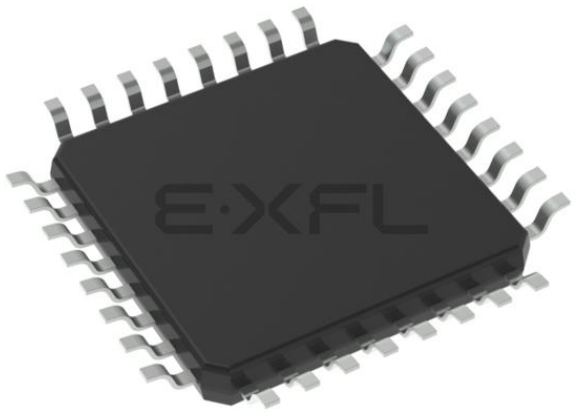

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Applications of "Embedded - Microcontrollers"

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	27
Program Memory Size	48KB (48K x 8)
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 12x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Surface Mount
Package / Case	32-TQFP
Supplier Device Package	32-TQFP (7x7)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/atmega4808-afr

1. Ordering Information

Find available ordering options online at microchipdirect.com, or contact your local sales representative.

4. I/O Multiplexing and Considerations

4.1 Multiplexed Signals

QFN32/ TQFP32	Pin name (1,2)	Special	ADC0	AC0	USARTn	SPI0	TWI0	TCA0	TCBn	Other	CCL-LUTn
30	PA0	EXTCLK			0,TxD			0-WO0			0-IN0
31	PA1				0,RxD			0-WO1			0-IN1
32	PA2	TWI			0,XCK		SDA(MS)	0-WO2	0-WO	EVOUTA	0-IN2
1	PA3	TWI			0,XDIR		SCL(MS)	0-WO3	1-WO		0-OUT
2	PA4				0,TxD(3)	MOSI		0-WO4			
3	PA5				0,RxD(3)	MISO		0-WO5			
4	PA6				0,XCK(3)	SCK					0-OUT(3)
5	PA7	CLKOUT		OUT	0,XDIR(3)	SS				EVOUTA(3)	
6	PC0				1,TxD	MOSI(3)		0-WO0(3)	2-WO		1-IN0
7	PC1				1,RxD	MISO(3)		0-WO1(3)	3-WO(3)		1-IN1
8	PC2	TWI			1,XCK	SCK(3)	SDA(MS)(3)	0-WO2(3)		EVOUTC	1-IN2
9	PC3	TWI			1,XDIR	SS(3)	SCL(MS)(3)	0-WO3(3)			1-OUT
10	PD0		AIN0					0-WO0(3)			2-IN0
11	PD1		AIN1	P3				0-WO1(3)			2-IN1
12	PD2		AIN2	P0				0-WO2(3)		EVOUTD	2-IN2
13	PD3		AIN3	N0				0-WO3(3)			2-OUT
14	PD4		AIN4	P1				0-WO4(3)			
15	PD5		AIN5	N1				0-WO5(3)			
16	PD6		AIN6	P2							2-OUT(3)
17	PD7	VREFA	AIN7	N2						EVOUTD(3)	
18	AVDD										
19	GND										
20	PF0	TOSC1			2,TxD			0-WO0(3)			3-IN0
21	PF1	TOSC2			2,RxD			0-WO1(3)			3-IN1
22	PF2	TWI	AIN12		2,XCK		SDA(S)(3)	0-WO2(3)		EVOUTF	3-IN2
23	PF3	TWI	AIN13		2,XDIR		SCL(S)(3)	0-WO3(3)			3-OUT
24	PF4		AIN14		2,TxD(3)			0-WO4(3)	0-WO(3)		
25	PF5		AIN15		2,RxD(3)			0-WO5(3)	1-WO(3)		
26	PF6	RESET			2,XCK(3)						3-OUT(3)
27	UPDI										
28	VDD										
29	GND										

Note:

1. Pin names are of type P*xn*, with *x* being the PORT instance (A,B,C, ...) and *n* the pin number. Notation for signals is PORT*x*_PIN*n*. All pins can be used as event input.
2. All pins can be used for external interrupt, where pins P*x*2 and P*x*6 of each port have full asynchronous detection.
3. Alternate pin positions. For selecting the alternate positions, refer to the PORTMUX documentation.

5. Electrical Characteristics

5.1 Absolute Maximum Ratings

Stresses beyond those listed in this section 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.

Table 5-1. Absolute Maximum Ratings

Symbol	Description	Conditions	Min.	Max.	Unit
V_{DD}	Power Supply Voltage		-0.5	6	V
I_{VDD}	Current into a V_{DD} pin	T_A=[-40, 85]°C	-	200	mA
		T_A=[85, 125]°C	-	100	mA
I_{GND}	Current out of a GND pin	T_A=[-40, 85]°C	-	200	mA
		T_A=[85, 125]°C	-	100	mA
V_{PIN}	Pin voltage with respect to GND		-0.5	V_{DD}+0.5	V
I_{PIN}	I/O pin sink/source current		-40	40	mA
I_{c1}(1)	I/O pin injection current except for the RESET pin	V_{pin}<GND-0.6V or 5.5V<V_{pin}≤6.1V 4.9V<V_{DD}≤5.5V	-1	1	mA
I_{c2}(1)	I/O pin injection current except for the RESET pin	V_{pin}<GND-0.6V or V_{pin}≤5.5V V_{DD}≤4.9V	-15	15	mA
$T_{storage}$	Storage temperature		-65	150	°C

Note:

1. – If V_{PIN} is lower than GND-0.6V, then a current limiting resistor is required. The negative DC injection current limiting resistor is calculated as R = (GND-0.6V – V_{pin})/I_{Cn}.
   – If V_{PIN} is greater than V_{DD}+0.6V, then a current limiting resistor is required. The positive DC injection current limiting resistor is calculated as R = (V_{pin}-(V_{DD}+0.6))/I_{Cn}.

