



# Technical Note

## MT9T111

## Programming OTP Memory for Rev1 and Rev2 Silicon

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### Introduction

This technical note explains how to program the 4-byte OTP memory in both the MT9T111 Rev1 and Rev2. Rev3 will have expanded OTP memory capacity (5 Kb). The programming and verification of this larger OTP memory will be covered in a separate document.

### Overview

The MT9T111 (Rev1 and Rev2) has 4 bytes of OTP memory that can be used during module manufacturing to store specific module information. This feature enables system integrators and module manufacturers to label and distinguish various module types based on lenses, IR-cut filters, or other properties.

During the programming process, a dedicated pin for high voltage is needed to perform the OTP memory programming. This voltage (VPP) should be  $8.5V \pm 3\%$ . Instantaneous VPP cannot exceed 9V at any time. Completion of the programming process will be communicated by a register through the two-wire serial interface.

Since this programming pin needs to sustain a higher voltage than other input/output pins, having a dedicated high voltage (VPP) pin minimizes the design risk. If the module manufacturing process can probe the sensor at the die or PCB level (that is, supply all the power rails, clocks, and two-wire serial interface signals), then this dedicated high voltage pin does not need to be assigned to the module connector pinout. However, if the VPP signal needs to be bonded out as a pin on the module, the trace for VPP needs to be able to carry a maximum of 1mA for programming only. This pin should be left floating when not programming the OTP memory.

Programming the OTP memory requires the sensor to be fully powered and remain in software standby with its clock input applied. The information from the host processor will be programmed through the use of the two-wire serial interface after VPP power is applied. Once the data is written to an internal register, the host processor sends a program command to the sensor to initiate the process. After the sensor has finished programming the OTP memory, a status bit will be set to indicate the end of the programming cycle, and the host machine can poll the setting of the status bit through the two-wire serial interface. Only one programming cycle for the 4 bytes of OTP memory can be performed.

Reading the OTP memory data requires the sensor to be fully powered and operational with its clock input applied. The data can be read through a register from the two-wire serial interface.

The steps below describe the process to program the OTP memory and verify the programmed data. The MT9T111 has different programming requirements for Rev1 and Rev2 silicon.



## TN-09-140: Programming OTP Memory for SilRev1 and SilRev2 MT9T111 Rev1 Silicon Programming and Verification Procedure

### MT9T111 Rev1 Silicon Programming and Verification Procedure

1. Sensor powering-up phase:
  - 1a. Apply power to all the power rails of the sensor (VDD, VDDIO, VAA, VAAPIX, and VDDPLL). Set VAA to 3.1V during the OTP memory programming phase. Disconnect VPP during the sensor powering-up phase. Other supplies are set at their nominal voltage.
  - 1b. Provide an 8 MHz EXTCLK clock input (valid for PLL bypass only, ensure the PLL is bypassed by checking that register 0x0014[0] is set to "1").
  - 1c. Place the sensor in soft standby (sensor default state upon power-up) or ensure that image streaming is turned OFF when the part is in active mode. Ensure that the sensor is in soft standby by checking that register 0x0018[0] is set to "1."
  - 1d. Ramp VPP to 8.5V in preparation to programming the sensor. Power supply (VPP) slew rate should be less than 1V/ $\mu$ s.
2. OTP memory programming phase:
  - 2a. Set register R0x001A = 0x0218.
  - 2b. Set register R0x001E = 0x0777.
  - 2c. Set register R0x0018 = 0x402C.
  - 2d. Set register R0x0016 = 0x00DE.
  - 2e. Set register R0x0982 = 0x0000.
  - 2f. Set register R0x098A = 0x3057.
  - 2g. Wait for 10ms.
  - 2h. Set register R0x0990 = 0x4000.
  - 2i. Write the first 16-bit word data by programming the register R0x3800.
  - 2j. Write the second 16-bit word data by programming the register R0x3802.
  - 2k. Initiate the OTP memory programming process by programming register R0x304A[0] = 0x01.
  - 2l. Wait for 10ms.
  - 2m. Poll the register bit R0x304A[1] and [2] until both bits set to "1" for program completion.
3. OTP memory verification phase:
  - 3a. Power down the sensor, remove the high voltage and disconnect the VPP pin.
  - 3b. Power up the sensor with the default settings.
  - 3c. Read the first word in R0x3800 and second word in R0x3802.



## MT9T111 Rev2 Silicon Programming and Verification Procedure

1. Sensor powering-up phase:
  - 1a. Apply power to all the power rails of the sensor (VDD, VDDIO, VAA, VAAPIX, and VDDPLL). Set VAA to 3.1V during the OTP memory programming phase. Disconnect VPP during the sensor powering-up phase. Other supplies are set at their nominal voltage.
  - 1b. Provide an 8 MHz EXTCLK clock input (valid for PLL bypass only, ensure the PLL is bypassed by checking that register 0x0014[0] is set to "1").
  - 1c. Place the sensor in soft standby (sensor default state upon power-up) or ensure that image streaming is turned OFF when the part is in active mode. Ensure that the sensor is in soft standby by checking that register 0x0018[0] is set to "1."
  - 1d. Ramp VPP to 8.5V in preparation to program. Power supply (VPP) slew rate should be less than 1V/μs.
2. OTP memory programming phase:
  - 2a. Set register R0x001A = 0x0218.
  - 2b. Set register R0x001E = 0x0777.
  - 2c. Set register R0x0018 = 0x402D.
  - 2d. Set register R0x0018 = 0x402C.
  - 2e. Set register R0x0016 = 0x00DE.
  - 2f. Write the first 16-bit word data by programming the register R0x3800.
  - 2g. Write the second 16-bit word data by programming the register R0x3802.
  - 2h. Initiate the OTP memory programming process by programming register R0x304A[0] = 0x01.
  - 2i. Wait for 10ms.
  - 2j. Poll the register bits R0x304A[1] and [2] until both bits set to "1" for program completion.
3. OTP memory verification phase:
  - 3a. Power down the sensor, remove the high voltage and float the VPP pin.
  - 3b. Power up the sensor with the default settings.
  - 3c. Read the first word in R0x3800 and second word in R0x3802.



## TN-09-140: Programming OTP Memory for SilRev1 and SilRev2 Conclusion

### Conclusion

This technical note describes the steps for programming and verifying the OTP memory in both Rev1 and Rev2 of the MT9T111 sensor. Rev3 of the MT9T111 will have a larger capacity of OTP memory and will require a different programming procedure. This procedure will be explained in detail in a separate document.

For further information and assistance on these features, refer to Micron's Web site at [www.micron.com/imaging](http://www.micron.com/imaging).



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## Revision History

Rev. A .....	9/11/2007
<ul style="list-style-type: none"><li>• Initial release</li></ul>	