Appendix A - ATmega64 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 on www.atmel.com

8-bit AVR® Microcontroller with 64K Bytes In-System Programmable Flash

ATmega64

Appendix A

2490 - Appendix A–AVR–10/09

Electrical Characteristics

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.

DC Characteristics

T_A = -40°C to 105°C, V_{CC} = 2.7V to 5.5V (unless otherwise noted)

Symbol	Parameter	Condition	Min	Typ	Max	Units
V_{IL}	Input Low Voltage	Except XTAL1 and $\overline{\text{RESET}}$ pins	-0.5		0.2 V_{CC}(1)	V
V_{IL1}	Input Low Voltage	XTAL1 pin, External Clock Selected	-0.5		0.1 V_{CC}(1)	V
V_{IL2}	Input Low Voltage	$\overline{\text{RESET}}$ pin	-0.5		0.2 V_{CC}(1)	V
V_{IH}	Input High Voltage	Except XTAL1 and $\overline{\text{RESET}}$ pins	0.6 V_{CC}(2)		V_{CC} + 0.5	V
V_{IH1}	Input High Voltage	XTAL1 pin, External Clock Selected	0.7 V_{CC}(2)		V_{CC} + 0.5	V
V_{IH2}	Input High Voltage	$\overline{\text{RESET}}$ pin	0.85 V_{CC}(2)		V_{CC} + 0.5	V
V_{OL}	Output Low Voltage(3) (Ports A,B,C,D, E, F, G)	I_{OL} = 20 mA, V_{CC} = 5V I_{OL} = 10 mA, V_{CC} = 3V			0.9 0.6	V V
V_{OH}	Output High Voltage(4) (Ports A,B,C,D, E, F, G))	I_{OH} = -20 mA, V_{CC} = 5V I_{OH} = -10 mA, V_{CC} = 3V	4.1 2.1			V V
I_{IL}	Input Leakage Current I/O Pin	Vcc = 5.5V, pin low (absolute value)			1.0	µA
I_{IH}	Input Leakage Current I/O Pin	Vcc = 5.5V, pin high (absolute value)			1.0	µA
R_{RST}	Reset Pull-up Resistor		30		60	kΩ
R_{PEN}	PEN Pull-up Resistor		20		60	kΩ
R_{PU}	I/O Pin Pull-up Resistor		20		50	kΩ

DC Characteristics

T_A = -40°C to 105°C, V_{CC} = 2.7V to 5.5V (unless otherwise noted) (Continued)

Symbol	Parameter	Condition	Min	Typ	Max	Units
I_{CC}	Power Supply Current	Active 4 MHz, V_{CC} = 3V			5	mA
		Active 8 MHz, V_{CC} = 5V			20	mA
		Idle 4 MHz, V_{CC} = 3V			3	mA
		Idle 8 MHz, V_{CC} = 5V			12	mA
	Power-down mode(5)	WDT enabled, V_{CC} = 3V		< 15	30	µA
		WDT disabled, V_{CC} = 3V		< 5	20	µA
V_{ACIO}	Analog Comparator Input Offset Voltage	V_{CC} = 5V V_{in} = V_{CC}/2	-40		40	mV
I_{ACLK}	Analog Comparator Input Leakage Current	V_{CC} = 5V V_{in} = V_{CC}/2	-50		50	nA
t_{ACPD}	Analog Comparator Propagation Delay	V_{CC} = 2.7V V_{CC} = 5.0		750 500		ns

Notes:
1. “Max” means the highest value where the pin is guaranteed to be read as low
2. “Min” means the lowest value where the pin is guaranteed to be read as high
3. Although each I/O port can sink more than the test conditions (20 mA at V_{CC} = 5V, 10 mA at V_{CC} = 3V) under steady state conditions (non-transient), the following must be observed:
   TQFP and QFN/MLF Package:
   1] The sum of all IOL, for all ports, should not exceed 400 mA.
   2] The sum of all IOL, for ports A0 - A7, G2, C3 - C7 should not exceed 100 mA.
   3] The sum of all IOL, for ports C0 - C2, G0 - G1, D0 - D7, XTAL2 should not exceed 100 mA.
   4] The sum of all IOL, for ports B0 - B7, G3 - G4, E0 - E7 should not exceed 100 mA.
   5] The sum of all IOL, for ports F0 - F7, should not exceed 100 mA.
   If IOL exceeds the test condition, VOL may exceed the related specification. Pins are not guaranteed to sink current greater than the listed test condition.
4. Although each I/O port can source more than the test conditions (20 mA at Vcc = 5V, 10 mA at Vcc = 3V) under steady state conditions (non-transient), the following must be observed:
   TQFP and QFN/MLF Package:
   1] The sum of all IOH, for all ports, should not exceed 400 mA.
   2] The sum of all IOH, for ports A0 - A7, G2, C3 - C7 should not exceed 100 mA.
   3] The sum of all IOH, for ports C0 - C2, G0 - G1, D0 - D7, XTAL2 should not exceed 100 mA.
   4] The sum of all IOH, for ports B0 - B7, G3 - G4, E0 - E7 should not exceed 100 mA.
   5] The sum of all IOH, for ports F0 - F7, should not exceed 100 mA.
   If IOH exceeds the test condition, VOH may exceed the related specification. Pins are not guaranteed to source current greater than the listed test condition.
5. Minimum V_{CC} for Power-down is 2.5V.

ATmega64 Typical Characteristics – Preliminary Data

The following charts show typical behavior. These figures are not tested during manufacturing. All current consumption measurements are performed with all I/O pins configured as inputs and with internal pull-ups enabled. A sine wave generator with rail-to-rail output is used as clock source.

The power consumption in Power-down mode is independent of clock selection.

The current consumption is a function of several factors such as: operating voltage, operating frequency, loading of I/O pins, switching rate of I/O pins, code executed and ambient temperature. The dominating factors are operating voltage and frequency.

The current drawn from capacitive loaded pins may be estimated (for one pin) as C_L*V_{CC}*f where C_L = load capacitance, V_{CC} = operating voltage and f = average switching frequency of I/O pin.

The parts are characterized at frequencies higher than test limits. Parts are not guaranteed to function properly at frequencies higher than the ordering code indicates.

The difference between current consumption in Power-down mode with Watchdog Timer enabled and Power-down mode with Watchdog Timer disabled represents the differential current drawn by the Watchdog Timer.

Active Supply Current

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

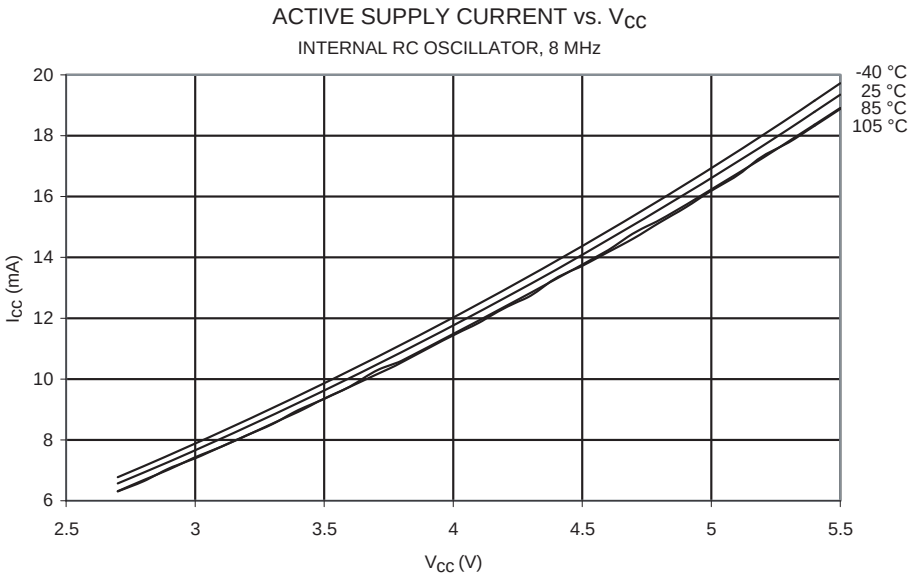


Figure 2. Active Supply Current vs. V_{CC} (Internal RC Oscillator, 4 MHz)

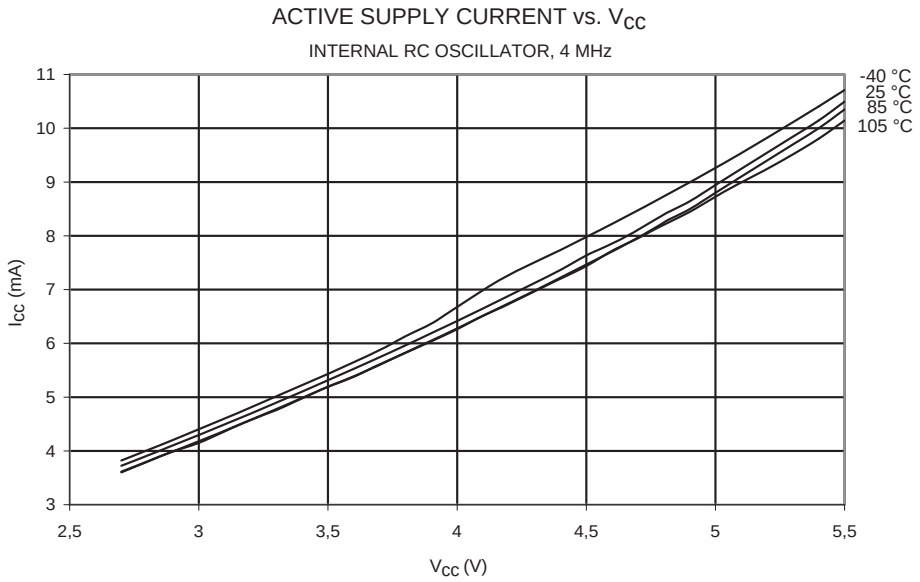


Figure 3. Active Supply Current vs. V_{CC} (Internal RC Oscillator, 2 kHz)