5.2 General Operating Ratings

The device must operate within the ratings listed in this section in order for all other electrical characteristics and typical characteristics of the device to be valid.

Table 5-2. General Operating Conditions

Symbol	Description	Condition	Min.	Max.	Unit
V_{DD}	Operating Supply Voltage		1.8(1)	5.5	V
T_A	Operating temperature range	Standard temperature range	-40	125	°C

Note:

1. Operation is guaranteed down to 1.8V or VBOD with BODLEVEL=1.8V, whichever is lower.

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

Table 5-14. 32.768 kHz External Crystal Oscillator (XOSC32K) Characteristics

Symbol	Description	Condition	Min.	Typ.	Max.	Unit
f_{out}	Frequency		-	32.768	-	kHz
$t_{startup}$	Startup time	C_L=7.5 pF	-	300	-	ms
		C_L=12.5 pF	-	TBD	-	
C_L	Crystal load capacitance		7.5	-	12.5	pF
C_{TOSC1}	Parasitic capacitor load		-	5.5	-	pF
C_{TOSC2}			-	5.5	-	pF
ESR	Equivalent Series Resistance - Safety Factor=3	C_L=7.5 pF	-	-	80	kΩ
		C_L=12.5 pF	-	-	40	

Figure 5-2. External Clock Waveform Characteristics

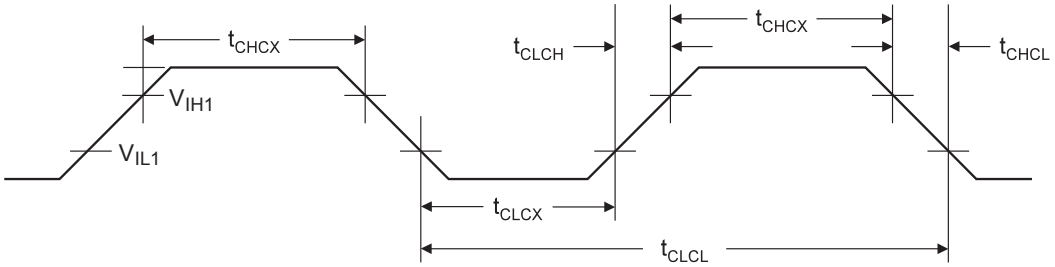


Table 5-15. External Clock Characteristics

Symbol	Description	Condition	V_{DD}=[1.8, 5.5]V		V_{DD}=[2.7, 5.5]V	V_{DD}=[4.5, 5.5]V	Unit		
			Min.	Max.	Min.	Max.		Min.	Max.
f_{CLCL}	Frequency		0	5.0	0.0	10.0	0.0	20.0	MHz
t_{CLCL}	Clock Period		200	-	100	-	50	-	ns
t_{CHCX}	High Time		80	-	40	-	20	-	ns
t_{CLCX}	Low Time		80	-	40	-	20	-	ns
t_{CLCH}	Rise Time (for maximum frequency)		-	40	-	20	-	10	ns
t_{CHCL}	Fall Time (for maximum frequency)		-	40	-	20	-	10	ns
Δt_{CLCL}	Change in period from one clock cycle to the next		-	20	-	20	-	20	%

Symbol(2)	Description	Condition	Min.	Typ.	Max.	Unit
INT15V INT25V						
INT055V INT11V INT15V INT25V INT43V	Internal reference voltage	V_{DD}=[1.8V, 5.5V] T=[-40 - 125]°C	-5.0		5.0	

Note:

1. These values are based on characterization and not covered by production test limits.
2. The symbols INTxxV refer to the respective values of the AC0REFSEL bit field in the VREF.CTRLA register.

5.11 ADC

5.11.1 Internal Reference Characteristics

Operating conditions:

- V_{DD} = 1.8 to 5.5V
- Temperature = -40°C to 125°C
- DUTYCYC = 25%
- CLK_{ADC} = 13 * f_{ADC}
- SAMPCAP is 10 pF for 0.55V reference, while it is set to 5 pF for V_{REF}≥1.1V
- Applies for all allowed combinations of V_{REF} selections and Sample Rates unless otherwise noted

Table 5-20. Power Supply, Reference, and Input Range

Symbol	Description	Conditions	Min.	Typ.	Max.	Unit
V_{DD}	Supply voltage	CLK_{ADC} ≤ 1.5 MHz	1.8	-	5.5	V
		CLK_{ADC} > 1.5 MHz	2.7	-	5.5	
V_{REF}	Reference voltage	REFSEL = Internal reference	0.55	-	V_{DD}-0.5	V
		REFSEL = External reference	1.1		V_{DD}	
		REFSEL = V_{DD}	1.8	-	5.5	
C_{IN}	Input capacitance	SAMPCAP=5 pF	-	5	-	pF
		SAMPCAP=10 pF	-	10	-	
V_{IN}	Input voltage range		0	-	V_{REF}	V
I_{BAND}	Input bandwidth	1.1V≤V_{REF}	-	-	57.5	kHz

