Fast Diode Current Modulators FM

Operating Manual

English Edition

Fast Diode Current Modulators FM

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Description

The fast diode current modulators FM 20, FM 60 and FM 100 are linear modulators which are well suited 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 200 A.

For achieving maximum performance it is required to mount the modulators as close as possible at the laser diodes and to connect them with low inductance. Conventional wires for connecting are not allowed, this will decrease performance significantly and may lead to an unstable operating.
The modulators are small and compact and they are designed for mounting them with low inductance as close as possible at the laser diodes or for integrating them in laser diode modules. Ask our support for more information and for important hints.

The modulators have two analogue inputs for the current setpoint, a high frequency input (50 Ohm input impedance) with a bandwidth of 20 MHz and a low frequency input with a bandwidth of 100 KHz.
Both inputs cover the full current range.
Additionally there is a 10 turns 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 loss

Dynamic performance of the modulators increase with supply voltage, however the electrical power loss also increase with supply voltage.
A good compromise is to choose a supply voltage of approx. 4 V for supplying one diode (2 V). For short pulses or for short pulses with a small bias current the supply voltage can be increased to 5 V or 6 V.

Simple formulas for calculating power loss:

U_s	Supply Voltage (V)
U_d	Diode Voltage (V)
I_{dcw}	Diode Current CW (A)
I_{dpeak}	Diode Current peak value (A) (für sinusoidal and rectangle currents)
t_p	Pulse Duration (s)
f	Pulse Frequency (Hz)
P_l	Power Loss (W)

For operating with CW current:
$P_l = (U_s - U_d) \times I_{dcw}$

For operating with sinusoidal current:
$P_l = (U_s - U_d) \times (I_{dpeak} / 2)$

For operating with rectangle current:
$P_l = (U_s - U_d) \times I_{dpeak} \times t_p \times f$

For operating with sinusoidal current plus CW current:
$P_l = (U_s - U_d) \times ((I_{dpeak} / 2) + I_{dcw})$

For operating with rectangle current plus CW current:
$P_l = (U_s - U_d) \times (I_{dpeak} \times t_p \times f + I_{dcw})$

Calculating power loss at arbitrary current waveforms is rather difficult, therefore a good method for estimating power loss is to measure the temperature of the modulator.
The modulators have 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) to 70 °C (3.5 V) are still not critical.

Current Limit
The modulators have 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 modulators will be switched off and remain in an off state.
The response time of 600 µs allows driving currents which are much higher than the specified CW current. Thus care must be 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 negativ 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 voltage during switching operation, this may damage laser diodes.

If you are not sure what will happen, we recommend the following procedure for starting up:
Disconnect the laser diode and short-circuit the output of the modulator (connect X6- to X7+ via a short thin metal sheet).
Connect an oscilloscope at the X3 current monitor output, terminate the oscilloscope input with 50 Ohm.
Feed in the current set point signals, switch on the power supply, enable the modulator and watch the X3 current monitor output.
If the current waveform and its amplitude is ok, switch off, remove the short circuit, connect the laser diode and run it.
Connect a voltmeter at the SA-TEMP output and GND and watch the temperature of the modulator. Values of 60 °C (3 V) to 70 °C (3.5 V) are still not critical.

Adjustment elements
10 turns potentiometer for a CW current set point (bias current)
The potentiomter covers the full current range.

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 and status signals
X2, female coaxial jack MMCX for current set point 1
X3, female coaxial jack MMCX for actual current (current monitor)
X4-, connection bolt ∅ 8 mm with female thread M4 for Supply Voltage Minus
X5+, connection bolt ∅ 8 mm with female thread M4 for Supply Voltage Plus
X6-, connection plate with six female thread M1.6 for laser diode cathode
X7+, connection plate with five female thread M1.6 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

CA=Control Data Analog
CD=Control Data Digital
SA=Status Data Analog
SD=Status Data Digital

