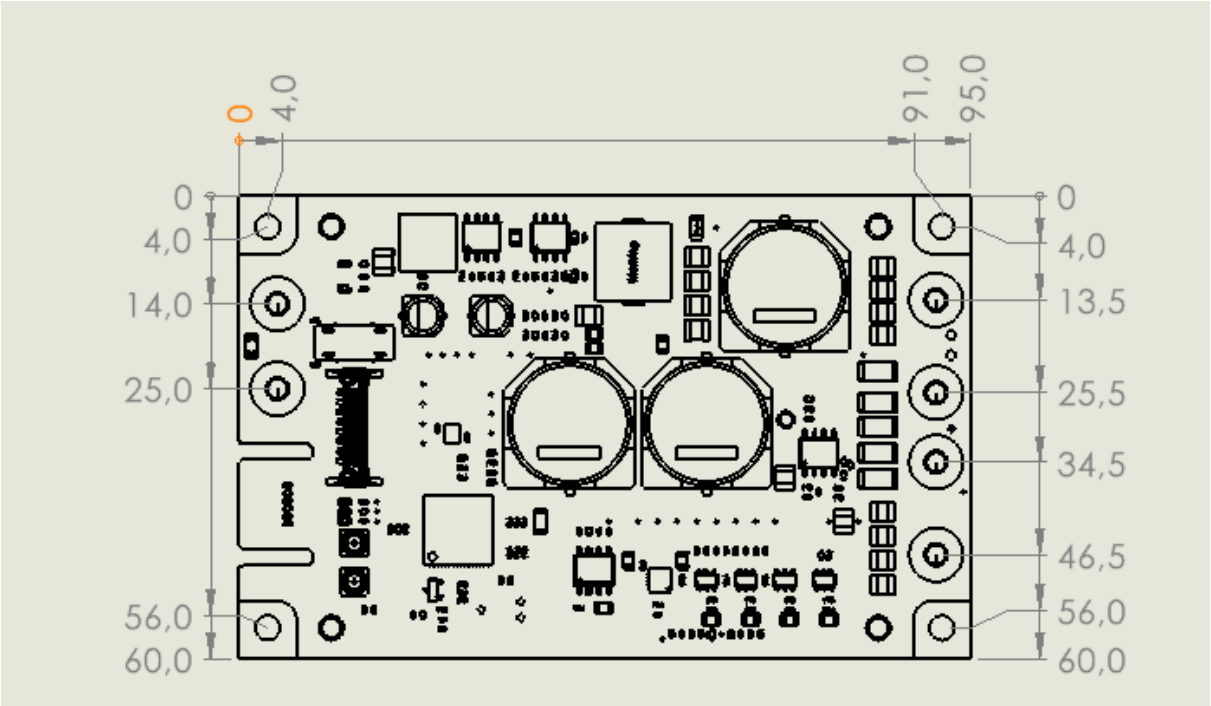
11. Set Setpoint 1: 5-20% of maximum diode current.
    Set Setpoint 2: 10% below diode threshold current.
    Set driver Voltage: 1-5 V above diode voltage.
    Set pulse length and pulse duration: use values that are typical for your final

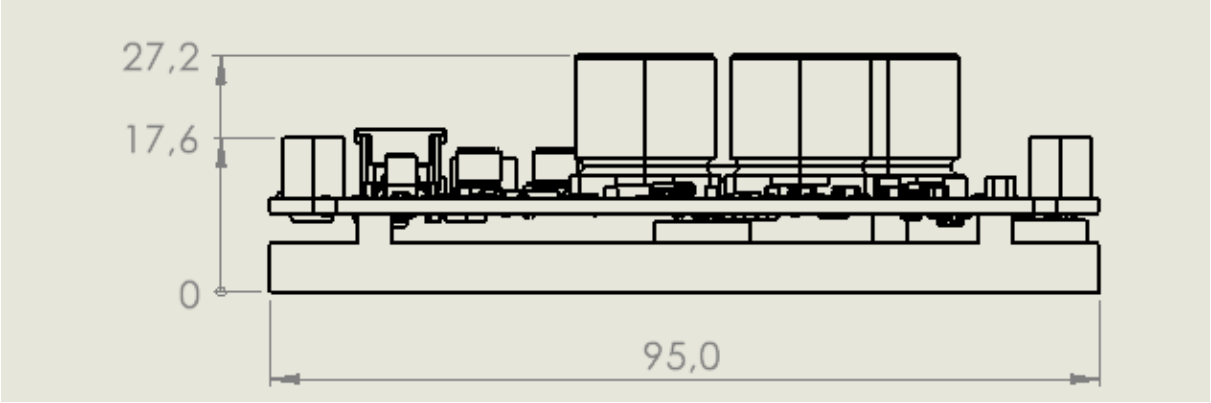
application. (It is recommended to start with pulse lengths shorter than 50 µs and duty cycle lower than 10%, preferable 1%)

12. Optimize Diode Param 1 and Diode Param 2 in Configuration mode.
    Increasing Diode Param 1 will increase risetime of modulator.
    Increasing Diode Param 2 will help to reduce overshoot at risetimes >200us.

13. After optimizing Diode Param 1 and Diode Param 2, the system is ready for your individual configurations. You can now also use arbitrary external setpoints or trigger signals instead of using the internal signal generator.

9. Section Drawing





Contact Data

MESSTEC Power Converter GmbH
Grube 41
D-82377 Penzberg
Phone +49 (0) 8856-80306-0
info@powerconverter.com
www.powerconverter.com