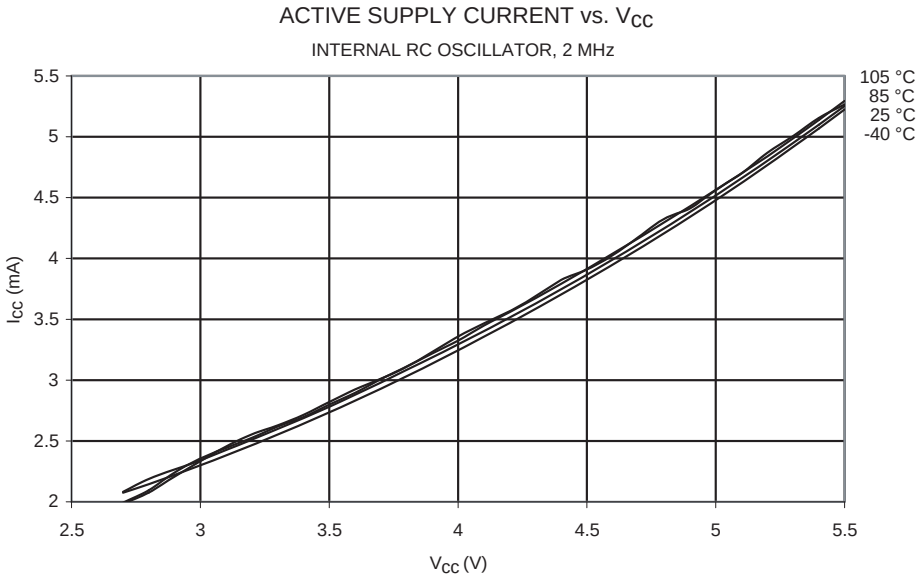


Figure 4. Active Supply Current vs. V_{CC} (Internal RC Oscillator, 1 kHz)

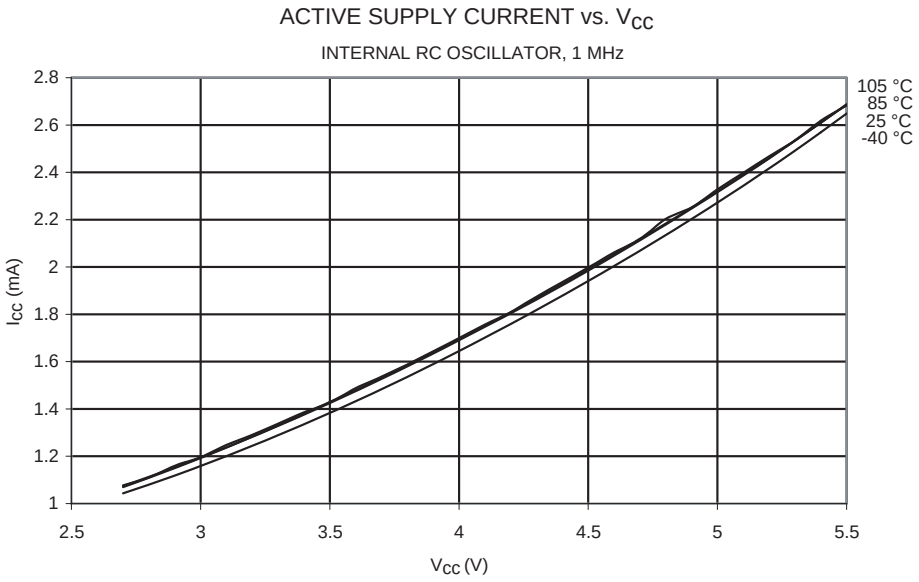
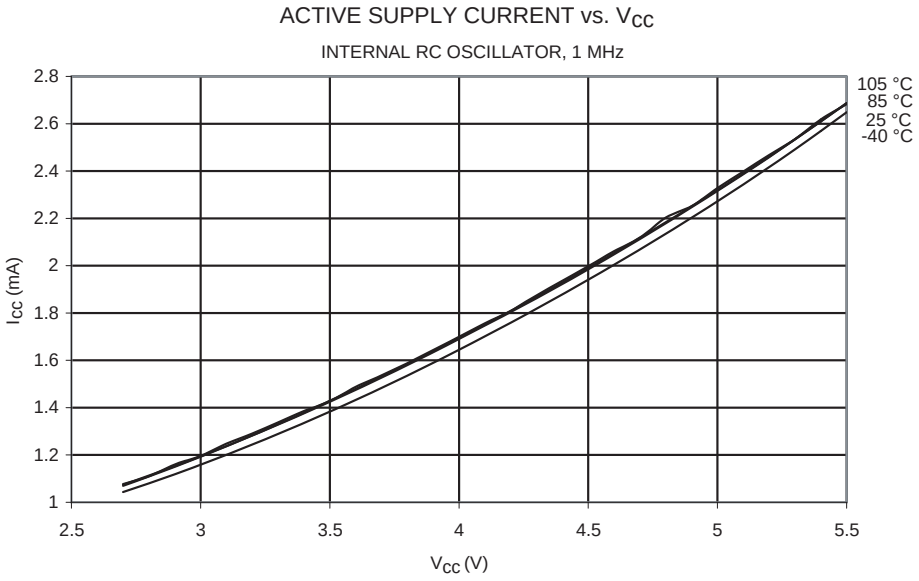


Figure 5. Active Supply Current vs. V_{CC} (Internal RC Oscillator, 1 kHz)



Idle Supply Current

Figure 6. Idle Supply Current vs. V_{CC} (Internal RC Oscillator, 1 MHz)

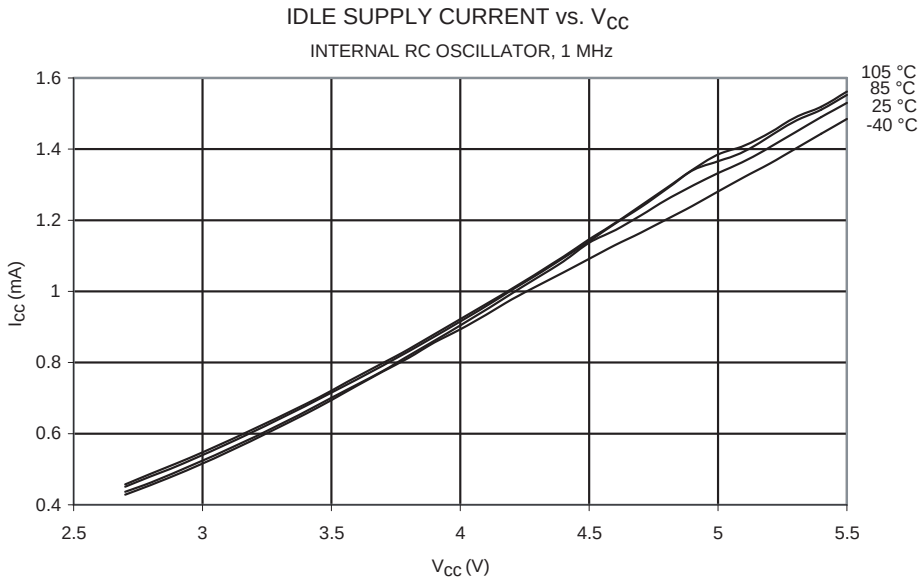


Figure 7. Idle Supply Current vs. V_{CC} (Internal RC Oscillator, 2 MHz)

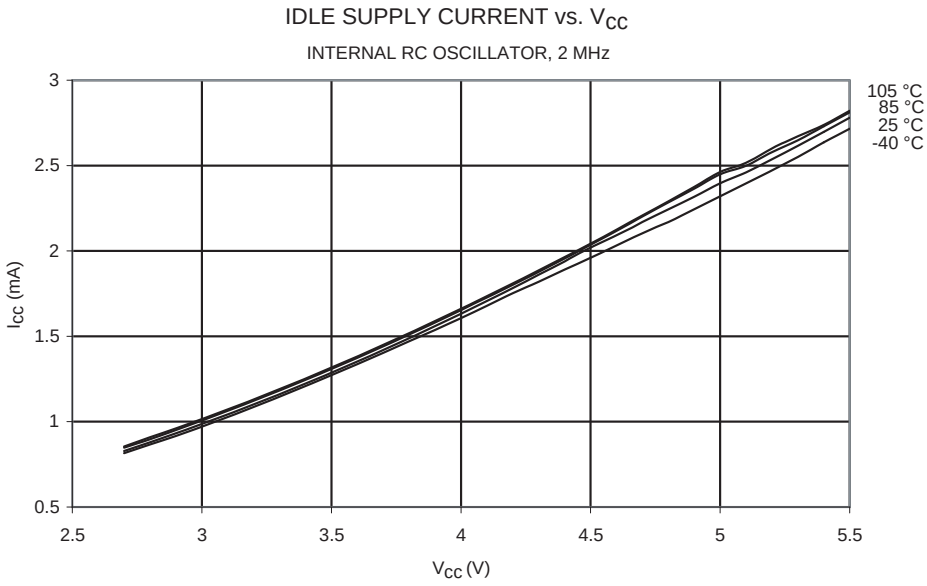


Figure 8. Idle Supply Current vs. V_{CC} (Internal RC Oscillator, 4 MHz)