Inputs		
Pin	Name	Function
2	CA-DCSP2	Diode Current Set Point 2
3	CD-ENABLE	Enable
4	CD-RESET	Reset
1	GND	Signal Ground
8	NC	Not connected
Outputs		
Pin	Name	Function
5	SA-TEMP	Temperature
6	SD-READY	Ready
7	SD-EXTEMP	Excess Temperature
1	GND	Signal Ground
8	NC	Not connected

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 ∅ 8 mm with female thread M4
Supply Voltage Minus

X5+
Connection bolt ∅ 8 mm with female thread M4
Supply Voltage Plus

X6-
Connection plate with six female thread M1.6
Laser Diode Cathode

X7+
Connection plate with five female thread M1.6
Laser Diode Anode

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 … 20 A FM 20
0 … 60 A FM 60
0 … 100 A FM 100

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 … 20 A FM 20
0 … 60 A FM 60
0 … 100 A FM 100

Diode Current Set Point 1, Diode Current Set Point 2 and the current value of the bias current potentiometer will be added internally and form 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 … 20 A FM 20
0 … 60 A FM 60
0 … 100 A FM 100

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 … 20 A FM 20
0 … 60 A FM 60
0 … 100 A FM 100

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 - Enabel
Digital TTL input, High if left open
A 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

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 goes out and the red Excess Temperature-LED lits.

Specification FM 20

Supply voltage	3 ... 6 V
Supply current	20 A max
Diode current CW	0 ... 20 A
Diode current pulsed	0 ... 40 A (50 % duty cycle)
Diode current pulsed	0 ... 80 A (for short pulses)
Frequency bandwidth	DC ... 20 MHz (CA-DCSP1)
Frequency bandwidth	DC ... 100 KHz (CA-DCSP2)
Rise time	16 ns
Fall time	9 ns
Rate of current change	1600 A / µs
Accuracy	± 0.2 %
Linearity	± 0.2 %
Temperature stability	± 100 ppm / °C
Current Limit	20 A, not adjustable, response time 600 µs
Accuracy of SA-DCACT output	± 2 %
Diode voltage	0 ... 4.5 V
Power dissipation	30 W max
Cooling	required
Operating temperature range	0 ... +45 °C
Dimensions	95 x 61 x 20 mm
Weight	250 g
Part Number	10100240

Scope of delivery:	
Fast Diode Current Modulator FM 20	Part Number 10100240
8-pole single row female connector	Part Number 10883510
2 pcs screw M4x6 DIN 7985	Part Number 10701642
2 pcs lock washer A4 DIN 127	Part Number 10706006
11 pcs screw M1.6x3 DIN 7985	Part Number 10701609
11 pcs washer A1.7 DIN 433	Part Number 10705300

Specification FM 60

Supply voltage	3 ... 6 V
Supply current	60 A max
Diode current CW	0 ... 60 A
Diode current pulsed	0 ... 120 A (50 % duty cycle)
Diode current pulsed	0 ... 240 A (for short pulses)
Frequency bandwidth	DC ... 20 MHz (CA-DCSP1)
Frequency bandwidth	DC ... 100 KHz (CA-DCSP2)
Rise time	16 ns
Fall time	9 ns
Rate of current change	4800 A / µs
Accuracy	± 0.2 %
Linearity	± 0.2 %
Temperature stability	± 100 ppm / °C
Current Limit	60 A, not adjustable, response time 600 µs
Accuracy of SA-DCACT output	± 2 %
Diode voltage	0 ... 4.5 V
Power dissipation	90 W max
Cooling	required
Operating temperature range	0 ... +45 °C
Dimensions	95 x 61 x 20 mm
Weight	260 g
Part Number	10100241

Scope of delivery:	
Fast Diode Current Modulator FM 60	Part Number 10100241
8-pole single row female connector	Part Number 10883510
2 pcs screw M4x6 DIN 7985	Part Number 10701642
2 pcs lock washer A4 DIN 127	Part Number 10706006
11 pcs screw M1.6x3 DIN 7985	Part Number 10701609
11 pcs washer A1.7 DIN 433	Part Number 10705300

