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Applications of "[Embedded - Microcontrollers](#)"

Details

Product Status	Active
Core Processor	ARM® Cortex®-M4
Core Size	32-Bit Single-Core
Speed	50MHz
Connectivity	I ² C, IrDA, SPI, UART/USART, USB, USB OTG
Peripherals	DMA, I ² S, LVD, POR, PWM, WDT
Number of I/O	40
Program Memory Size	32KB (32K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	8K x 8
Voltage - Supply (Vcc/Vdd)	1.71V ~ 3.6V
Data Converters	A/D 13x16b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 105°C (TA)
Mounting Type	Surface Mount
Package / Case	64-LQFP
Supplier Device Package	64-LQFP (10x10)
Purchase URL	https://www.e-xfl.com/product-detail/nxp-semiconductors/mk20dn32vlh5

Table of Contents

1 Ordering parts.....	3	5.4.1 Thermal operating requirements.....	21
1.1 Determining valid orderable parts.....	3	5.4.2 Thermal attributes.....	21
2 Part identification.....	3	6 Peripheral operating requirements and behaviors.....	22
2.1 Description.....	3	6.1 Core modules.....	22
2.2 Format.....	3	6.1.1 JTAG electricals.....	22
2.3 Fields.....	3	6.2 System modules.....	25
2.4 Example.....	4	6.3 Clock modules.....	25
3 Terminology and guidelines.....	4	6.3.1 MCG specifications.....	25
3.1 Definition: Operating requirement.....	4	6.3.2 Oscillator electrical specifications.....	27
3.2 Definition: Operating behavior.....	5	6.3.3 32 kHz Oscillator Electrical Characteristics.....	29
3.3 Definition: Attribute.....	5	6.4 Memories and memory interfaces.....	30
3.4 Definition: Rating.....	6	6.4.1 Flash electrical specifications.....	30
3.5 Result of exceeding a rating.....	6	6.4.2 EzPort Switching Specifications.....	34
3.6 Relationship between ratings and operating requirements.....	6	6.5 Security and integrity modules.....	35
3.7 Guidelines for ratings and operating requirements.....	7	6.6 Analog.....	35
3.8 Definition: Typical value.....	7	6.6.1 ADC electrical specifications.....	35
3.9 Typical value conditions.....	8	6.6.2 CMP and 6-bit DAC electrical specifications.....	40
4 Ratings.....	9	6.6.3 Voltage reference electrical specifications.....	43
4.1 Thermal handling ratings.....	9	6.7 Timers.....	44
4.2 Moisture handling ratings.....	9	6.8 Communication interfaces.....	44
4.3 ESD handling ratings.....	9	6.8.1 USB electrical specifications.....	44
4.4 Voltage and current operating ratings.....	9	6.8.2 USB DCD electrical specifications.....	45
5 General.....	10	6.8.3 USB VREG electrical specifications.....	45
5.1 AC electrical characteristics.....	10	6.8.4 DSPI switching specifications (limited voltage range).....	46
5.2 Nonswitching electrical specifications.....	11	6.8.5 DSPI switching specifications (full voltage range).....	47
5.2.1 Voltage and current operating requirements.....	11	6.8.6 I2C switching specifications.....	49
5.2.2 LVD and POR operating requirements.....	11	6.8.7 UART switching specifications.....	49
5.2.3 Voltage and current operating behaviors.....	12	6.8.8 I2S/SAI Switching Specifications.....	49
5.2.4 Power mode transition operating behaviors.....	13	6.9 Human-machine interfaces (HMI).....	54
5.2.5 Power consumption operating behaviors.....	14	6.9.1 TSI electrical specifications.....	54
5.2.6 EMC radiated emissions operating behaviors.....	18	7 Dimensions.....	55
5.2.7 Designing with radiated emissions in mind.....	19	7.1 Obtaining package dimensions.....	55
5.2.8 Capacitance attributes.....	19	8 Pinout.....	56
5.3 Switching specifications.....	19	8.1 K20 Signal Multiplexing and Pin Assignments.....	56
5.3.1 Device clock specifications.....	19	8.2 K20 Pinouts.....	58
5.3.2 General switching specifications.....	20	9 Revision History.....	60
5.4 Thermal specifications.....	21		

1 Ordering parts

1.1 Determining valid orderable parts

Valid orderable part numbers are provided on the web. To determine the orderable part numbers for this device, go to <http://www.freescale.com> and perform a part number search for the following device numbers: PK20 and MK20 .

2 Part identification

2.1 Description

Part numbers for the chip have fields that identify the specific part. You can use the values of these fields to determine the specific part you have received.

2.2 Format

Part numbers for this device have the following format:

