## Standard Characteristics Example

Standard characteristics described below are just examples of the M16C/29 group(M16C/29,M16C/29T,M16C/29V) characteristics and are not guaranteed.
For rated values, refer to "M16C/29 Group Hardware manual".

### (1) Power Supply Current Standard Characteristics Example (Vcc-Icc)

f(Xin)=20MHz (Pluse generator, Ta = 25°C, output transistor is in the cut-off state.*)

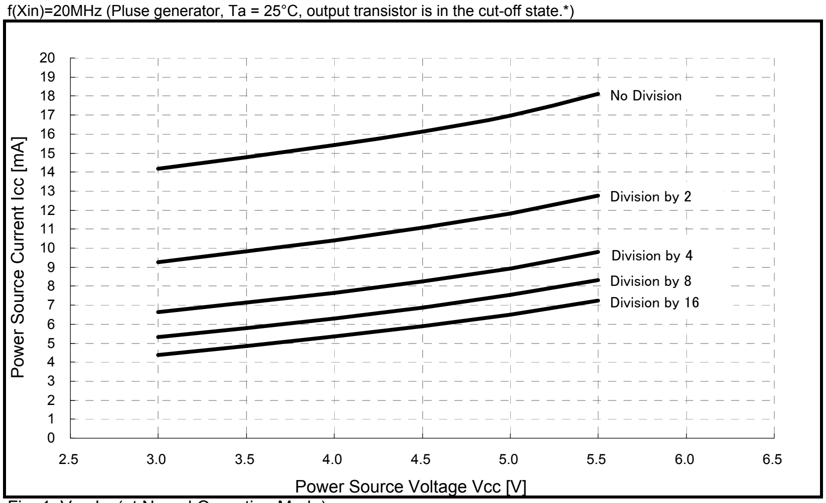



Fig. 1. Vcc-Icc(at Nomal Operation Mode)

Clock source

f(Xin) = Pulse Generator
Square wave
Xout:Open

Division setting

| Main Clock | Timer A, B | Timer S | Serial I/O | MMIIC | AD con -version |
|---|---|---|---|---|---|
| 1/1 | f1 | f1 | f1sio | (fiic/2)/31 | fad/ 1 |
| 1/2 | f2 | f2 | f2sio | (fiic/2)/31 | fad/ 2 |
| 1/4 | f8 | f2/4 | f8sio | (fiic/4)/31 | fad/12 |
| 1/8 | f8 | f2/16 | f8sio | (fiic/8)/31 | fad/12 |
| 1/16 | f32 | f2/16 | f32sio | (fiic/8)/31 | fad/12 |

* Timer pulse and serial data is output
* $SDA_{MM}$ & $SCL_{MM}$ are pull-up.

No division operation(Pluse generator, Ta = 25 °C, output transistor is in the cut-off state.*)

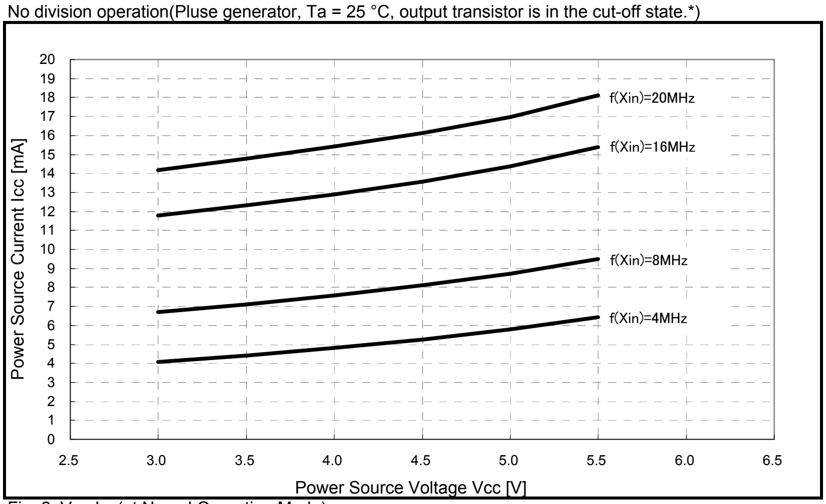



Fig. 2. Vcc-Icc(at Nomal Operation Mode)

Clock source

f(Xin) = Pulse Generator
Square wave
Xout:Open

Division setting

| Main Clock | Timer A, B | Timer S | Serial I/O | MMIIC | AD con -version |
|---|---|---|---|---|---|
| 1/1 | f1 | f1 | f1sio | (fiic/2)/31 | fad/ 1 |

* Timer pulse and serial data is output
* $SDA_{MM}$ & $SCL_{MM}$ are pull-up.

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

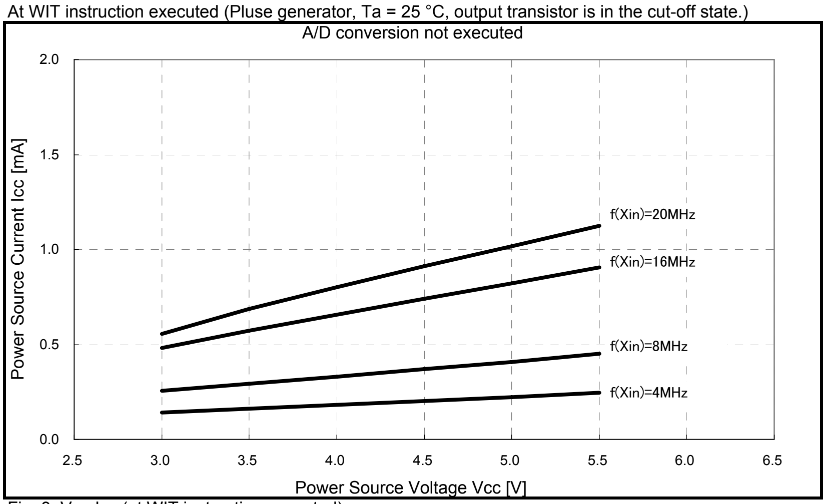



Fig. 3. Vcc-Icc (at WIT instruction executed)

Clock source

f(Xin) = Pulse Generator
Square wave
Xout:Open

Stop peripheral function clock.
Xin-Xout drive capacity : High

f(Xcin)=32kHz in low-power consumption mode, Program running on RAM
(Main clock oscillation stop, Ta = 25 °C, output transistor is in the cut-off state.)

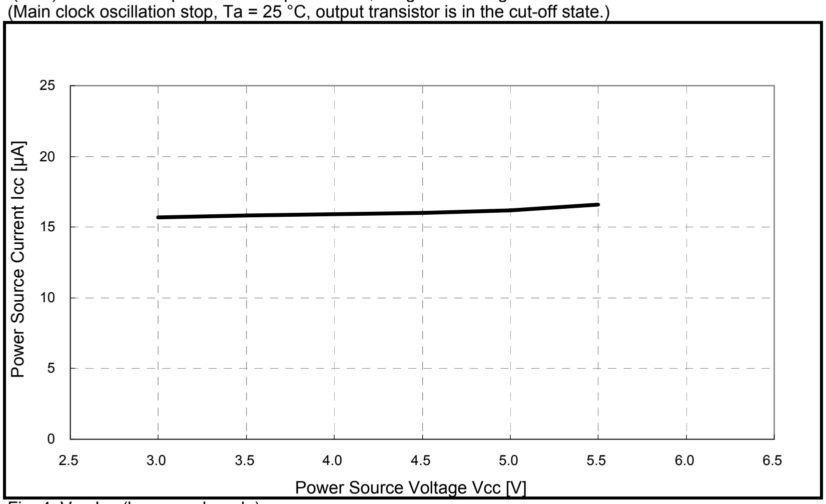
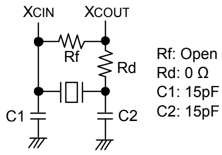



Fig. 4. Vcc-Icc (low-speed mode)

Clock source

f(Xcin) = Crystal oscillator
Frequency: 32.768kHz
Load capacitance:12.5pF

No Peripheral functions.
Xcin-Xcout drive capacity : Low
Flash memory stop.




f(Xcin)=32kHz in low-power consumption mode, Program running on flash memory
(Main clock oscillation stop, Ta = 25 °C, output transistor is in the cut-off state.)

