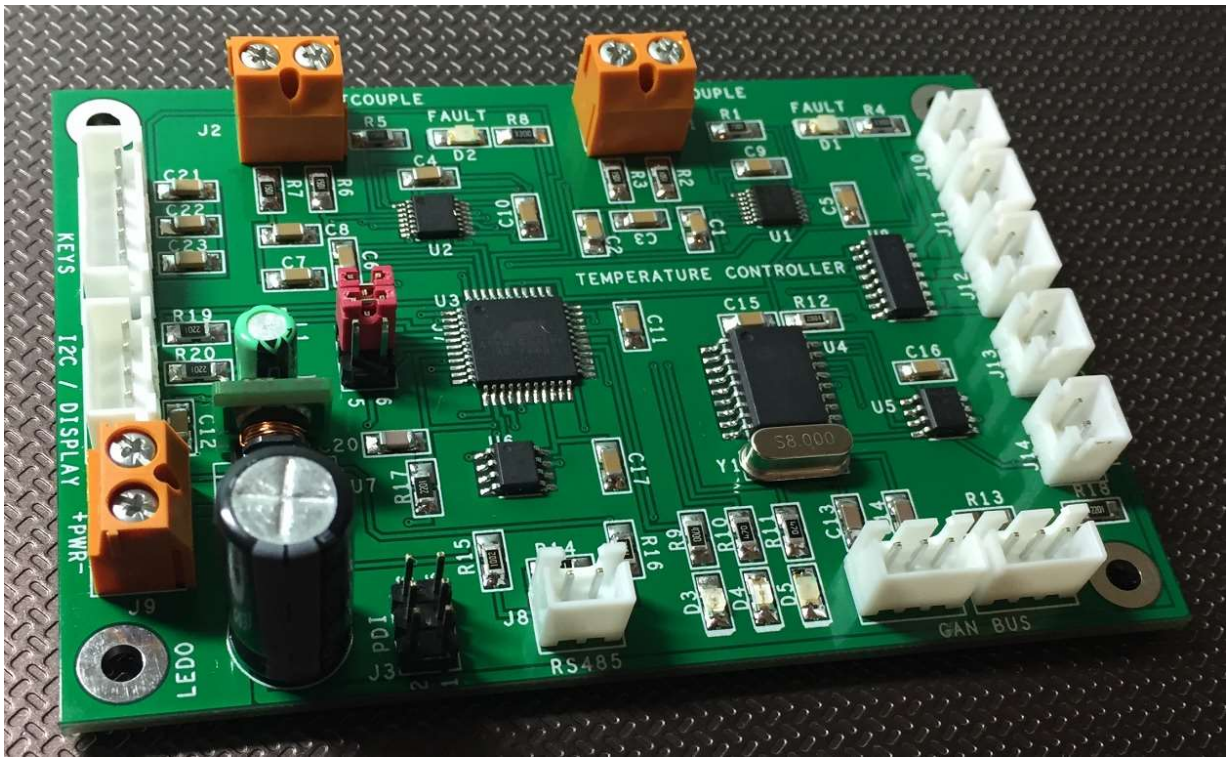
TEMPERATURE CONTROLLER WITH ATXMEGA32A4U



- **Two -210ºC…1800ºC PID channels**
- **K, J, N, R, S, T and B Thermocouples Compatibility**
- **Thermocouples fail detection**
- **0.0078125ºC Resolution (0.25ºC accuracy with Thermocouples)**
- **PWM and Dimmer Control**
- **Local and Remote Control**
- **CAN BUS Interface**
- **RS485 Interface**
- **I2C Interface**
- **Two +/-19.531mV or +/-78.12 mV Analog Inputs**
- **Three Buttons Inputs**
- **NTC Sensor Input**
- **Zero Cross Signal Input**
- **Three 500 mA Transistor Outputs**
- **ATXMEGA32A4U Microcontroller programmable in system with AVRISPMKII and Amel-Ice Programmers. C++ Libraries and sample application.**
- **5.0…30V DC Power Voltage**

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The board is a professional system for temperature control, and can also be used as a three-temperature remote sensor, as it is equipped with RS-485 and CAN Bus industrial communication interfaces.

