
Appendix A – ATtiny24A/44A Specification at 105°C

This document contains information specific to devices operating at temperatures up to 105°C. Only deviations are covered in this appendix, all other information can be found in the complete datasheet. The complete datasheet can be found at www.atmel.com.



**8-bit AVR[®]
Microcontroller
with 2K/4K
Bytes In-System
Programmable
Flash**

**ATtiny24A
ATtiny44A**

Appendix A

Rev. 8183D-Appendix A-AVR-08/11



1. Memories

1.1 EEPROM Data Memory

The EEPROM has an endurance of at least 50,000 write/erase cycles.

2. Electrical Characteristics

2.1 Absolute Maximum Ratings*

| | |
|--|------------------------|
| Operating Temperature | -55°C to +125°C |
| Storage Temperature | -65°C to +150°C |
| Voltage on any Pin except $\overline{\text{RESET}}$ with respect to Ground | -0.5V to $V_{CC}+0.5V$ |
| Voltage on $\overline{\text{RESET}}$ with respect to Ground..... | -0.5V to +13.0V |
| Maximum Operating Voltage | 6.0V |
| DC Current per I/O Pin | 40.0 mA |
| DC Current V_{CC} and GND Pins | 200.0 mA |

*NOTICE: Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

2.2 DC Characteristics

Table 2-1. DC Characteristics. $T_A = -40^\circ\text{C}$ to $+105^\circ\text{C}$

| Symbol | Parameter | Condition | Min | Typ ⁽¹⁾ | Max | Units |
|-----------|--|---|-------------------|--------------------|-------------------|---------------|
| V_{IL} | Input Low Voltage | $V_{CC} = 1.8V - 2.4V$ | -0.5 | | $0.2V_{CC}^{(3)}$ | V |
| | | $V_{CC} = 2.4V - 5.5V$ | -0.5 | | $0.3V_{CC}^{(3)}$ | V |
| | Input Low Voltage, $\overline{\text{RESET}}$ Pin as Reset ⁽⁴⁾ | $V_{CC} = 1.8V - 5.5$ | -0.5 | | $0.2V_{CC}^{(3)}$ | |
| V_{IH} | Input High-voltage Except $\overline{\text{RESET}}$ pin | $V_{CC} = 1.8V - 2.4V$ | $0.7V_{CC}^{(2)}$ | | $V_{CC} + 0.5$ | V |
| | | $V_{CC} = 2.4V - 5.5V$ | $0.6V_{CC}^{(2)}$ | | $V_{CC} + 0.5$ | V |
| | Input High-voltage $\overline{\text{RESET}}$ pin as Reset ⁽⁴⁾ | $V_{CC} = 1.8V$ to $5.5V$ | $0.9V_{CC}^{(2)}$ | | $V_{CC} + 0.5$ | V |
| V_{OL} | Output Low Voltage ⁽⁵⁾ Except $\overline{\text{RESET}}$ pin ⁽⁷⁾ | $I_{OL} = 10\text{ mA}, V_{CC} = 5V$ | | | 0.6 | V |
| | | $I_{OL} = 5\text{ mA}, V_{CC} = 3V$ | | | 0.5 | V |
| V_{OH} | Output High-voltage ⁽⁶⁾ Except $\overline{\text{RESET}}$ pin ⁽⁷⁾ | $I_{OH} = -10\text{ mA}, V_{CC} = 5V$ | 4.3 | | | V |
| | | $I_{OH} = -5\text{ mA}, V_{CC} = 3V$ | 2.5 | | | V |
| I_{LIL} | Input Leakage Current I/O Pin | $V_{CC} = 5.5V$, pin low (absolute value) | | < 0.05 | 1 ⁽⁸⁾ | μA |
| I_{LIH} | Input Leakage Current I/O Pin | $V_{CC} = 5.5V$, pin high (absolute value) | | < 0.05 | 1 ⁽⁸⁾ | μA |
| R_{PU} | Pull-up Resistor, I/O Pin | $V_{CC} = 5.5V$, input low | 20 | | 50 | $k\Omega$ |
| | Pull-up Resistor, Reset Pin | $V_{CC} = 5.5V$, input low | 30 | | 60 | $k\Omega$ |

Table 2-1. DC Characteristics. $T_A = -40^{\circ}\text{C}$ to $+105^{\circ}\text{C}$ (Continued)

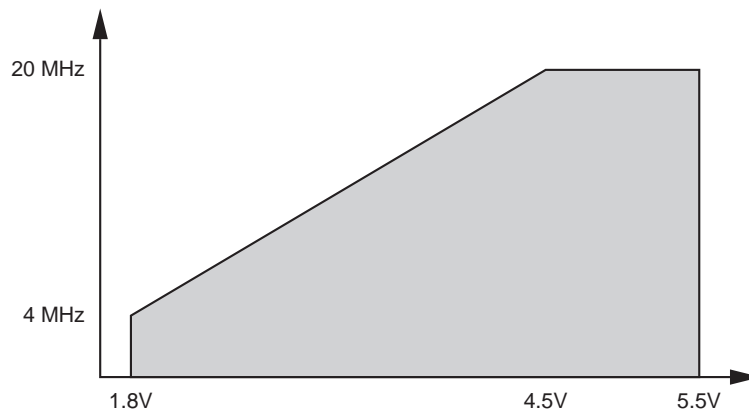
| Symbol | Parameter | Condition | Min | Typ ⁽¹⁾ | Max | Units | |
|----------|---|---------------------------------------|-----|--------------------|------|-------|---------------|
| I_{CC} | Supply Current, Active Mode ⁽⁹⁾ | $f = 1\text{MHz}, V_{CC} = 2\text{V}$ | | 0.25 | 0.5 | mA | |
| | | $f = 4\text{MHz}, V_{CC} = 3\text{V}$ | | 1.2 | 2 | mA | |
| | | $f = 8\text{MHz}, V_{CC} = 5\text{V}$ | | 4.4 | 7 | mA | |
| | Supply Current, Idle Mode ⁽⁹⁾ | $f = 1\text{MHz}, V_{CC} = 2\text{V}$ | | | 0.04 | 0.2 | mA |
| | | $f = 4\text{MHz}, V_{CC} = 3\text{V}$ | | | 0.25 | 0.6 | mA |
| | | $f = 8\text{MHz}, V_{CC} = 5\text{V}$ | | | 1.3 | 2 | mA |
| | Supply Current, Power-Down Mode ⁽¹⁰⁾ | WDT enabled, $V_{CC} = 3\text{V}$ | | | 4 | 20 | μA |
| | | WDT disabled, $V_{CC} = 3\text{V}$ | | | 0.2 | 10 | μA |

- Notes:
1. Typical values at 25°C .
 2. “Min” means the lowest value where the pin is guaranteed to be read as high.
 3. “Max” means the highest value where the pin is guaranteed to be read as low.
 4. Not tested in production.
 5. Although each I/O port can sink more than the test conditions (10 mA at $V_{CC} = 5\text{V}$, 5 mA at $V_{CC} = 3\text{V}$) under steady state conditions (non-transient), the sum of all I_{OL} (for all ports) should not exceed 60 mA. If I_{OL} exceeds the test conditions, V_{OL} may exceed the related specification. Pins are not guaranteed to sink current greater than the listed test condition.
 6. Although each I/O port can source more than the test conditions (10 mA at $V_{CC} = 5\text{V}$, 5 mA at $V_{CC} = 3\text{V}$) under steady state conditions (non-transient), the sum of all I_{OH} (for all ports) should not exceed 60 mA. If I_{OH} exceeds the test condition, V_{OH} may exceed the related specification. Pins are not guaranteed to source current greater than the listed test condition.
 7. The $\overline{\text{RESET}}$ pin must tolerate high voltages when entering and operating in programming modes and, as a consequence, has a weak drive strength as compared to regular I/O pins. See [Figure 3-25](#), [Figure 3-26](#), [Figure 3-27](#), and [Figure 3-28](#) (starting on [page 22](#)).
 8. These are test limits, which account for leakage currents of the test environment. Actual device leakage currents are lower.
 9. Values are with external clock using methods described in “Minimizing Power Consumption”. Power reduction is enabled (PRR = 0xFF) and there is no I/O drive.
 10. BOD disabled.

2.3 Speed

The maximum operating frequency of the device depends on V_{CC} . As shown in [Figure 2-1](#), the relationship between maximum frequency and V_{CC} is linear in the region $1.8\text{V} < V_{CC} < 4.5\text{V}$.

Figure 2-1. Maximum Frequency vs. V_{CC} . $T_A = -40^{\circ}\text{C}$ to $+105^{\circ}\text{C}$



2.4 Clock Characteristics

2.4.1 Accuracy of Calibrated Internal Oscillator

It is possible to manually calibrate the internal oscillator to be more accurate than default factory calibration. Note that the oscillator frequency depends on temperature and voltage. Voltage and temperature characteristics can be found in [Figure 3-46 on page 32](#).

Table 2-2. Calibration Accuracy of Internal RC Oscillator

| Calibration Method | Target Frequency | V _{CC} | Temperature | Accuracy at given voltage & temperature ⁽¹⁾ |
|---------------------|---------------------------------------|-----------------------------------|--|--|
| Factory Calibration | 8.0 MHz | 3V | 25°C | ±10% |
| User Calibration | Fixed frequency within: 7.3 – 8.1 MHz | Fixed voltage within: 1.8V – 5.5V | Fixed temperature within: -40°C to 105°C | ±1% |

Note: 1. Accuracy of oscillator frequency at calibration point (fixed temperature and fixed voltage).

2.5 System and Reset Characteristics

2.5.1 Power-On Reset

Table 2-3. Characteristics of Enhanced Power-On Reset. T_A = -40 to +105°C

| Symbol | Parameter | Min ⁽¹⁾ | Typ ⁽¹⁾ | Max ⁽¹⁾ | Units |
|------------------|---|--------------------|--------------------|--------------------|-------|
| V _{POR} | Release threshold of power-on reset ⁽²⁾ | 1.1 | 1.4 | 1.7 | V |
| V _{POA} | Activation threshold of power-on reset ⁽³⁾ | 0.6 | 1.3 | 1.7 | V |
| SR _{ON} | Power-On Slope Rate | 0.01 | | | V/ms |

Notes: 1. Values are guidelines, only
 2. Threshold where device is released from reset when voltage is rising
 3. The Power-on Reset will not work unless the supply voltage has been below V_{POA}

2.6 Analog Comparator Characteristics

Table 2-4. Analog Comparator Characteristics, T_A = -40°C to +105°C

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|------------------|--|---|-----|------|-----|-------|
| V _{AIO} | Input Offset Voltage | V _{CC} = 5V, V _{IN} = V _{CC} / 2 | | < 10 | 40 | mV |
| I _{LAC} | Input Leakage Current | V _{CC} = 5V, V _{IN} = V _{CC} / 2 | -50 | | 50 | nA |
| t _{APD} | Analog Propagation Delay (from saturation to slight overdrive) | V _{CC} = 2.7V | | 750 | | ns |
| | | V _{CC} = 4.0V | | 500 | | |
| | Analog Propagation Delay (large step change) | V _{CC} = 2.7V | | 100 | | |
| | | V _{CC} = 4.0V | | 75 | | |
| t _{DPD} | Digital Propagation Delay | V _{CC} = 1.8V - 5.5 | | 1 | 2 | CLK |

Note: All parameters are based on simulation results and are not tested in production

2.7 ADC Characteristics

Table 2-5. ADC Characteristics, Single Ended Channels. T = -40°C to +105°C

| Symbol | Parameter | Condition | Min | Typ | Max | Units | |
|-----------|---|---|-----|------|-----------|------------|-----|
| | Resolution | | | | 10 | Bits | |
| | Absolute accuracy (Including INL, DNL, and Quantization, Gain and Offset Errors) | $V_{REF} = 4V, V_{CC} = 4V,$ ADC clock = 200 kHz | | 2.0 | | LSB | |
| | | $V_{REF} = 4V, V_{CC} = 4V,$ ADC clock = 1 MHz | | 2.5 | | LSB | |
| | | $V_{REF} = 4V, V_{CC} = 4V,$ ADC clock = 200 kHz Noise Reduction Mode | | | 1.5 | | LSB |
| | | $V_{REF} = 4V, V_{CC} = 4V,$ ADC clock = 1 MHz Noise Reduction Mode | | | 2.0 | | LSB |
| | Integral Non-Linearity (INL) (Accuracy after Offset and Gain Calibration) | $V_{REF} = 4V, V_{CC} = 4V,$ ADC clock = 200 kHz | | 1.0 | | LSB | |
| | Differential Non-linearity (DNL) | $V_{REF} = 4V, V_{CC} = 4V,$ ADC clock = 200 kHz | | 0.5 | | LSB | |
| | Gain Error | $V_{REF} = 4V, V_{CC} = 4V,$ ADC clock = 200 kHz | | 2.0 | | LSB | |
| | Offset Error (Absolute) | $V_{REF} = 4V, V_{CC} = 4V,$ ADC clock = 200 kHz | | 1.5 | | LSB | |
| | Conversion Time | Free Running Conversion | 14 | | 280 | μs | |
| | Clock Frequency | | 50 | | 1000 | kHz | |
| V_{IN} | Input Voltage | | GND | | V_{REF} | V | |
| | Input Bandwidth | | | 38.5 | | kHz | |
| A_{REF} | External Voltage Reference | | 2.0 | | V_{CC} | V | |
| V_{INT} | Internal Voltage Reference | | 1.0 | 1.1 | 1.2 | V | |
| R_{REF} | Reference Input Resistance | | | 32 | | k Ω | |
| R_{AIN} | Analog Input Resistance | | | 100 | | M Ω | |
| | ADC Conversion Output | | 0 | | 1023 | LSB | |

Table 2-6. ADC Characteristics, Differential Channels (Unipolar Mode), $T_A = -40^{\circ}\text{C}$ to $+105^{\circ}\text{C}$

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|------------|---|--|-----|-----|-----------------------|---------------|
| | Resolution | Gain = 1x | | | 10 | Bits |
| | | Gain = 20x | | | 10 | Bits |
| | Absolute accuracy (Including INL, DNL, and Quantization, Gain and Offset Errors) | Gain = 1x $V_{REF} = 4\text{V}$, $V_{CC} = 5\text{V}$ ADC clock = 50 - 200 kHz | | 10 | | LSB |
| | | Gain = 20x $V_{REF} = 4\text{V}$, $V_{CC} = 5\text{V}$ ADC clock = 50 - 200 kHz | | 15 | | LSB |
| | Integral Non-Linearity (INL) (Accuracy after Offset and Gain Calibration) | Gain = 1x $V_{REF} = 4\text{V}$, $V_{CC} = 5\text{V}$ ADC clock = 50 - 200 kHz | | 4 | | LSB |
| | | Gain = 20x $V_{REF} = 4\text{V}$, $V_{CC} = 5\text{V}$ ADC clock = 50 - 200 kHz | | 10 | | LSB |
| | Gain Error | Gain = 1x | | 10 | | LSB |
| | | Gain = 20x | | 15 | | LSB |
| | Offset Error | Gain = 1x $V_{REF} = 4\text{V}$, $V_{CC} = 5\text{V}$ ADC clock = 50 - 200 kHz | | 3 | | LSB |
| | | Gain = 20x $V_{REF} = 4\text{V}$, $V_{CC} = 5\text{V}$ ADC clock = 50 - 200 kHz | | 4 | | LSB |
| | Conversion Time | Free Running Conversion | 70 | | 280 | μs |
| | Clock Frequency | | 50 | | 200 | kHz |
| V_{IN} | Input Voltage | | GND | | V_{CC} | V |
| V_{DIFF} | Input Differential Voltage | | | | V_{REF}/Gain | V |
| | Input Bandwidth | | | 4 | | kHz |
| A_{REF} | External Reference Voltage | | 2.0 | | $V_{CC} - 1.0$ | V |
| V_{INT} | Internal Voltage Reference | | 1.0 | 1.1 | 1.2 | V |
| R_{REF} | Reference Input Resistance | | | 32 | | k Ω |
| R_{AIN} | Analog Input Resistance | | | 100 | | M Ω |
| | ADC Conversion Output | | 0 | | 1023 | LSB |

Table 2-7. ADC Characteristics, Differential Channels (Bipolar Mode), $T_A = -40^{\circ}\text{C}$ to $+105^{\circ}\text{C}$

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|------------|---|---|------|-----|-----------------------|---------------|
| | Resolution | Gain = 1x | | | 10 | Bits |
| | | Gain = 20x | | | 10 | Bits |
| | Absolute accuracy (Including INL, DNL, and Quantization, Gain and Offset Errors) | Gain = 1x $V_{REF} = 4V, V_{CC} = 5V$ ADC clock = 50 - 200 kHz | | 8 | | LSB |
| | | Gain = 20x $V_{REF} = 4V, V_{CC} = 5V$ ADC clock = 50 - 200 kHz | | 8 | | LSB |
| | Integral Non-Linearity (INL) (Accuracy after Offset and Gain Calibration) | Gain = 1x $V_{REF} = 4V, V_{CC} = 5V$ ADC clock = 50 - 200 kHz | | 4 | | LSB |
| | | Gain = 20x $V_{REF} = 4V, V_{CC} = 5V$ ADC clock = 50 - 200 kHz | | 5 | | LSB |
| | Gain Error | Gain = 1x | | 4 | | LSB |
| | | Gain = 20x | | 5 | | LSB |
| | Offset Error | Gain = 1x $V_{REF} = 4V, V_{CC} = 5V$ ADC clock = 50 - 200 kHz | | 3 | | LSB |
| | | Gain = 20x $V_{REF} = 4V, V_{CC} = 5V$ ADC clock = 50 - 200 kHz | | 4 | | LSB |
| | Conversion Time | Free Running Conversion | 70 | | 280 | μs |
| | Clock Frequency | | 50 | | 200 | kHz |
| V_{IN} | Input Voltage | | GND | | V_{CC} | V |
| V_{DIFF} | Input Differential Voltage | | | | V_{REF}/Gain | V |
| | Input Bandwidth | | | 4 | | kHz |
| A_{REF} | External Reference Voltage | | 2.0 | | $V_{CC} - 1.0$ | V |
| V_{INT} | Internal Voltage Reference | | 1.0 | 1.1 | 1.2 | V |
| R_{REF} | Reference Input Resistance | | | 32 | | k Ω |
| R_{AIN} | Analog Input Resistance | | | 100 | | M Ω |
| | ADC Conversion Output | | -512 | | 511 | LSB |

2.8 Serial Programming Characteristics

Table 2-8. Serial Programming Characteristics, $T_A = -40^\circ\text{C}$ to $+105^\circ\text{C}$, $V_{CC} = 1.8 - 5.5\text{V}$
(Unless Otherwise Noted)

| Symbol | Parameter | Min | Typ | Max | Units |
|---------------------|---|---------------------------|-----|-----|-------|
| $1/t_{\text{CLCL}}$ | Oscillator Frequency | 0 | | 4 | MHz |
| t_{CLCL} | Oscillator Period | 250 | | | ns |
| $1/t_{\text{CLCL}}$ | Oscillator Frequency ($V_{CC} = 4.5\text{V} - 5.5\text{V}$) | 0 | | 20 | MHz |
| t_{CLCL} | Oscillator Period ($V_{CC} = 4.5\text{V} - 5.5\text{V}$) | 50 | | | ns |
| t_{SHSL} | SCK Pulse Width High | $2 t_{\text{CLCL}}^{(1)}$ | | | ns |
| t_{SLSH} | SCK Pulse Width Low | $2 t_{\text{CLCL}}^{(1)}$ | | | ns |
| t_{OVSH} | MOSI Setup to SCK High | t_{CLCL} | | | ns |
| t_{SHOX} | MOSI Hold after SCK High | $2 t_{\text{CLCL}}$ | | | ns |

Note: 1. $2 t_{\text{CLCL}}$ for $f_{\text{ck}} < 12\text{ MHz}$, $3 t_{\text{CLCL}}$ for $f_{\text{ck}} \geq 12\text{ MHz}$

3. Typical Characteristics

3.1 ATtiny24A

3.1.1 Current Consumption in Active Mode

Figure 3-1. Active Supply Current vs. V_{CC} (Internal RC Oscillator, 8 MHz)

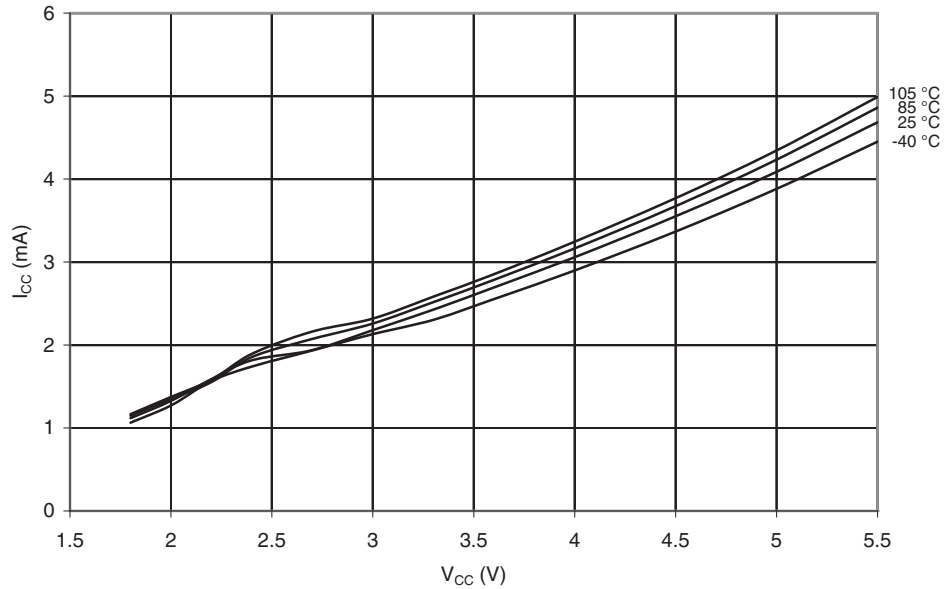


Figure 3-2. Active Supply Current vs. V_{CC} (Internal RC Oscillator, 1 MHz)

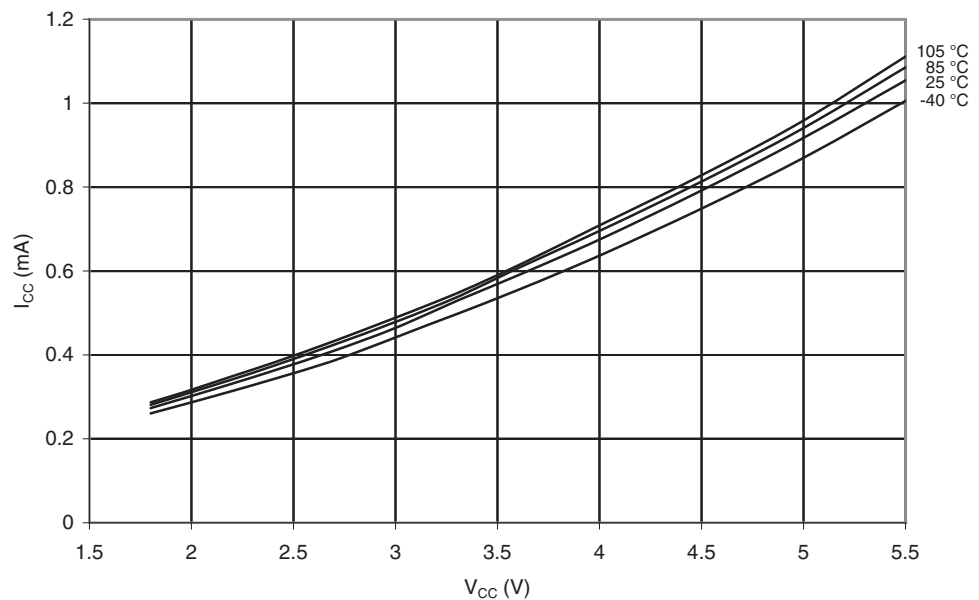
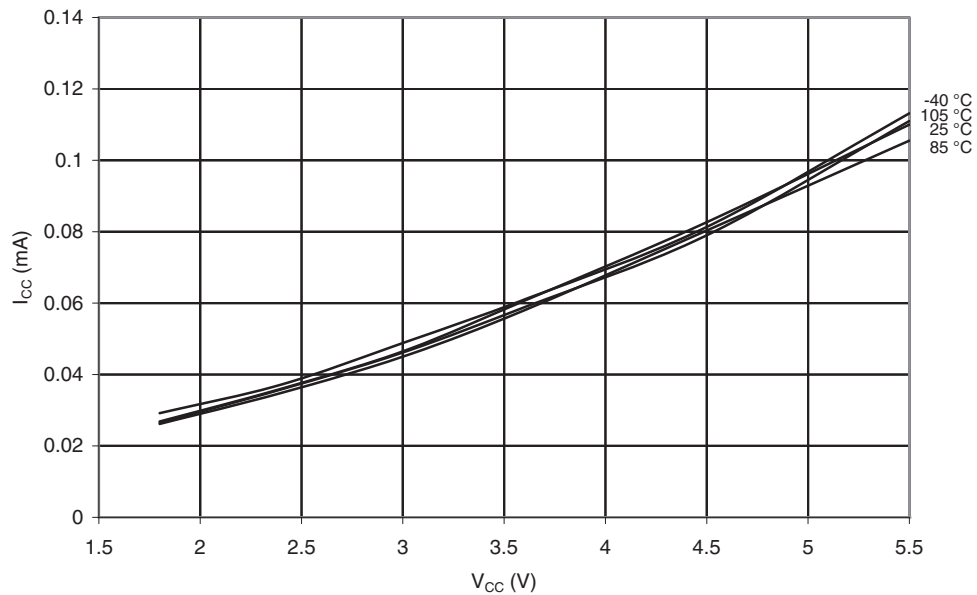


Figure 3-3. Active Supply Current vs. V_{CC} (Internal RC Oscillator, 128 kHz)



3.1.2 Current Consumption in Idle Mode

Figure 3-4. Idle Supply Current vs. V_{CC} (Internal RC Oscillator, 8 MHz)

