

**Operating Manual**  
**Fast Diode Current Modulator VFM 60-50**  
**10100417**



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**Description**

The fast diode current modulator VFM 60-50 is a linear modulator with improved properties for driving arbitrary current waveforms into laser diodes. Current waveforms can be CW, pulsed, modulated or mixed with frequencies up to 8.3 MHz and currents up to 60 A.

For achieving maximum performance it is required to mount the modulator as close as possible at the laser diode and to connect it with low inductance. Conventional wires for connecting are not allowed, this will decrease performance significantly and may lead to an unstable operating.

The modulator is small and compact and it is designed for mounting it with low inductance at laser diodes or for integrating it in laser diode modules. Ask our support for more information and for important hints.

The modulator has two analogue inputs for the current set point, a high frequency input (50 Ohm input impedance) and a low frequency input. Both inputs cover the full current range. Additionally there is a 10 turn potentiometer for generating a CW-current (bias current). All set points are added and form the effective current set point. A set point with a negative sign acts subtracting.

Furthermore the modulator has a trigger input (TTL or CMOS 3 V ... 5 V) which acts at the high frequency input X2. This trigger input controls the Diode Current Set Point 1 (CA-DCSP1) signal.

A logic High-level at the trigger input puts through the Diode Current Set Point 1 signal to the modulator, a logic Low-level inhibits the the Diode Current Set Point 1 signal.

In this way it is possible to generate fast and clean pulses by feeding in a DC voltage at the X2 input, even if the trigger signal has a bad waveform.

**Power dissipation**

Dynamic performance of the modulator normally increases with supply voltage, however the electrical power dissipation increases with supply voltage too.

A good compromise is to choose a supply voltage of approx. 1 V ... 5 V above the diode voltage.

Simple formulas for calculating power dissipation:

Us	Supply Voltage (V)
Ud	Diode Voltage (V)
I <sub>dcw</sub>	Diode Current CW (A)
I <sub>dpeak</sub>	Diode Current peak value (A) (for sinusoidal and rectangle currents)
t <sub>p</sub>	Pulse Duration (s)
f	Pulse Frequency (Hz)
PI	Power Dissipation (W)

For operating with CW current:

$$PI = (Us - Ud) \times I_{dcw}$$

For operating with sinusoidal current:

$$PI = (Us - Ud) \times (I_{dpeak} / 2)$$

For operating with rectangle current:

$$PI = (U_s - U_d) \times I_{dpeak} \times t_p \times f$$

For operating with sinusoidal current plus CW current:

$$PI = (U_s - U_d) \times ((I_{dpeak} / 2) + I_{dcw})$$

For operating with rectangle current plus CW current:

$$PI = (U_s - U_d) \times (I_{dpeak} \times t_p \times f + I_{dcw})$$

The calculating of power dissipation with arbitrary current waveforms is difficult, therefore a good method for estimating power dissipation is to measure the temperature of the modulator.

The modulator has a precise temperature measurement system inside.

The SA-TEMP output reflects the actual temperature in the range of 0 °C ... +80 °C.

Values of 60 °C (3 V) are still not critical.

### Current Limit

The modulator has a diode current limit mechanism which has a response time of approximately 600 µs.

If the maximum allowed current is exceeded for more than 600 µs, the modulator will be switched off and remains in an off state. The response time of 600 µs allows driving currents which are much higher than the specified CW current. This measure is taken to prevent laser diodes from damage.

### General Instructions

Never run a negative current set point (effective current set point), this may lead to an overshoot if you alter the negative current set point to a positive current set point.

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.

