1. Introduction

The MicroCC uses the TSM6025 voltage reference, a drop-in replacement for the MAX6025, with better than 15ppm/°C stability. This is an ideal part to use both as the reference voltage and regulator for the TS1001IJ5 (previously covered here) powered by a single CR2032 coin cell. A 20- or 25-turn 10k trimmer pot serves as the adjustment. Using 0.1% resistors at the load allows confident current measurements in the micro amp range to be taken with any volt meter capable of 1mV resolution. A printed circuit board layout of the MicroCC is illustrated in Figure 1.

![Figure 1. MicroCC PCB Layout](image)

As shown in Figure 2, the MicroCC uses the TS1001IJ5 in a modified voltage follower mode where the feedback is taken from the emitter side of transistor T1 instead of the output of the op-amp, easily translating voltage regulation to current regulation. This is by no means a new type of circuit; however, it demonstrates that a simple circuit is capable of operating in ranges usually reserved for more complex and more expensive circuits.
Initial testing confirms total supply current draw (power consumption) is less than 0.3mA, allowing a single CR2032 battery to last up to 600 hours. While testing, one of our multimeters was discovered to produce a large amount of noise when on the µA setting and we are looking into this.

Calibration is unnecessary as there is no part to calibrate; however, it is suggested that it be powered on for a few minutes to allow the circuit to stabilize before attaching a load.

There was an error with the identification and license not being on the correct layer, and is missing from the prototype batch of PCBs. This may not make it to production, but there are plans to improve the range and overall accuracy. Overall, the MicroCC performs better than expected, and any improvements would include adding a precision analog microcontroller and the ability to go all the way down to null current.
1.1. Parts List

- R3–R5: 1k, 0.1% resistors – this is the load, the higher tolerance parts allows confident readings with a standard volt meter.
- TSM6025AEUR+: A 2.5V precision voltage reference. For improved tempco performance, the TSM6025AEUR+ could be replaced with a TS6001AIG325 or TS6001BIG325.
- TS1001IJ5: A 0.8V/0.65μA super low power op amp.
- T1: FMMTA14TA – NPN Darlington transistor, the maximum collector cutoff current is 100 nA, most will be lower than this.
- R7: 89PR10KLF – a 20-turn trimmer, allows finer control of current vs. a single turn pot.
- BK-883-TR CR2032 coin cell holder.
- C2-C5: 1nF ceramic capacitors
- R1: 1k to 10k resistor, for the base of the transistor

Unfortunately, our instruments do not have sufficient resolution and are plagued by a noisy environment to even be able to fully characterize the operating conditions more accurately.

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