

LOW-CURRENT SENSING APPLICATIONS

By Allegro MicroSystems

INTRODUCTION

Allegro MicroSystems is extending its current-sensing product portfolio to include a high-bandwidth, low-current sensor up to ± 15 APK. Based on Allegro-patented tunnel magnetoresistance (TMR) technology, the CT110 features superior linearity and over-temperature performance with the capability to sense current as low as 10 mA to enable a high dynamic range.

The CT110 is a six-pin device that features a linear ratiometric analog output in addition to a digital active-low overcurrent-protection output that is triggered in less than 0.5 μ s.

It is a factory-trimmed device that guarantees the sensor gain and the overcurrent protection threshold.

OPERATING PRINCIPLE

The CT110 is an isolated device that measures the magnetic field generated by the current flowing inside the package. The galvanic separation between the die and the current-carrying conductor allows the sensor to perform isolated current measurements.

The CT110 sensor is based on a monolithic die that includes a highly linear, one-dimensional (1D) TMR sensor configured in a full-bridge layout, and an integrated circuit for amplification, gain, and overcurrent-protection threshold trimming.

The CT110 is factory-trimmed and cannot be reprogrammed on the application side.

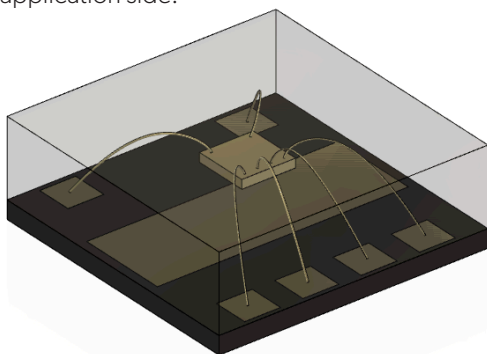


Figure 1: CT110 Packaging Showing Die, Pads, and Current-Carrying Conductor

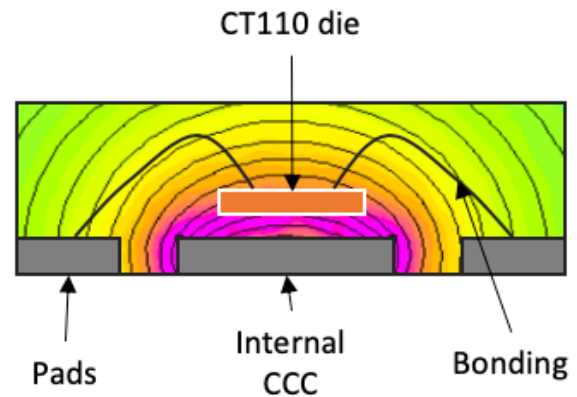


Figure 2: Cross Section of CT110 Package Showing Internal Magnetic Field

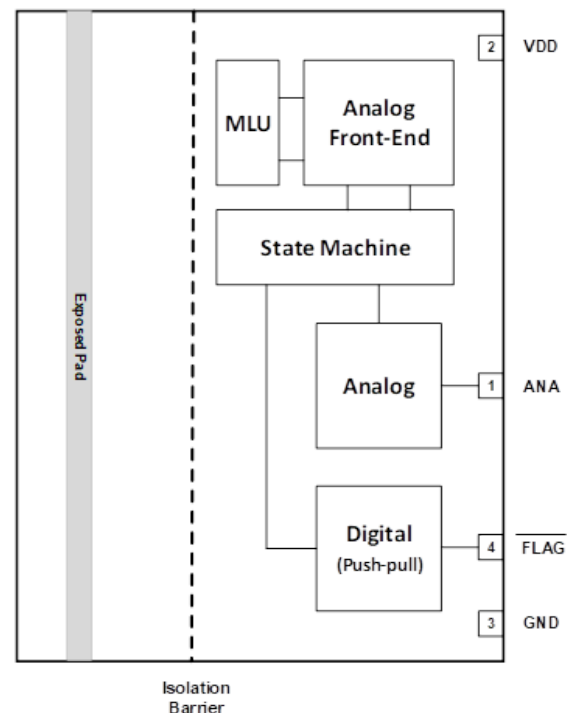


Figure 3: CT110 Block Diagram

REFERENCE DESIGN

The CT110 measures bidirectional current; hence, the ANA output pin is trimmed to be equal to half of V_{DD} when the current is null and varies towards V_{DD} or GND depending on the direction of the current. The sensor does not require any additional circuitry and can be connected directly to an analog-to-digital converter (ADC) or comparator.

