

# Multi-Channel Temperature Sensor

Aiming at the high and low temperature test requirements of cars before being sent on roads, this paper designs and implements a multi-channel thermocouple temperature measurement system based on FPGA. The system adopts thermocouple as temperature sensor, and K Type is used as thermocouple cold junction temperature compensation, which solves the problem of thermocouple cold junction compensation better. The front end adopts MAX11200, a 24-bit analog-to-digital converter with low noise, multi-channel and low power consumption, to amplify and A/D convert the signal at measuring junction of thermocouple. The control core is a field programmable logic gate array FPGA, which can better solve the problem of parallel processing of multi-channel temperature signals. At the same time, it uses the transposition method of the thermocouple standard graduation table, the interpolation look-up table algorithm and the cold junction compensation reverse look-up table algorithm, which is effective. The temperature measurement accuracy of each channel is improved. The experimental results show that the system can be connected to 8 K-type thermocouple sensors, the measurement range can reach  $-200^{\circ}\text{C}\sim 220^{\circ}\text{C}$  (73.15K~493.15K), and the relative error is less than  $\pm 0.3\%$ F.S.



Fig : MTS

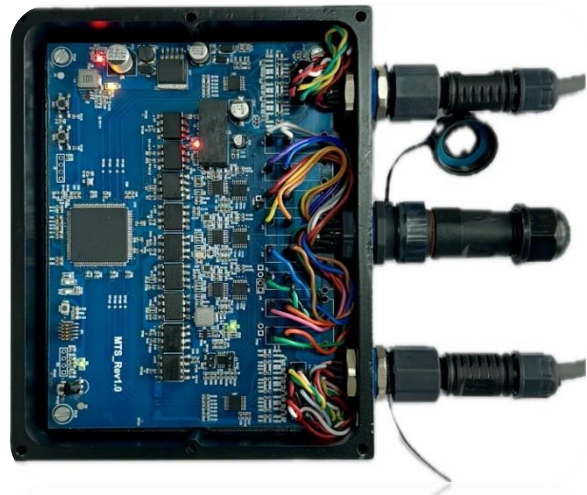


Fig : MTS without enclosure

## TECHNICAL FEATURES :

- FPGA Mach XO2 7000 with Flash Memory , Plug and Play model.
- 8 channel compatible for each board.
- 23 bits ENOB (Effective Number of Bits) for each Temperature Channel with ADC MAX11200 which is ultra low-power ( $< 300\text{fA}$  active current), high-resolution, serial output.
- 201 bit FRAME, where 192 bits is 8 channel ADC data, 6 bits are Device ID, and 3 bits are CRC bits (Cyclic Redundancy Check) for error detection.
- K Type Thermocouple with temperature range  $200^{\circ}\text{C}\sim 220^{\circ}\text{C}$ .
- Parallel multiplexing and data processing at 50Mhz speed.
- ADC conversion time  $\sim 10\mu\text{sec}$  with 10 SPS (Samples Per Seconds) settings.
- LVDS connections between MTS board for longer connectivity and noise elimination.
- On Board Op-to Couplers for device protection.
- USB, Ethernet, Wi-Fi and SD card compatibility for data outsourcing

## ADVANTAGES :

- Lattice Mach XO2 7000 FPGA with Plug and play connection with least development cost.
- High Speed Data transfer and parallel Multiplexing of

## ADC Channels.

- Inter – Board LVDS connection for longer communication and inter Channel Noise Elimination.
- On- Board damage protection circuit with optical isolation.
- Low Full Scale ADC error with 23 bit ENOB (Effective Number of Bits) mechanism
- In – Frame error detection mechanism.
- High processing speed Gateway for data outsourcing with SD card, Ethernet, Wi-Fi and USB compatibility.

## APPLICATIONS :

- Vehicle Prototyping (cars, truck, etc).
- Temperature Sensitive Monitoring in factories.
- Weather Monitoring.
- Geo – Thermal applications.
- Space – Craft Testing for various temperature.
- Temperature Monitoring for agricultural use for Temperature sensitive crop.
- Home automation based on Temperature monitoring in extreme climates.