

**Standard Characteristics Example**

Standard characteristics described below are just examples of the 38D5 Group's characteristics and are not guaranteed. For rated values, refer to "38D5 Group Data sheet".

**(1) Power Source Current Standard Characteristics Example (Vcc-Icc)**

When system is operating in frequency/2 mode (ceramic oscillation, Ta = 25 °C, output transistor is in the cut-off state)

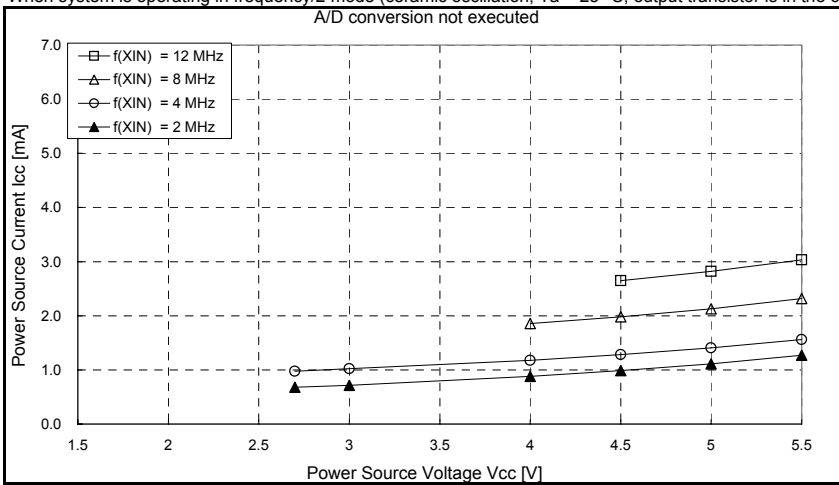


Fig. 1. Vcc-Icc (frequency/2 mode)

When system is operating in frequency/4 mode (ceramic oscillation, Ta = 25 °C, output transistor is in the cut-off state)

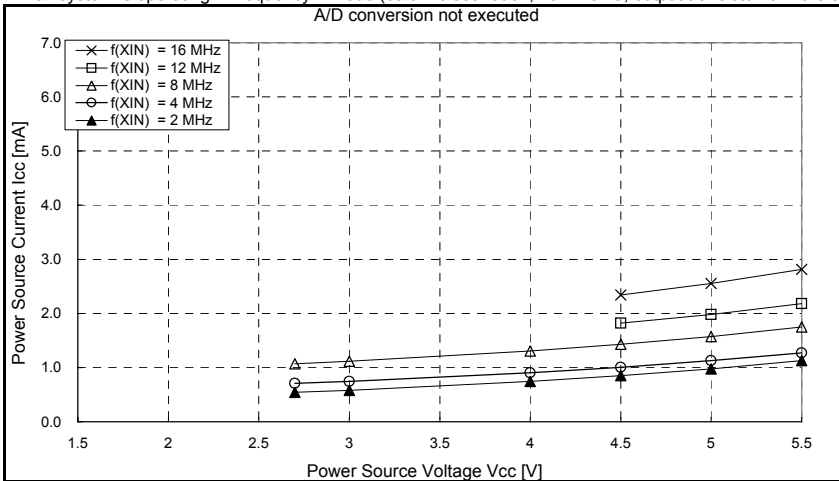


Fig. 2. Vcc-Icc (frequency/4 mode)

When system is operating in frequency/8 mode (ceramic oscillation, Ta = 25 °C, output transistor is in the cut-off state)

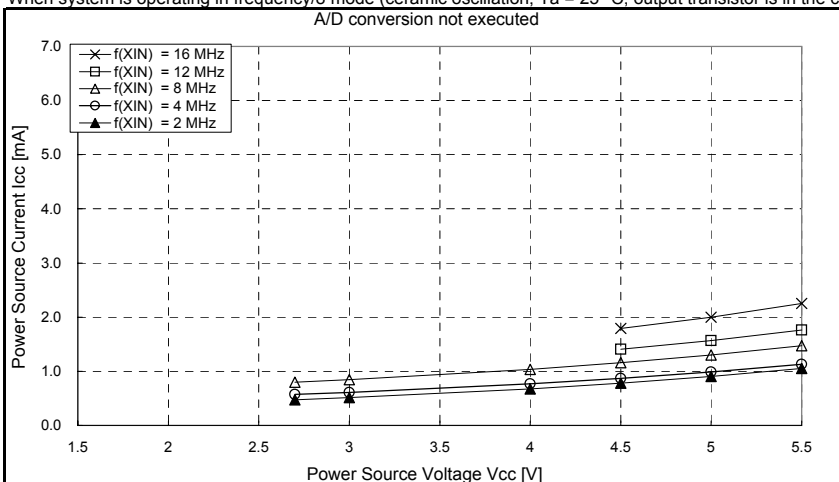


Fig. 3. Vcc-Icc (frequency/8)

At WIT instruction executed (ceramic oscillation, Ta = 25 °C, output transistor is in the cut-off state)

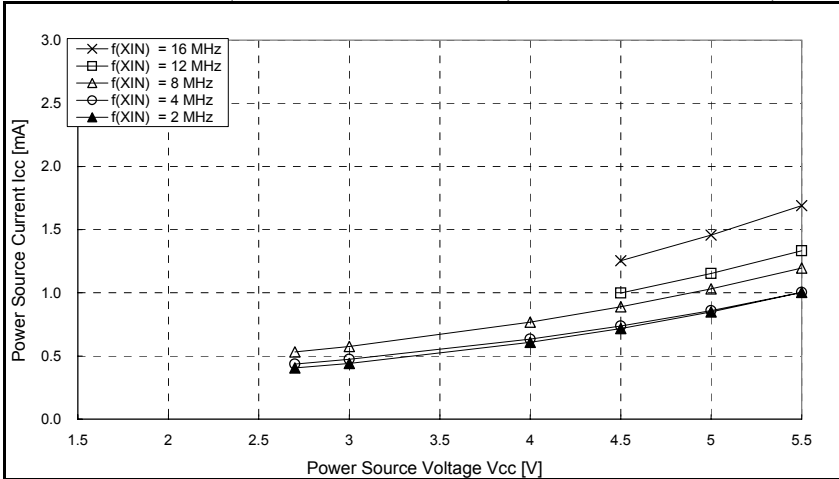


Fig. 4. Vcc-Icc (at WIT instruction executed)

At STP instruction executed (Ta = 25 °C, output transistor is in the cut-off state)

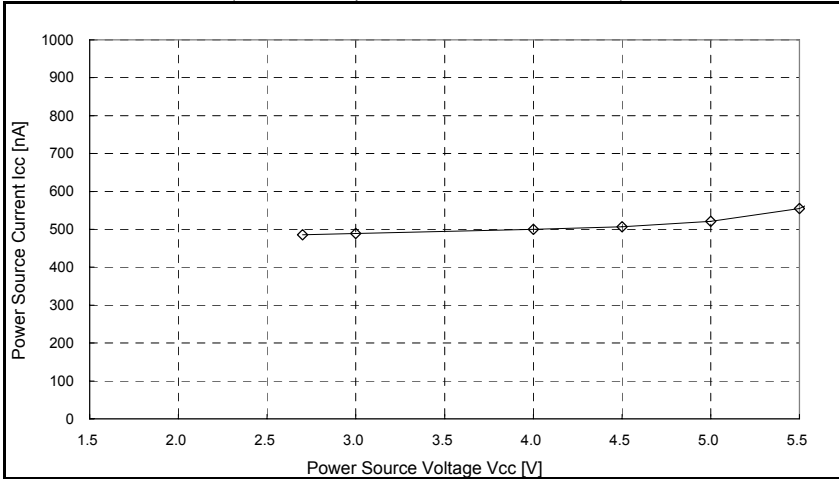


Fig. 5. Vcc-Icc (at STP instruction executed)

At 12 MHz frequency/2, increment at A/D conversion executed (ceramic oscillation, Ta = 25 °C, output transistor is in the cut-off state)

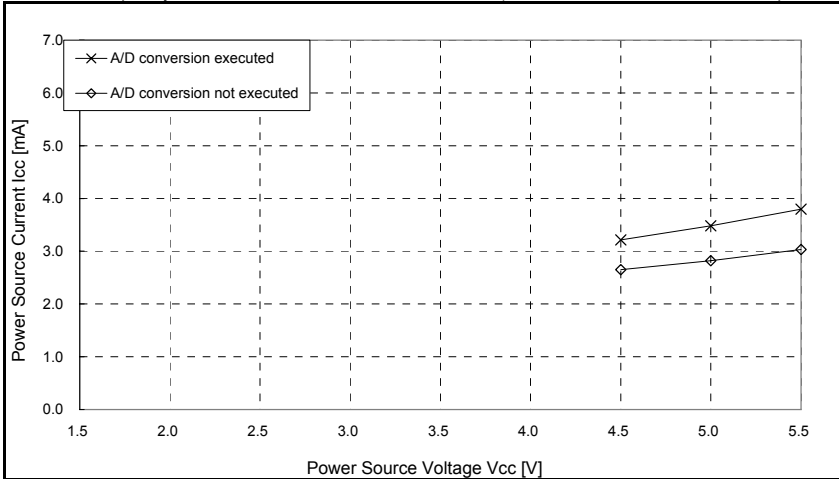


Fig. 6. Vcc-Icc (increment at A/D conversion executed)

At 16 MHz frequency/4 mode, increment at A/D conversion executed (ceramic oscillation, Ta = 25 °C, output transistor is in the cut-off state)

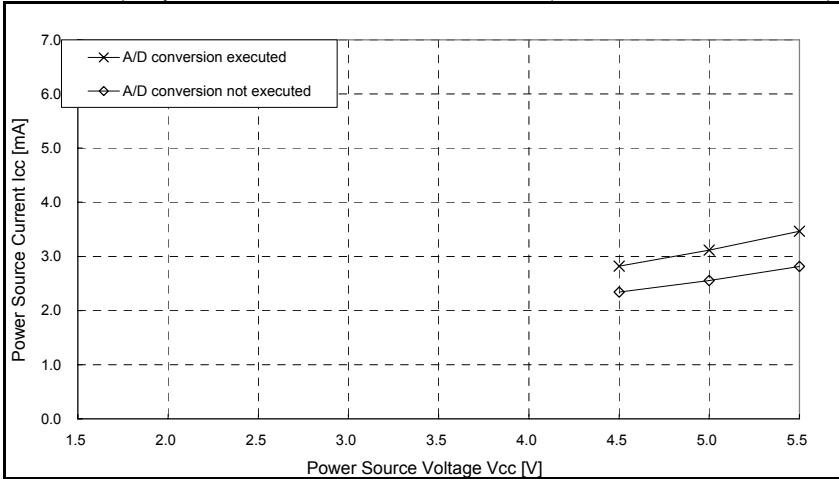


Fig. 7. Vcc-Icc (increment at A/D conversion executed)

At 16 MHz frequency/8 mode, increment at A/D conversion executed (ceramic oscillation, Ta = 25 °C, output transistor is in the cut-off state)

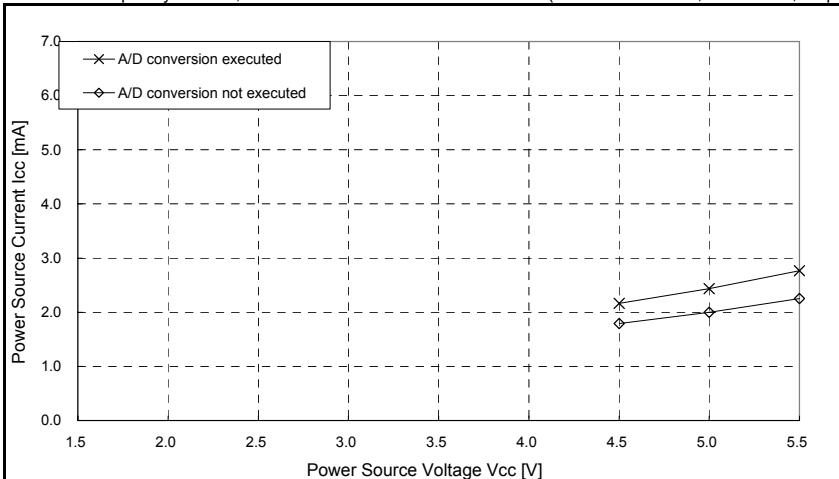


Fig. 8. Vcc-Icc (increment at A/D conversion executed)

When system is operating in low-speed mode (crystal oscillation, ceramic oscillation stop, Ta = 25 °C, output transistor is in the cut-off state)