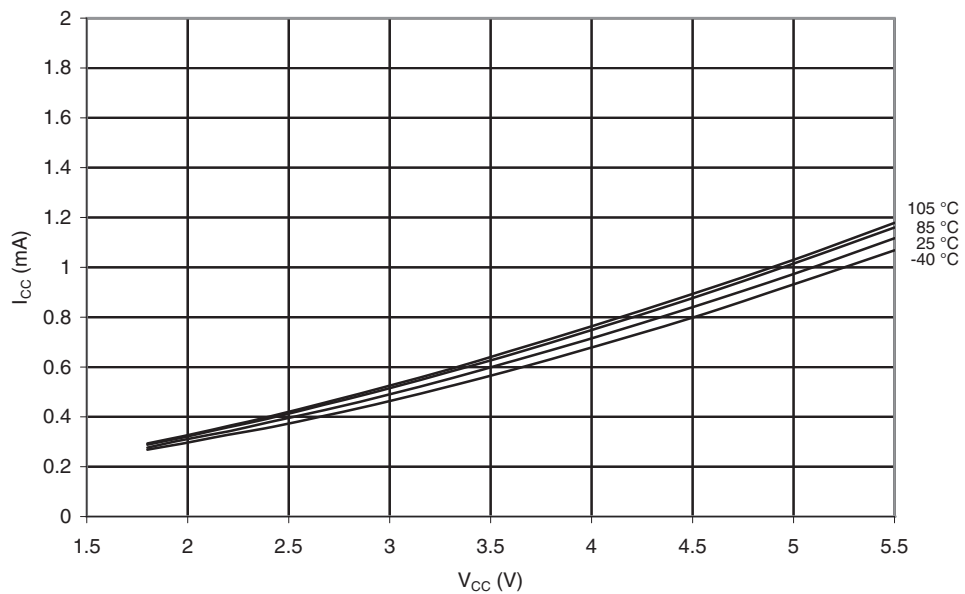


Figure 3-5. Idle Supply Current vs. V_{CC} (Internal RC Oscillator, 1 MHz)

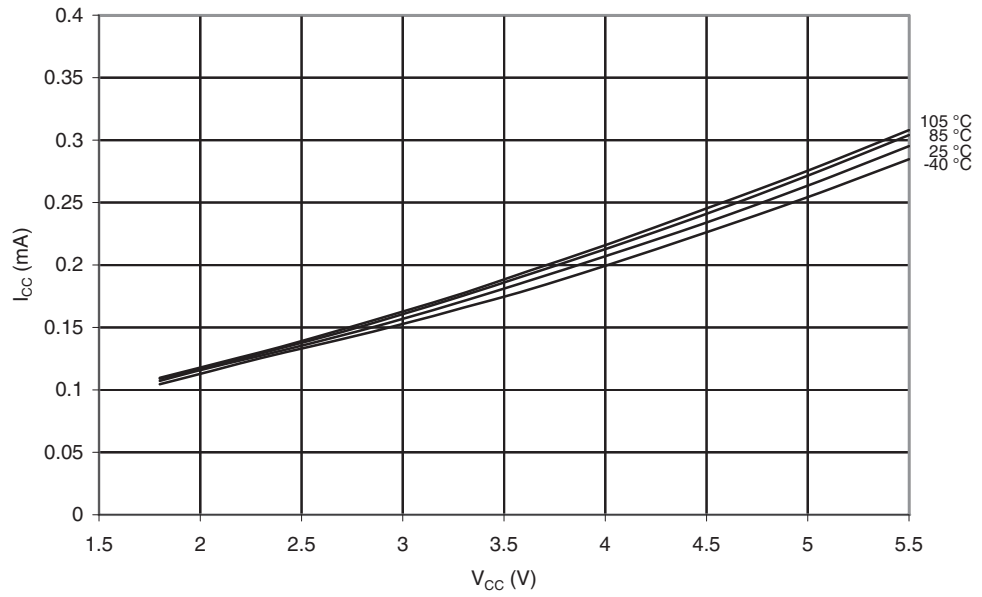
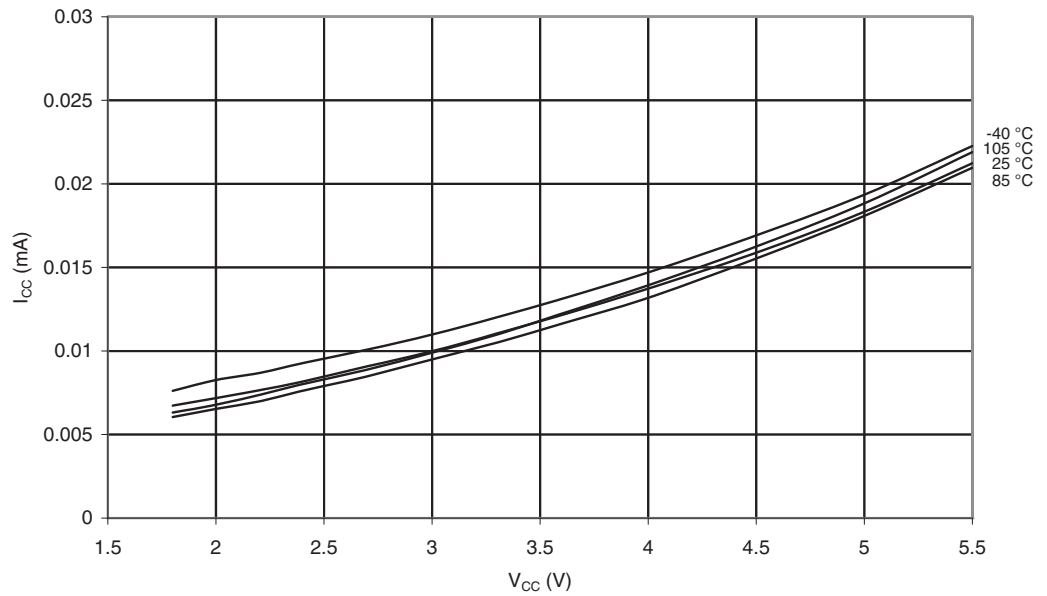
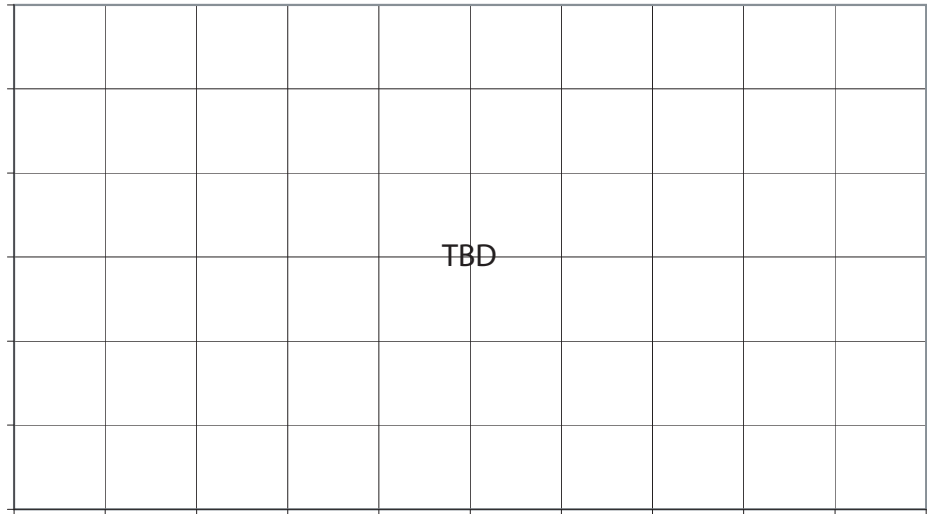


Figure 3-6. Idle Supply Current vs. V_{CC} (Internal RC Oscillator, 128 kHz)



3.1.3 Current Consumption of Standby Supply

Figure 3-7. Standby Supply Current vs. V_{CC} (4 MHz External Crystal, External Capacitors, Watchdog Timer Disabled)



3.1.4 Current Consumption in Power-down Mode

Figure 3-8. Power-down Supply Current vs. V_{CC} (Watchdog Timer Disabled)

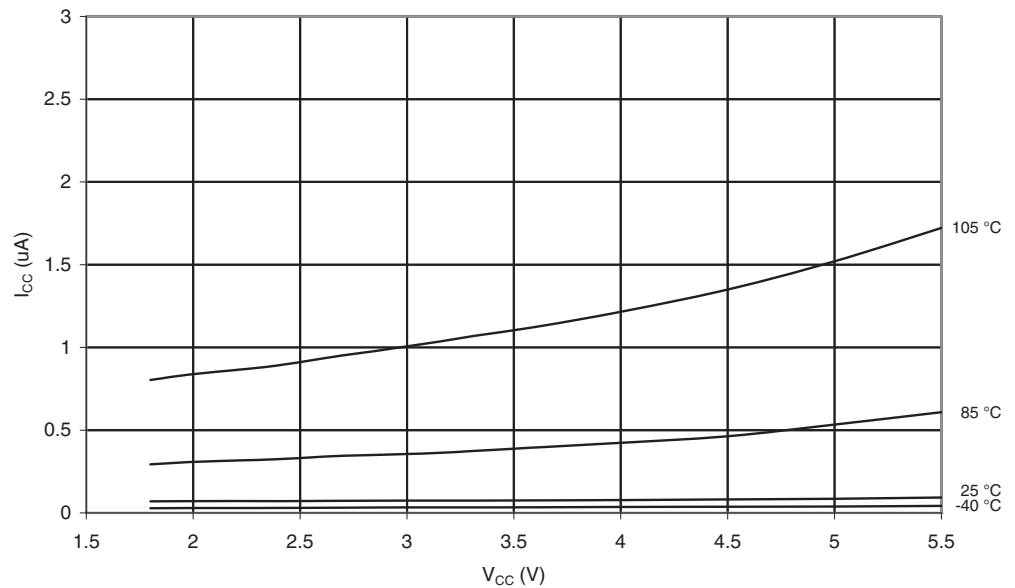
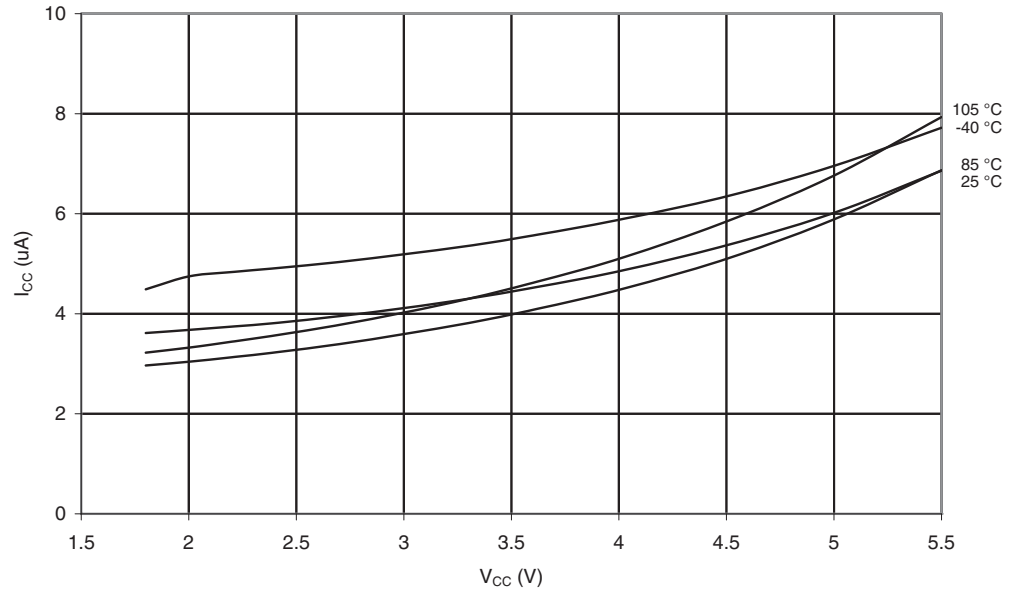


Figure 3-9. Power-down Supply Current vs. V_{CC} (Watchdog Timer Enabled)



3.1.5 Current Consumption of Peripheral Units

Figure 3-10. Programming Current vs. V_{CC}

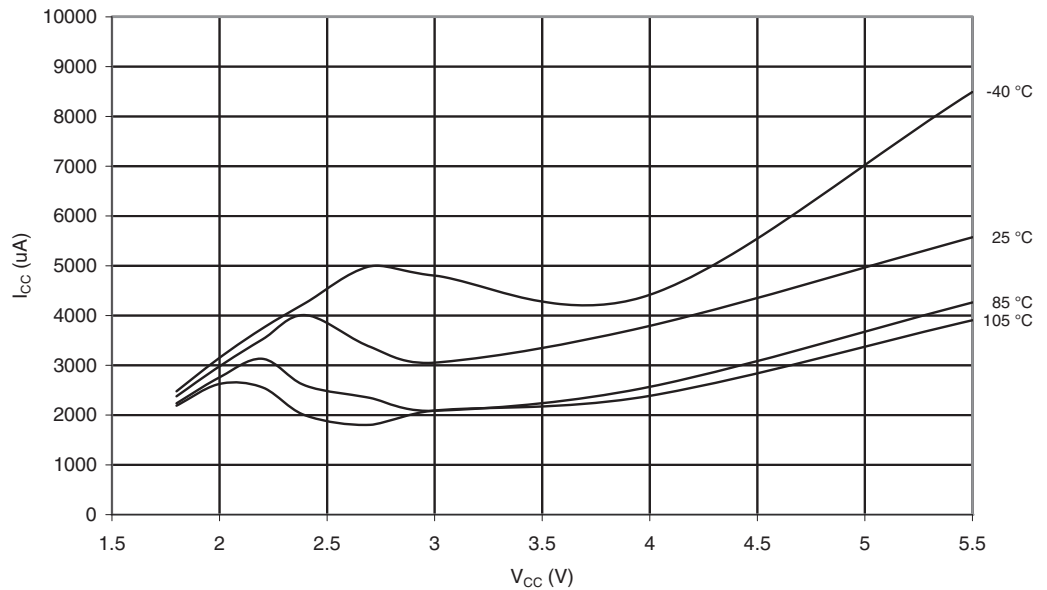


Figure 3-11. Brownout Detector Current vs. V_{CC} (BOD Level = 1.8V)

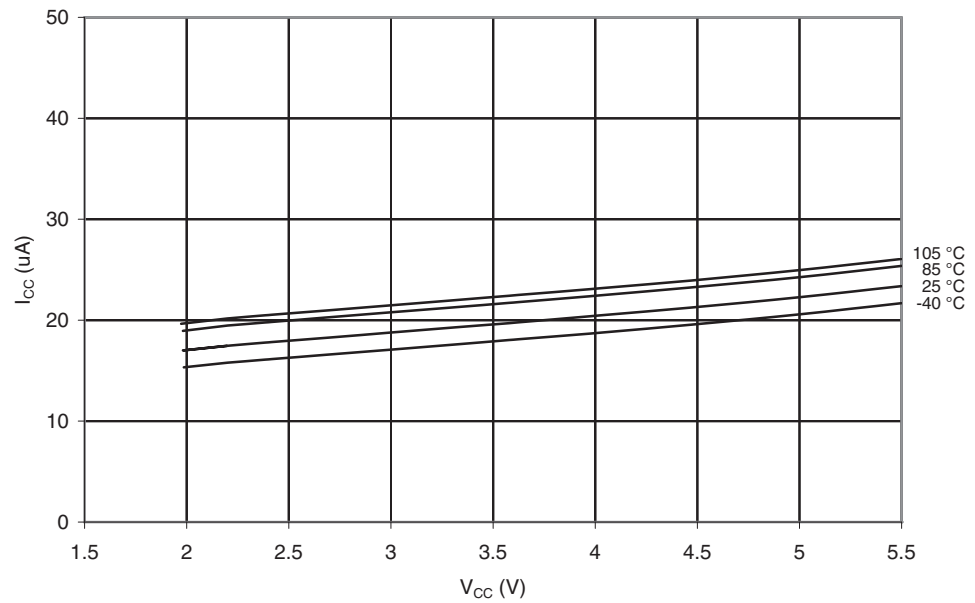
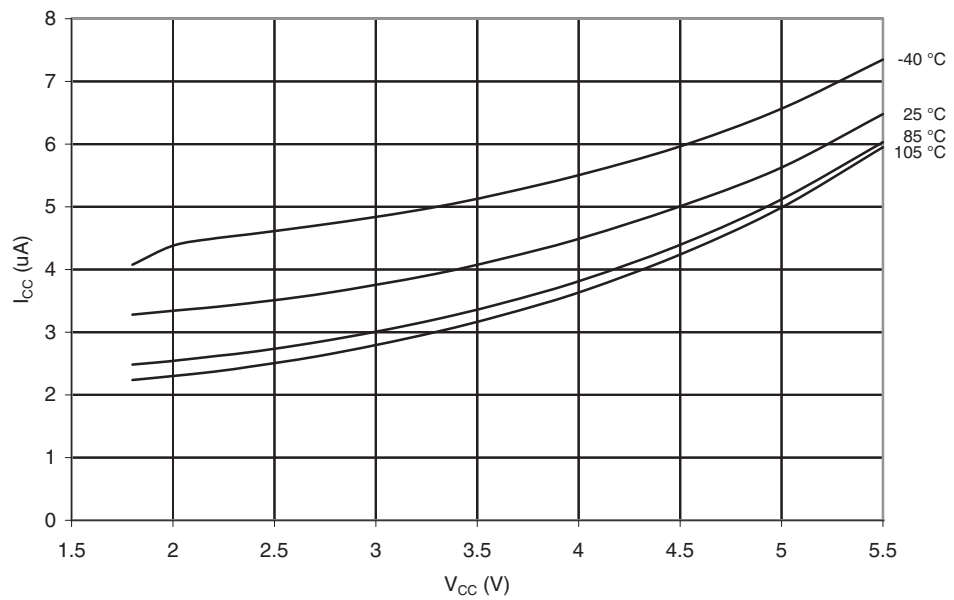


Figure 3-12. Watchdog Timer Current vs. V_{CC}



3.1.6 Pull-up Resistors

Figure 3-13. Pull-up Resistor Current vs. Input Voltage (I/O Pin, $V_{CC} = 1.8V$)

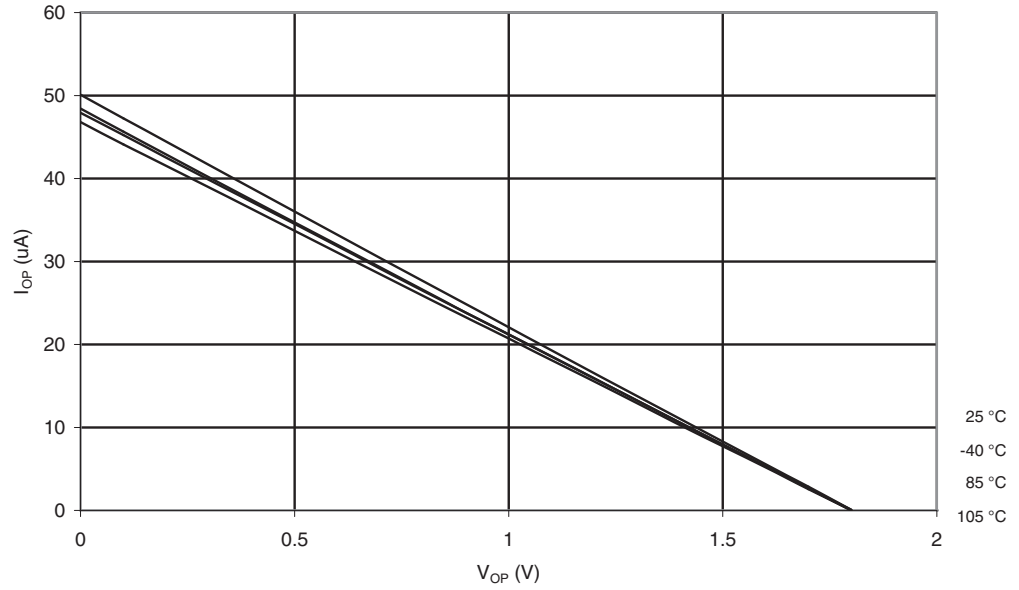


Figure 3-14. Pull-up Resistor Current vs. input Voltage (I/O Pin, $V_{CC} = 2.7V$)

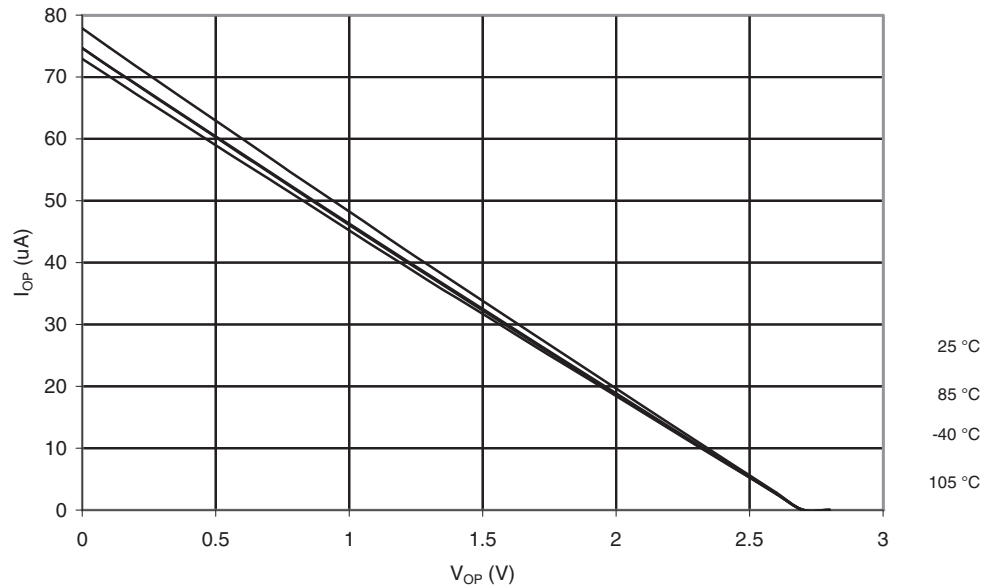


Figure 3-15. Pull-up Resistor Current vs. Input Voltage (I/O Pin, $V_{CC} = 5V$)

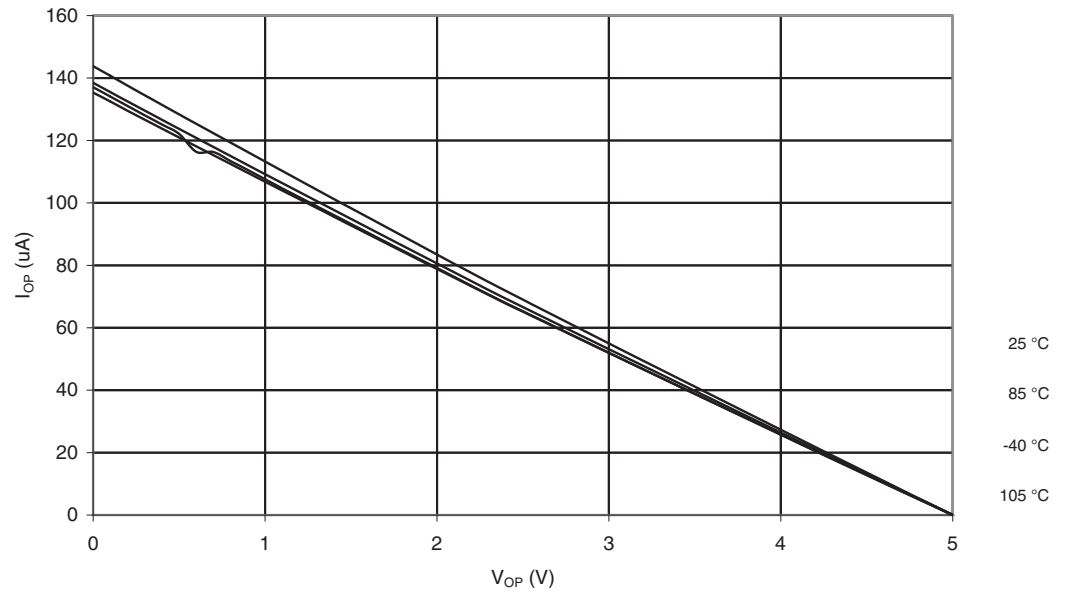


Figure 3-16. Reset Pull-up Resistor Current vs. Reset Pin Voltage ($V_{CC} = 1.8V$)

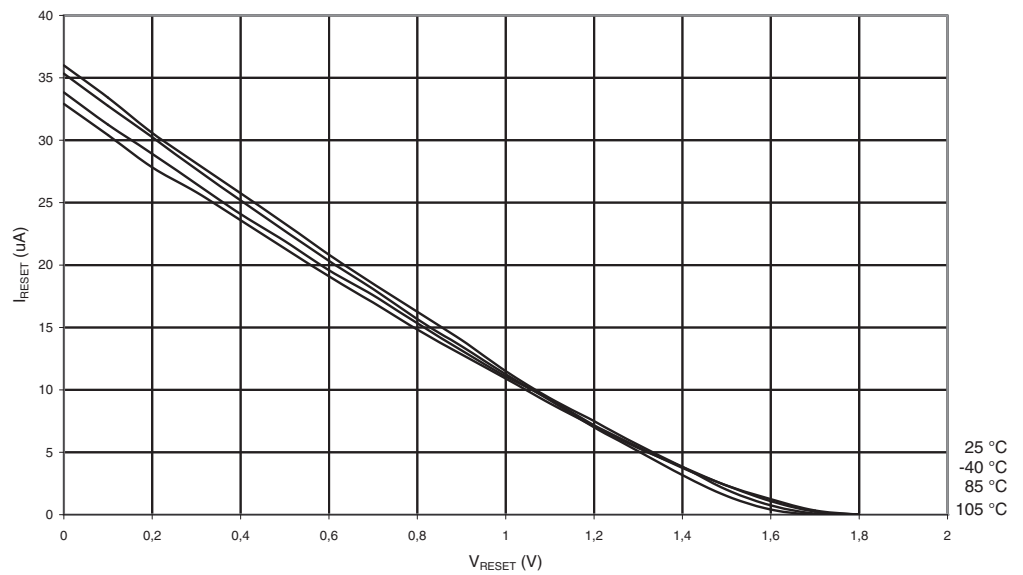


Figure 3-17. Reset Pull-up Resistor Current vs. Reset Pin Voltage ($V_{CC} = 2.7V$)