Q K## A M FFF R T PP CC N

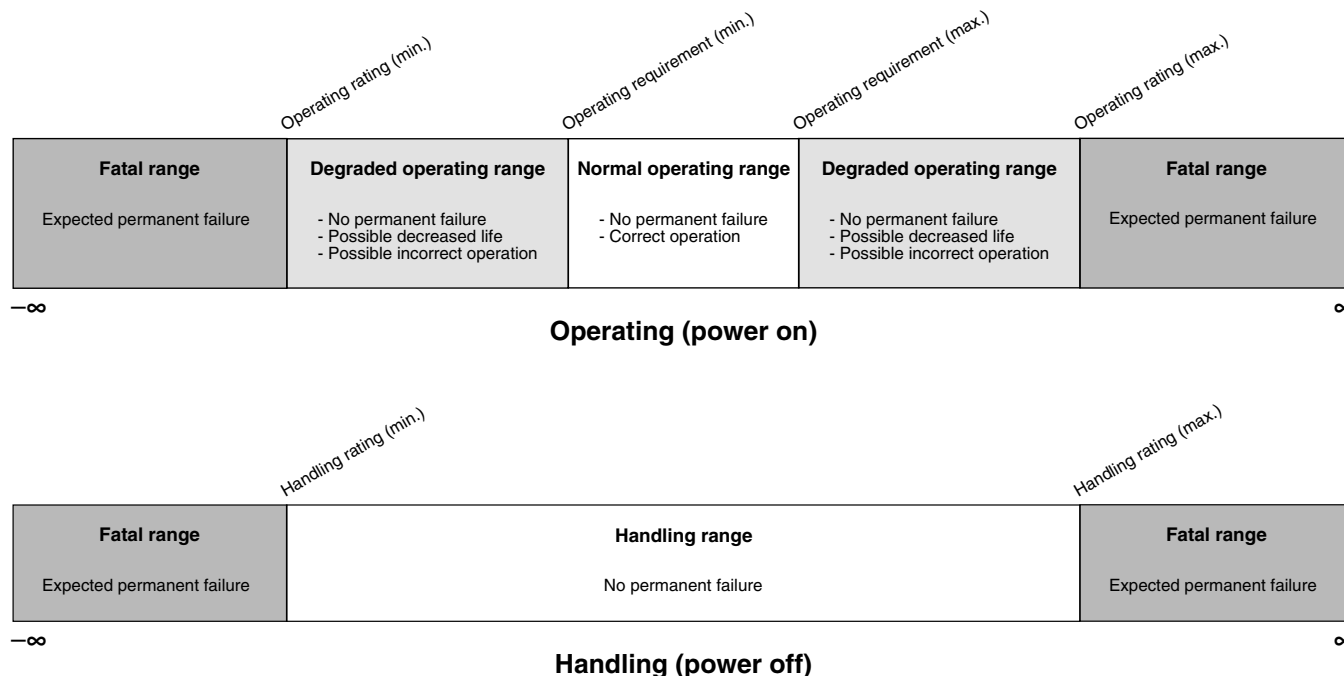
2.3 Fields

This table lists the possible values for each field in the part number (not all combinations are valid):

Field	Description	Values
Q	Qualification status	- M = Fully qualified, general market flow - P = Prequalification
K##	Kinetis family	K20
A	Key attribute	- D = Cortex-M4 w/ DSP - F = Cortex-M4 w/ DSP and FPU
M	Flash memory type	- N = Program flash only - X = Program flash and FlexMemory

Table continues on the next page...

3.6 Relationship between ratings and operating requirements



3.7 Guidelines for ratings and operating requirements

Follow these guidelines for ratings and operating requirements:

- Never exceed any of the chip's ratings.
- During normal operation, don't exceed any of the chip's operating requirements.
- If you must exceed an operating requirement at times other than during normal operation (for example, during power sequencing), limit the duration as much as possible.

3.8 Definition: Typical value

A *typical value* is a specified value for a technical characteristic that:

- Lies within the range of values specified by the operating behavior
- Given the typical manufacturing process, is representative of that characteristic during operation when you meet the typical-value conditions or other specified conditions

Typical values are provided as design guidelines and are neither tested nor guaranteed.

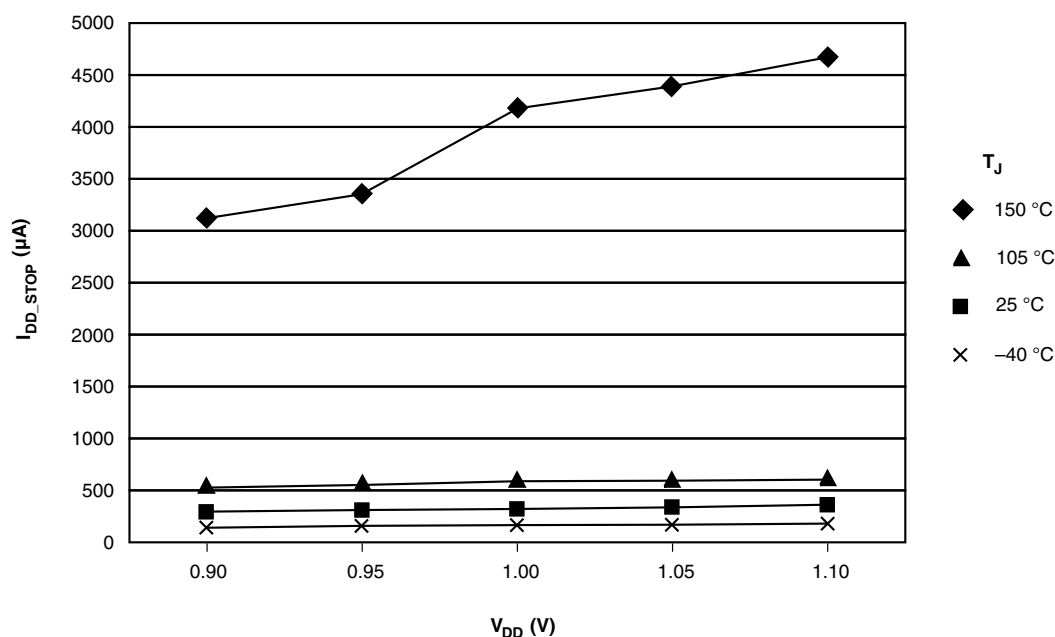
3.8.1 Example 1

This is an example of an operating behavior that includes a typical value:

Symbol	Description	Min.	Typ.	Max.	Unit
I_{WP}	Digital I/O weak pullup/pulldown current	10	70	130	μA

3.8.2 Example 2

This is an example of a chart that shows typical values for various voltage and temperature conditions:



3.9 Typical value conditions

Typical values assume you meet the following conditions (or other conditions as specified):

Symbol	Description	Value	Unit
T_A	Ambient temperature	25	°C
V_{DD}	3.3 V supply voltage	3.3	V

4 Ratings

4.1 Thermal handling ratings

Symbol	Description	Min.	Max.	Unit	Notes
T _{STG}	Storage temperature	–55	150	°C	1
T _{SDR}	Solder temperature, lead-free	—	260	°C	2

1. Determined according to JEDEC Standard JESD22-A103, *High Temperature Storage Life*.
2. Determined according to IPC/JEDEC Standard J-STD-020, *Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices*.

4.2 Moisture handling ratings

Symbol	Description	Min.	Max.	Unit	Notes
MSL	Moisture sensitivity level	—	3	—	1

1. Determined according to IPC/JEDEC Standard J-STD-020, *Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices*.

4.3 ESD handling ratings

Symbol	Description	Min.	Max.	Unit	Notes
V _{HBM}	Electrostatic discharge voltage, human body model	–2000	+2000	V	1
V _{CDM}	Electrostatic discharge voltage, charged-device model	–500	+500	V	2
I _{LAT}	Latch-up current at ambient temperature of 105°C	–100	+100	mA	

1. Determined according to JEDEC Standard JESD22-A114, *Electrostatic Discharge (ESD) Sensitivity Testing Human Body Model (HBM)*.
2. Determined according to JEDEC Standard JESD22-C101, *Field-Induced Charged-Device Model Test Method for Electrostatic-Discharge-Withstand Thresholds of Microelectronic Components*.

4.4 Voltage and current operating ratings

Symbol	Description	Min.	Max.	Unit
V _{DD}	Digital supply voltage	–0.3	3.8	V

Table continues on the next page...

