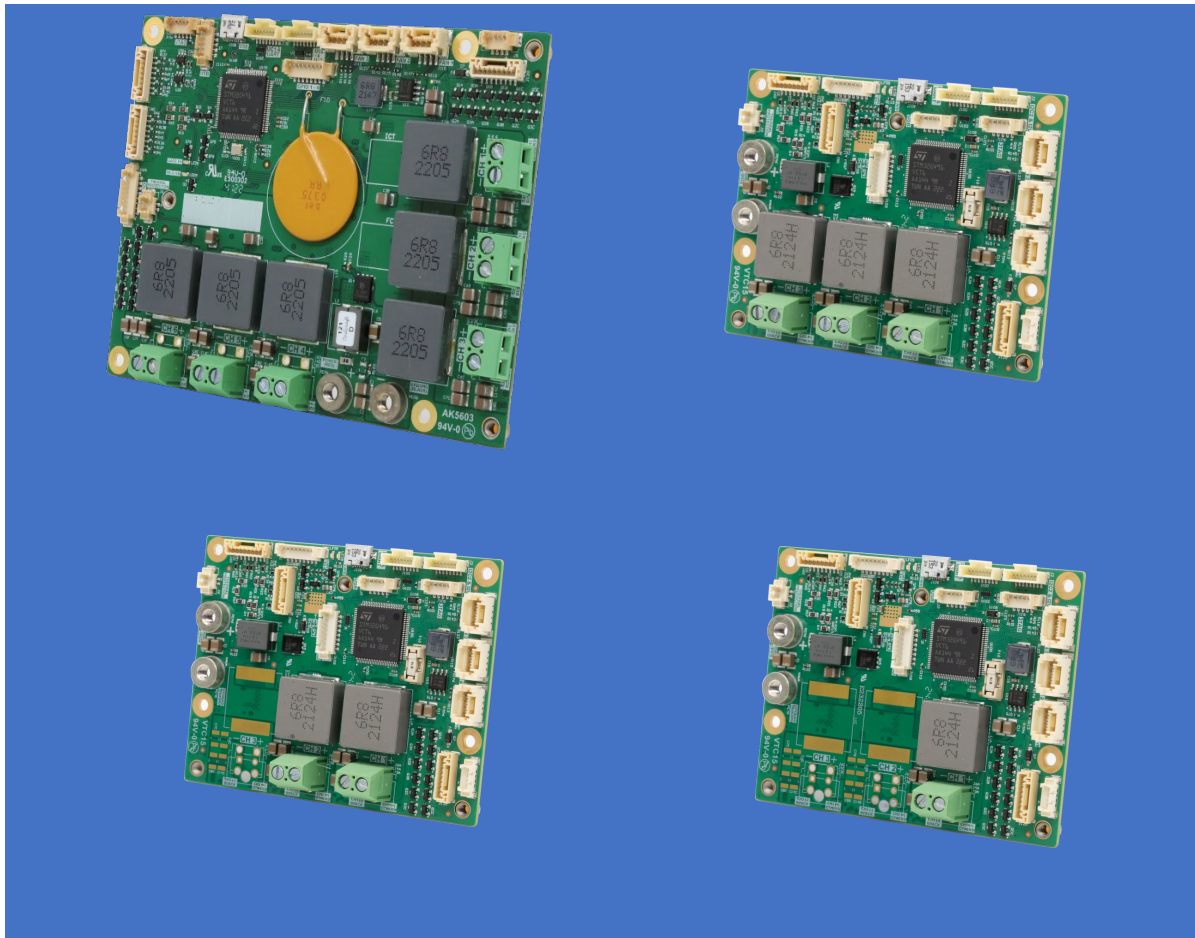


VTC HARDWARE SETUP GUIDE



Introduction

The VTC Series is a thermoelectric temperature controller with DC bipolar outputs. The VTC Series features our patent pending technology that delivers temperature stability to within $\pm 0.002^{\circ}\text{C}^1$ with high-power efficiency of 95%². The VTC Series has an input voltage range of 12 – 36V, and it delivers up to 16A @ 36V to control each Peltier module.

The VTC Series supports both analogue and digital inputs for temperature sensing. There are 8 analogue inputs for NTC, PT100, PT1000, TMP61/63/64 temperature probes, and 16 digital sensors (e.g., TMP117, TMP116, TMP1075, MAX30208) for inputs on the I2C bus. There are 6 configurable GPIOs that can use as inputs or outputs for customer applications.

The VTC can operate in stand-alone mode or be remotely controlled with USB, using APIs or the supplied VTC Utility Software. Configuration of the controller is done using the VTC Utility Software. The auto-tuning feature of VTC enables user to easily determine the appropriate PID control parameters for their application. Users familiar with PID loops, can fine-tune the PID control parameters with the manual tuning feature. VTC Series also supports thermal profile control, making this controller ideal for applications that requires thermal cycling (e.g., PCR machines).

The VTC has multiple levels of in-built thermal protection. To protect the device, hot and cold limits can be set independently via the VTC Utility Software. This safety feature ensures that your TEC will not be driven beyond the specified limits. Additionally, VTC Series continuously monitors the temperature sensors and when a fault is detected, the controller will alert the user, and automatically turn off the power to your TEC. Lastly, for system protection thermal fuse are supported.

