Technical Note

MT9V023
Internal Temperature Sensor

Introduction

This document describes the function and use of the temperature calibration and thermal information registers internal to the MT9V023. Monitoring these registers will assist users in keeping the imaging sensor within functional limits. When the junction temperature of the MT9V023 reaches +120°C—corresponding to an approximate +105°C ambient temperature—the sensor should be powered down.

Temperature Calibration

Three registers are used for monitoring the sensor temperature. The thermal information register (R0xC1) reports the value of an internal temperature diode. Since the temperature response varies slightly from part to part, two temperature calibration values of the thermal information register are measured during manufacturing, with the sensor held at +55°C and +100°C junction temperature. The resulting values are stored in reserved registers—the temperature calibration registers.

Calibration Registers Usage

The temperature calibration registers are accessed through the two-wire serial interface at R0x60, using a different index for each calibration value.

To read the values, follow this procedure:

1. Configure the sensor.
   1a. Write a value of 0 to R0x07[9]. This is a shadowed register and one frame-time delay should be permitted after writing R0x07.
2. Read the calibration values.
   2a. To read the +55°C calibration value, write a value of 0x12 to R0x60.
   2b. A subsequent read of R0x60 returns a +55°C calibration value.
   2c. To read the +100°C calibration value, write a value of 0x13 to R0x60.
   2d. A subsequent read of R0x60 returns a +100°C calibration value.

The following conditions should be noted:
- The index value (0x12 or 0x13) must be written to R0x60 immediately before each read from R0x60, otherwise the read results are indeterminate.
- It is only necessary to write R0x07[9] once.

Thermal Information Register Access

The thermal information register contains the current relative temperature and is updated once per frame. This register can be accessed through the two-wire interface at R0xC1. By using the two temperature calibration values to establish a temperature response slope for the internal thermal diode, the thermal information register can be used to accurately monitor sensor temperature. When the sensor's temperature reaches +120°C (approximately +105°C ambient) the imaging sensor should be powered down.

Several settings must be configured for reading the thermal information register:

1. VREF_ADC Control (R0x2C) should be left at default (4).
2. Companding must be disabled—set R0x1C to 0x0202.
3. R0x25 should be left at its reset value.

Note: The default value for R0x25 varies from part to part, so it should be left at its power-up value.

4. Digital Test Pattern (R0x7F) must be set to default (0x0).
5. HBlank (R0x05) must be set to a value of 400 or lower.

The thermal information register can then be read directly at R0xC1. As an approximate guide in determining temperature change, the internal temperature sensor has a response of about one count per 1°C. There is approximately a 15°C difference between ambient and junction temperatures for the MT9V023, depending on device mounting.

Using the calibration values and thermal register value, actual junction temperature can be calculated:

Letting CAL55 and CAL100 represent the temperature calibration values for +55°C and +100°C, respectively, the temperature response slope (m_{TEMP}) is:

$$m_{TEMP} = 45 \,/(CAL100 - CAL55) \qquad \text{(EQ 1)}$$

then

$$T_{JUNCT} = m_{TEMP}\,(R0xC1 - CAL55) + 55 \qquad \text{(EQ 2)}$$

Thermal Circuit Location

The MT9V023 uses a proprietary thermometer that is designed into the imager. The location of the circuit in the chip is the corner of the first row and column. This facilitates isolating the circuit from any other circuits that might affect it or cause a localized hot spot. Additionally, the circuit is covered by black light block to prevent focused bright light from causing a temperature change.

Conclusion

The temperature calibration and thermal information registers of the MT9V023 provide a convenient means for monitoring the sensor's internal temperature. This temperature information may be used to operate the sensor within its specified limits. For more information on this sensor, refer to the latest MT9V023 CMOS digital image sensor data sheet on Micron's Web site at www.micron.com/imaging.

Revision History

Rev. A **11/7/2007**
- Initial release