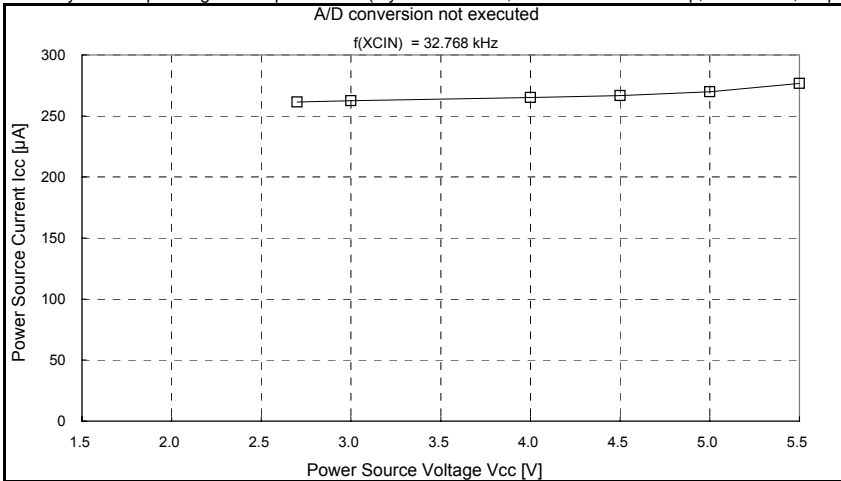


Fig. 9. Vcc-Icc (low-speed mode)

At WIT instruction executed (crystal oscillation, ceramic oscillation stop, Ta = 25 °C, output transistor is in the cut-off state)

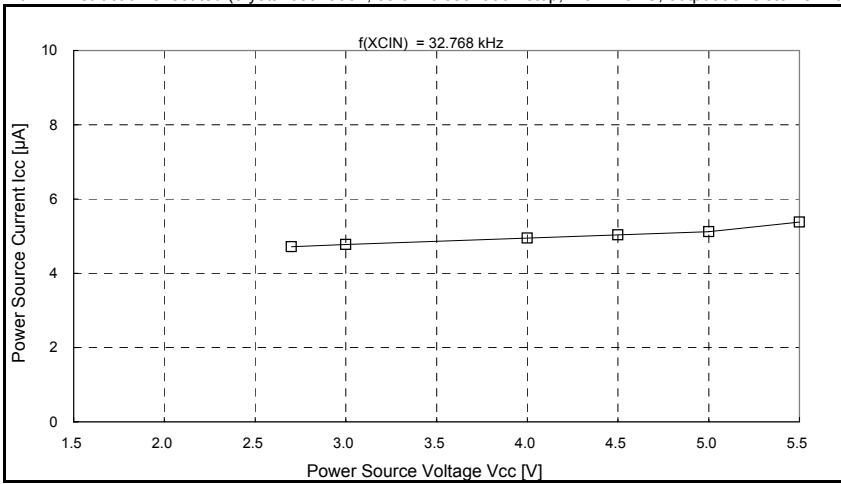


Fig. 10. Vcc-Icc (at WIT instruction executed)

When system is operating in on-chip oscillator mode (external oscillation stop, output transistor is in the cut-off state)

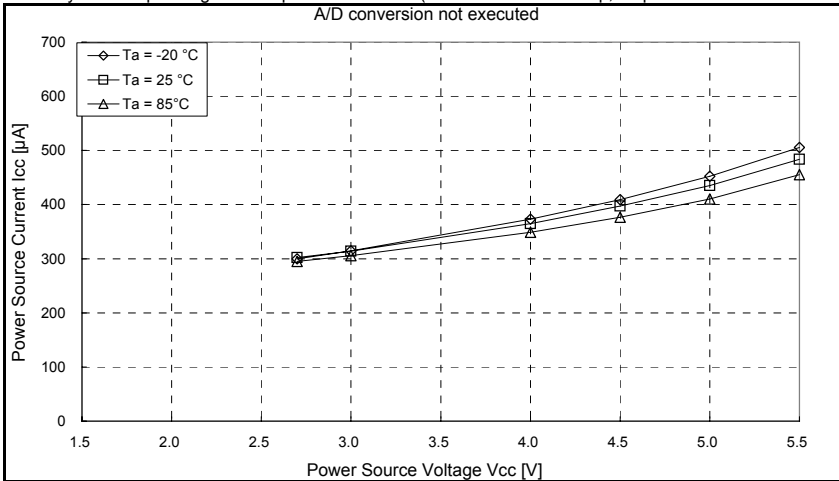


Fig. 11. Vcc-Icc (on-chip oscillator mode)

On-chip oscillator operating mode, at WIT instruction executed (external oscillation stop, output transistor is in the cut-off state)

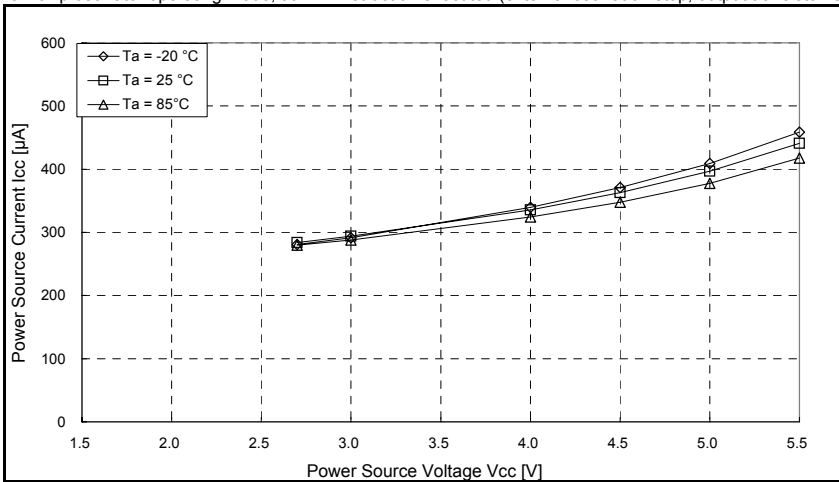


Fig. 12. Vcc-Icc (on-chip oscillator mode at WIT instruction executed)

(2) Power Supply Current Standard Characteristics Example (f(XIN) -Icc)

When system is operating in frequency/2 mode (ceramic oscillation, Ta = 25 °C, output transistor is in the cut-off state)  
A/D conversion not executed

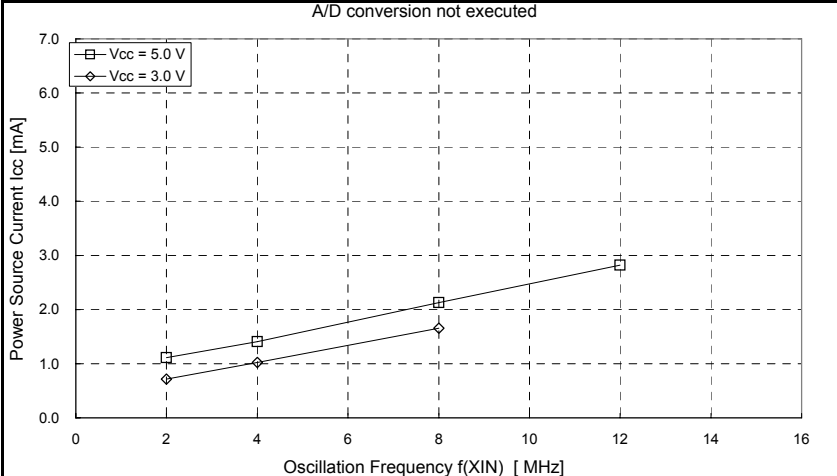


Fig. 13. f(XIN) -Icc (frequency/2 mode)

When system is operating in frequency/4 mode (ceramic oscillation, Ta = 25 °C, output transistor is in the cut-off state)  
A/D conversion not executed

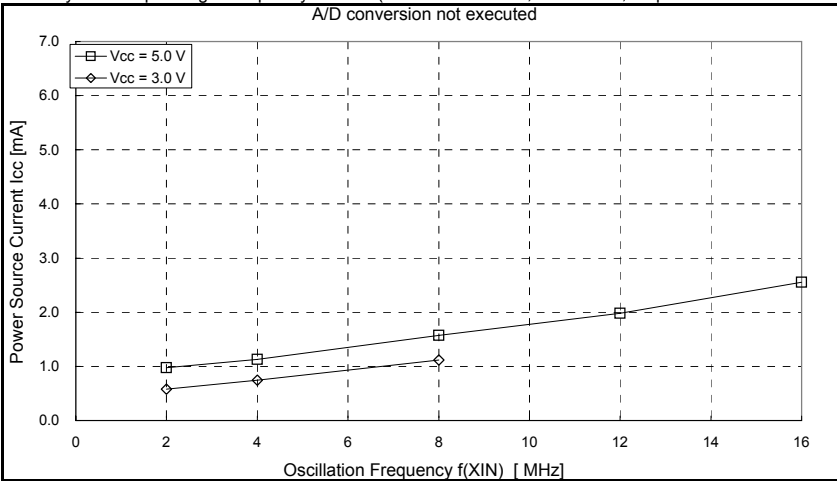


Fig. 14. f(XIN) -Icc (frequency/4 mode)

When system is operating in frequency/8 mode (ceramic oscillation, Ta = 25 °C, output transistor is in the cut-off state)  
A/D conversion not executed

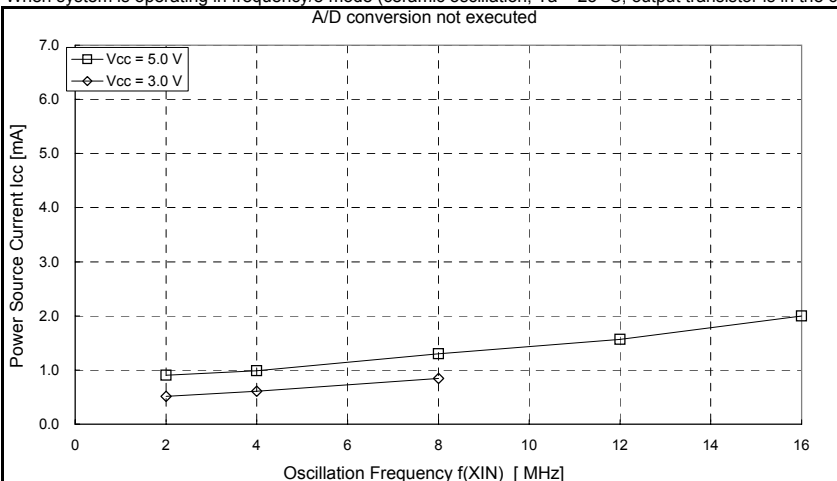


Fig. 15. f(XIN) -Icc (frequency/8 mode)

At WIT instruction executed (ceramic oscillation, Ta = 25 °C, output transistor is in the cut-off state)

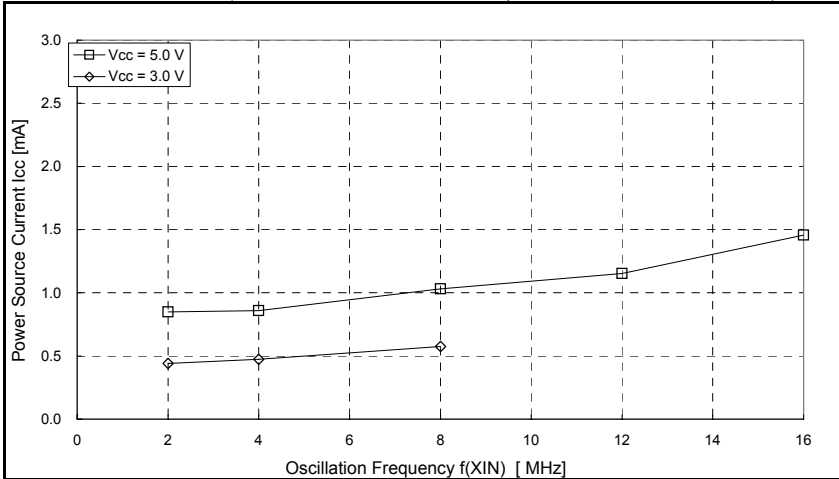


Fig. 16. f(XIN) - Icc (at WIT instruction executed)

**(3) Power Supply Current Standard Characteristics Example (Ta-icc)**

When system is operating in on-chip oscillator mode (external oscillation stop, output transistor is in the cut-off state)

