Operating Manual
Fast Diode Current Modulator FM 40-06
10100253

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Index of contents **Page**

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Description

The fast diode current modulator FM 40-06 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 20 MHz and currents up to 40 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.

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 … 3 V above the diode voltage.

Simple formulas for calculating power dissipation:

Us	Supply Voltage (V)
Ud	Diode Voltage (V)
Idcw	Diode Current CW (A)
Idpeak	Diode Current peak value (A) (for sinusoidal and rectangle currents)
tp	Pulse Duration (s)
f	Pulse Frequency (Hz)
Pl	Power Dissipation (W)

For operating with CW current:
Pl = (Us - Ud) x Idcw

For operating with sinusoidal current:
Pl = (Us - Ud) x (Idpeak / 2)

For operating with rectangle current:
Pl = (Us - Ud) x Idpeak x tp x f

For operating with sinusoidal current plus CW current:
Pl = (Us - Ud) x ((Idpeak / 2) + Idcw))

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For operating with rectangle current plus CW current:
Pl = (Us - Ud) x (Idpeak x tp x f + Idcw)

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	1 ... 6 V
Supply current	40 A max
Diode voltage	0 ... 4.5 V
Diode current CW	0 ... 40 A
Diode current pulsed	0 ... 80 A
Output power	180 W max
Power dissipation	60 W max. allowed
Frequency bandwidth	DC ... 20 MHz (CA-DCSP1)
Frequency bandwidth	DC ... 100 kHz (CA-DCSP2)
Rise time	16 ns
Fall time	9 ns
Accuracy	± 0.2 %
Linearity	± 0.2 %
Temperature stability	± 100 ppm / °C
Accuracy of SA-DCACT output	± 2 %
Cooling	required
Operating temperature range	0 ... +45 °C
Dimensions	95 x 61 x 20 mm
Weight	250 g
Part Number	10100253

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Scope of Delivery

Fast Diode Current Modulator	Part Number 10100253
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.

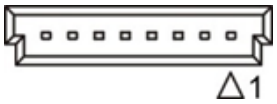
Indicator elements

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

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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
8	NC	Do not connect, do not use

Outputs Control Port X1		
Pin	Name	Function
1	GND	Signal Ground
5	SA-TEMP	Temperature
6	SD-READY	Ready
7	SD-EXTEMP	Excess Temperature

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 ø 8 mm with female thread M 4
Supply Voltage Minus for the laser diode

X5+
Connection bolt ø 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

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Signal Description

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 … 40 A CW operation
0 … 1000 mV corresponds to a diode current of 0 … 80 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 … 40 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 … 100 mV (off-load voltage), output impedance 50 Ohm, reflects the actual diode current.
0 … 100 mV corresponds to a diode current of 0 ... 40 A.
For maximum performance the coaxial cable should be terminated with 50 Ohm.
In this case 0 … 50 mV corresponds to a diode current of 0 ... 40 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).

SD-READY (X1-6)
Status Digital – Ready
Digital TTL output, High if there are no errors.

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SD-EXTEMP (X1-7)

Status Digital - Excess Temperature

Digital TTL output, High if the temperature of the modulator has exceeded 80 °C.

The modulator will be switched off and remains in an off state.

SD-READY signal goes Low, the green Ready-LED turns off and the red Excess Temperature-LED lights up.

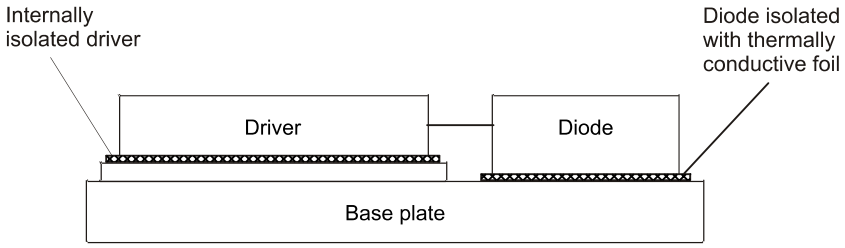
Warning!

