Figure 1. The physical photo of ATFC105D

FEATURES

Digital Display for Parameter Setting and Monitoring
High Output Power for TEC: 12V20A
High Efficiency: >98%
No Heat Sink Required
Panel Mounting Design
Over Current Protected
Compact Size

APPLICATIONS

Drive and monitor TEC/Fan assemblies

DESCRIPTION

ATFC105D is designed for regulating an enclosed chamber temperature by driving a TEC array and a fan array. In addition, upon detecting the chamber temperature goes beyond the safety windows, see the table below, it cuts off an AC power switch by sending the relay control signal. The ATFC105D is a digitally controlled TEC/fan assembly controller for driving TEC assemblies with fans and monitoring the working status at the same time. It allows setting the parameters of the set-point temperature window, the safety temperature window, monitoring the heat sink hot side temperature, heat sink cold side temperature, and the chamber temperature, as shown in Figure 2. The controller integrates a digital display, a TEC controller, a fan controller, and temperature controlled relay control output into one assembly, see Figure 3.

In the controller, there are 2 control loops: TEC and Fan. The former has a bi-directional output for achieving both heating and cooling effects, the latter switches the fan on and off.

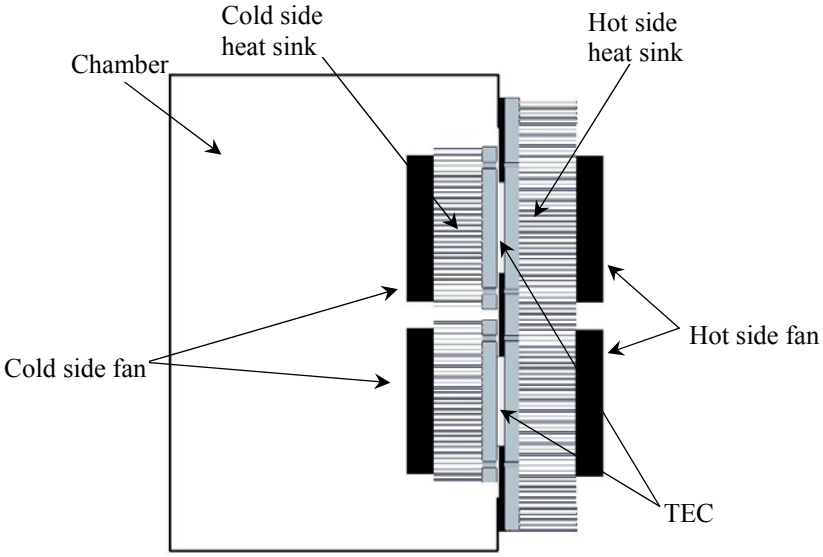

Figure 2. TEC/ fan Assembly

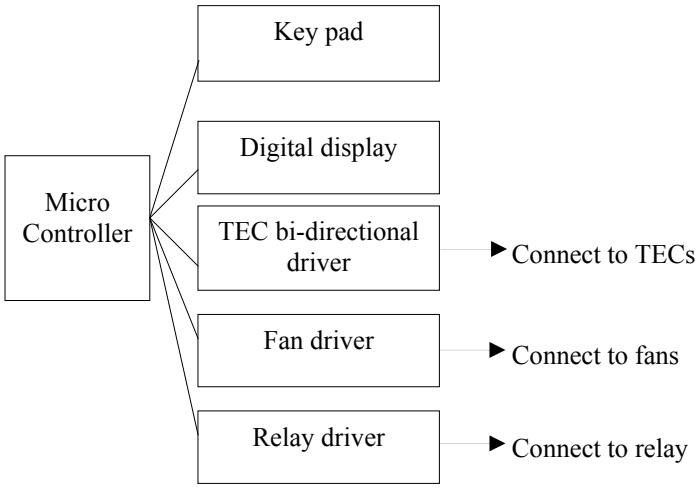

Figure 3. Block Diagram of the ATFC105D TEC/ fan Assembly

As shown in Figure 4, a digital display is used to show these temperatures: Safety High Temperature, Safety Low Temperature, Cool On Temperature, Heat On Temperature, Satisfied, TEC Outside Temperature, TEC Inside Temperature and Chamber Temperature. There are 8 LEDs indicating which of these temperatures is shown in the display.