### Specification

Supply voltage for the internal electronics	3 V ... 6 V DC
Supply current	1 A approx.
Supply voltage	1 ... 49 V
Supply current	60 A max
Diode voltage	0 ... 49 V
Diode current CW	0 ... 60 A
Diode current pulsed	0 ... 120 A
Frequency bandwidth	DC ... 8.3 MHz (CA-DCSP1)
Frequency bandwidth	DC ... 100 kHz (CA-DCSP2)
Rise time	60 ns
Fall time	60 ns
Accuracy	± 0.2 %
Linearity	± 0.2 %
Temperature stability	± 100 ppm / °C

Accuracy of SA-DCACT output	± 2 %
Power dissipation	90 W max. allowed
Cooling	required
Operating temperature range	0 ... +45 °C
Dimensions	95 x 61 x 20 mm
Weight	240 g
Part Number	10100417

**Scope of Delivery**

Fast Diode Current Modulator	Part Number 10100417
8-pole single row female connector	Part Number 10883510
2 pcs screw M4x6 DIN 7985	Part Number 10701642
11 pcs screw M1.6x3 DIN 7985	Part Number 10701609
11 pcs washer A1.7 DIN 433	Part Number 10705300

**Adjustment elements**

10 turns potentiometer for a CW current set point (bias current)  
The potentiometer covers the full current range.  
Turn clockwise for increasing current.

**Indicator elements**

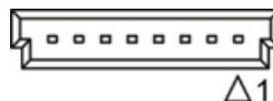
Green LED for indicating status Ready  
Red LED for indicating status Excess Temperature

**Connectors**

- X1 8-pole single row male connector for control signals, status signals and supply voltage for the internal electronics
- X2 female coaxial jack MMCX for current set point 1
- X3 female coaxial jack MMCX for actual current (current monitor)
- X4- connection bolt ø 8 mm with female thread M 4 for Supply Voltage Minus
- X5+ connection bolt ø 8 mm with female thread M 4 for Supply Voltage Plus
- X6- connection plate with six female thread M 1.6 for laser diode cathode
- X7+ connection plate with five female thread M 1.6 for laser diode anode

**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



**Signals and data at the interfaces**

CA=Control Data Analog

CD=Control Data Digital

SA=Status Data Analog

SD=Status Data Digital

Inputs Control Port X1		
Pin	Name	Function
1	GND	Signal Ground
2	CA-DCSP2	Diode Current Set Point 2
3	CD-ENABLE	Enable
4	CD-RESET	Reset
7	CD-TRIGG	Trigger
8	SVI+	Supply Voltage for the internal electronics
Outputs Control Port X1		
Pin	Name	Function
1	GND	Signal Ground
5	SA-TEMP	Temperature
6	SD-READY	Ready

**X2 Control Port**

Female coaxial jack MMCX

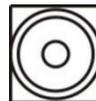


**CA-DCSP1**

Diode Current Set Point 1

**X3 Current Monitor Port**

Female coaxial jack MMCX



**SA-DCACT**

Diode Current Actual

**X4-**

Connection bolt  $\varnothing$  8 mm with female thread M 4

Supply Voltage Minus for the laser diode

**X5+**

Connection bolt  $\varnothing$  8 mm with female thread M 4

Supply Voltage Plus for the laser diode

**X6-**

Connection plate with six female thread M 1.6, Laser Diode Cathode

**X7+**

Connection plate with five female thread M 1.6, Laser Diode Anode

**Signal Description****SVI+**

Supply voltage for the internal electronics

Required supply voltage: 3 V ... 6 V

Supply current: 1 A approx.

Plus must be connected at X1-8, Minus at X4-

**CA-DCSP1 (X2)**

Control Analog - Diode Current Set Point 1

Analog input 0 ... 500 mV, input impedance 50 Ohm

0 ... 500 mV corresponds to a diode current of 0 ... 60 A CW operation

0 ... 1000 mV corresponds to a diode current of 0 ... 120 A pulsed operation

**CA-DCSP2 (X1-2)**

Control Analog - Diode Current Set Point 2

Analog input 0 ... 5 V, input impedance 10 kOhm

0 ... 5 V corresponds to a diode current of 0 ... 60 A CW operation

Diode Current Set Point 1, Diode Current Set Point 2 and the current value of the bias current potentiometer are added internally and build the effective current set point.

A current set point with negative sign acts subtracting.