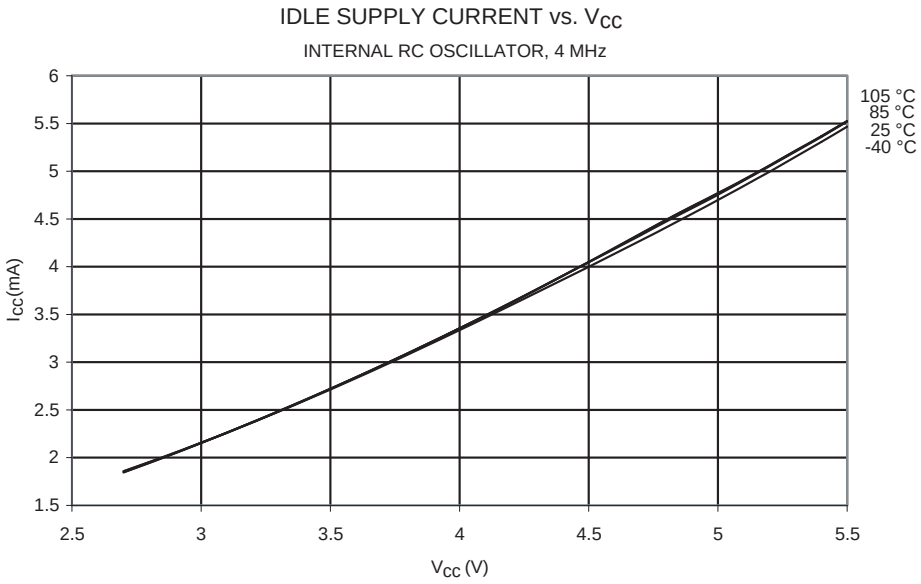
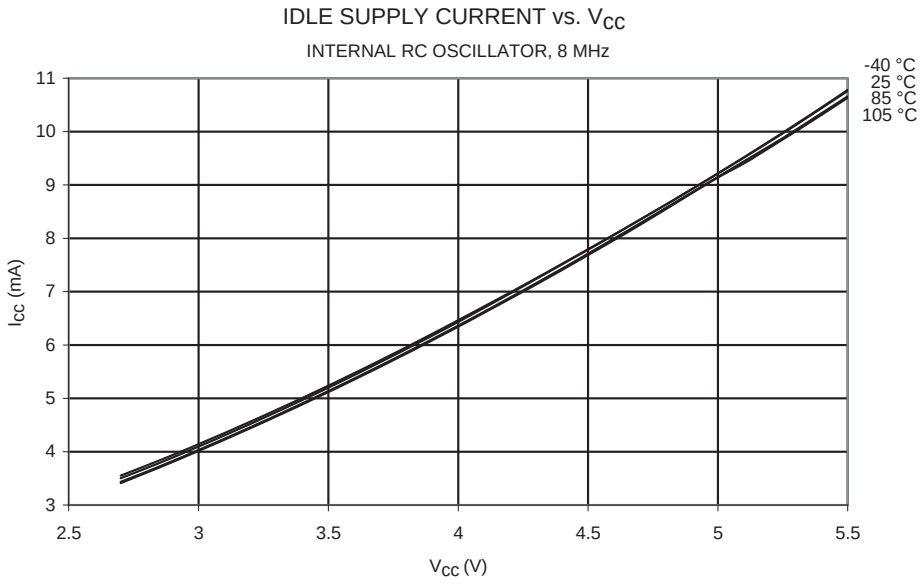


Figure 9. Idle Supply Current vs. V_{CC} (Internal RC Oscillator, 8 MHz)



Power-Down Supply Current

Figure 10. Power-Down Supply Current vs. V_{CC} (Watchdog Timer Disabled)

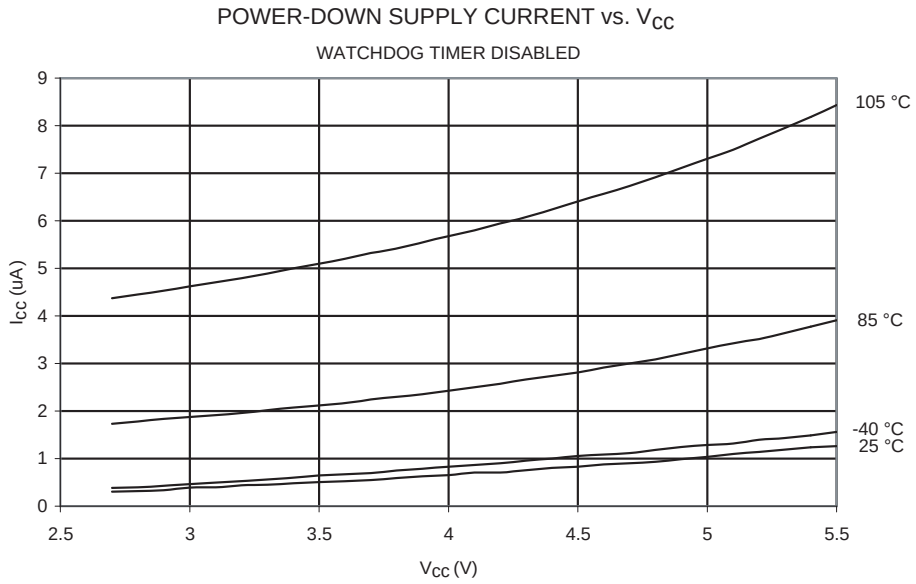
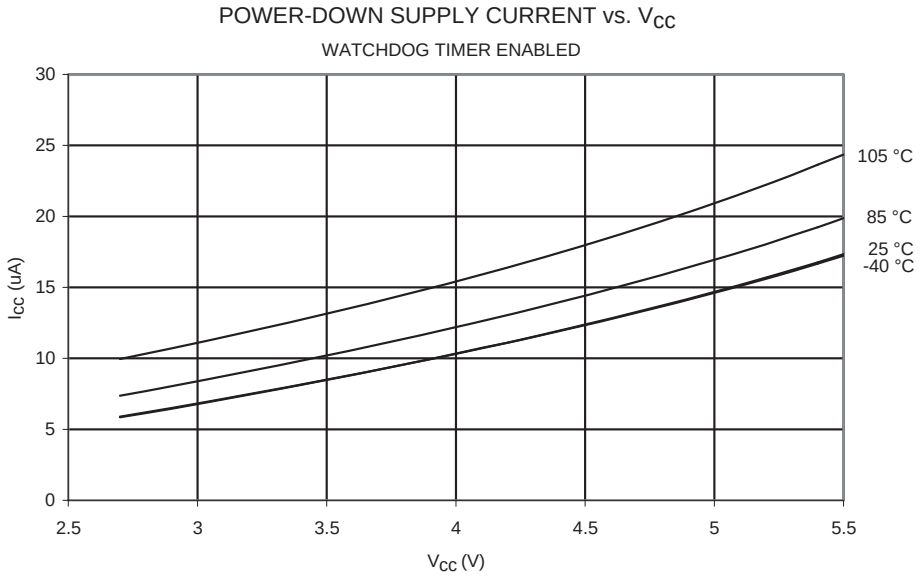


Figure 11. Power-Down Supply Current vs. V_{CC} (Watchdog Timer Enabled)



Pin Pull-up

Figure 12. I/O Pin Pull-Up Resistor Current vs. Input Voltage (V_{CC} = 5V)

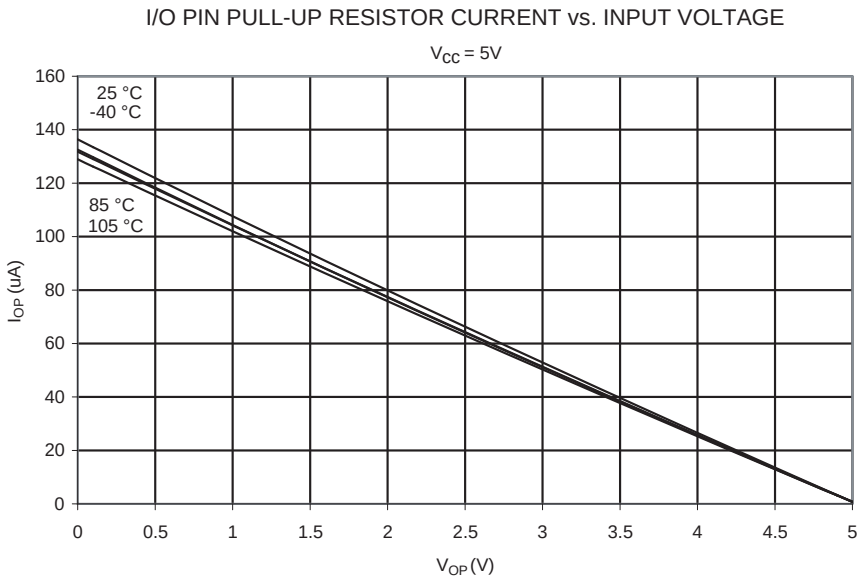


Figure 13. I/O Pin Pull-Up Resistor Current vs. Input Voltage (V_{CC} = 2.7V)

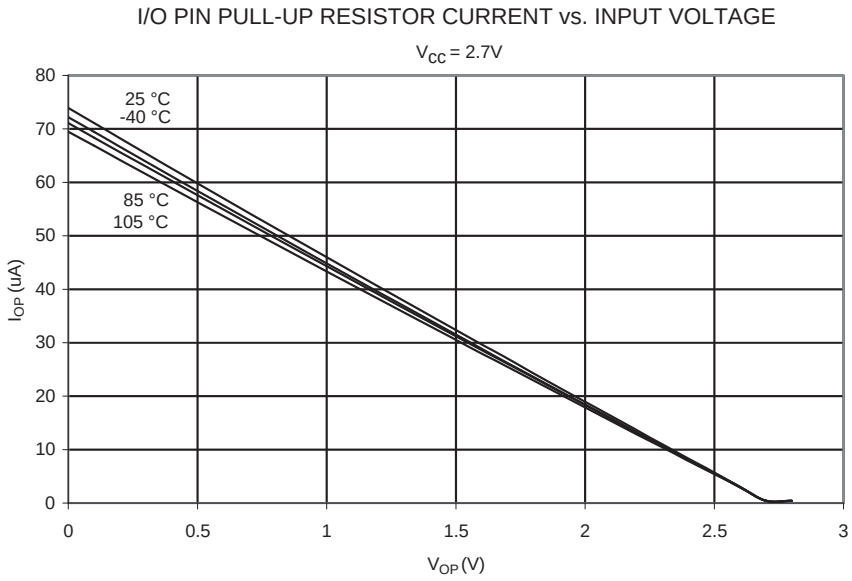


Figure 14. Reset Pull-Up Resistor Current vs. Reset Pin Voltage (V_{CC} = 5V)