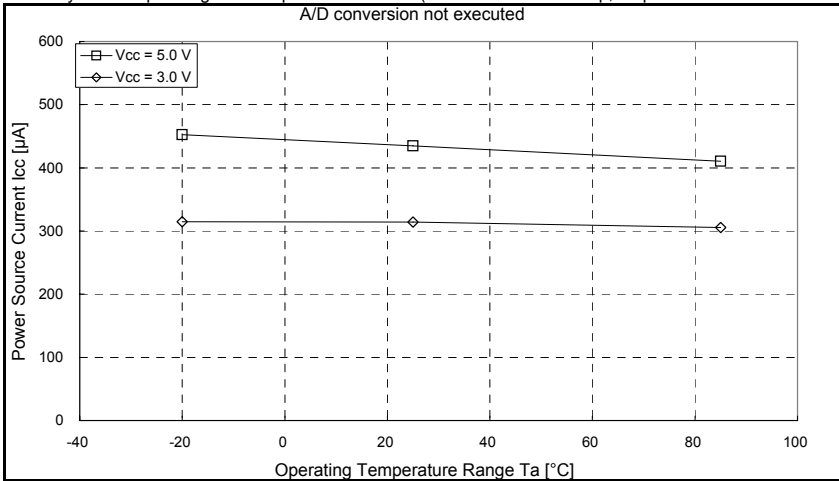


Fig. 17. Ta-icc (on-chip oscillator mode)

On-chip oscillator operating mode at WIT instruction executed (external oscillation stop, output transistor is in the cut-off state)

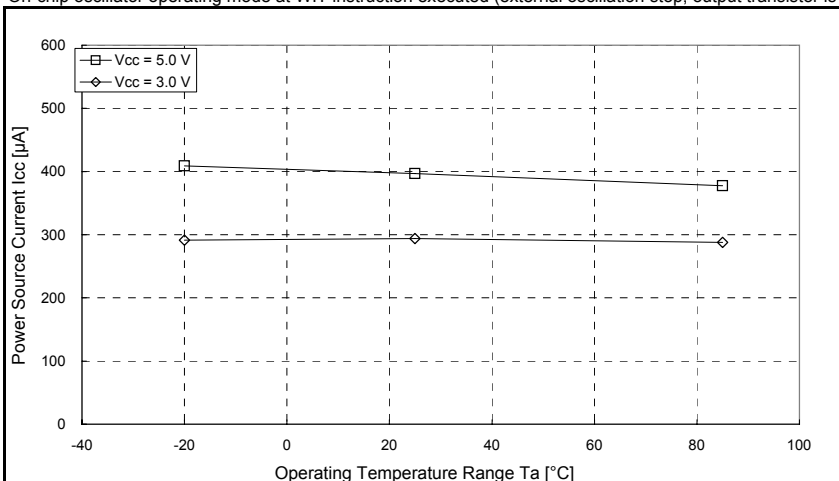


Fig. 18. Ta-icc (on-chip oscillator mode at WIT instruction executed)

(4) Port Standard characteristics Example (VOH-IOH)

VOH-IOH (Vcc = 5.5 V, Ports P00-P07,P10-P17,P20-P27,P30-P37)

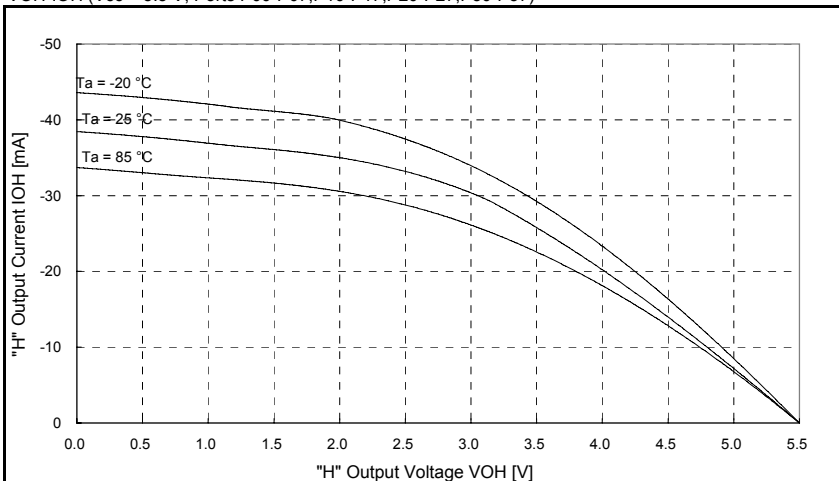


Fig. 19. VOH-IOH (Vcc = 5.5 V, Ports P00-P07,P10-P17,P20-P27,P30-P37)

VOH-IOH (Vcc = 4.0 V, Ports P00-P07,P10-P17,P20-P27,P30-P37)

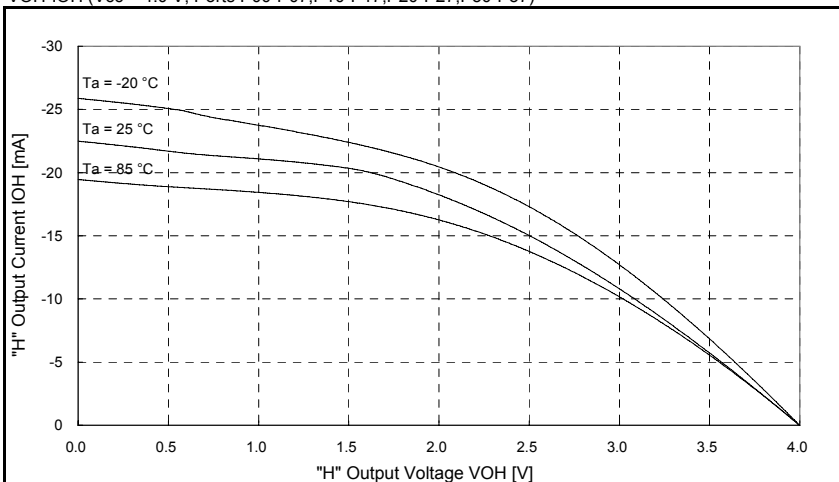


Fig. 20. VOH-IOH (Vcc = 4.0 V, Ports P00-P07,P10-P17,P20-P27,P30-P37)

VOH-IOH (Vcc = 2.7 V, Ports P00-P07,P10-P17,P20-P27,P30-P37)

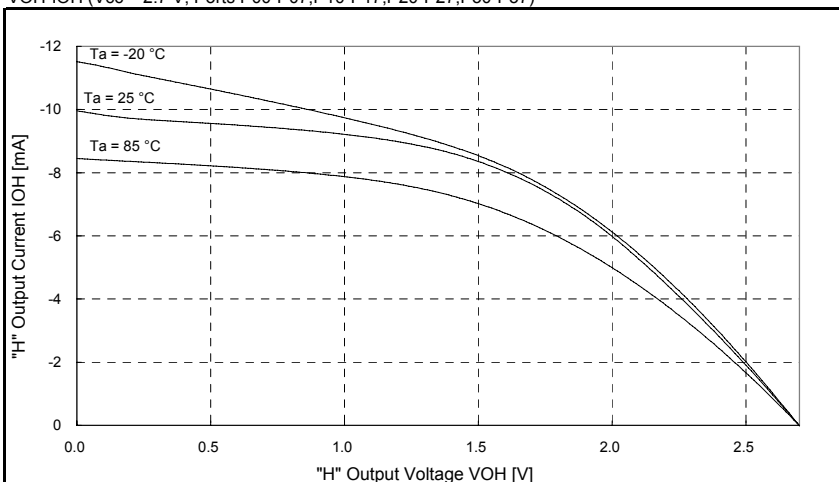


Fig. 21. VOH-IOH (Vcc = 2.7 V, Ports P00-P07,P10-P17,P20-P27,P30-P37)



VOH-IOH (Vcc = 5.5 V, Ports P40-P47,P50-P57,P60-P67,P72-P74)

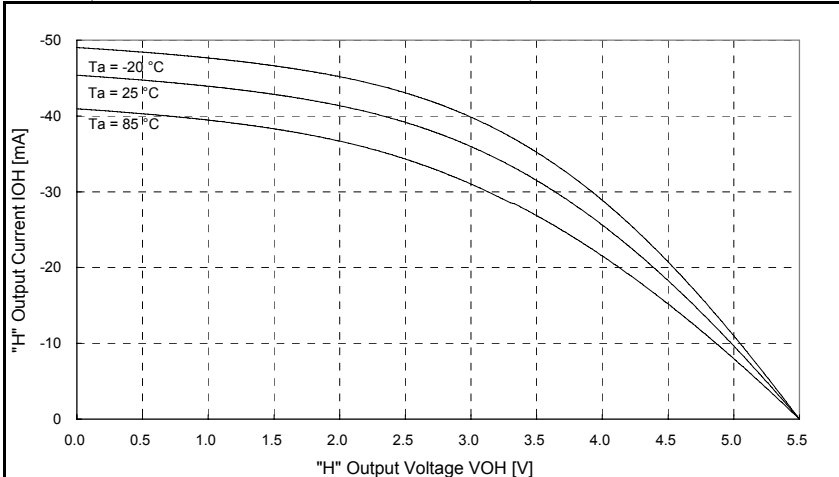


Fig. 22. VOH-IOH (Vcc = 5.5 V, Ports P40-P47,P50-P57,P60-P67,P72-P74)

VOH-IOH (Vcc = 4.0 V, Ports P40-P47,P50-P57,P60-P67,P72-P74)

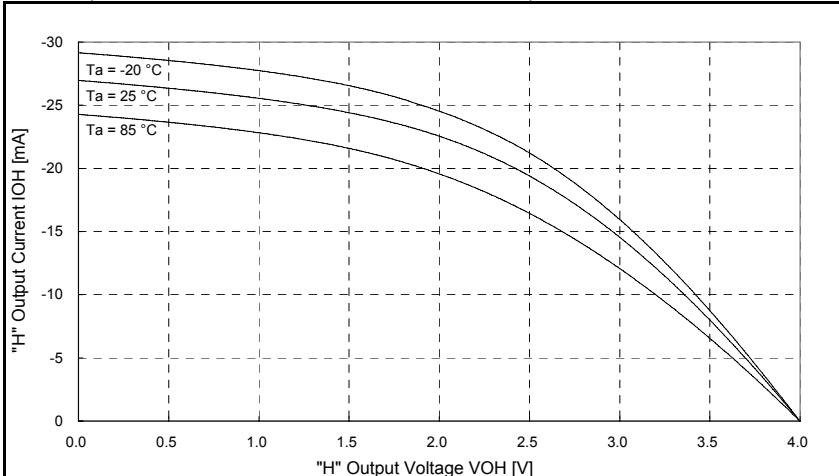


Fig. 23. VOH-IOH (Vcc = 4.0 V, Ports P40-P47,P50-P57,P60-P67,P72-P74)

VOH-IOH (Vcc = 2.7 V, Ports P40-P47,P50-P57,P60-P67,P72-P74)

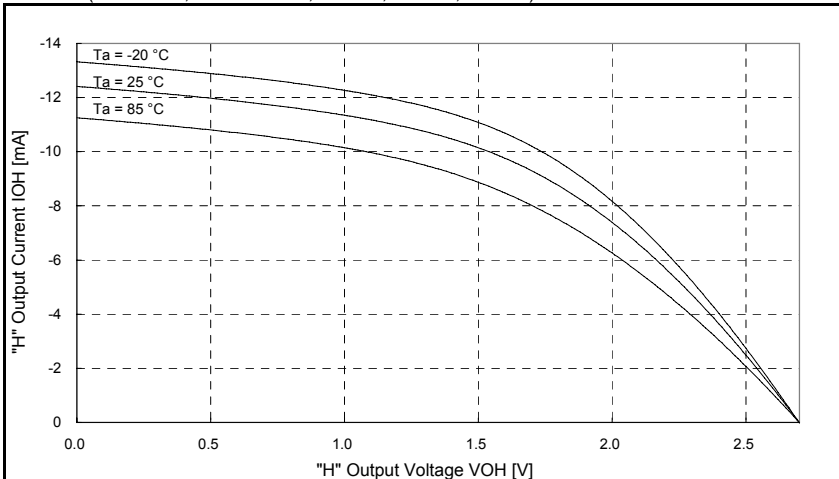


Fig. 24. VOH-IOH (Vcc = 2.7 V, Ports P40-P47,P50-P57,P60-P67,P72-P74)

(5) Port Standard Characteristics Example (VOL-IOL)

VOL-IOL (Vcc = 5.5 V, Ports P00-P07,P10-P17,P20-P27,P30-P37)

