

SMC20 – Cézallier – Temperature Controller

C-Series Modules – Diode Laser Controller

- Low-drift $\leq 1 \text{ mK}/^\circ\text{C}$ @ 25°C
- Temperature range from 17°C to 31°C
- 500-mK/V temperature setpoint input
- 50-mK/V temperature servo input
- Bumpless, anti-windup analog PID controller
- Constant Temperature (CT) and Constant Current (CC) modes
- Fault detection:
 - Thermistor connections
 - Power stage overload
 - Out-of-range temperature
- For use with SMC31 TEC Driver
- Analog design - Free of digital noise
- EMI noise immunity
- Ideal for rapid prototyping
- All schematic diagrams included



Overview

The SMC-Series modules are the ideal instruments for controlling the current and the temperature of diodes laser for AMO physics. With an ultra-low current noise density $\leq 20 \text{ pA}/\sqrt{\text{Hz}}$ (SMC10) and sub-mK thermal control stability (SMC20 & SMC31), the SMC-Series is the right choice for the most demanding applications.

Because SMC-Series was first designed for frequency stabilization and OPLL applications, the SMC20 temperature controller provides both high-stability and analog setpoint control features to maintain a laser locked continuously. The SMC20 presents a typical stability less than $1 \text{ mK}/^\circ\text{C}$ with respect to room temperature, and has a temperature control range from 17°C to 31°C .

When the temperature controller is used with the SMC31 TEC Linear Driver, two modes of operation are supported: constant temperature mode (CT) and constant current mode (CC). A laser frequency control application normally operates in CT mode. In this case, the temperature is tightly controlled using a high-resolution thermistor bridge and an analog PID controller. The CC mode operates the TEC at fixed current, which is set using front-panel trimmer or analog control. Because laser diodes usually come with integrated TEC and such sensor, only 10-k Ω NTC thermistors are supported.

Like all SM-Series modules, the SMC20 is shipped with the schematic diagrams of its electronic circuitry providing all required information for advanced users.

Important Notice

The specifications provided apply to the SMC20-R19A module. Information in this document is subject to change without notice. Copyright © SISYPH, 2019. All rights reserved.

Temperature Control Specifications

Sensor^a

Terminals	AIO bus connector (50-pin header) DSUB9 ^c connector (front-panel)
Type	10-kΩ NTC thermistor
Minimal Operating Resistance ^d	3.6 kΩ (+50°C)
Maximal Operating Resistance ^d	20 kΩ (+10°C)

Setpoint Temperature

Control Range (Coarse)	$T_{SET} = 17, 19, 21, 23, 25, 27, 29$ and 31 °C switches located on PCB
Control Range (Fine)	-5 K to 0 K
20-turn trimmer on front-panel	
Remote Control Range	±500 mK
Servo Control Range	±50 mK

Stability

Drift	< 1 mK/°C @ $T_{SET} = 25\text{ °C}$
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Controller

Topology	Analog P, PI or PID
Special Features	Bumpless ^b , Anti-windup ^b and Tracking ^b (Remote or Manual Steering)
Operating Modes	Constant temperature (CT) Constant current ^{b,c} (CC)
Loop-Gain	Tunable from 0 to +40 dB (20-turn trimmer on front-panel)
Integrator	$T_i = 0.47, 1, 2.2, 4.7, 10, 22$ and 47 s (PCB switches)
Differentiator	$T_d = 0.1, 0.22, 0.47, 1, 2.2, 4.7$ and 10 s (PCB switches)
Manual Steering Control Range ^b	±10 V (20-turn trimmer on front-panel)
Remote Steering Control Range ^b	±10 V

Command Signal

Terminal	AIO bus connector (50-pin header)
Output Range ^b	±10 V

TEC Output

refer to *SMC31 Linear TEC Driver* documentation.

^aNot supplied.

^bThe integrator must be enabled.

^cApplies when the *SMC31 Linear TEC Driver* is used as power stage.

^dAn out-of-range thermistor resistance value disables the controller.