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 power supply, 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 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 5 mV, corresponding to 10 % of the maximum output current of 40 A.

Turn the BIAS potentiometer counterclockwise back to zero.

Disable the modulator.

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

Enable the modulator.

Apply 50 mV to the CA-DCSP1 (X2) and observe the SA-DCACT (X3) on the oscilloscope.

Its value must be 5 mV, corresponding to 10 % of the maximum output current of 40 A.

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 5 mV, corresponding to 10 % of the maximum output current of 40 A.

Disable the modulator.

Turn off the power supply.

Disconnect CA-DCSP2 (X1-2).

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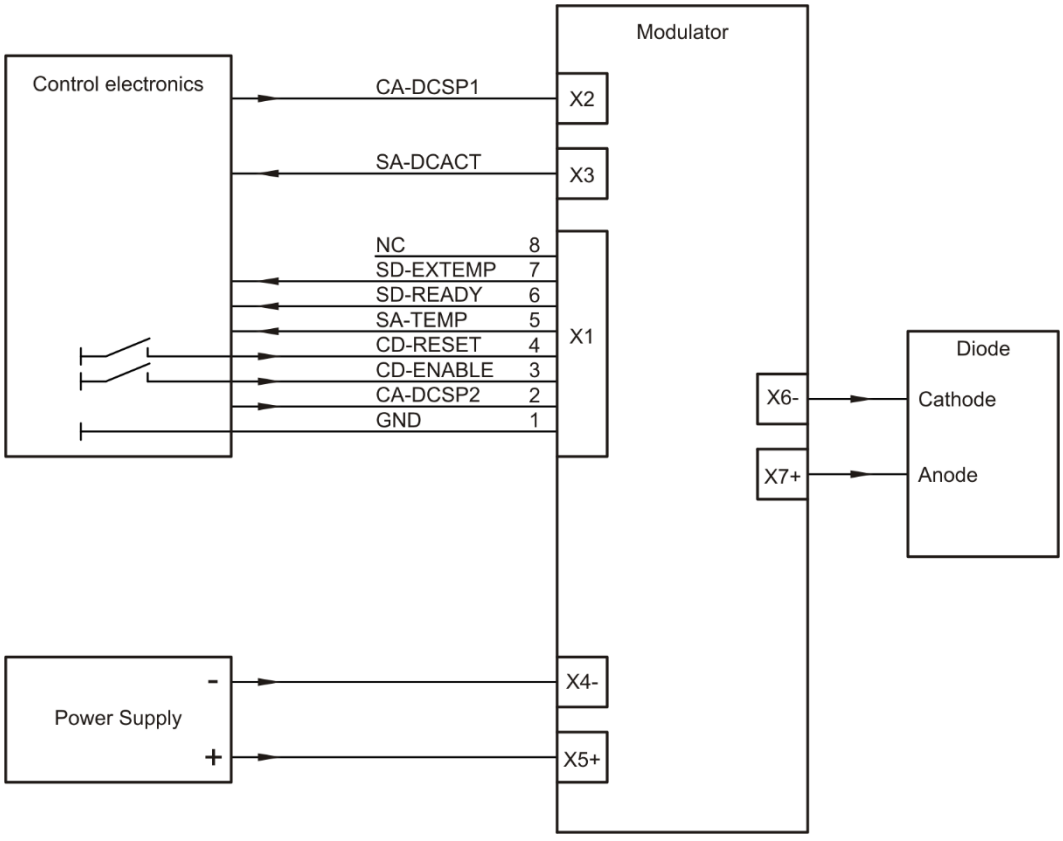
Remove the shortcircuit at the output of the modulator.