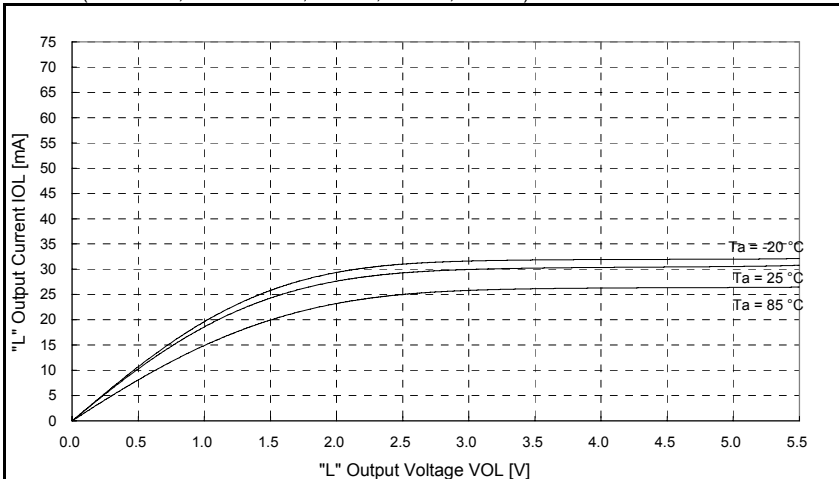


Fig. 25. VOL-IOL (Vcc = 5.5 V, Ports P00-P07,P10-P17,P20-P27,P30-P37)

VOL-IOL (Vcc = 4.0 V, Ports P00-P07,P10-P17,P20-P27,P30-P37)

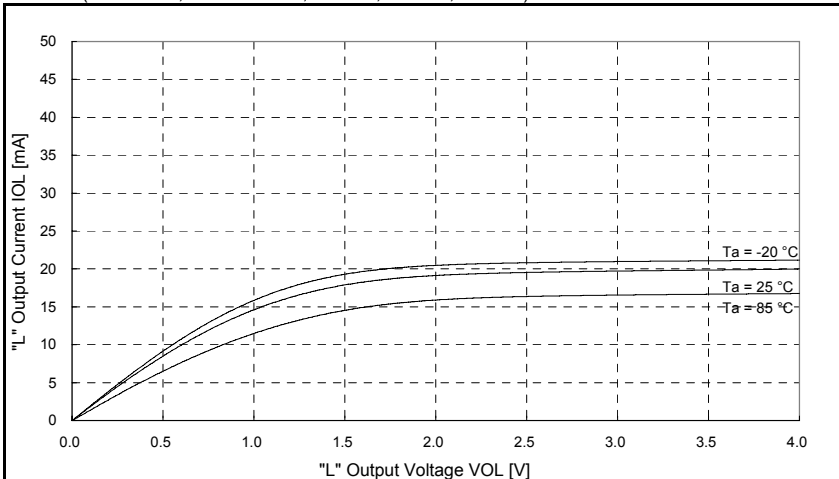


Fig. 26. VOL-IOL (Vcc = 4.0 V, Ports P00-P07,P10-P17,P20-P27,P30-P37)

VOL-IOL (Vcc = 2.7 V, Ports P00-P07,P10-P17,P20-P27,P30-P37)

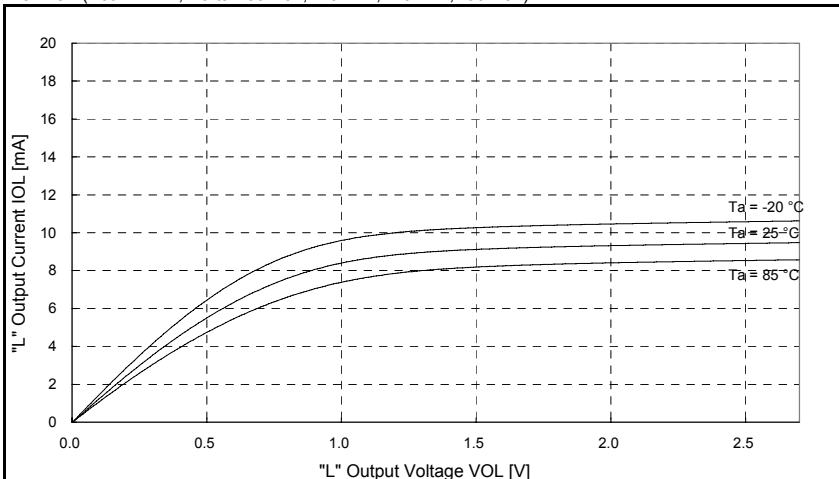


Fig. 27. VOL-IOL (Vcc = 2.7 V, Ports P00-P07,P10-P17,P20-P27,P30-P37)

VOL-IOL (Vcc = 5.5 V, Ports P62-P67)

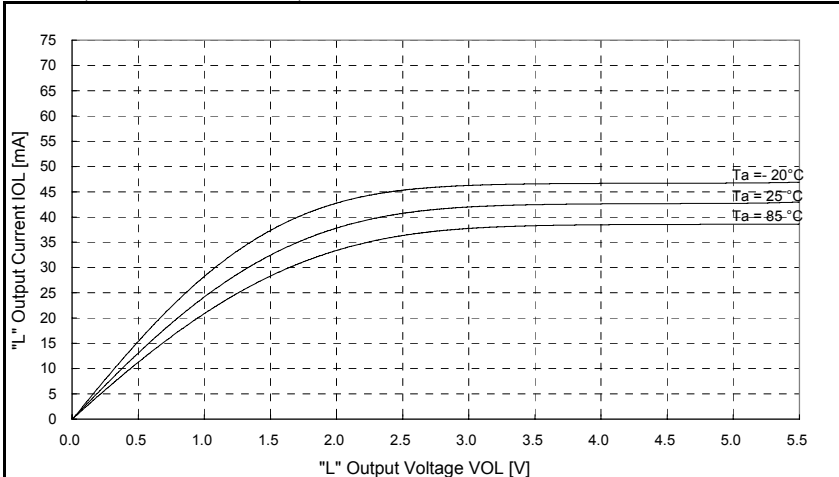


Fig. 28. VOL-IOL (Vcc = 5.5 V, Ports P62-P67)

VOL-IOL (Vcc = 4.0 V, Ports P62-P67)

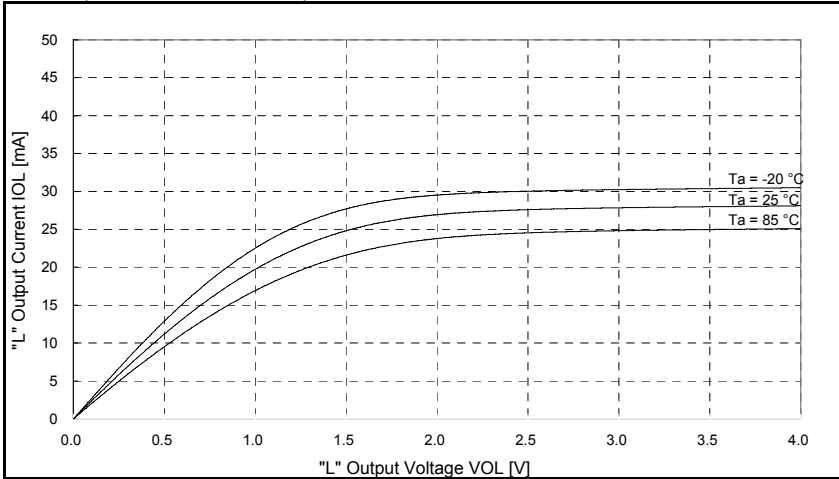


Fig. 29. VOL-IOL (Vcc = 4.0 V, Ports P62-P67)

VOL-IOL (Vcc = 2.7 V, Ports P62-P67)

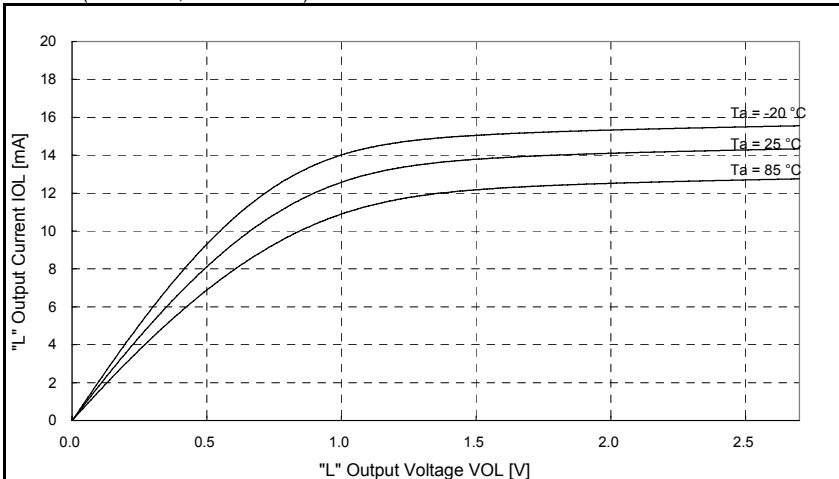


Fig. 30. VOL-IOL (Vcc = 2.7 V, Ports P62-P67)

VOL-IOL (Vcc = 5.5 V, Ports P40-P47,P50-P57,P60,P61,P72-P74)

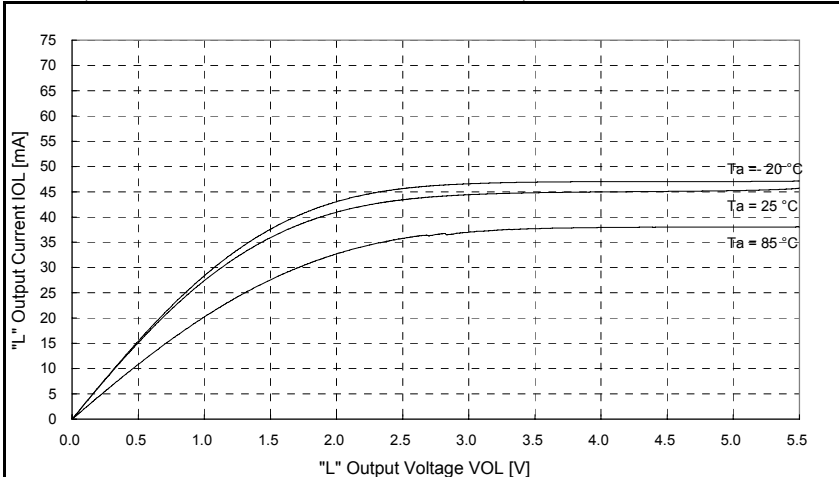


Fig. 31. VOL-IOL (Vcc = 5.5 V, Ports P40-P47,P50-P57,P60,P61,P72-P74)

VOL-IOL (Vcc = 4.0 V, Ports P40-P47,P50-P57,P60,P61,P72-P74)

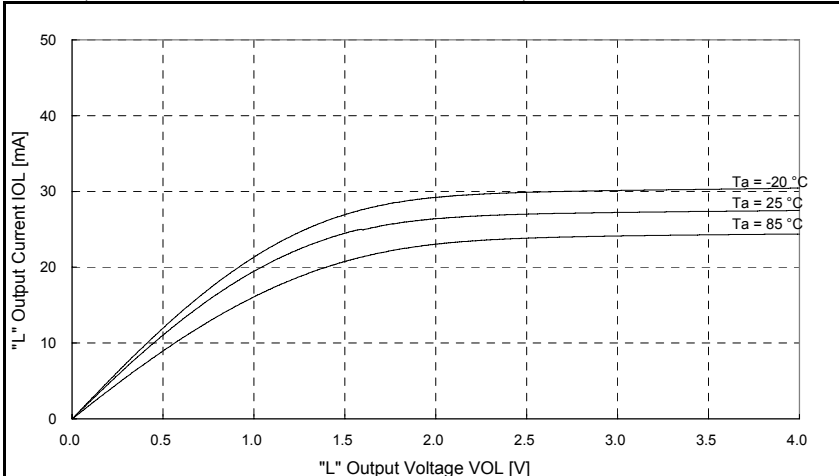


Fig. 32. VOL-IOL (Vcc = 4.0 V, Ports P40-P47,P50-P57,P60,P61,P72-P74)

VOL-IOL (Vcc = 2.7 V, Ports P40-P47,P50-P57,P60,P61,P72-P74)

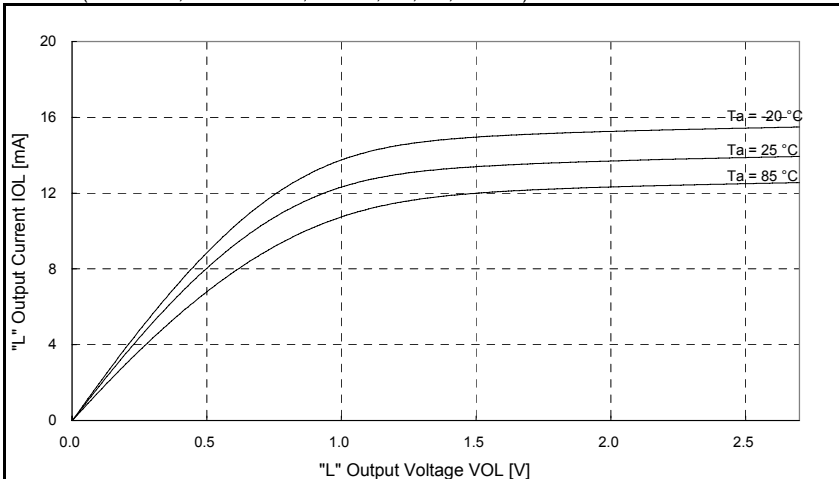


Fig. 33. VOL-IOL (Vcc = 2.7 V, Ports P40-P47,P50-P57,P60,P61,P72-P74)