Table 6. Power consumption operating behaviors (continued)

Symbol	Description	Min.	Typ.	Max.	Unit	Notes
I_{DD_VLLS0}	Very low-leakage stop mode 0 current at 3.0 V with POR detect circuit disabled • @ -40 to 25°C • @ 70°C • @ 105°C	— — —	0.176 2.2 13	0.859 13.1 23.9	μA μA μA	
I_{DD_VBAT}	Average current with RTC and 32kHz disabled at 3.0 V • @ -40 to 25°C • @ 70°C • @ 105°C	— — —	0.19 0.49 2.2	0.22 0.64 3.2	μA μA μA	
I_{DD_VBAT}	Average current when CPU is not accessing RTC registers • @ 1.8V • @ -40 to 25°C • @ 70°C • @ 105°C • @ 3.0V • @ -40 to 25°C • @ 70°C • @ 105°C	— — — — — — —	0.57 0.90 2.4 0.67 1.0 2.7	0.67 1.2 3.5 0.94 1.4 3.9	μA μA μA μA μA μA	9

1. The analog supply current is the sum of the active or disabled current for each of the analog modules on the device. See each module's specification for its supply current.
2. 50MHz core and system clock, 25MHz bus clock, and 25MHz flash clock. MCG configured for FEI mode. All peripheral clocks disabled.
3. 50MHz core and system clock, 25MHz bus clock, and 25MHz flash clock. MCG configured for FEI mode. All peripheral clocks enabled, and peripherals are in active operation.
4. Max values are measured with CPU executing DSP instructions
5. 25MHz core and system clock, 25MHz bus clock, and 12.5MHz flash clock. MCG configured for FEI mode.
6. 4 MHz core, system, and bus clock and 1MHz flash clock. MCG configured for BLPE mode. All peripheral clocks disabled. Code executing from flash.
7. 4 MHz core, system, and bus clock and 1MHz flash clock. MCG configured for BLPE mode. All peripheral clocks enabled but peripherals are not in active operation. Code executing from flash.
8. 4 MHz core, system, and bus clock and 1MHz flash clock. MCG configured for BLPE mode. All peripheral clocks disabled.
9. Includes 32kHz oscillator current and RTC operation.

5.2.5.1 Diagram: Typical I_{DD_RUN} operating behavior

The following data was measured under these conditions:

- MCG in FBE mode
- USB regulator disabled
- No GPIOs toggled

Table 9. Device clock specifications (continued)

Symbol	Description	Min.	Max.	Unit	Notes
f _{FLASH}	Flash clock	—	1	MHz	
f _{ERCLK}	External reference clock	—	16	MHz	
f _{LPTMR_pin}	LPTMR clock	—	25	MHz	
f _{LPTMR_ERCLK}	LPTMR external reference clock	—	16	MHz	
f _{I2S_MCLK}	I2S master clock	—	12.5	MHz	
f _{I2S_BCLK}	I2S bit clock	—	4	MHz	

1. The frequency limitations in VLPR mode here override any frequency specification listed in the timing specification for any other module.

5.3.2 General switching specifications

These general purpose specifications apply to all signals configured for GPIO, UART, CMT, and I²C signals.

Table 10. General switching specifications

Symbol	Description	Min.	Max.	Unit	Notes
	GPIO pin interrupt pulse width (digital glitch filter disabled) — Synchronous path	1.5	—	Bus clock cycles	1, 2
	GPIO pin interrupt pulse width (digital glitch filter disabled, analog filter enabled) — Asynchronous path	100	—	ns	3
	GPIO pin interrupt pulse width (digital glitch filter disabled, analog filter disabled) — Asynchronous path	50	—	ns	3
	External reset pulse width (digital glitch filter disabled)	100	—	ns	3
	Mode select (EZP_CS) hold time after reset deassertion	2	—	Bus clock cycles	
	Port rise and fall time (high drive strength)				4
	• Slew disabled				
	• 1.71 ≤ V _{DD} ≤ 2.7V	—	13	ns	
	• 2.7 ≤ V _{DD} ≤ 3.6V	—		ns	
	• Slew enabled		7		
	• 1.71 ≤ V _{DD} ≤ 2.7V	—		ns	
	• 2.7 ≤ V _{DD} ≤ 3.6V	—	36	ns	
			24		

Table continues on the next page...

Table 10. General switching specifications (continued)

Symbol	Description	Min.	Max.	Unit	Notes
	Port rise and fall time (low drive strength)				5
	- Slew disabled $1.71 \leq V_{DD} \leq 2.7V$ $2.7 \leq V_{DD} \leq 3.6V$ - Slew enabled $1.71 \leq V_{DD} \leq 2.7V$ $2.7 \leq V_{DD} \leq 3.6V$	—	12	ns	
		—	6	ns	
		—	36	ns	
		—	24	ns	

1. This is the minimum pulse width that is guaranteed to pass through the pin synchronization circuitry. Shorter pulses may or may not be recognized. In Stop, VLPS, LLS, and VLLSx modes, the synchronizer is bypassed so shorter pulses can be recognized in that case.
2. The greater synchronous and asynchronous timing must be met.
3. This is the minimum pulse width that is guaranteed to be recognized as a pin interrupt request in Stop, VLPS, LLS, and VLLSx modes.
4. 75pF load
5. 15pF load

5.4 Thermal specifications

5.4.1 Thermal operating requirements

Table 11. Thermal operating requirements

Symbol	Description	Min.	Max.	Unit
T_J	Die junction temperature	−40	125	°C
T_A	Ambient temperature	−40	105	°C

5.4.2 Thermal attributes

Board type	Symbol	Description	64 MAPBGA	64 LQFP	Unit	Notes
Single-layer (1s)	$R_{\theta JA}$	Thermal resistance, junction to ambient (natural convection)	107	65	°C/W	1, 2
Four-layer (2s2p)	$R_{\theta JA}$	Thermal resistance, junction to ambient (natural convection)	56	46	°C/W	1, 3

Table continues on the next page...