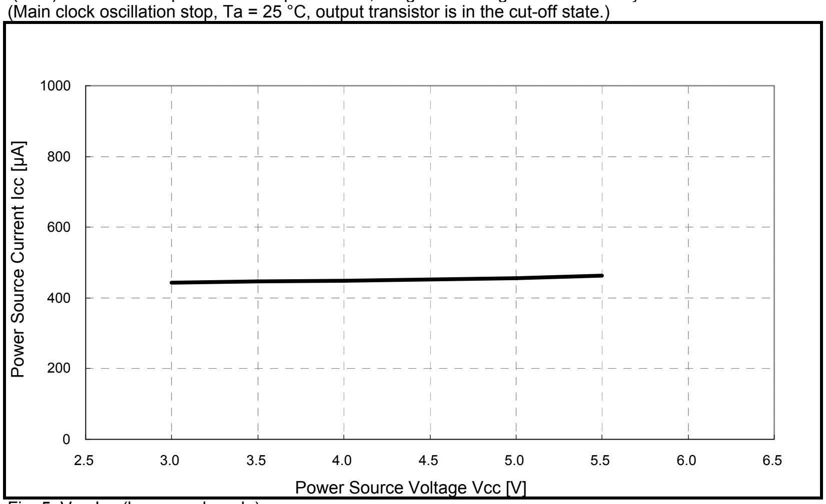
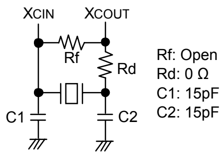



Fig. 5. Vcc-Icc (low-speed mode)

Clock source

f(Xcin) = Crystal oscillator
Frequency: 32.768kHz
Load capacitance:12.5pF

No Peripheral functions.
Xcin-Xcout drive capacity : Low




On-chip oscillator operating, f2(ROC) selected, f(BCLK)=1MHz (external oscillation stop, output transistor is in the cut-off state.* )

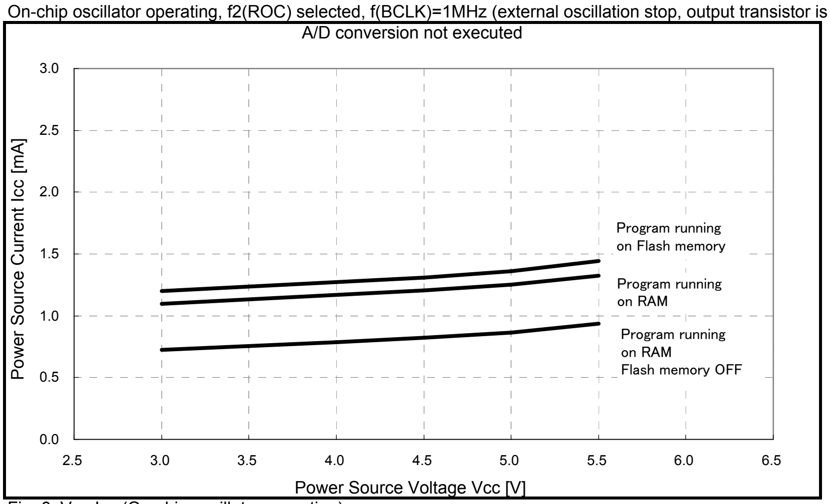



Fig. 6. Vcc-Icc (On-chip oscillator operating)

Clock source

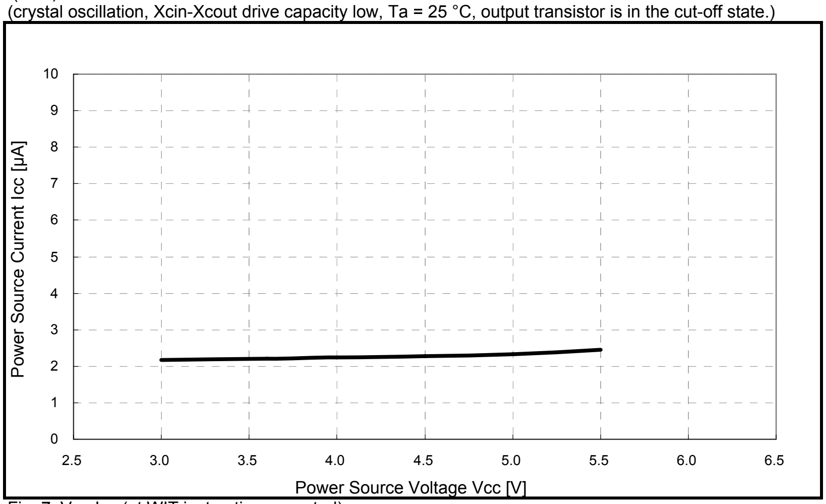
On-chip oscillator
Select f2(ROC)

Division setting

| ROC Divider | Main Clock | Timer A, B | Timer S | SI/O3 SI/O4 | MMIIC |
|---|---|---|---|---|---|
| 1/2 | 1/1 | f1 | f1 | f1 | (fiic/2)/31 |

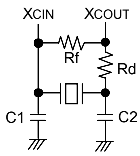
* Timer pulse and serial data is output

f(Xcin)=32kHz in WIT instruction executed
(crystal oscillation, Xcin-Xcout drive capacity low, Ta = 25 °C, output transistor is in the cut-off state.)




Clock source
f(Xcin) = Crystal oscillator
Frequency: 32.768kHz
Load capacitance:12.5pF

Xcin-Xcout drive capacity : Low
Timer A0 running in timer mode from fc32.




Rf: Open
Rd: 0 Ω
C1: 15pF
C2: 15pF

Fig. 7. Vcc-Icc (at WIT instruction executed)

**Standard Characteristics Example**

VOH-IOH (Vcc = 5.5V, Ports P00-P07, P10-P17, P20-P27, P30-P37, P60-P67, P70-P77 P80-P87, P90-P93, P95-P97, P100-P107)

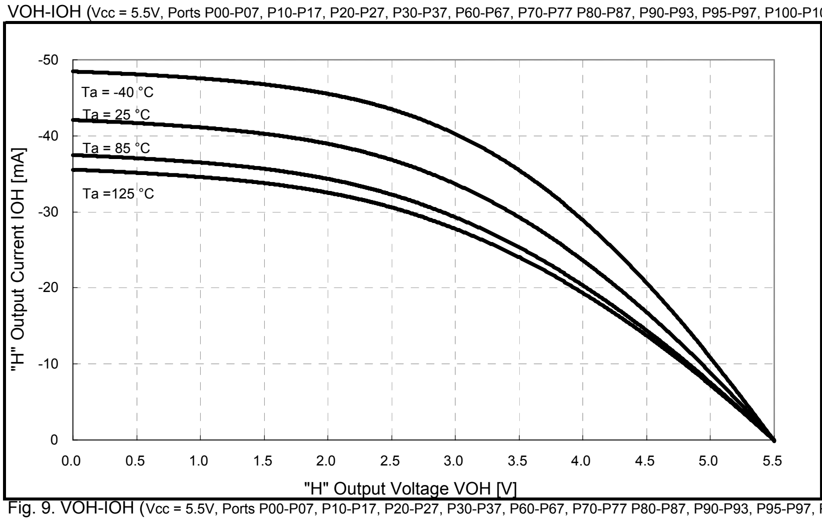



Fig. 9. VOH-IOH (Vcc = 5.5V, Ports P00-P07, P10-P17, P20-P27, P30-P37, P60-P67, P70-P77 P80-P87, P90-P93, P95-P97, P100-P107)

VOH-IOH (Vcc = 4.0V, Ports P00-P07, P10-P17, P20-P27, P30-P37, P60-P67, P70-P77 P80-P87, P90-P93, P95-P97, P100-P107)