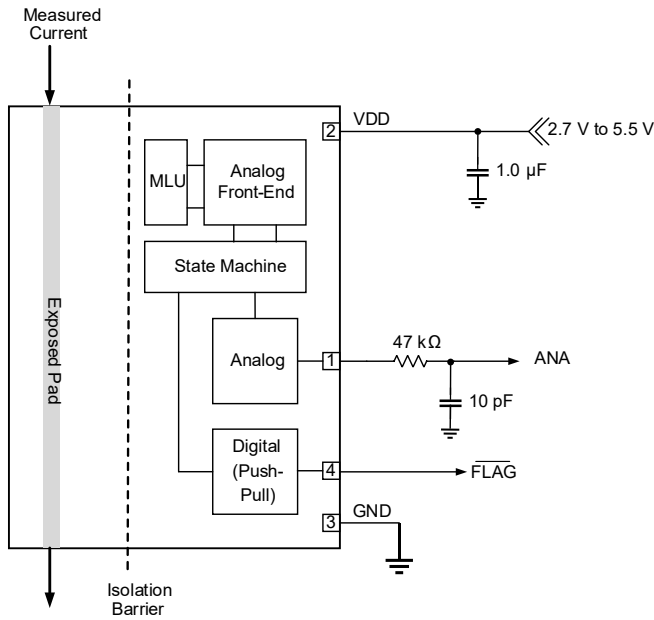


Figure 4: CT110 Application Block Diagram

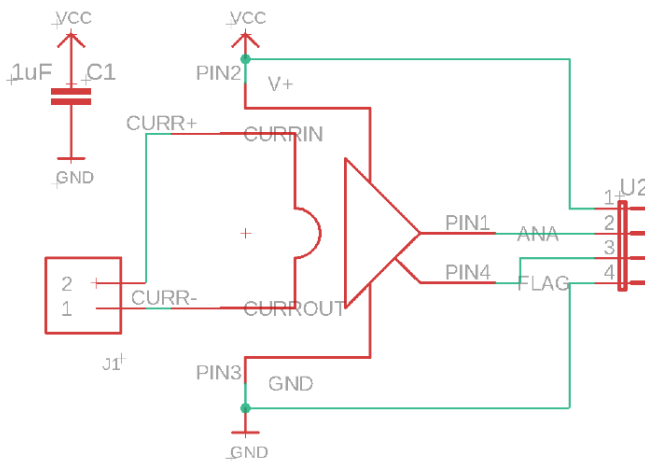


Figure 5: CT110 Application Schematic Diagram

A recommended circuit featuring the CT110 along with a decoupling capacitor $C1 = 1.0 \mu\text{F}$ is shown in Figure 5. An RC filter may be connected to the ANA pin to lower noise.

The top layer of the printed circuit board (PCB) layout for the CT110 evaluation board is shown in Figure 6; the PCB layout for the bottom or ground layer of the CT110 evaluation board is shown in Figure 7.

