Figure 1. Physical photos of ATFC109D Controller

FEATURES

Digital Display for Setting and Monitoring Main Parameters

High Output Power for Driving TECs: 20V 15A

High Efficiency: >90% @ Full Load

Bi-directional Output for Cooling or Heating

Continuous Regulated DC Output Current

Window Temperature Control Algorithm

User Friendly Panel Configuration and Operation Design

Communication with Computers through a USB Port

No Heat Sink Required

Over Current Protection

Compact Size: 4"×3"×0.76" (103mm×76mm×19.4mm)

100 % Lead (Pb)-free and RoHS Compliant

APPLICATIONS

Drive and monitor TEC/Fan assemblies, and display in real time important parameter values and status of the controller on both the controller and the computer.

DESCRIPTION

ATFC109D is designed for maintaining the temperature inside an enclosed chamber by driving one TEC or multiple TECs and a fan array with the working status and parameters monitored and displayed at the same time. It allows setting the parameters of Upper Object Temperature Limit, T_{UOTL}, and Lower Object Temperature Limit, T_{LOTL}. The controller integrates a micro-controller, a digital display, a few buttons and indication LEDs, a bidirectional TEC H bridge output stage and a fan driver.

In the controller as shown in Figure 2, there are 2 control loops: TEC and Fan. The former has a bi-directional output for both heating and cooling functions, and the latter switches the fan on and off to keep the heat sink under proper temperature.

Table 1 shows the relationship between the temperature regions and the status of TEC, fan, and LED display:

LED1: heating state;

LED2: Temperature Loop good, it means the object temperature is within the desired temperature range.

LED3: cooling state.

Temperature codes and their meanings are as follows:

t_{CP}: Cold Plate Temperature

t_{HS}: Heat Sink Temperature

t_{CH}: Chamber Air Temperature

T_{UOTL}: Upper Object Temperature Limit

T_{LOTL}: Lower Object Temperature Limit

Table 1. LED logics

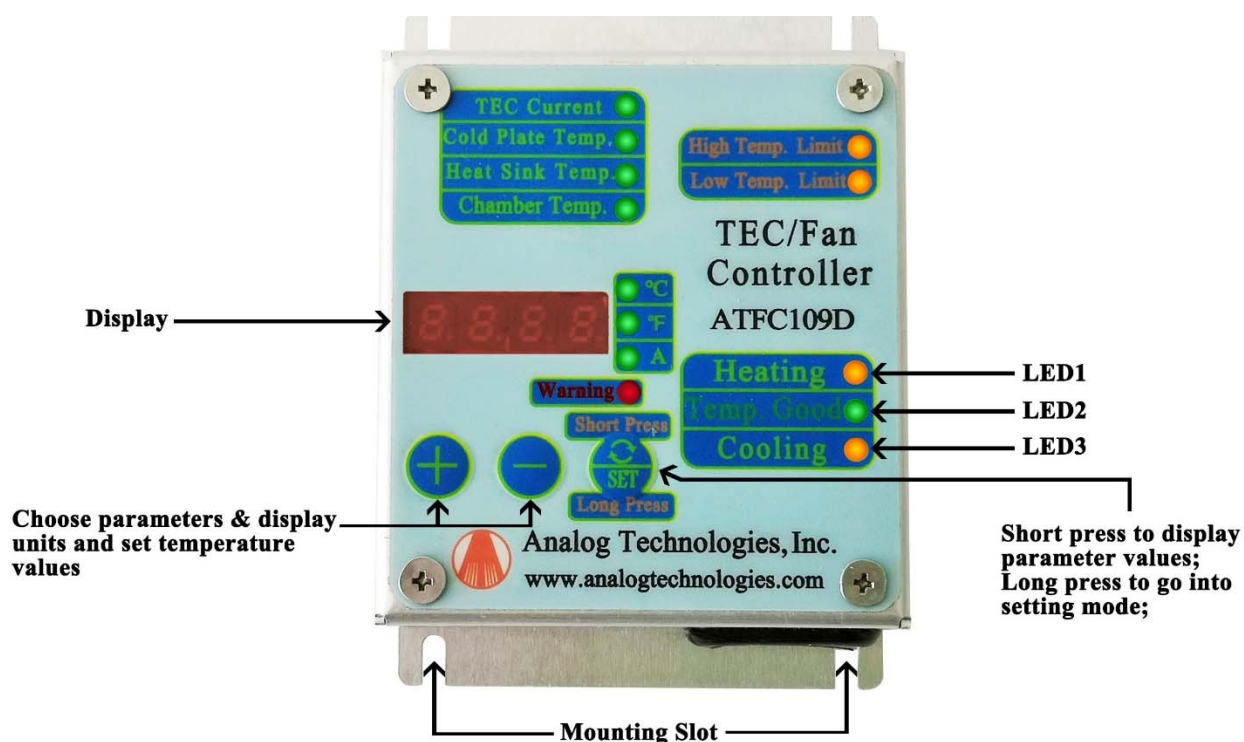| Temperature Regions	TEC	Fan	LED1	LED2	LED3
$t_{CP} \geq T_{UOTL}$	Cooling	On	On	Off	Off
$T_{UOTL} > t_{CP} \geq T_{UOTL}-2°C$ $t_{CH} < t_{CP}$ $t_{HS} < t_{CP}$	On	On	Off	On	Off
$T_{UOTL}-2°C > t_{CP} > T_{LOTL}+2°C$	Off	Off	Off	On	Off
$T_{LOTL}+2°C \leq t_{CP} < T_{LOTL}$ $t_{CH} > t_{CP}$ $t_{HS} > t_{CP}$	On	On	Off	On	Off
$t_{CP} \leq T_{LOTL}$	Heating	On	Off	Off	On