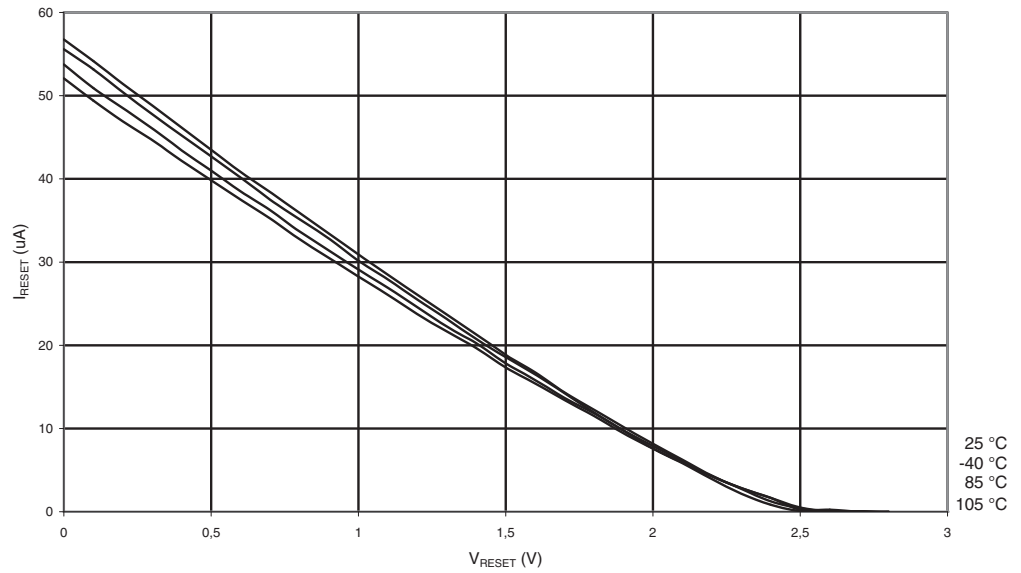
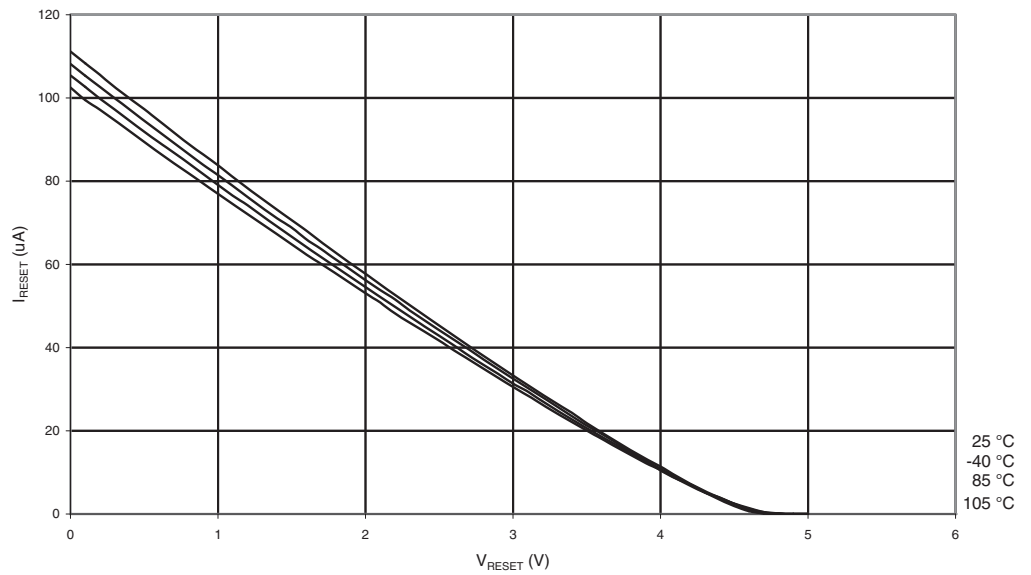


Figure 3-18. Reset Pull-up Resistor Current vs. Reset Pin Voltage ($V_{CC} = 5V$)



3.1.7 Output Driver Strength

Figure 3-19. V_{OL} : Output Voltage vs. Sink Current (I/O Pin, $V_{CC} = 1.8V$)

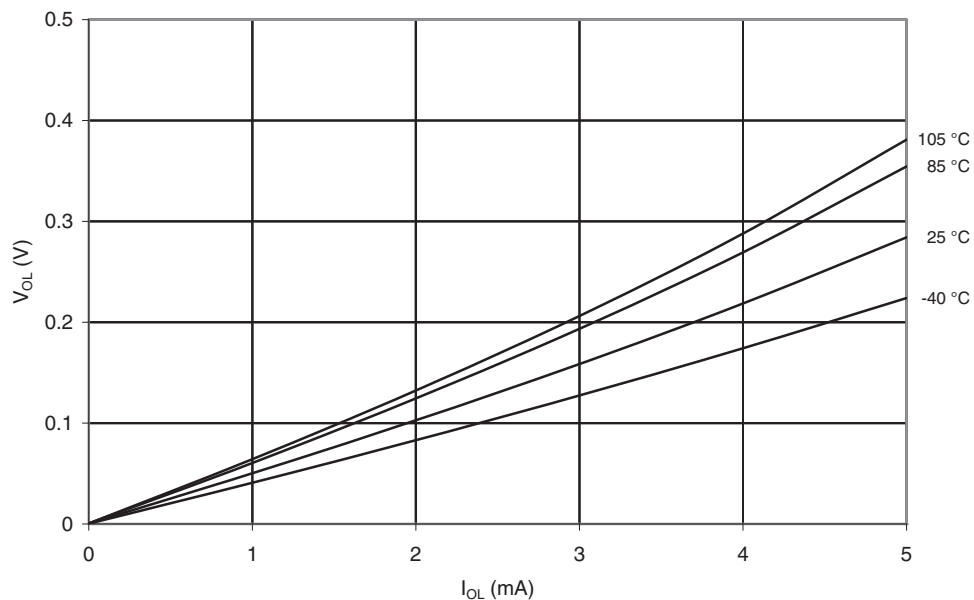


Figure 3-20. V_{OL} : Output Voltage vs. Sink Current (I/O Pin, $V_{CC} = 3V$)

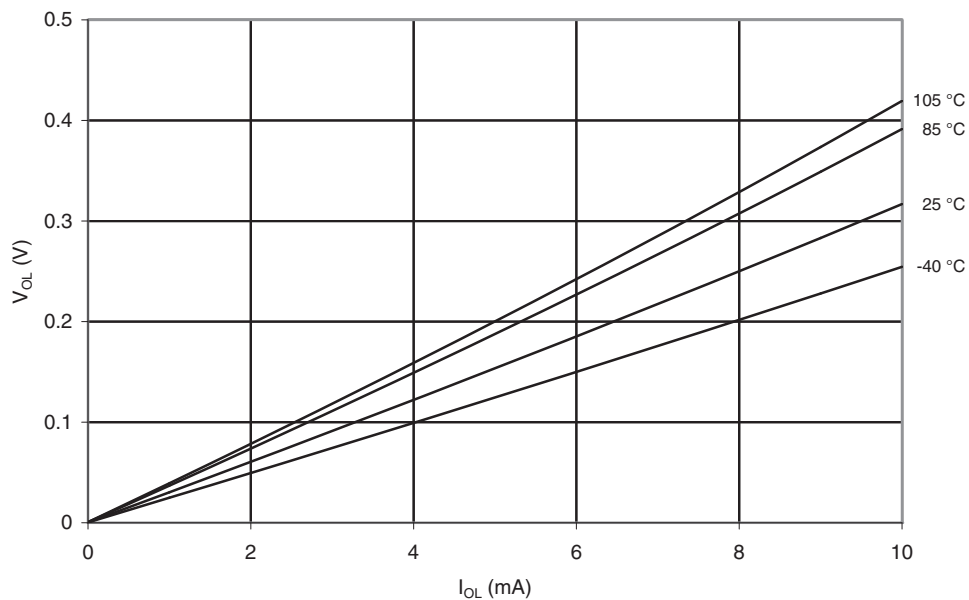


Figure 3-21. V_{OL} : Output Voltage vs. Sink Current (I/O Pin, $V_{CC} = 5V$)

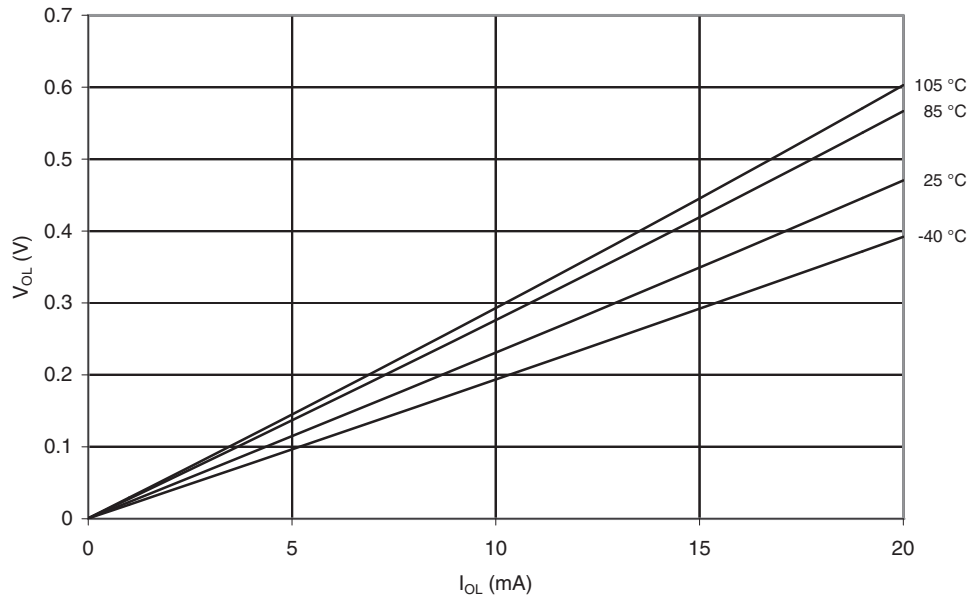


Figure 3-22. V_{OH} : Output Voltage vs. Source Current (I/O Pin, $V_{CC} = 1.8V$)

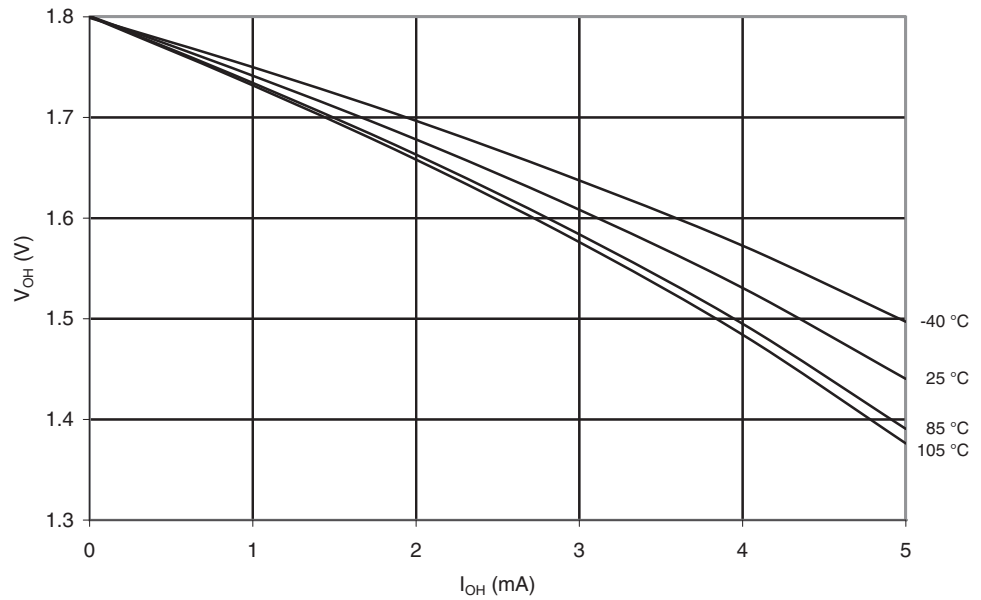


Figure 3-23. V_{OH} : Output Voltage vs. Source Current (I/O Pin, $V_{CC} = 3V$)

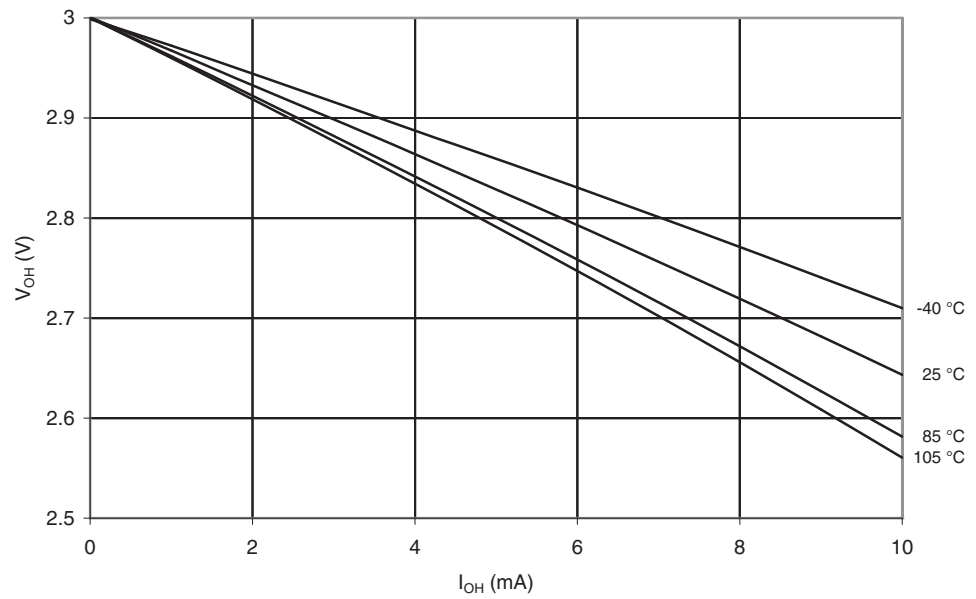


Figure 3-24. V_{OH} : Output Voltage vs. Source Current (I/O Pin, $V_{CC} = 5V$)

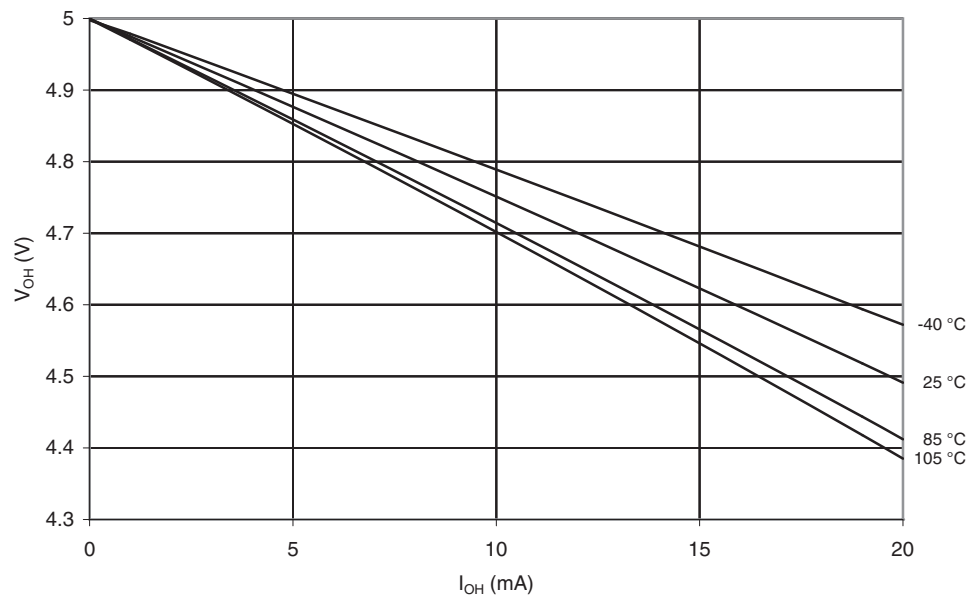


Figure 3-25. V_{OL} : Output Voltage vs. Sink Current (Reset Pin as I/O, $V_{CC} = 3V$)

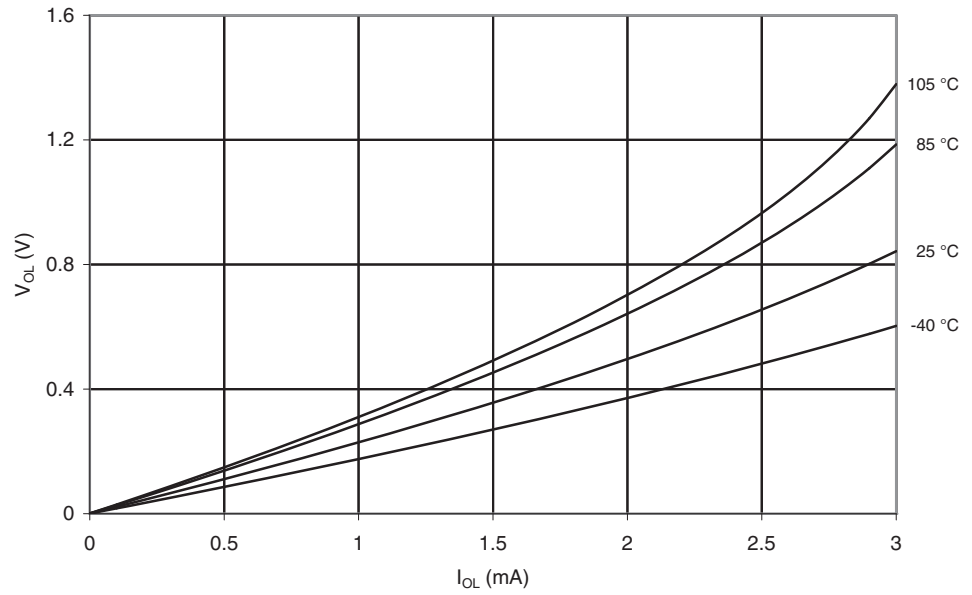


Figure 3-26. V_{OL} : Output Voltage vs. Sink Current (Reset Pin as I/O, $V_{CC} = 5V$)

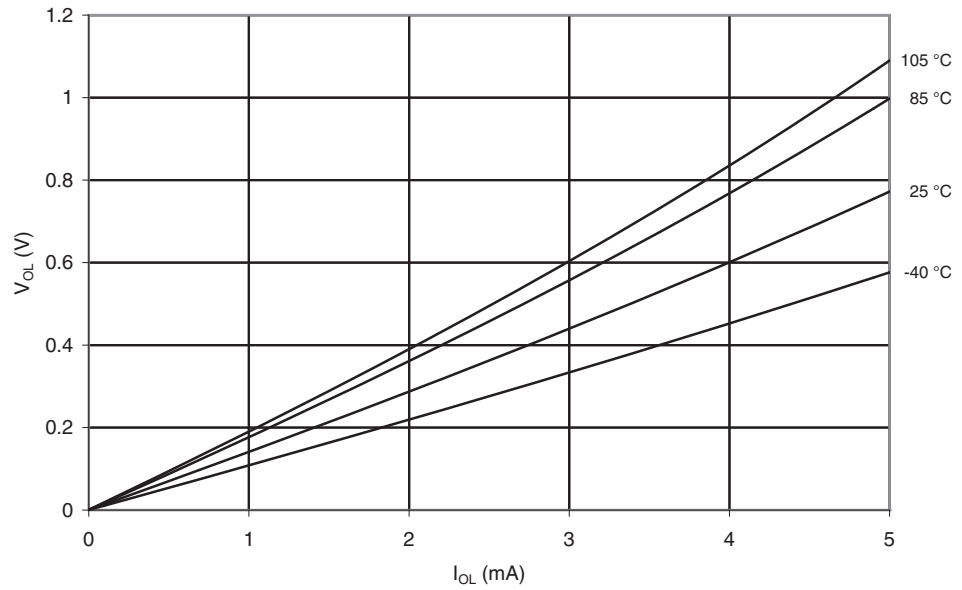


Figure 3-27. V_{OH} : Output Voltage vs. Source Current (Reset Pin as I/O, $V_{CC} = 3V$)

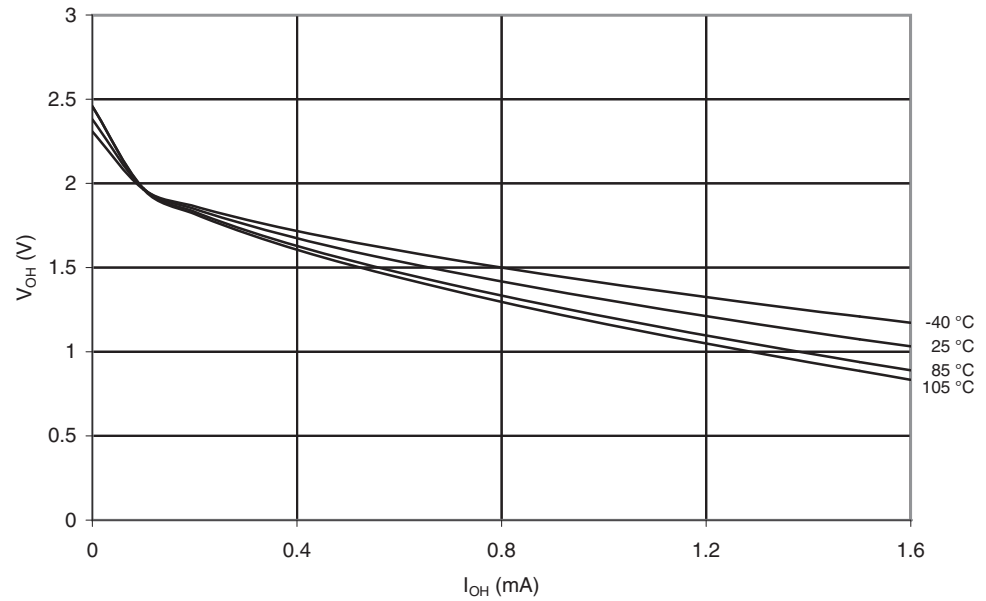
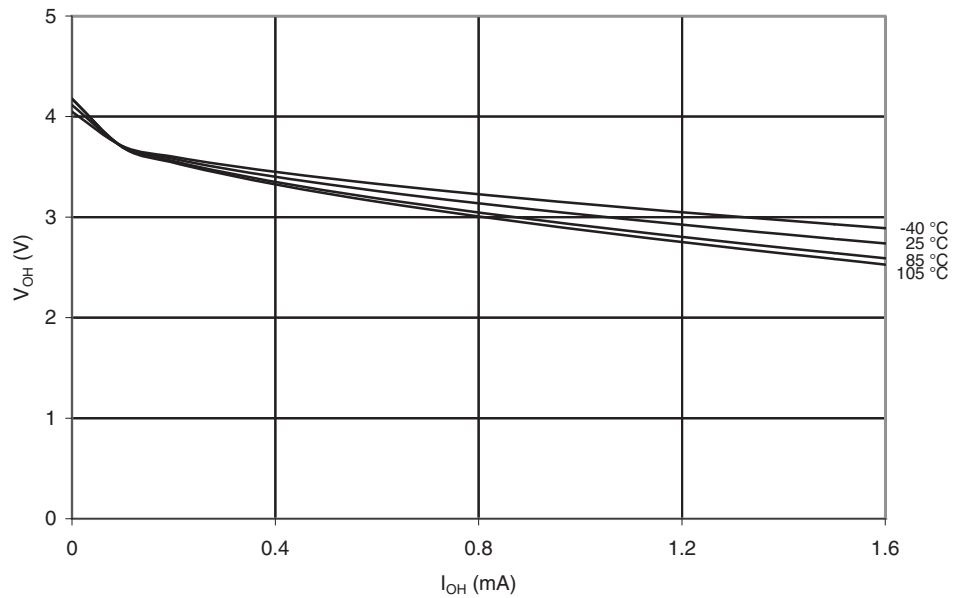


Figure 3-28. V_{OH} : Output Voltage vs. Source Current (Reset Pin as I/O, $V_{CC} = 5V$)



3.1.8 Input Threshold and Hysteresis (for I/O Ports)

Figure 3-29. V_{IH} : Input Threshold Voltage vs. V_{CC} (I/O Pin, Read as '1')

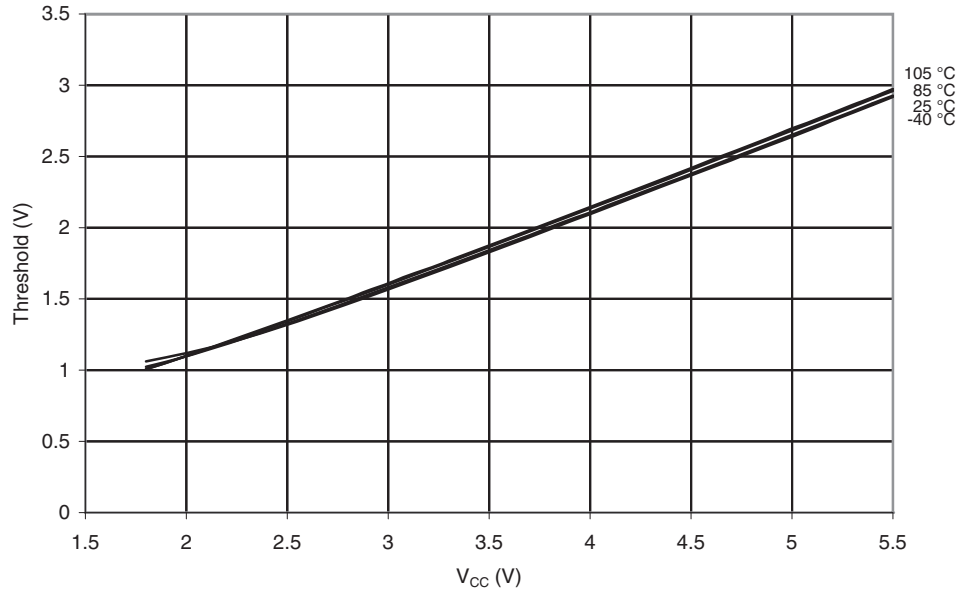


Figure 3-30. V_{IL} : Input Threshold Voltage vs. V_{CC} (I/O Pin, Read as '0')

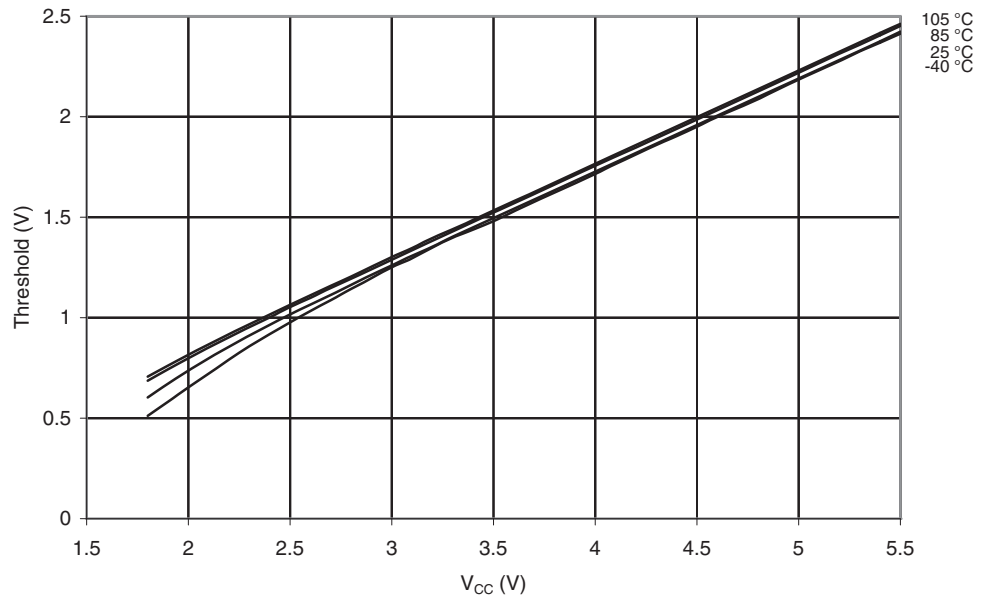


Figure 3-31. $V_{IH}-V_{IL}$: Input Hysteresis vs. V_{CC} (I/O Pin)

