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What is "Embedded - Microcontrollers"?

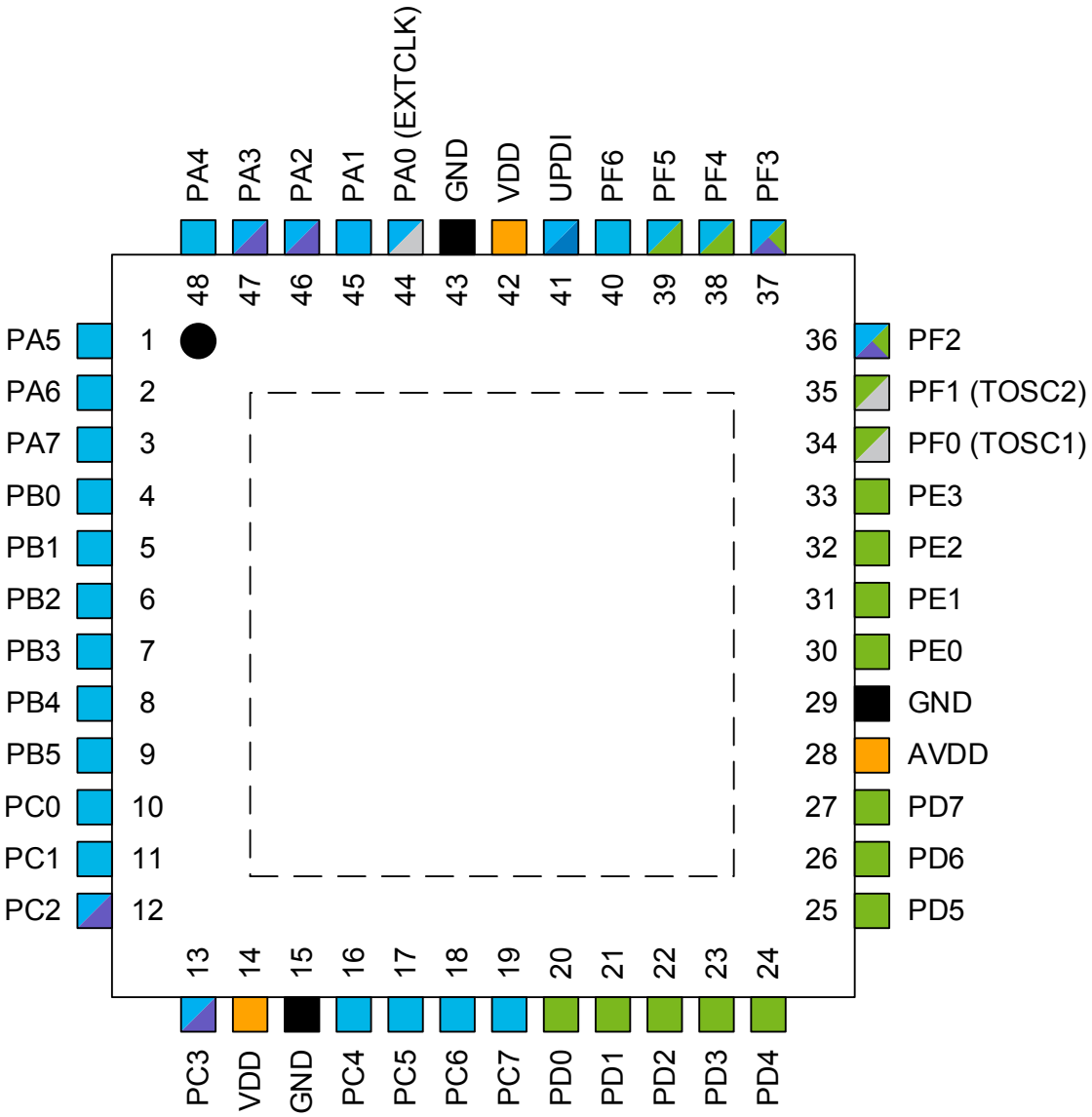
"Embedded - Microcontrollers" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" because they are embedded within electronic devices to control various functions, rather than serving as standalone computers. Microcontrollers are crucial in modern electronics, providing the intelligence and control needed for a wide range of applications.

Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	AVR
Core Size	8-Bit
Speed	20MHz
Connectivity	I²C, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, POR, WDT
Number of I/O	41
Program Memory Size	48KB (24K x 16)
Program Memory Type	FLASH
EEPROM Size	256 x 8
RAM Size	6K x 8
Voltage - Supply (Vcc/Vdd)	1.8V ~ 5.5V
Data Converters	A/D 16x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Surface Mount
Package / Case	48-UFQFN Exposed Pad
Supplier Device Package	48-UQFN (6x6)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/atmega4809-mfr

3. Pinout

3.1 48-pin QFN/TQFP



Power

- Input supply
- Ground
- GPIO on VDD power domain
- GPIO on AVDD power domain

Functionality

- Programming, debug
- Clock, crystal
- TWI
- Digital functions only
- Analog functions

Peripheral	Conditions	Typ.(1)	Unit
TCB	16-bit count @ 1 MHz	7.4	µA
RTC	16-bit count @ OSCULP32K	1.2	µA
WDT (including OSCULP32K)		0.7	µA
OSC20M		125	µA
AC	Fast Mode(2)	92	µA
	Low Power Mode(2)	45	µA
ADC	50 ksps	325	µA
	100 ksps	340	µA
XOSC32K	C_L=7.5 pF	0.5	µA
OSCULP32K		0.4	µA
USART	Enable @ 9600 Baud	13	µA
SPI (Master)	Enable @ 100 kHz	2.1	µA
TWI (Master)	Enable @ 100 kHz	23.9	µA
TWI (Slave)	Enable @ 100 kHz	17.1	µA
Flash programming	Erase Operation	1.5	mA
	Write Operation	3.0	

Note:

1. Current consumption of the module only. To calculate the total power consumption of the system, add this value to the base value in section “Power Consumption”.
2. CPU in Standby mode.

5.6 BOD and POR Characteristics

Table 5-8. Power Supply Characteristics

Symbol	Description	Condition	Min.	Typ.	Max.	Unit
SRON	Power-on Slope		-	-	100	V/ms

Table 5-9. Power On Reset (POR) Characteristics

Symbol	Description	Condition	Min.	Typ.	Max.	Unit
V_{POR}	POR threshold voltage on V_{DD} falling	V_{DD} falls/rises at 0.5V/ms or slower	0.8	-	1.6	V
	POR threshold voltage on V_{DD} rising		1.4	-	1.8	

Table 5-10. Brownout Detection (BOD) Characteristics

Symbol	Description	Condition	Min.	Typ.	Max.	Unit
V_{BOD}	BOD detection level (falling)	BODLEVEL=1.8V	1.71	1.78	1.85	V
		BODLEVEL=2.7V	2.45	2.60	2.75	
		BODLEVEL=4.3V	4.05	4.25	4.45	
V_{HYS}	Hysteresis	BODLEVEL=1.8V	-	25	-	mV
		BODLEVEL=2.7V	-	40	-	
		BODLEVEL=4.3V	-	80	-	
t_{BOD}	Detection time	Continuous	-	7	-	µs
		Sampled, 1 kHz	-	1	-	ms
		Sampled, 125 Hz	-	8	-	
$t_{startup}$	Start-up time	Time from enable to ready	-	40	-	µs
ΔV_{LVD}	Interrupt level 0	Percentage above the selected BOD level	-	4	-	%
	Interrupt level 1		-	13	-	
	Interrupt level 2		-	25	-	

5.7 External Reset Characteristics

Table 5-11. External Reset Characteristics

Mode	Description	Condition	Min.	Typ.	Max.	Unit
V_{VIH_RST}	Input Voltage for $\overline{\text{RESET}}$		0.7×V_{DD}	-	V_{DD}+0.2	V
V_{VIL_RST}	Input Low Voltage for $\overline{\text{RESET}}$		-0.2	-	0.3×V_{DD}	
t_{MIN_RST}	Minimum pulse width on $\overline{\text{RESET}}$ pin		300	-	-	ns
R_{p_RST}	$\overline{\text{RESET}}$ pull-up resistor	V_{Reset}=0V	20	35	50	kΩ

5.8 Oscillators and Clocks

Operating conditions:

- V_{DD}=3V, except where specified otherwise.