Figure 2. Front View on the ATFC109D Controller

As shown in Figure 2, a digital display is used to show these temperatures:
TEC Current
Cold Plate Temperature
Heat Sink Temperature
Chamber Temperature
High Temperature Limit
Low Temperature Limit
Heating
Temperature Good
Cooling

A total of 9 LEDs is used to indicate these parameters.

All the buttons, LEDs, and the display screen are protected by a waterproof vinyl face.

The controller has a metal front plate for panel mounting.

On the back side of the controller, there are 2 terminal blocks with 6 ports and 3 IC ports. See Figure 3.
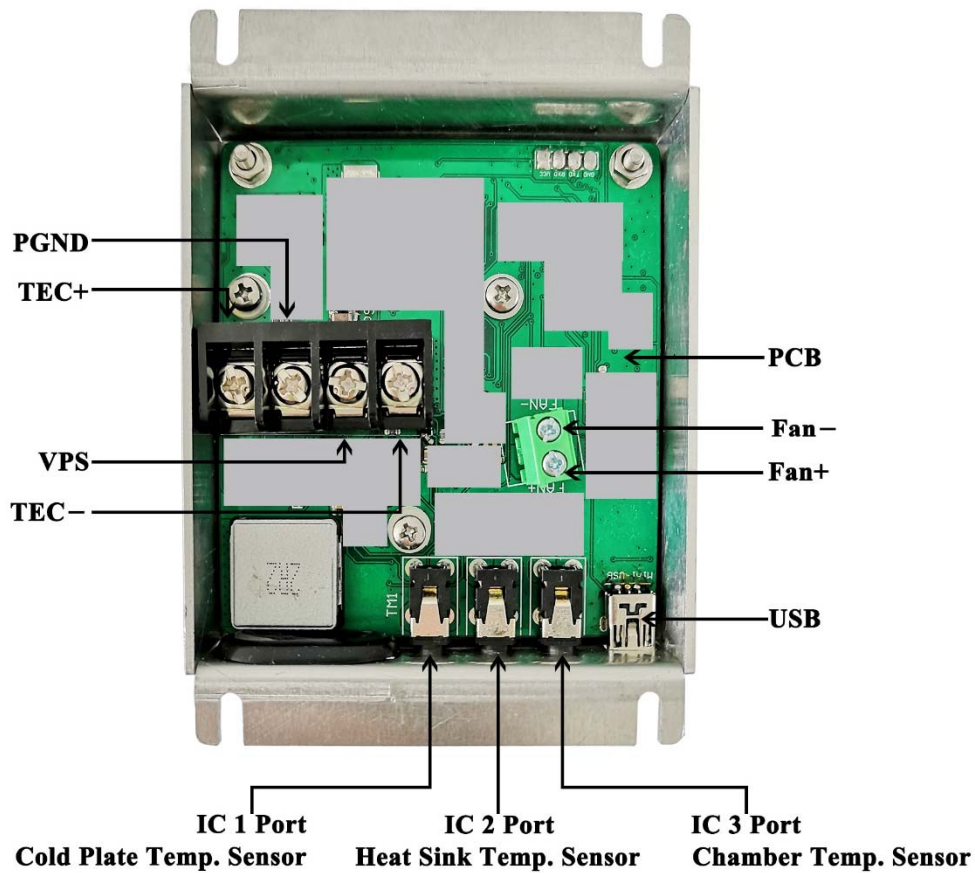
Figure 3. Terminal Blocks and Ports on the Back Side
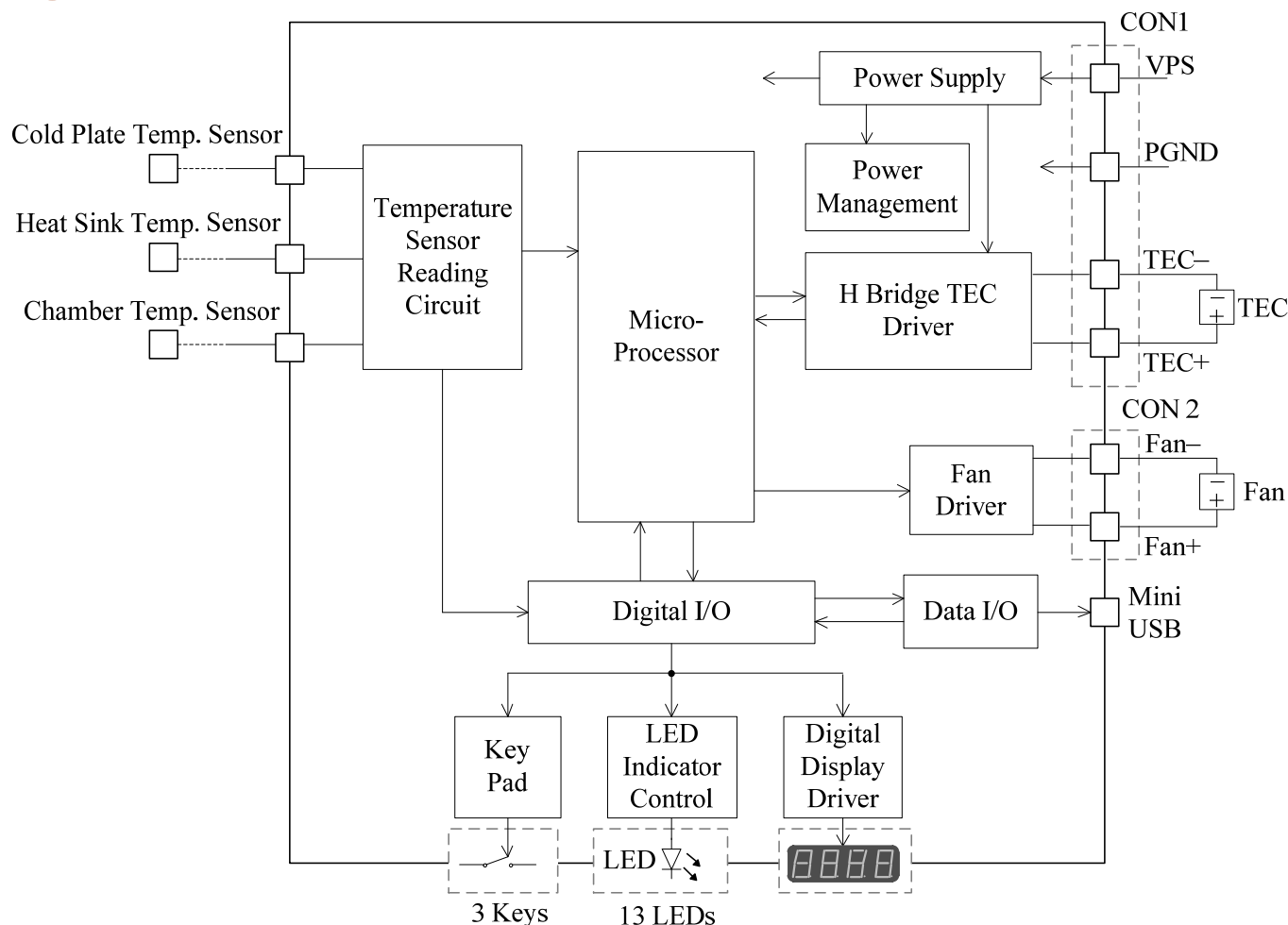

Figure 4. Temperature Sensor

Figure 5. Block Diagram of the ATFC109D

OPERATING PRINCIPLE

This controller has two modes, the working mode and the setting mode.