(6) Port Standard Characteristics Example (Vcc-IIL)

Vcc-IIL (Ports P00-P07, P10-P17, P20-P27, P30-37 when connecting pull-up transistor) (clerical error revised in rev.2.00)

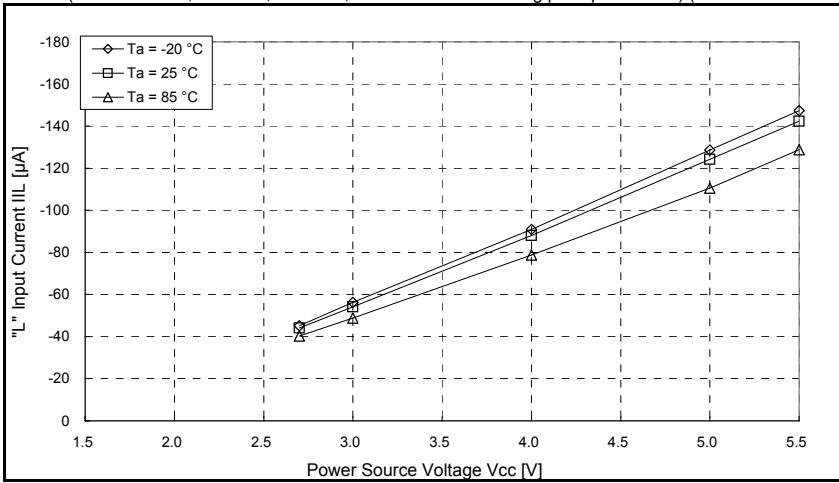


Fig. 34. Vcc-IIL (when connecting pull-up transistor)

Vcc-IIL (Ports P40-P47, P50-P57, P60-P62, P72-P74 when connecting pull-up transistor) (revised in rev.2.00)

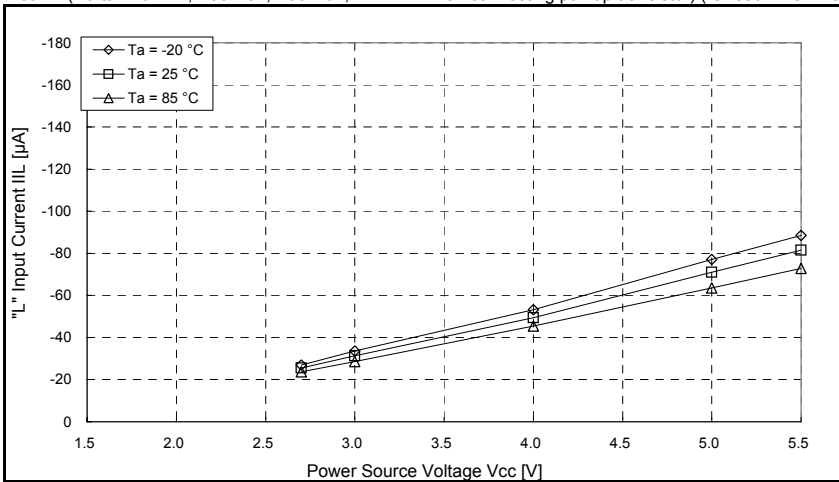


Fig. 35. Vcc-IIL (when connecting pull-up transistor)

(7) Port Standard Characteristics Example (Vcc-VIHL)

Vcc-VIHL (I/O Ports (CMOS) , Ta = 25 °C, Ports P41,P43,P50-P57, P72-P74)

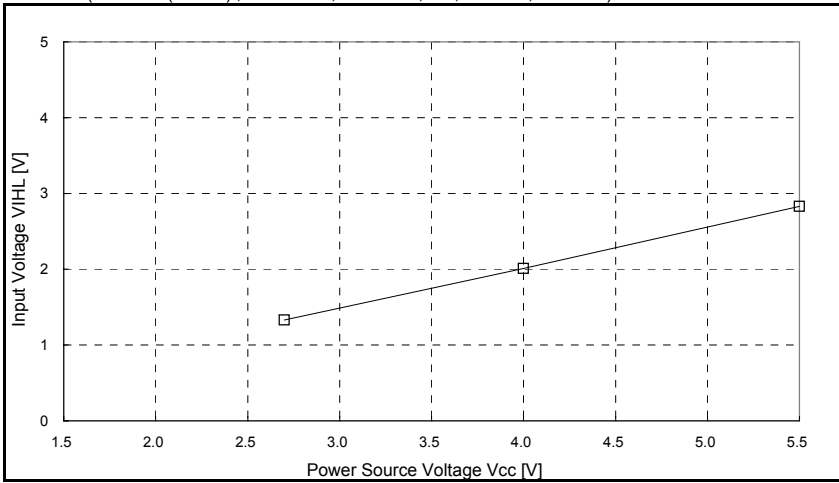


Fig. 36. Vcc-VIHL (I/O Port (CMOS))

Vcc-VIHL (I/O Ports (CMOS) , Ta = 25 °C, Ports P40,P42,P44-P47, P70,P71)

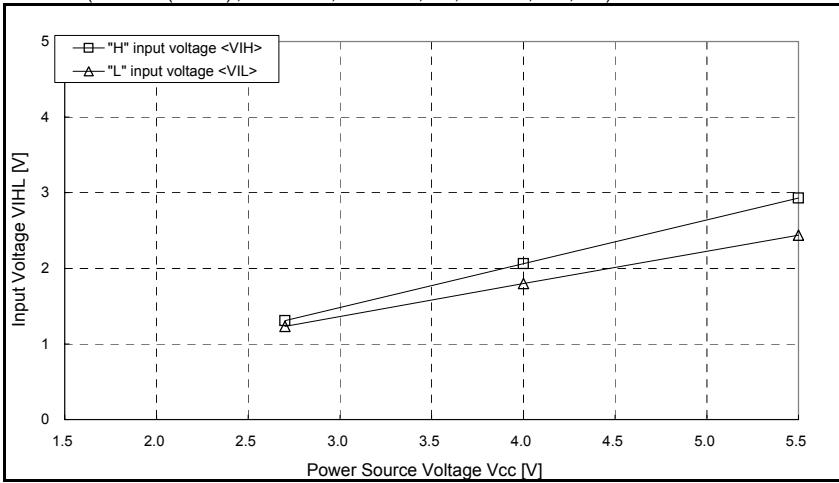


Fig. 37. Vcc-VIHL (I/O Port (CMOS))

Vcc-VIHL(RESET pin, Ta = 25 °C)

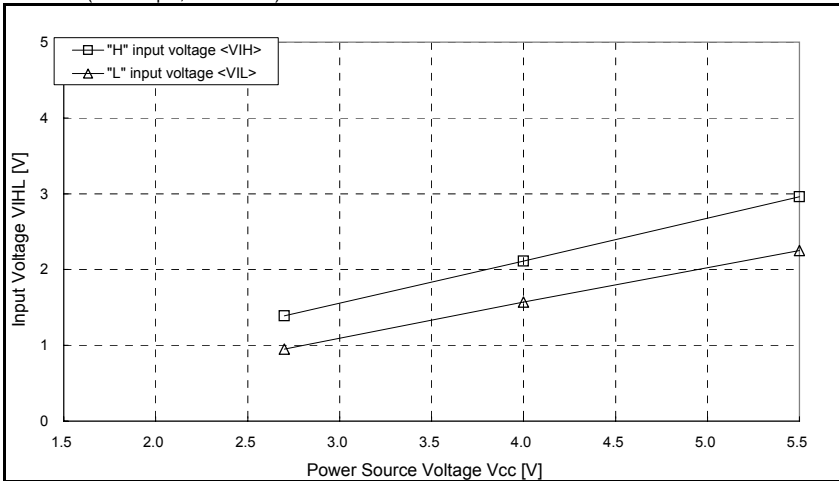


Fig. 38. Vcc-VIHL (RESET pin)

Vcc-VIHL (XIN pin, Ta = 25 °C)

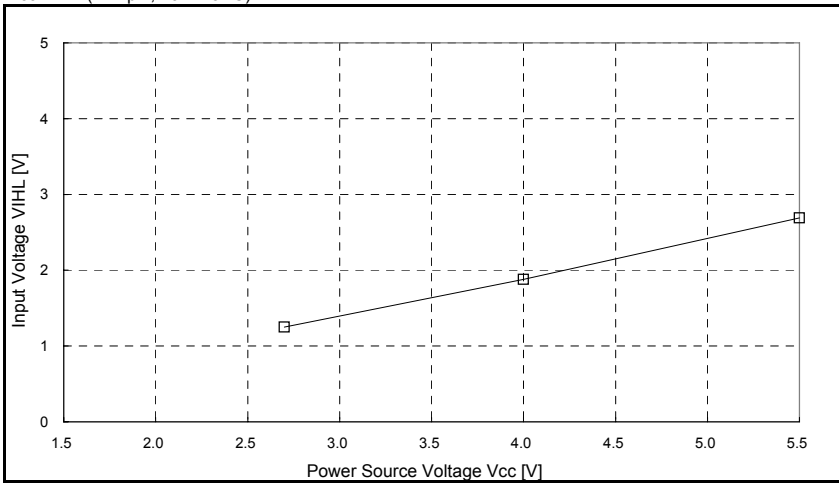


Fig. 39. Vcc-VIHL (XIN pin)

Vcc-HYS (RESET pin, Ta = 25 °C)

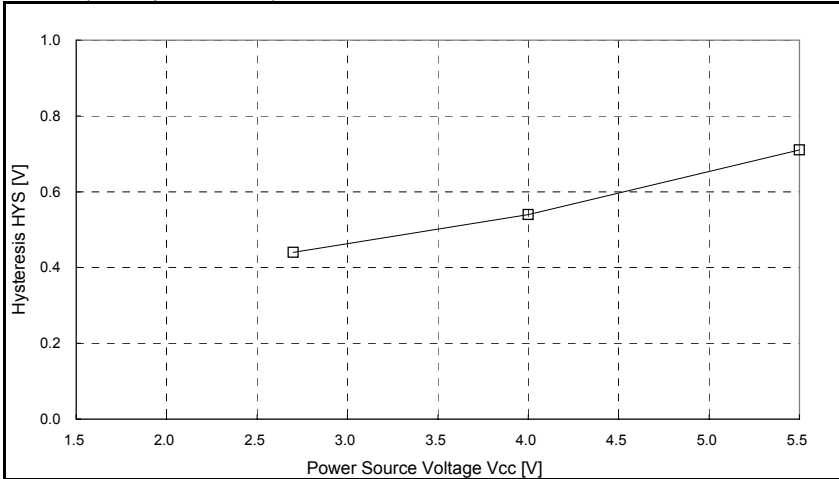


Fig. 40. Vcc-HYS (RESET pin)

Vcc-HYS (SIO function pin (RXD, SCLK) , Ta = 25 °C)

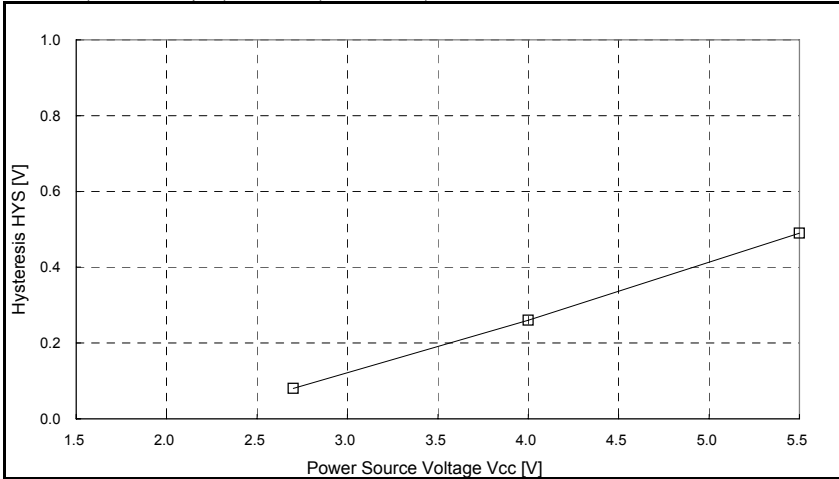


Fig. 41. Vcc-HYS (SIO function pin)