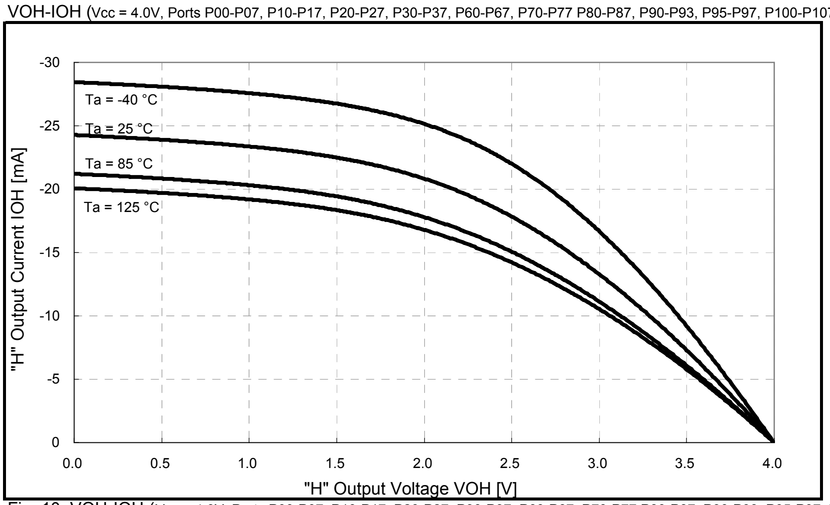



Fig. 10. VOH-IOH (Vcc = 4.0V, Ports P00-P07, P10-P17, P20-P27, P30-P37, P60-P67, P70-P77 P80-P87, P90-P93, P95-P97, P100-P107)

VOH-IOH (Vcc = 3.0V, Ports P00-P07, P10-P17, P20-P27, P30-P37, P60-P67, P70-P77 P80-P87, P90-P93, P95-P97, P100-P107)

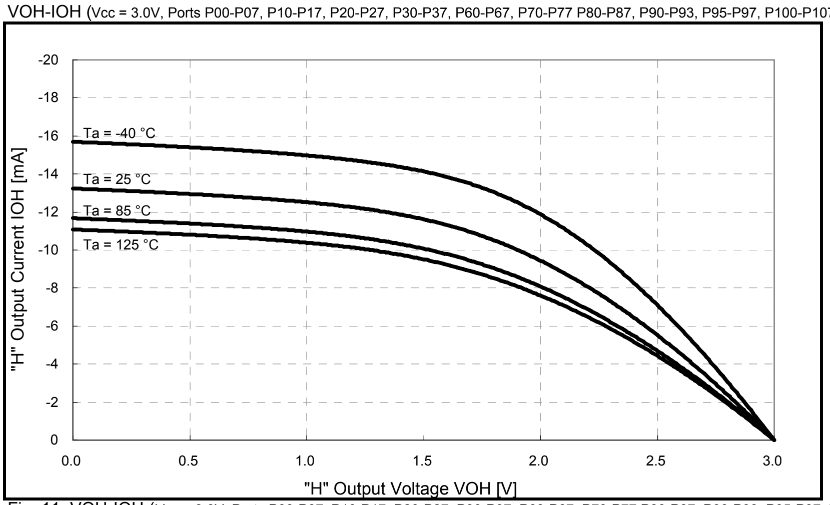



Fig. 11. VOH-IOH (Vcc = 3.0V, Ports P00-P07, P10-P17, P20-P27, P30-P37, P60-P67, P70-P77 P80-P87, P90-P93, P95-P97, P100-P107)

**(3) Port Standard Characteristics Example (VOL-IOL)**

VOL-IOL (Vcc = 5.5V, Ports P00-P07, P10-P17, P20-P27, P30-P37, P60-P67, P70-P77 P80-P87, P90-P93, P95-P97, P100-P107)

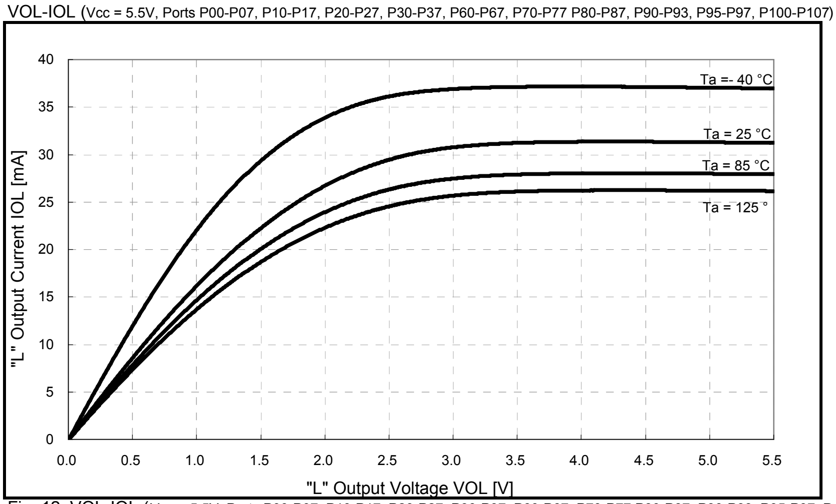



Fig. 12. VOL-IOL (Vcc = 5.5V, Ports P00-P07, P10-P17, P20-P27, P30-P37, P60-P67, P70-P77 P80-P87, P90-P93, P95-P97, P100-P107)

VOL-IOL (Vcc = 4.0V, Ports P00-P07, P10-P17, P20-P27, P30-P37, P60-P67, P70-P77 P80-P87, P90-P93, P95-P97, P100-P107)

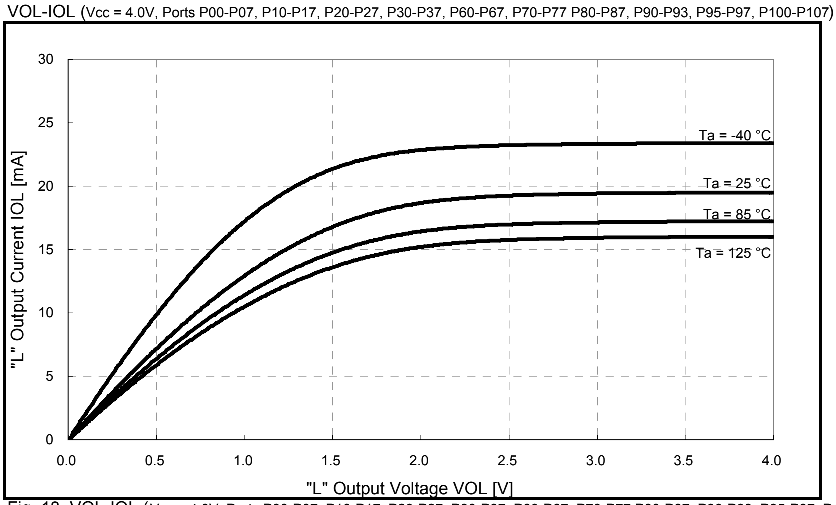



Fig. 13. VOL-IOL (Vcc = 4.0V, Ports P00-P07, P10-P17, P20-P27, P30-P37, P60-P67, P70-P77 P80-P87, P90-P93, P95-P97, P100-P107)

VOL-IOL (Vcc = 3.0V, Ports P00-P07, P10-P17, P20-P27, P30-P37, P60-P67, P70-P77 P80-P87, P90-P93, P95-P97, P100-P107)

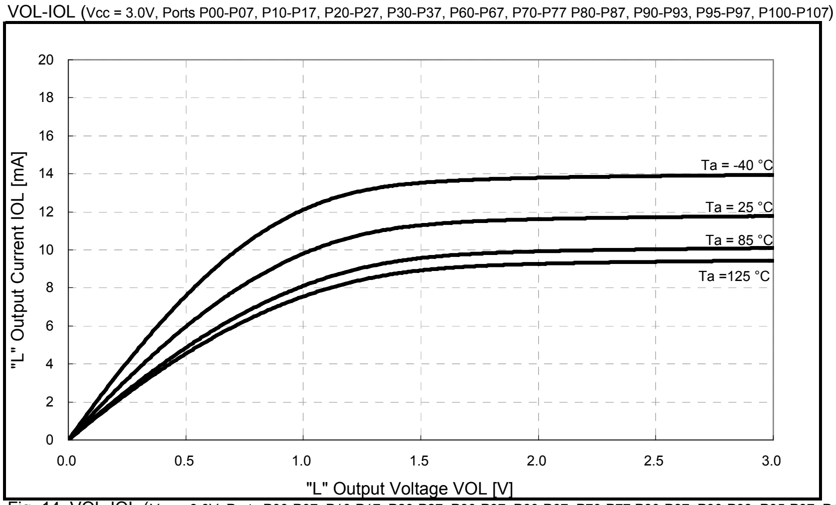



Fig. 14. VOL-IOL (Vcc = 3.0V, Ports P00-P07, P10-P17, P20-P27, P30-P37, P60-P67, P70-P77 P80-P87, P90-P93, P95-P97, P100-P107)

**(4) Port Standard Characteristics Example (Vcc-IIL)**

Vcc-IIL (Ports P00-P07, P10-P17, P20-P27, P30-P37, P60-P67, P70-P77 P80-P87, P90-P93, P95-P97, P100-P107 when connecting pull-up transistor.)