Analog Interface Specifications

Common Characteristics

Terminals AIO Bus (50-pin stack-through)

Remote Steering (Tracking) Input

Range $\pm 10\text{ V}$
 Input Resistance $10\text{ k}\Omega$, Differential amplifier

Servo Input

Range $\pm 10\text{ V}$
 Sensitivity $+50\text{ mK/V } \pm 1\%$
 Input Resistance $10\text{ k}\Omega$, Differential amplifier

Setpoint Input

Range $\pm 10\text{ V}$
 Sensitivity $+500\text{ mK/V}$
 Input Resistance $10\text{ k}\Omega$, Differential amplifier

Error Monitor

Range $\pm 10\text{ V}$
 Output Resistance $1\text{ k}\Omega$
 Sensitivity $+1\text{ V/K}$

Command Output

Range $\pm 10\text{ V}$
 Output Resistance $1\text{ k}\Omega$

Digital Interface Specifications

Common Characteristics

Terminals	DIO Bus (50-pin stack-through)
Range	5-V TTL-CMOS compatible
Input Pull-up Resistor	100 k Ω
Output Current Limit Resistor	1 k Ω

/Enable Input

Activates (low) or disables (high or left open) the temperature controller.

Tracking/Auto Input

Enables Open-loop (high or left open) or Closed-loop control (low).

Remote/Manual Input

Tracking signal from front-panel (low) or AIO Interface (high or left open).

/Setpoint Input

Setpoint signal from AIO Interface (low) or front-panel trimmer (high or left open).

/Amplifier-Fault Input

Fault (low) from power amplifier stage (SMC31).

/Power-Fault Input

Fault (low) from power supply monitoring (SMZ00).

Below/Above Output

Temperature error $> +150$ mK (low) or Temperature error < -150 mK (high).

/Fault Output

Sensor fault is detected (low).

/Locked Output

Temperature is locked (low).

/On Output

The controller operates (low).

/Saturation Output

Command signal saturation detected (low).

Front-Panel Specifications

Servo Input

Terminal	BNC
Range	± 10 V
Sensitivity	+50 mK/V $\pm 1\%$
Input Resistance	10 k Ω , Differential amplifier

Temperature Error Leds

Green	Temperature locked
Yellow	Temperature error < -150 mK
Red	Temperature error > +150 mK

Status Leds

Green	Controller operating
Yellow	Command saturation detected (± 10 V)
Red	Sensor fault

Loop-Gain Adjust

Range	0 to +40 dB
Resolution	20-turn trimmer

Manual Steering Control

Range	± 10 V
Resolution	20-turn trimmer

Temperature Setpoint (Fine) Adjust

Range	-5 K (counter-clockwise) to 0 K (clockwise)
Resolution	20-turn trimmer

Printed Circuit Board Settings Specifications

Temperature Setpoint (Coarse) Switches

Range $T_{SET} = 17, 19, 21, 23, 25, 27, 29$ and $31\text{ }^{\circ}\text{C}$

Differentiator Time Constant Switches

Range $T_d = 0.1, 0.22, 0.47, 1, 2.2, 4.7$ and 10 s
 Control Differentiator ON/OFF

Integrator Time Constant Switches

Range $T_i = 0.47, 1, 2.2, 4.7, 10, 22$ and 47 s
 Control Integrator ON/OFF

Digital Voltmeter Connector

Signal Error Monitor
 Range $\pm 10\text{ V}$
 Sensitivity $+1\text{ K/V}$
 Power Supply $+5\text{ V}$

General Specifications

This module is designed to be operated in laboratory environment.

Operating

Temperature $+15^{\circ}\text{C}$ to $+30^{\circ}\text{C}$

Power Requirements

$+15\text{ V}$ $< 50\text{ mA}$
 -15 V $< 50\text{ mA}$
 $+5\text{ V}$ $< 20\text{ mA}$
 $+24\text{ V}$ Not used

Physical Properties

Height (component side) $\leq 17\text{ mm}$
 Weight $\approx 110\text{ g}$
 PCB 4-layer FR4, $100 \times 100\text{ mm}$

Warranty

One (1) year parts and labor on defects in material and workmanship.

Ordering Information

Front-Panel Options

SMC20-FP-xx	Shielded 3U-4HP front-panel
SMC20-NP-xx	none

Stack-through Header Options

SMC20-xx-SC	50-pin header ^a
SMC20-xx-NC	none

Ordering Code

SMC20-FP-SC	Standard
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^aTyco Part Number: 1-173145-4.

Document Revision History

Release	Comments
SMC20-SS01-R19A	Updated module identifier Added full name
SMC20-SS01-R17A	Updated current noise density of SMC11 First release