Besides being a highly precise highly efficient TEC controller, the VTC series is also highly flexible, with many parameters configurable using the supplied VTC Utility Software. This makes the VTC series an ideal thermoelectric temperature controller to be very desirable against other competitors, due to its flexibility in addition to the efficiency/performance aspect whilst operating it.

Other models in the VTC Series offer configuration in various number of channels.

¹ $\pm 0.002^{\circ}\text{C}$ 1 hour duration @ 25°C ambient temperature

² 95% efficacy @ 50% load

VTC Series Feature Set

TEC Controller	OEM Type Family of TEC Controller board
Performance	• Input Voltage V_{in}: 12 – 36VDC • Max input current: 60A (VTC) 30A(VTC) • Output Voltage V_{max}: $\pm V_{in}$ • Output Current I_{max}: $\pm 16A$ per channel • Typical Cooling Power Per Channel: 288W • Temperature Stability: ± 0.002 °C (1 hour duration @ 25 °C ambient temperature) • Power Efficiency: 95% @ 50% load, 98% @ 100% load
Features	• Bipolar Output: Heat & Cool • Analog Temperature Input: 8x PT100, PT1000, NTC, TMP61, TMP63, TMP64 • Digital Temperature Input: 3X I2C Bus for sensor IC(E.g., TMP117, TMP116, TMP1075, MAX30208) • PID Control: Auto-tune, Manual-tune, Direct feedback (sensor) and indirect feedback (sensor + thermal model) • Operating Mode: Constant temperature, Constant Voltage / Current, Temperature profile • Communication: USB/RS485/TTL UART • GPIO: 6x Configurable, 3.3V output, 3.3V to 5V input. (GPIO5 support V_{in} output) • Fan Control: 3 x (fan Voltage = V_{in}, 4A max, speed control & detection)
Operating Environment	• Operating: -40 to 60 °C (RH 0 to 85%). • Storage: -40 to 85 °C (RH 0 to 85%). • Regulatory: RoHS
Usability	• VTC Utility Software: Windows Software (Windows 10 and above) • Middleware Library (Windows 10) • Documentation: User Manual, API Specification
Others	• Dimensions W x H x D: 120mm x 90mm x 15mm (VTC2000) • Dimensions W x H x D: 70mm x 90mm x 15mm (VTC1500)

Safety Precaution

VTC Series and TEC Module should be installed and configured by person with technical background that has read and understood the user manual. Operating the VTC Series before reading this user manual can result in personal injury, or damage to the system.

**Assembly Structure**

The VTC Series should be operated inside a chassis.

**Certified Power Supply**

The VTC Series should be operated using safety 62368-1 or 61010-1 certified power supply with short circuit and over current protection.

**ESD**

User should avoid direct contact with the IC components on VTC Series by hand.

**Hot Surface**

The VTC Series contact surface may be hot to touch. Avoid direct contact with the power ICs whether it is powered off or on.

All repairs must be done by an authorized repair service.

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OVERVIEW

This document explains the hardware setup required to use the VTC Series. When setting up the VTC Series for the first time, it is recommended that you read and understand this user manual.

The VTC Series is connected via USB/RS485/TTL UART, allowing users to command and control it using the VTC Utility software or the Venture middleware. Refer to VTC-UM-0006 for info on using the VTC Utility software.

HARDWARE SETUP

The VTC series supports the following features:

1. 24 x Temperature sensors (inclusive of both analogue and digital types)
2. Up to 6x Peltier Element/ Thermal Module(VTC2000)
Up to 3x Peltier Element/ Thermal Module(VTC1500)
3. 3 x Fans
4. 1 x Thermal Fuse connector that supports a thermal fuse or multiple thermal fuses in serial
5. Power Input
6. Micro USB connection to PC

the VTC series is available in 6-channel and 3-channel variants. The board can be configured, modified and monitored through the VTC Utility Software which is installed onto a PC.

The layout of the VTC2000 series is as shown below.