Table 5-12. 20 MHz Internal Oscillator (OSC20M) Characteristics

Symbol	Description	Condition		Min.	Typ.	Max.	Unit
f_{OSC20M}	Factory calibration frequency	FREQSEL=0	T_A=25°C, 3.0V		16		MHz
		FREQSEL=1			20		
f_{CAL}	Frequency calibration range	OSC16M(2)		14.5		17.5	MHz
		OSC20M(2)		18.5		21.5	MHz

The accuracy characteristics numbers are based on characterization of the following input reference levels and V_{DD} ranges:

- Vref = 1.8 V, V_{DD} = 1.8 to 5.5V
- Vref = 2.6 V, V_{DD} = 2.7 to 5.5V
- Vref = 4.096 V, V_{DD} = 4.5 to 5.5V
- Vref = 4.3 V, V_{DD} = 4.5 to 5.5V

Table 5-23. Accuracy Characteristics External Reference(2)

Symbol	Description	Conditions		Min.	Typ.	Max.	Unit
Res	Resolution			-	10	-	bit
INL	Integral Non-linearity		f_{ADC}=15 ksps	-	0.9	-	LSB
			f_{ADC}=77 ksps	-	0.9	-	
			f_{ADC}=115 ksps	-	1.2	-	
DNL(1)	Differential Non-linearity		f_{ADC}=15 ksps	-	0.2	-	LSB
			f_{ADC}=77 ksps	-	0.4	-	
			f_{ADC}=115 ksps	-	0.8	-	
EABS	Absolute accuracy		f_{ADC}=15 ksps	-	2	-	LSB
			f_{ADC}=77 ksps	-	2	-	
			f_{ADC}=115 ksps	-	2	-	
EGAIN	Gain error		f_{ADC}=15 ksps	-	2	-	LSB
			f_{ADC}=77 ksps	-	2	-	
			f_{ADC}=115 ksps	-	2	-	
EOFF	Offset error			-	-0.5	-	LSB

Note:

1. A DNL error of less than or equal to 1 LSB ensures a monotonic transfer function with no missing codes.
2. These values are based on characterization and not covered by production test limits.

5.12 AC

Table 5-24. Analog Comparator Characteristics

Symbol	Description	Condition	Min.	Typ.	Max.	Unit
V_{IN}	Input Voltage	Low Power Mode	-0.2	-	V_{DD}	V
		High speed mode	-0.2	-	V_{DD}	
C_{IN}	Input Pin Capacitance	PD1 to PD6	-	3.5	-	pF
		PD7	-	14	-	

Symbol	Description	Condition	Min.	Typ.	Max.	Unit
V_{OFF}	Input Offset Voltage, Low Power Mode	0.7V<V_{IN}<(V_{DD}-0.7V)	TBD	±10	TBD	mV
		V_{IN}=[0V, V_{DD}]	-	±30	-	
	Input Offset Voltage, High-speed Mode	0.7V<V_{IN}<(V_{DD}-0.7V)	TBD	±5	TBD	
		V_{IN}=[-0.2V, V_{DD}]	-	±20	-	
I_L	Input Leakage Current		-	5	-	nA
T_{START}	Start-up Time		-	1.3	-	µs
V_{HYS}	Hysteresis, High-speed mode	HYSMODE=0x0	-	0	-	mV
		HYSMODE=0x1	-	10	-	
		HYSMODE=0x2	-	25	-	
		HYSMODE=0x3	-	50	-	
t_{PD}	Propagation Delay	25 mV Overdrive, V_{DD}≥2.7V, High speed mode	-	50	-	ns
		25 mV Overdrive, V_{DD}≥2.7V, Low Power Mode	-	150	-	

5.13 UPDI Timing

UPDI Enable Sequence

Symbol	Description	Min.	Max.	Unit
T_{RES}	Duration of Handshake/Break on RESET	10	200	µs
T_{UPDI}	Duration of UPDI.txd=0	10	200	µs
T_{Deb0}	Duration of Debugger.txd=0	0.2	1	µs
T_{DebZ}	Duration of Debugger.txd=z	200	14000	µs

Figure 6-3. Active Supply Current vs. Temperature (f=20 MHz OSC20M)

