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Thermocouple Interfacing With MSP430F5529 for Furnace Management System

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ABSTRACT

The thermocouple is standardized by the National Institute of Standards and Technology. This project show how to implement a thermocouple interface with MSP430F5529.The thermocouple interfaces with the MSP430F5529's integrated 12-bit analog/digital converter (ADC12_A) through an operational amplifier circuit(LM358).The MSP430 encodes the thermocouple readings into a digital value, converts them to temperature, and stores them in memory and then display on LCD display. The thermocouple circuit interfaces with the MSP430F5529 microcontroller from Texas Instrument .The MSP430F5529 is a 16-bit ultra-low-power microcontroller with 20-bit addressing and an integrated high performance 12 bit analog-to-digital converter (ADC).The integrated ADC is used to convert the digital values into temperature and stores them in memory. A complete code set accompanies this document. For this document, a Type K thermocouple is used, and the measured temperature range is limited to 0Cto 100C.A thermocouple is a temperature sensor that consists of two dissimilar metals welded at one end. In industry, certain combinations of alloys have been standardized in this application i.e (chromel-alumel) is used ,a Commonly used general purpose Type K thermocouple is used given their low cost and large temperature range (-200C to +1350C),Type K thermocouple are the most commonly used general purpose thermocouples. Compared to thermistors, thermocouples sacrifice precision and accuracy for an extremely wide temperature range. Because of this, thermocouples tend to be used in industrial applications where very high temperature may be encountered.

Keywords: MSP430F5529, Thermocouple Sensor(Type K),LCD, ADC12 ,LM358

INTRODUCTION

As world grows ever smarter, the use of electronics system in industrial, consumer, home automation and other areas have become progressively commonplace. With this trend comes the increasing need for the electronics system to be aware of elements of the operating system, Whether it be a refrigerator making sure to keep the milk cold, a water heater ensuring the shower is not too hot or too cold or a glucose knowing that the ambient temperature is within the specified range for correct test strip operation, temperature sensing is everywhere. There are many different methods and devices that may be used to measure temperature within an electronic device, and this paper will discuss some considerations and available when selecting a temperature-measuring device .Due to its ultra-low-power nature, the MSP430 microcontroller is well-suited for monitoring temperature within many different devices. The objectives of this paper are understanding the MSP430F5529 controller, Thermocouple sensor for detecting temperature in industries, and code composer studio v6 code development and dumping it on MSP430F5529 controller board.

LITERATURE REVIEW

This section explains about the block diagram and specifications of the paper. Before going to start this paper ,identified the modules and software's which are required to do this proposed system and after this paper ,identified the modules and software's which are required to do this proposed system and after that combining all this modules finally design the proposed system of block diagram is done.

Existing System

In this existing system, the thermocouple finds the temperature in the educational institutions, furnace regions, metro cities, industrial areas, universities and metro and other locations selected for establishment of such energy centres where the waste heat can be easily available and can be recycled

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after conversion to the same system. In reality, thermocouples are affected by such issues such as alloy manufacturing uncertainties, aging effects and circuit design mistakes/understandings.

Proposed System

In this proposed system, we are doing this project by using Furnace management system by using candle light, by soldering rod, water heater. So that we can find out the accurate room temperature weare using this proposed new method by MSP430F5529 microcontroller, so the microcontroller will take consume less power and it saves the power

HARDWARE IMPLEMENTATION

The block diagram of the design is as shown in Fig.1. It consists of power supply unit, microcontroller, Thermocouple sensor, ADC12 and LCD .the brief description of each unit is explained as follows.

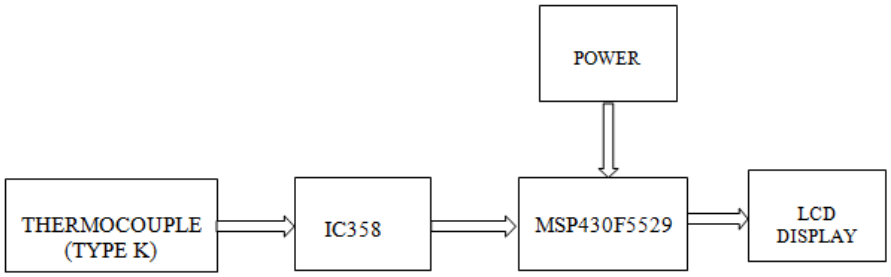

Figure1. *Block diagram Thermocouple Interfacing for MSP430F5529 Microcontroller*

MSP430F5529

The microcontroller MSP430F5529 series is an ultra-low-power mixed signal microcontrollers with built-in 4x16-bit timers with PWM capability, up to 40 I/O pins, a 12 channel comparator, and built-in communication capability using the universal serial communication interface. In addition, it also has a 12-bit analog-to-digital (A/D) converter. It is the heart of the circuit, holds the logic to run each of the peripherals.