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

6. Typical Characteristics

6.1 Power Consumption

6.1.1 Supply Currents in Active Mode

Figure 6-1. Active Supply Current vs. Frequency (1-20 MHz) at T=25°C

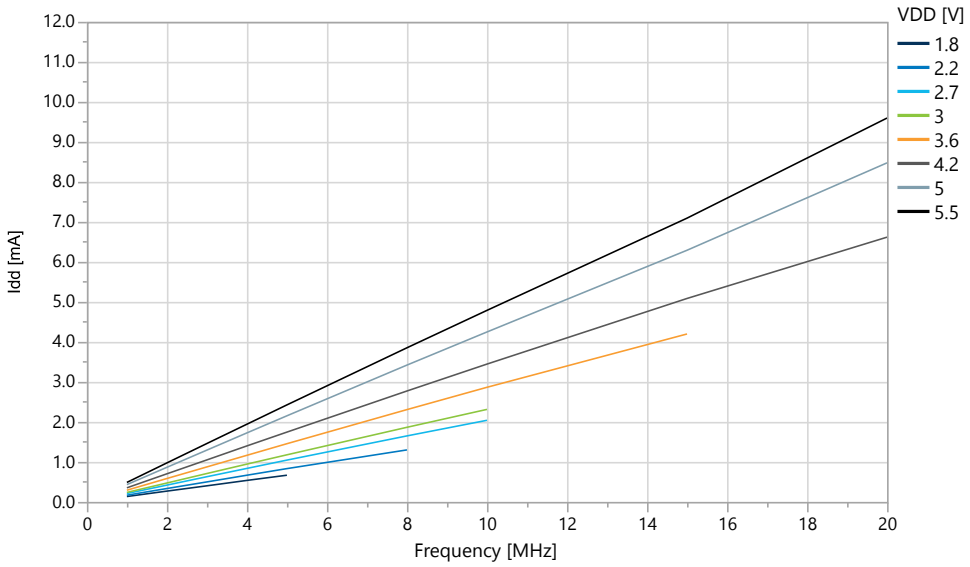


Figure 6-2. Active Supply Current vs. Frequency [0.1, 1.0] MHz at T=25°C

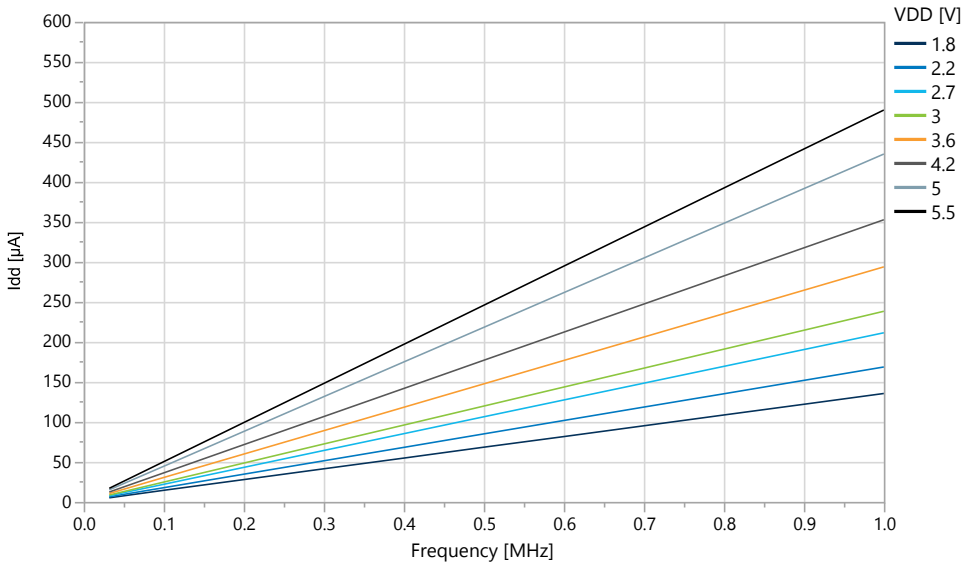


Figure 6-3. Active Supply Current vs. Temperature (f=20 MHz OSC20M)