Peripheral operating requirements and behaviors

Board type	Symbol	Description	64 MAPBGA	64 LQFP	Unit	Notes
Single-layer (1s)	$R_{\theta JA}$	Thermal resistance, junction to ambient (200 ft./min. air speed)	90	53	°C/W	1,3
Four-layer (2s2p)	$R_{\theta JA}$	Thermal resistance, junction to ambient (200 ft./min. air speed)	51	40	°C/W	,
—	$R_{\theta JB}$	Thermal resistance, junction to board	31	28	°C/W	5
—	$R_{\theta JC}$	Thermal resistance, junction to case	31	15	°C/W	6
—	Ψ_{JT}	Thermal characterization parameter, junction to package top outside center (natural convection)	6	3	°C/W	7

1. Junction temperature is a function of die size, on-chip power dissipation, package thermal resistance, mounting site (board) temperature, ambient temperature, air flow, power dissipation of other components on the board, and board thermal resistance.
2. Determined according to JEDEC Standard JESD51-2, *Integrated Circuits Thermal Test Method Environmental Conditions—Natural Convection (Still Air)* with the single layer board horizontal. For the LQFP, the board meets the JESD51-3 specification. For the MAPBGA, the board meets the JESD51-9 specification.
3. Determined according to JEDEC Standard JESD51-6, *Integrated Circuits Thermal Test Method Environmental Conditions—Forced Convection (Moving Air)* with the board horizontal.
5. Determined according to JEDEC Standard JESD51-8, *Integrated Circuit Thermal Test Method Environmental Conditions—Junction-to-Board*. Board temperature is measured on the top surface of the board near the package.
6. Determined according to Method 1012.1 of MIL-STD 883, *Test Method Standard, Microcircuits*, with the cold plate temperature used for the case temperature. The value includes the thermal resistance of the interface material between the top of the package and the cold plate.
7. Determined according to JEDEC Standard JESD51-2, *Integrated Circuits Thermal Test Method Environmental Conditions—Natural Convection (Still Air)*.

6 Peripheral operating requirements and behaviors

6.1 Core modules

Table 13. MCG specifications (continued)

Symbol	Description		Min.	Typ.	Max.	Unit	Notes
f _{fill_ref}	FLL reference frequency range		31.25	—	39.0625	kHz	
f _{dco}	DCO output frequency range	Low range (DRS=00) 640 × f _{fill_ref}	20	20.97	25	MHz	2, 3
		Mid range (DRS=01) 1280 × f _{fill_ref}	40	41.94	50	MHz	
		Mid-high range (DRS=10) 1920 × f _{fill_ref}	60	62.91	75	MHz	
		High range (DRS=11) 2560 × f _{fill_ref}	80	83.89	100	MHz	
f _{dco_t_DMx3} 2	DCO output frequency	Low range (DRS=00) 732 × f _{fill_ref}	—	23.99	—	MHz	4, 5
		Mid range (DRS=01) 1464 × f _{fill_ref}	—	47.97	—	MHz	
		Mid-high range (DRS=10) 2197 × f _{fill_ref}	—	71.99	—	MHz	
		High range (DRS=11) 2929 × f _{fill_ref}	—	95.98	—	MHz	
J _{cyc_fill}	FLL period jitter - f_{VCO} = 48 MHz - f_{VCO} = 98 MHz		— —	180 150	— —	ps	
t _{fill_acquire}	FLL target frequency acquisition time		—	—	1	ms	6
PLL							
f _{vco}	VCO operating frequency		48.0	—	100	MHz	
I _{pll}	PLL operating current PLL @ 96 MHz (f_{osc_hi_1} = 8 MHz, f_{pll_ref} = 2 MHz, VDIV multiplier = 48)		—	1060	—	μA	7
I _{pll}	PLL operating current PLL @ 48 MHz (f_{osc_hi_1} = 8 MHz, f_{pll_ref} = 2 MHz, VDIV multiplier = 24)		—	600	—	μA	7
f _{pll_ref}	PLL reference frequency range		2.0	—	4.0	MHz	
J _{cyc_pll}	PLL period jitter (RMS) - f_{vco} = 48 MHz - f_{vco} = 100 MHz		— —	120 50	— —	ps ps	8

Table continues on the next page...

Table 13. MCG specifications (continued)

Symbol	Description	Min.	Typ.	Max.	Unit	Notes
$J_{\text{acc_pll}}$	PLL accumulated jitter over 1 μs (RMS) $f_{\text{vco}} = 48 \text{ MHz}$ $f_{\text{vco}} = 100 \text{ MHz}$	—	1350	—	ps	8
		—	600	—	ps	
D_{lock}	Lock entry frequency tolerance	± 1.49	—	± 2.98	%	
D_{unl}	Lock exit frequency tolerance	± 4.47	—	± 5.97	%	
$t_{\text{pll_lock}}$	Lock detector detection time	—	—	$150 \times 10^{-6} + 1075(1/f_{\text{pll_ref}})$	s	9

1. This parameter is measured with the internal reference (slow clock) being used as a reference to the FLL (FEI clock mode).
2. These typical values listed are with the slow internal reference clock (FEI) using factory trim and DMX32=0.
3. The resulting system clock frequencies should not exceed their maximum specified values. The DCO frequency deviation ($\Delta f_{\text{dco_t}}$) over voltage and temperature should be considered.
4. These typical values listed are with the slow internal reference clock (FEI) using factory trim and DMX32=1.
5. The resulting clock frequency must not exceed the maximum specified clock frequency of the device.
6. This specification applies to any time the FLL reference source or reference divider is changed, trim value is changed, DMX32 bit is changed, DRS bits are changed, or changing from FLL disabled (BLPE, BLPI) to FLL enabled (FEI, FEE, FBE, FBI). If a crystal/resonator is being used as the reference, this specification assumes it is already running.
7. Excludes any oscillator currents that are also consuming power while PLL is in operation.
8. This specification was obtained using a Freescale developed PCB. PLL jitter is dependent on the noise characteristics of each PCB and results will vary.
9. This specification applies to any time the PLL VCO divider or reference divider is changed, or changing from PLL disabled (BLPE, BLPI) to PLL enabled (PBE, PEE). If a crystal/resonator is being used as the reference, this specification assumes it is already running.

6.3.2 Oscillator electrical specifications

This section provides the electrical characteristics of the module.

6.3.2.1 Oscillator DC electrical specifications

Table 14. Oscillator DC electrical specifications

Symbol	Description	Min.	Typ.	Max.	Unit	Notes
V_{DD}	Supply voltage	1.71	—	3.6	V	
I_{DDOSC}	Supply current — low-power mode (HGO=0)					1
	• 32 kHz	—	500	—	nA	
	• 4 MHz	—	200	—	μA	
	• 8 MHz (RANGE=01)	—	300	—	μA	
	• 16 MHz	—	950	—	μA	
	• 24 MHz	—	1.2	—	mA	
	• 32 MHz	—	1.5	—	mA	

Table continues on the next page...

6.6.1 ADC electrical specifications

The 16-bit accuracy specifications listed in [Table 23](#) and [Table 24](#) are achievable on the differential pins ADCx_DP0, ADCx_DM0.

All other ADC channels meet the 13-bit differential/12-bit single-ended accuracy specifications.