**SA-DCACT (X3)**

Status Analog - Diode Current Actual

Analog output 0 ... 220 mV (off-load voltage), output impedance 50 Ohm, reflects the actual diode current.

0 ... 220 mV corresponds to a diode current of 0 ... 60 A.

For maximum performance the coaxial cable should be terminated with 50 Ohm.

In this case 0 ... 110 mV corresponds to a diode current of 0 ... 60 A.

**SA-TEMP (X1-5)**

Status Analog - Temperature

Analog output 0 ... 4 V, reflects the actual temperature of the modulator

0 V corresponds to 0 °C, 4 V corresponds to +80 °C.

**CD-ENABLE (X1-3)**

Control Digital - Enable

Digital TTL input, High if left open.

Low-Signal or pulling the input to GND enables diode current.

**CD-RESET (X1-4)**

Control Digital - Reset

Digital TTL input, High if left open.

A Low-Signal or pulling the input to GND resets the modulator if there was an error (maximum allowed current exceeded or excessive temperature).

**CD-TRIGG (X1-7)**

Control Digital - Trigger

Digital TTL input, controls the Diode Current Set Point 1 signal at X2.

A logic High-level puts through the current set point 1 signal to the modulator, a logic Low-level inhibits the Diode Current Set Point 1 signal.

**SD-READY (X1-6)**

Status Digital - Ready

Digital TTL output, High if there are no errors.

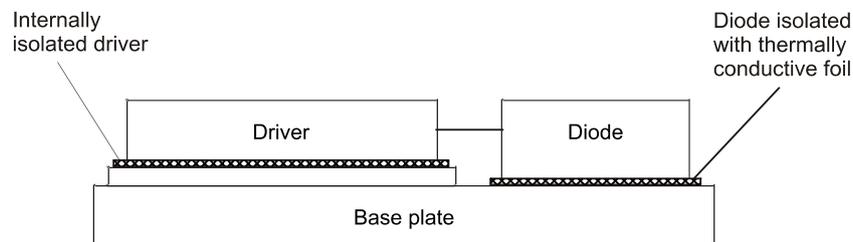
**Warning!**

Do not connect GND (X1-1) to X4- !

**Initial Setup**

Mount the modulator at a air- or water-cooled base plate.

Mount the diode in isolation directly next to the modulator at the base plate.



Short-circuit the output of the modulator (connect X6- to X7+ via a short thin metal sheet).

Connect the supply voltage (3 V ... 6 V, preferred 5 V) for the internal electronics, connect Plus to X1-8 (SVI+) and Minus to X4-.

Connect the power supply for the diode, connect Plus to X5+ and Minus to X4-.

Connect an oscilloscope at SA-DCACT (X3), terminate the oscilloscope input with 50 Ohm.

Turn the BIAS potentiometer counterclockwise to zero.

Turn on the power supply for the internal electronics, the green LED must light up.

Turn on the power supply for the diode and set its output voltage to approx. 5 V.

Enable the modulator by connecting X1-3 to X1-1.

Turn the BIAS potentiometer one full turn clockwise and observe the SA-DCACT (X3) on the oscilloscope.

Its value must be 11 mV, corresponding to 10 % of the maximum output current of 60 A.

Turn the BIAS potentiometer counterclockwise back to zero.

Disable the modulator.

Connect an adjustable DC power supply or a function generator to CA-DCSP2 (X1-2).

Enable the modulator.

Apply 500 mV to the CA-DCSP2 (X1-2) and observe the SA-DCACT (X3) on the oscilloscope.

Its value must be 11 mV, corresponding to 10 % of the maximum output current of 60 A.

Disable the modulator.

Disconnect CA-DCSP2 (X1-2).

Connect an adjustable DC power supply or a function generator to CA-DCSP1 (X2).

Apply 250 mV to the CA-DCSP1 (X2).

Feed in a TTL-square wave or a CMOS-square wave with a pulse length of approx. 5  $\mu$ s and a repetition rate of approx. 100 Hz at CD-TRIGG (X1-7).