A.   The working mode:

The controller is in the working mode automatically after power-up:

a.   When one of three LEDs, **Cooling** LED, **Satisfied** LED, and **Heating** LED, is on, it indicates the current status of the controller.

b.   The display screen shows the temperature of the cold plate, which can be altered to the temperature of TEC current, cold plate temperature, heatsink temperature, or chamber temperature by pressing "SET" and the corresponding LEDs will be on.

c.   The ºC LED is on by default when the controller is on. The temperature unit can be changed by pressing "+" or "−".

d.   The "Warning" LED has two modes:

Red off: normal;

Red On: this LED is on when there are some faults. The potential faults and the reasons are shown in Table 2.

B.   The setting mode:

In the working mode, press "+" and "−" to select the temperature unit.
Press and hold "SET" to start the temperature setting.
Press "SET" to select the high temperature limit or low temperature limit, and then adjust the temperature with "+" or "−".Press and hold "SET" to confirm the temperature and enter the working mode.

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Table 2. Fault code interpretation

Fault #	Fault Name	Description
1	Cold Plate Temperature too low	Cold Plate Temperature < Lower Object Temperature Limit
2	Cold Plate Temperature too high	Cold Plate Temperature > Upper Object Temperature Limit

SPECIFICATIONS

Table 3. Characteristics

Parameter	Value	Parameter	Value
Input voltage	20V/DC ±1%	Temperature t_{CP}	0°C to 35°C
Max. input current	15A	Temperature T_{UOTL}	25°C to 40°C
Output voltage for TEC	20V/DC ±1%	Temperature T_{LOTL}	−10°C to 10°C
Max. output current for TEC	15A	Temperature accuracy	±1°C
Output voltage of fan	20V/DC ±1%	Operating temp. range	−20°C to 85°C (−4°F to +185°F)
Max. output current of fan	3.2A		

One controller assembly includes: 1 PCB assembly, 2 terminal blocks, 3 IC ports, 3 buttons, 1 digital display tube, and 13 LEDs. Pin functions of the terminal blocks and IC ports are shown in Table 4.

Table 4. Pin functions

Terminal Block	Pin #	Pin Name	Description	Type
Terminal 1	1	TEC+	TEC positive terminal	Output
	2	PGND	Signal ground	Input
	3	VPS	Power ground	Input
	4	TEC−	TEC negative terminal	Output
Terminal 2	1	FAN−	Fan negative terminal	Output
	2	FAN+	Fan positive terminal	Output
IC port 1		IC1	The cold plate temperature sensor input	Input
IC port 2		IC2	The heatsink temperature sensor input	Input
IC port 3		IC3	The chamber temperature sensor input	Input

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COMMUNICATION FUNCTION

Utilizing serial port communication, SCM (Single Chip Microcomputer) sends data to the computer through USB serial communication interface. The principal computer interface is shown in Figure 6.
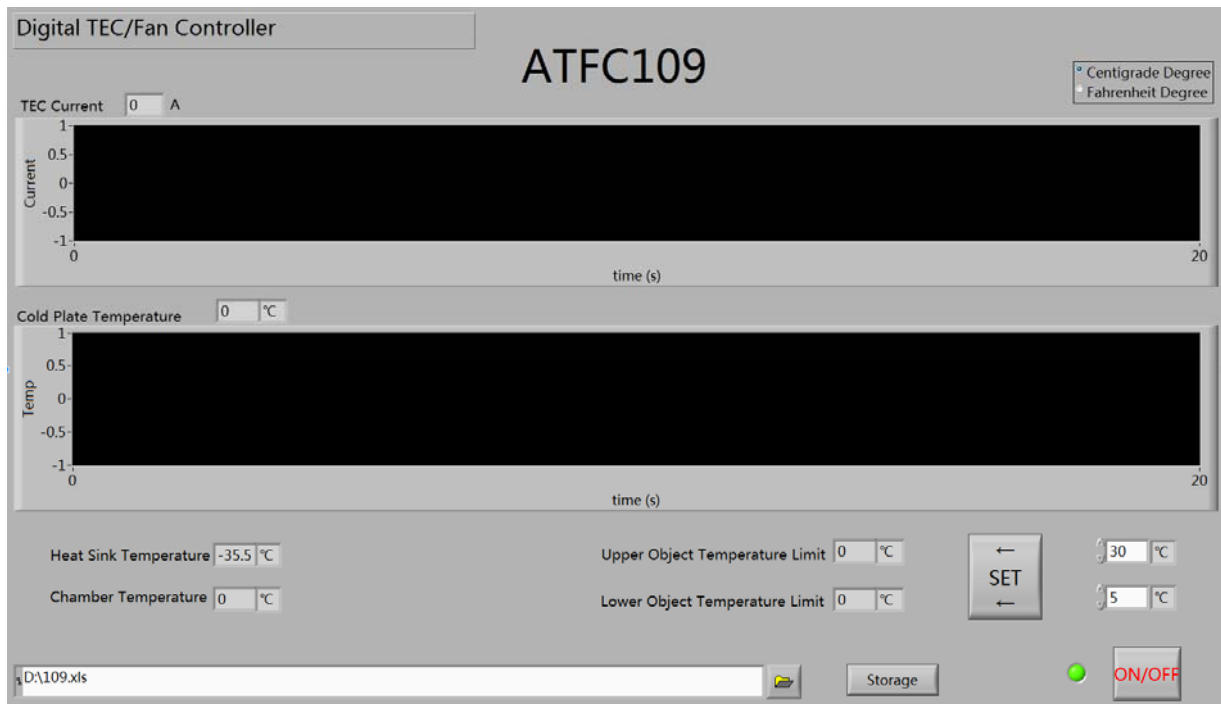