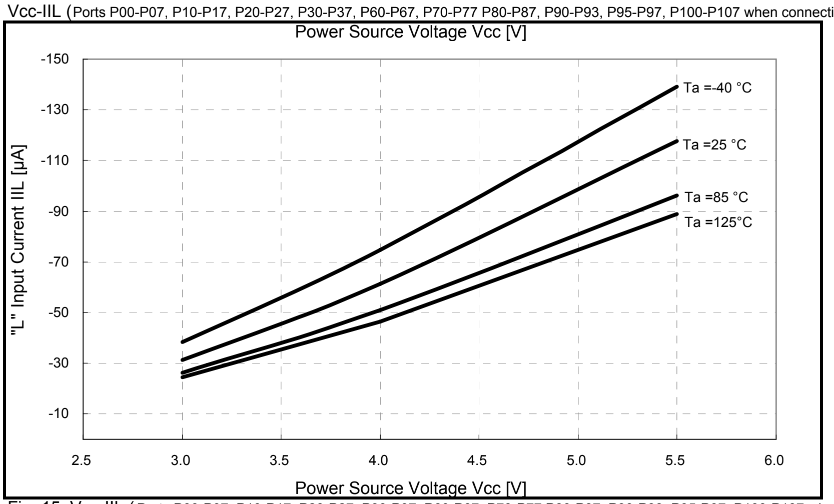



Fig. 15. Vcc-IIL ( Ports P00-P07, P10-P17, P20-P27, P30-P37, P60-P67, P70-P77 P80-P87, P90-P93, P95-P97, P100-P107 when connecting pull-up transistor.)

**(5) Port Standard Characteristics Example (Vcc-VIH VIL)**

Vcc-VIH VIL (I/O Ports (CMOS) , Ports P60-P67, P70-P77, P80, P81, P85-P87, P90-P93, P100-P107, Ta = 25℃)

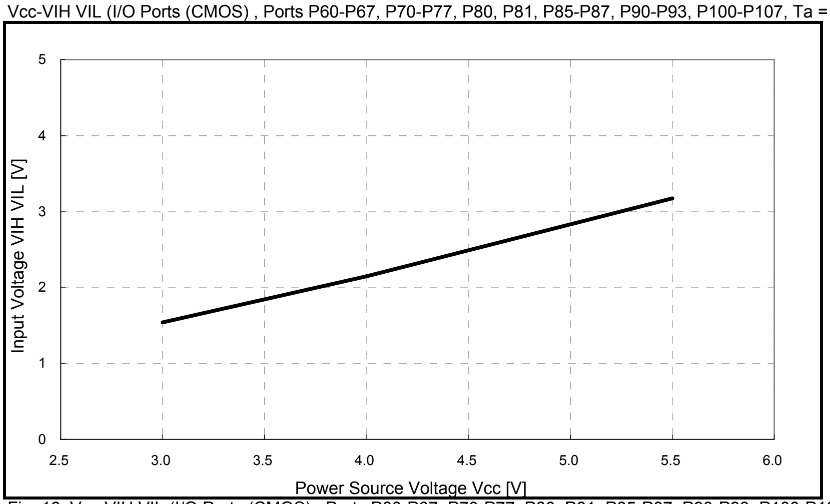



Fig. 16. Vcc-VIH VIL (I/O Ports (CMOS) , Ports P60-P67, P70-P77, P80, P81, P85-P87, P90-P93, P100-P107)

Vcc-VIH VIL (I/O Ports, Ports P15-P17, P82, P84, Ta = 25℃)

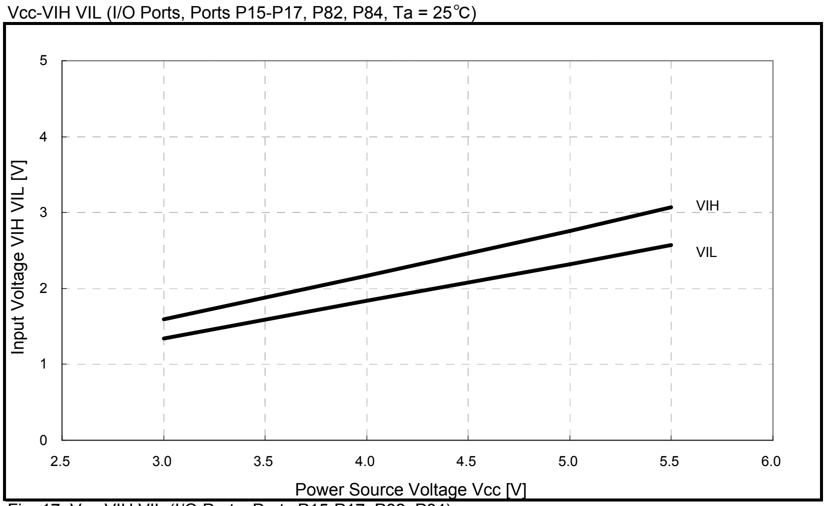



Fig. 17. Vcc-VIH VIL (I/O Ports, Ports P15-P17, P82, P84)

Vcc-VIH VIL (RESET pin, Ta = 25℃)

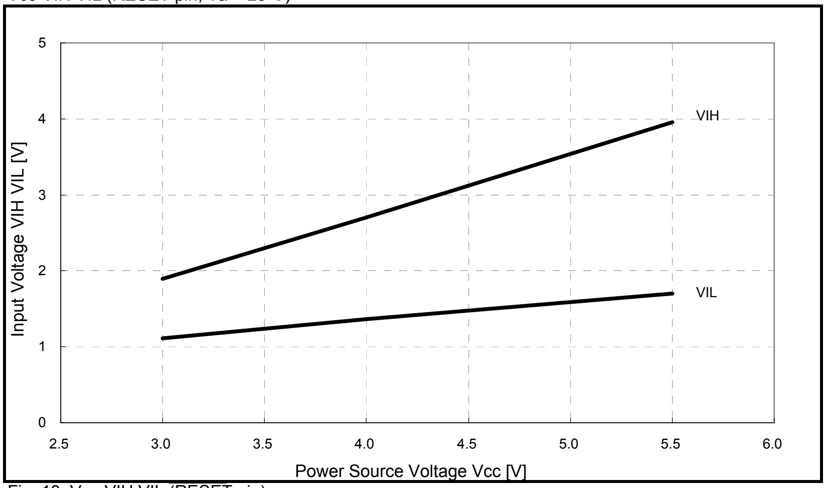



Fig. 18. Vcc-VIH VIL (RESET pin)

Vcc-VIH VIL (XIN pin, Ta = 25℃)

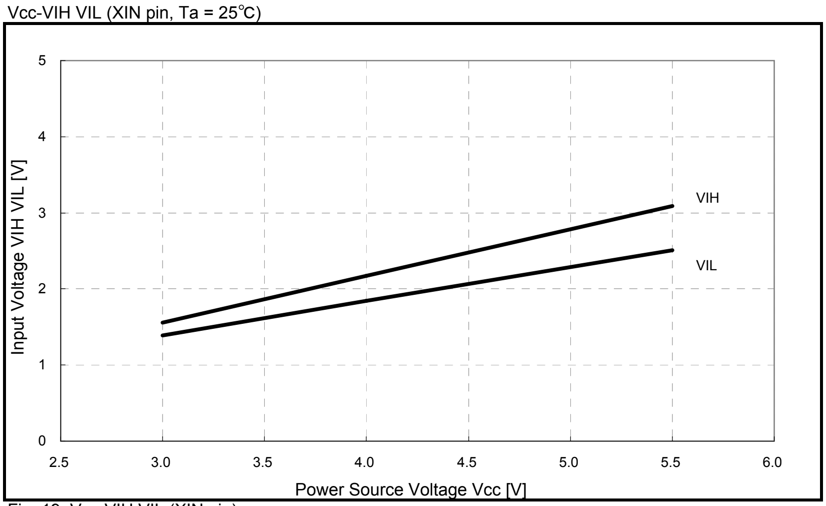



Fig. 19. Vcc-VIH VIL (XIN pin)