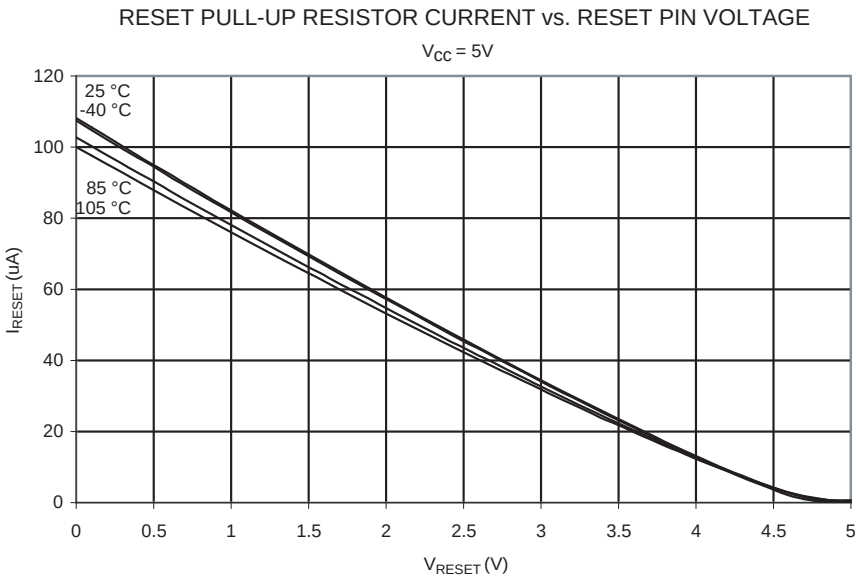
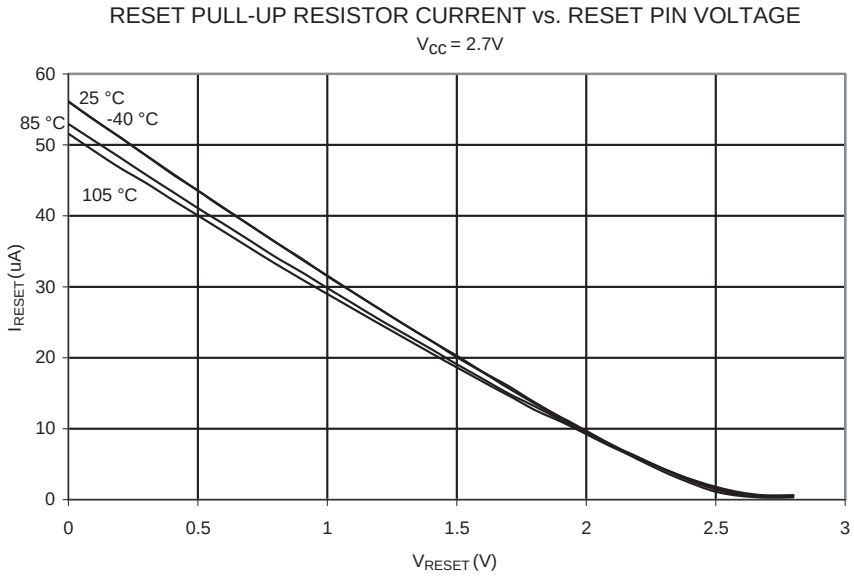


Figure 15. Reset Pull-Up Resistor Current vs. Reset Pin Voltage (V_{CC} = 2.7V)



Pin Driver Strength

Figure 16. I/O Pin Source Current vs. Output Voltage (Low Power Ports, V_{CC} = 5V)

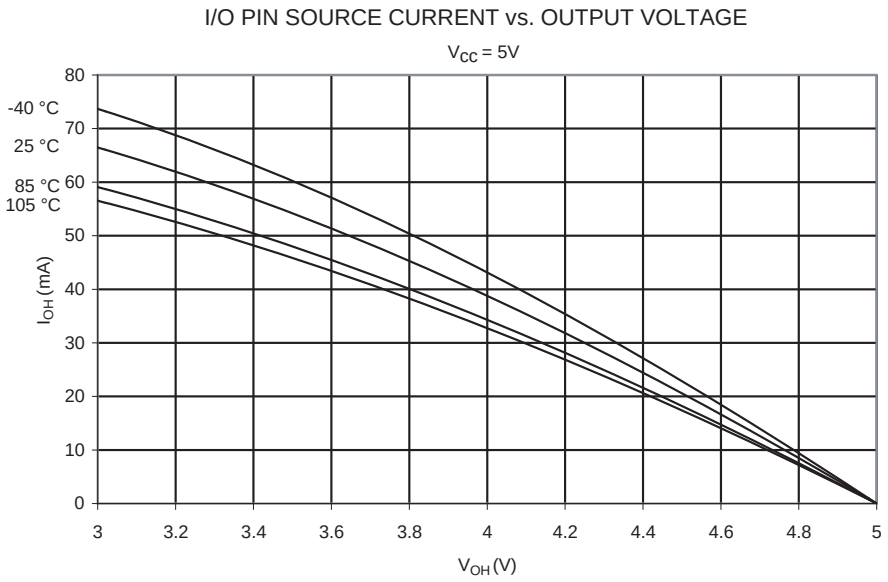


Figure 17. I/O Pin Source Current vs. Output Voltage (Low Power Ports, V_{CC} = 2.7V)

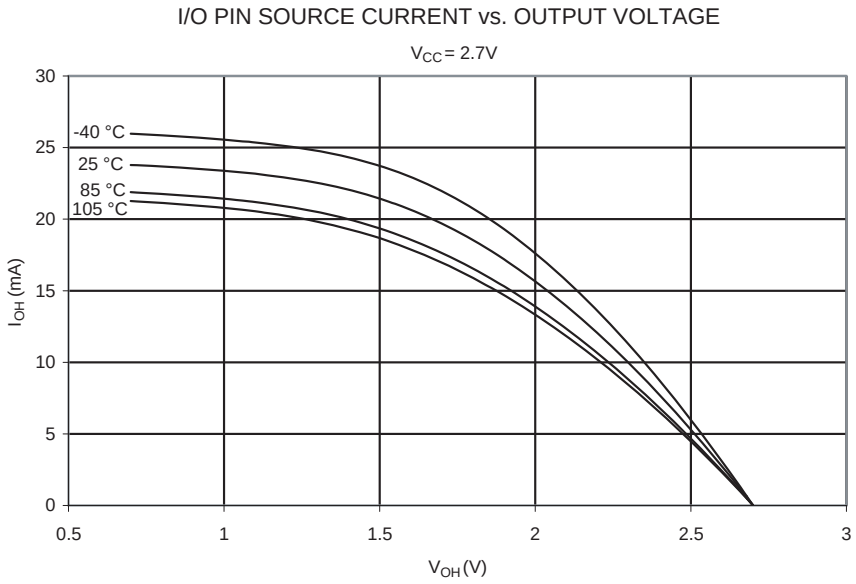


Figure 18. I/O Pin Sink Current vs. Output Voltage (Low Power Ports , V_{CC} = 5V)

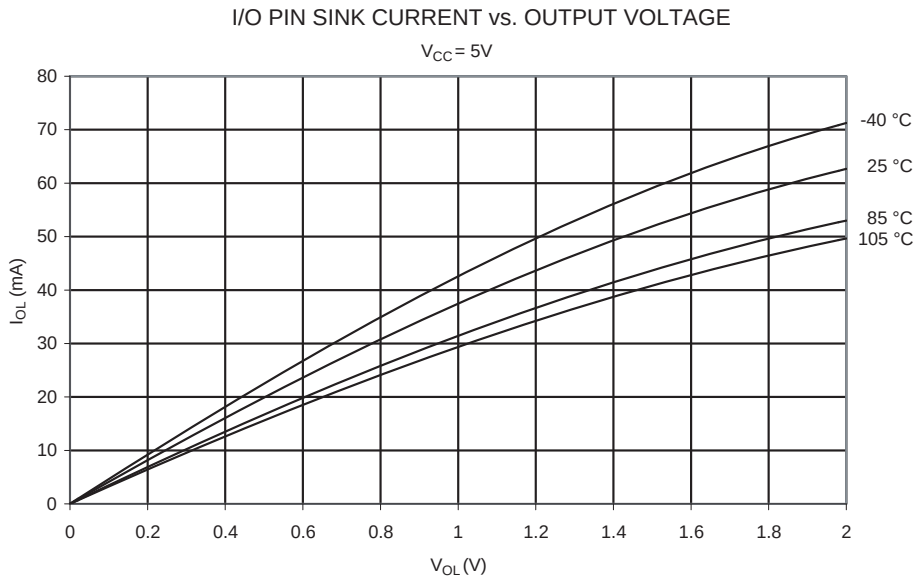
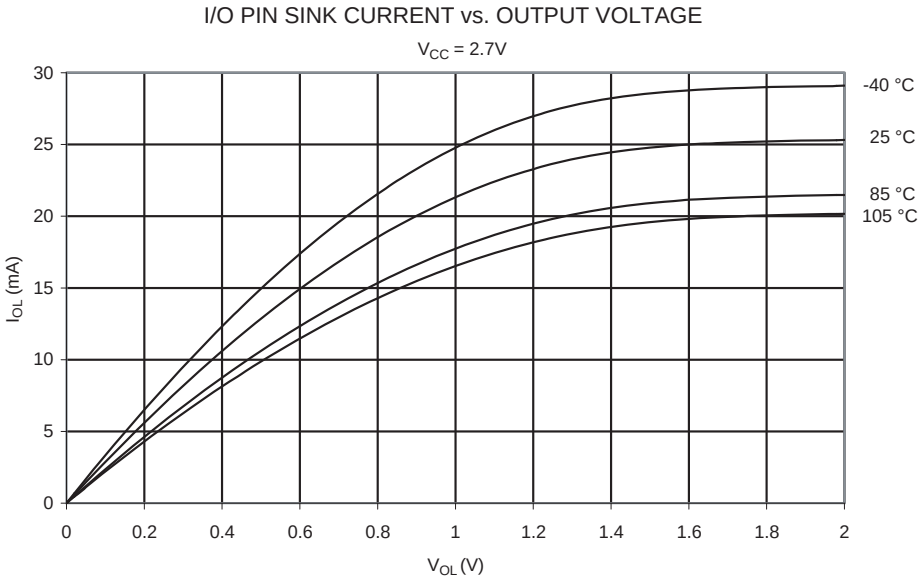