The Safety High Temperature, T1, is the temperature point on which the chamber air temperature gets too high that the load control relay is turned off, but the TECs keep cooling down the chamber air.

The Cool On Temperature, T2, is the temperature point on which triggers the TECs to start cooling down the chamber air.

The Heat On Temperature, T3, is the temperature point on which triggers the TECs to start heating up the chamber air.

The Safety Low Temperature, T4, is the temperature point on which the chamber air temperature gets too low that the load control relay is turned off, but the TECs keeps heating up the chamber air. There is an option that when the chamber temperature gets too low, the load control relay is not turned off so that the load is still on and works as a heating element, helping increase the chamber temperature.

The LED indication logic for the above 4 temperatures is shown in Table 1.

Table 1. LED Indication Logic Form

Temperature Regions	TEC	Fan	Relay Output	LED1	LED2	LED3	LED4	LED5
T > T1 Temp. too high[1]	Cooling	On	Off	🔴	⚫	⚫	⚫	⚫
T1 > T > T2 Temp. high[1]	Cooling	On	On	⚫	🟡	⚫	⚫	⚫
T2 > T > T3 Temp. good	Off	Off	On	⚫	⚫	🟢	⚫	⚫
T3 > T > T4 Temp. low	Heating	On	On	⚫	⚫	⚫	🟡	⚫
T4 > T Temp. too low	Heating	On	Off	⚫	⚫	⚫	⚫	🔴

There are 2 ARROW keys: ⌃ and ⌄, for increasing or lowering the temperature values when setting the set-point temperatures.

There is a SET key, to store the displayed temperature into the set-point temperature memories in the control software.

There are 8 temperature parameter indicating LEDs, each is dedicated to indicate which of the above 8 temperatures is being shown in the display.

There is 1 LED indicating when the chamber temperature is within the normal operating temperature, i.e. T2 > T > T3.

There are 2 LEDs, indicate setting temperature or displaying temperature modes respectively.

The total LED indicating logic is shown in Table 4.

The display can display the temperature from –4 F° to 185 F°. It can also show and flash an “ERROR” sign when the system has a fault.

All the buttons, the LEDs, and the display are protected by a vinyl face and is of water proof.

The controller has a metal front plate for panel mounting. There is a seal slot so that the mount will be water proof.

On the back side of the controller, there is a 14 conductor terminal block with these connection ports, see Table 5.

OPERATING PRINCIPLE

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

A. The working mode

When the controller is powered up, it is in the working mode automatically:

a. One of five LEDs, **Safety High** LED, **Cooling** LED, **Satisfied** LED, **Heating** LED and **Safety Low** LED, will be lit up, which is in line with the current state of the controller.

b. **Chamber Temp** lights. The display screen shows the temperature of the chamber at this time. It can be altered to the temperature of **TEC outside** and **TEC inside** by pressing "⩔" and the corresponding LEDs will be lit up.

c. The ºF LED is lit up by default when the controller is on.

d. The LED near the "SET" key has two lighting modes:

Red off: normal;

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

e. The display screen is controlled by the button "On/Off". The display screen is off by default when the controller is powered up, so please turn on the display screen by pressing the button "On/Off". This button is used to turn on or off the display screen.