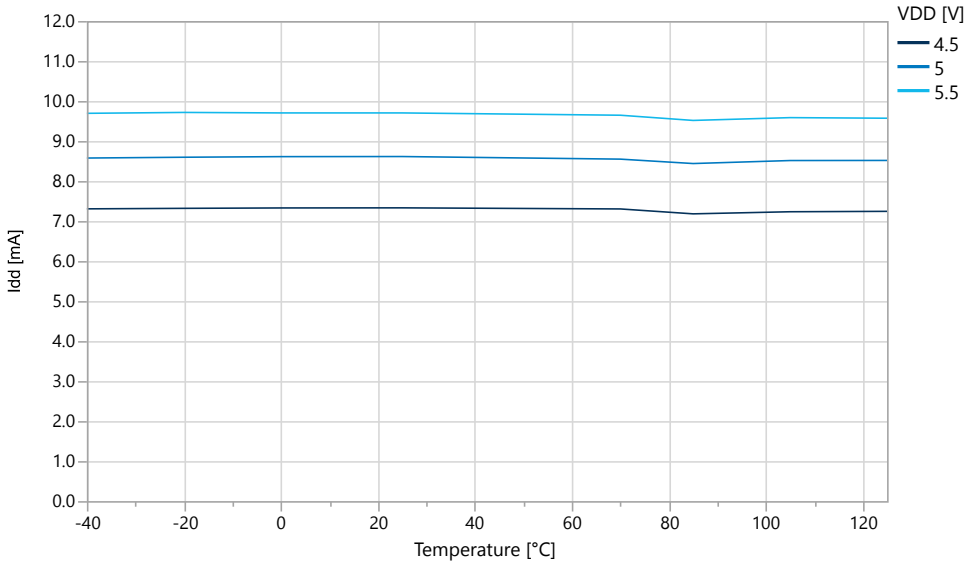


Figure 6-4. Active Supply Current vs. V_{DD} (f=[1.25, 20] MHz OSC20M) at T=25°C

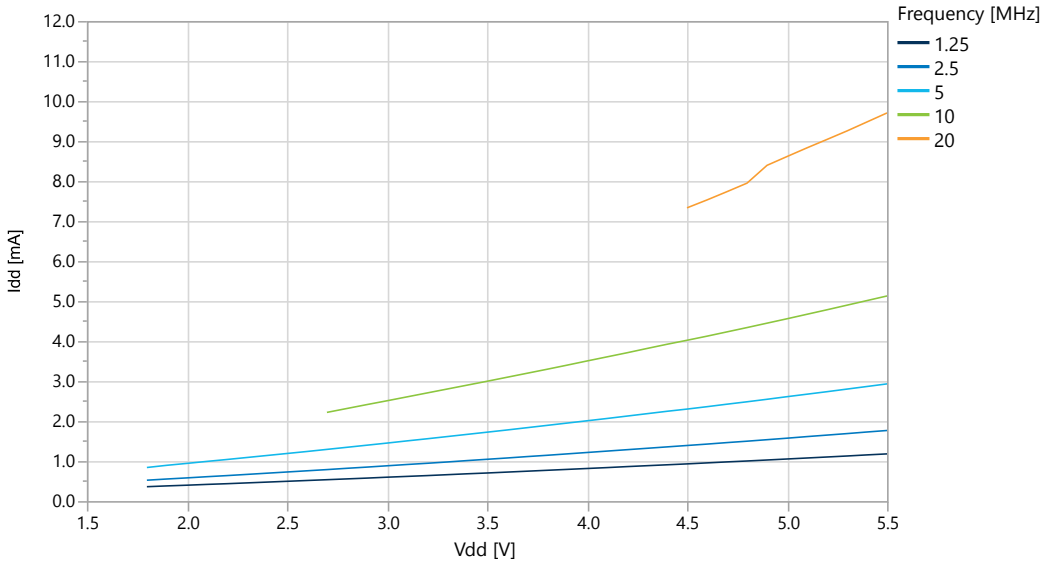


Figure 6-11. Power-Down Mode Supply Current vs. V_{DD} (all functions disabled)

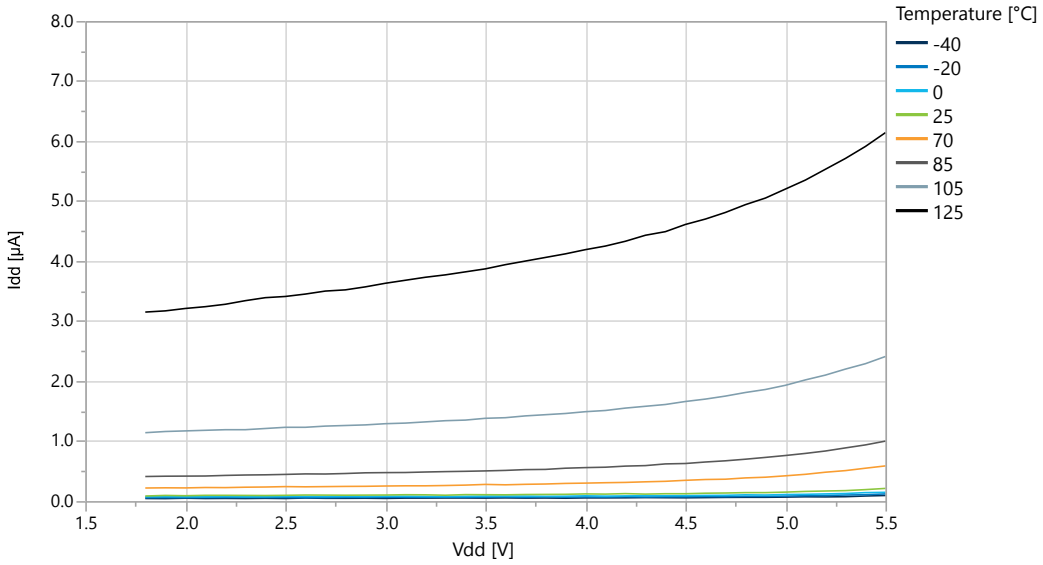
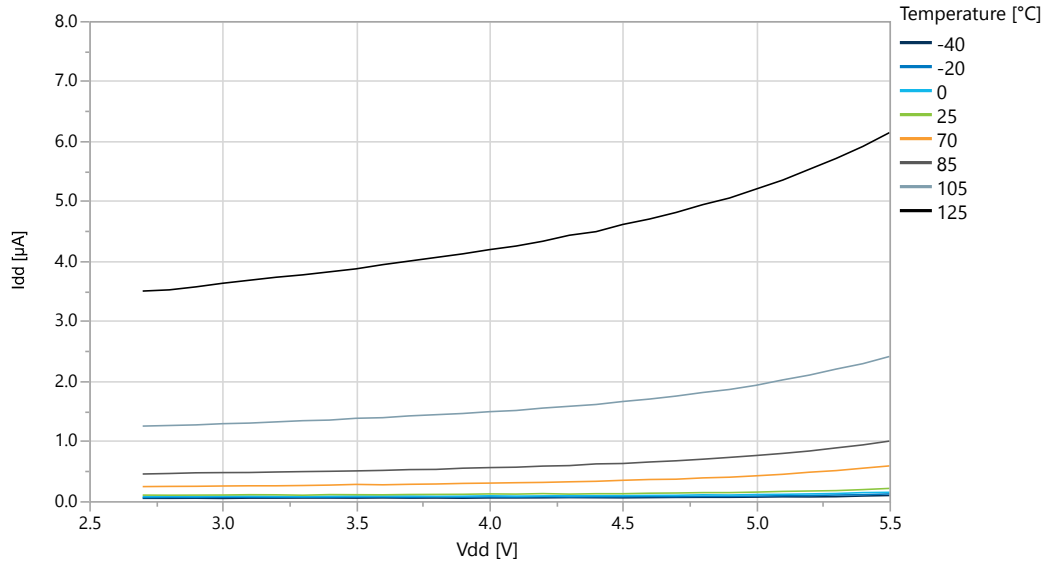


Figure 6-12. Power-Down Mode Supply Current vs. V_{DD} (all functions disabled)



6.2 GPIO

GPIO Input Characteristics

Figure 6-17. I/O Pin Input Hysteresis vs. V_{DD}

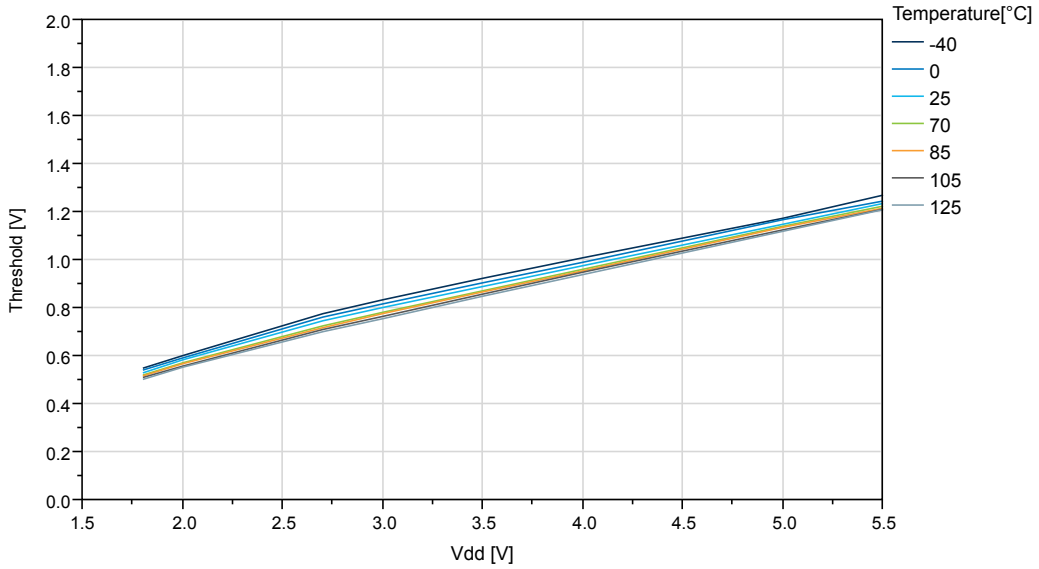


Figure 6-18. I/O Pin Input Threshold Voltage vs. V_{DD} (T=25°C)