Vcc-HYS (RESET pin, Ta = 25℃)

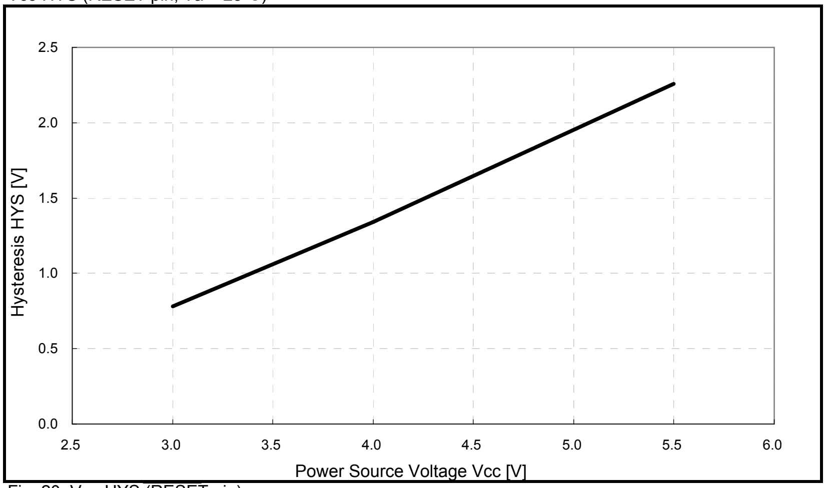



Fig. 20. Vcc-HYS (RESET pin)

Vcc-HYS (INT2-INT5, TA0IN-TA1IN, ADTRIG, CTS0-CTS2, CLK1-CLK2, TA0OUT-TA1OUT, RxD1-RxD2. Ta = 25℃)

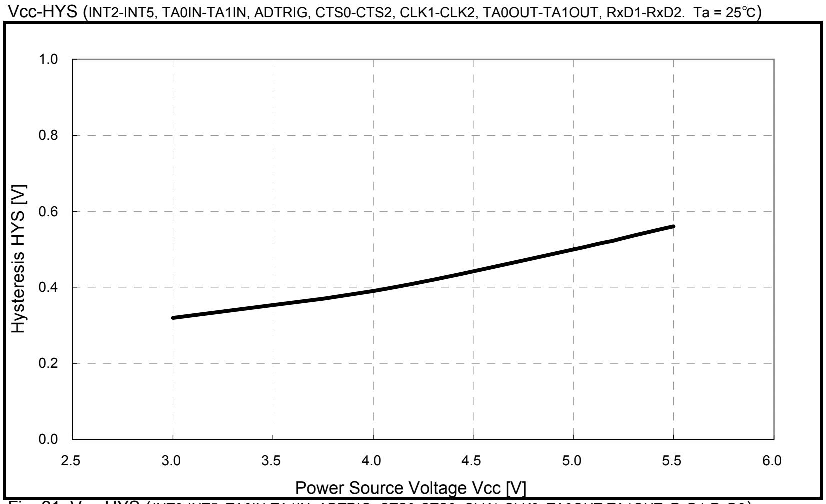



Fig. 21. Vcc-HYS (INT2-INT5, TA0IN-TA1IN, ADTRIG, CTS0-CTS2, CLK1-CLK2, TA0OUT-TA1OUT, RxD1-RxD2)

Vcc-HYS (INT0- INT1, TA2IN-TA4IN, TB0IN-TB2IN, NMI, CTS0-CTS1, CLK0-CLK1, TA2OUT-TA4OUT, KI0-KI3, RxD0-RxD1, SIN3-SIN4. Ta = 25℃)

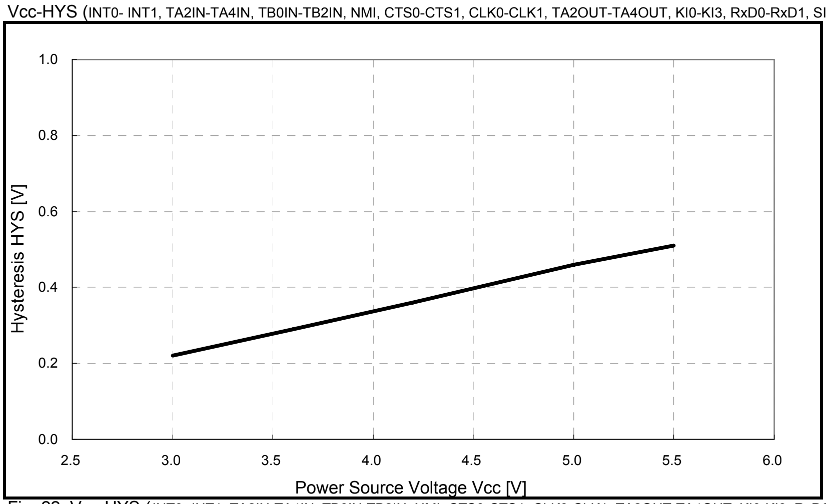



Fig. 22. Vcc-HYS (INT0- INT1, TA2IN-TA4IN, TB0IN-TB2IN, NMI, CTS0-CTS1, CLK0-CLK1, TA2OUT-TA4OUT, KI0-KI3, RxD0-RxD1, SIN3-SIN4)