Figure 19. I/O Pin Sink Current vs. Output Voltage (Low Power Ports, V_{CC} = 2,7V)



Pin Thresholds and Hysteresis

Figure 20. I/O Pin Input Threshold Voltage vs. V_{CC} (V_{IH}, I/O Pin Read as '1')

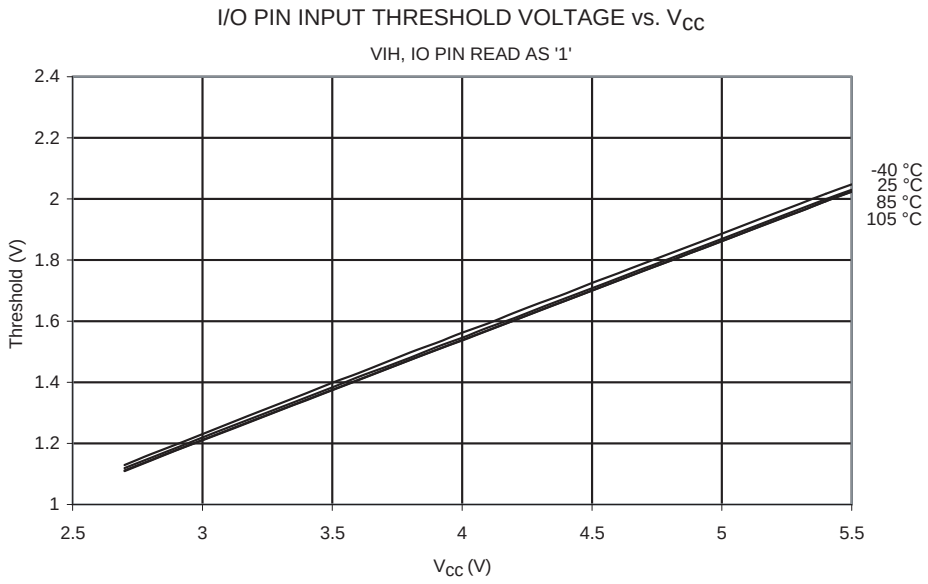


Figure 21. I/O Pin Input Threshold Voltage vs. V_{CC} (V_{IL}, I/O Pin Read as '0')

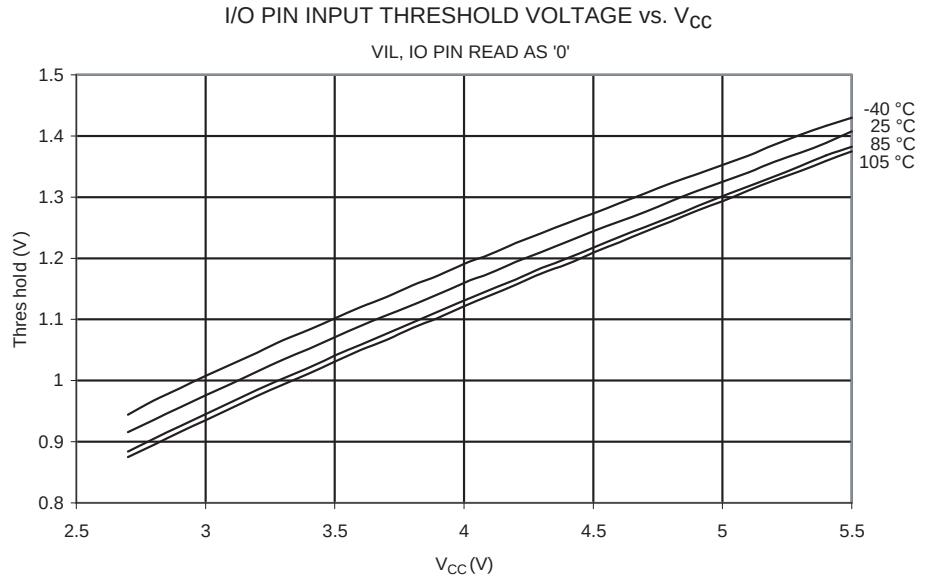


Figure 22. I/O Pin Input Hysteresis vs. V_{CC}

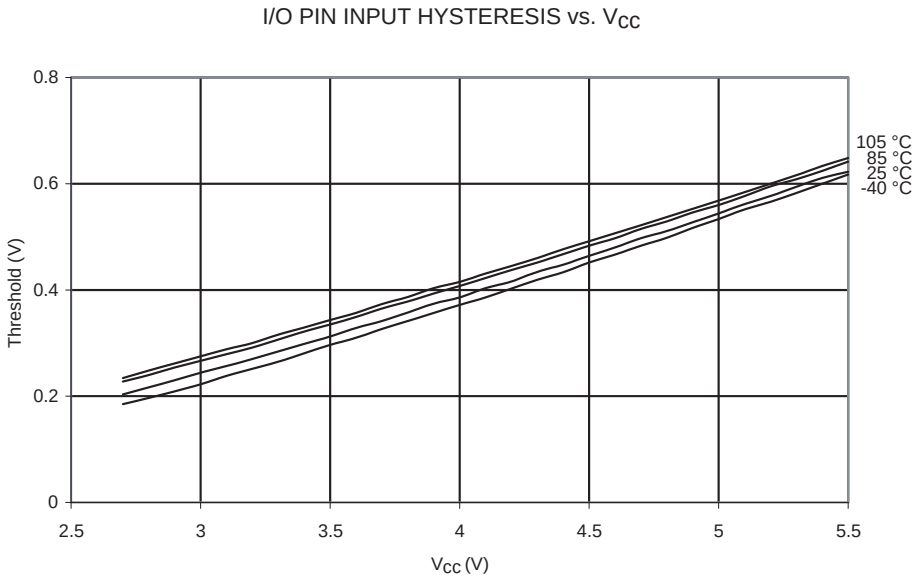
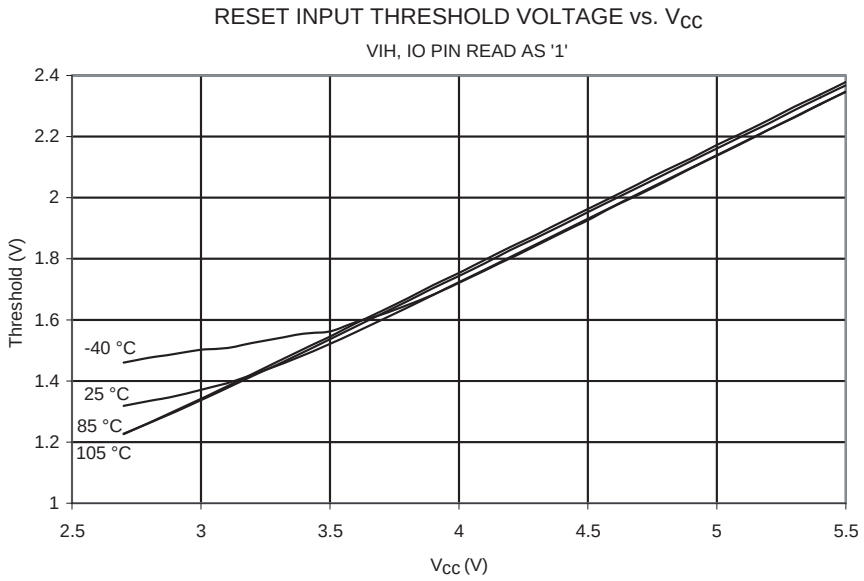
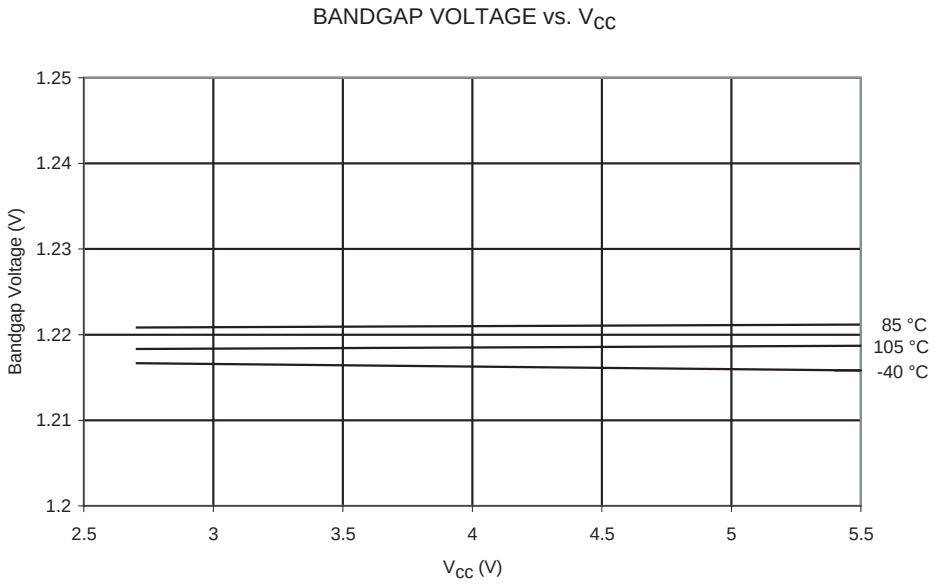