Enable the modulator and observe the SA-DCACT (X3) on the oscilloscope.

The SA-DCACT (X3) signal must be a square wave with a pulse length of 5  $\mu$ s, a repetition rate of 100 Hz and an amplitude of 55 mV, corresponding to 50 % of the maximum output current of 60 A.

Disable the modulator.

Disconnect CA-DCSP1 (X2).

Disconnect CD-TRIGG (X1-7).

Turn off the power supply for the diode and turn off the power supply for the internal electronics.

Remove the shortcircuit at the output of the modulator.

Connect the diode to the modulator, use striplines or short twisted leads.

Set the output voltage of the power supply for the diode according to the diode voltage.

Recommended values are approx. 2 V above diode voltage for CW operation and approx. 4 V above diode voltage for pulsed or mixed signal operation.

Turn on the power supply for the internal electronics.

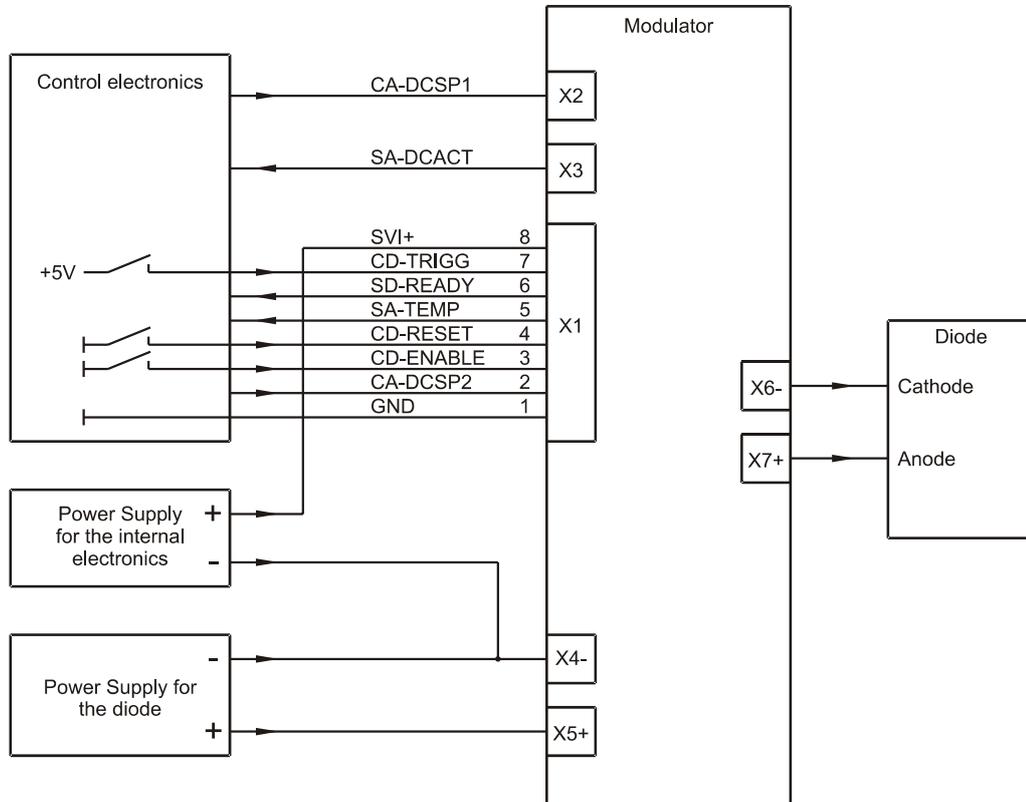
Turn on the power supply for the diode.

Apply signals to CA-DCSP1 (X2), to CD-TRIGG (X1-7) and / or to CA-DCSP2 (X1-2) according to your requirements and set BIAS current if necessary.