It has two channels of measurement by thermocouple, of high quality and flexibility through the MAX MAX31856 IC, which allows to select by software the type of thermocouple, and the alarm conditions, either due to thermocouple failure, or due to temperature variations outside the programmed range. The third measurement channel can be implemented, by connecting an NTC to connector J14.

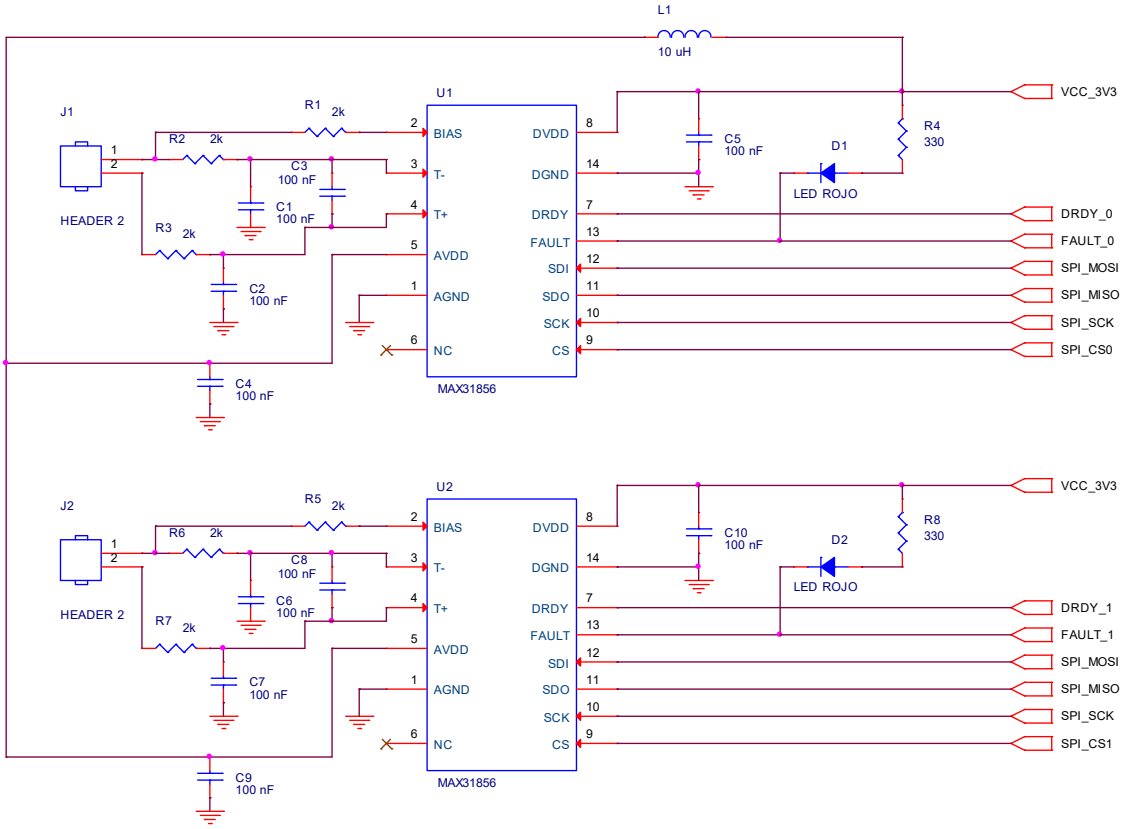

Fig.1. Termocouples Signal Conditioning.

The temperature probes are connected to connectors J1 and J2, with the polarity indicated on the board. The passive components R2, R3, R6, R7, C1, C2, C3, C6, C7 and C8 constitute low pass filters, which help to reduce the noise level. R1 and R5 constitute an additional protection against voltage spikes that may appear in the inputs of U1 and U2.