Figure 23. Reset Input Threshold Voltage vs. V_{CC} (V_{IH}, Reset Pin Read as '1')



Bod Thresholds and Analog Comparator Offset

Figure 24. Bandgap Voltage vs Vcc)



Internal Oscillator Speed

Figure 25. WDT Oscillator Frequency vs. Operativn Voltage

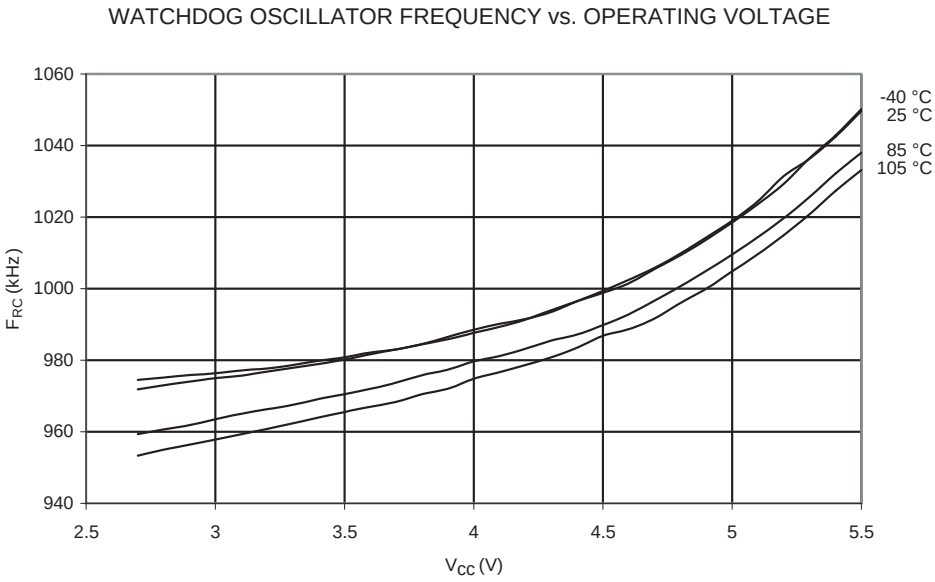


Figure 26. Calibrated 4 MHz RC Oscillator Frequency vs. V_{CC}

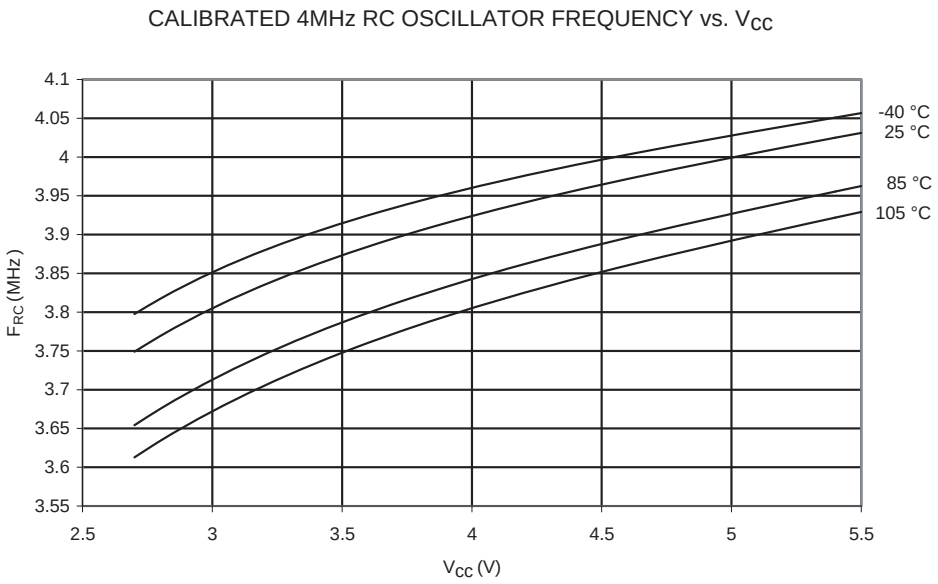


Figure 27. 8 MHz RC Oscillator Frequency vs. V_{CC}

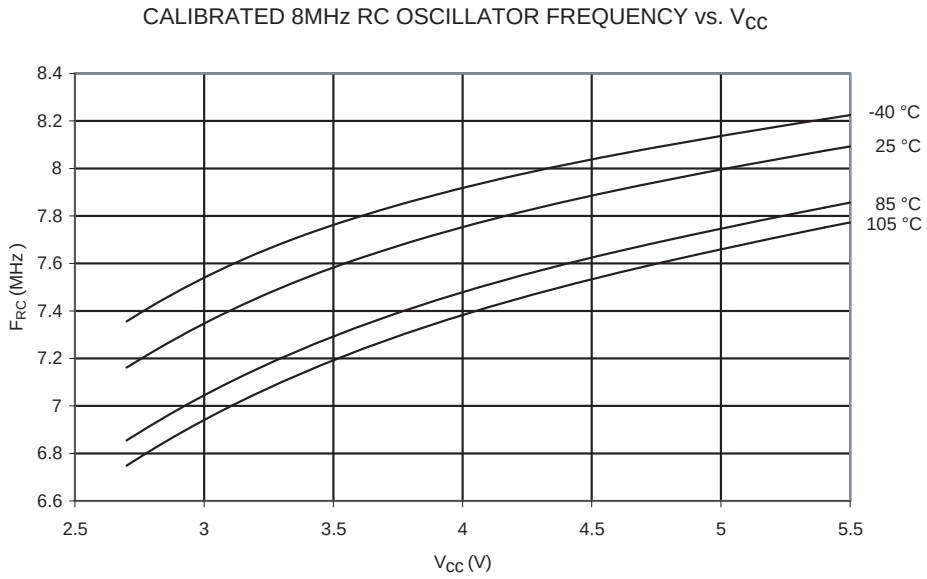