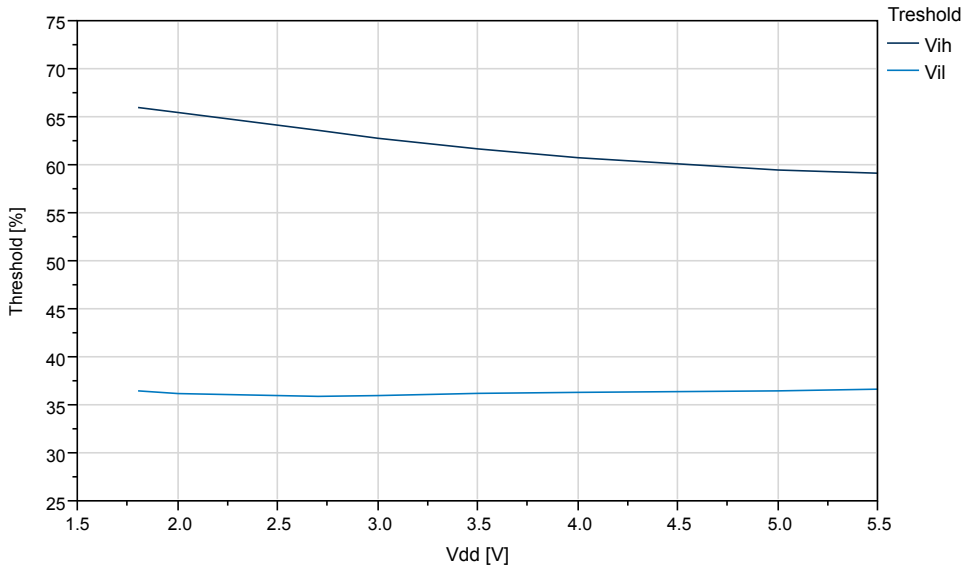
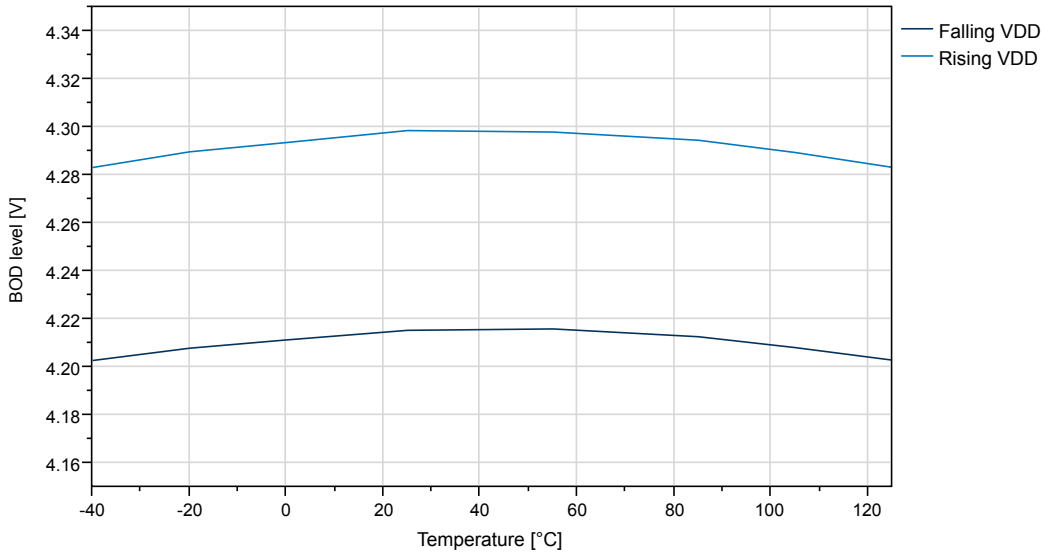


Figure 6-41. BOD Threshold vs. Temperature (Level 4.3V)



6.5 ADC Characteristics

Figure 6-42. Absolute Accuracy vs. V_{DD} (f_{ADC}=115 ksps) at T=25°C, REFSEL = Internal Reference

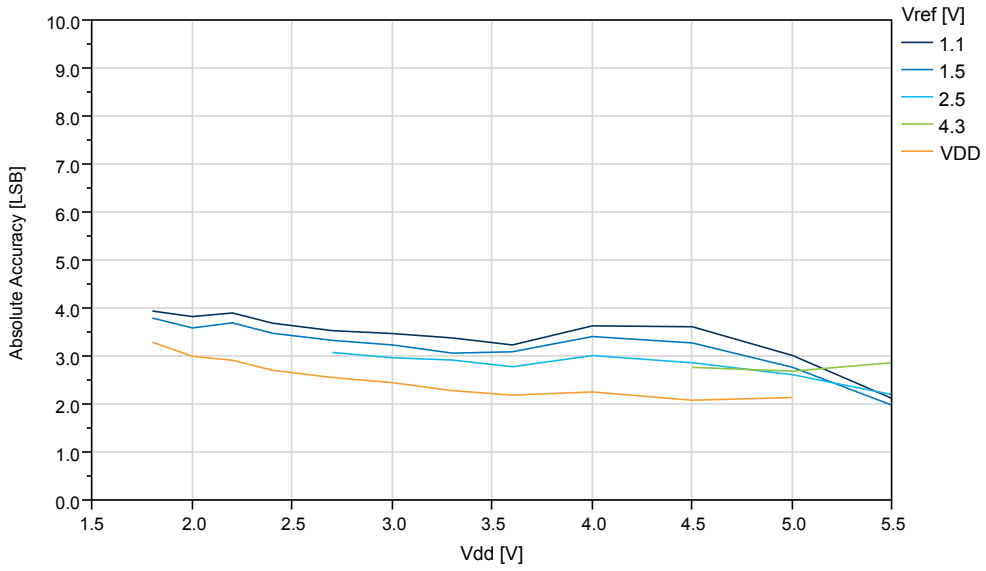


Figure 6-49. INL vs. V_{ref} (V_{DD}=5.0V, f_{ADC}=115 ksps), REFSEL = Internal Reference

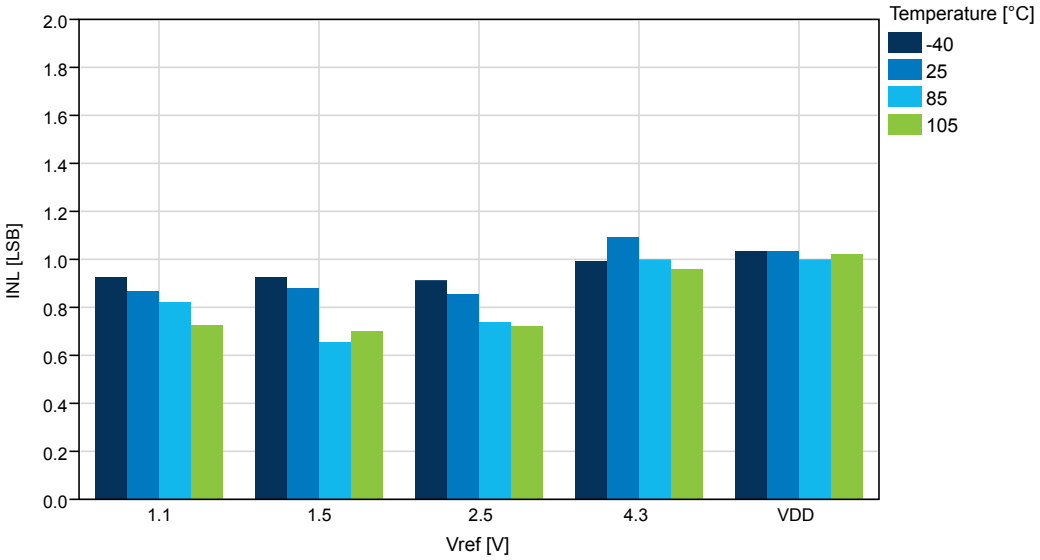


Figure 6-50. Offset Error vs. V_{DD} (f_{ADC}=115 ksps) at T=25°C, REFSEL = Internal Reference