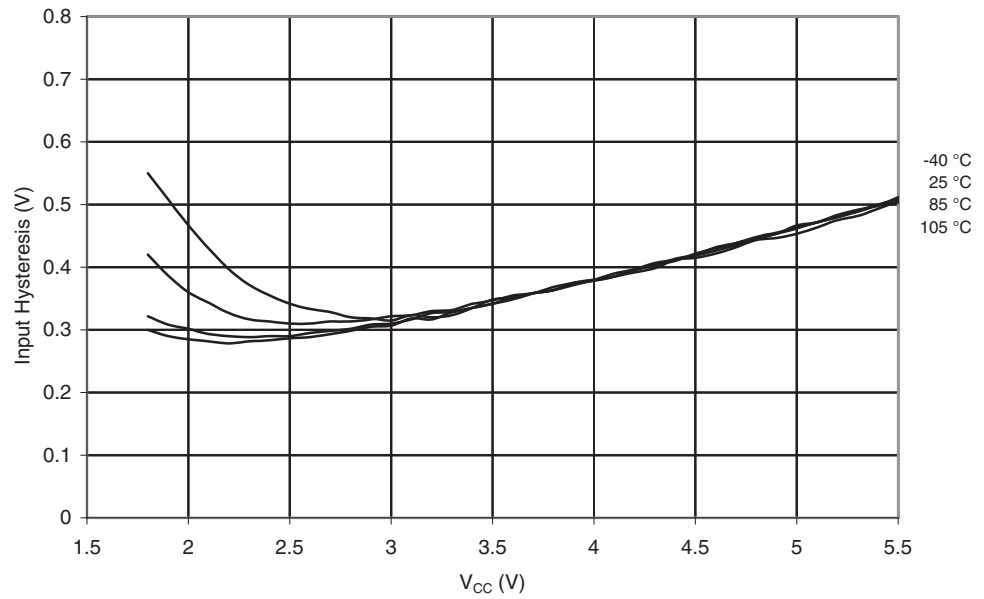


Figure 3-32. V_{IH} : Input Threshold Voltage vs. V_{CC} (Reset Pin as I/O, Read as '1')

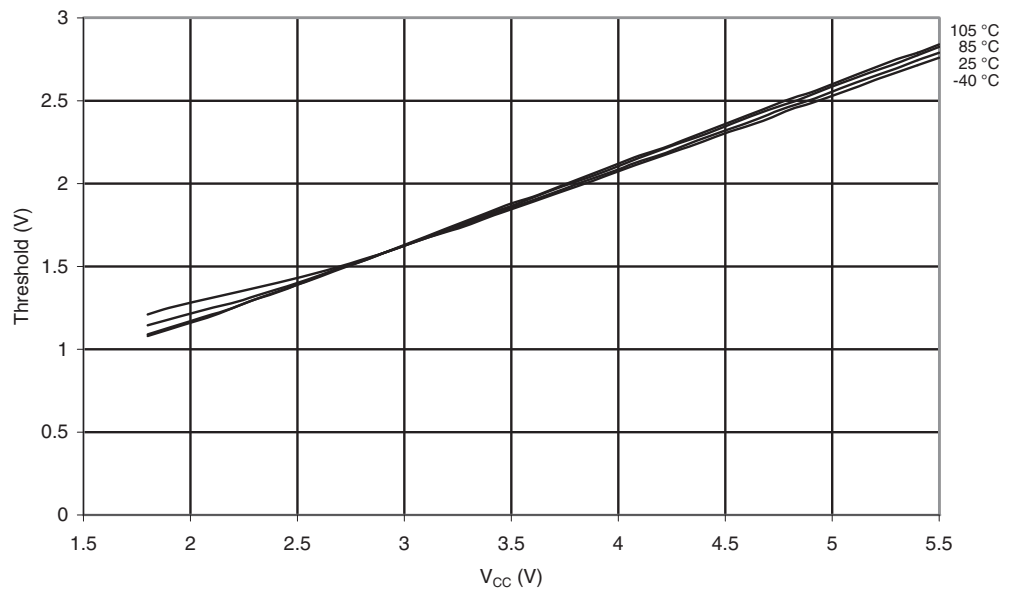


Figure 3-33. V_{IL} : Input Threshold Voltage vs. V_{CC} (Reset Pin as I/O, Read as '0')

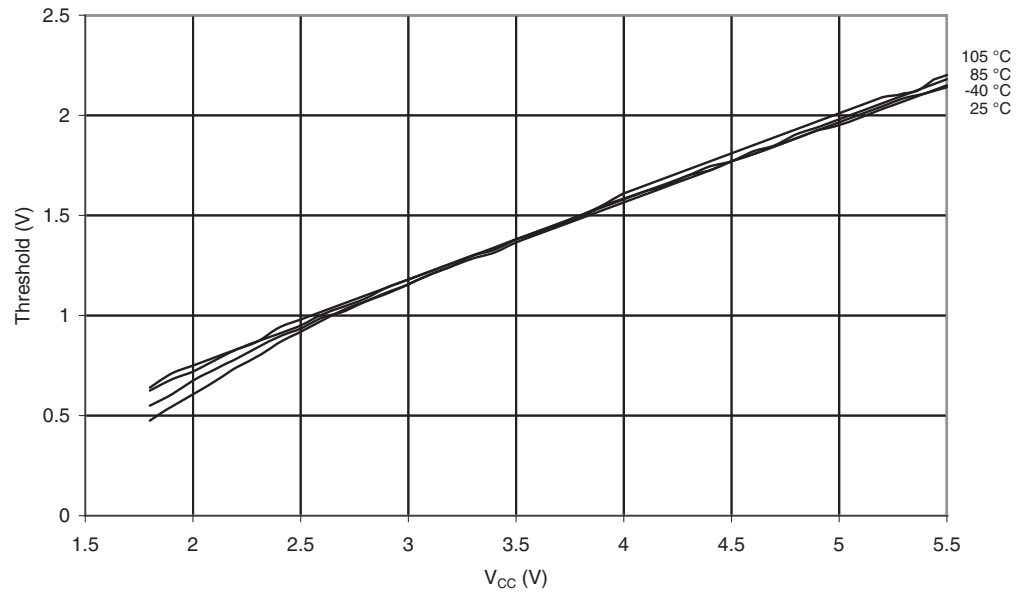
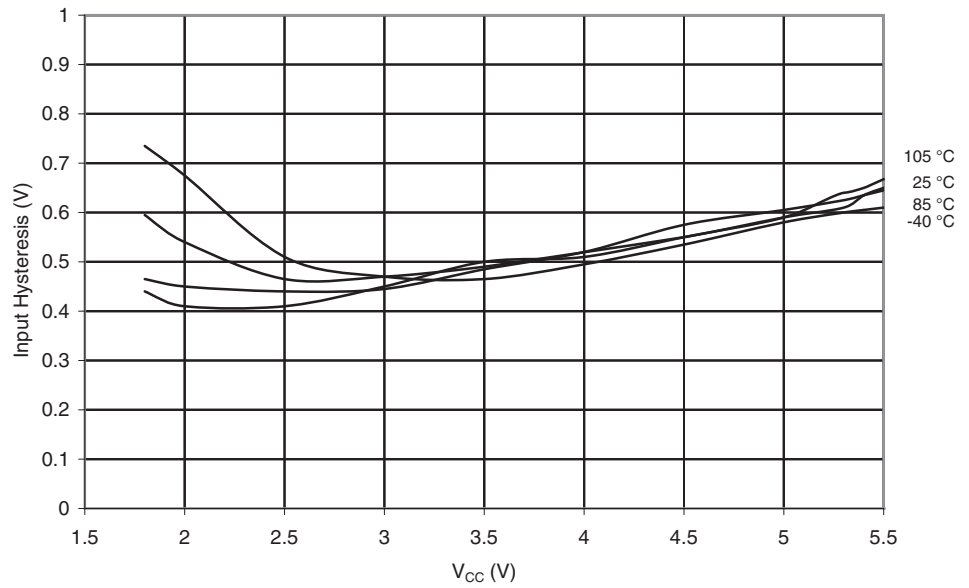


Figure 3-34. $V_{IH}-V_{IL}$: Input Hysteresis vs. V_{CC} (Reset Pin as I/O)



3.1.9 BOD and Bandgap

Figure 3-35. BOD Threshold vs. Temperature (BODLEVEL = 4.3V)

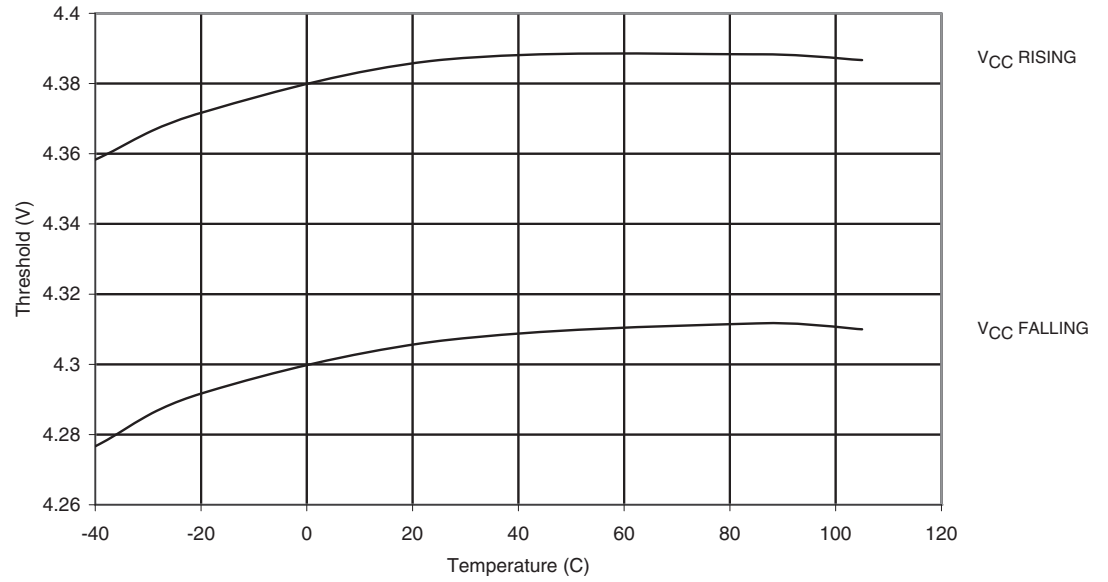


Figure 3-36. BOD Threshold vs. Temperature (BODLEVEL = 2.7V)

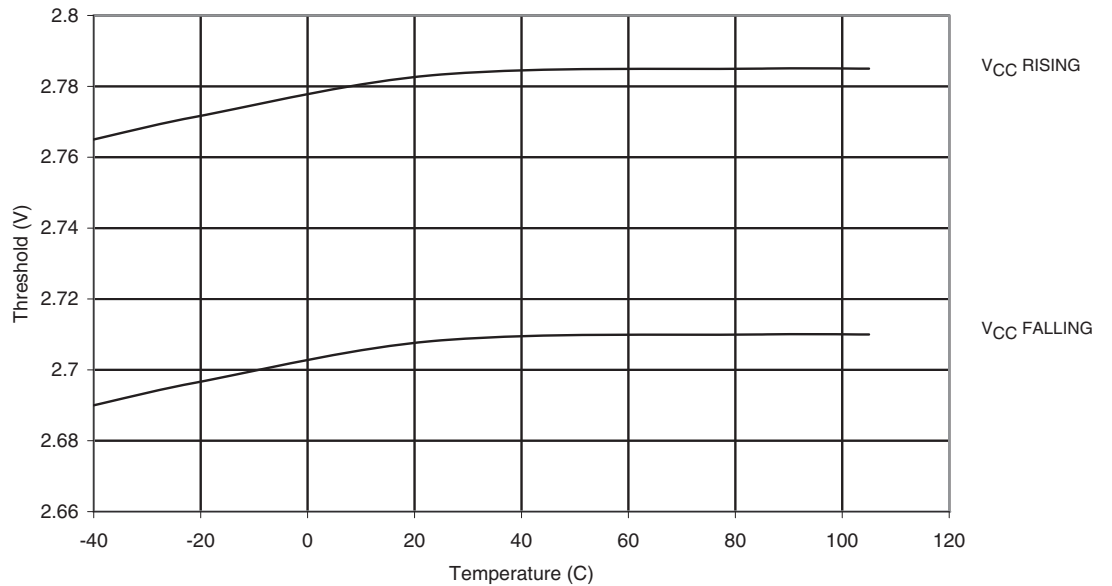


Figure 3-37. BOD Threshold vs. Temperature (BODLEVEL = 1.8V)

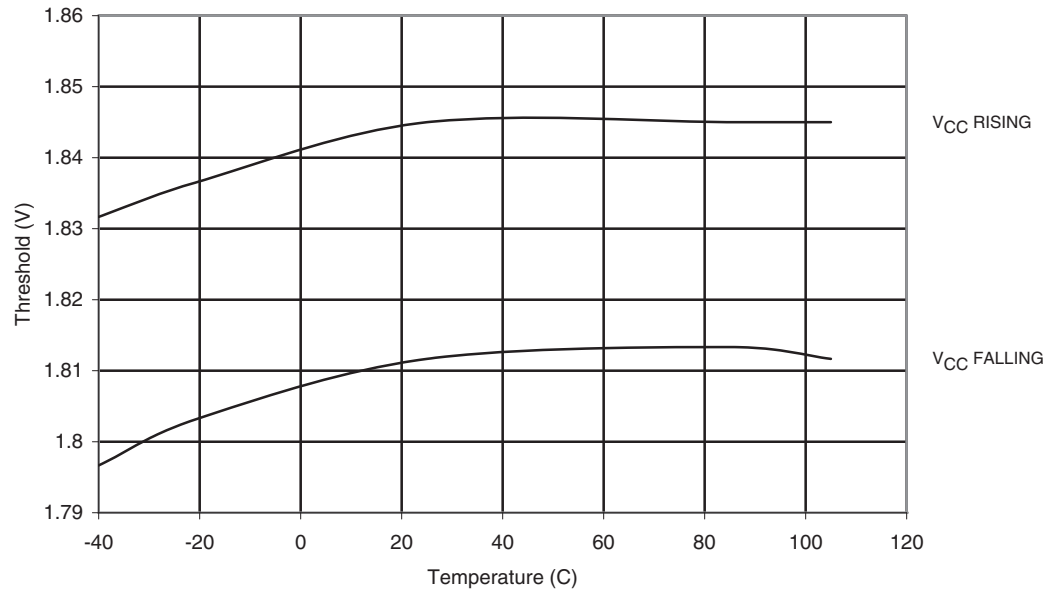


Figure 3-38. Bandgap Voltage vs. Temperature ($V_{CC} = 5V$)

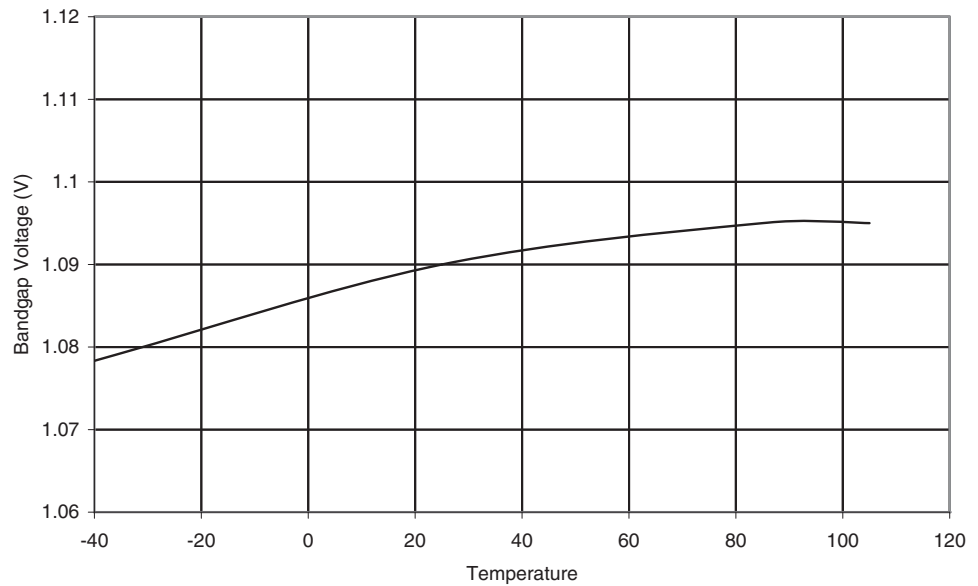


Figure 3-39. V_{IH} : Input Threshold Voltage vs. V_{CC} (Reset Pin, Read as '1')

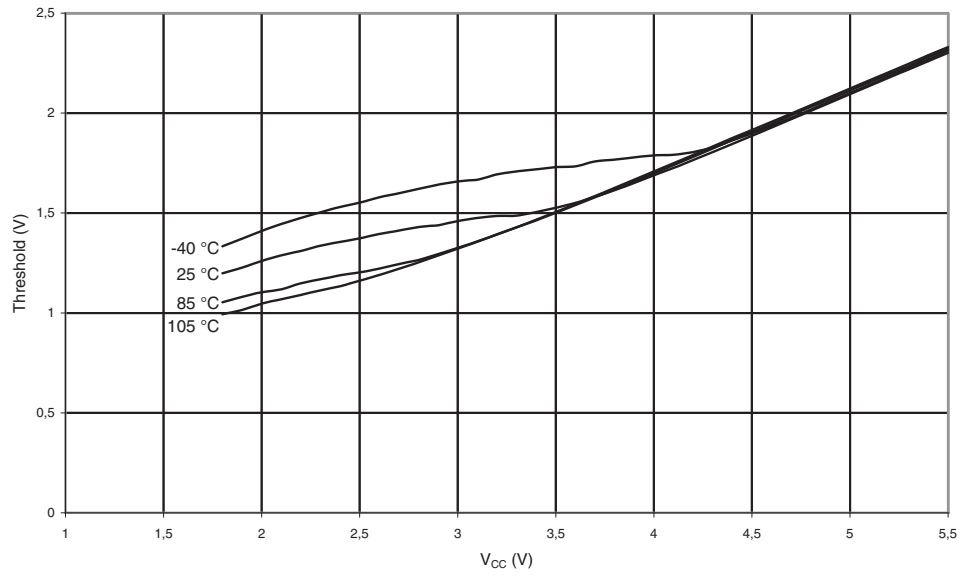


Figure 3-40. V_{IL} : Input Threshold Voltage vs. V_{CC} (Reset Pin, Read as '0')

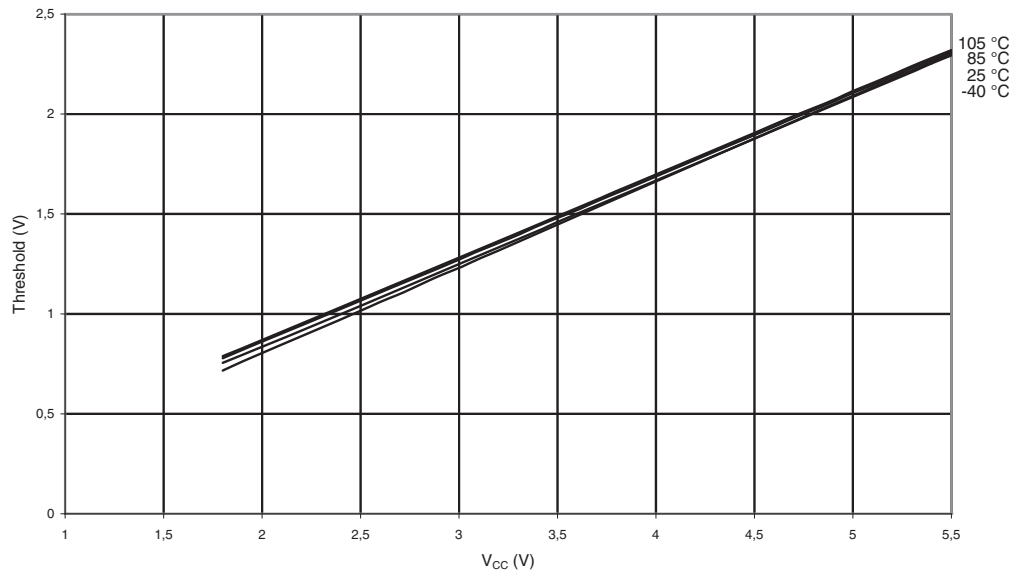


Figure 3-41. V_{IH} - V_{IL} : Input Hysteresis vs. V_{CC} (Reset Pin)

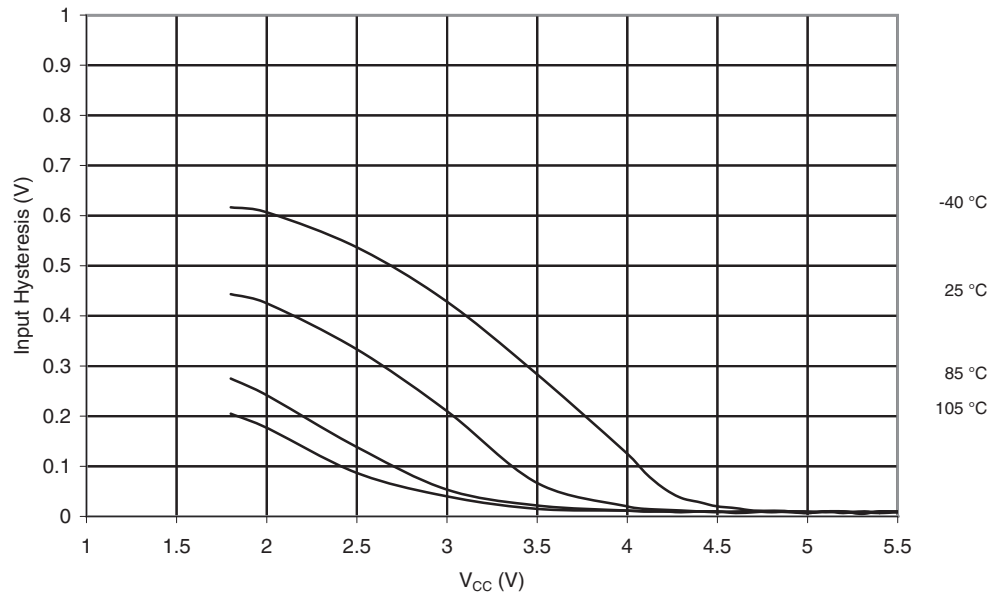
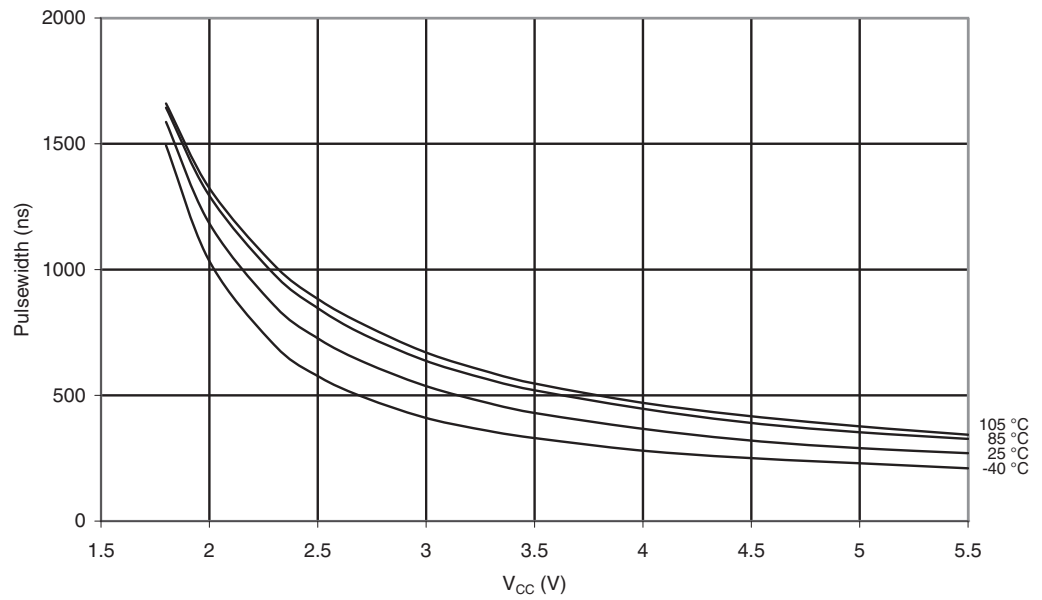
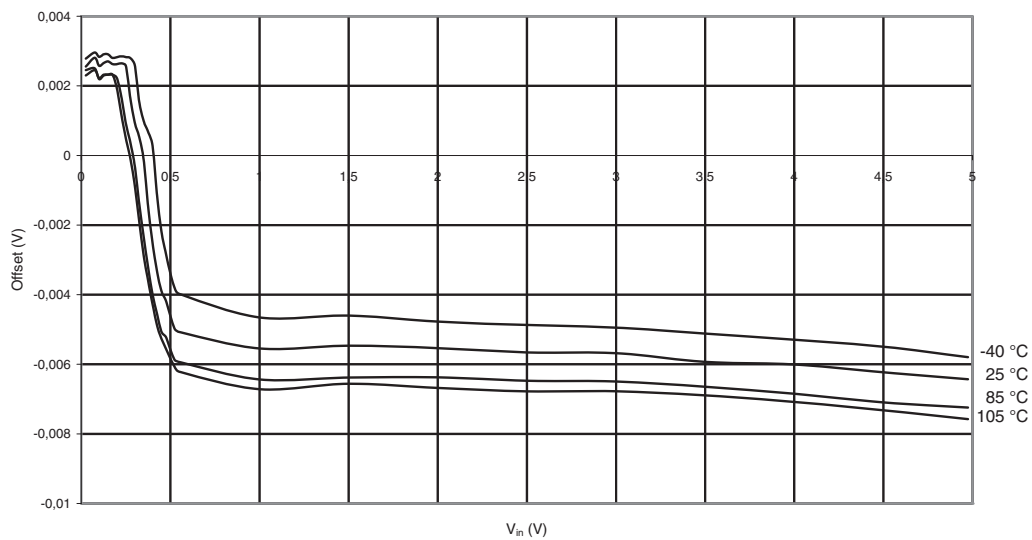