Vcc-HYS (INT0- INT2, CNTR0, CNTR1, KW0-KW7, Ta = 25 °C)

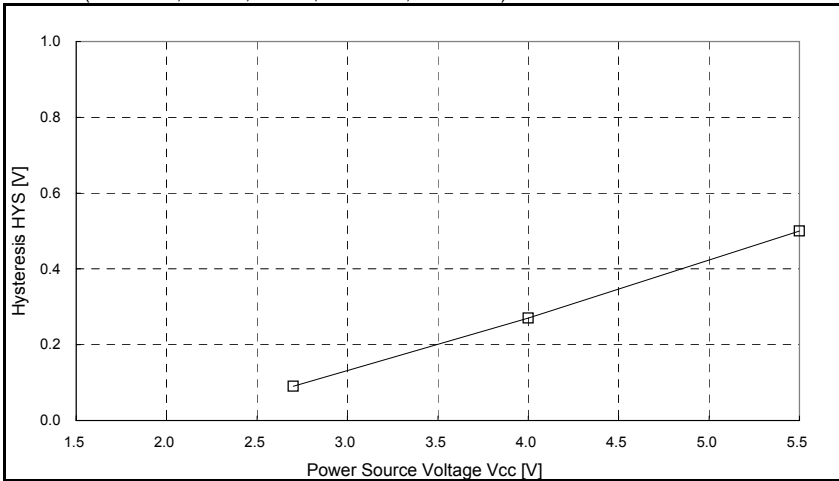


Fig. 42. Vcc-HYS (INT0- INT2, CNTR0, CNTR1, KW0-KW7)



(8) Port Standard Characteristics Example (VIN-IIA, A/D conversion mode = 10bit )

VIN-IIA (A/D converter operation,  $f(Xin) = 12$  MHz, frequency/2 mode, A/D conversion clock =  $f(Xin)$ ,  $V_{cc} = V_{REF} = 5.5$  V,  $T_a = 25$  °C )

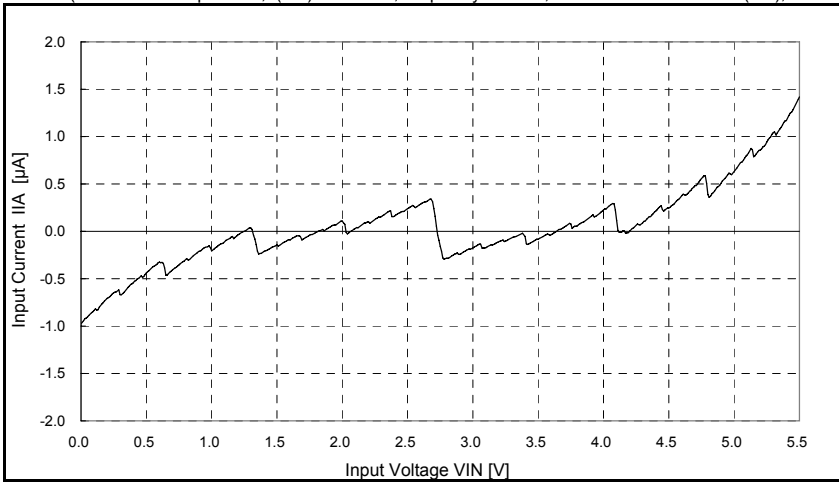


Fig. 43. VIN-IIA ( $f(Xin) = 12$  MHz frequency/2 mode )

VIN-IIA (A/D converter operation,  $f(Xin) = 10$  MHz, frequency/2 mode, A/D conversion clock =  $f(Xin)$ ,  $V_{cc} = V_{REF} = 5.5$  V,  $T_a = 25$  °C )

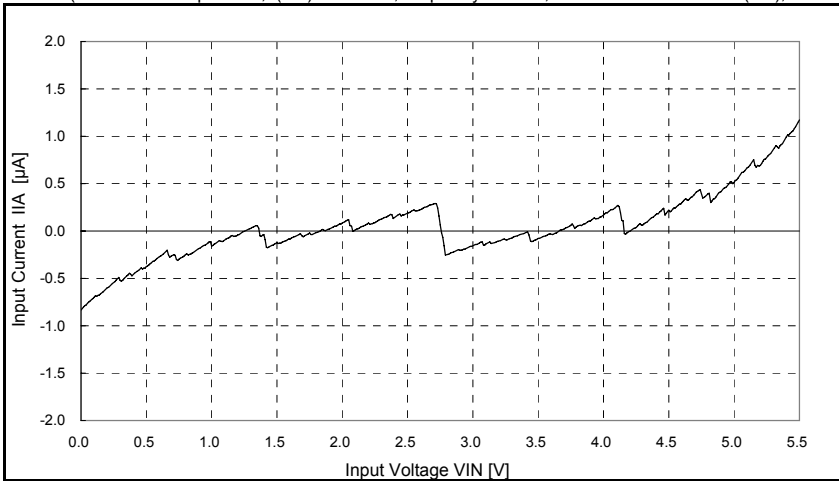


Fig. 44. VIN-IIA ( $f(Xin) = 10$  MHz frequency/2 mode )

VIN-IIA (A/D converter operation,  $f(Xin) = 8$  MHz, frequency/2 mode, A/D conversion clock =  $f(Xin)$ ,  $V_{cc} = V_{REF} = 5.5$  V,  $T_a = 25$  °C )

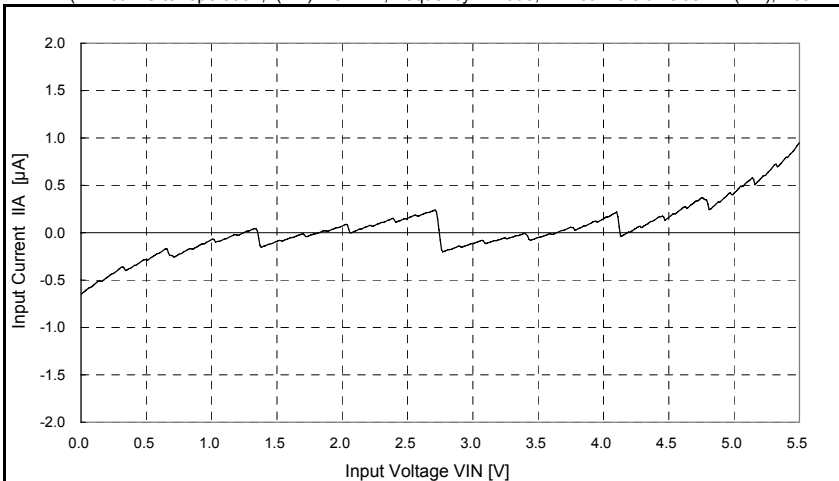


Fig. 45. VIN-IIA ( $f(Xin) = 8$  MHz frequency/2 mode )

VIN-IIA (A/D converter operating,  $f(Xin) = 4 \text{ MHz}$ , frequency/2 mode, A/D conversion clock =  $f(Xin)$ ,  $V_{cc} = V_{REF} = 5.5 \text{ V}$ ,  $T_a = 25 \text{ }^\circ\text{C}$  )

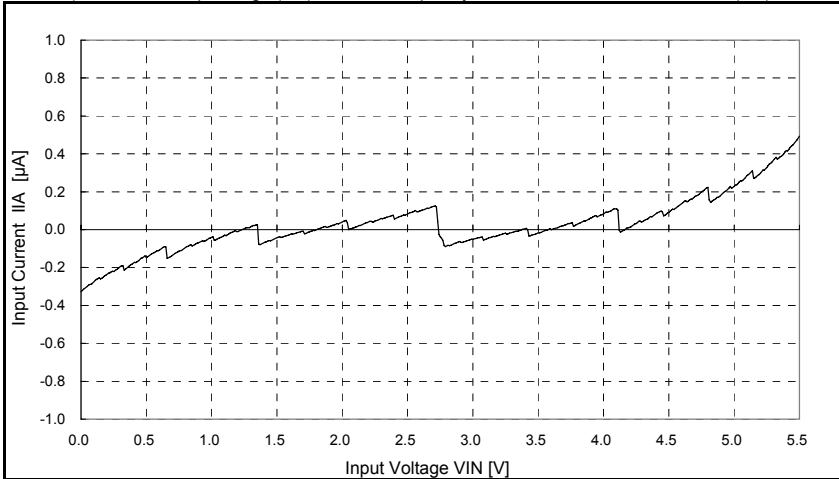


Fig. 46. VIN-IIA ( $f(Xin) = 4 \text{ MHz}$  frequency/2 mode )

VIN-IIA (A/D converter operating,  $f(Xin) = 2 \text{ MHz}$ , frequency/2 mode, A/D conversion clock =  $f(Xin)$ ,  $V_{cc} = V_{REF} = 5.5 \text{ V}$ ,  $T_a = 25 \text{ }^\circ\text{C}$  )

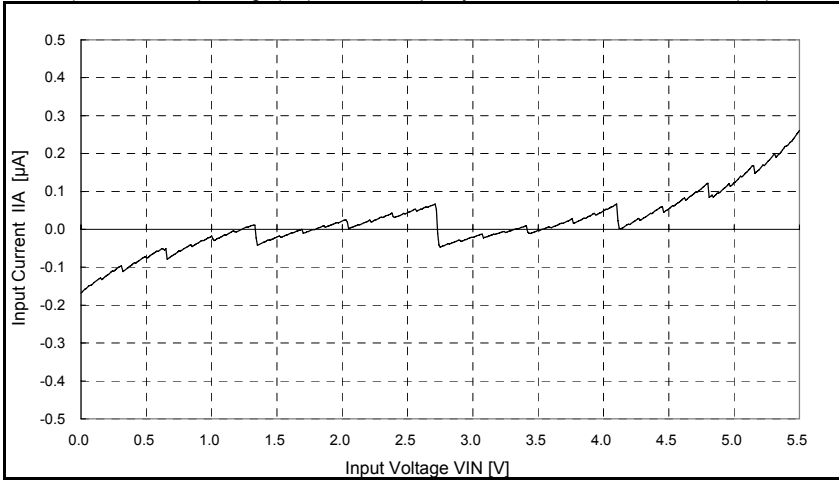


Fig. 47. VIN-IIA ( $f(Xin) = 2 \text{ MHz}$  frequency/2 mode )

(9) On-chip Oscillator Frequency Characteristics Example

On-chip oscillator frequency characteristics (Vcc-OCO)

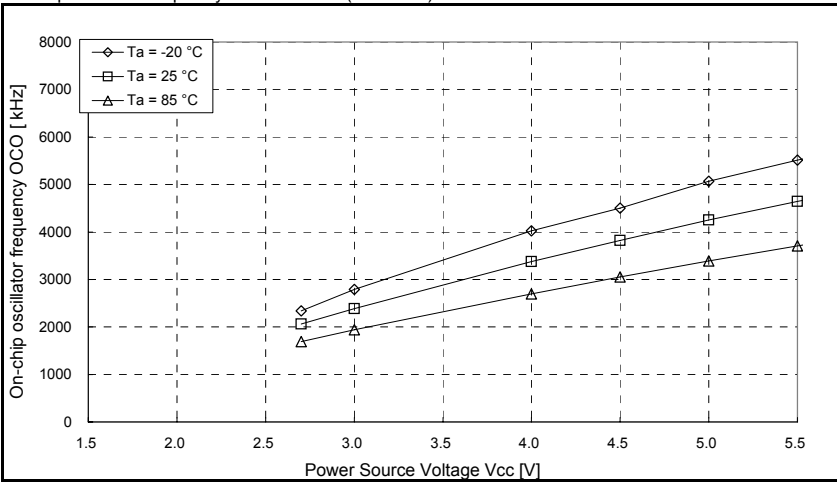


Fig. 48. Vcc-OCO

On-chip oscillator frequency characteristics (Ta-OCO)

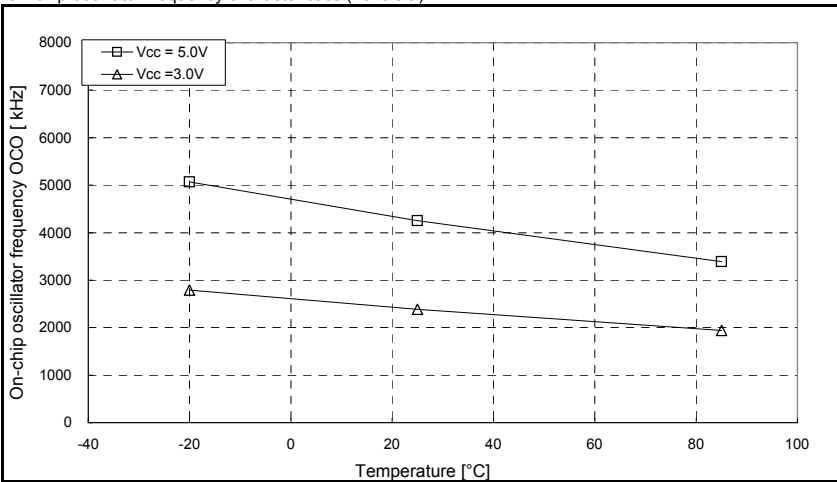


Fig. 49. Ta-OCO

(10) A/D Conversion Accuracy Characteristics  
A/D conversion accuracy standard characteristics example-1