6.6.1.1 16-bit ADC operating conditions

Table 23. 16-bit ADC operating conditions

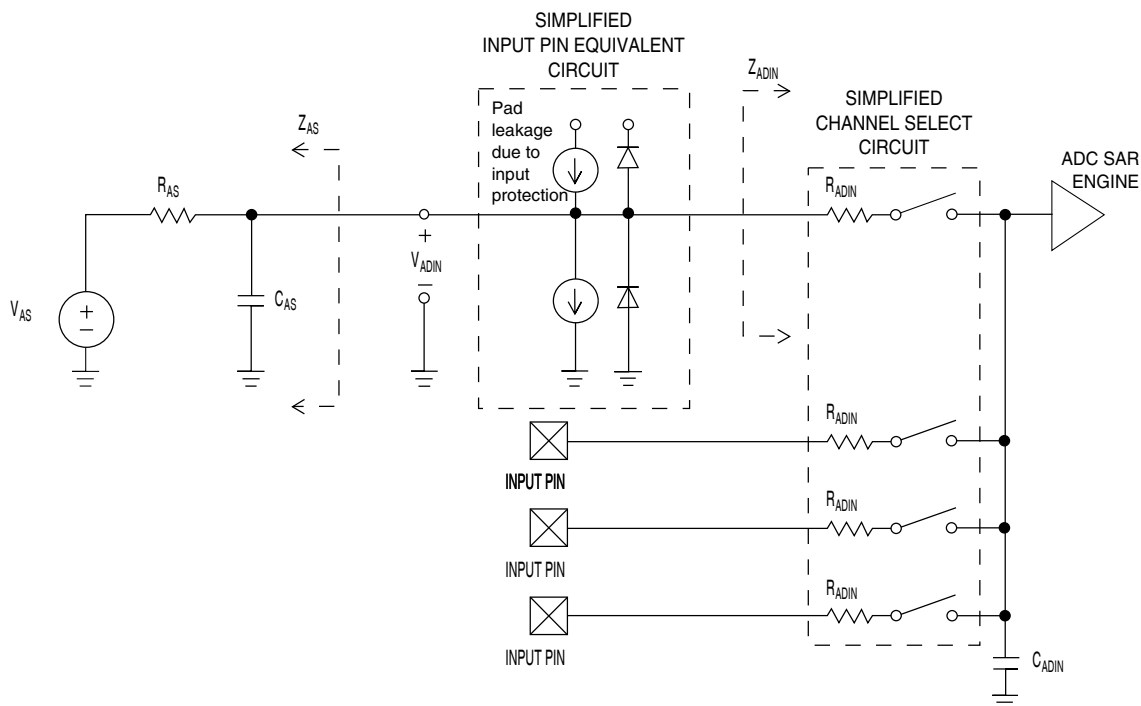
Symbol	Description	Conditions	Min.	Typ. ¹	Max.	Unit	Notes
V _{DDA}	Supply voltage	Absolute	1.71	—	3.6	V	
ΔV _{DDA}	Supply voltage	Delta to V _{DD} (V _{DD} - V _{DDA})	-100	0	+100	mV	2
ΔV _{SSA}	Ground voltage	Delta to V _{SS} (V _{SS} - V _{SSA})	-100	0	+100	mV	2
V _{REFH}	ADC reference voltage high		1.13	V _{DDA}	V _{DDA}	V	
V _{REFL}	Reference voltage low		V _{SSA}	V _{SSA}	V _{SSA}	V	
V _{ADIN}	Input voltage		V _{REFL}	—	V _{REFH}	V	
C _{ADIN}	Input capacitance	16 bit modes 8/10/12 bit modes	— —	8 4	10 5	pF	
R _{ADIN}	Input resistance		—	2	5	kΩ	
R _{AS}	Analog source resistance	13/12 bit modes f _{ADCK} < 4MHz	—	—	5	kΩ	3
f _{ADCK}	ADC conversion clock frequency	≤ 13 bit modes	1.0	—	18.0	MHz	4
f _{ADCK}	ADC conversion clock frequency	16 bit modes	2.0	—	12.0	MHz	4
C _{rate}	ADC conversion rate	≤ 13 bit modes No ADC hardware averaging Continuous conversions enabled, subsequent conversion time	20.000	—	818.330	Ksps	5

Table continues on the next page...

Table 23. 16-bit ADC operating conditions (continued)

Symbol	Description	Conditions	Min.	Typ. ¹	Max.	Unit	Notes
C_{rate}	ADC conversion rate	16 bit modes No ADC hardware averaging Continuous conversions enabled, subsequent conversion time	37.037	—	461.467	Ksps	5

1. Typical values assume $V_{DDA} = 3.0\text{ V}$, $\text{Temp} = 25^{\circ}\text{C}$, $f_{ADCK} = 1.0\text{ MHz}$ unless otherwise stated. Typical values are for reference only and are not tested in production.
2. DC potential difference.
3. This resistance is external to MCU. The analog source resistance should be kept as low as possible in order to achieve the best results. The results in this datasheet were derived from a system which has $<8\ \Omega$ analog source resistance. The R_{AS}/C_{AS} time constant should be kept to $<1\text{ ns}$.
4. To use the maximum ADC conversion clock frequency, the ADHSC bit should be set and the ADLPC bit should be clear.
5. For guidelines and examples of conversion rate calculation, download the ADC calculator tool: http://cache.freescale.com/files/soft_dev_tools/software/app_software/converters/ADC_CALCULATOR_CNV.zip?fp=1

**Figure 10. ADC input impedance equivalency diagram**

6.6.1.2 16-bit ADC electrical characteristics

Table 24. 16-bit ADC characteristics ($V_{REFH} = V_{DDA}$, $V_{REFL} = V_{SSA}$)

Symbol	Description	Conditions ¹	Min.	Typ. ²	Max.	Unit	Notes
I_{DDA_ADC}	Supply current		0.215	—	1.7	mA	3

Table continues on the next page...

