Heißes Eisen: Discovering the Properties of a Soldering-Iron Tip and Building a Matching Soldering Station

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Abstract

Professional soldering stations impose a high financial burden for electronics hobbyists. Some commercial soldering iron tips with integrated heating- and thermal-elements use connectors that can be used with standard sockets. Heißes Eisen describes the discovering of these thermal-elements parameters and the build process of a temperature-controlled soldering station.

Part I
Soldering-Iron Tip

1. mechanical tip properties

Weller WMRP tip "RT 3" 1,3x0,4mm approx 10cm tip, heater, sensor, grip, 3,5mm jack nominal

2. thermal element

2.1. common element types

type K -> tried AD8495 AR: $5mV/\deg C$ output other types: very unlikely

2.2. custom measurement amplifier

to accurately measure the thermocouple voltage and to record the tips characteristics, an amplifier has to satisfy the following conditions: - Very high input resistance (thus very low input current) because of the t/cs low impedance - very low offset to be able to amplify signals in the microvolt-range - rail-to-rail input and output, because of low input voltage and 5V supply - high linearity (low gain error)

AD 8552 AR provides: - $1\,\mu V$ offset - $0,005\,\mu V/\deg C$ drift

With the AD 8552 a simple non-inverting amp was constructed. Gain was trimmed to $g = 400$.

Previously constructed AD8495 circuit was used to provide reference temperature information.

WMRP Tip, reference type K thermocouple were closely thermally coupled to another soldering iron. An Atmel Atmega8 MCU with an 10bit ADC was used to record data.

First results showed a linear dependence of thermocouple voltage and temperature in a range of 150-250 $\deg C$ with a coefficient of about $16\,\mu V/K$.

3. heating element

Part II
Soldering Station

4. system overview

Figure 1. system overview

4.1. UI

Functional Requirements

- Show the real and control temperature of the tip.
- Allow an arbitrary change of temperature by interaction with a single UI element.
- Provide (with additional systems) the ability to monitor the system and set control parameters.

Interface Components

- Rotary encoder.
- 7-Segment display.
- Serial (USB) debug line.

5. temperature control

6. performance evaluation