B. The setting mode

The setting mode needs a password to enter. When the button "set" is pressed, "2200" is shown on the display, the first two digits stand for the version model of the program and the last two figures are for the password. Use "⩓" to change the last second figure (0－9 recurring), and the " ⩔" to change the last figure. The default password is "10". After you enter the right password, you can begin to set the controller. The **Setting Mode** LED and the **Safety High Temp** LED are both lit up.

a. Setting the temperature

At first, **Safety High temperature** can be set by pressing "⩓" and "⩔". After that, press "Set" to confirm. Then, **Cool On Temp** LED is lit up. Apply the same methods to set **Cool On Temp**, **Heat On Temp** and **Safety Low Temp**. The default temperatures of **Safety High Temp**, **Cool On Temp**, **Heat On Temp** and **Safety Low Temp** are 131ºF, 88 ºF, 55 ºF and 20 ºF respectively.

b. Setting the temperature unit

After temperature setting, the "ºF" LED is lit up, due to "ºF" being the default temperature of the system. This unit can be altered to "ºC" by pressing the key "⩓"

Table 2. Fault Code Interpretation

Fault #	Fault Name	Description
1	Chamber temperature too low	Chamber Temperature is lower than the lower safety limit value
2	Chamber temperature too high	Chamber Temperature is higher than the higher safety limit value
3	Fan output over current	The fan current is > 4A
4	Under voltage lock out	The voltage of the power supply is < 10V
5	Relay output over current	The relay current is > 1A
6	Over-heat protection	The temperature of the PCB ≥ 110

After all the setting, press "Select" to withdraw from this setting. Please note that in the setting mode, the button "On/Off" doesn't function.

SPECIFICATIONS

Table 3. Characteristics

Parameter	Value	Parameter	Value
Input voltage	12VDC ± 5%	Temperature T1	131°F (55°C)
Max. input current	25A	Temperature T2	88°F(31.1°C)
Output voltage for TEC	12V ± 5%	Temperature T3	55°F(12.8°C)
Max. output current for TEC	20A	Temperature T4	20°F (–6.7°C)
Output voltage for Fan	12V ± 5%	Temperature accuracy	±1.5°F
Max. output current for Fan	2A	Operating temp. range	–4°F to +185°F(–20°C to 85°C)
Output voltage for relay	12V ± 5%	PCB dimension	70mm x 100mm
Max. output current for relay	0.5A	Output connector	Terminal block
Relay drive side	high side		