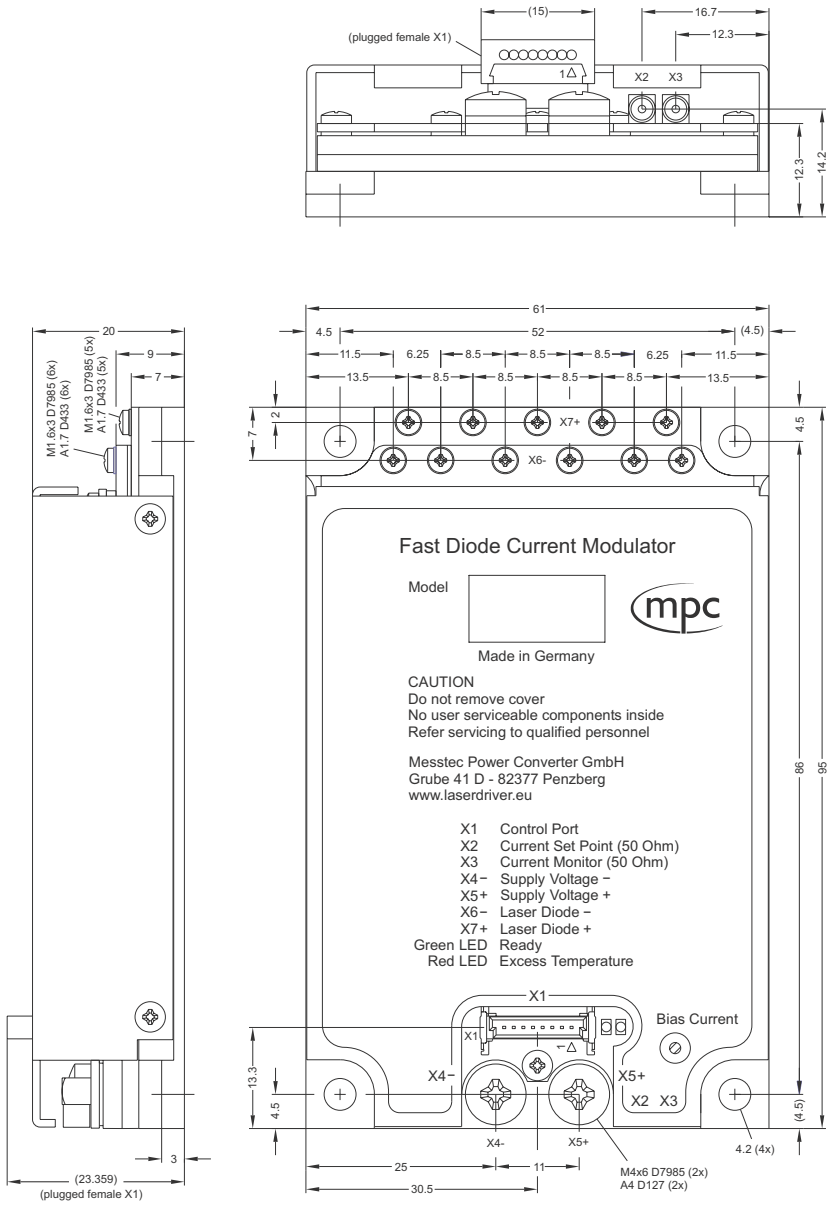
Specification FM 100

Supply voltage	3 ... 6 V
Supply current	100 A max
Diode current CW	0 ... 100 A
Diode current pulsed	0 ... 200 A (50 % duty cycle)
Diode current pulsed	0 ... 400 A (for short pulses)
Frequency bandwidth	DC ... 20 MHz (CA-DCSP1)
Frequency bandwidth	DC ... 100 KHz (CA-DCSP2)
Rise time	16 ns
Fall time	9 ns
Rate of current change	8000 A / µs
Accuracy	± 0.2 %
Linearity	± 0.2 %
Temperature stability	± 100 ppm / °C
Current Limit	100 A, not adjustable, response time 600 µs
Accuracy of SA-DCACT output	± 2 %
Diode voltage	0 ... 4.5 V
Power dissipation	150 W max
Cooling	required
Operating temperature range	0 ... +45 °C
Dimensions	95 x 61 x 20 mm
Weight	275 g
Part Number	10100242