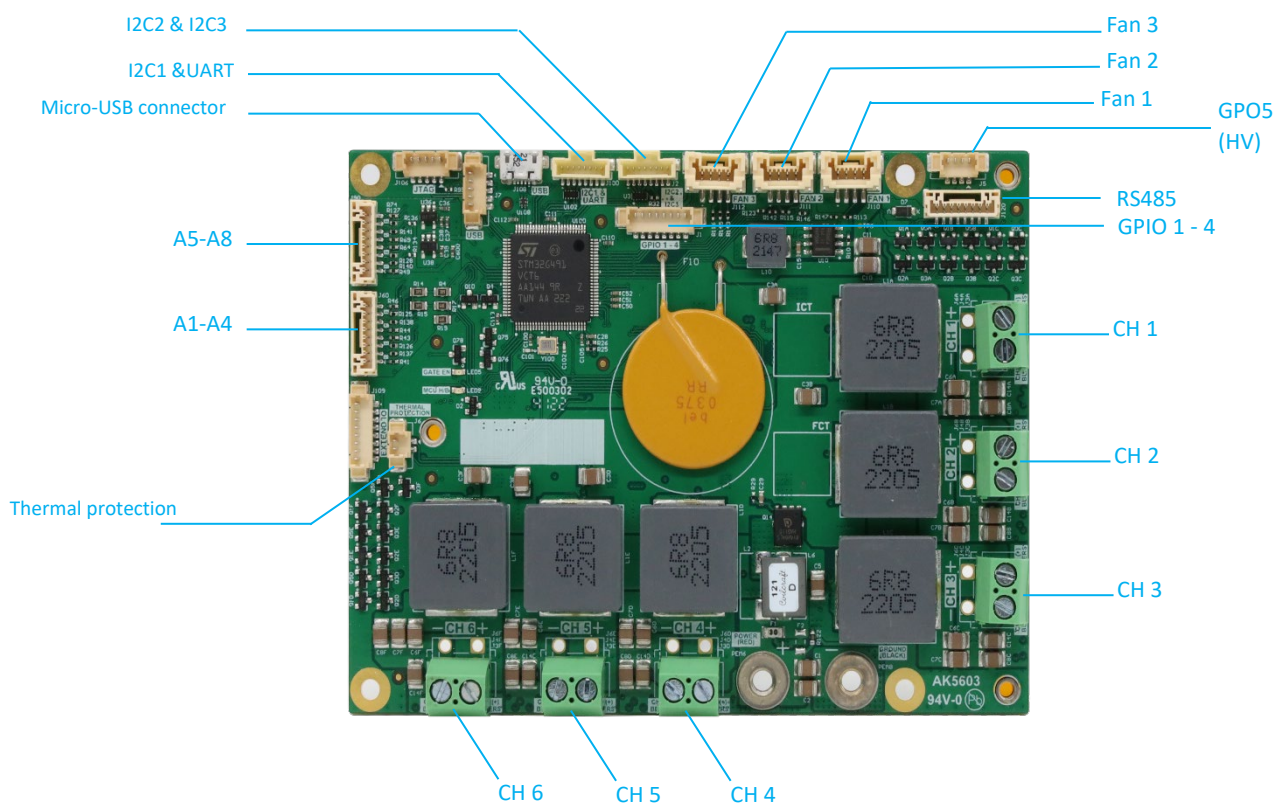


Figure 2.1: VTC2000 serial

The layout of VTC1503 series is as shown below.

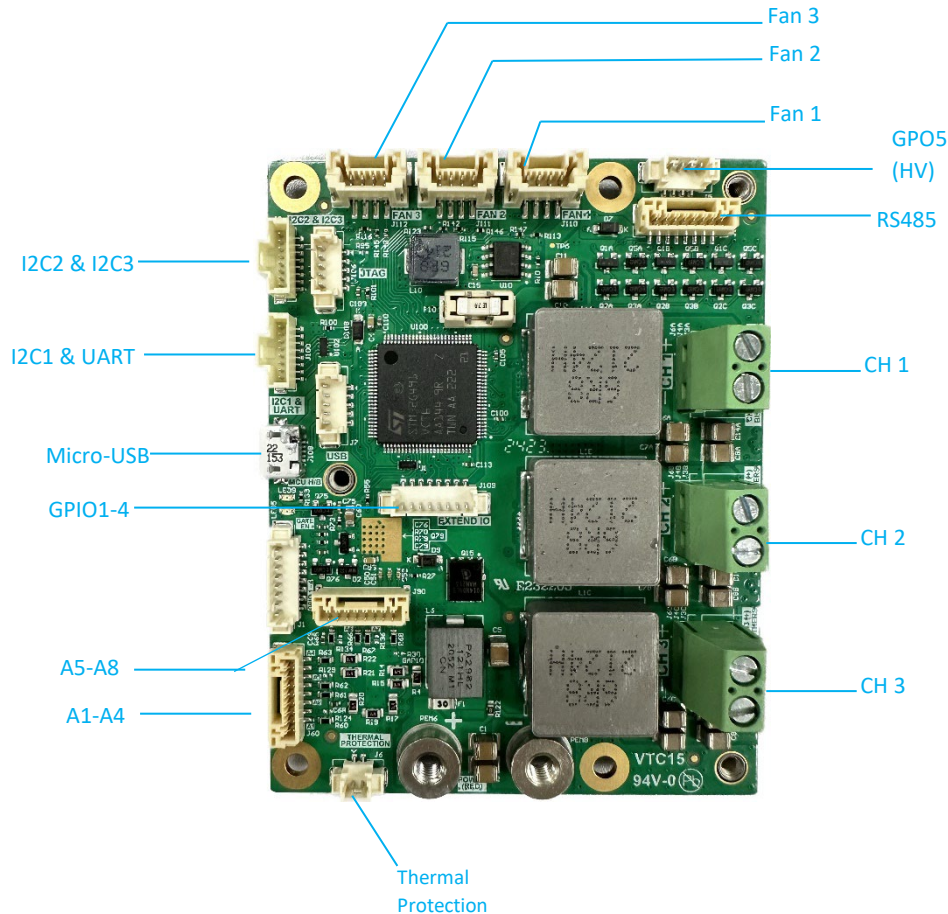


Figure 2.2: VTC1500 serial

The major difference between VTC2000 serial and VTC1500 serial is the output channel numbers. VTC1500 board can support up to 3 Peltier modules while VTC2000 serial can support up to 6 Peltier modules. In this document, all features demonstration is made on 6-channel VTC board as representative.

1.1. TEMPERATURE SENSORS (ANALOG AND DIGITAL)

Analog temperature sensors can be connected to A1-A4 and A5-A8 connectors, while digital sensors are connected to the I2C1, I2C2, I2C3 connectors, as shown in Figure 0.3 and Figure 0.4.