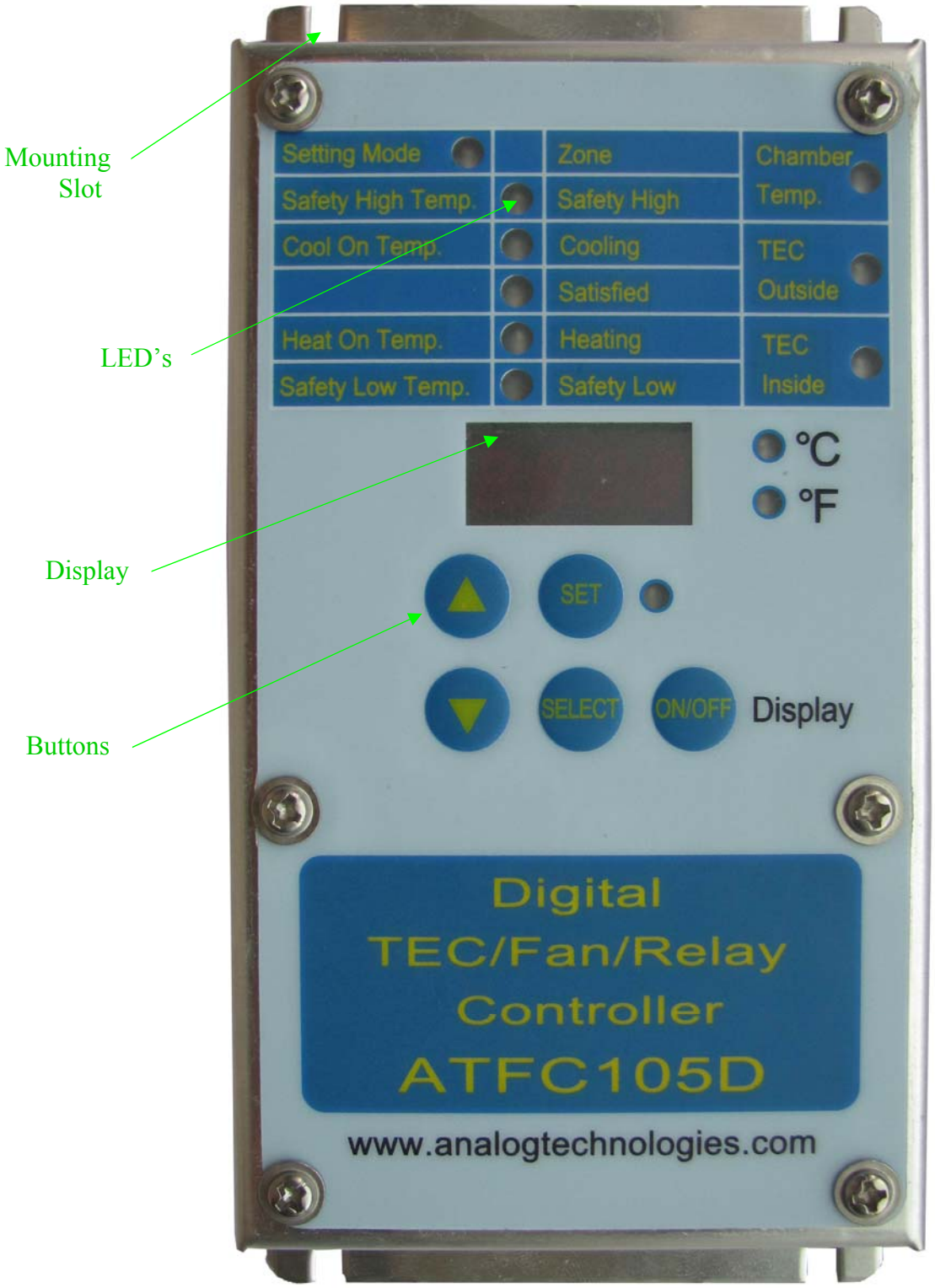

Figure 4. Front Control Panel of the ATFC105D

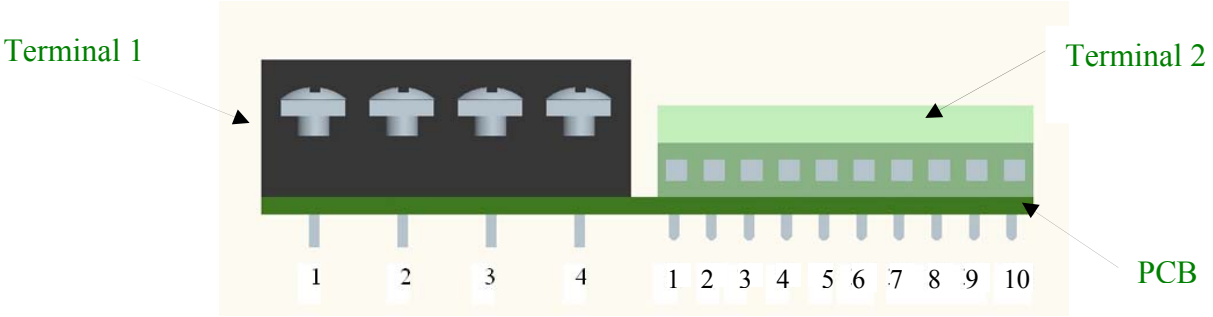

Figure 5. Front Control Panel

Figure 6. Terminal 1 for VPS, TEC+ and TEC– ports

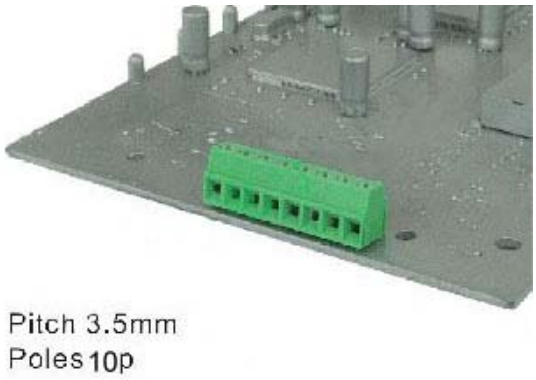

Figure 7. Terminal 2 for Control and Monitor Signals

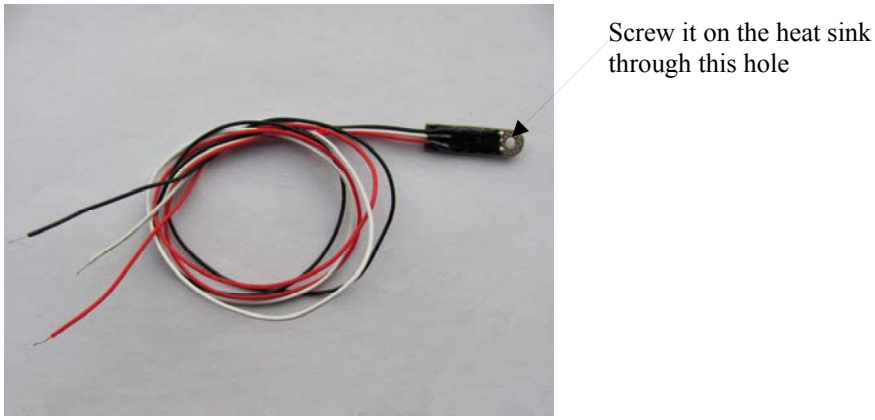

Figure 8. The Temperature Sensor

Figure 8 shows one of the three temperature sensors in the assembly. The lead color is different. For sensor 1, the lead color is black, white and red; sensor 2, black white and green; and sensor 3, black, white and blue. The black lead needs to be connected to ground on ATFC105D; the green lead connects to TM1; the white lead is to TM2; the blue lead is connected to TM3; and the red lead connects to the 5V terminal on ATFC105D.

Table 4. LED Indication Protocol

Digital Display	Set Temp LED	T1 LED	T2 LED	T Satisfied	T3 LED	T4 LED
Actual Temp.	●	●	●	●	●	●
Actual Temp	●	●	●	●	●	●
Actual Temp	●	●	●	●	●	●
Actual Temp	●	●	●	●	●	●
Actual Temp	●	●	●	●	●	●
Set-point Temp for T1: Safety High	●	●	●	●	●	●
Set-point Temp for T2: Cooling	●	●	●	●	●	●
Set-point Temp for T Satisfied	●	●	●	●	●	●
Set-point Temp for T3: Heating	●	●	●	●	●	●
Set-point Temp for T4: Safety Low	●	●	●	●	●	●

One controller assembly will include: a PCB assembly which contains: two terminal blocks, 5 buttons, a digital display tube and 13 LEDs. The terminal block connectors will have these pin assignments, see Table 5. The Pin number order is in Figure 5.