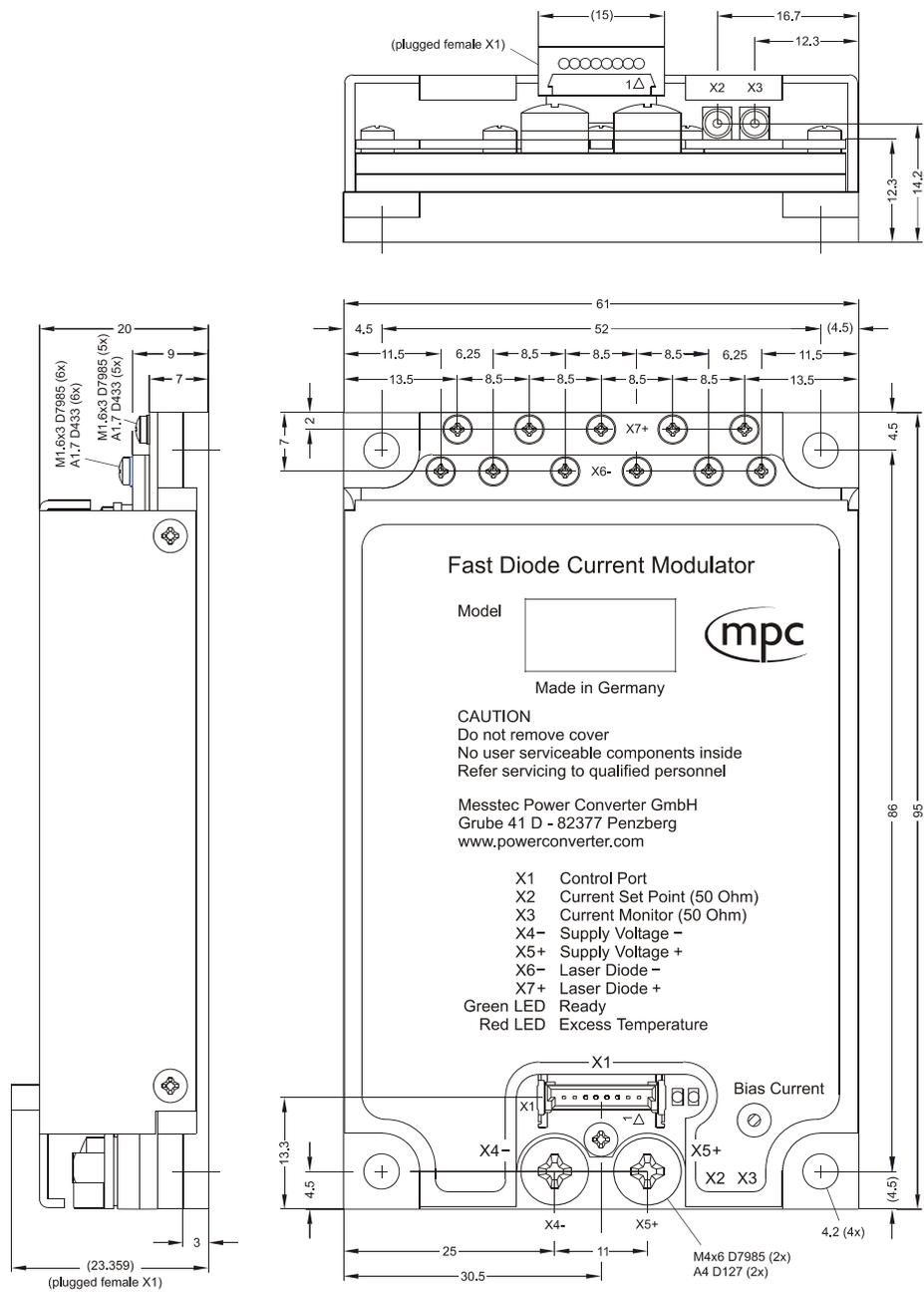
Enable the modulator and run the system.

**Pay attention to the maximum diode current and the maximum allowable power dissipation of the modulator!**

Wiring Diagram



Dimensioned drawing (mm)



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