Figure 3-42. Minimum Reset Pulse Width vs. V_{CC}



3.1.10 Analog Comparator Offset

Figure 3-43. Analog Comparator Offset ($V_{CC} = 5V$)



3.1.11 Internal Oscillator Speed

Figure 3-44. Watchdog Oscillator Frequency vs. V_{CC}

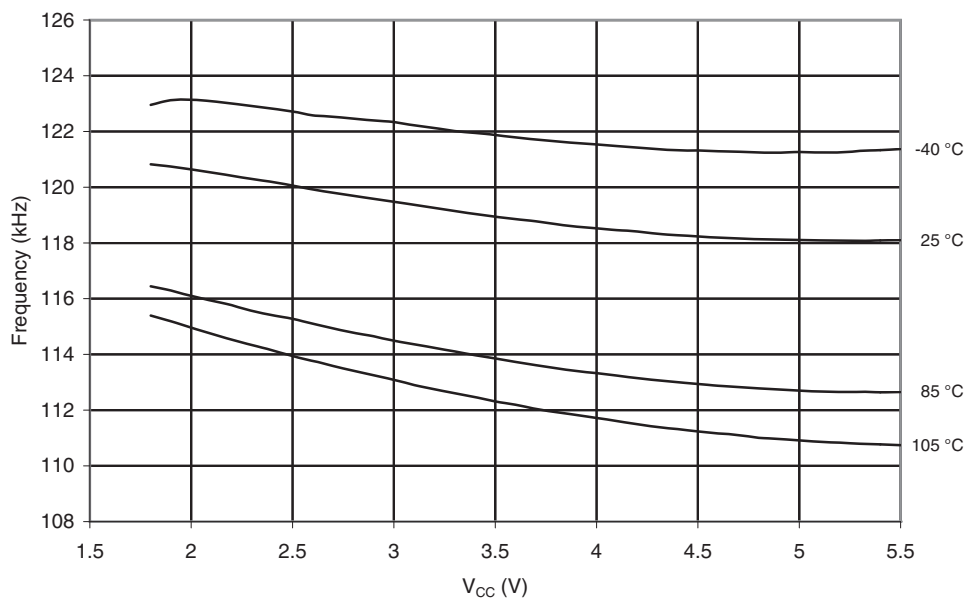


Figure 3-45. Watchdog Oscillator Frequency vs. Temperature

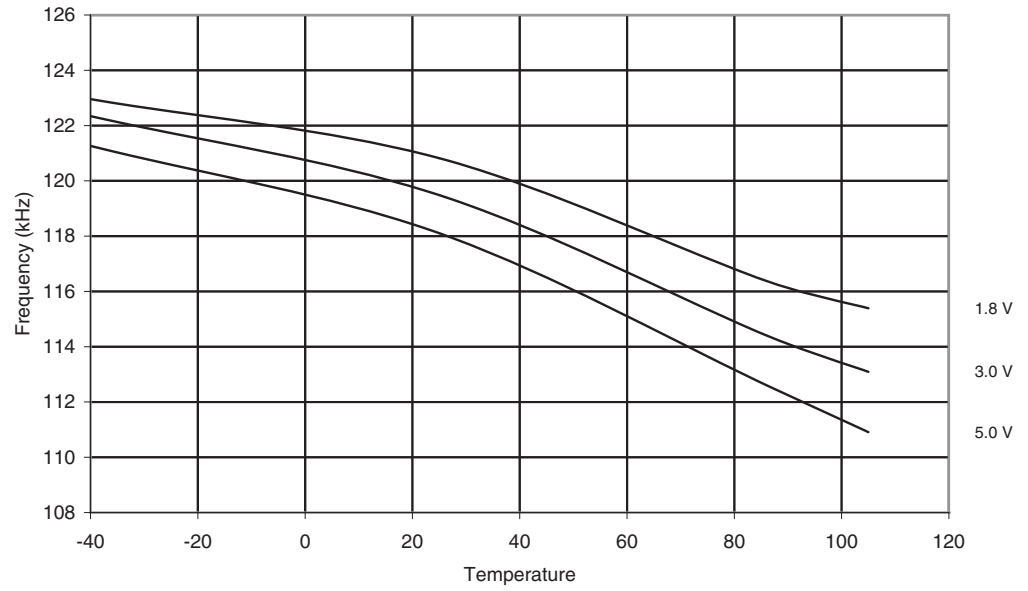


Figure 3-46. Calibrated 8 MHz Oscillator Frequency vs. Temperature

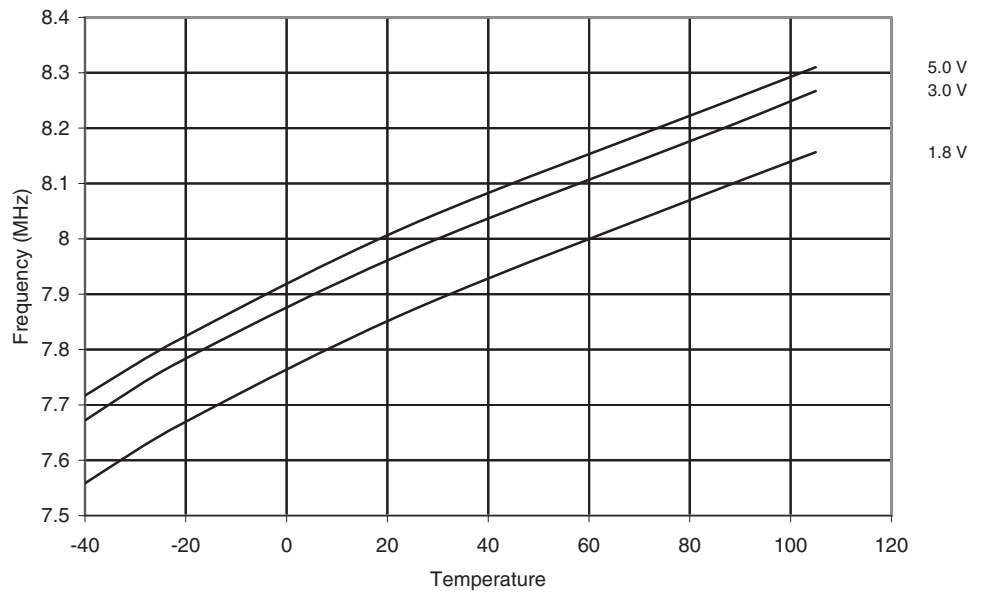
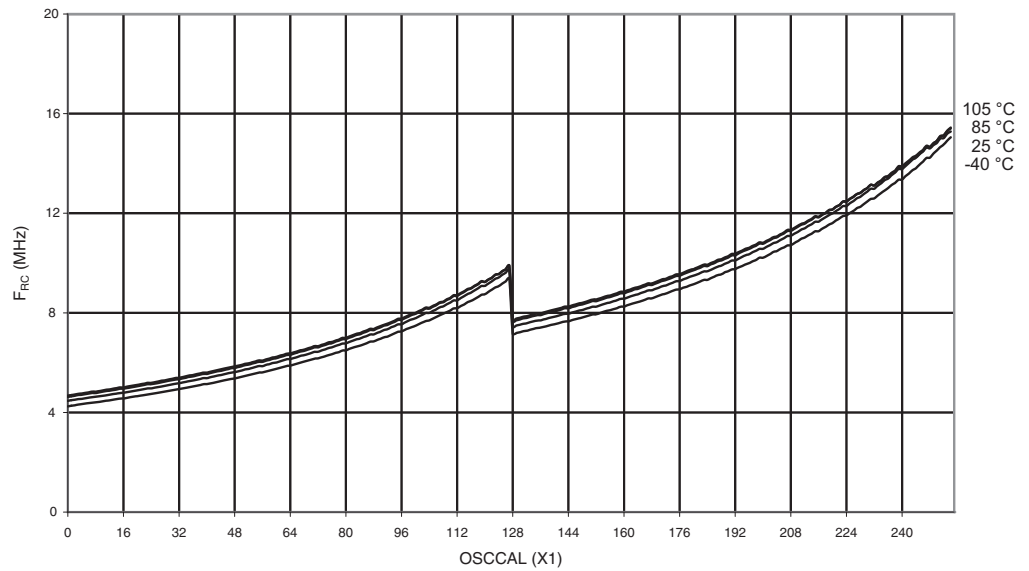


Figure 3-47. Calibrated 8 MHz Oscillator Frequency vs. OSCCAL Value ($V_{CC} = 3V$)



3.2 ATtiny44A

3.2.1 Current Consumption in Active Mode

Figure 3-48. Active Supply Current vs. V_{CC} (Internal RC Oscillator, 8 MHz)

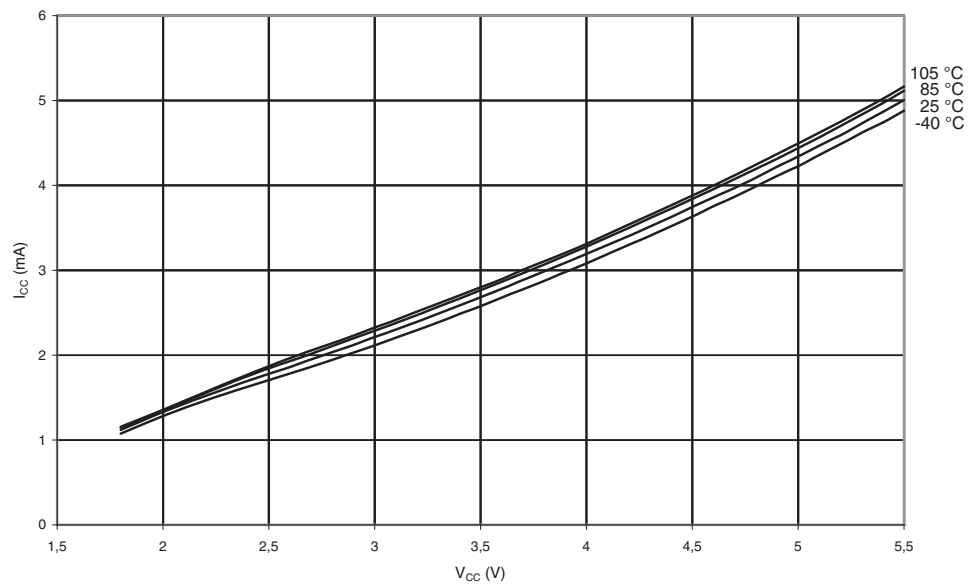


Figure 3-49. Active Supply Current vs. V_{CC} (Internal RC Oscillator, 1 MHz)

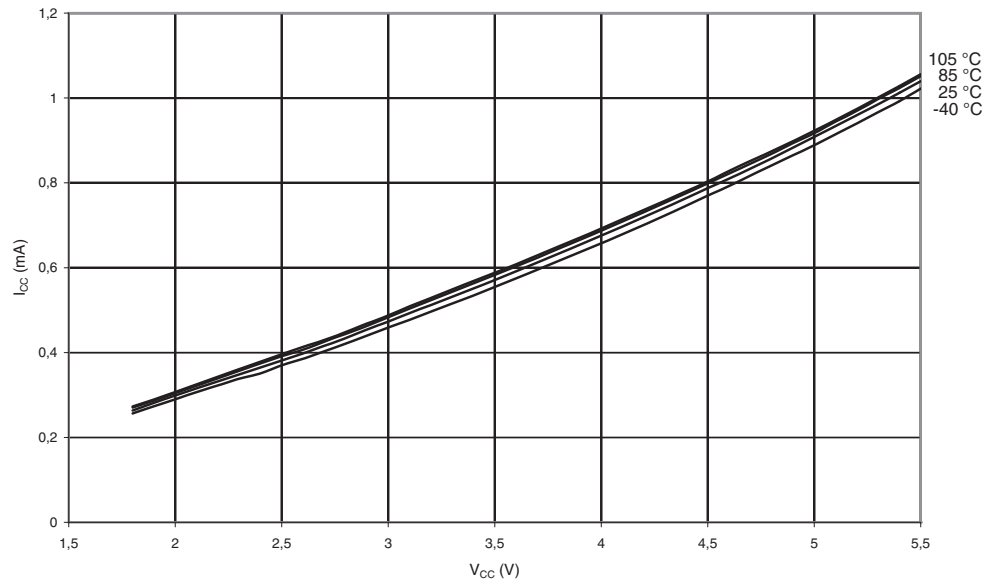
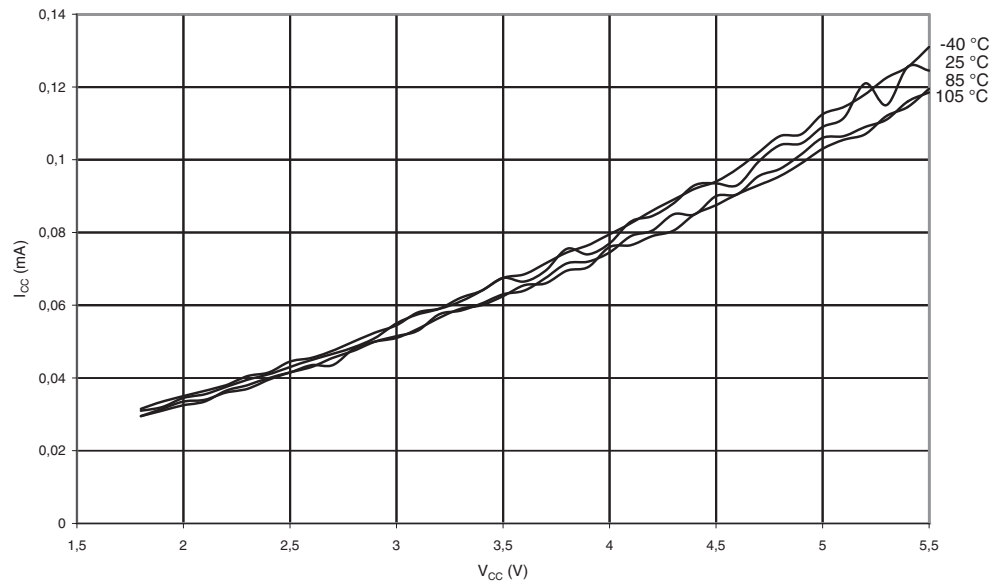


Figure 3-50. Active Supply Current vs. V_{CC} (Internal RC Oscillator, 128 kHz)



3.2.2 Current Consumption in Idle Mode

Figure 3-51. Idle Supply Current vs. V_{CC} (Internal RC Oscillator, 8 MHz)

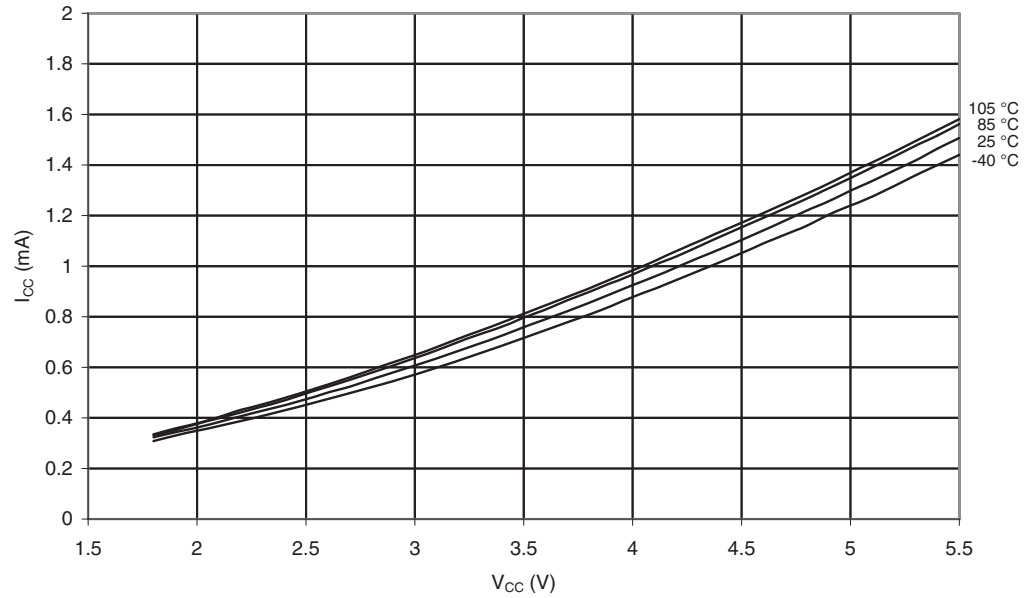


Figure 3-52. Idle Supply Current vs. V_{CC} (Internal RC Oscillator, 1 MHz)

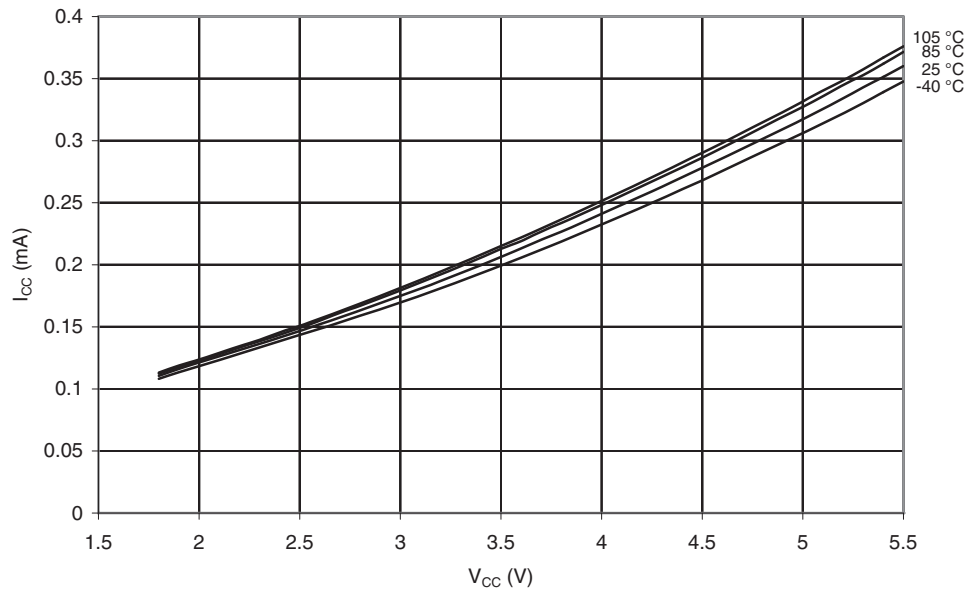
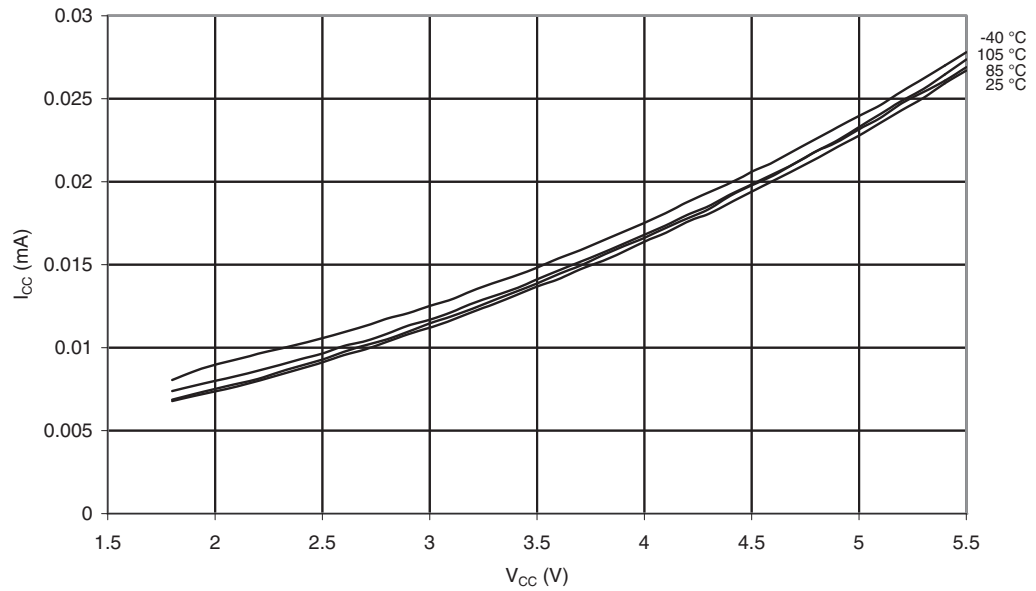
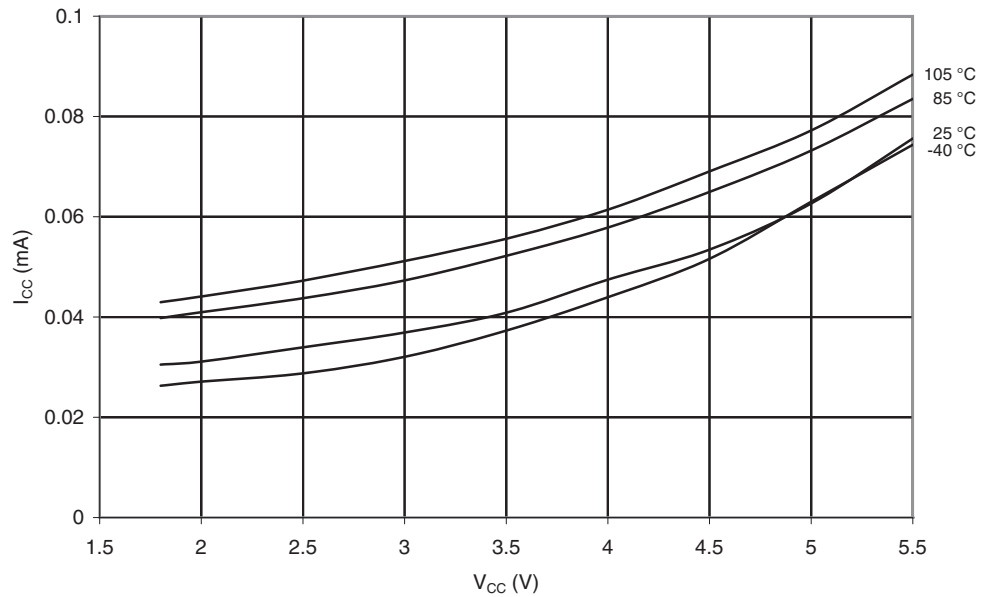


Figure 3-53. Idle Supply Current vs. V_{CC} (Internal RC Oscillator, 128 kHz)



3.2.3 Current Consumption of Standby Supply

Figure 3-54. Standby Supply Current vs. V_{CC} (4 MHz External Crystal, External Capacitors, Watchdog Timer Disabled)



3.2.4 Current Consumption in Power-down Supply Mode

Figure 3-55. Power-down Supply Current vs. V_{CC} (Watchdog Timer Disabled)

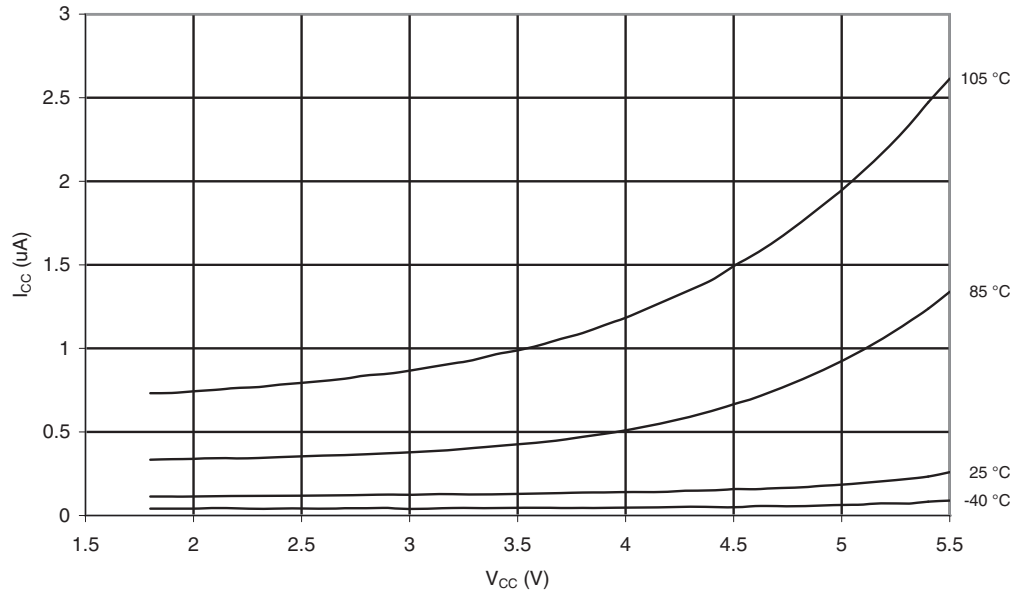
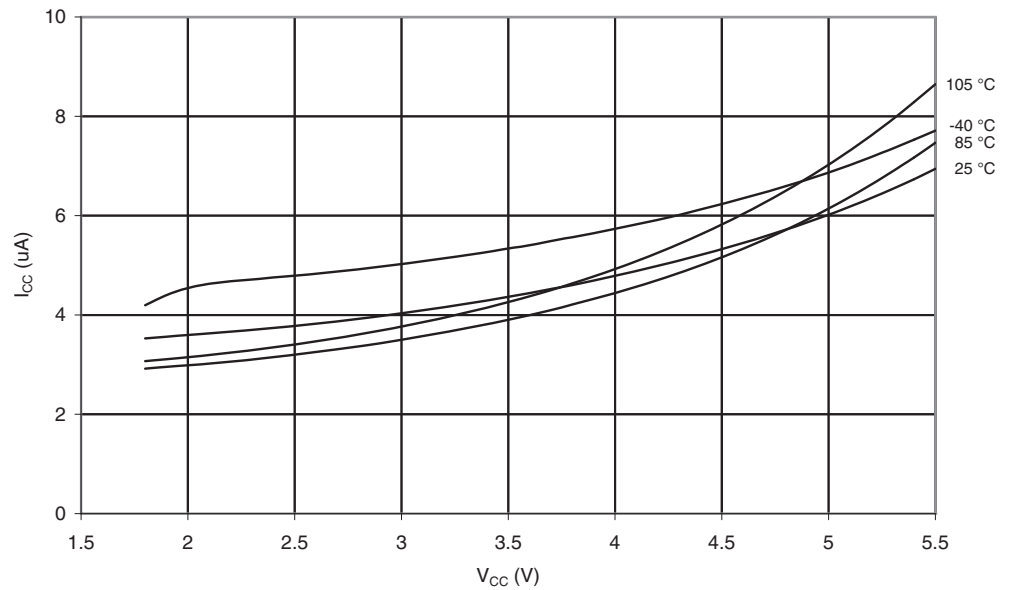