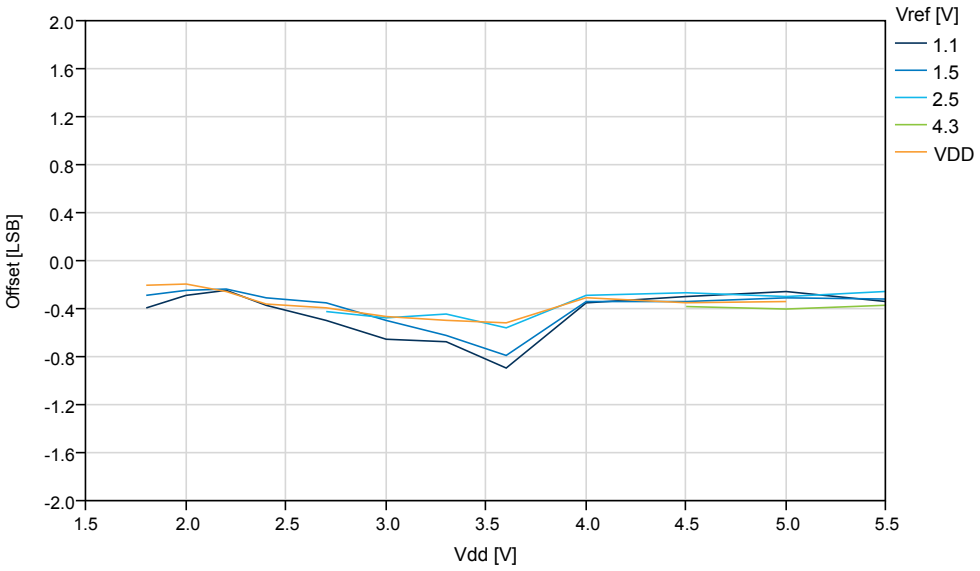


Figure 6-51. Offset Error vs. V_{ref} (V_{DD}=5.0V, f_{ADC}=115 ksps), REFSEL = Internal Reference

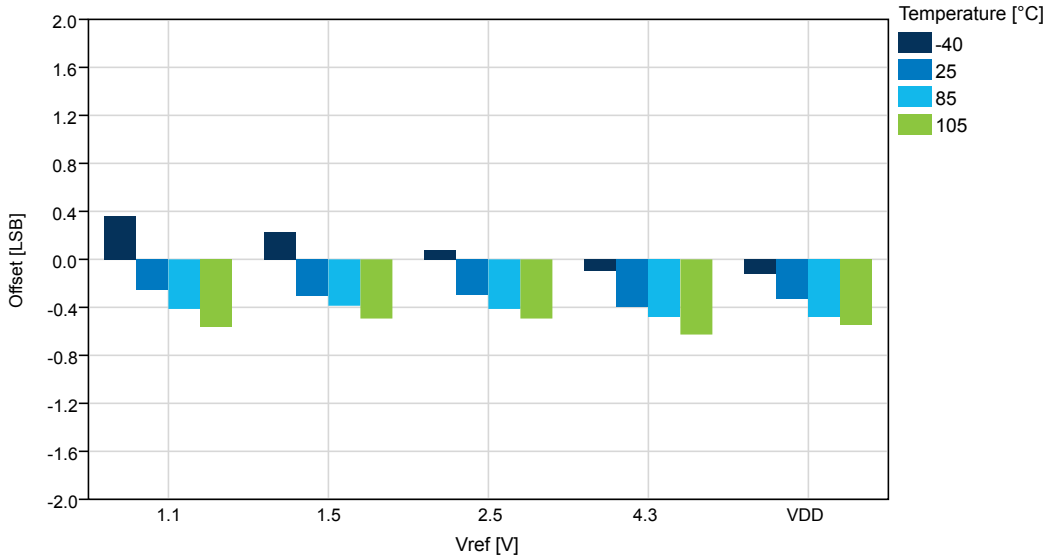


Figure 6-52. Absolute Accuracy vs. V_{DD} (f_{ADC}=115 ksps, T=25°C), REFSEL = External Reference

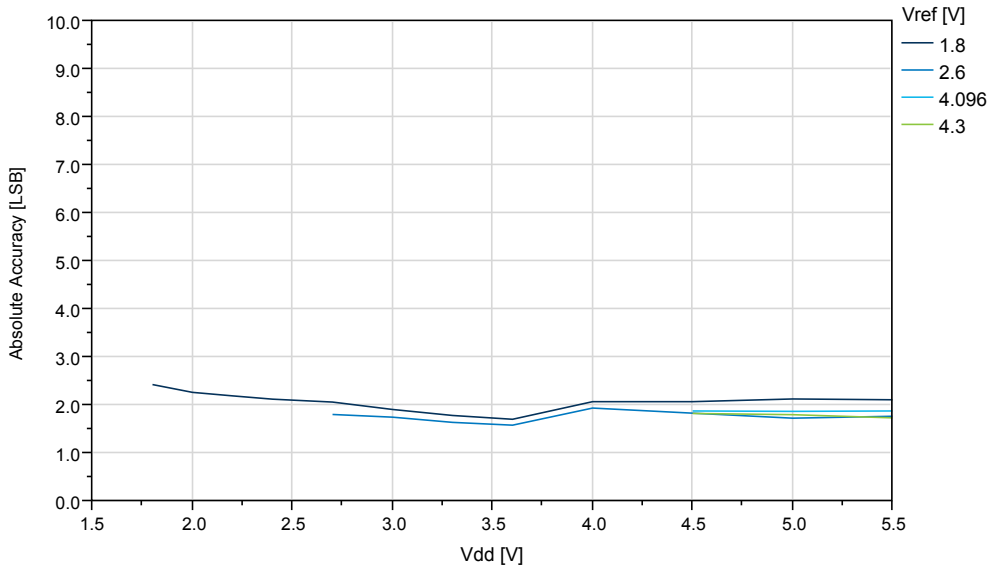


Figure 6-53. Absolute Accuracy vs. V_{REF} (V_{DD}=5.0V, f_{ADC}=115 ksps, REFSEL = External Reference)

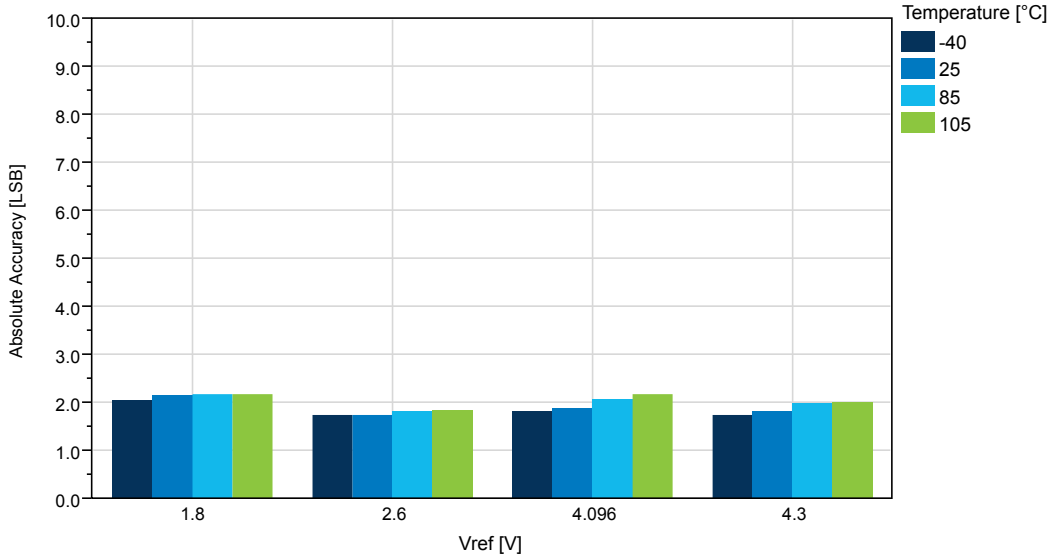


Figure 6-54. DNL vs. V_{DD} (f_{ADC}=115 ksps, T=25°C, REFSEL = External Reference)