Table 5. Pin functions

Terminal Block	Pin #	Pin Name	Description	Note
Terminal 1	1	TEC+	TEC positive terminal	Output
	2	TEC–	TEC negative terminal	Output
	3	12V	Power ground	Input
	4	GND	Signal ground	Input
Terminal 2	1	FAN–	Fan negative terminal	Output
	2	FAN+	Fan positive terminal	Output
	3	Shutdown	Shut down or restart the controller	Input
	4	RELAY+	Relay positive terminal	Output
	5	RELAY–	Relay negative terminal	Output
	6	GND (IC–)	The negative terminal of the sensor	Input
	7	5V (IC+)	The positive terminal of the sensor	Input
	8	TM3	the TEC inside thermistor input	Input
	9	TM2	the TEC outside thermistor input	Input
	10	TM1	the chamber sensor input	Input

Note: For Shutdown pin in Terminal block for low current, we can connect a switch to this pin and the other side of the switch to the ground. Then close the switch to shutdown the controller, and open the switch to recover the current state of the system.

When the system crashes, use Shutdown to restart the controller. To protect outside devices, you could shutdown first and then power off when turning off the controller.

Table 6. Ordering Information

Part Number	1 – 4 PCs	5 – 24 PCs	25 – 99 PCs	100 – 499 PCs	≥500 PCs
ATFC105D	$156	$144	$132	$120	$108

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