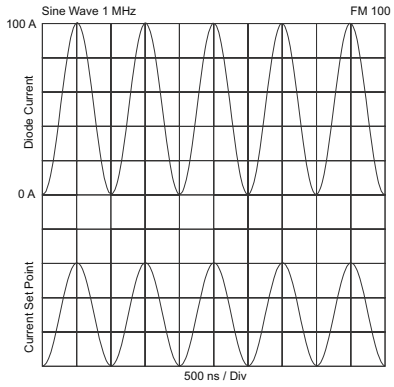
Scope of delivery:

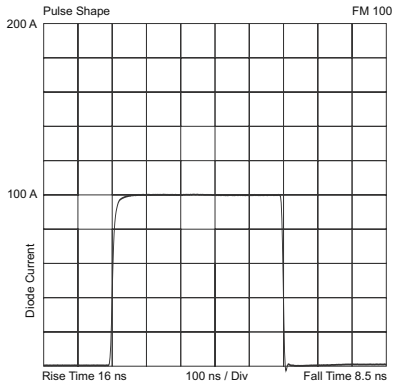
Fast Diode Current Modulator FM 100	Part Number 10100242
8-pole single row female connector	Part Number 10883510
2 pcs screw M4x6 DIN 7985	Part Number 10701642
2 pcs lock washer A4 DIN 127	Part Number 10706006
11 pcs screw M1.6x3 DIN 7985	Part Number 10701609
11 pcs washer A1.7 DIN 433	Part Number 10705300

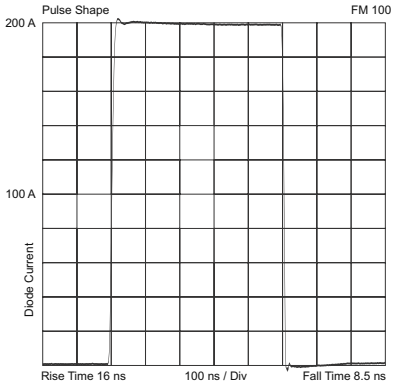
Dimensions (in mm)