**Standard Characteristics Example**

**A/D conversion accuracy standard characteristics example-1**

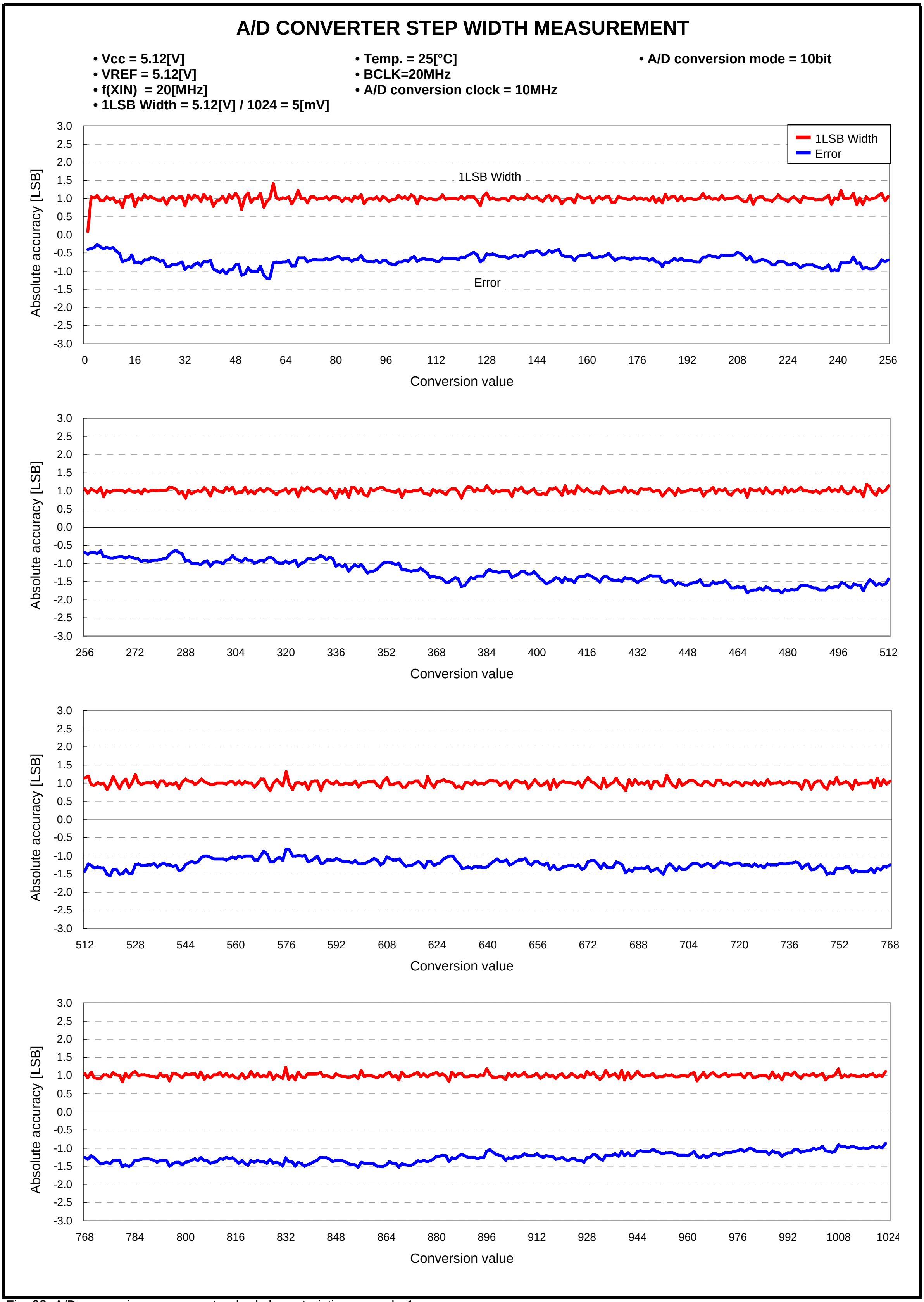



Fig. 23. A/D conversion accuracy standard characteristics example-1

**A/D conversion accuracy standard characteristics example-2**

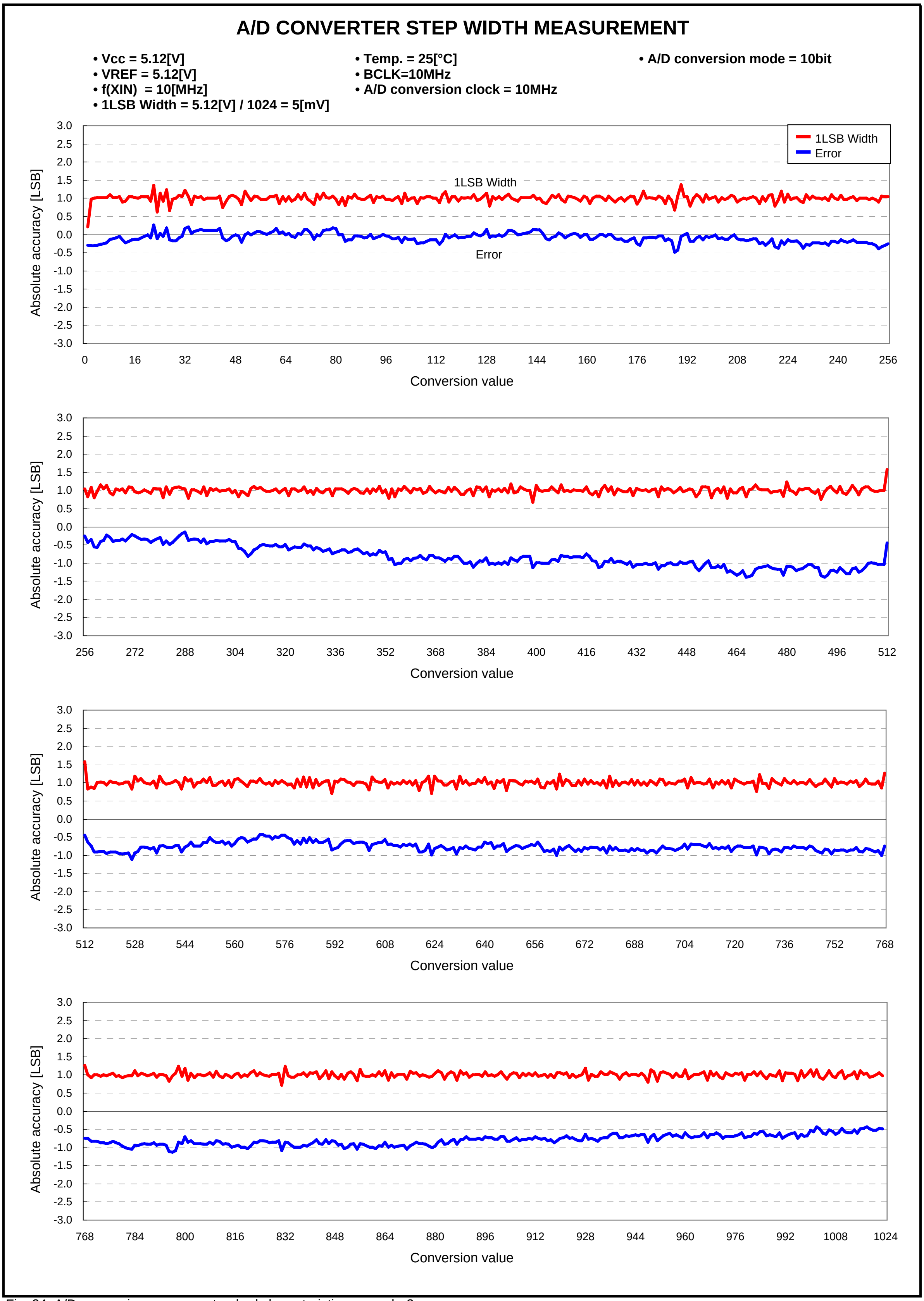



Fig. 24. A/D conversion accuracy standard characteristics example-2

**A/D conversion accuracy standard characteristics example-3**

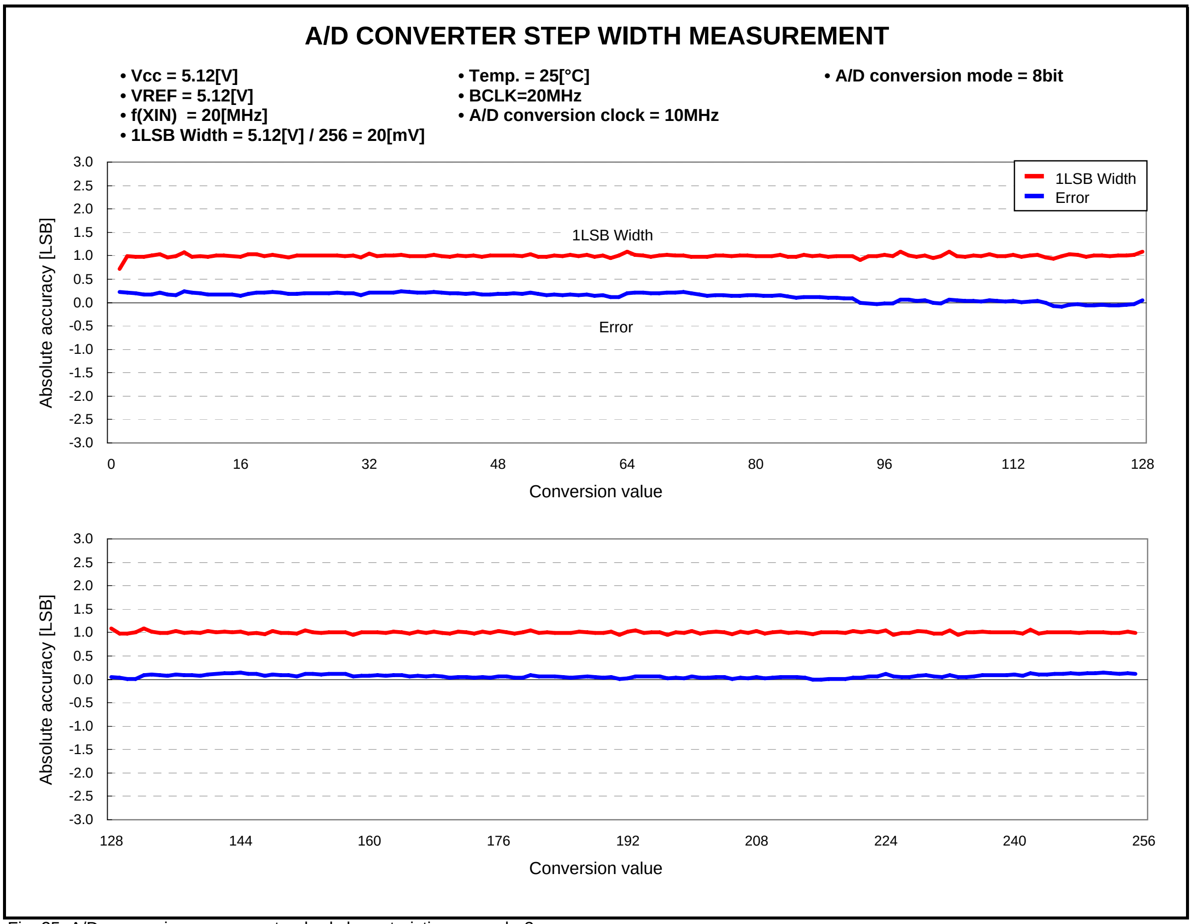