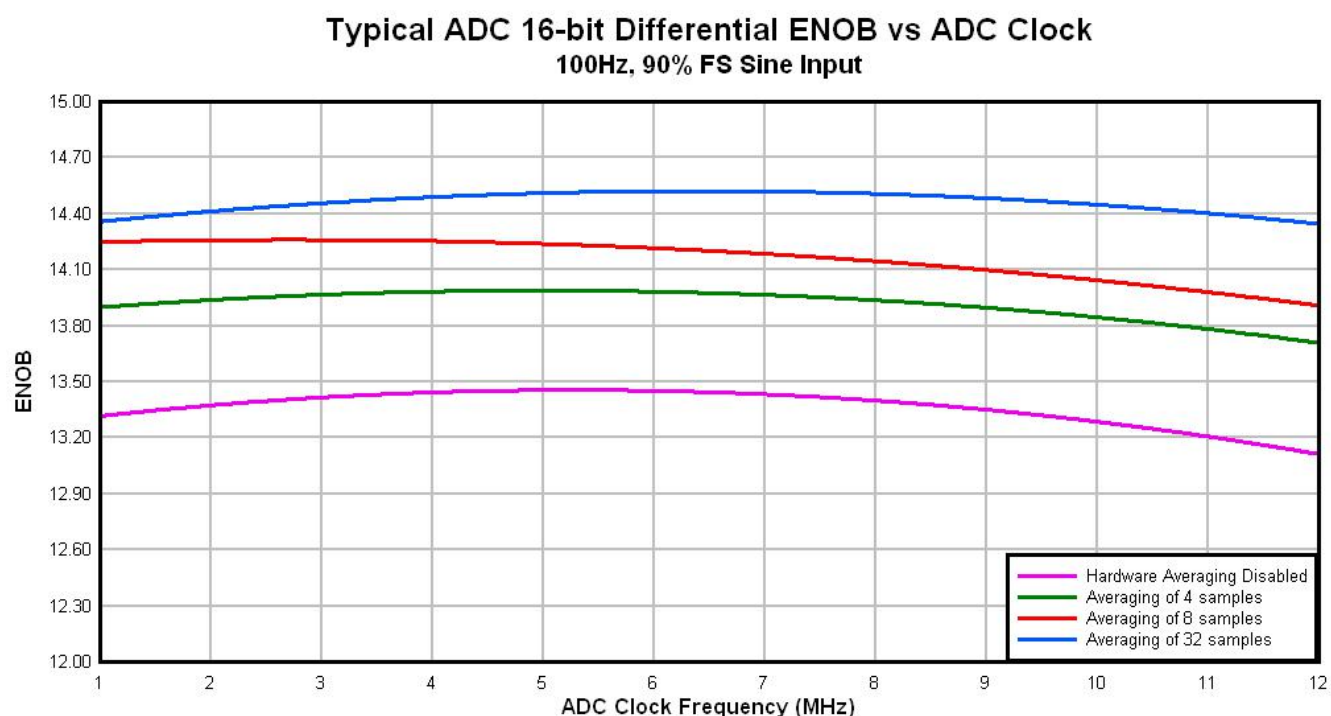


Figure 11. Typical ENOB vs. ADC_CLK for 16-bit differential mode

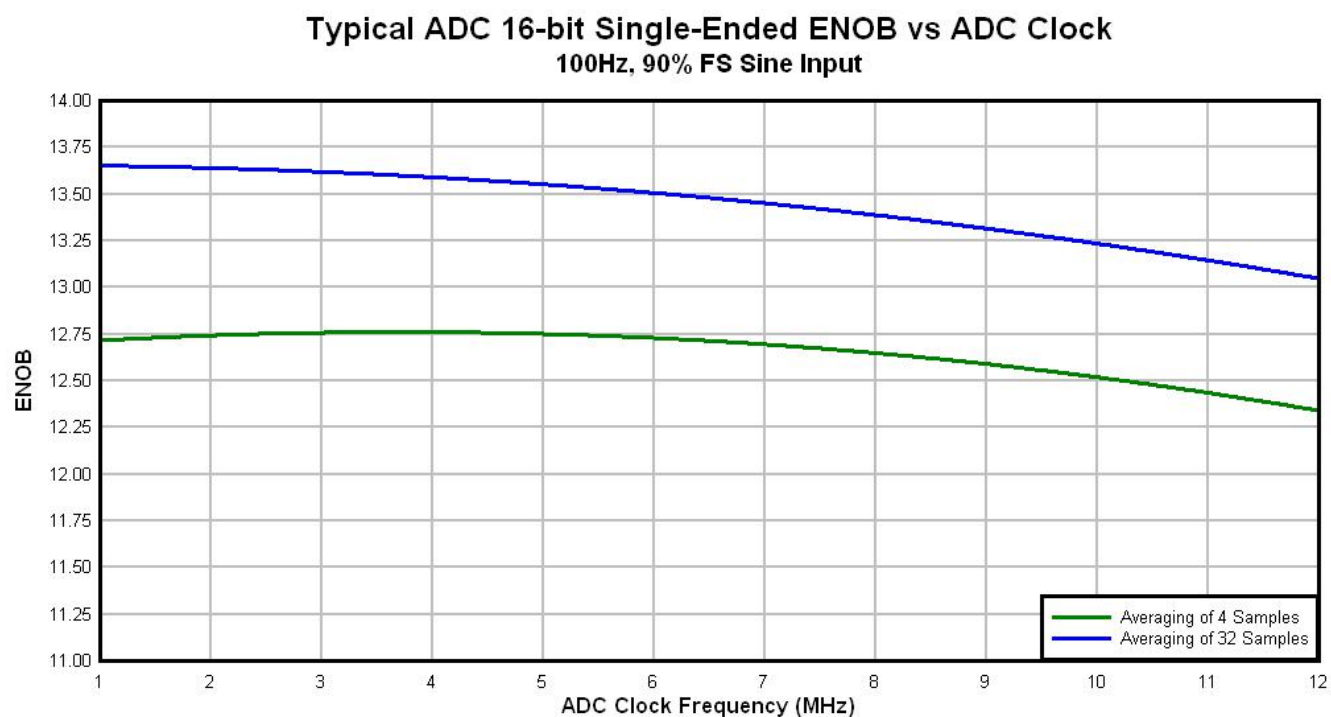


Figure 12. Typical ENOB vs. ADC_CLK for 16-bit single-ended mode

**Table 31. USB VREG electrical specifications
(continued)**

Symbol	Description	Min.	Typ. ¹	Max.	Unit	Notes
C _{OUT}	External output capacitor	1.76	2.2	8.16	μF	
ESR	External output capacitor equivalent series resistance	1	—	100	mΩ	
I _{LIM}	Short circuit current	—	290	—	mA	

1. Typical values assume VREGIN = 5.0 V, Temp = 25 °C unless otherwise stated.

2. Operating in pass-through mode: regulator output voltage equal to the input voltage minus a drop proportional to I_{Load}.

6.8.4 DSPI switching specifications (limited voltage range)

The DMA Serial Peripheral Interface (DSPI) provides a synchronous serial bus with master and slave operations. Many of the transfer attributes are programmable. The tables below provide DSPI timing characteristics for classic SPI timing modes. Refer to the DSPI chapter of the Reference Manual for information on the modified transfer formats used for communicating with slower peripheral devices.