Figure 3-56. Power-down Supply Current vs. V_{CC} (Watchdog Timer Enabled)



3.2.5 Current Consumption of Peripheral Units

Figure 3-57. Programming Current vs. V_{CC}

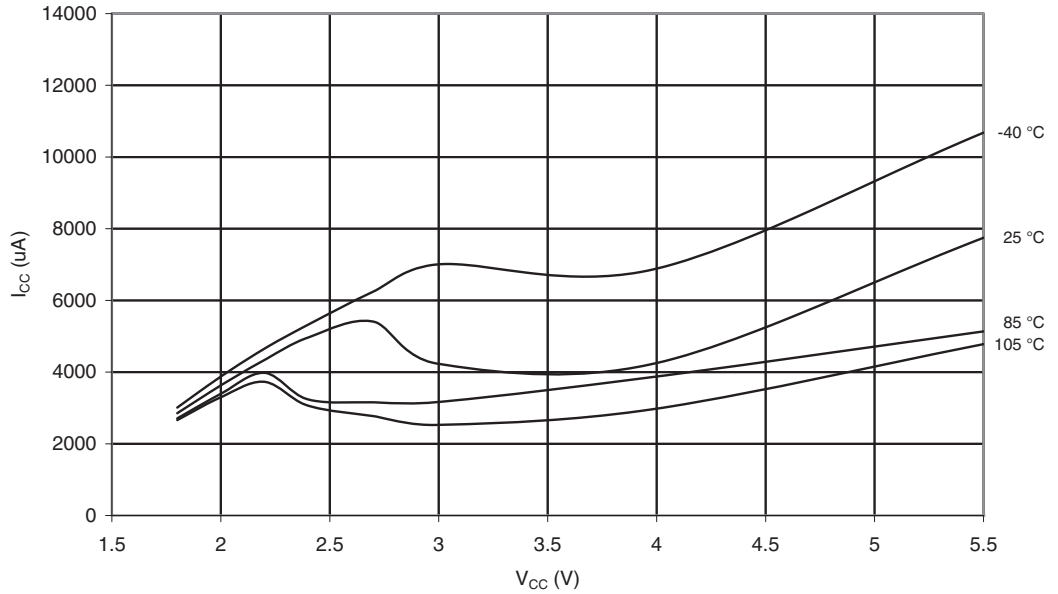


Figure 3-58. Brownout Detector Current vs. V_{CC} (BOD Level = 1.8V)

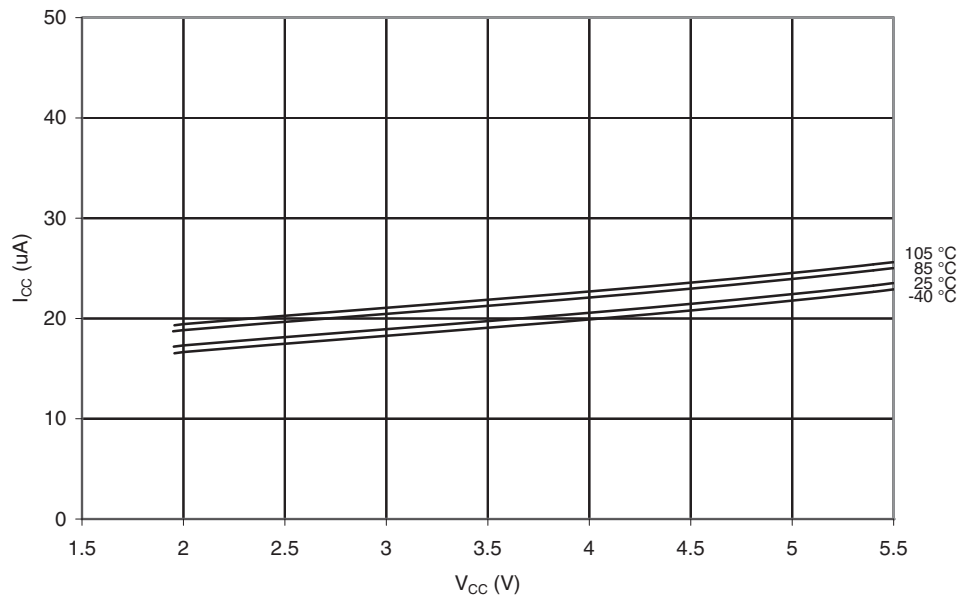
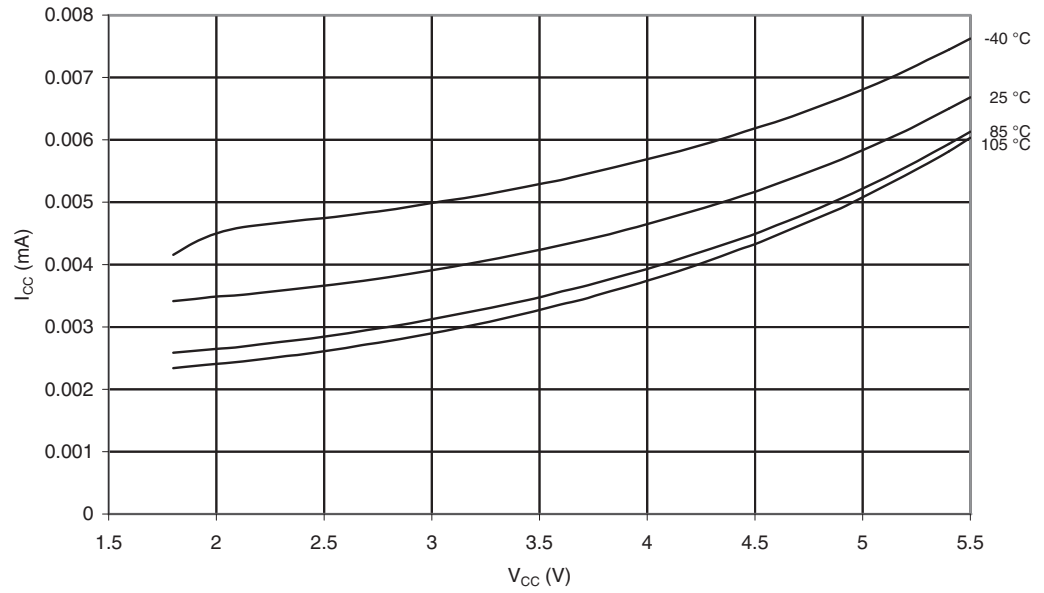


Figure 3-59. Watchdog Timer Current vs. V_{CC}



3.2.6 Pull-up Resistors

Figure 3-60. Pull-up Resistor Current vs. Input Voltage (I/O Pin, $V_{CC} = 1.8V$)

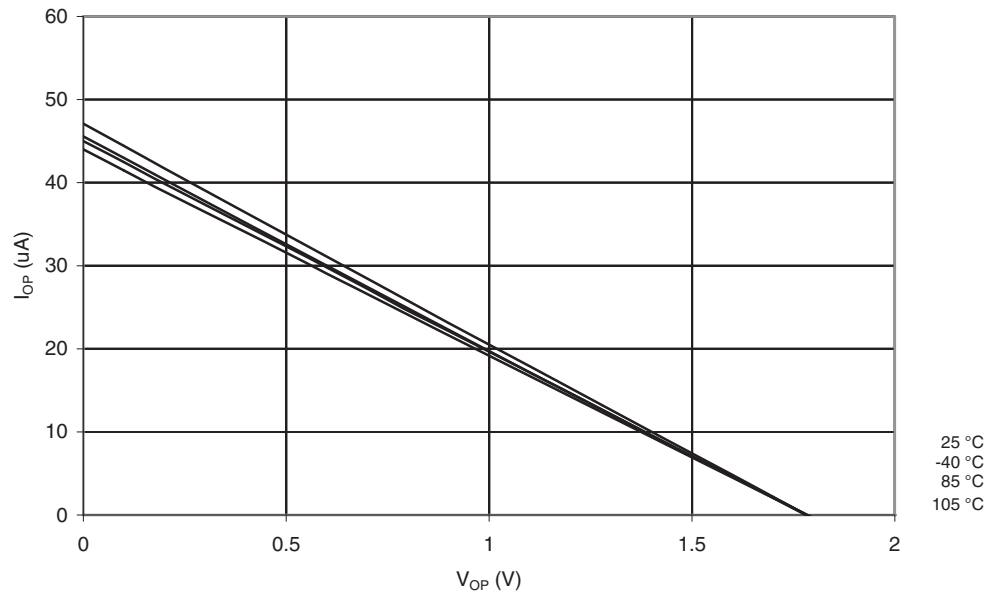


Figure 3-61. Pull-up Resistor Current vs. Input Voltage (I/O Pin, $V_{CC} = 2.7V$)

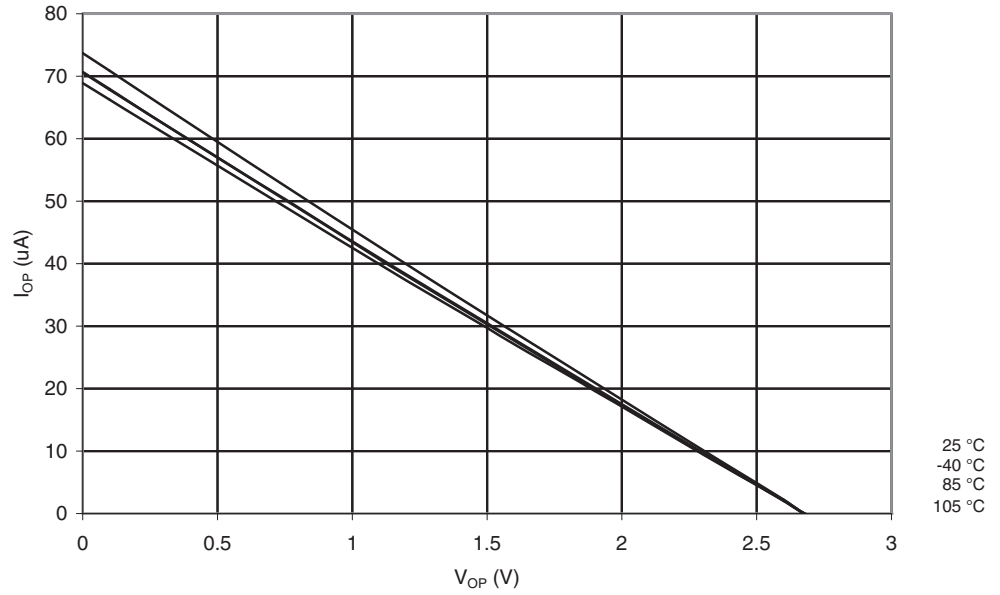


Figure 3-62. Pull-up Resistor Current vs. Input Voltage (I/O Pin, $V_{CC} = 5V$)

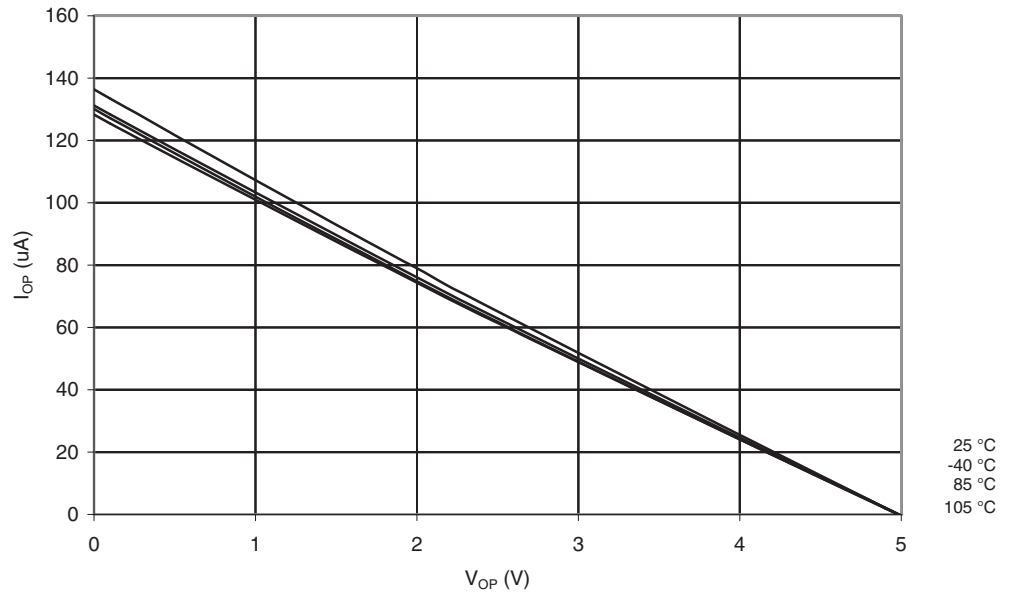


Figure 3-63. Reset Pull-up Resistor Current vs. Reset Pin Voltage ($V_{CC} = 1.8V$)

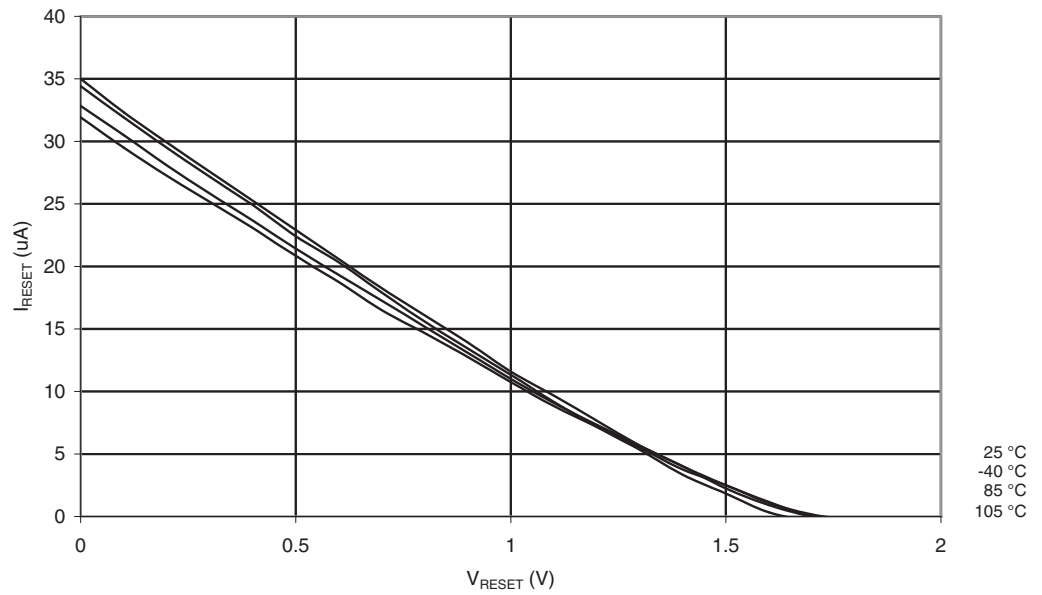


Figure 3-64. Reset Pull-up Resistor Current vs. Reset Pin Voltage ($V_{CC} = 2.7V$)

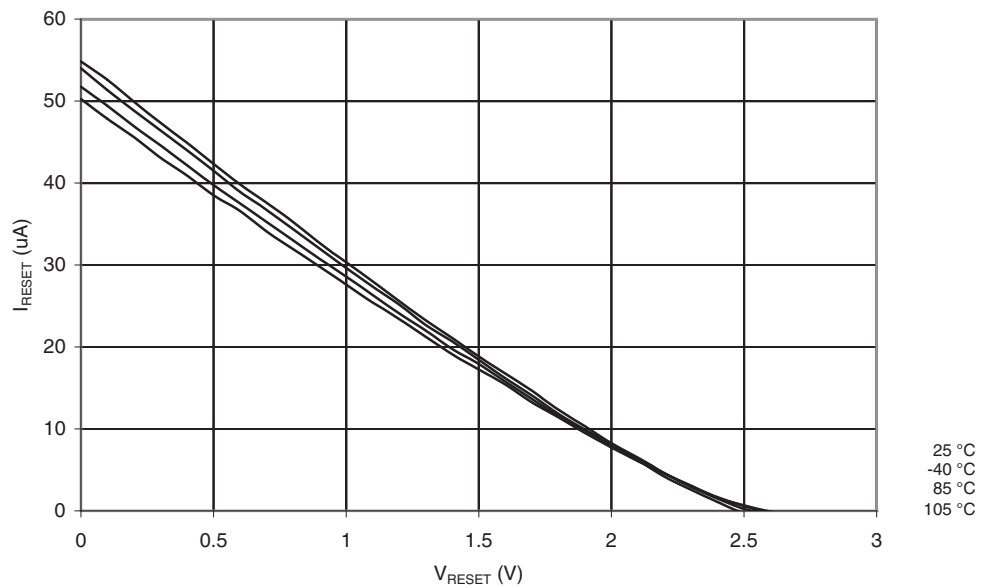
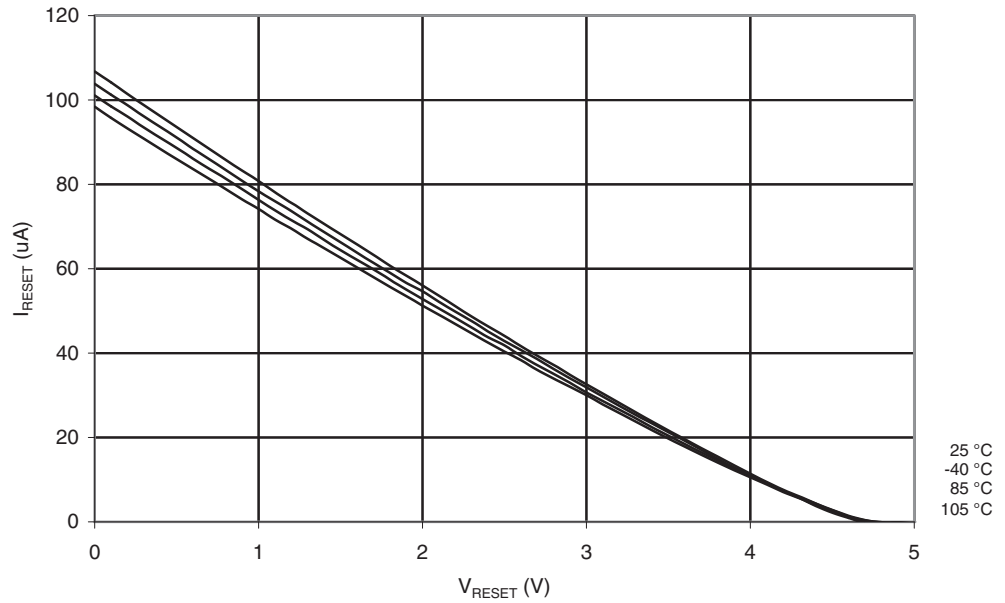


Figure 3-65. Reset Pull-up Resistor Current vs. Reset Pin Voltage ($V_{CC} = 5V$)



3.2.7 Output Driver Strength

Figure 3-66. V_{OL} : Output Voltage vs. Sink Current (I/O Pin, $V_{CC} = 1.8V$)

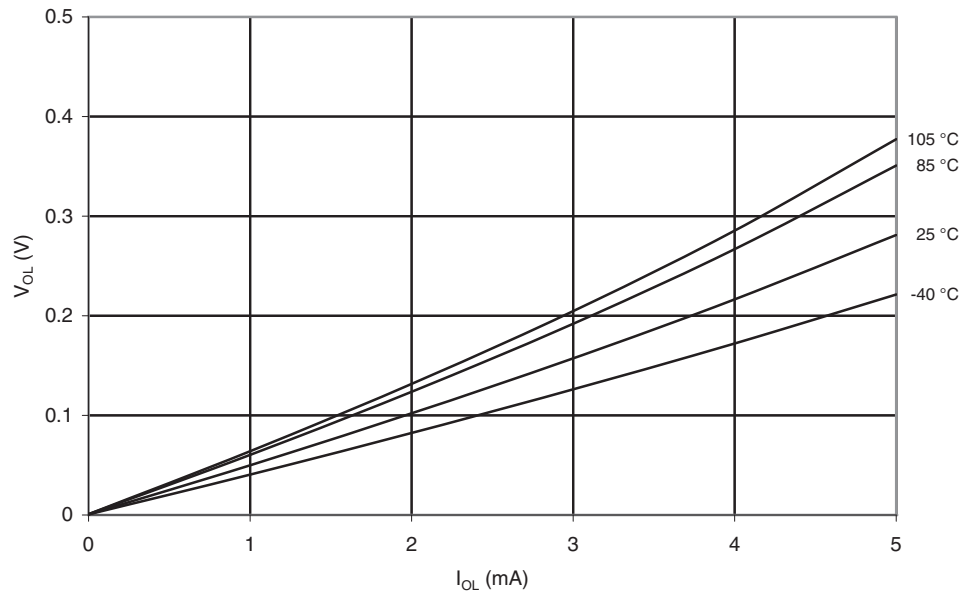


Figure 3-67. V_{OL} : Output Voltage vs. Sink Current (I/O Pin, $V_{CC} = 3V$)

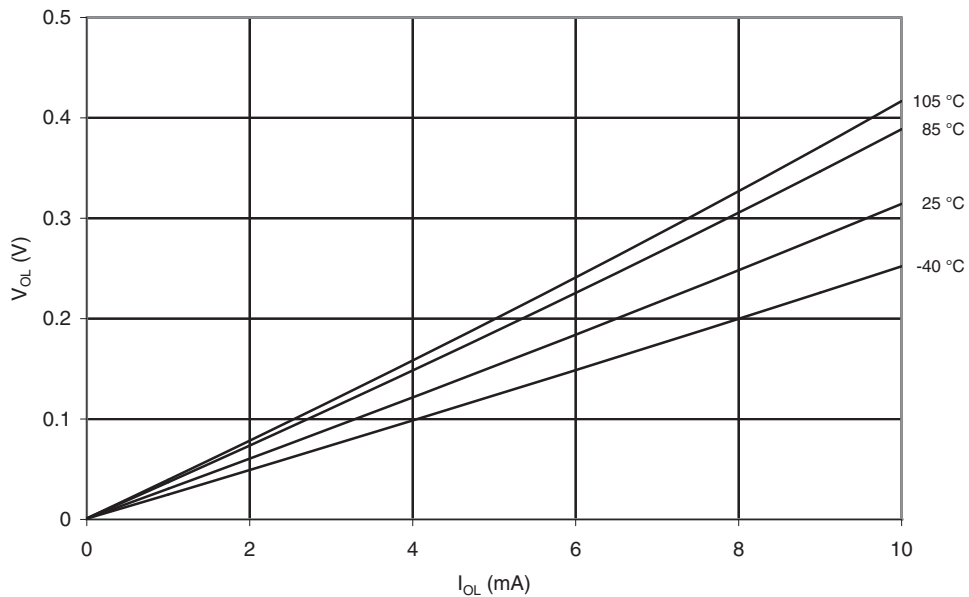


Figure 3-68. V_{OL} : Output Voltage vs. Sink Current (I/O Pin, $V_{CC} = 5V$)

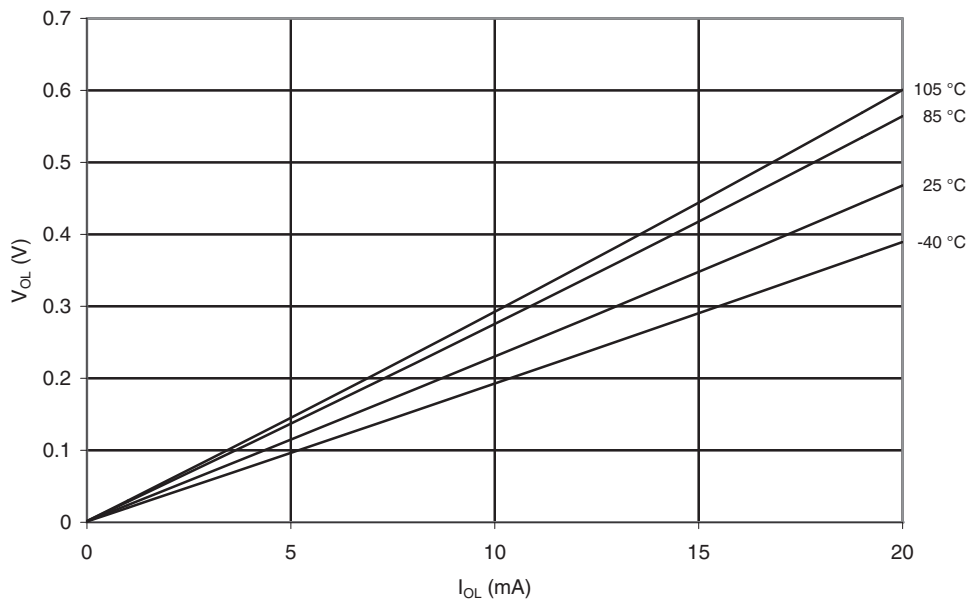


Figure 3-69. V_{OH} : Output Voltage vs. Source Current (I/O Pin, $V_{CC} = 1.8V$)

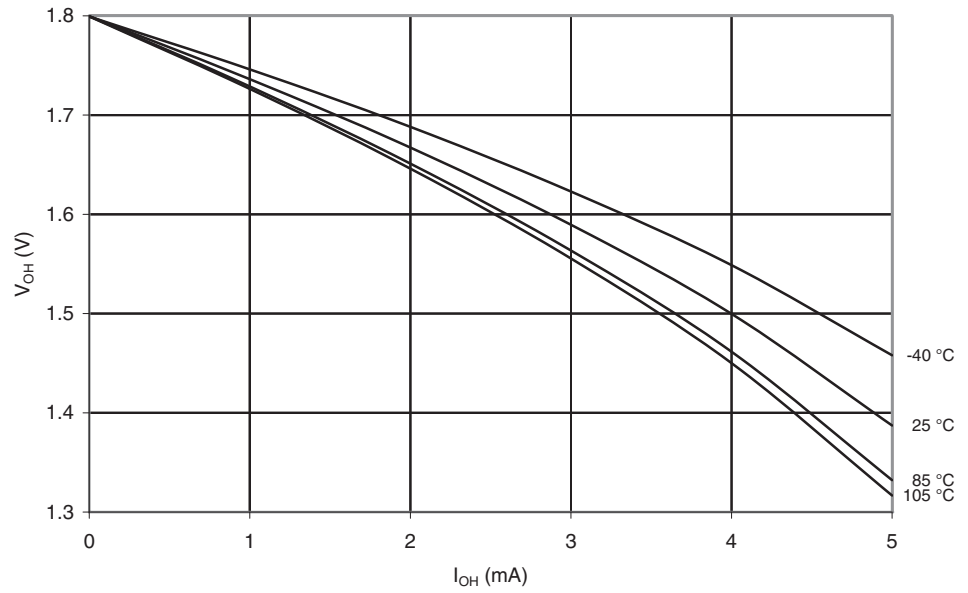


Figure 3-70. V_{OH} : Output Voltage vs. Source Current (I/O Pin, $V_{CC} = 3V$)