The Maxim MAX31856 CI is an excellent option as an interface between thermocouples and microcontrollers. Not only does it offer high measurement quality, it also allows you to select the type of thermocouple, and program the different types of alarms. It also has a mode that allows measuring the voltage at its input, with two different ranges (± 19,531 mV and ± 78.12 mV).

The red LEDs D1 and D2 indicate the fault status detected by each of the MAX31856, in case of thermocouple breakage, overvoltages at the input, or temperature range output. The alarm signals also reach the control microcontroller U3, directly to one of its pins, and through the SPI interface.

The control is carried out by the powerful microcontroller XMEGA32A4U of Microchip, specialized in real-time process control. The operating frequency of the CPU is 32 MHz.

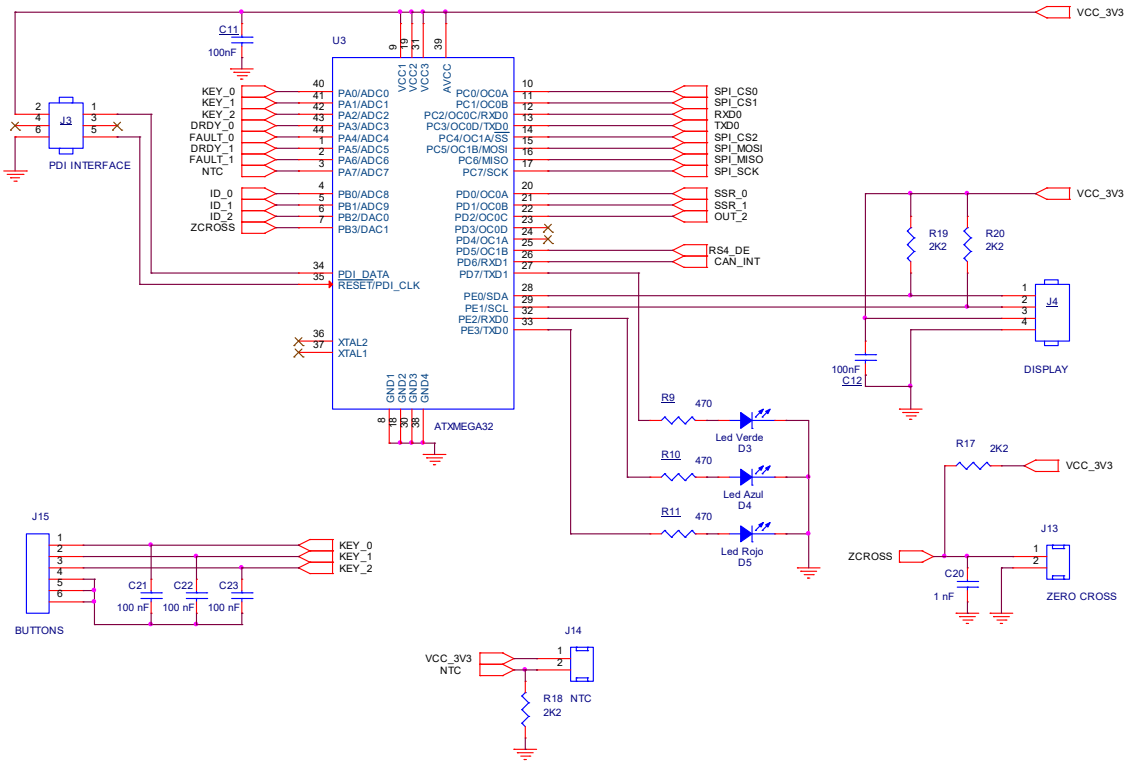

Fig.2. CPU.

The CPU executes the PID control algorithms necessary for temperature regulation, and all the routines necessary for the maintenance of communications. Three digital inputs are available on the J15 connector, which can be used to read the status of three buttons, or a matrix keypad.