Table 32. Master mode DSPI timing (limited voltage range)

Num	Description	Min.	Max.	Unit	Notes
	Operating voltage	2.7	3.6	V	
	Frequency of operation	—	25	MHz	
DS1	DSPI_SCK output cycle time	2 x t _{BUS}	—	ns	
DS2	DSPI_SCK output high/low time	(t _{SCK} /2) – 2	(t _{SCK} /2) + 2	ns	
DS3	DSPI_PCS _n valid to DSPI_SCK delay	(t _{BUS} x 2) – 2	—	ns	1
DS4	DSPI_SCK to DSPI_PCS _n invalid delay	(t _{BUS} x 2) – 2	—	ns	2
DS5	DSPI_SCK to DSPI_SOUT valid	—	8	ns	
DS6	DSPI_SCK to DSPI_SOUT invalid	0	—	ns	
DS7	DSPI_SIN to DSPI_SCK input setup	14	—	ns	
DS8	DSPI_SCK to DSPI_SIN input hold	0	—	ns	

1. The delay is programmable in SPIx_CTARn[PSSCK] and SPIx_CTARn[CSSCK].

2. The delay is programmable in SPIx_CTARn[PASC] and SPIx_CTARn[ASC].

6.8.8 I2S/SAI Switching Specifications

This section provides the AC timing for the I2S/SAI module in master mode (clocks are driven) and slave mode (clocks are input). All timing is given for noninverted serial clock polarity (TCR2[BCP] is 0, RCR2[BCP] is 0) and a noninverted frame sync (TCR4[FSP] is 0, RCR4[FSP] is 0). If the polarity of the clock and/or the frame sync have been inverted, all the timing remains valid by inverting the bit clock signal (BCLK) and/or the frame sync (FS) signal shown in the following figures.

6.8.8.1 Normal Run, Wait and Stop mode performance over the full operating voltage range

This section provides the operating performance over the full operating voltage for the device in Normal Run, Wait and Stop modes.

Table 36. I2S/SAI master mode timing

Num.	Characteristic	Min.	Max.	Unit
	Operating voltage	1.71	3.6	V
S1	I2S_MCLK cycle time	40	—	ns
S2	I2S_MCLK pulse width high/low	45%	55%	MCLK period
S3	I2S_TX_BCLK/I2S_RX_BCLK cycle time (output)	80	—	ns
S4	I2S_TX_BCLK/I2S_RX_BCLK pulse width high/low	45%	55%	BCLK period
S5	I2S_TX_BCLK/I2S_RX_BCLK to I2S_TX_FS/ I2S_RX_FS output valid	—	15	ns
S6	I2S_TX_BCLK/I2S_RX_BCLK to I2S_TX_FS/ I2S_RX_FS output invalid	0	—	ns
S7	I2S_TX_BCLK to I2S_TXD valid	—	15	ns
S8	I2S_TX_BCLK to I2S_TXD invalid	0	—	ns
S9	I2S_RXD/I2S_RX_FS input setup before I2S_RX_BCLK	25	—	ns
S10	I2S_RXD/I2S_RX_FS input hold after I2S_RX_BCLK	0	—	ns

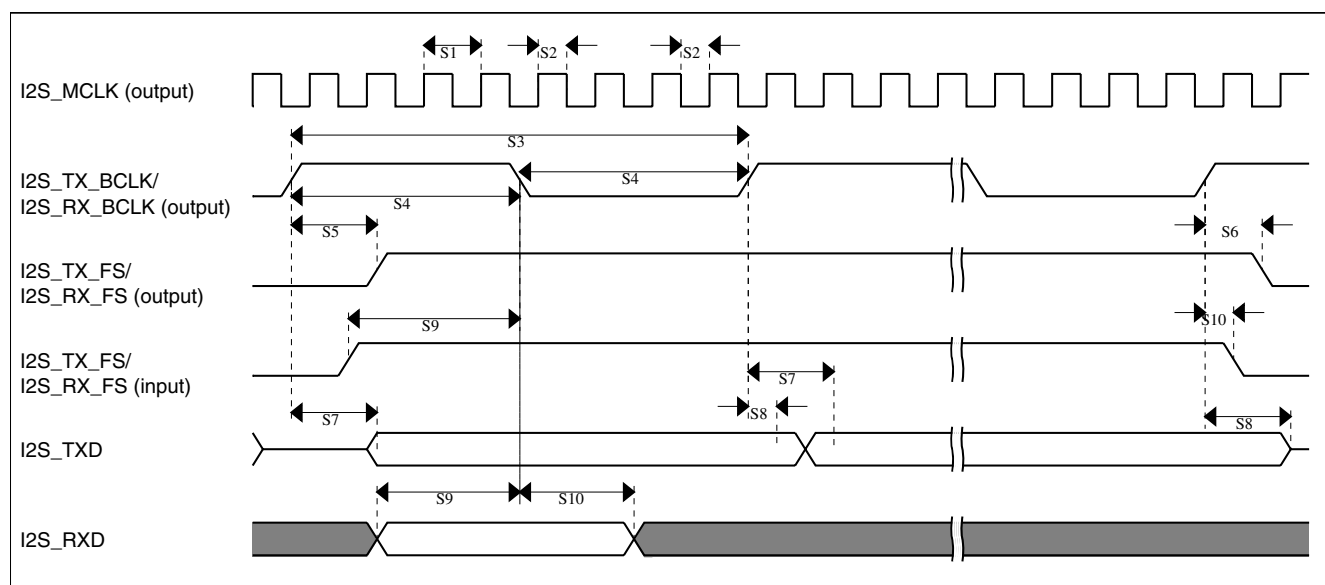


Figure 19. I2S/SAI timing — master modes

Table 37. I2S/SAI slave mode timing

Num.	Characteristic	Min.	Max.	Unit
	Operating voltage	1.71	3.6	V
S11	I2S_TX_BCLK/I2S_RX_BCLK cycle time (input)	80	—	ns
S12	I2S_TX_BCLK/I2S_RX_BCLK pulse width high/low (input)	45%	55%	MCLK period
S13	I2S_TX_FS/I2S_RX_FS input setup before I2S_TX_BCLK/I2S_RX_BCLK	10	—	ns
S14	I2S_TX_FS/I2S_RX_FS input hold after I2S_TX_BCLK/I2S_RX_BCLK	2	—	ns
S15	I2S_TX_BCLK to I2S_TXD/I2S_TX_FS output valid	—	29	ns
S16	I2S_TX_BCLK to I2S_TXD/I2S_TX_FS output invalid	0	—	ns
S17	I2S_RXD setup before I2S_RX_BCLK	10	—	ns
S18	I2S_RXD hold after I2S_RX_BCLK	2	—	ns
S19	I2S_TX_FS input assertion to I2S_TXD output valid ¹	—	21	ns