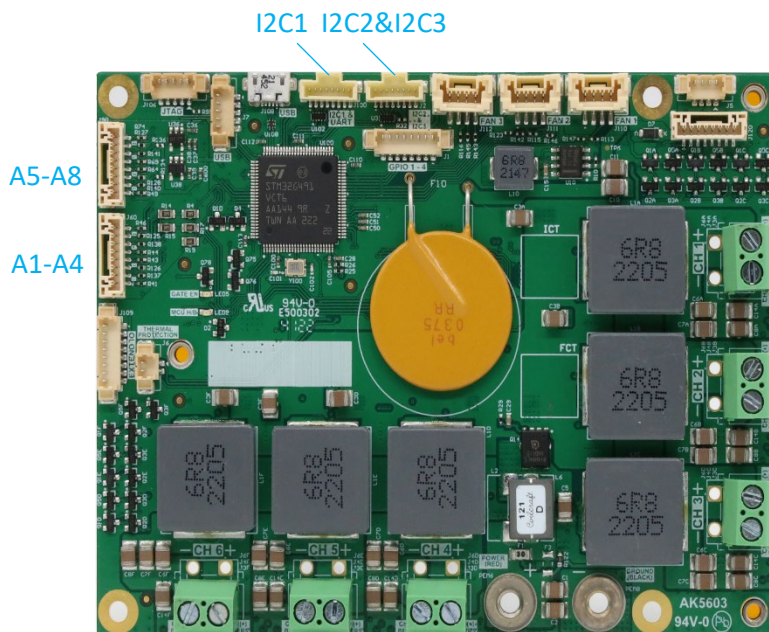


Figure 2.3: Temperature sensor connectors (VTC2000 serial)

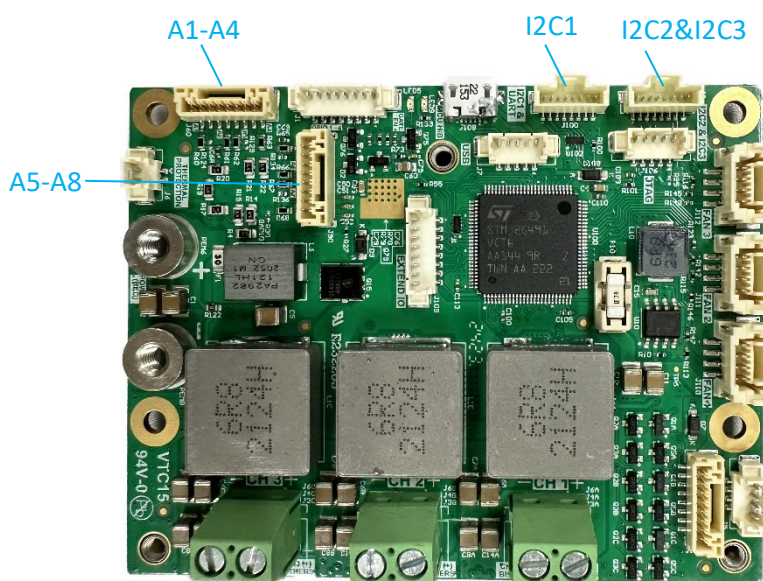


Figure 2.4: Temperature sensor connectors (VTC1500 serial)

Table 0.1 and Table 0.2 show the circuit pin assignments for analog temperature sensors (Connector ref. number J90 for A5-A8, ref number J60 for A1-A4).

Circuit pin number	Assigned temperature sensor	Polarity
1	A1	+
2	A1	-
3	A2	-
4	A2	+
5	A3	+
6	A3	-
7	A4	-
8	A4	+

Table 2.1: A1-A4 connection layout (J60)

Circuit pin number	Assigned temperature sensor	Polarity
1	A5	+
2	A5	-
3	A6	-
4	A6	+
5	A7	+
6	A7	-
7	A8	-
8	A8	+

Table 2.2: A5-A8 connection layout (J90)

When prepare the analogue temperature sensor, user can reference to Table 2.3, of the corresponding connectors paring to the VTC series board J60 and J90.

Part type	Company	Product number	Qty.
Housing	JST	GHR-08V-S	1
Crimp	JST	SSHL-002T-P0.2	8

Table 2.3: suggested analogue temperature sensors connector

For digital sensors, the pinout for the I2C1 (ref. number J100 on PCB) is shown as below.

Pin	Connection
1	I2C1_SCL
2	I2C1_SDA
3	UART1_TX (TTL)
4	UART1_RX (TTL)
5	GPIO5 (3.3V) *
6	3.3V power output (maximum 50mA)
7	5V power output (maximum 500mA)
8	Ground

Table 2.4: I2C1 pinout (J100)

* GPIO5 and GPO5(HV) share same signal, GPIO5 support input and output.
GPO5(HV) only support output and out voltage same as Vin. GPO5 can be used to turn on external relay.

The pinout for I2C2 and I2C3 (ref. number J2 on PCB) is shown as below.

Pin	Connection
1	I2C2_SCL
2	I2C2_SDA
3	I2C2_SCL
4	I2C3_SDA
5	GPIO6 (3.3V)
6	3.3V power output (maximum 50mA)
7	5V power output (maximum 500mA)
8	Ground

Table 2.5: I2C2 and I2C3 pinout (J2)

When prepare the digital temperature sensor, user can reference to Table 2.7 of the corresponding connectors paring to the VTC series board, connector J100 or J2.