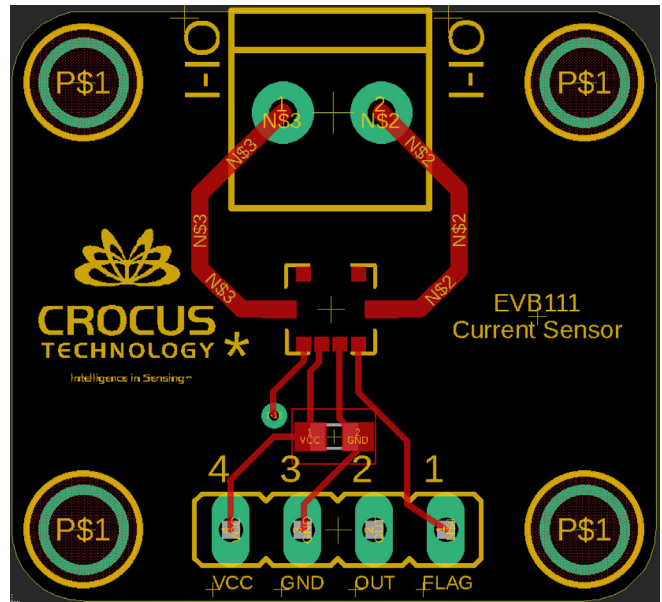


Figure 6: Typical GDS Layout of Top Layer for CT110 Evaluation Board

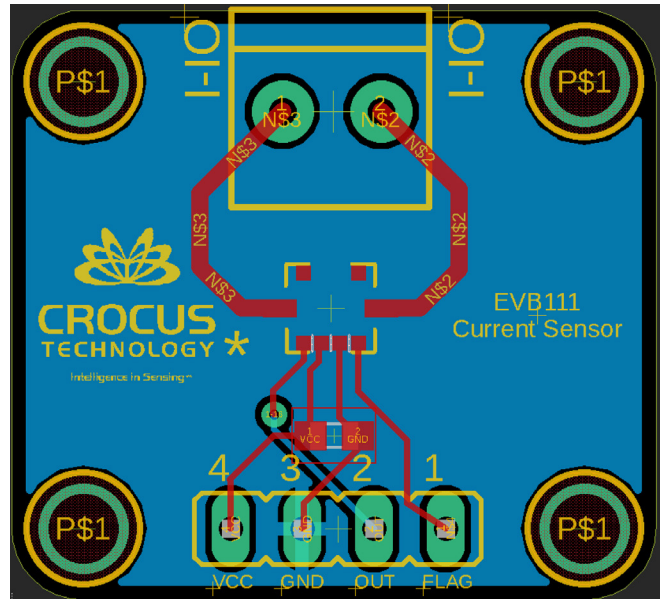


Figure 7: Typical GDS Layout of Ground Layer for CT110 Evaluation Board

RESULTS

The typical ANA voltage output of the CT110 for the 5 A variant is shown in Figure 8. The device was powered using a 5 V supply. The typical full-scale linearity and total output errors are $\pm 0.1\%$ and $\pm 0.5\%$, respectively.

The $\overline{\text{FLAG}}$ pin is push-pull, digital output active low. This pin outputs a low signal when the current measured exceeds 110% of the nominal current.

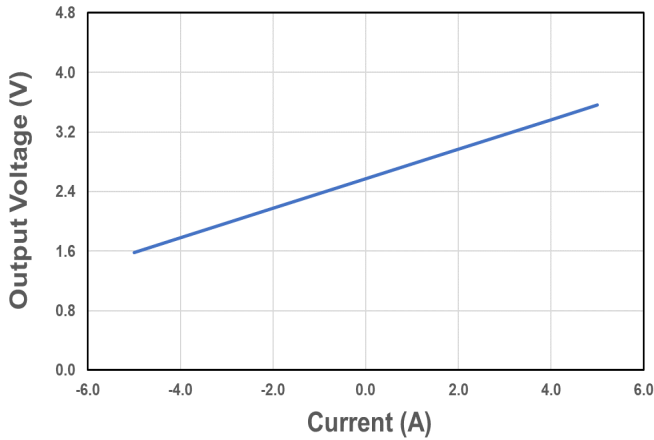


Figure 8: Typical ANA Voltage Output at $V_{DD} = 5\text{ V}$

SUMMARY

The CT110 is a new TMR sensor from Allegro that is optimized for low-current applications. It is factory-programmed and offers a small-footprint, cost-effective, isolated, current-sensing solution.

Revision History

Number	Date	Description	Responsibility
1	November 14, 2023	Document rebrand and minor editorial corrections	J. Henry

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