1. Applies to first bit in each frame and only if the TCR4[FSE] bit is clear

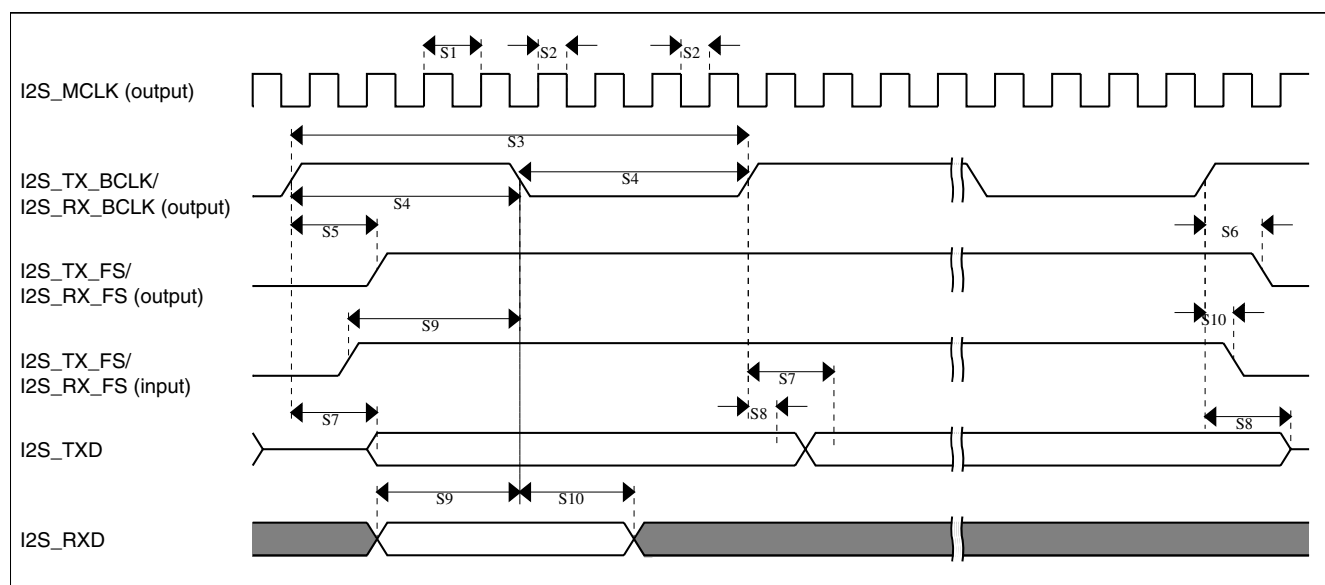


Figure 21. I2S/SAI timing — master modes

Table 39. I2S/SAI slave mode timing in VLPR, VLPW, and VLPS modes (full voltage range)

Num.	Characteristic	Min.	Max.	Unit
	Operating voltage	1.71	3.6	V
S11	I2S_TX_BCLK/I2S_RX_BCLK cycle time (input)	250	—	ns
S12	I2S_TX_BCLK/I2S_RX_BCLK pulse width high/low (input)	45%	55%	MCLK period
S13	I2S_TX_FS/I2S_RX_FS input setup before I2S_TX_BCLK/I2S_RX_BCLK	30	—	ns
S14	I2S_TX_FS/I2S_RX_FS input hold after I2S_TX_BCLK/I2S_RX_BCLK	3	—	ns
S15	I2S_TX_BCLK to I2S_TXD/I2S_TX_FS output valid	—	63	ns
S16	I2S_TX_BCLK to I2S_TXD/I2S_TX_FS output invalid	0	—	ns
S17	I2S_RXD setup before I2S_RX_BCLK	30	—	ns
S18	I2S_RXD hold after I2S_RX_BCLK	2	—	ns
S19	I2S_TX_FS input assertion to I2S_TXD output valid ¹	—	72	ns

1. Applies to first bit in each frame and only if the TCR4[FSE] bit is clear

8 Pinout

8.1 K20 Signal Multiplexing and Pin Assignments

The following table shows the signals available on each pin and the locations of these pins on the devices supported by this document. The Port Control Module is responsible for selecting which ALT functionality is available on each pin.

64 MAP BGA	64 LQFP	Pin Name	Default	ALT0	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6	ALT7	EzPort
A1	1	PTE0	DISABLED		PTE0		UART1_TX				RTC_CLKOUT	
B1	2	PTE1/ LLWU_P0	DISABLED		PTE1/ LLWU_P0		UART1_RX					
C5	3	VDD	VDD	VDD								
C4	4	VSS	VSS	VSS								
E1	5	USB0_DP	USB0_DP	USB0_DP								
D1	6	USB0_DM	USB0_DM	USB0_DM								
E2	7	VOUT33	VOUT33	VOUT33								
D2	8	VREGIN	VREGIN	VREGIN								
G1	9	ADC0_DP0	ADC0_DP0	ADC0_DP0								
F1	10	ADC0_DM0	ADC0_DM0	ADC0_DM0								
G2	11	ADC0_DP3	ADC0_DP3	ADC0_DP3								
F2	12	ADC0_DM3	ADC0_DM3	ADC0_DM3								
F4	13	VDDA	VDDA	VDDA								
G4	14	VREFH	VREFH	VREFH								
G3	15	VREFL	VREFL	VREFL								
F3	16	VSSA	VSSA	VSSA								
H1	17	VREF_OUT/ CMP1_IN5/ CMP0_IN5	VREF_OUT/ CMP1_IN5/ CMP0_IN5	VREF_OUT/ CMP1_IN5/ CMP0_IN5								
H2	18	CMP1_IN3/ ADC0_SE23	CMP1_IN3/ ADC0_SE23	CMP1_IN3/ ADC0_SE23								
H3	19	XTAL32	XTAL32	XTAL32								
H4	20	EXTAL32	EXTAL32	EXTAL32								
H5	21	VBAT	VBAT	VBAT								
D3	22	PTA0	JTAG_TCLK/ SWD_CLK/ EZP_CLK	TSIO_CH1	PTA0	UART0_CTS_ b/ UART0_COL_ b	FTM0_CH5				JTAG_TCLK/ SWD_CLK	EZP_CLK
D4	23	PTA1	JTAG_TDI/ EZP_DI	TSIO_CH2	PTA1	UART0_RX	FTM0_CH6				JTAG_TDI	EZP_DI

Table 41. Revision History (continued)

Rev. No.	Date	Substantial Changes
4	5/2012	- For the "32kHz oscillator frequency specifications", added specifications for an externally driven clock. - Renamed section "Flash current and power specifications" to section "Flash high voltage current behaviors" and improved the specifications. - For the "VREF full-range operating behaviors" table, removed the Ac (aging coefficient) specification. - Corrected the following DSPI switching specifications: tightened DS5, DS6, and DS7; relaxed DS11 and DS13. - For the "TSI electrical specifications", changed and clarified the example calculations for the MaxSens specification.