Keywords: temperature measurement, wearable, temperature, medical patches, wrist wearables, medical wearables, contact sensor, smart clothing, health sensing, bio sensing

TUTORIAL 6866

GUIDELINES FOR USING CONTACT TEMPERATURE SENSORS TO ADD TEMPERATURE MEASUREMENT TO WEARABLE PRODUCTS

Abstract: The MAX30205 is a clinical grade ±0.1°C accurate contact temperature sensor that is targeted for use in medical and consumer wearable products from clothing and patches to wrist worn products. Temperature measurement requires advanced consideration of how to add this functionality. This application note recommends how to add temperature measurement capability.

Introduction

This application note recommends how to add temperature measurements into a wearable product, either a wrist worn wearable, embedded clothing, or a sticky medical patch. The Maxim temperature sensors, such as the MAX30205, are integrated solutions that allow a direct connection to host micro controllers to read the temperature of the area that the sensor is physically in contact with. This application note also shows that integrating a temperature sensor in a wearable product requires very few components.

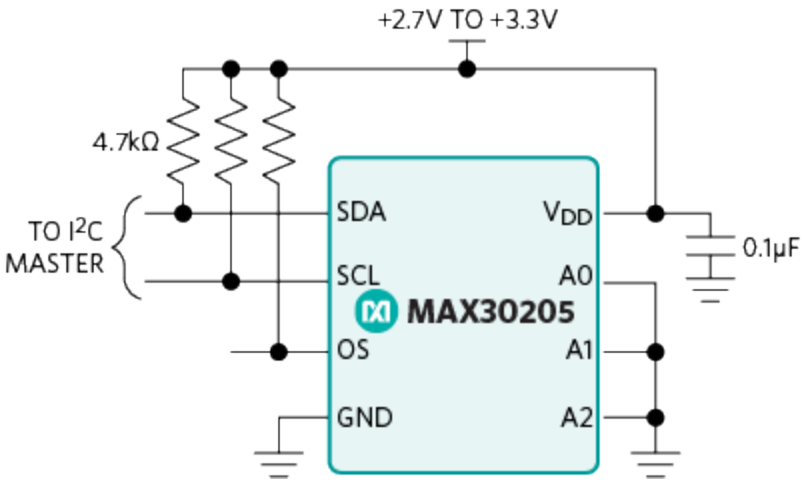

Figure 1. MAX30205 typical application circuit.

Overview

The Maxim wearable contact temperature sensors work by connecting the temperature measuring digital device to the target surface for temperature measurement. Temperature measurement with a clinical grade accuracy of ±0.1°C allows the user to have a good understanding of a person's health and general well-being. The use of temperature measurements and other body vital signs (such as PPG and ECG) allows decisions about the user's health to be made. Some companies assess the user's core body temperature based on the skin surface temperature. Hence temperature is an important body vital sign in the growing marketplace of medical and consumer wearables.

Guidelines

The difficulty of measuring temperature in a wearable product is making sure that you are measuring the user's temperature and not the temperature of the wearable product. Also make sure the electronics in the wearable do not influence the temperature measurement, making the measurement invalid.

Because of the complexity involved, designing the product requires some trial and error. Some protocols to test and confirm the temperature measurement must also be done before an industrial design is considered complete.

Consider the following recommendations and suggestions based on the use case of a wearable that is measuring the surface temperature of human skin:

- Maximize the skin contact area.
  Increase the available heat capacity from the skin by having the device make contact with as much skin as possible. This also increases the perfusion rate and lowers the RSKIN.
- Minimize the system thermal mass.
  Use the thinnest possible PCB or polyamide flex circuit to minimize the system thermal mass.
- Minimize the system losses to environment in the PCB and the enclosure.
  When designing the PCB, use the thinnest possible copper traces (i.e. ½oz or less) by considering the following:
  - Design cutouts around the temperature sensor or use a separate small PCB for the sensor.

- Use one thin ground trace and one thin power trace with the sensor chip.
- Do not connect to batteries that are larger than your power requirements.
- Minimize the power and ground planes.

Minimize the enclosure surface area that is exposed directly to room temperature air, and to reduce thermal conductivity, minimize the enclosure wall thickness.

Related Parts		
MAX30205	Human Body Temperature Sensor	Samples

More Information
For Technical Support: https://www.maximintegrated.com/en/support
For Samples: https://www.maximintegrated.com/en/samples
Other Questions and Comments: https://www.maximintegrated.com/en/contact

Application Note 6866: https://www.maximintegrated.com/en/an6866
TUTORIAL 6866, AN6866, AN 6866, APP6866, Appnote6866, Appnote 6866