Figure 28. 1 MHz RC Oscillator Frequency vs. Vcc

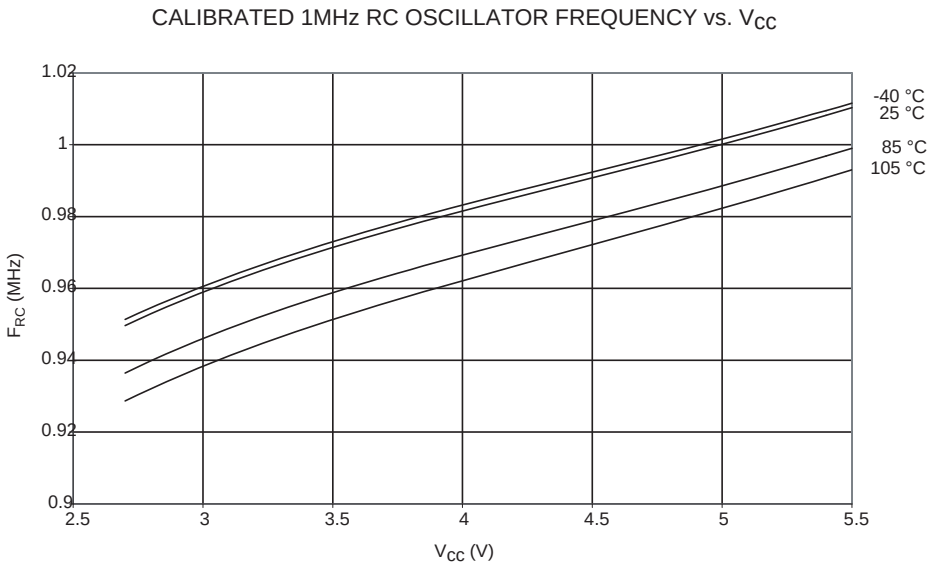


Figure 29. 1 kHz RC Oscillator Frequency vs. Oscillator

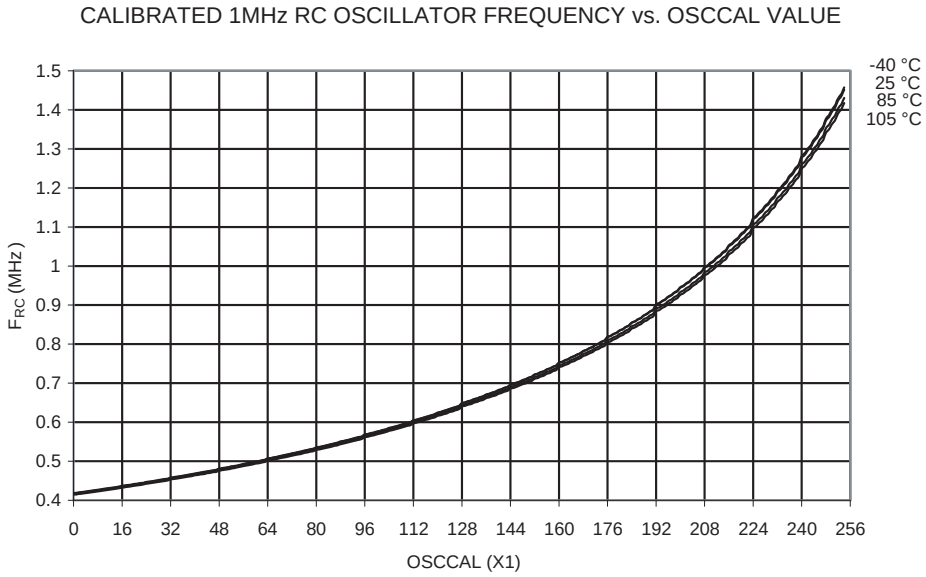


Figure 30. 2 MHz RC Oscillator Frequency vs. Vcc

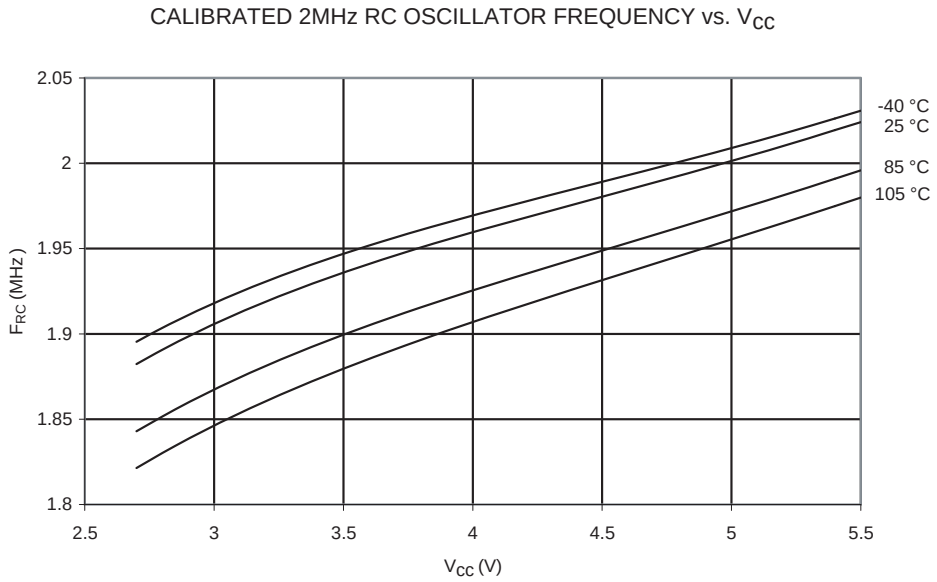


Figure 31. 2 MHz RC Oscillator Frequency vs Osccal

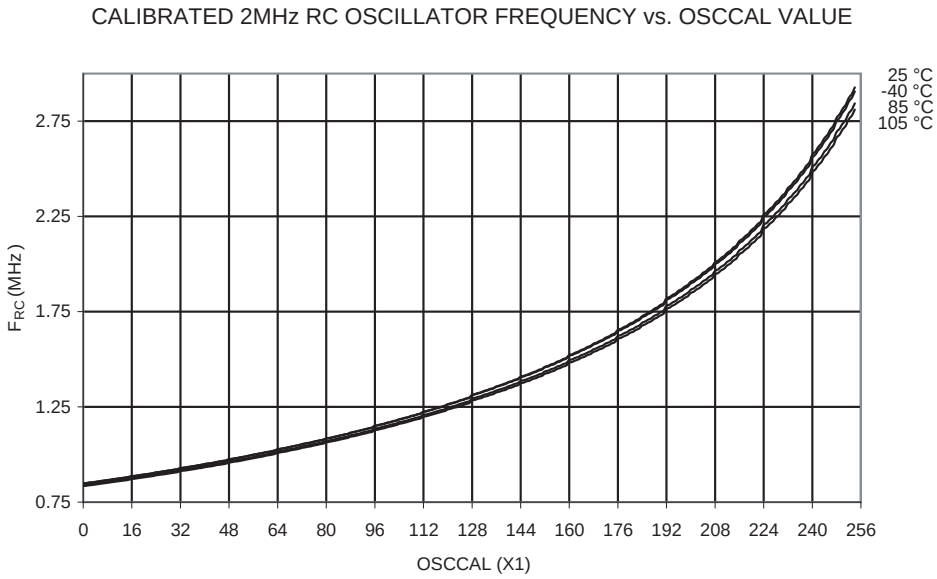


Figure 32. 4 MHz RC Oscillator Frequency vs. Osccal

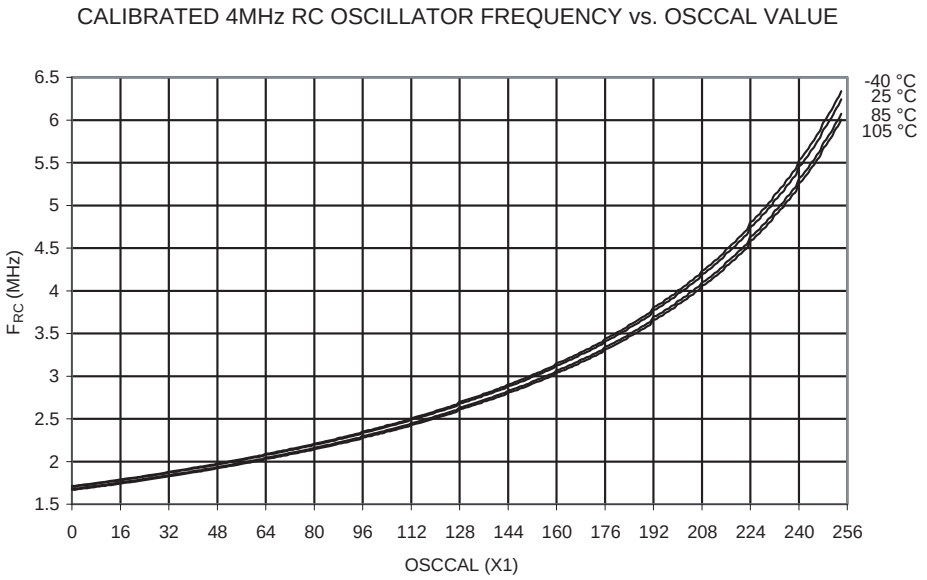
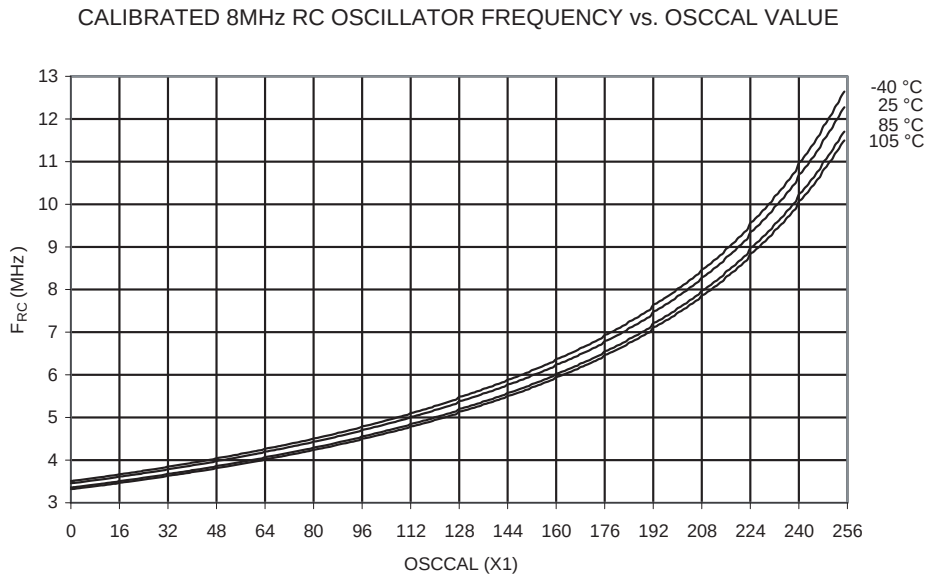