Connect the diode to the modulator, use striplines or short twisted leads.
Set the output voltage of the power supply 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.
Apply signals to CA-DCSP1 (X2) 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



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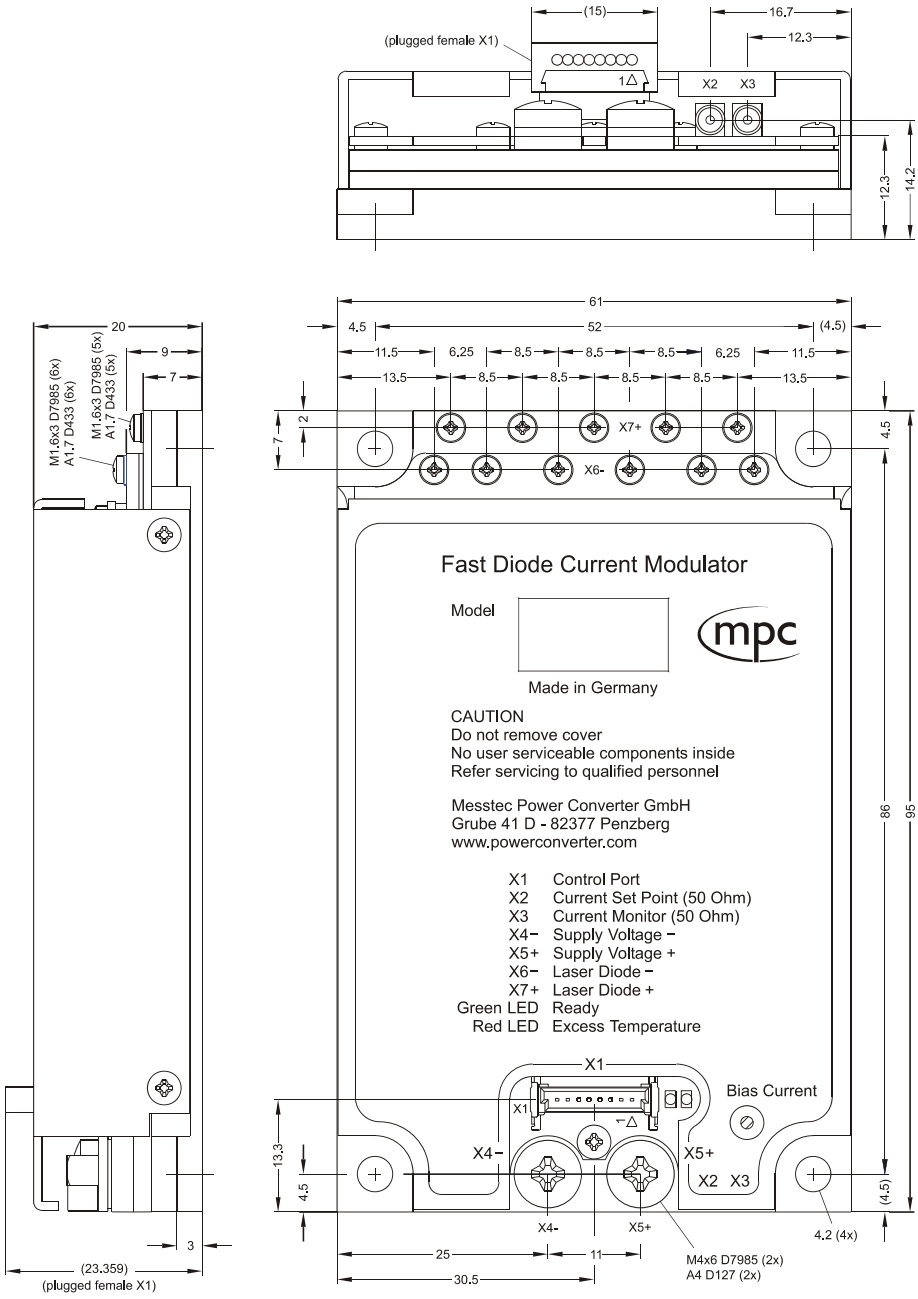
Dimensioned drawing (mm)



Contact Data

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

Technical subjects to change without notice