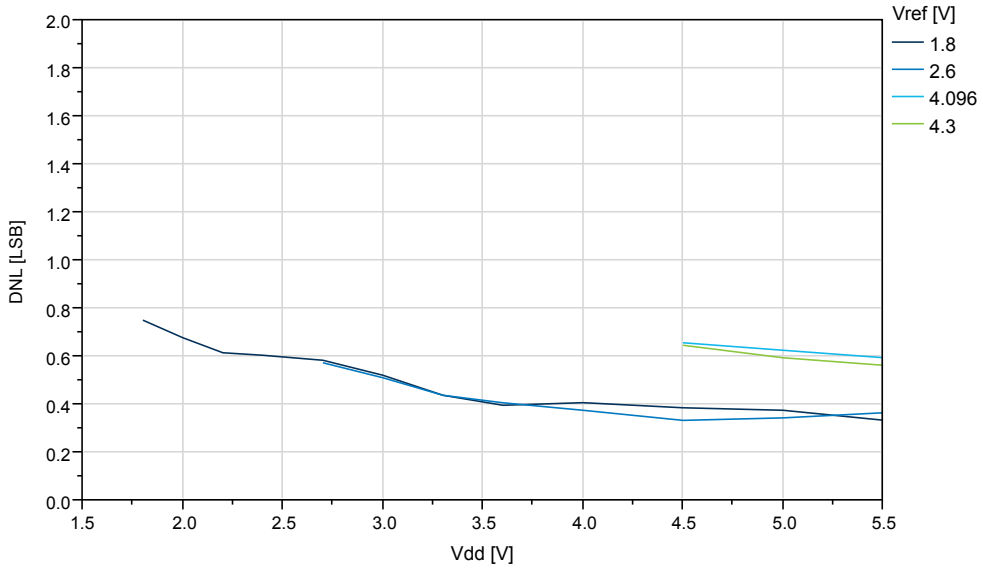


Figure 6-57. Gain vs. V_{REF} (V_{DD}=5.0V, f_{ADC}=115 ksps, REFSEL = External Reference)

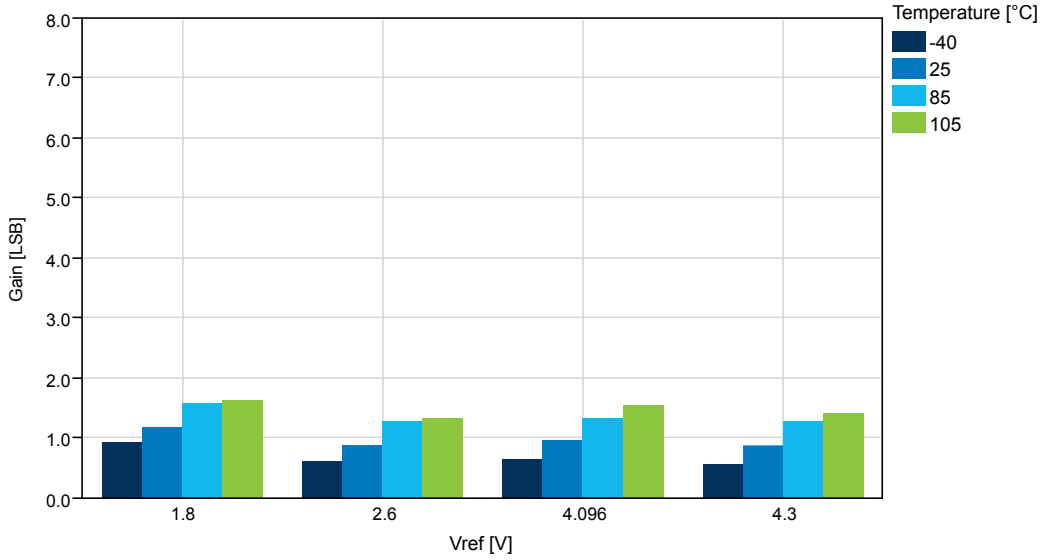


Figure 6-58. INL vs. V_{DD} (f_{ADC}=115 ksps, T=25°C, REFSEL = External Reference)

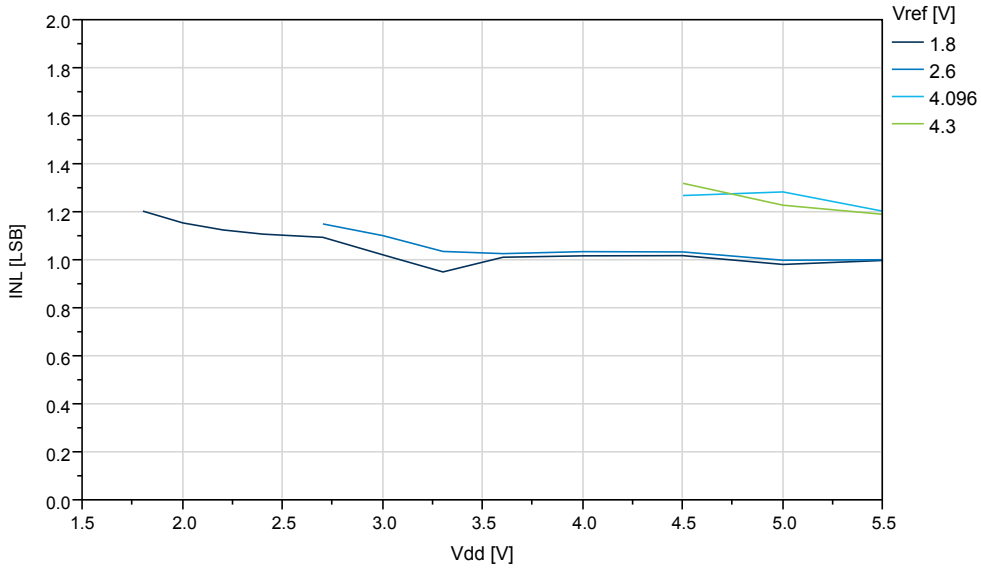
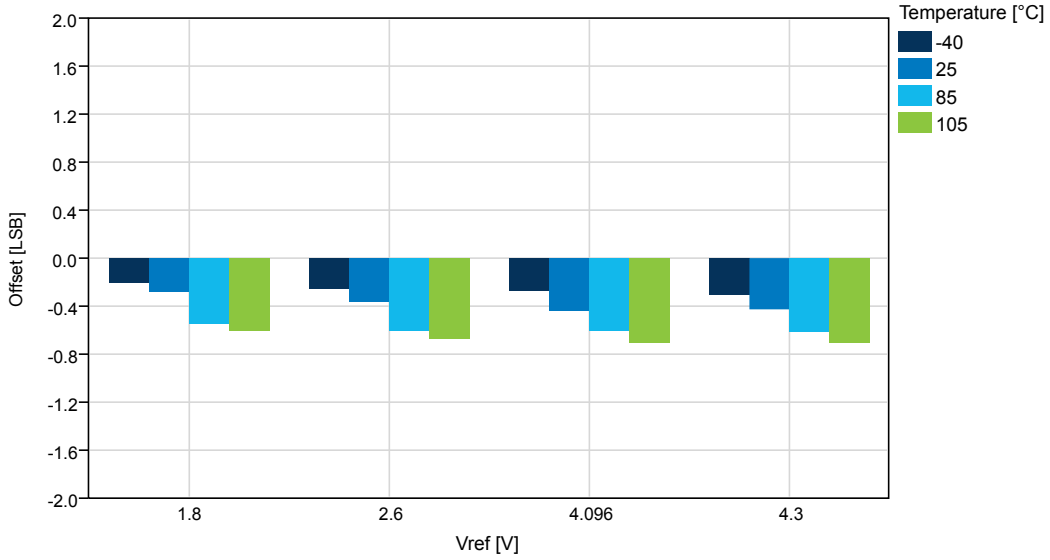