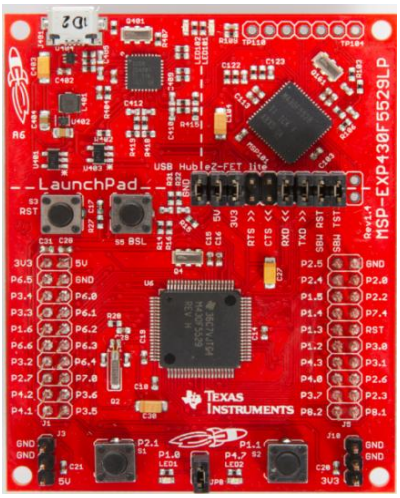

Figure2. MSP430F5529 launch pad

Thermocouple Sensor (Type K)

The thermocouple sensor is a sensing device used to measure the temperature range Type K (chromel –alumel) is the most common thermocouple purpose general thermocouple with a sensitivity of approximately 41μV/°C approximately (chromel positive relative to alumel when the junction temperature is higher than the reference temperature).It is expensive, and a wide variety of probes are available in its −200 °C to +1350 °C / -330 °F to +2460 °F range. Type K was specified at a time when metallurgy was less ad Type K was specified at a time when metallurgy was less advanced than it is today, samples and consequently characteristics may vary considerably bet and consequently characteristics may vary considerably between samples. One of the constituent metals, nickel, is

magnetic; a characteristic of thermocouples made with magnetic material is that they undergo a deviation in output when the material reaches its Curie point; this occurs for type K thermocouples at around 185 °C. Type K thermocouples may be used up to 1260 °C in non-oxidizing or inert atmospheres without rapid aging. In marginally oxidizing atmospheres (such as carbon dioxide) between 800 °C–1050 °C, the chromel wire rapidly corrodes and becomes magnetic in a phenomenon known as "green rot"; this induces a large and permanent degradation of the thermocouple, causing the thermocouple to read too low if the corroded area is exposed to thermal gradient. Another source of drift in type K thermocouples is that near 400 °C, a slow reordering in the chromel wire occurs; this is reversible and leads to hysteresis between heating and cooling.

Fig3. *Thermocouple sensor(Type K)*

LM358 IC

The LM358 is a low power dual operational amplifier integrated circuit originally introduced by National Semiconductor, it is used in detector circuits. The LM358 datasheet that it consist of two independent, high gain internally frequency compensated operational amplifiers which were designed specially to operate from a single power supply over a wide range of voltages designed. Operation from spilt supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage. The LM358 are available in a chip sized package (8-Bumo micro SMD) using National's micro SMD package technology.

Fig4. *LM358 IC*

SOFTWARE IMPLEMENTATION

Code Composer Studio

CCS is the integrated development environment for TI's DSP, microcontroller and application processors. It includes compilers for each of TI's device families, source code editor, project build environment, debugger, profiler, simulators and many other features. Following are the steps for implementing application.

- Open CCS and select a workspace directory.
- Select project > import existing CCS/CCE eclipse project.
- Make sure the project is selected and click finish.
- Build and Debug the code on MSP430F5529.
- Connect "eZ-FET" USB to the PC.1

PROCEDURE AND RESULTS

Procedure

The thermocouple will detect the temperature from the furnace and it is being sent to the amplifier IC of type (LM358) and it is used to maximize precision ,i.e it converts micro volts(uv) to mill volts(mv).

The MSP430F5529 collects the information from amplifier and sends the data to the ADC12 which is in built in the microcontroller and its takes the analog signal and converts that signal into digital values. The MSP430 encodes the thermocouple readings into a digital value, converts them to temperature, and stores them in memory and then display on LCD display. The thermocouple circuit interfaces with the MSP430F5529 microcontroller from Texas Instrument.

Results

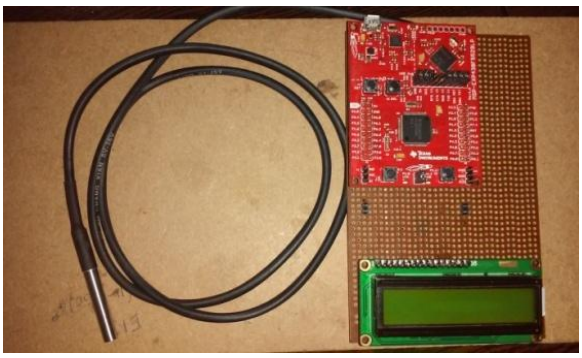

Fig5. *Thermocouple interfacing with MSP430F5529 when Power is off*

Fig6. *Thermocouple interfacing with MSP430F5529 when Power is on and displays the room temperature*

ADVANTAGES

- Temperature range is -200C to +1260C
- Robust
- Rapid response
- No-self heating

DISADVANTAGES

- Complex signal conditioning
- Accuracy
- Susceptibility to corrosion
- Susceptibility to noise

APPLICATIONS

- Steel industry
- Gas Applicance safety
- Manufacturing
- Power production

CONCLUSION AND FUTURE SCOPE

Conclusion

This proposed model of thermocouple interfacing with MSP430F5529 microcontroller using furnace management system is achieved successfully whenever the temperature is displayed on the LCD, in this we can detect the high temperature and control the temperature whenever it is high, or whenever it is low, so mainly this is used in real time in boilers in industries for measuring the temperature. So for further indication of recognising the temperature values whenever it is high or low, we can add a buzzer, to know when it is danger of exceeding the values.

Future Scope

The future scope is in these days the society face the energy crisis but also harmful effects of pollution. The thermoelectricity is a "Green Technology" to generate without any harmful effect. The educational institutions, furnace regions, metro cities, industrial areas, universities and other locations can be selected for the establishment of such energy centres where the waste heat can be easily available and can be recycled after conversion to the same system.

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