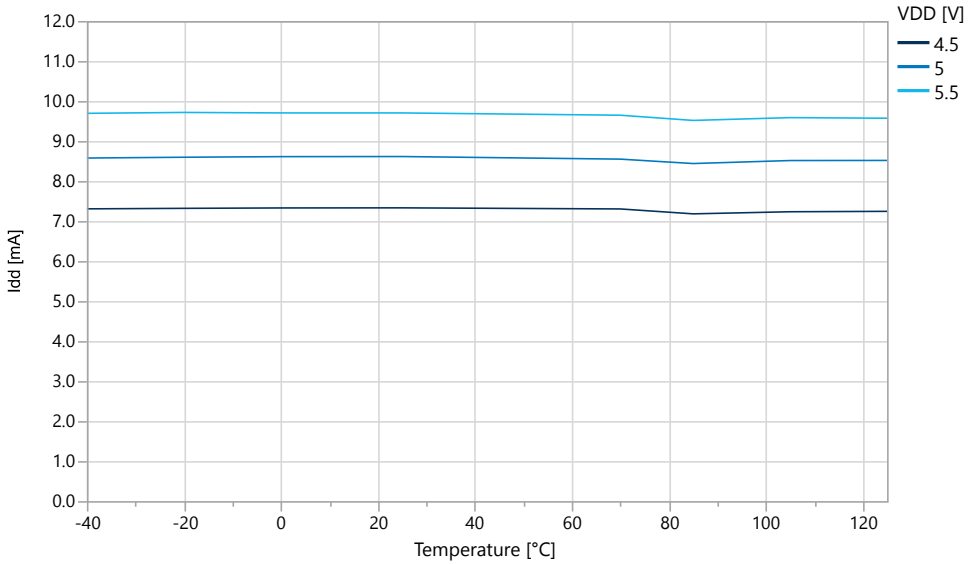


Figure 6-4. Active Supply Current vs. V_{DD} (f=[1.25, 20] MHz OSC20M) at T=25°C

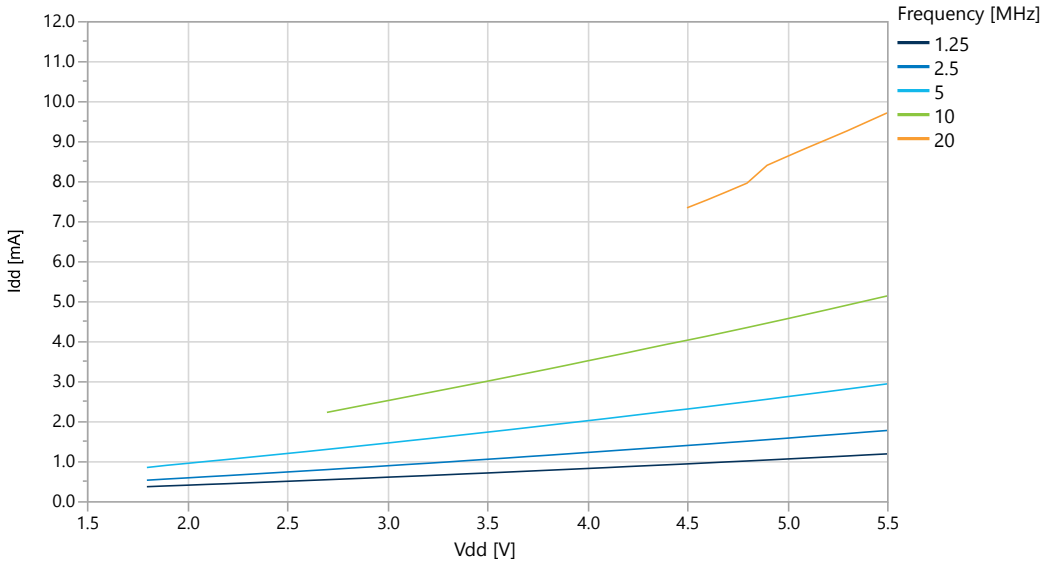


Figure 6-19. I/O Pin Input Threshold Voltage vs. V_{DD} (V_{IH})

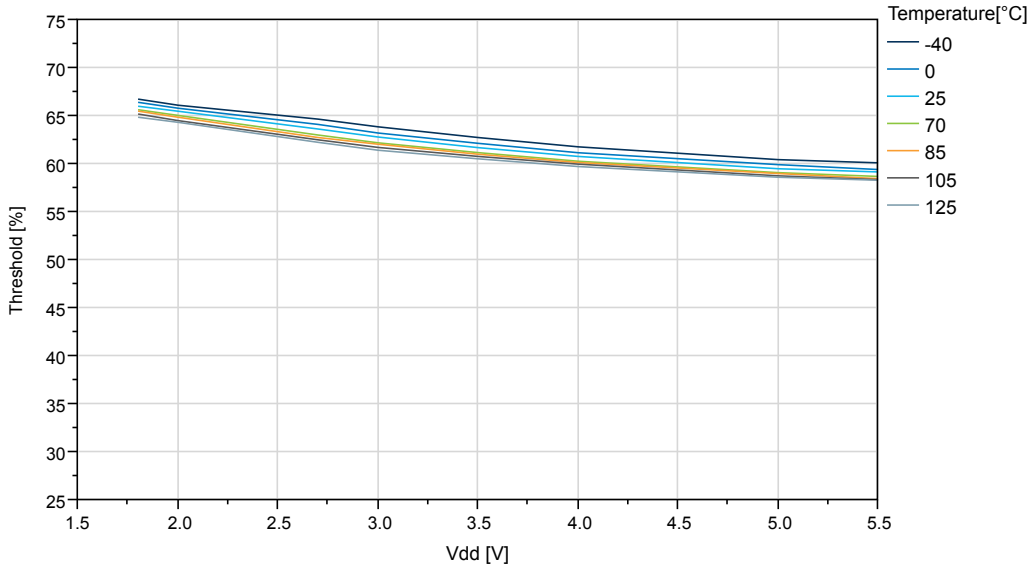


Figure 6-20. I/O Pin Input Threshold Voltage vs. V_{DD} (V_{IL})