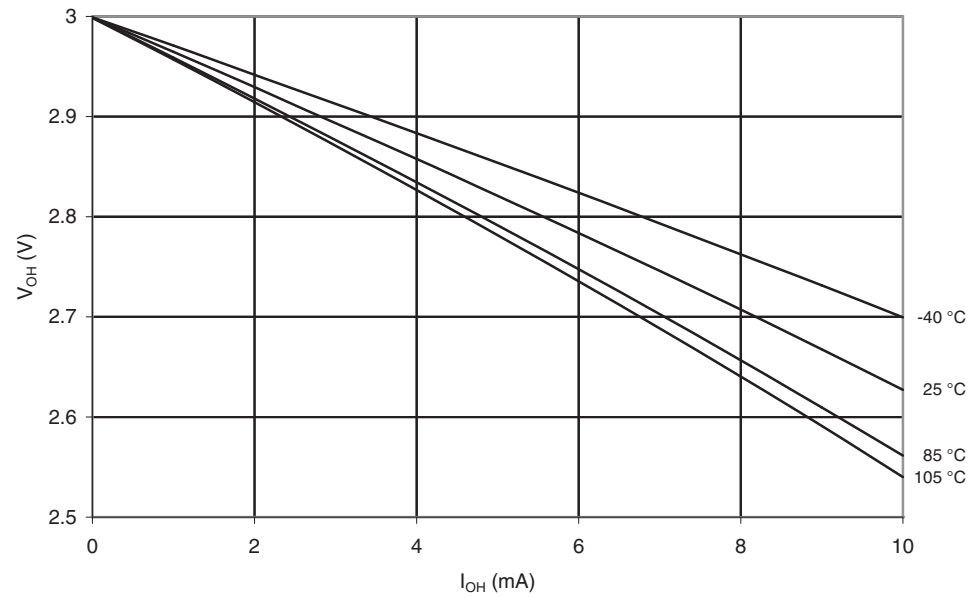


Figure 3-71. V_{OH} : Output Voltage vs. Source Current (I/O Pin, $V_{CC} = 5V$)

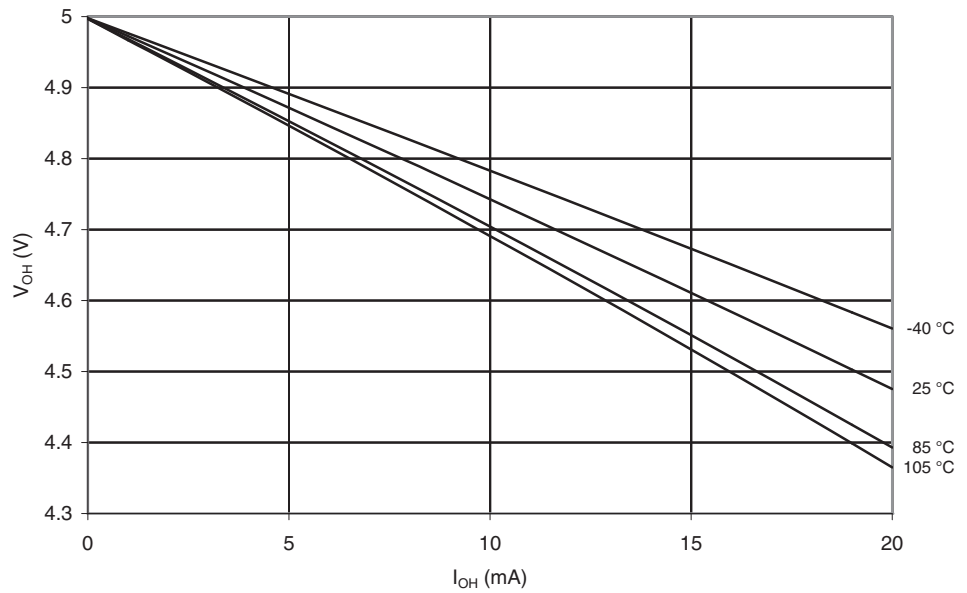


Figure 3-72. V_{OL} : Output Voltage vs. Sink Current (Reset Pin as I/O, $V_{CC} = 3V$)

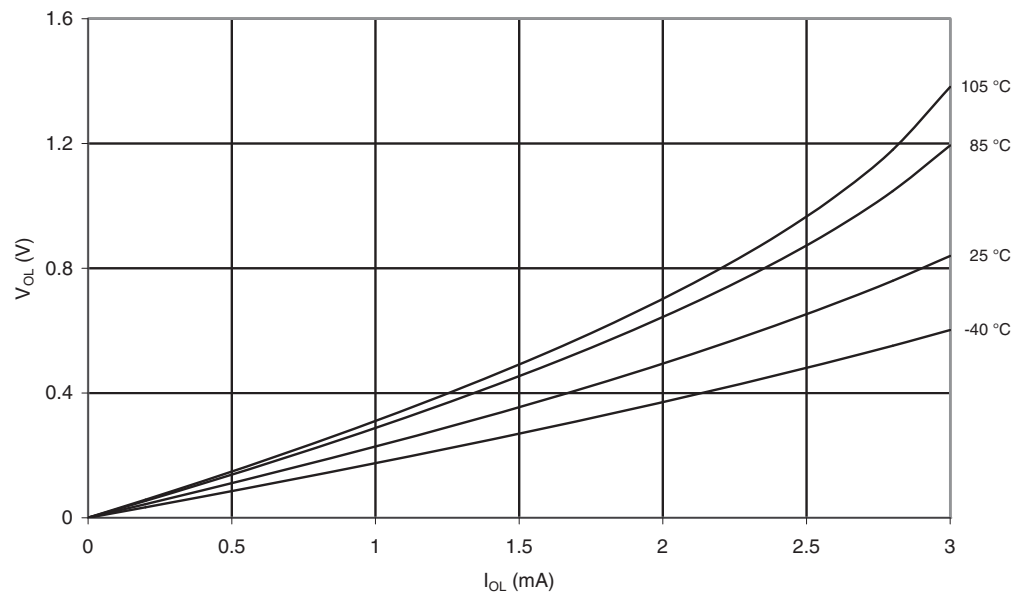


Figure 3-73. V_{OL} : Output Voltage vs. Sink Current (Reset Pin as I/O, $V_{CC} = 5V$)

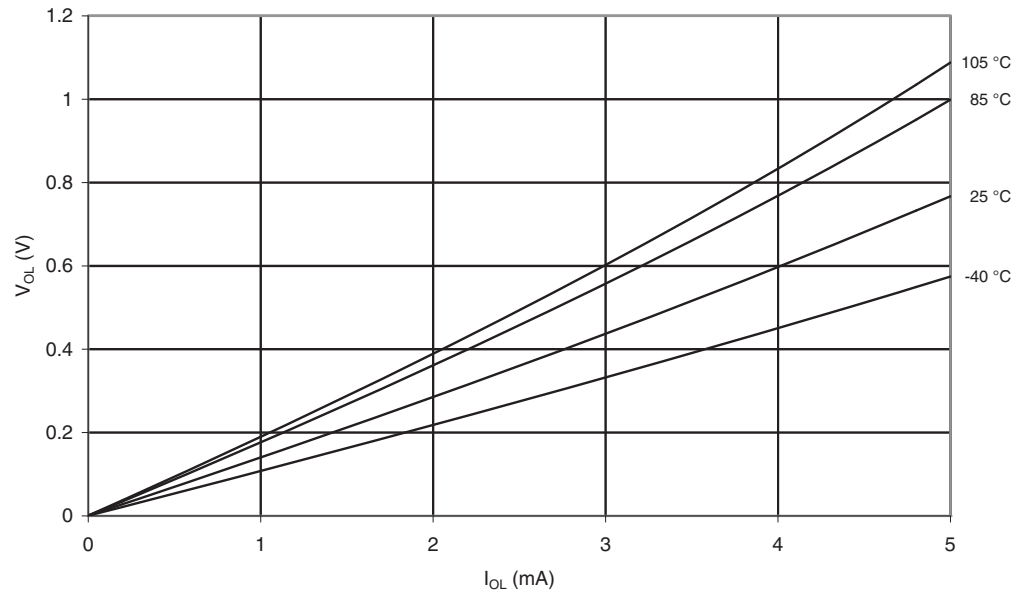


Figure 3-74. V_{OH} : Output Voltage vs. Source Current (Reset Pin as I/O, $V_{CC} = 3V$)

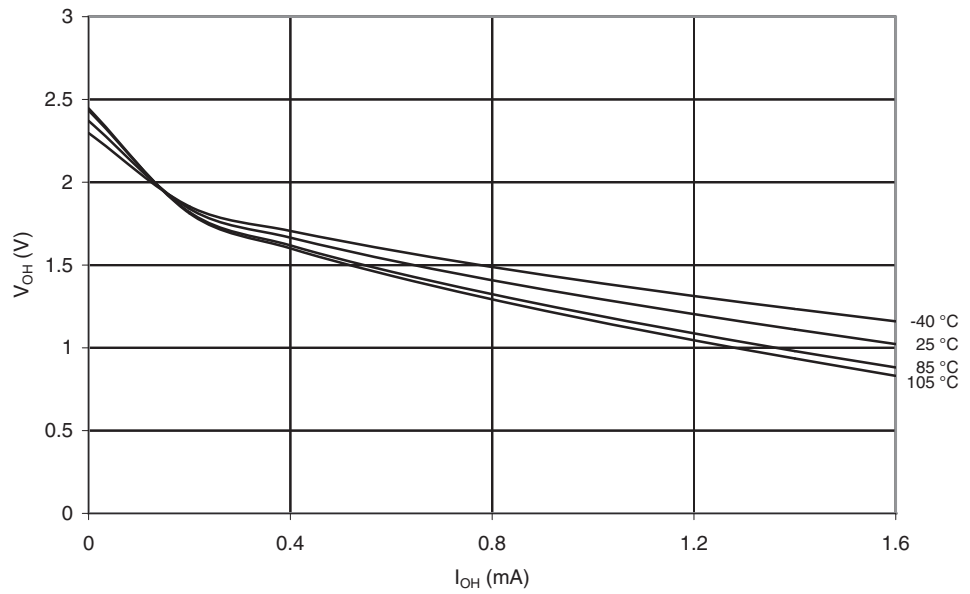
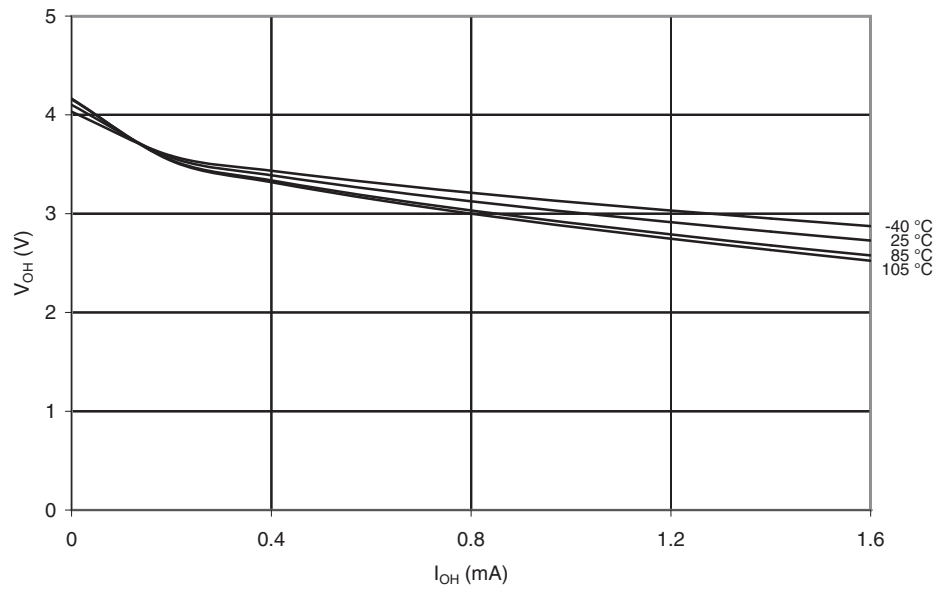


Figure 3-75. V_{OH} : Output Voltage vs. Source Current (Reset Pin as I/O, $V_{CC} = 5V$)



3.2.8 Input Threshold and Hysteresis (for I/O Ports)

Figure 3-76. V_{IH} : Input Threshold Voltage vs. V_{CC} (IO Pin, Read as '1')

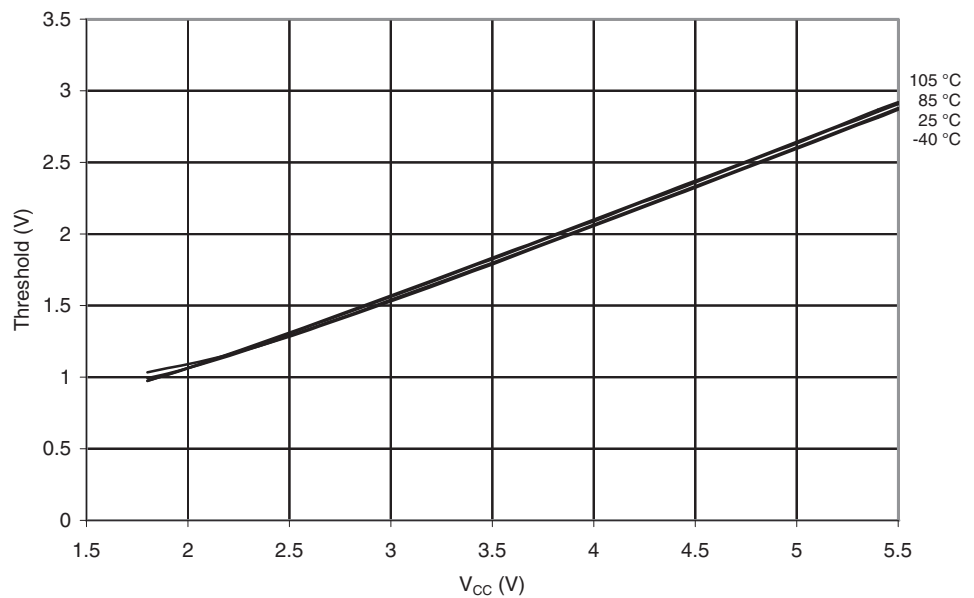


Figure 3-77. V_{IL} : Input Threshold Voltage vs. V_{CC} (I/O Pin, Read as '0')

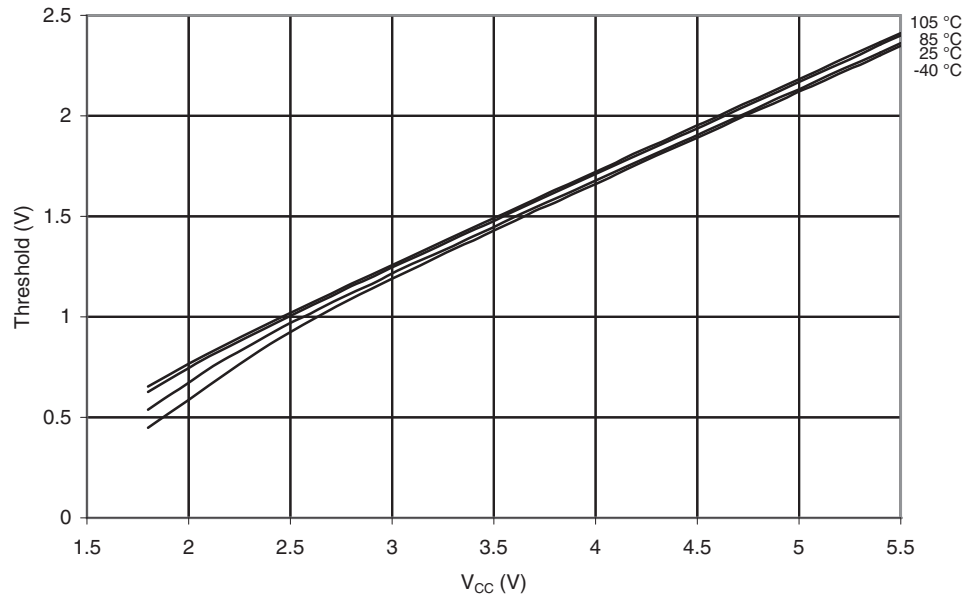


Figure 3-78. $V_{IH}-V_{IL}$: Input Hysteresis vs. V_{CC} (I/O Pin)

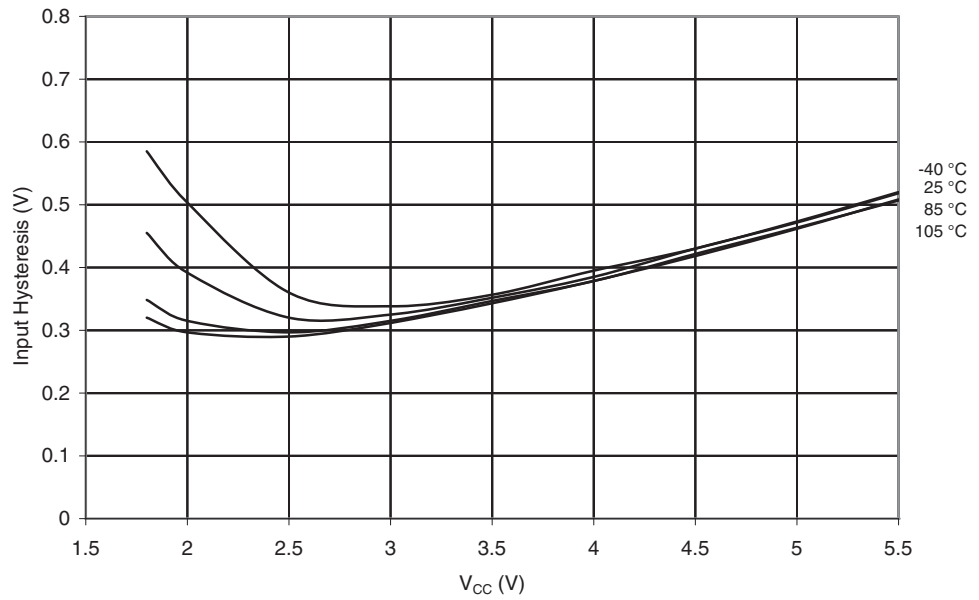


Figure 3-79. V_{IH} : Input Threshold Voltage vs. V_{CC} (Reset Pin as I/O, Read as '1')

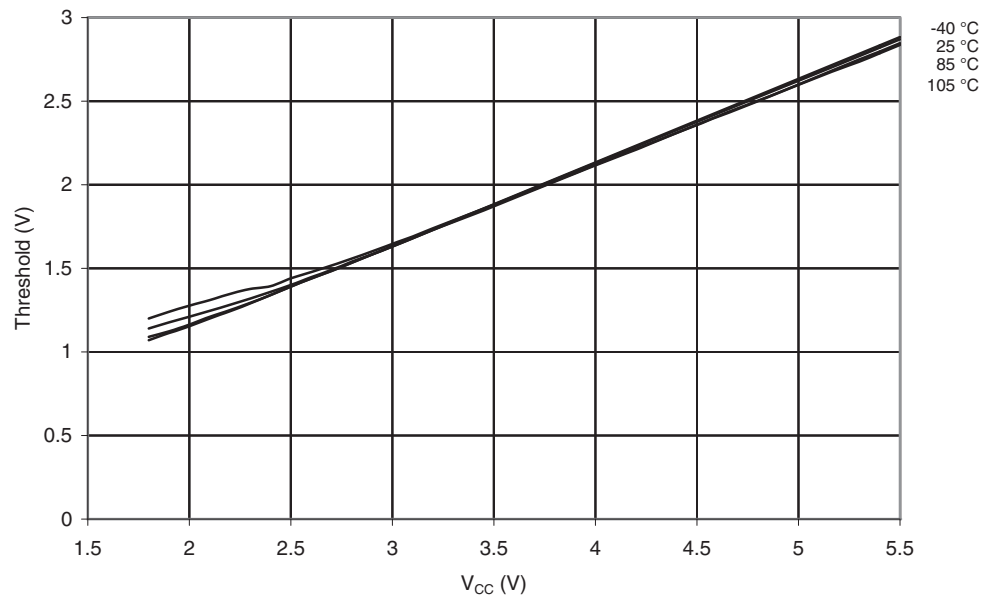


Figure 3-80. V_{IL} : Input Threshold Voltage vs. V_{CC} (Reset Pin as I/O, Read as '0')

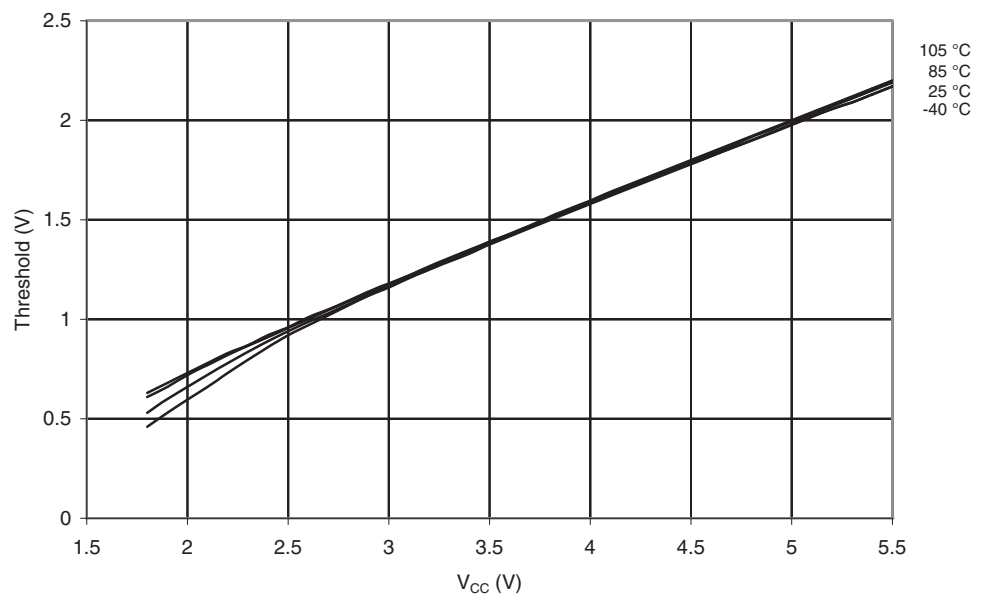
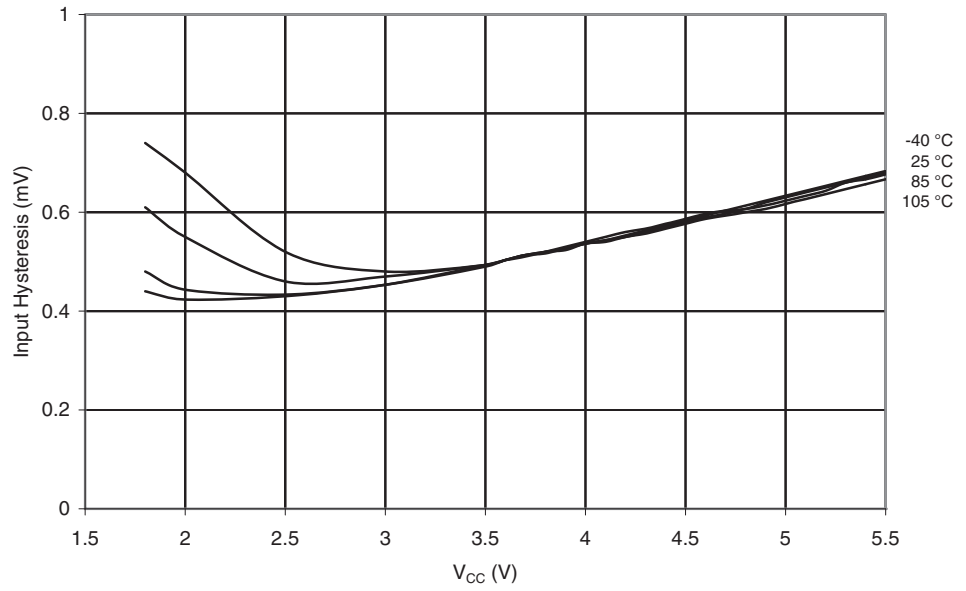


Figure 3-81. $V_{IH}-V_{IL}$: Input Hysteresis vs. V_{CC} (Reset Pin as I/O)



3.2.9 BOD and Bandgap and Reset

Figure 3-82. BOD Threshold vs. Temperature (BODLEVEL = 4.3V)

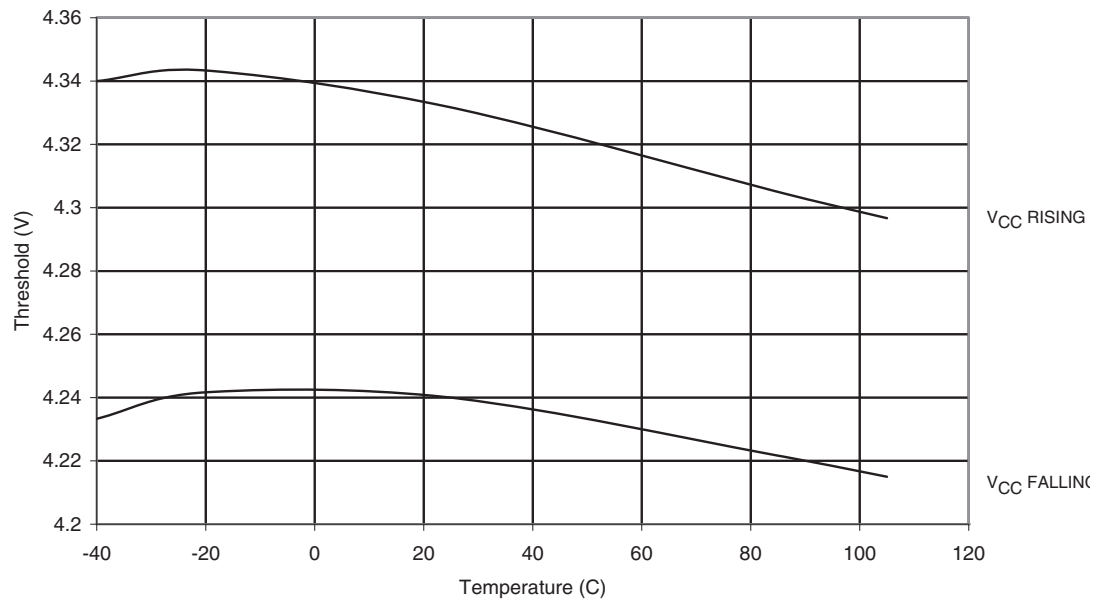


Figure 3-83. BOD Threshold vs. Temperature (BODLEVEL = 2.7V)