The connectors J10, J11 and J12 are three transistor outputs from the ULN2003A chip, these are the control outputs intended for the excitation of solid state relays that are used to drive the heating elements.

In connector J13, we have a digital input, which could be the zero crossing signal of the network, in case you want to implement the regulation by phase (dimmer), for example, if we use the Le-SR400 power board -16A_2 from Ledoelectronics.

In the J4 connector, the I2C interface is present, which can be used to connect to a display, a real time clock, etc.

The green LED D3 is used as a program execution indicator (system LED), and flashes in normal state.

The blue LED D4, indicates the operational status of the CAN Bus node, while the red LED D5, lights up if there are errors in the CAN Bus communication, both are related to the status of the MCP2515 IC.

Jumpers ID_0, ID_1 and ID_2 (J7), can be used to set different RS-485 addresses or different CAN IDs.

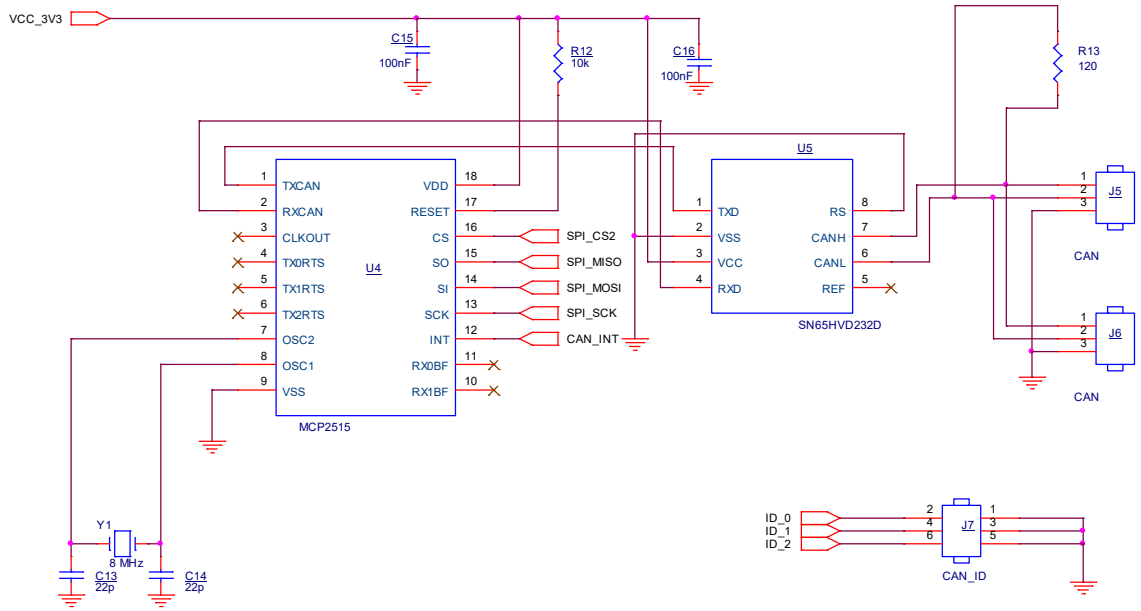

Fig.3. CAN BUS Interface.

The RS485 interface is based on the CI MAX3485, and complies with all protocol specifications, in half-duplex mode.

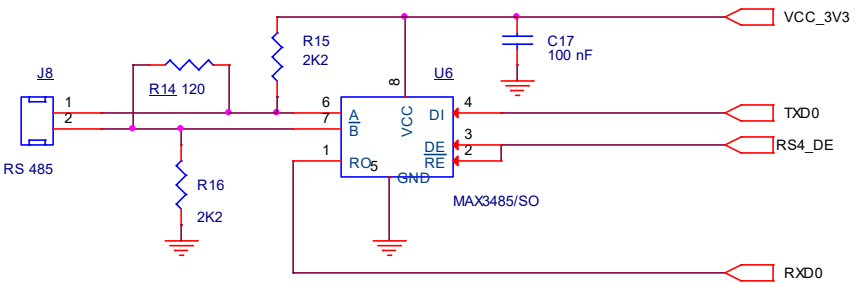

Fig.4. RS-485 Interface.