Part type	Company	Product number	Qty.
Housing	Molex	5013300800	1
Crimp	Molex	5013340000	8

Table 2.6: Mating parts for digital temperature sensors

1.2. PELTIER ELEMENT

Peltier elements can be connected to the VTC board connector CH 1 to CH 6 as shown in Figure 2.5 .

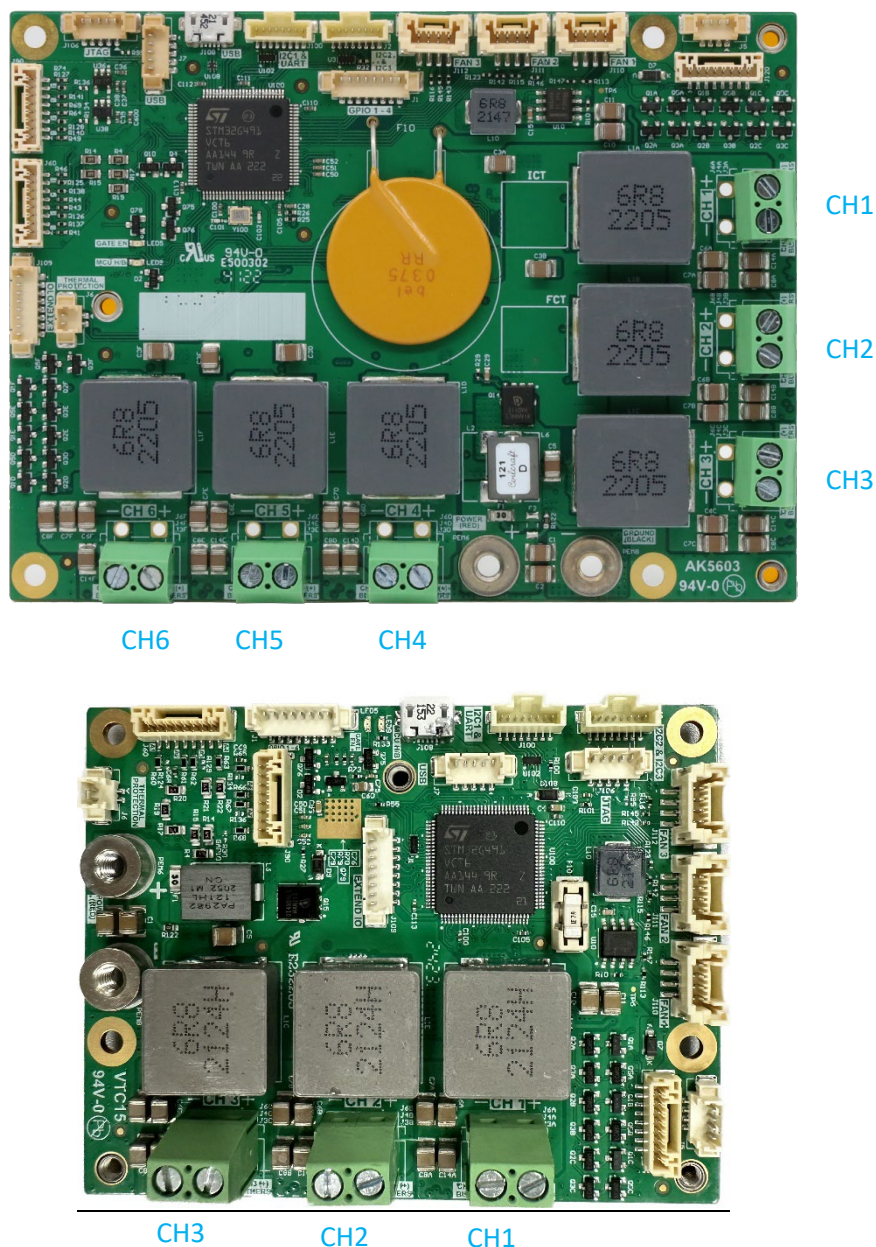


Figure 2.5: Channels outline

The “Hot” side Peltier element should be pasted on heatsink, Cool side pasted on the object that intend to control. Red Line of the Peltier element connect to the “+” markings labelled on the VTC

series board. Each channel independent output +/- voltage. **Different channel “+”/”- “, can’t be short together.**

For the output channel connector, user can choose following three types of connectors:

Connector Type	Connector Picuture	Features
Type A		Terminal Block AWG 14-28
Type B		Molex 2002411212 AWG 12-16
Type C		Molex 39889-0042 AWG 12-16

1.3. POWER SUPPLY

The proper connection of the DC power supply (12 to 36 V) to the VTC Series is as shown in Figure 0.6 and Figure 0.7.

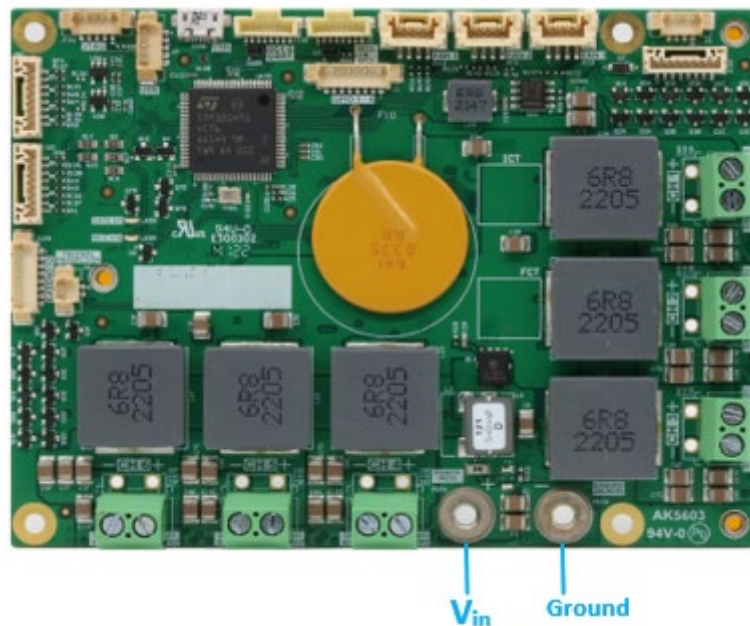


Figure 2.6: Power supply connectors (VTC2000 serial)