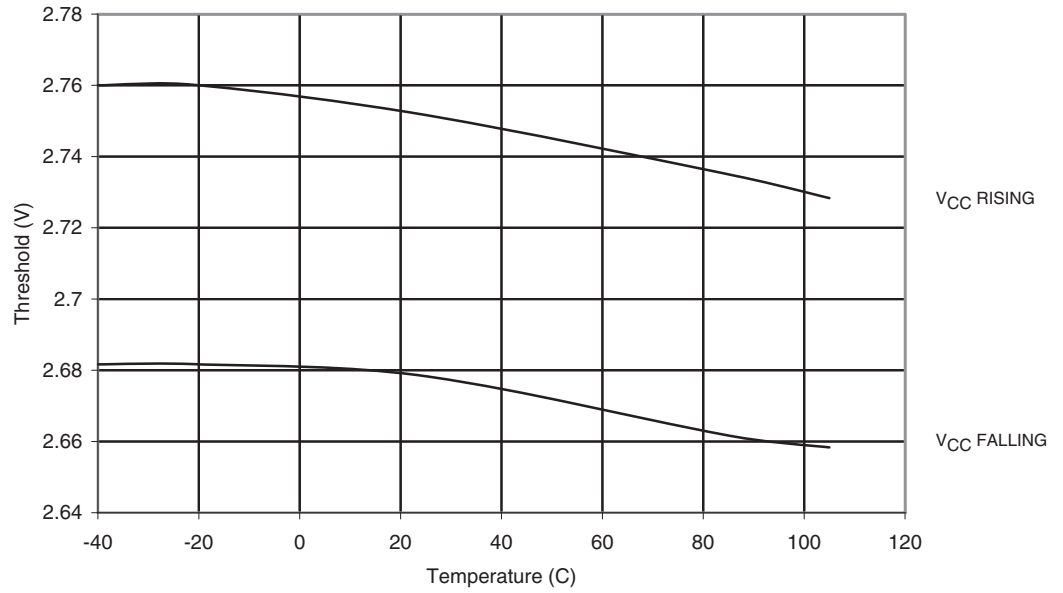


Figure 3-84. BOD Threshold vs. Temperature (BODLEVEL = 1.8V)

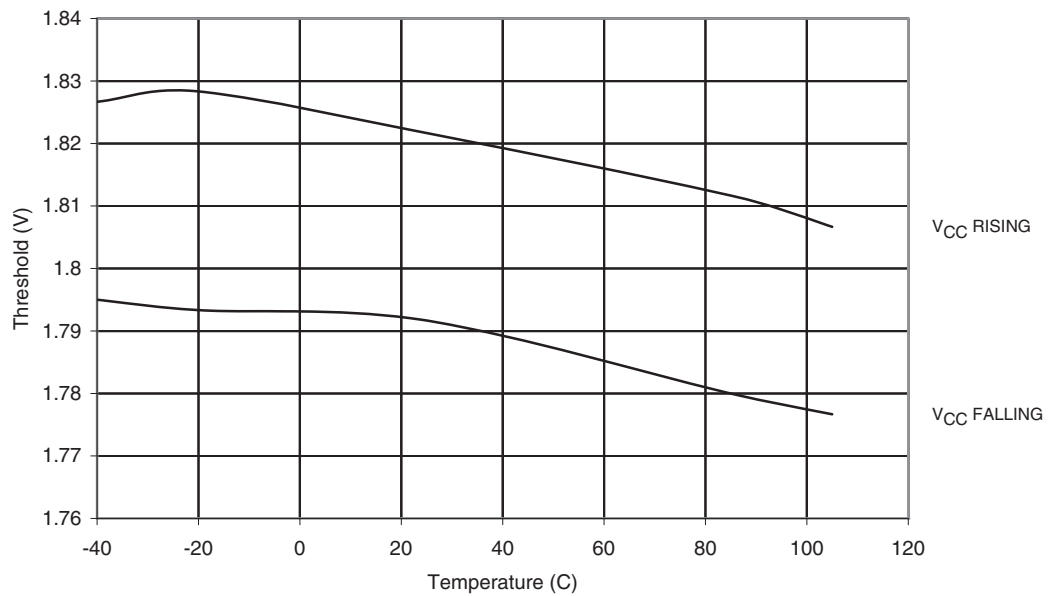


Figure 3-85. Bandgap Voltage vs. Temperature ($V_{CC} = 5V$)

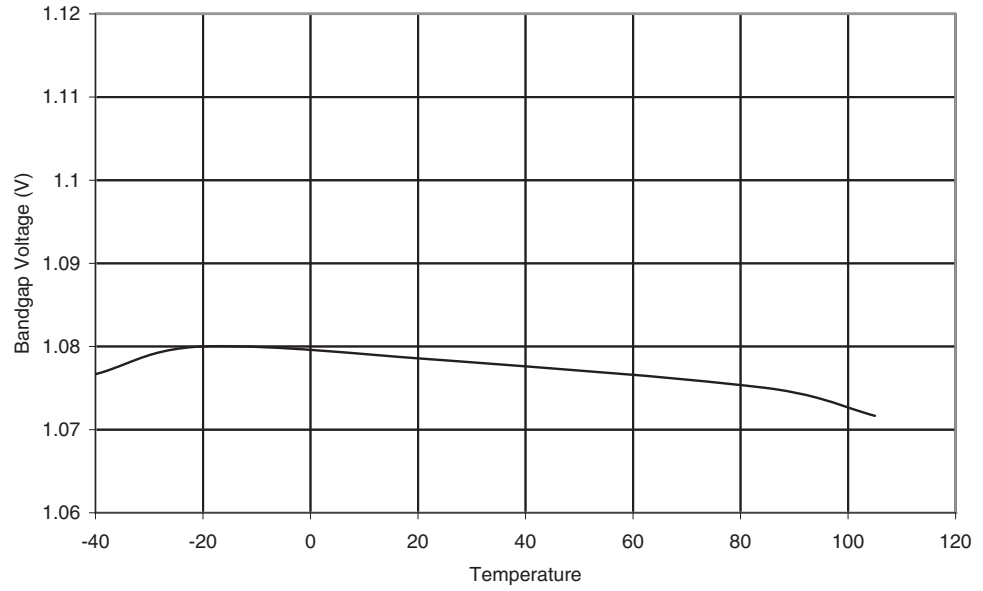


Figure 3-86. V_{IH} : Input Threshold Voltage vs. V_{CC} (Reset Pin as I/O, Read as '1')

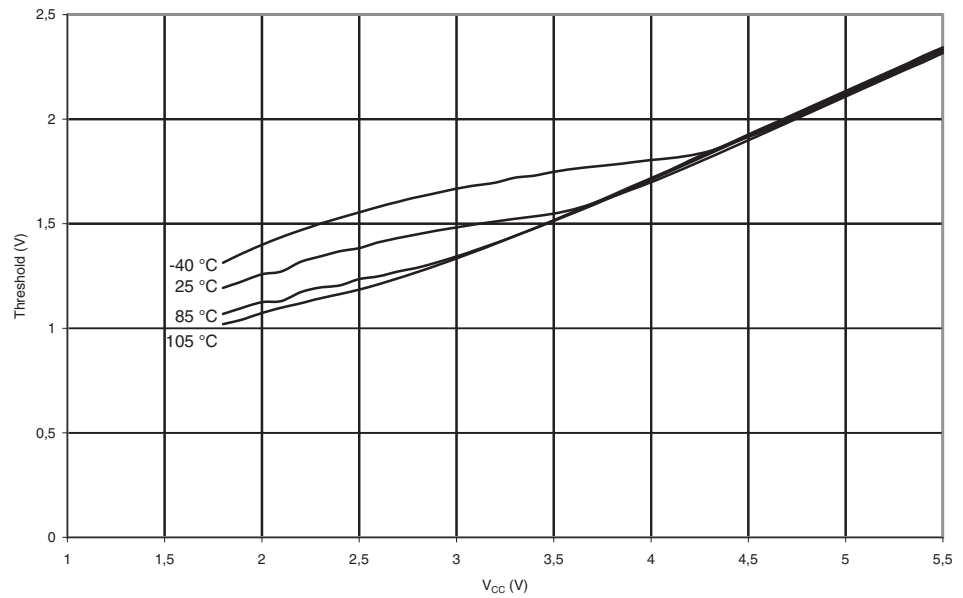


Figure 3-87. V_{IL} : Input Threshold Voltage vs. V_{CC} (Reset Pin as I/O, Read as '0')

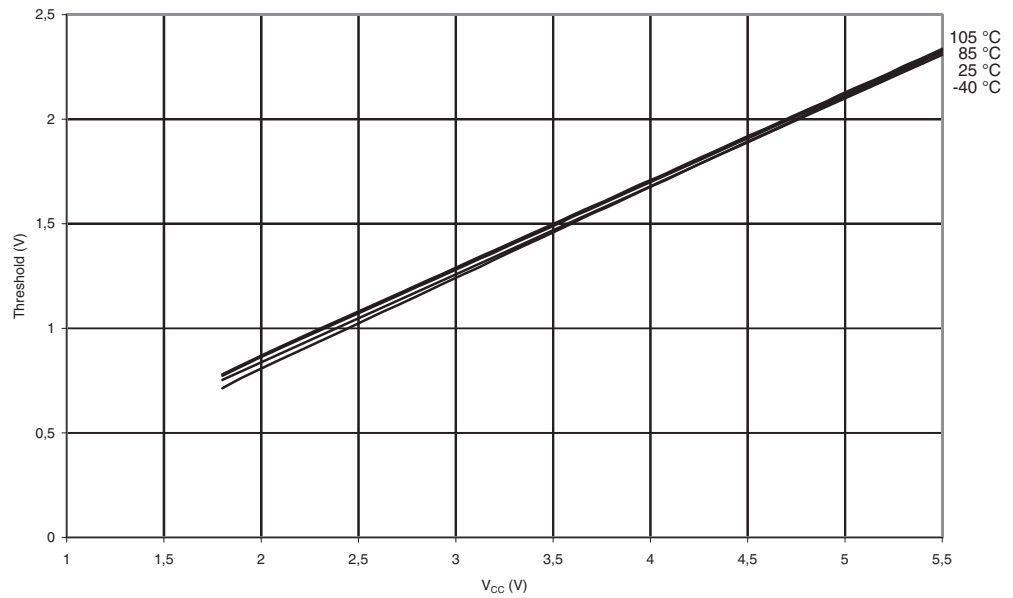


Figure 3-88. Reset Pin Input Hysteresis vs. V_{CC}

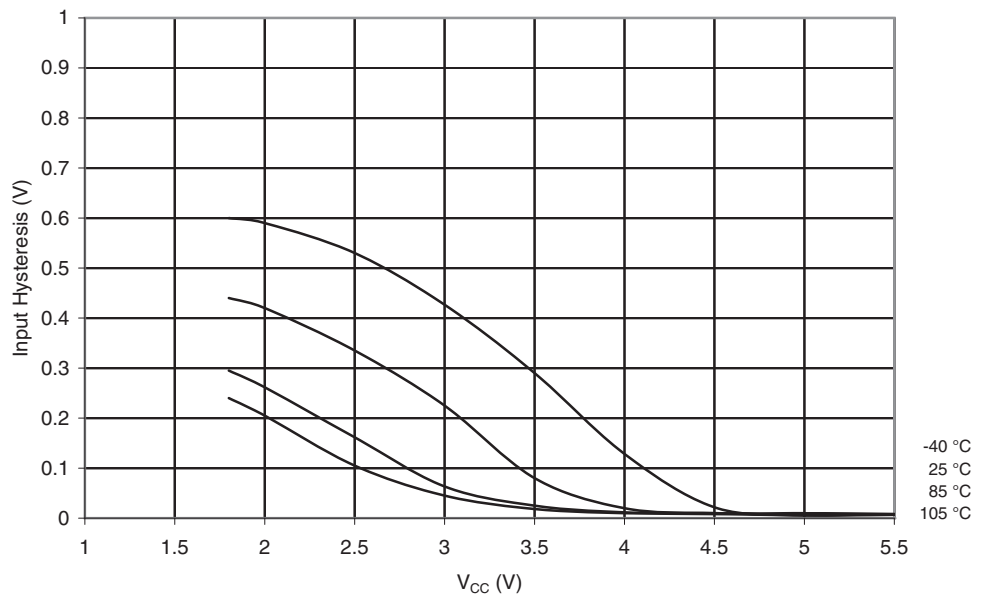
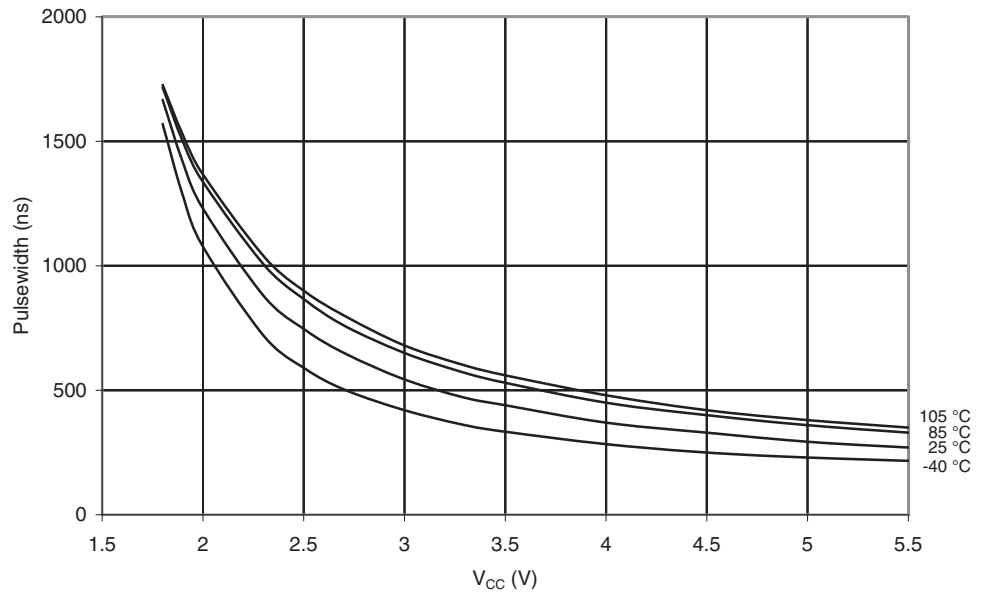
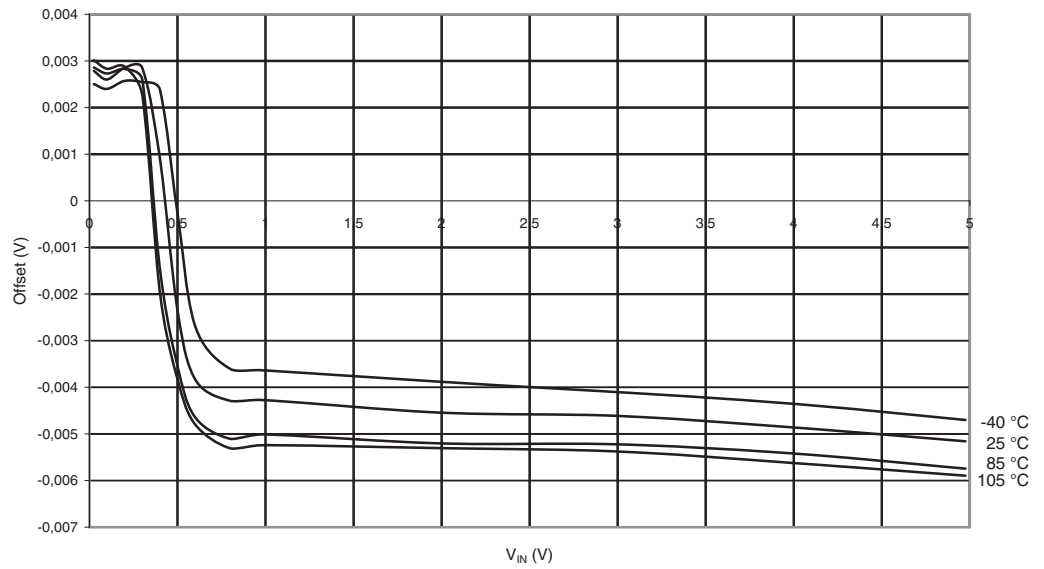


Figure 3-89. Minimum Reset Pulse Width vs. V_{CC}



3.2.10 Analog Comparator Offset

Figure 3-90. Analog Comparator Offset ($V_{CC} = 5V$)



3.2.11 Internal Oscillator Speed

Figure 3-91. Watchdog Oscillator Frequency vs. V_{CC}

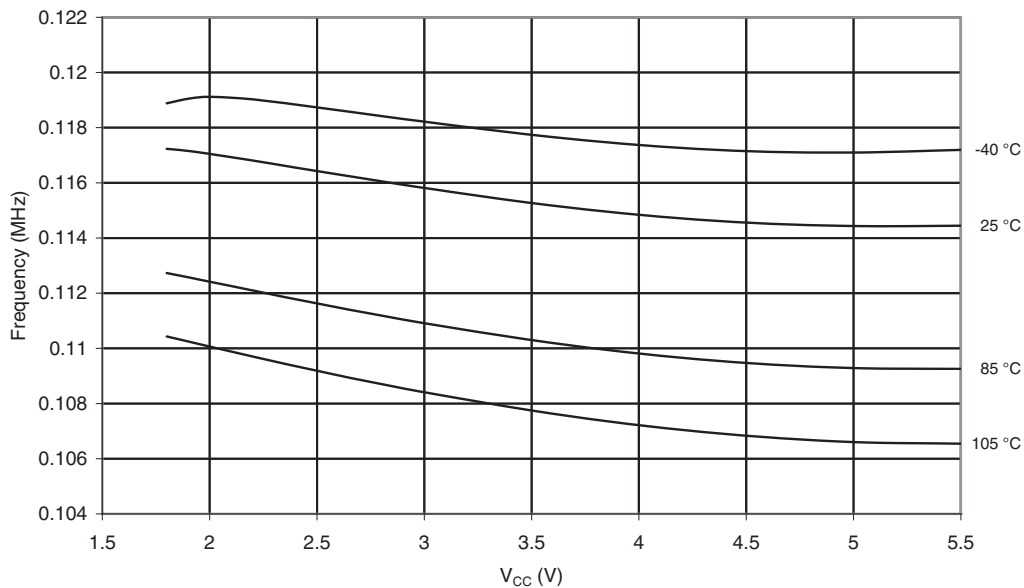


Figure 3-92. Watchdog Oscillator Frequency vs. Temperature

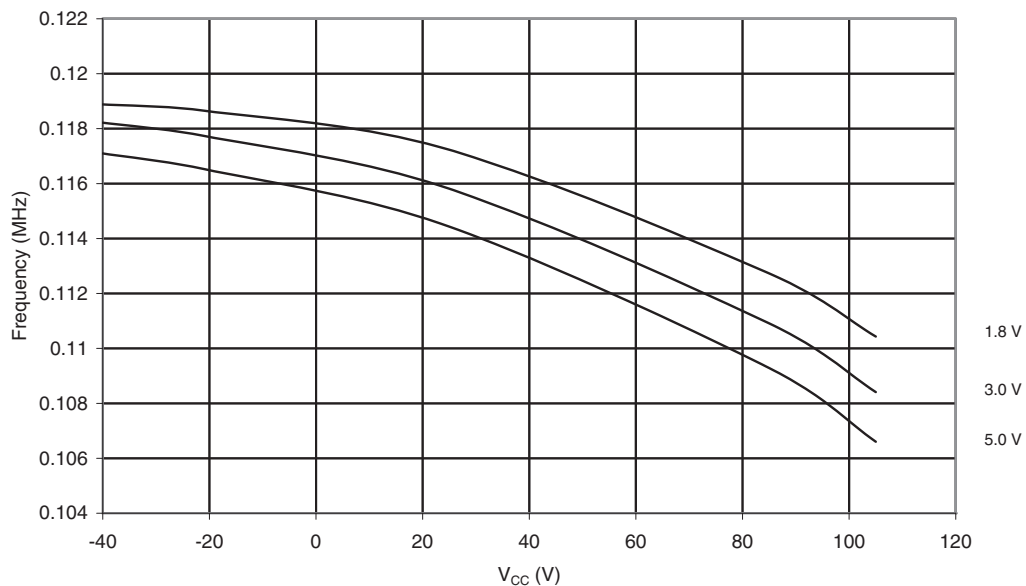


Figure 3-93. Calibrated 8 MHz RC Oscillator Frequency vs. Temperature

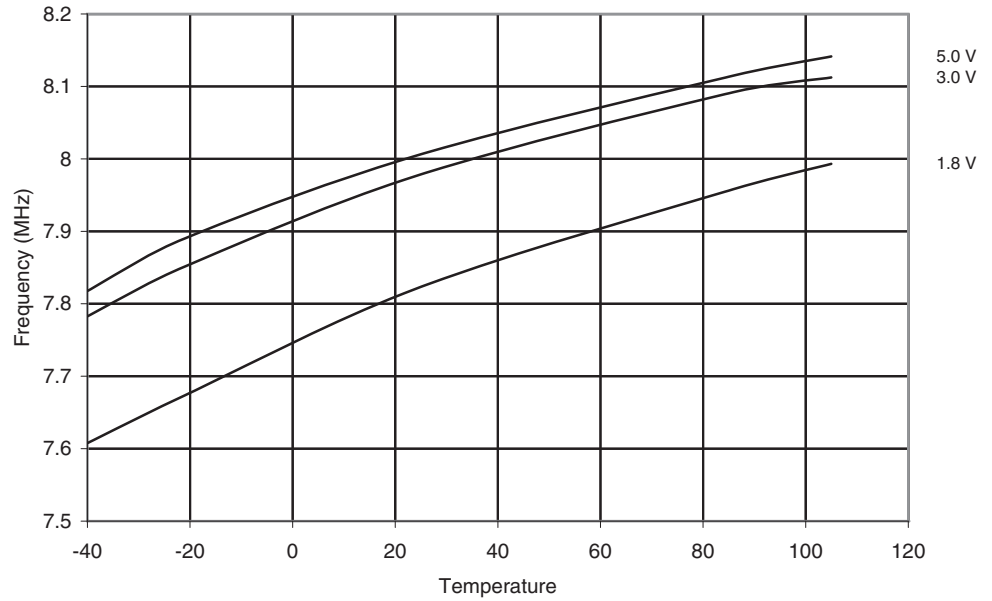
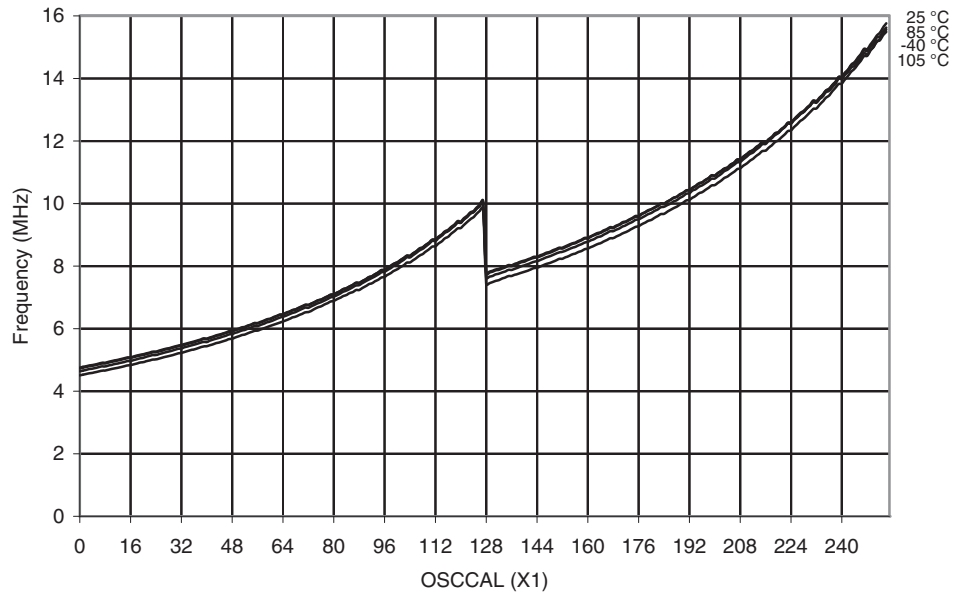


Figure 3-94. Calibrated 8 MHz RC Oscillator Frequency vs. OSCCAL Value ($V_{CC} = 3V$)



4. Ordering Information

4.1 ATtiny24A

| Speed (MHz) | Power Supply | Ordering Code ⁽¹⁾ | Package ⁽²⁾ | Operational Range |
|-------------|--------------|---------------------------------|------------------------|-------------------------------|
| 20 | 1.8 - 5.5V | ATtiny24A-SSN ATtiny24A-SSNR | 14S1 14S1 | Extended (-40°C to +105°C) |

Notes: 1. Code indicators:

- F: matte tin
- R: tape & reel

2. All packages are Pb-free, halide-free and fully green and they comply with the European Directive for Restriction of Hazardous Substances (RoHS directive).

| Package Type | |
|--------------|---|
| 14S1 | 14-lead, 0.150" Wide Body, Plastic Gull Wing Small Outline Package (SOIC) |



4.2 ATtiny44A

| Speed (MHz) | Power Supply | Ordering Code ⁽¹⁾ | Package ⁽²⁾ | Operational Range |
|-------------|--------------|---------------------------------|------------------------|-------------------------------|
| 20 | 1.8 - 5.5V | ATtiny44A-SSN ATtiny44A-SSNR | 14S1 14S1 | Extended (-40°C to +105°C) |

Notes: 1. Code indicators:

- F: matte tin
- R: tape & reel

2. All packages are Pb-free, halide-free and fully green and they comply with the European Directive for Restriction of Hazardous Substances (RoHS directive).

| Package Type | |
|--------------|---|
| 14S1 | 14-lead, 0.150" Wide Body, Plastic Gull Wing Small Outline Package (SOIC) |

5. Revision History

| Revision No. | History |
|----------------------------|------------------------------------|
| 8183A-Appendix A-AVR-12/10 | Initial revision |
| 8183D-Appendix A-AVR-08/11 | Added ordering codes for tape&reel |



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