Figure 6-61. Offset vs. V_{REF} (V_{DD}=5.0V, f_{ADC}=115 ksps, REFSEL = External Reference)



6.6 AC Characteristics

Figure 6-62. Hysteresis vs. V_{CM} - 10 mV (V_{DD}=5V)

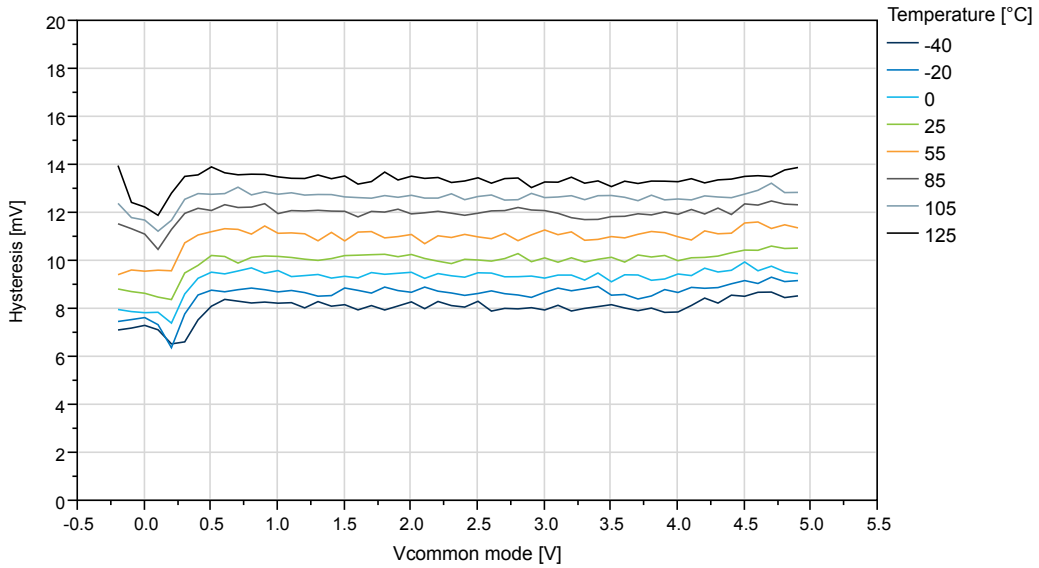


Figure 6-63. Hysteresis vs. V_{CM} - 10 mV to 50 mV (V_{DD}=5V, T=25°C)

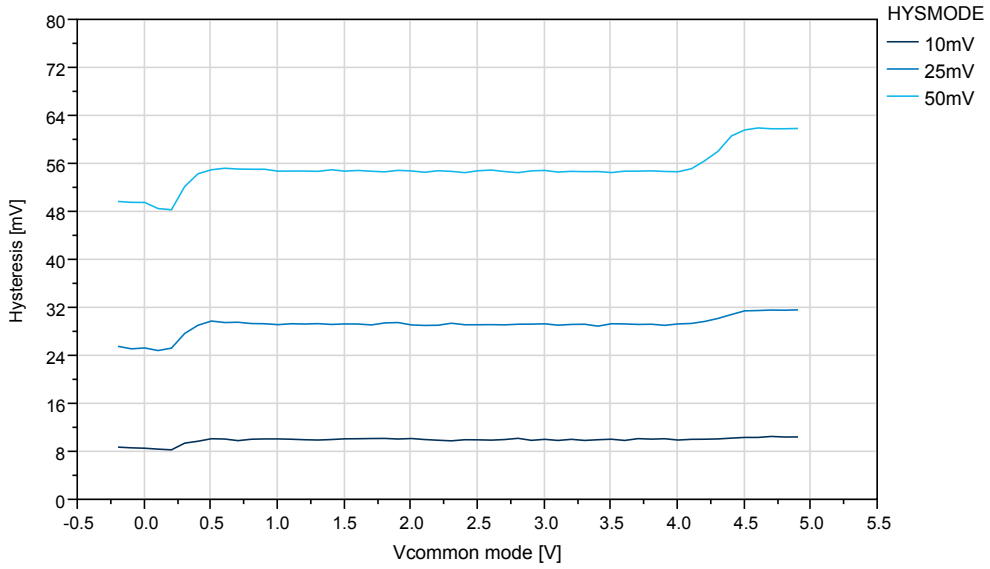


Figure 6-64. Offset vs. V_{CM} - 10 mV (V_{DD}=5V)