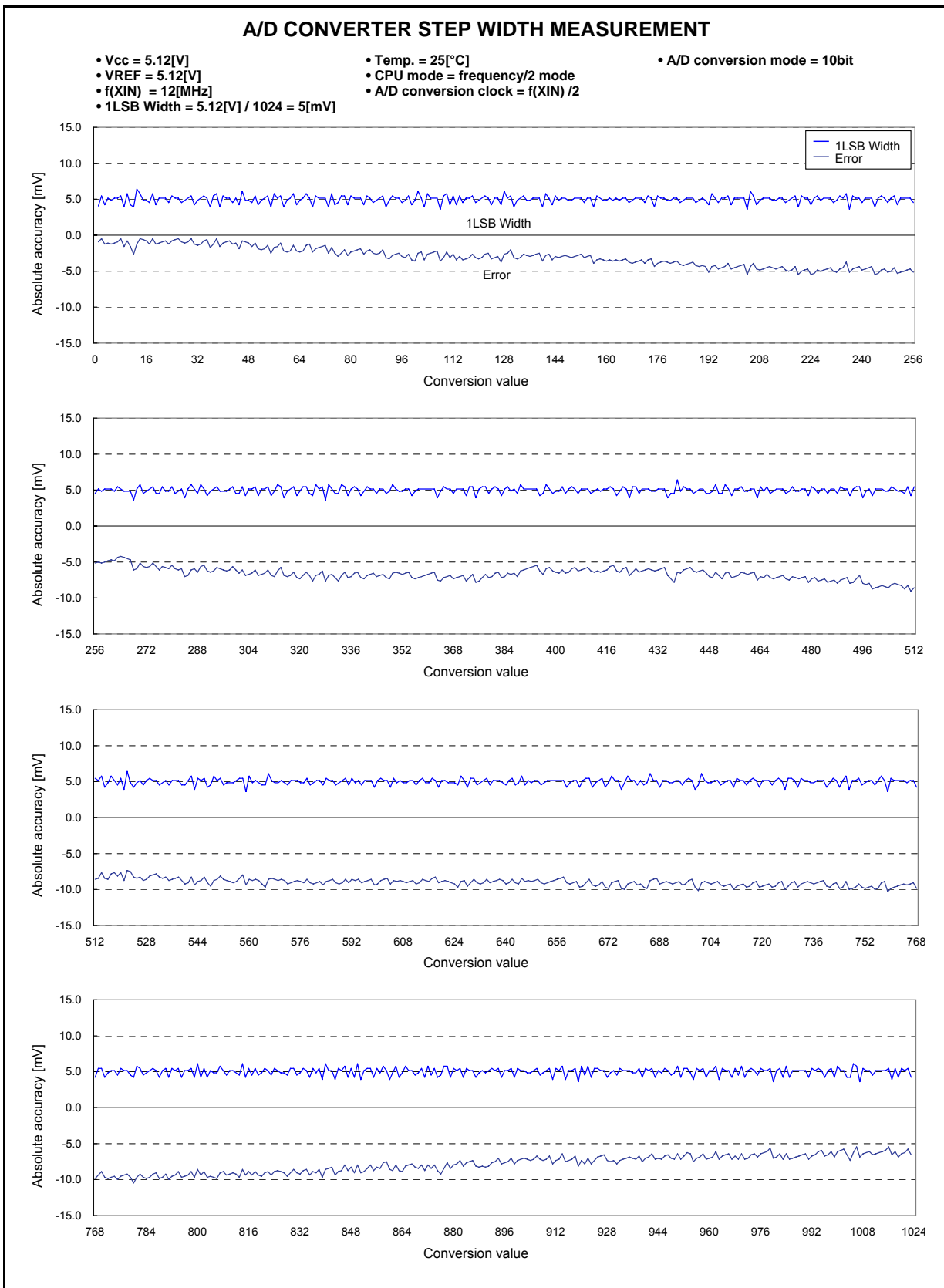


Fig. 50. A/D conversion accuracy standard characteristics example-1

A/D conversion accuracy standard characteristics example-2

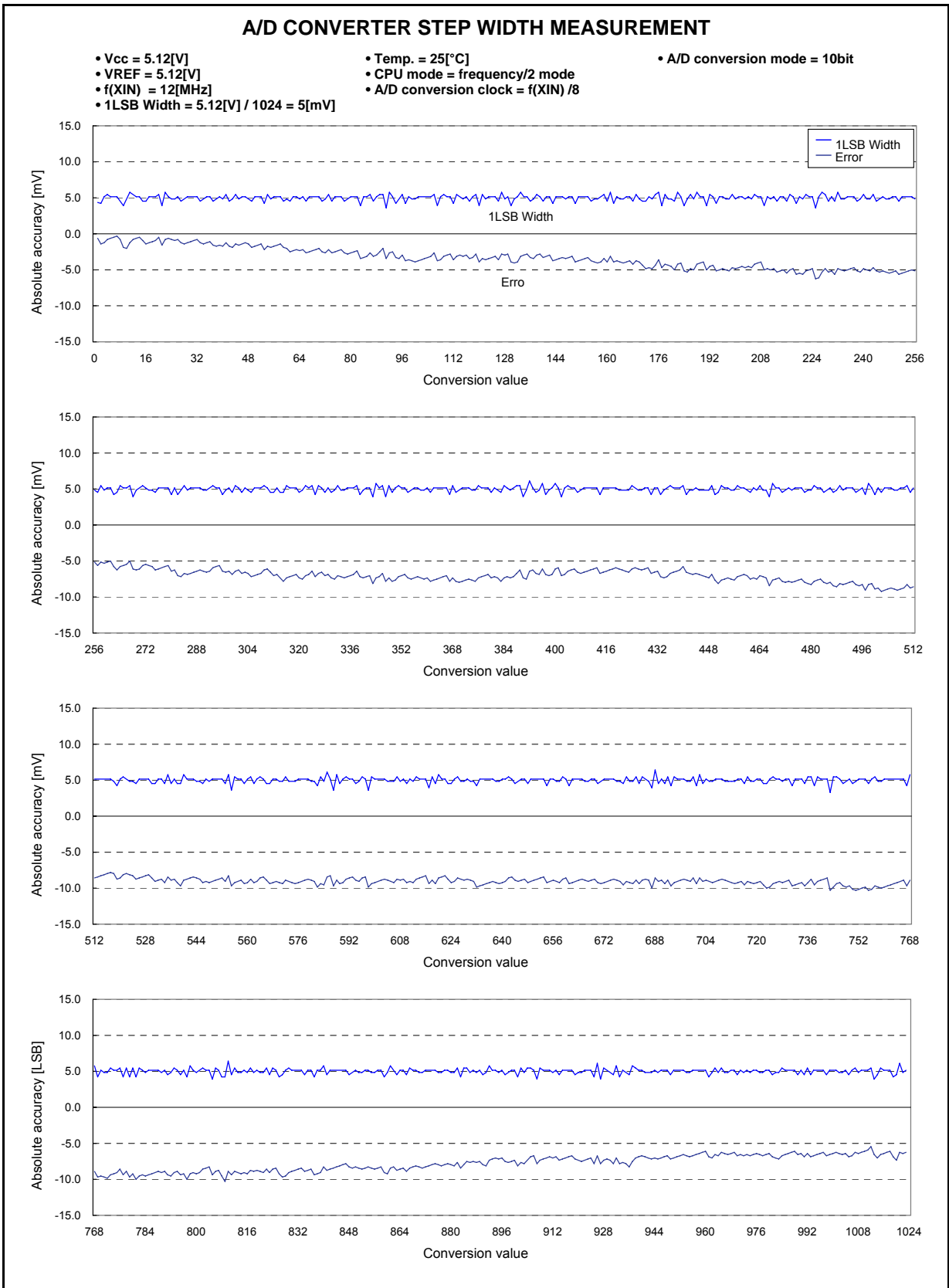


Fig. 51. A/D conversion accuracy standard characteristics example-2

A/D conversion accuracy standard characteristics example-3

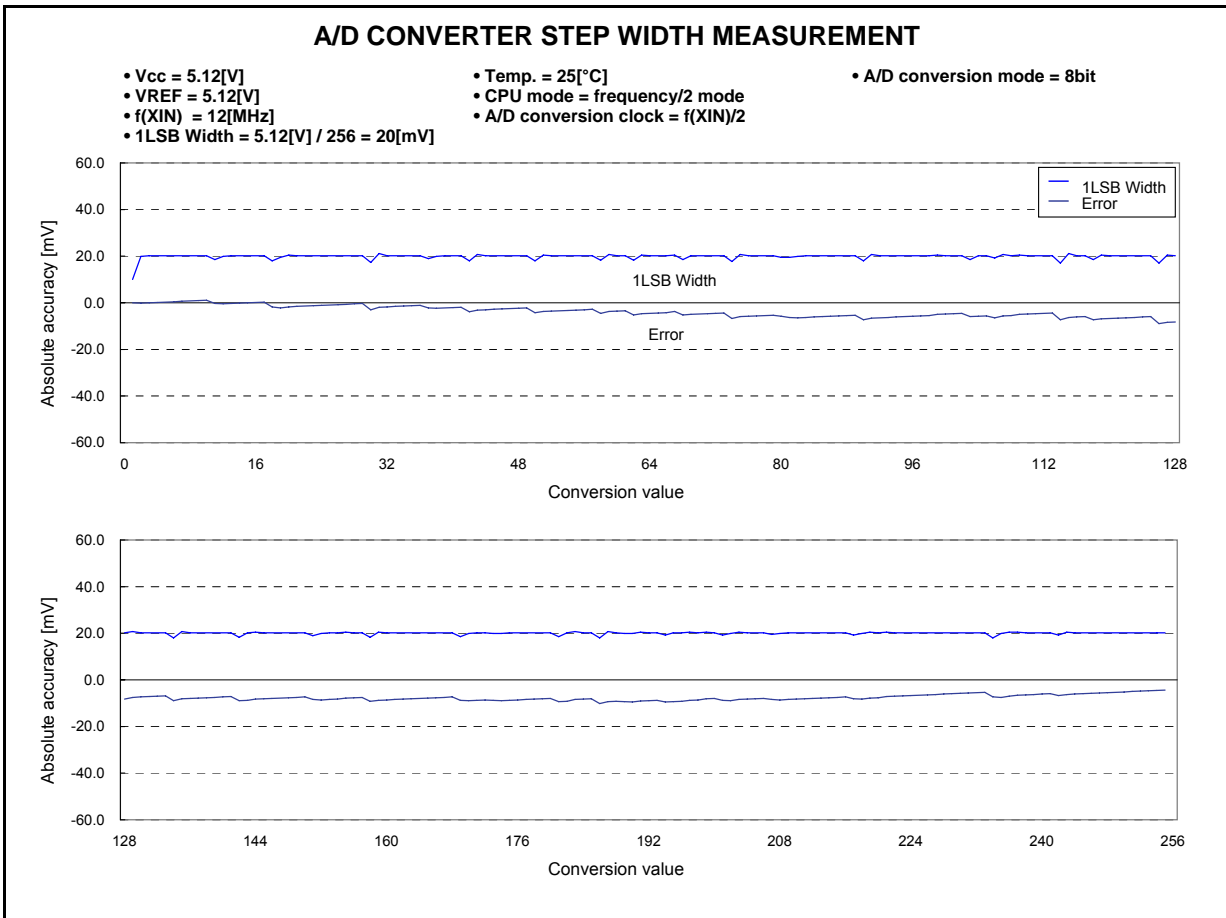


Fig. 52. A/D conversion accuracy standard characteristics example-3

A/D conversion accuracy standard characteristics example-4

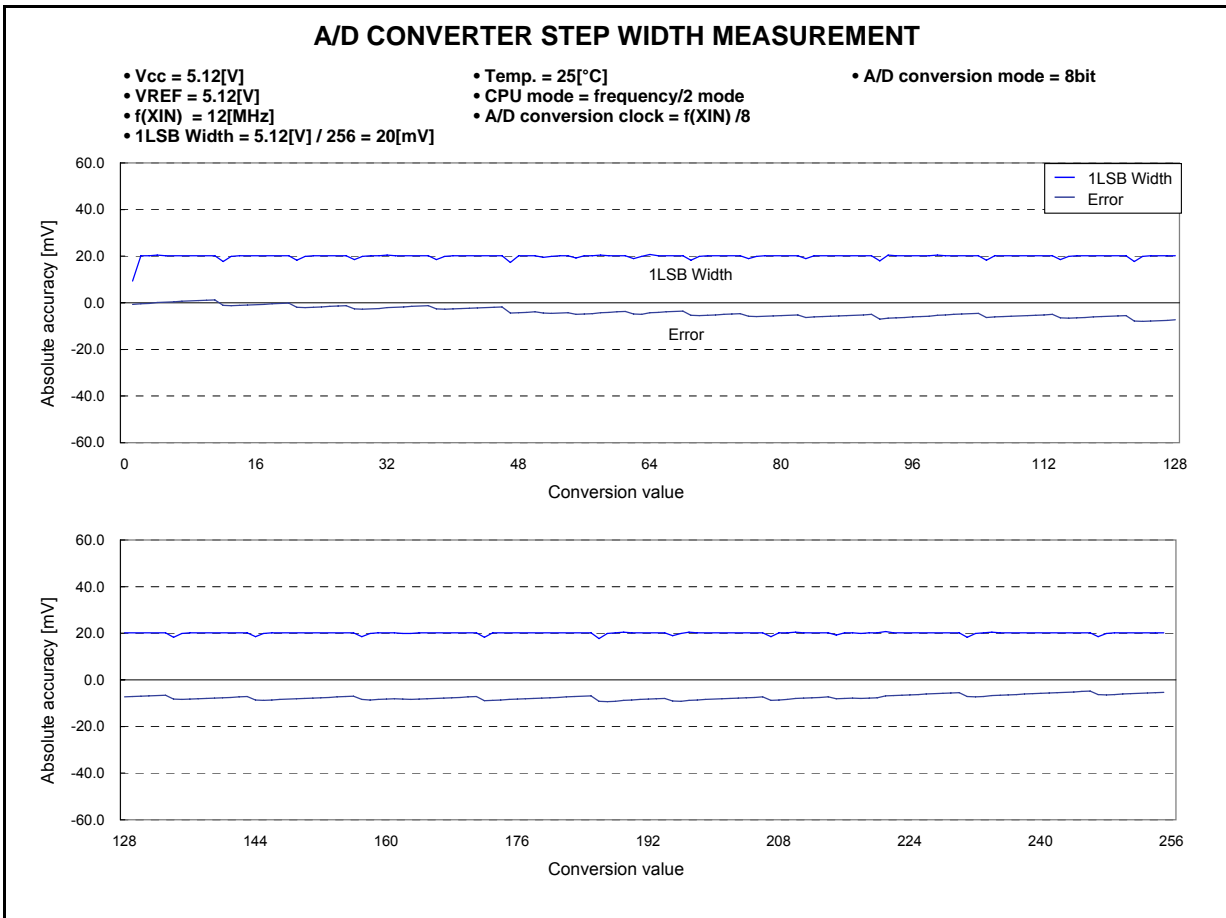


Fig. 53. A/D conversion accuracy standard characteristics example-4

A/D conversion accuracy standard characteristics example-5