Fig. 25. A/D conversion accuracy standard characteristics example-3

**A/D conversion accuracy standard characteristics example-4**

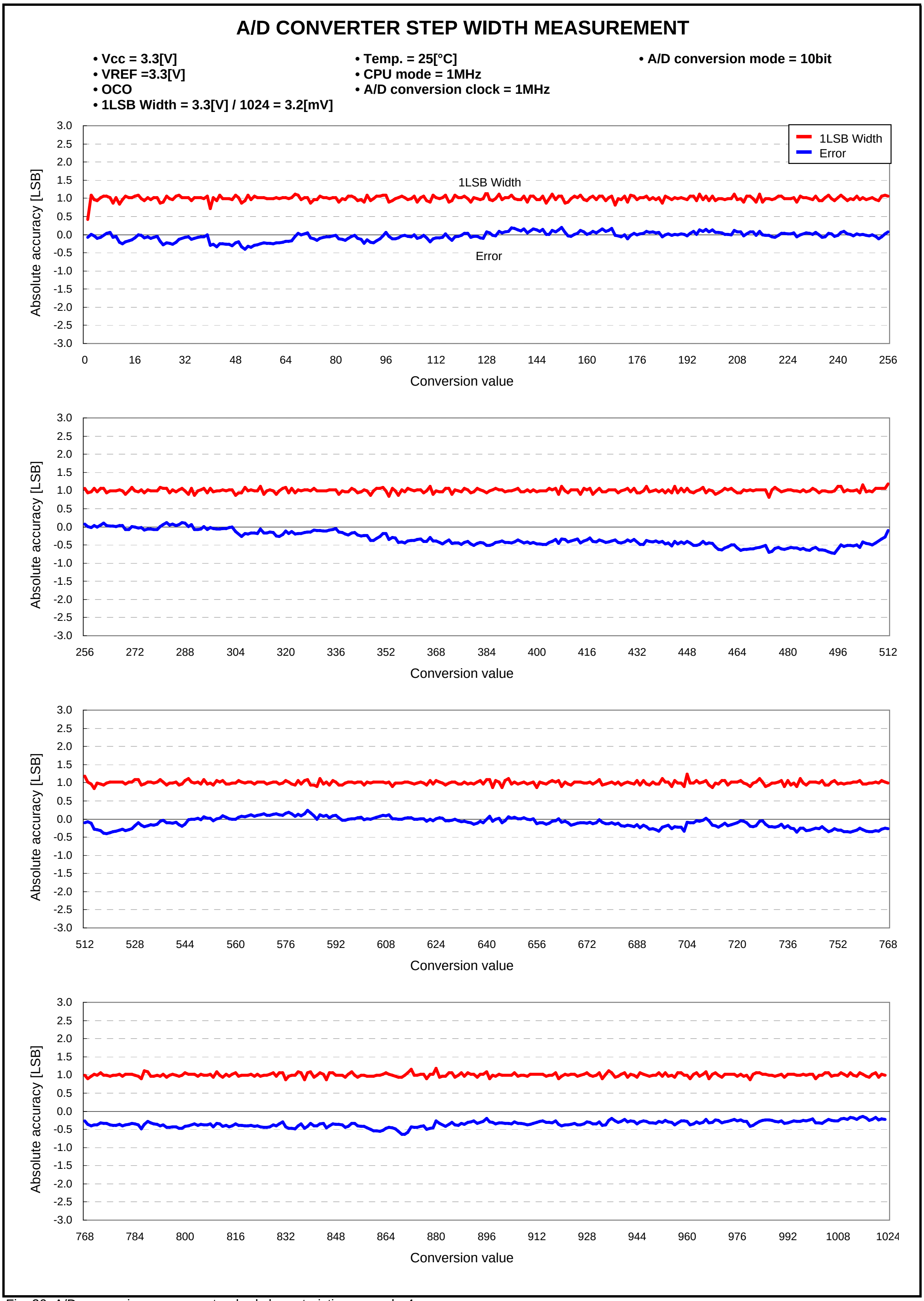



Fig. 26. A/D conversion accuracy standard characteristics example-4

**A/D conversion accuracy standard characteristics example-5**

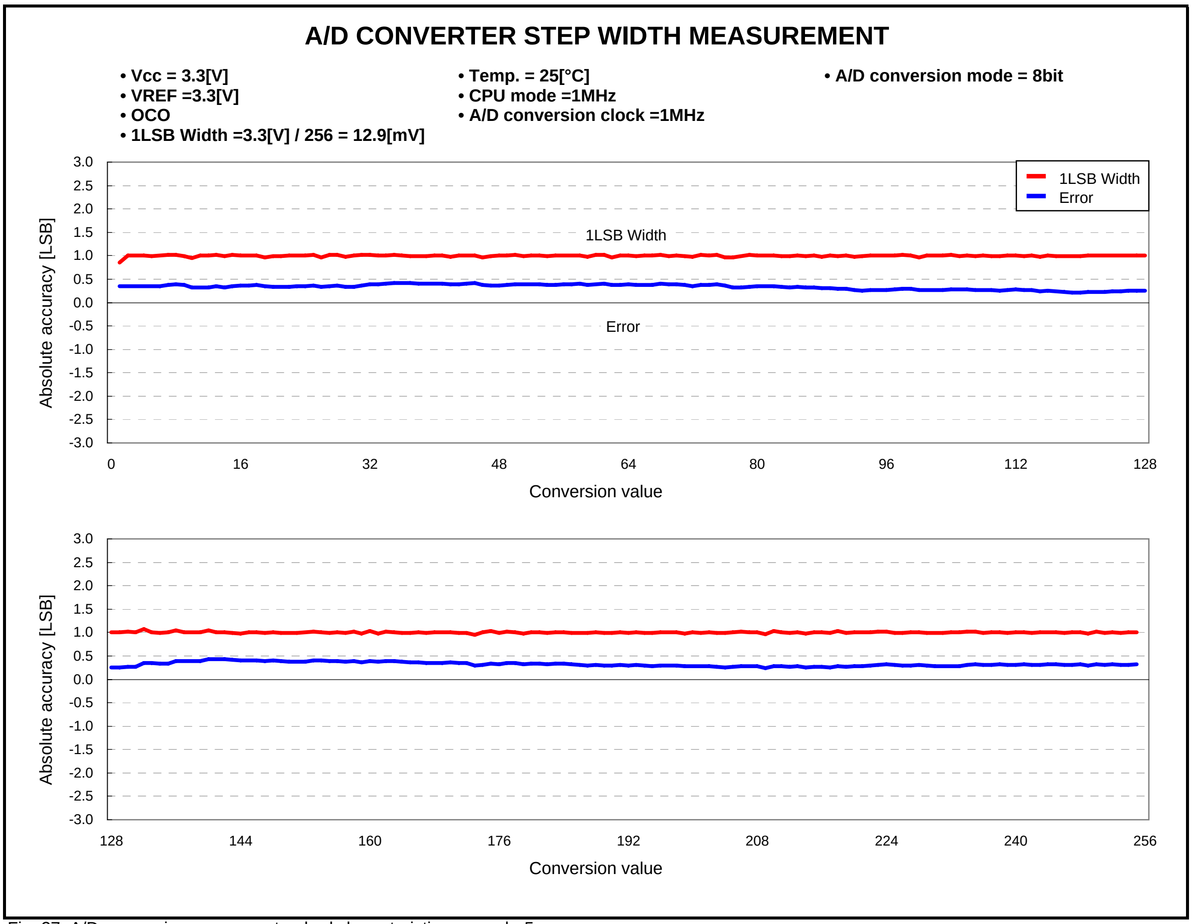



Fig. 27. A/D conversion accuracy standard characteristics example-5

**Standard Characteristics Example**

On-chip oscillator frequency characteristics (Vcc-f1(ROC))