Figure 33. 8 MHz RC Oscillator Frequency vs. Osccal



Current Consumption Of Peripheral Units

Figure 34. 1 MHz Aref Current vs. V_{CC}

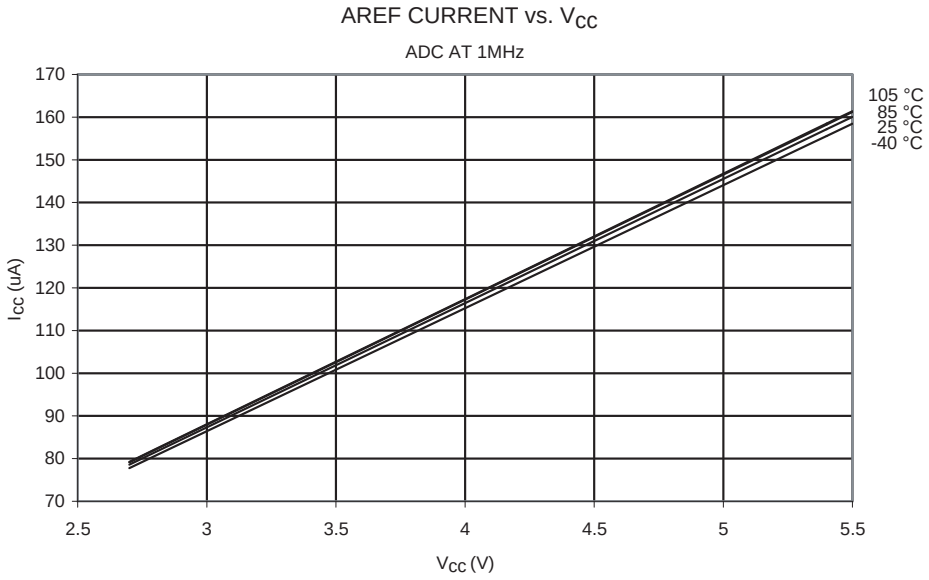


Figure 35. Brownout Detector Current vs. V_{CC}

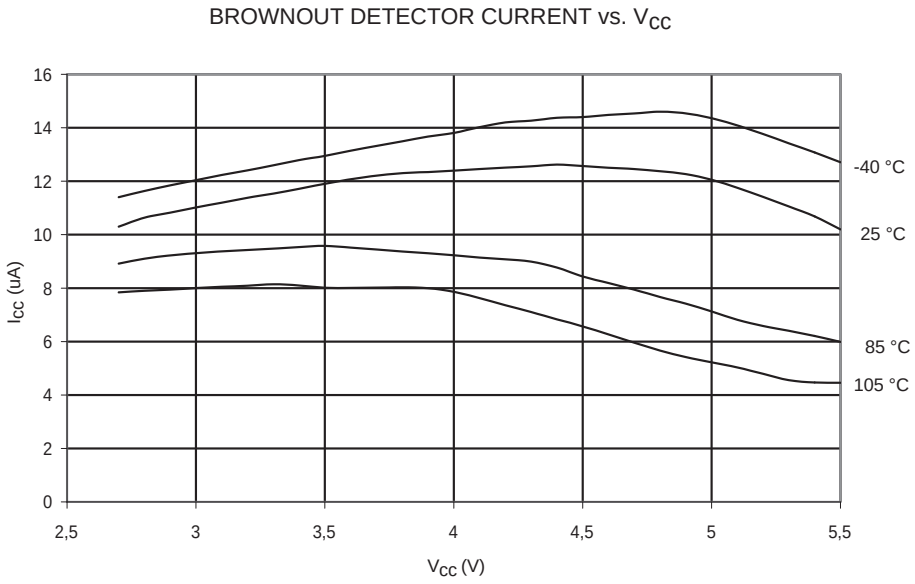


Figure 36. ADC Current vs. V_{CC}

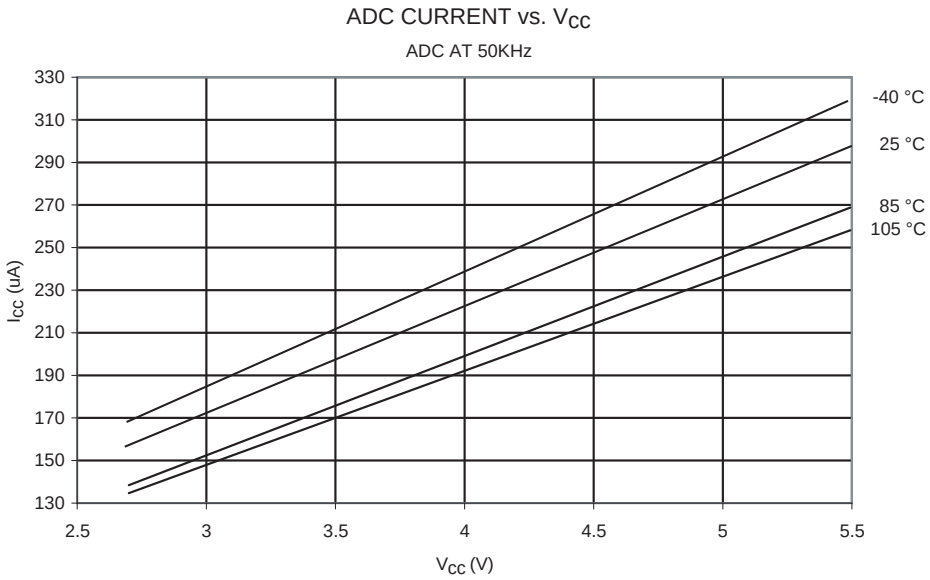


Figure 37. Analog Comparator Current vs. V_{CC}

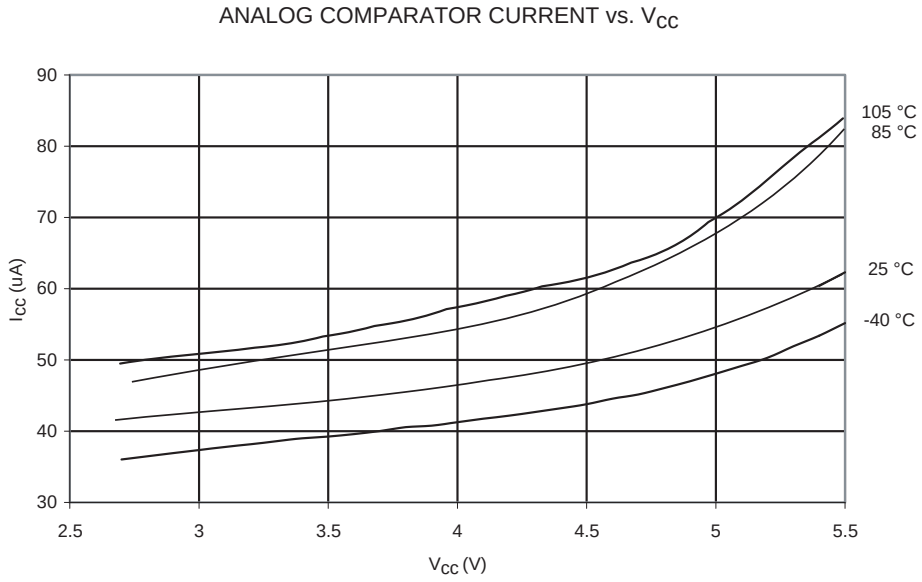
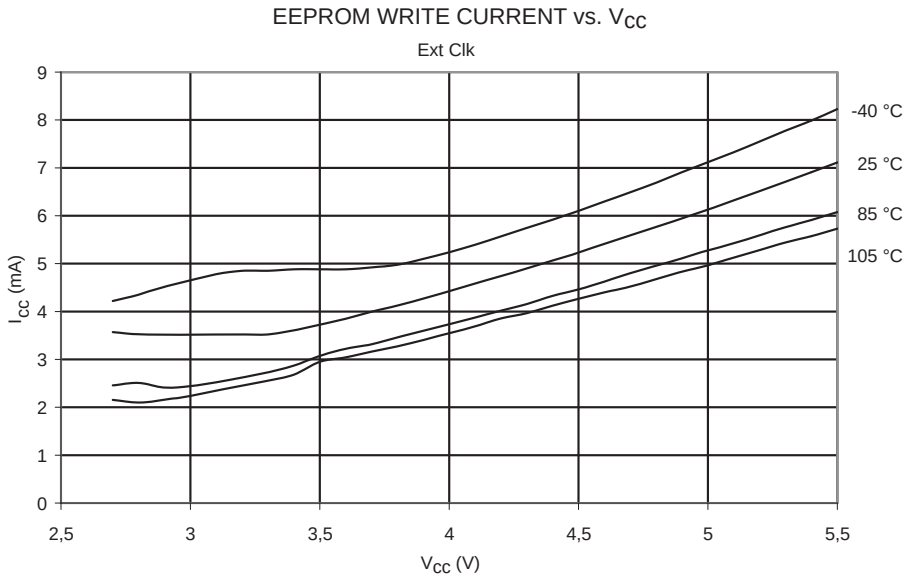
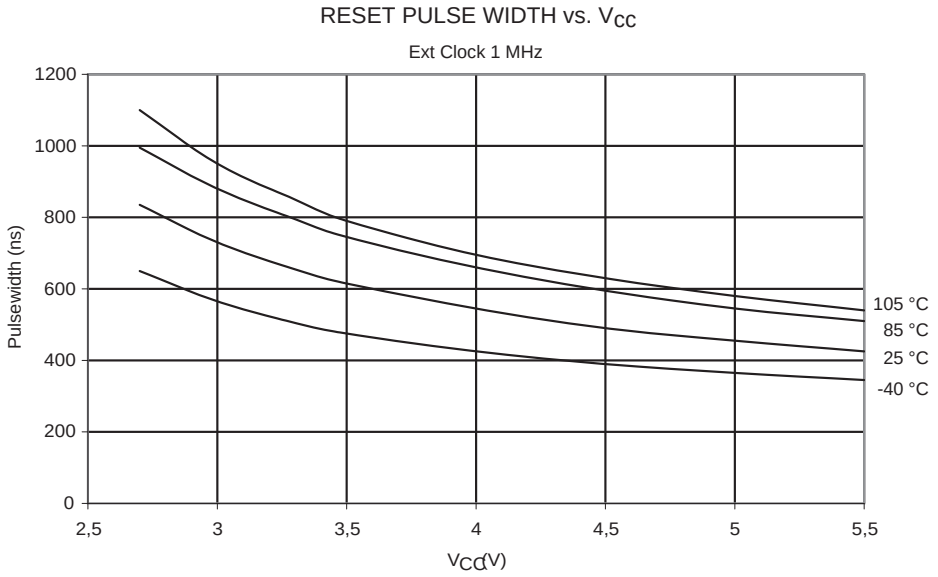


Figure 38. Programming Current vs. V_{CC}



Current Consumption In Reset and Reset Pulse Width

Figure 39. Reset Pulse Width vs. V_{CC}



Ordering Information

Speed (MHz)	Power Supply	Ordering Code	Package[1]	Operation Range
8	2.7 - 5.5V	ATmega64L-8AQ ATmega64L-8MQ	64A 64M1	Extended (-40°C to 105°C)

Note: 1. Pb-free packaging, complies to the European Directive for Restriction of Hazardous Substances (RoHS directive). Also Halide free and fully Green.

Package Type	
64A	64-lead, 14 x 14 x 1 mm, Thin Profile Plastic Quad Flat Package (TQFP)
64M1	64-pad, 9 x 9 x 1.0 mm body, lead pitch 0.50 mm, Quad Flat No-Lead/Micro Lead Frame Package (QFN/MLF)

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