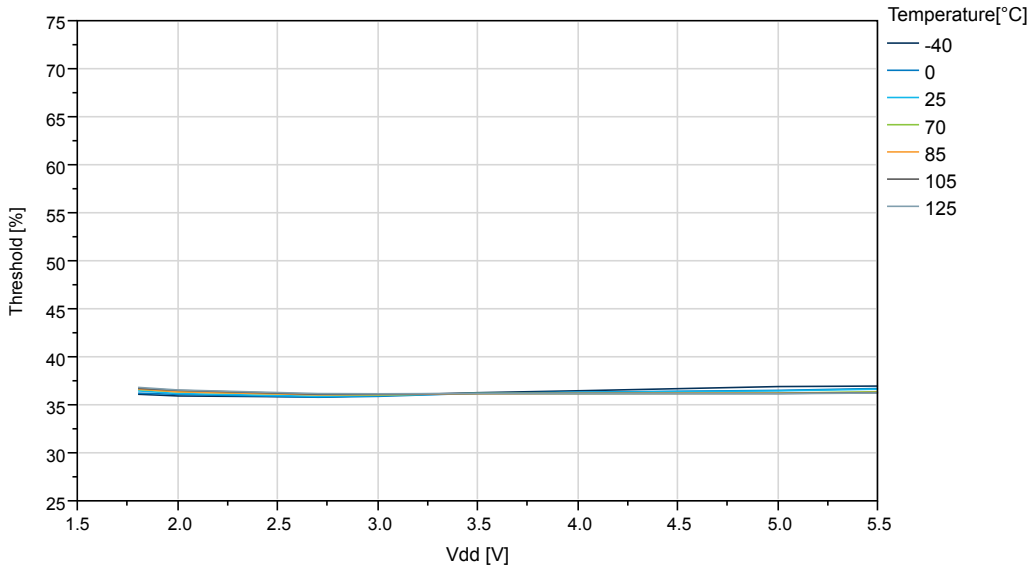
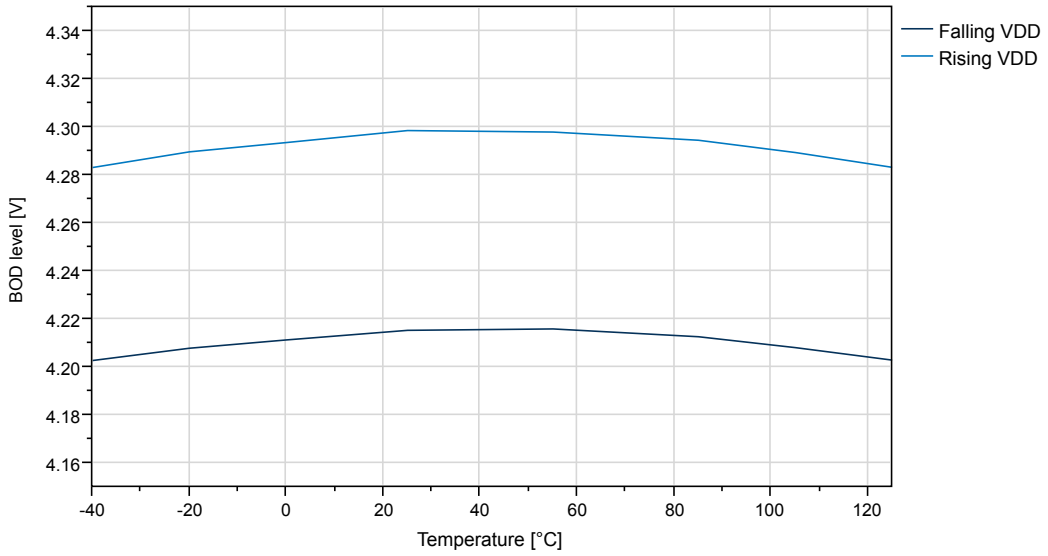


Figure 6-41. BOD Threshold vs. Temperature (Level 4.3V)



6.5 ADC Characteristics

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

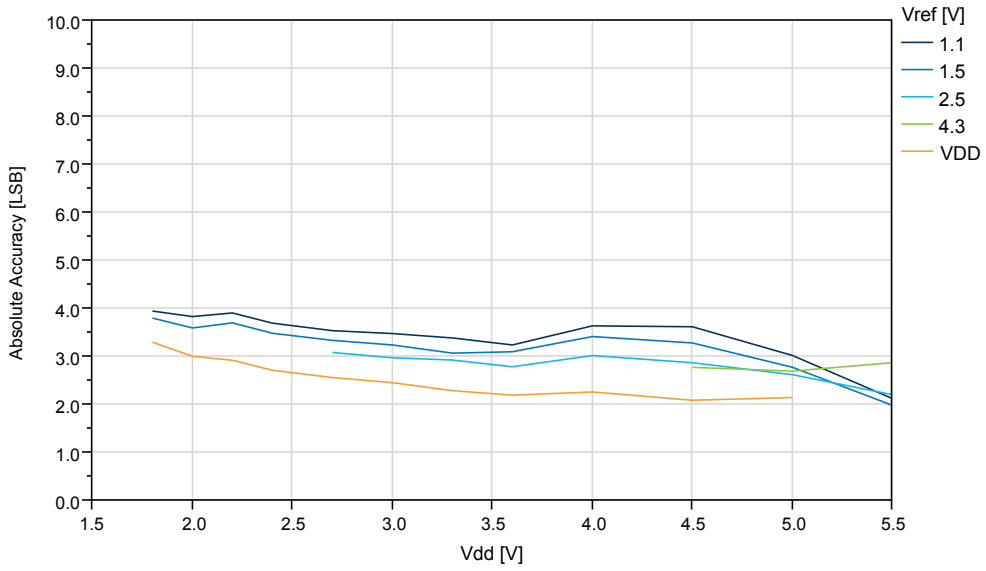


Figure 6-63. Hysteresis vs. V_{CM} - 10 mV to 50 mV (V_{DD}=5V, T=25°C)