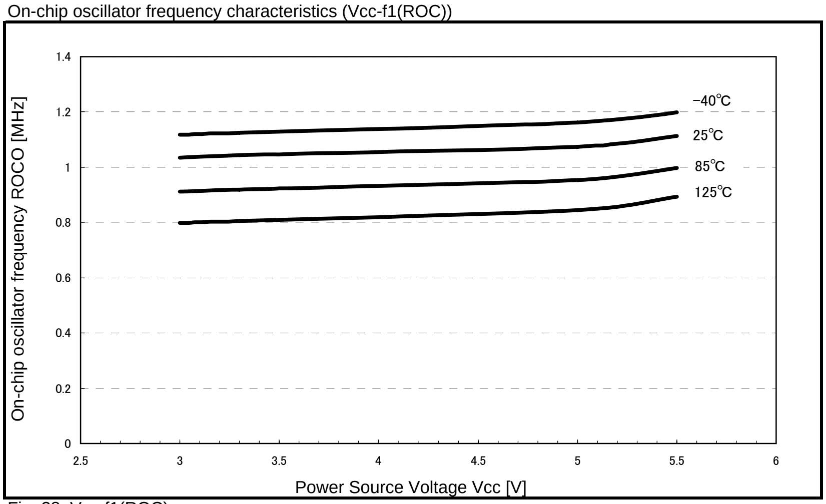



Fig. 28. Vcc-f1(ROC)

On-chip oscillator frequency characteristics (Ta-f1(ROC))

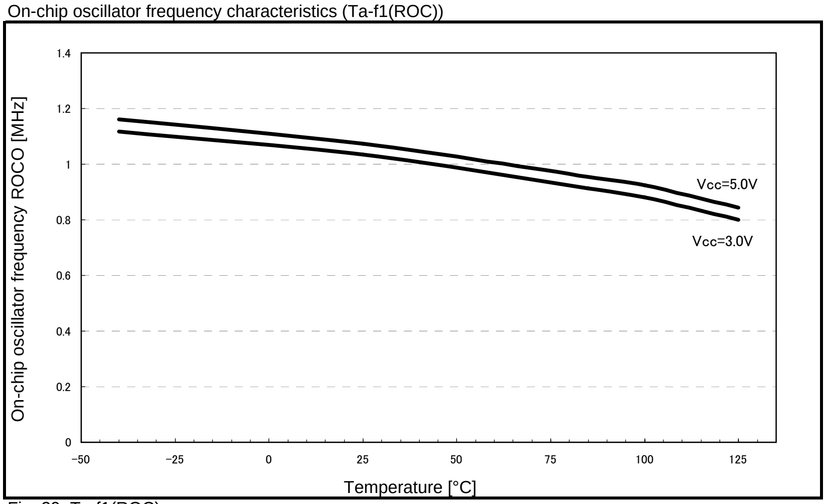



Fig. 29. Ta-f1(ROC)

On-chip oscillator frequency characteristics (Vcc-f2(ROC))

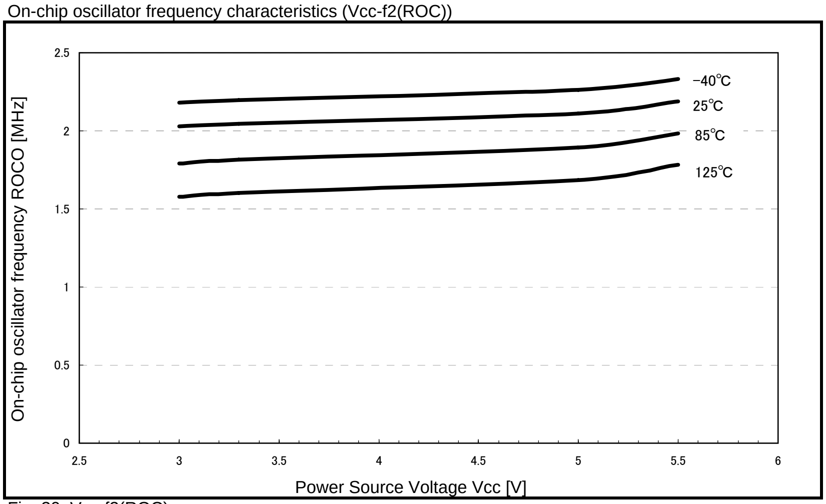



Fig. 30. Vcc-f2(ROC)

On-chip oscillator frequency characteristics (Ta-f2(ROC))

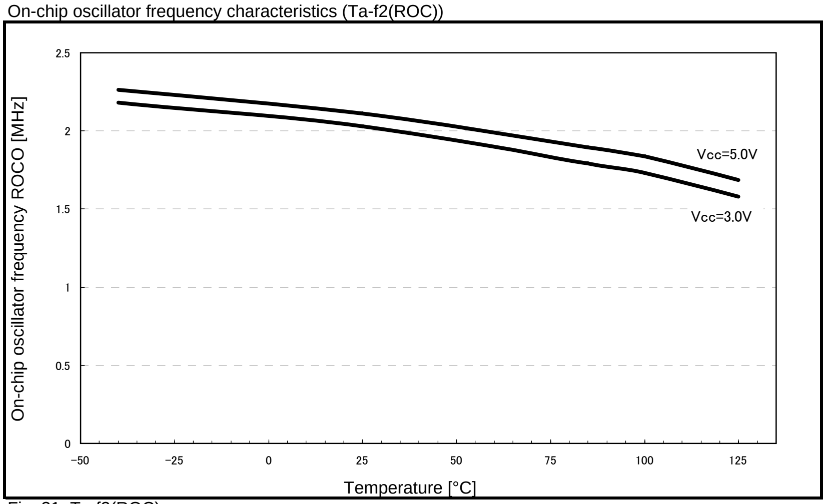



Fig. 31. Ta-f2(ROC)

On-chip oscillator frequency characteristics (Vcc-f3(ROC))

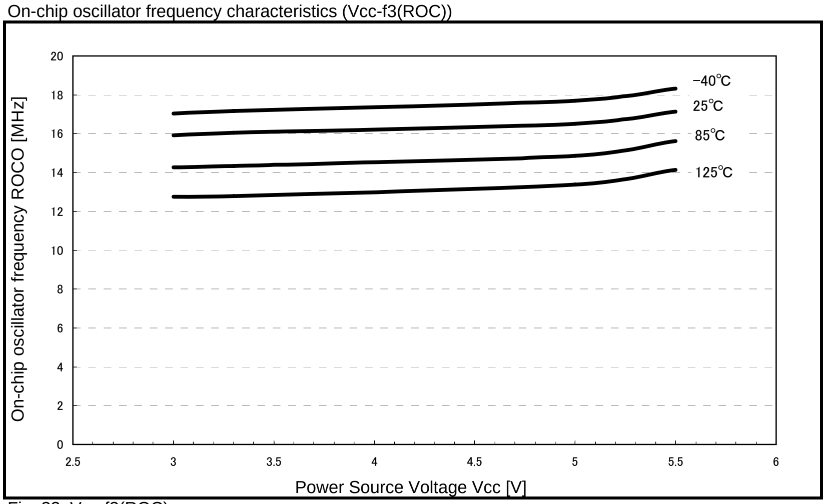



Fig. 32. Vcc-f3(ROC)

On-chip oscillator frequency characteristics (Ta-f3(ROC))

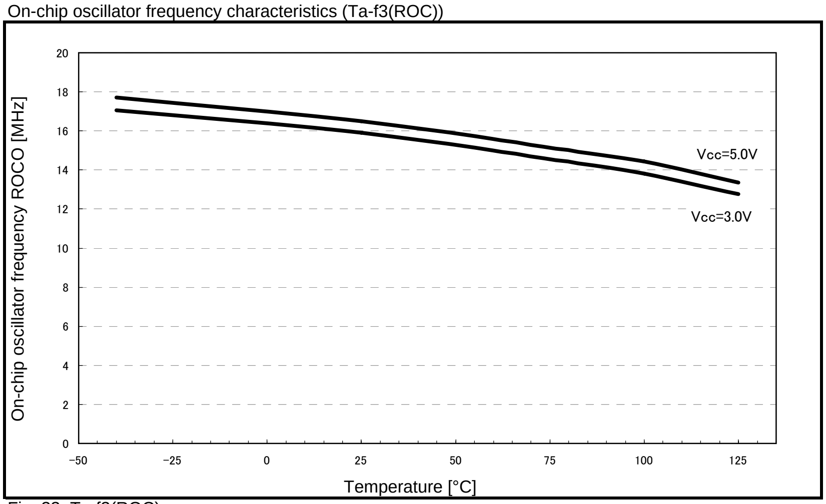



Fig. 33. Ta-f3(ROC)