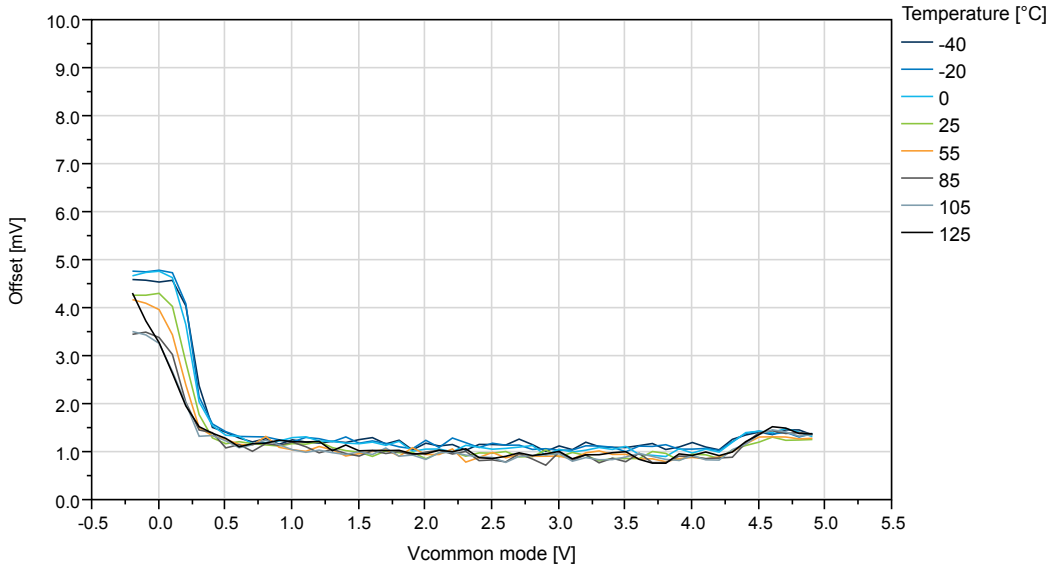
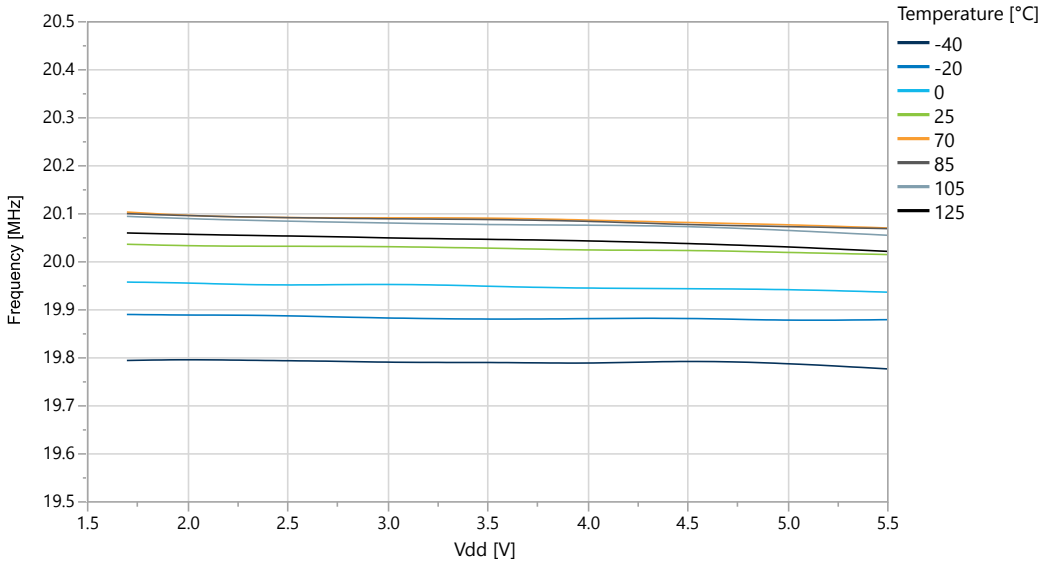
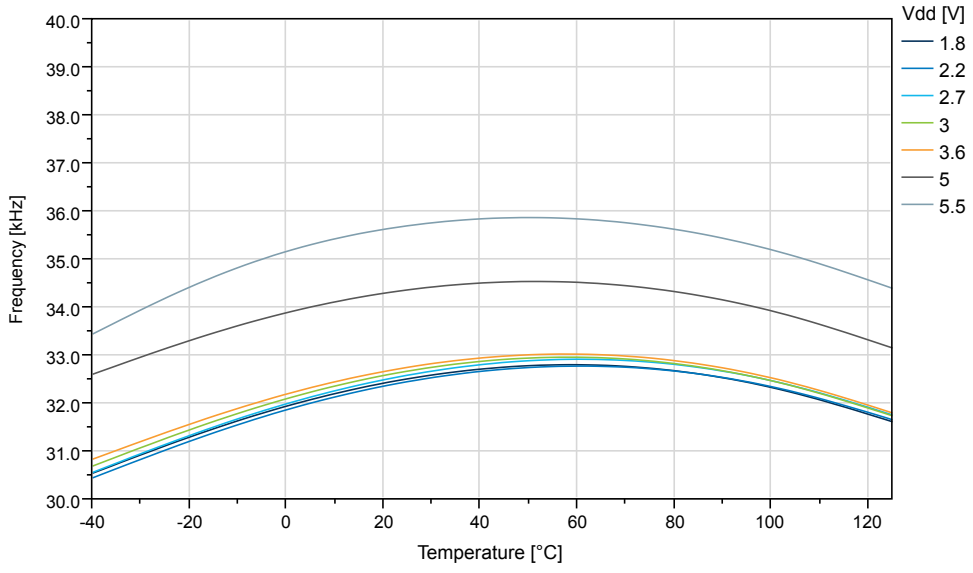


Figure 6-69. OSC20M Internal Oscillator: Frequency vs. V_{DD}



6.8 OSCULP32K Characteristics

Figure 6-70. OSCULP32K Internal Oscillator Frequency vs. Temperature



7. Package Drawings

7.1 48 pin TQFP

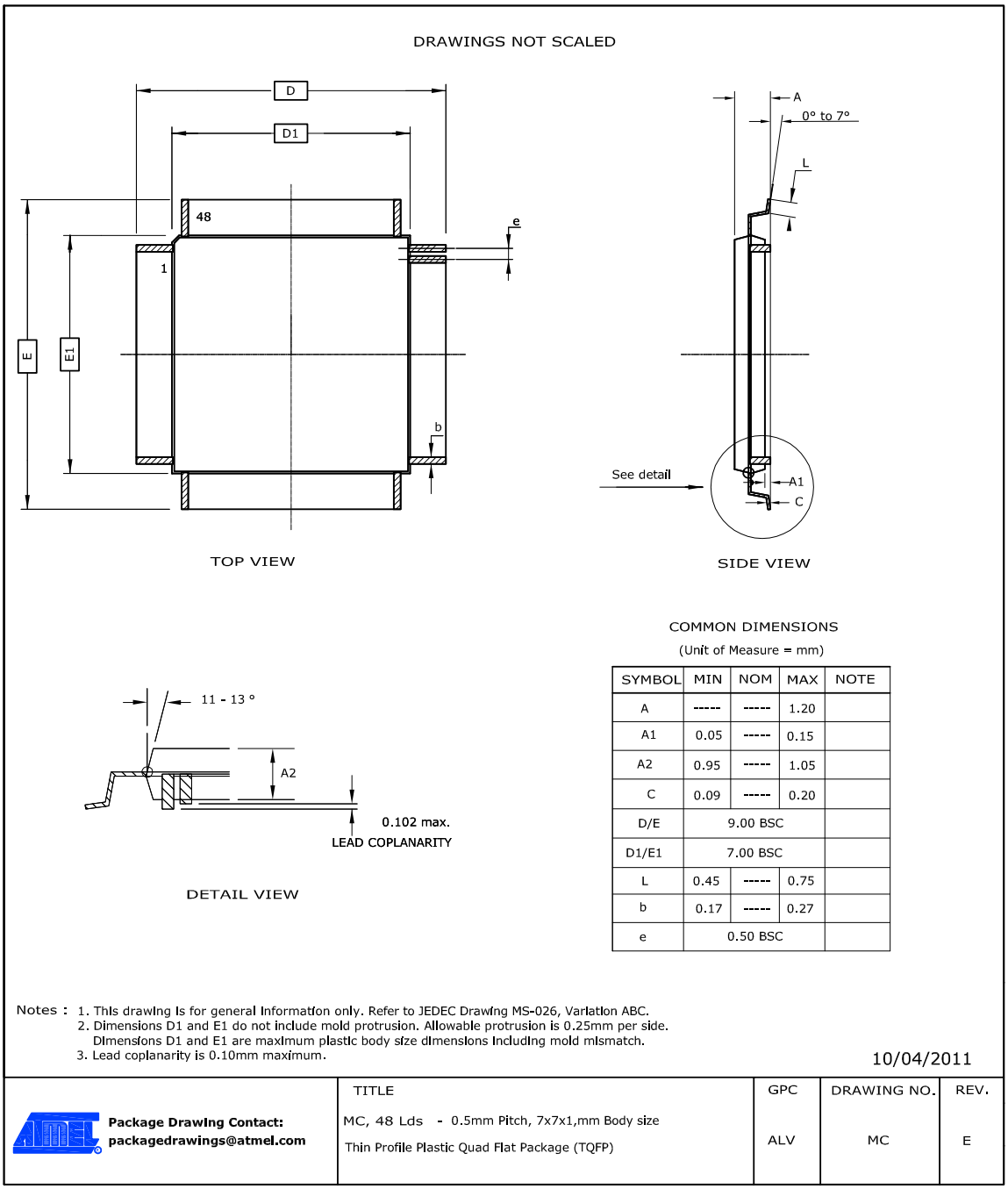


Table 7-1. Device and Package Maximum Weight

140	mg

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