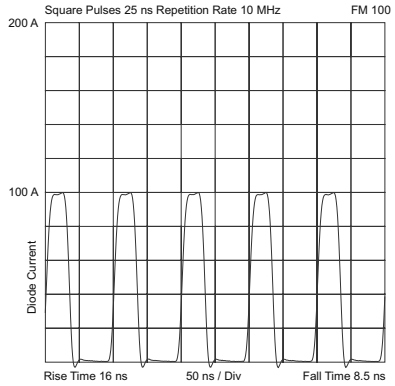


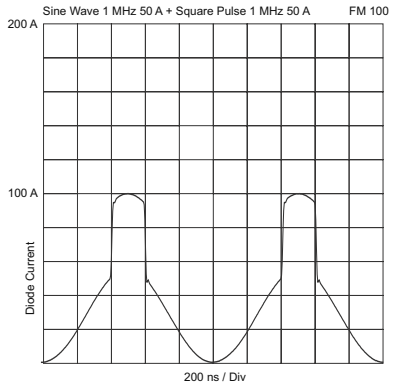
Examples of current waveforms

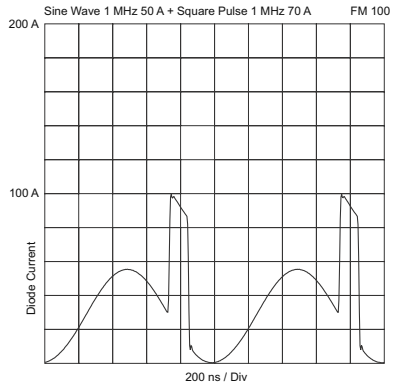






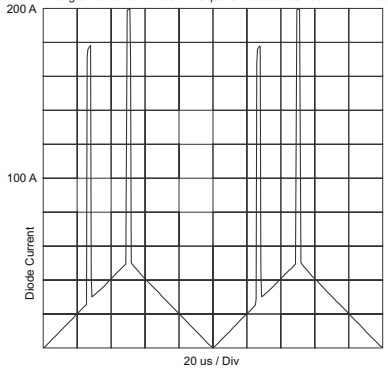




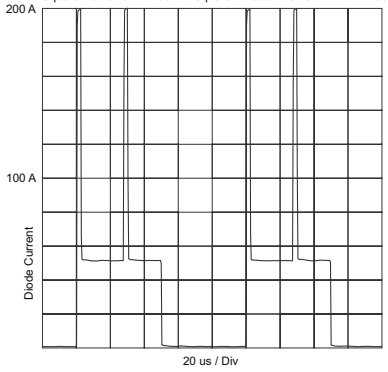


Examples of current waveforms

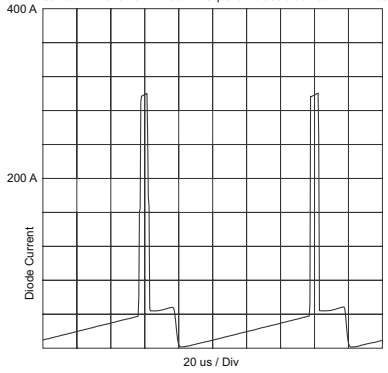
Triangle Wave 10 KHz 50 A + Square Pulses 2 us 150 A FM 100



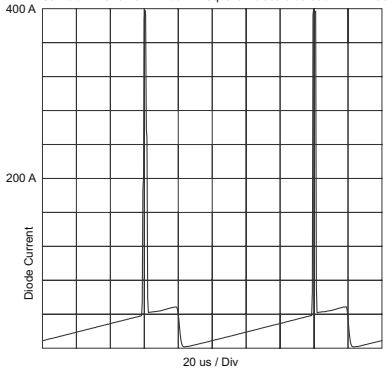
Square Wave 10 KHz 50 A + Square Pulses 2 us 150 A FM 100



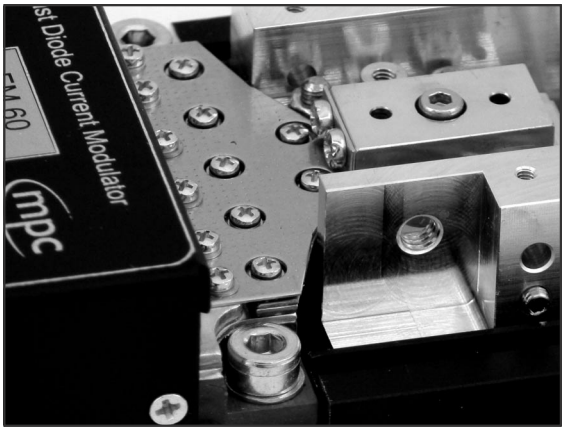
Sawtooth Wave 10 KHz 50 A + Square Pulses 5 us 250 A FM 100

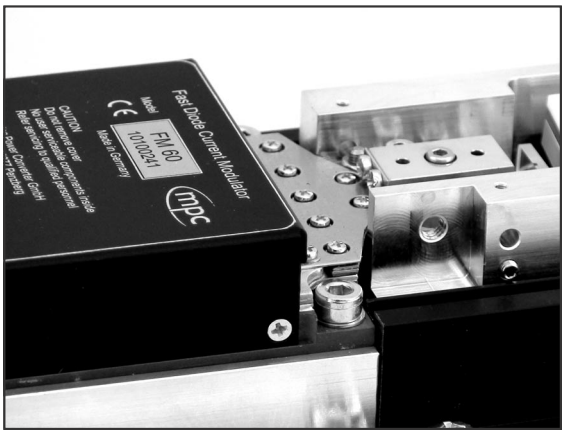


Sawtooth Wave 10 KHz 50 A + Square Pulses 5 us 350 A FM 100



Examples of connected laser diodes





Contact information

Messtec Power Converter GmbH
Grube 41
D-82377 Penzberg
Phone +49 (0) 8856-80306-0
Fax +49 (0) 8856-9998
info@powerconverter.eu
www.powerconverter.eu
www.laserdriver.eu

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