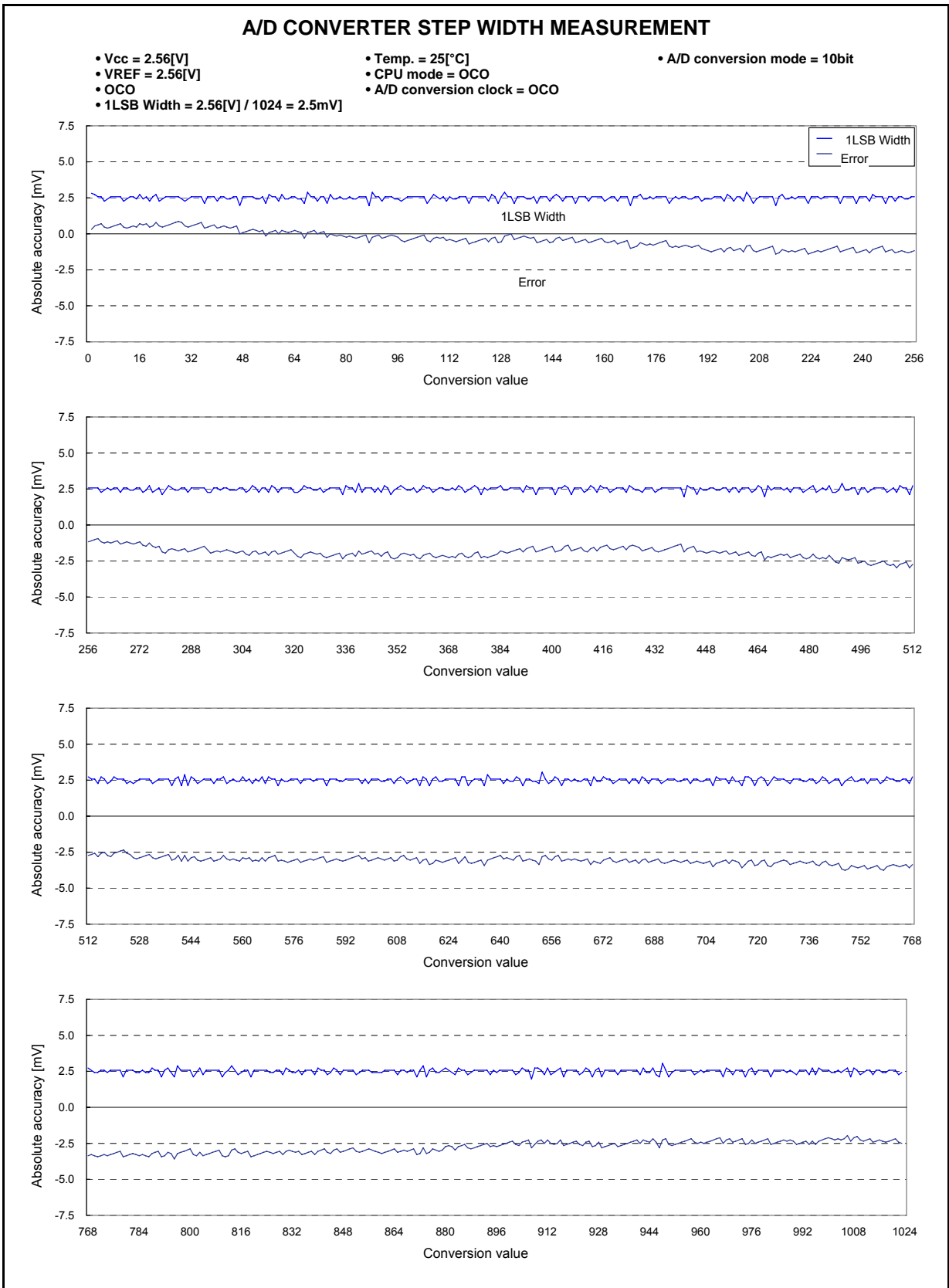


Fig. 54. A/D conversion accuracy standard characteristics example-5



A/D conversion accuracy standard characteristics example-6

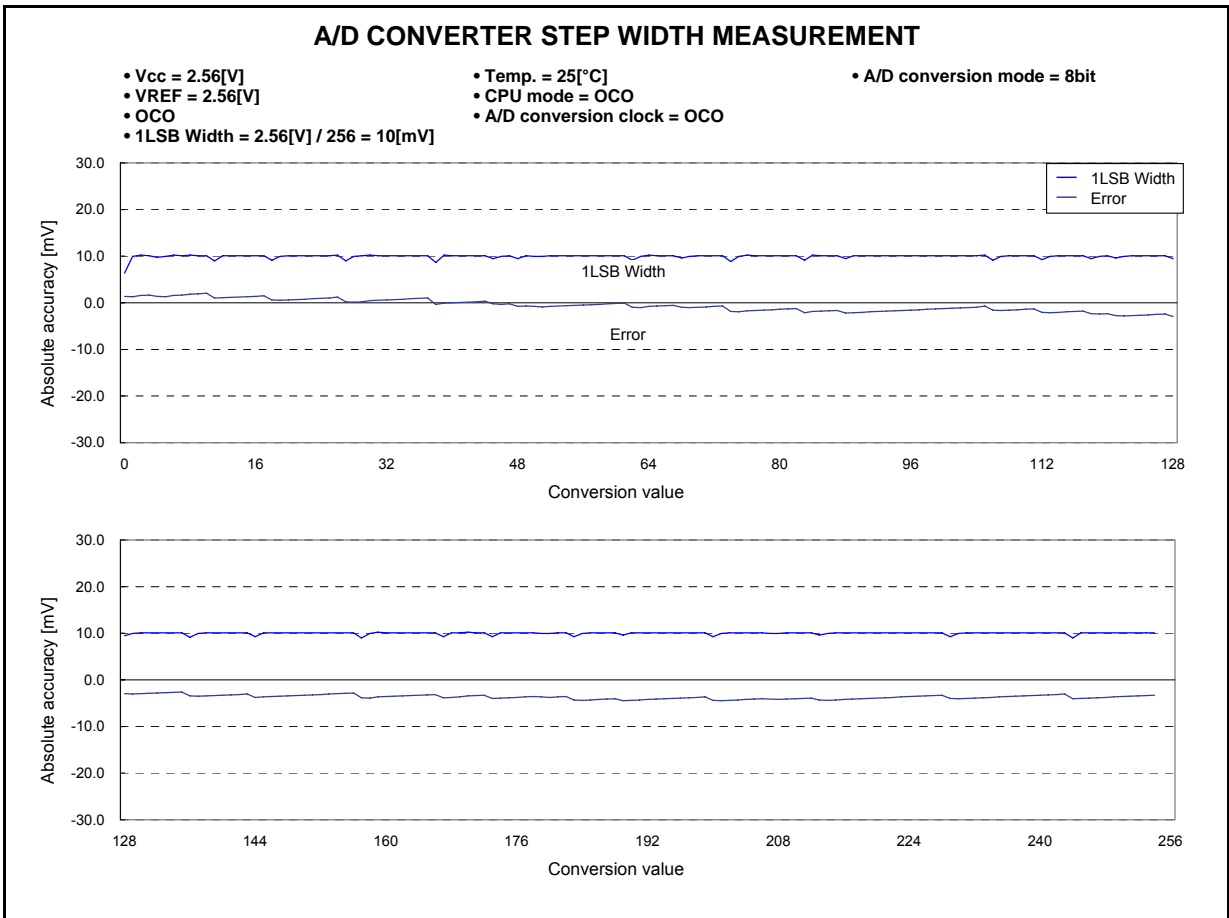


Fig. 55. A/D conversion accuracy standard characteristics example-6

(11) Icc increment by on-chip oscillator operation at f(Xin) operation

f(Xin)=8 MHz (high-speed mode), Vcc= 2.7V to 5.5V, Ta = 25°C, output transistor is in cut-off state, A/D converter not operating)

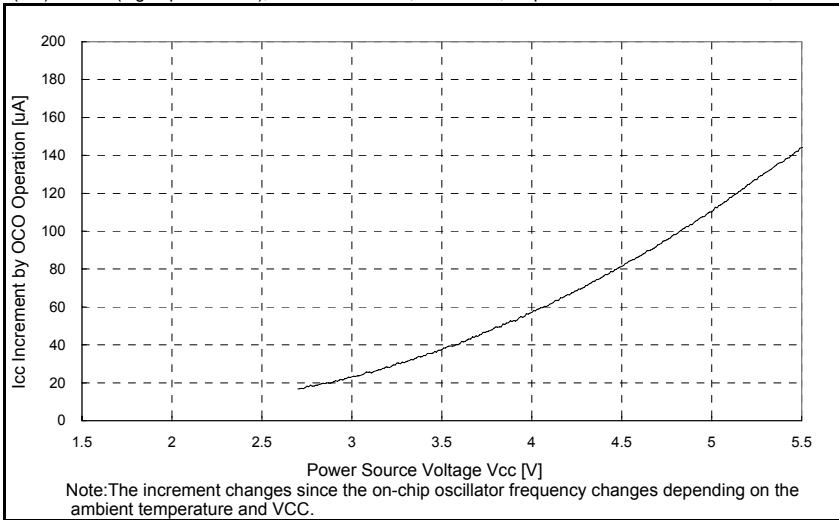


Fig. 56. Icc increment by on-chip oscillator operation at f(Xin) operation

To our customers,

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