Figure 6. Principal Computer Interface

MECHANICAL DIMENSIONS
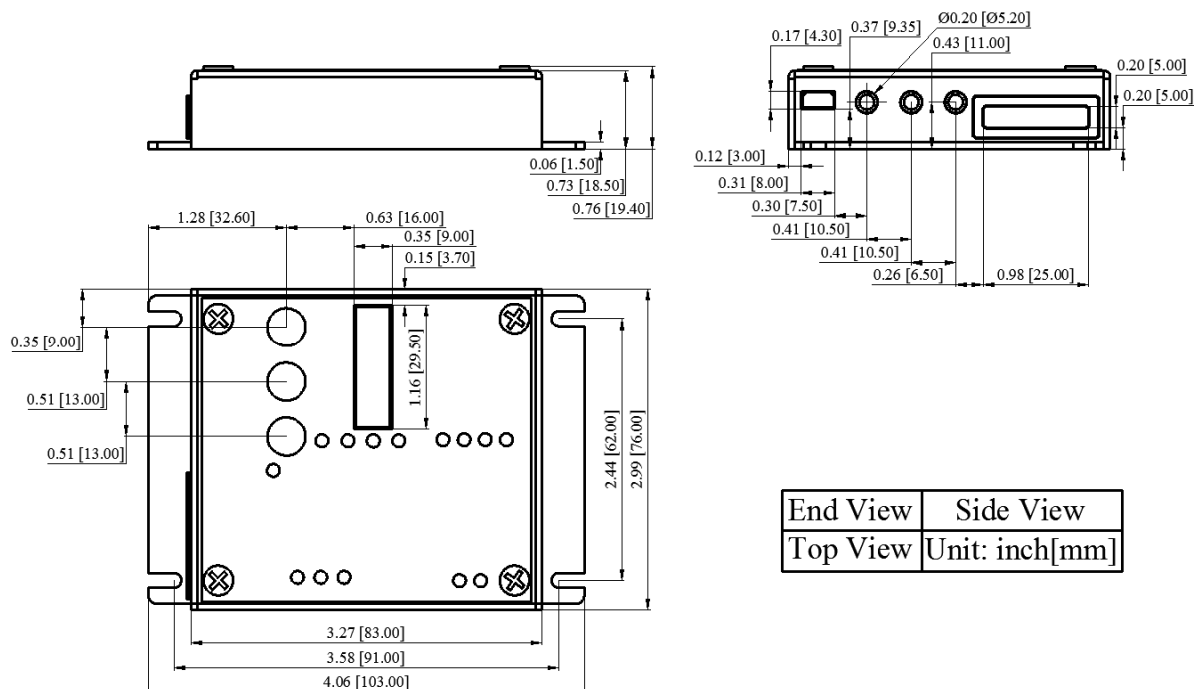
Figure 6 shows the mechanical dimensions of ATFC109D.

End View	Side View
Top View	Unit: inch[mm]

Figure 7. Mechanical Dimensions of ATFC109D

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