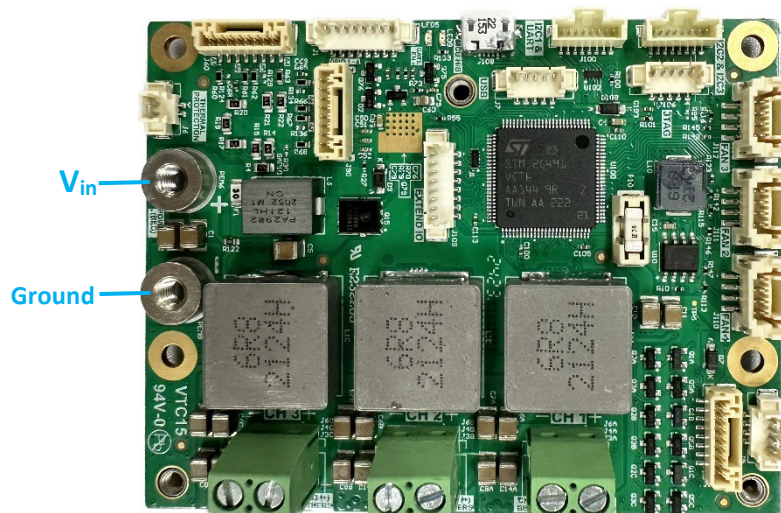


Figure 2.7: Power supply connectors (VTC1500 serial)

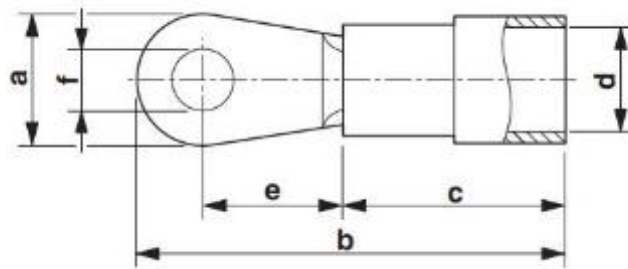


Figure 2.8: Power supply connector mating part

Figure 0.8 shows the mating parts for the power input connector. An M4 O-ring connector with $f = 4.3\text{mm}$ and $a < 9.5\text{mm}$ is required.



Current limit

The current limit for the board must be lower than the current supplied by the power supply.

Steps to safely power up the VTC board are as follows:

- Turn off AC input.
- Screw in the power supply to the VTC Series.
- Turn On AC input.

1.4. FAN

The VTC Series is able to support 3 fans. The fan connectors are shown in Figure 0.9 and Figure 0.10.

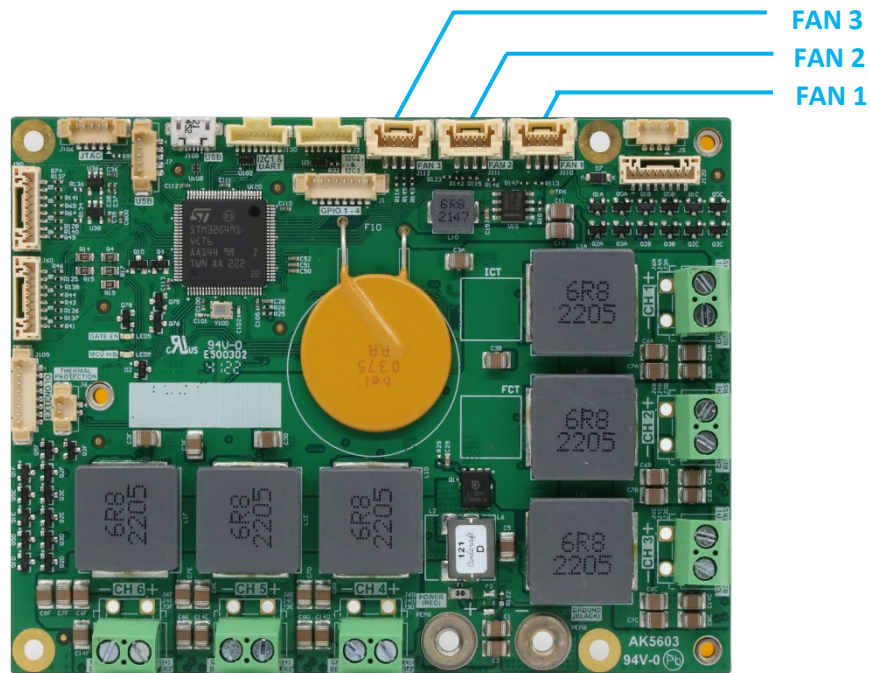


Figure 2.9: Fan connectors (VTC2000 serial)