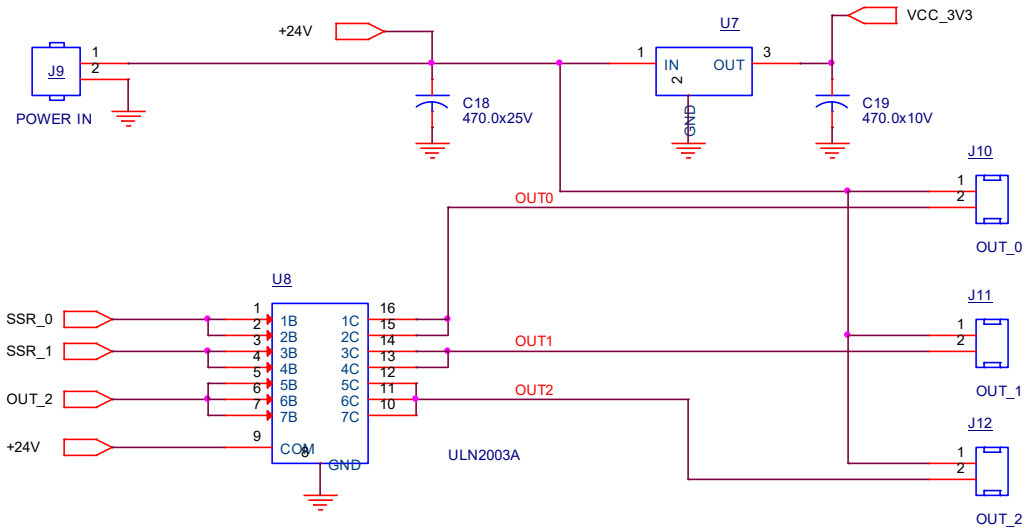

Fig.5. CPU Power and Outputs.

XH serie JST Connectors with 2.5 mm pitch are used in the board

CONNECTOR	PORT	FUNCTION	ALTERNATIVE
J1			
J1-1		TERMOPAR -	
J1-2		TERMOPAR +	
J2			
J2-1		TERMOPAR -	
J2-2		TERMOPAR +	
J3			
J3-1		PDI_DATA	
J3-2		VCC_3V3	
J3-3		NC	
J3-4		NC	
J3-5		PDI_CLK	RESET
J3-6		GND	
J4			
J4-1	PE0	I2C_SDA	
J4-2	PE1	I2C_SCL	
J4-3		VCC_3V3	
J4-4		GND	
J5			
J5-1		CAN HIGH	
J5-2		CAN LOW	
J5-3		GND	
J6			
J6-1		CAN HIGH	
J6-2		CAN LOW	
J6-3		GND	
J7			
J7-1-J7-2	PB0	ID0	

J7-3-J7-4	PB1	ID1	
J7-5-J7-6	PB2	ID2	
J8			
J8-1		RS485 A	
J8-2		RS485 B	
J9			
J9-1		POWER +	
J9-2		POWER -	
J10			
J10-1		POWER +	
J10-2		OUT0	
J11			
J11-1		POWER +	
J11-2		OUT1	
J12			
J12-1		POWER +	
J12-2		OUT2	
J13			
J13-1	PB3	ZERO CROSS	
J13-2		GND	
J14			
J14-1		VCC_3V3	
J14-2	PA7	NTC	
J15			
J15-1	PA0	KEY_0	
J15-2	PA1	KEY_1	
J15-3	PA2	KEY_2	
J15-4	GND		
J15-5	GND		
J15-6	GND