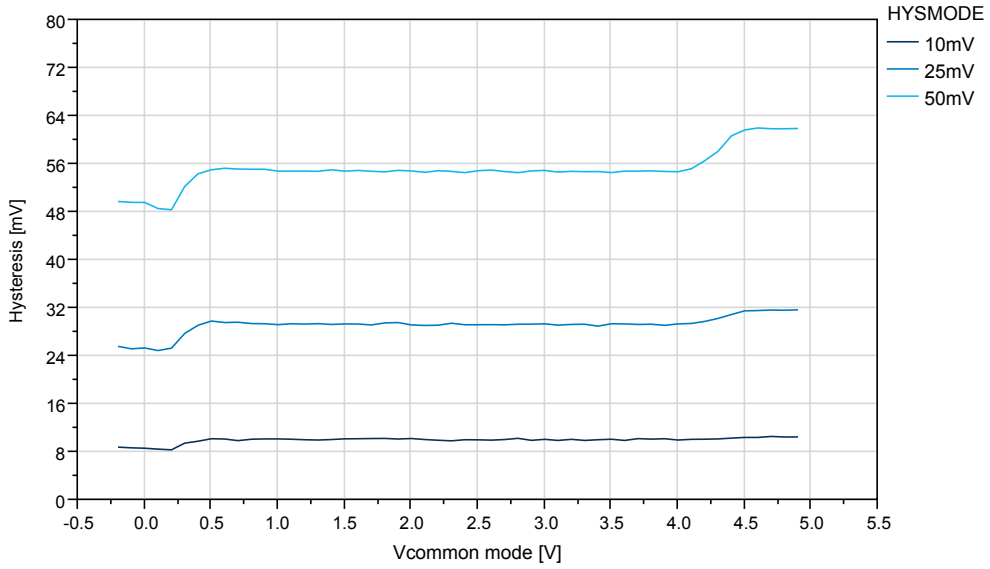


Figure 6-64. Offset vs. V_{CM} - 10 mV (V_{DD}=5V)

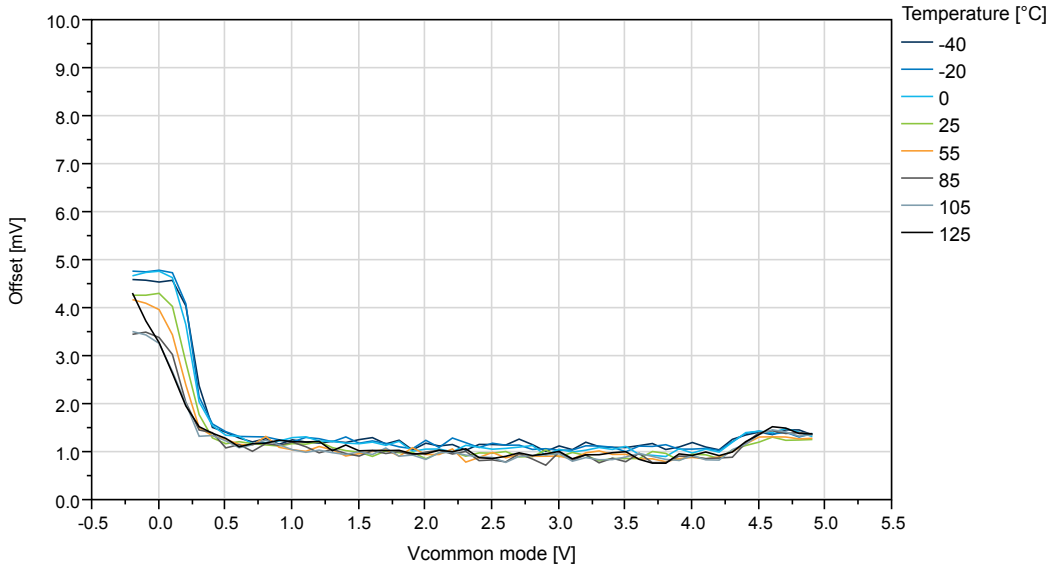
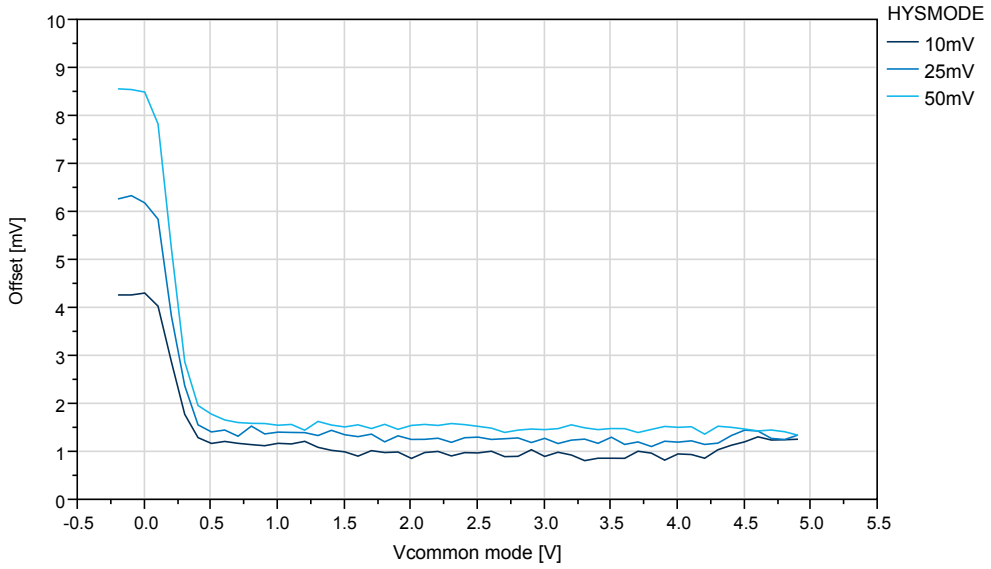