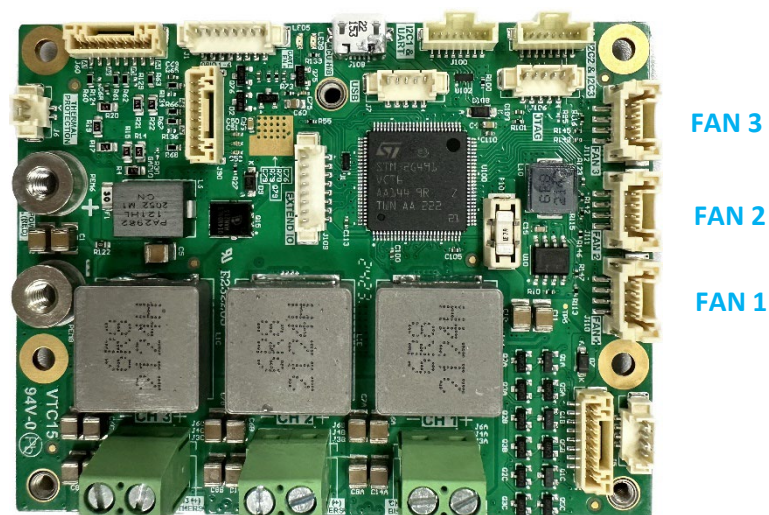


Figure 2.10: Fan connectors (VTC1500 serial)

Each fan connector able support 2, 3 and 4 pin tye fans. Table 0.7 show the pin functions and the colour code commonly used for the wiring of them.

Pin			Name	Colour
1	1	1	GND	Black
2	2	2	V _{in}	Red
	3	3	Sense	Yellow
		4	Control	Blue

Table 2.7: Pinout for 2,3,4-pin fan

From the user's end, the VTC Series PCB would require the following parts (Table 0.8) to connect the fan to the PCB.

Part type	Company	Product code
Housing	JST	ZER-04V-S
Pin	JST	SZE-002T-P0.3

Table 2.8: Mating parts for Fan connector

1.5. THERMAL PROTECTION

A fuse can be connected in the J6 connector on the VTC for thermal protection. Components required for the fuse connection are shown in below. If Thermal protection is not required, Need use loop wire short two pins of J6 .

Refer to in the next section for wiring connection layout.

Part type	Company	Product number
Housing	Molex	510210200
Crimp	Molex	500588000
Supports AWG 28 - 32		

Table 2.9: Mating parts for Thermal protection connector

1.6. OTHER IO PIN DEFINE

Pin	Connection
1	GND
2	GND
3	GPO5 (HV) maximum 1A
4	GPO5 (HV) maximum 1A

Table 2.10: J5 GPO5(HV) control by GPIO5, output only, voltage same as Vin

Pin	Connection
1	Ground
2	3.3V power output (maximum of 50mA)
3	5.0V power output (maximum of 1A)
4	GPIO 1
5	GPIO 2
6	GPIO 3
7	GPIO 4
8	Ground

Table 2.11: J1 (GPIO)

Part type	Company	Product number
Housing	Molex	510210800
Crimp	Molex	500588000
Supports AWG 28 - 32		

Table 2.12: Mating parts for GPIO connector

Pin	Connection
1	I2C1_SCL
2	I2C1_SDA
3	RS485_B
4	RS485_A
5	GPIO_6
6	3.3V power output (maximum 50mA)
7	5V power output maximum (1A)
8	Ground

Table 2.13: J120 (RS485)

Pin	Connection
1	VBUS
2	USB_N
3	USB_P
4	GND
5	GND

Table 2.14: J7 (Internal USB)

1.7. FINAL ASSEMBLY

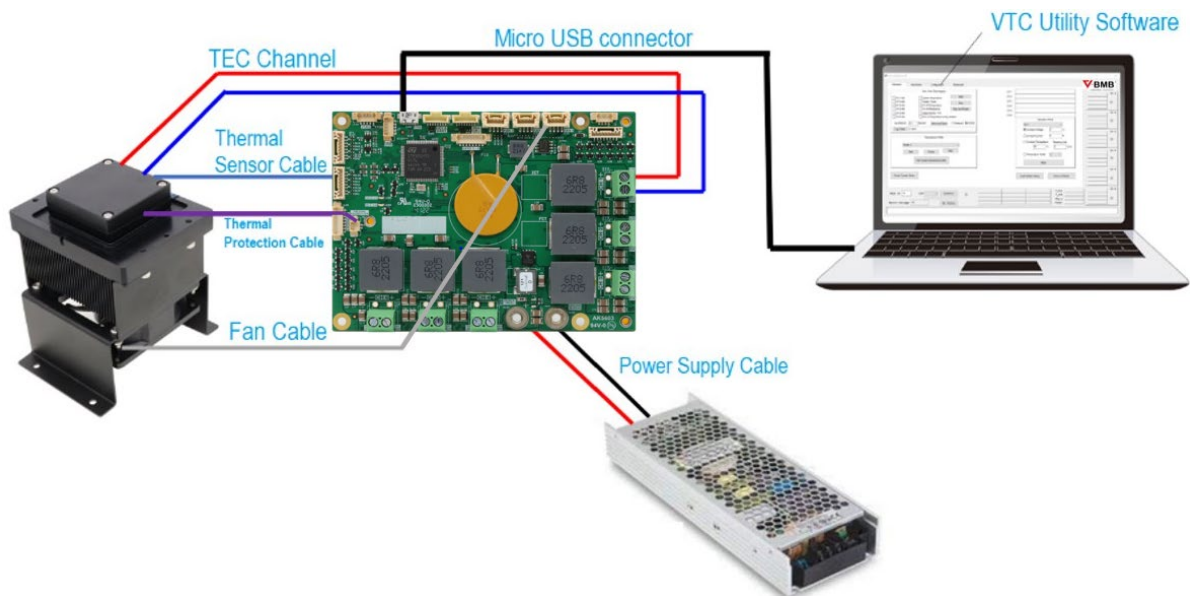


Figure 2.11: Final Assembly

After connecting the various components, the final assembly³ should consist of a wiring connection layout as shown in Figure 0.11:

When system operate properly, the MCU H/B LED blinking at 1HZ, and 'GATE EN' LED being lit up.

If some thing going wrong, MCU H/B LED fast blinking at 2HZ, and 'GATE EN' LED is off.

³ Note that the figure shown is using the VTM100-SC Thermal module as an example. If not using the VTM100-SC, only the wiring connection layout should be used as an example.

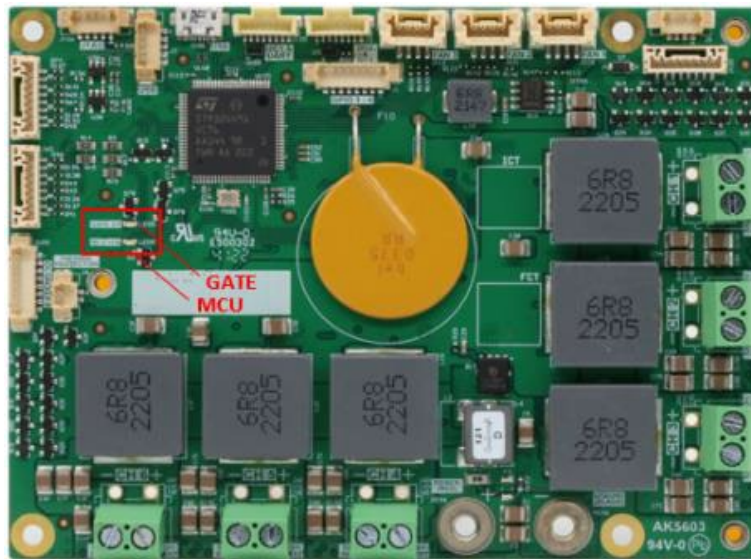


Figure 2.12: MCU H/B and GATE EN LEDs (VTC2000 Serial)

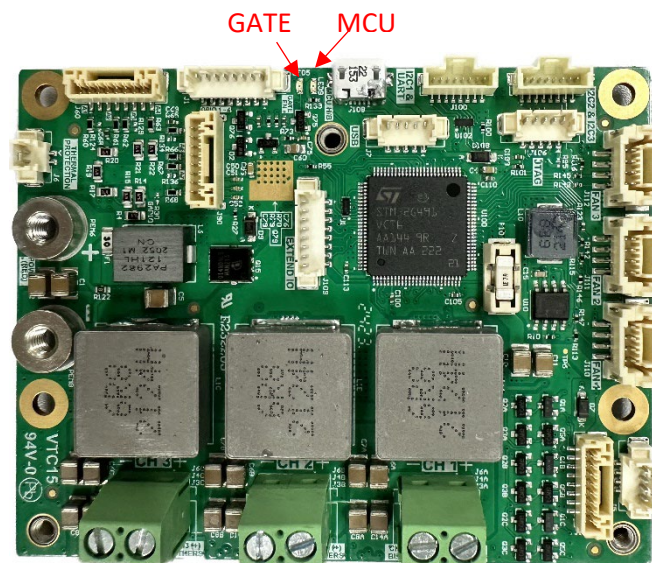


Figure 2.13: MCU H/B and GATE EN LEDs (VTC1500 serial)

REVISION HISTORY

Version	Date	Description of Change
0.0.1	09 Mar 2022	Initial Release
0.0.2	20 Jun 2022	Updated manual layout
0.0.3	14 Jul 2022	Added section on thermal protection
0.0.4	21 Jul 2022	Added legal notices
0.0.5	21 Nov 2022	Added VTC 2016-A images
0.0.6	18 Feb 2023	Updated as per VTC Release v3.0.0
0.0.7	21 Feb 2023	1. Updated as per VTC Release v3.1.0 2. Added details about Autopush Data format 3. Update temperature sensor mating part numbers 4. Update H/B LED colour
0.0.8	02 Mar 2023	Updated info for all mating connectors in Section 0
0.0.9	06 Mar 2023	Updated Fan pinout in Table 0.7
0.0.10	10 Apr 2023	Separated hardware setup guide from the software user manual
0.0.11	14 Apr 2023	Updated Fan connector number
0.0.12	23 May 2023	Added info about 3-channel VTC
0.0.14	16 Aug 2023	Added J5,J7,J120 pin define. Hardward spec move to product Datasheet.
0.0.15	8 Sep 2023	GPO5 (Vin) change to GPO5(HV) to avoid confusion. Pg13 add warning: Different channel “+”/”-“, can’t be short together.
0.0.16	10 Oct 2023	Revised the legal notice page to “VBMB”. Update page 20, figure 2.11.
0.0.17	11 Aug 2025	Added mating parts for GPIO connector in Table 2.12

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