Figure 6-65. Offset vs. V_{CM} - 10 mV to 50 mV (V_{DD}=5V, T=25°C)



6.7 OSC20M Characteristics

Figure 6-66. OSC20M Internal Oscillator: Calibration Stepsize vs. Calibration Value (V_{DD}=3V)

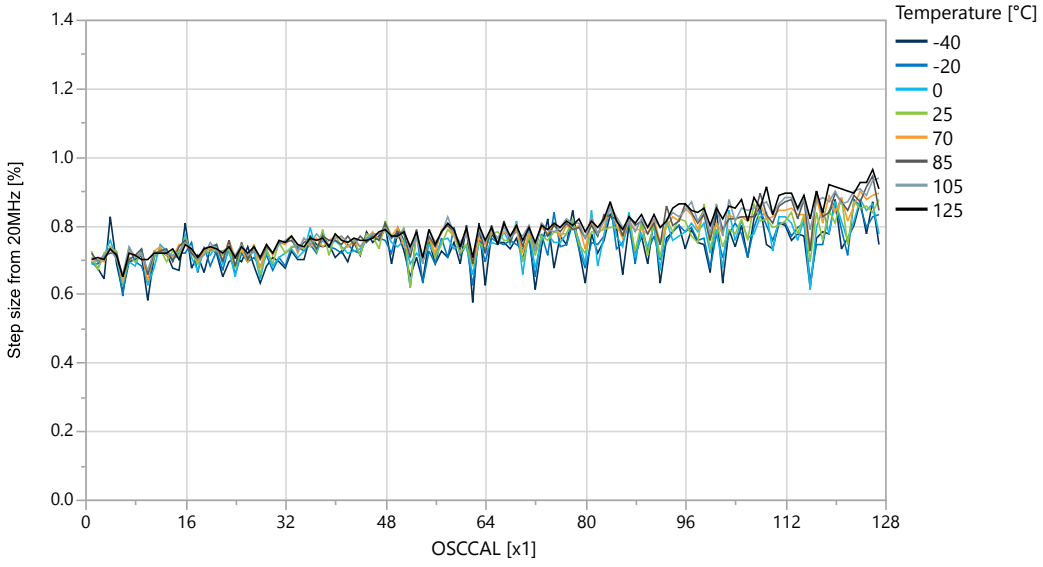
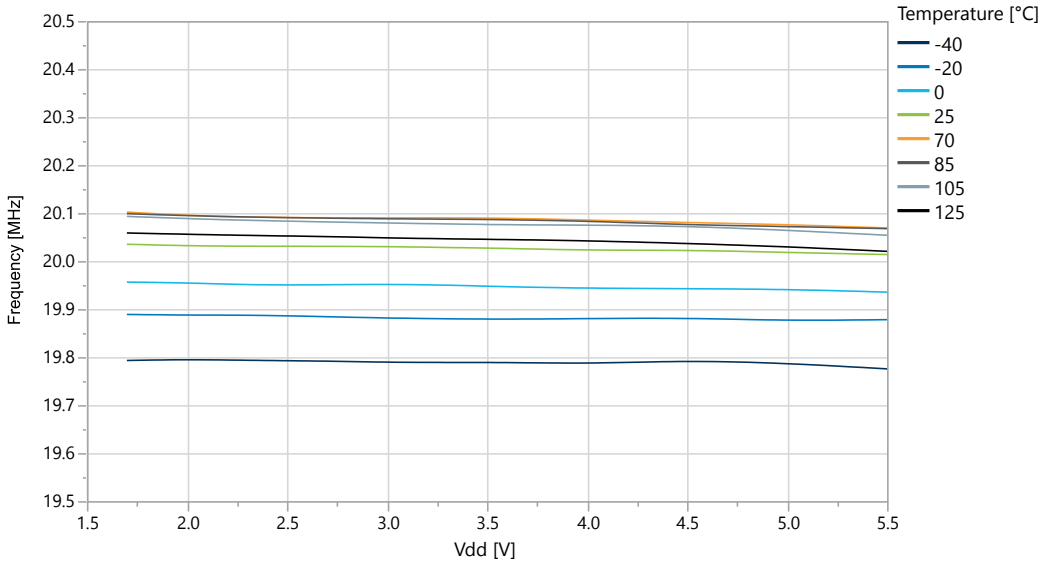


Figure 6-69. OSC20M Internal Oscillator: Frequency vs. V_{DD}



6.8 OSCULP32K Characteristics

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

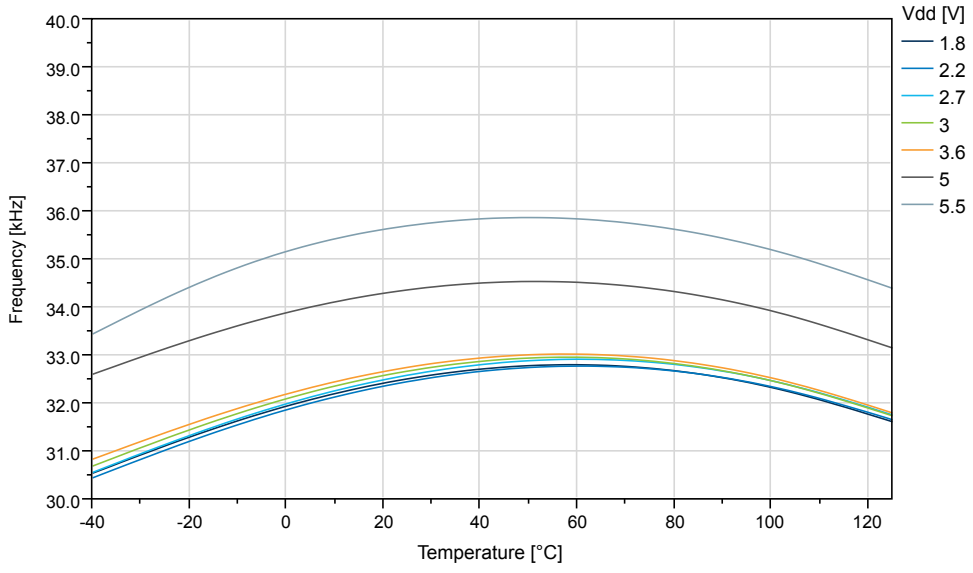


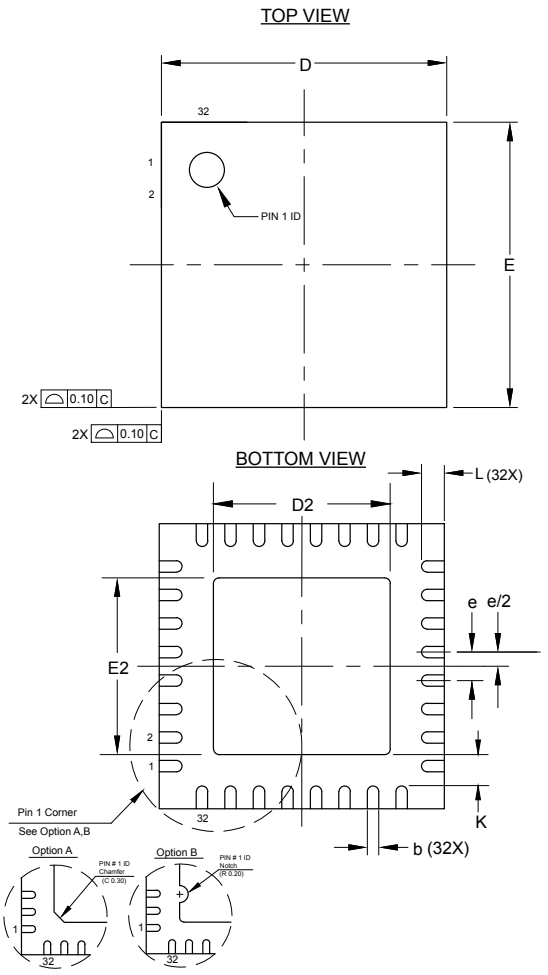
Table 7-2. Package Charateristics

Moisture Sensitivity Level	MSL3

Table 7-3. Package Reference

JEDEC Drawing Reference	MS-026
JESD97 Classification	E3

7.2 32-pin VQFN



NOTE:

1. Refer to JEDEC Drawing MO-220, Variation VHHD-2 (Figure 1/Saw Singulation)
2. Dimension “b” applies to metalized terminal and is measured between 0.15mm and 0.30mm from the terminal tip. If the terminal has the optional radius on the other end of the terminal, the dimensions should not be measured in that radius area.

COMMON DIMENSIONS
(Unit of Measure = mm)

SYMBOL	MIN	TYP	MAX	NOTE
A	0.80	-	0.90	
A1	0.00	-	0.05	
A3		0.20 REF		
b	0.18	0.25	0.30	2
D	4.90	5.00	5.10	
D2	3.00	3.10	3.20	
E	4.90	5.00	5.10	
E2	3.00	3.10	3.20	
e	-	0.50	-	
L	0.30	0.40	0.50	
K	0.20	-	-	

12/4/13

Atmel Package Drawing Contact: packagedrawings@atmel.com	TITLE 32MS1, 32-pad 5.0x5.0x0.9 mm Body, 0.50mm pitch, 3.1x3.1 mm Exposed pad, Saw Singulated Thermally Enhanced Plastic Very-thin Fine pitch, Quad Flat No Lead package (VFQFN)	GPC ZMF	DRAWING NO. 32MS1	REV. A

9. Data Sheet Revision History

Note: The data sheet revision is independent of the die revision and the device variant (last letter of the ordering number).

9.1 Rev. A - 02/2018

Initial release.

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