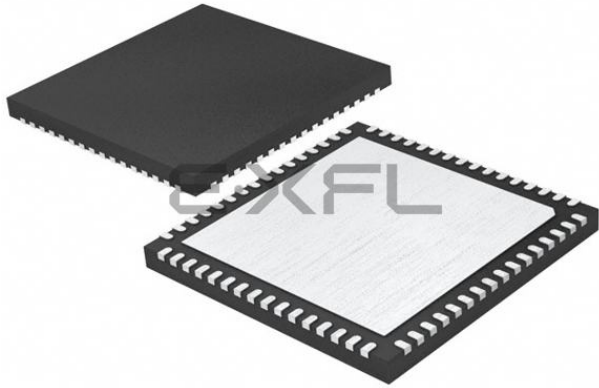




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Details

Product Status	Active
Core Processor	ARM® Cortex®-M0
Core Size	32-Bit Single-Core
Speed	48MHz
Connectivity	CANbus, I²C, LINbus, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, I²S, POR, PWM, WDT
Number of I/O	48
Program Memory Size	128KB (128K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	16K x 8
Voltage - Supply (Vcc/Vdd)	1.8V ~ 5.5V
Data Converters	A/D 12x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 105°C (TA)
Mounting Type	Surface Mount
Package / Case	64-VFQFN Exposed Pad
Supplier Device Package	PG-VQFN-64-6
Purchase URL	https://www.e-xfl.com/product-detail/infineon-technologies/xmc1403q064x0128aaxuma1

1 Summary of Features

The XMC1400 devices are members of the XMC1000 Family of microcontrollers based on the ARM Cortex-M0 processor core. The XMC1400 series addresses the real-time control needs of motor control and digital power conversion. It also features peripherals for LED Lighting applications and Human-Machine Interface (HMI).

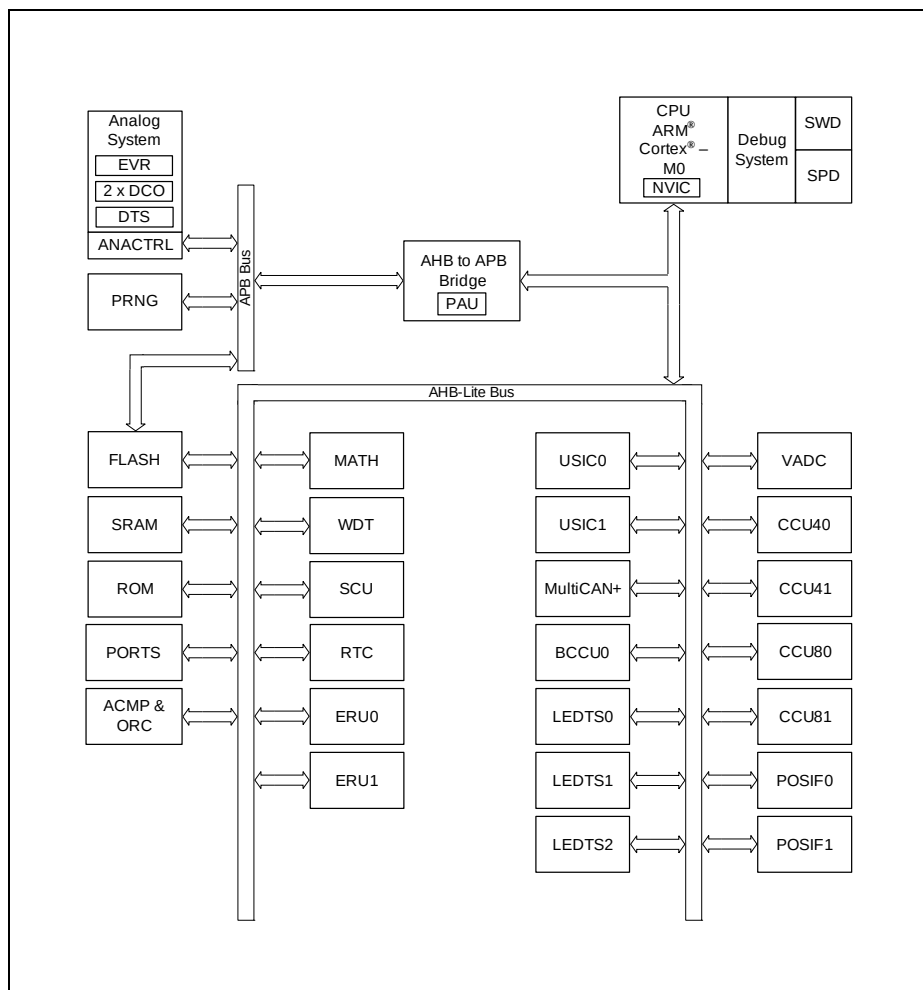


Figure 1 Block Diagram

1.3 Device Types

These device types are available and can be ordered through Infineon's direct and/or distribution channels.

Table 2 Synopsis of XMC1400 Device Types

Derivative	Package	Flash Kbytes
XMC1401-Q048F0064	PG-VQFN-48	64
XMC1401-Q048F0128	PG-VQFN-48	128
XMC1401-F064F0064	PG-LQFP-64	64
XMC1401-F064F0128	PG-LQFP-64	128
XMC1402-T038X0032	PG-TSSOP-38	32
XMC1402-T038X0064	PG-TSSOP-38	64
XMC1402-T038X0128	PG-TSSOP-38	128
XMC1402-T038X0200	PG-TSSOP-38	200
XMC1402-Q040X0032	PG-VQFN-40	32
XMC1402-Q040X0064	PG-VQFN-40	64
XMC1402-Q040X0128	PG-VQFN-40	128
XMC1402-Q040X0200	PG-VQFN-40	200
XMC1402-Q048X0032	PG-VQFN-48	32
XMC1402-Q048X0064	PG-VQFN-48	64
XMC1402-Q048X0128	PG-VQFN-48	128
XMC1402-Q048X0200	PG-VQFN-48	200
XMC1402-Q064X0064	PG-VQFN-64	64
XMC1402-Q064X0128	PG-VQFN-64	128
XMC1402-Q064X0200	PG-VQFN-64	200
XMC1402-F064X0064	PG-LQFP-64	64
XMC1402-F064X0128	PG-LQFP-64	128
XMC1402-F064X0200	PG-LQFP-64	200
XMC1403-Q040X0064	PG-VQFN-40	64
XMC1403-Q040X0128	PG-VQFN-40	128
XMC1403-Q040X0200	PG-VQFN-40	200
XMC1403-Q048X0064	PG-VQFN-48	64
XMC1403-Q048X0128	PG-VQFN-48	128

Table 3 XMC1400 Chip Identification Number (cont'd)

Derivative	Value	Marking
XMC1402-Q048X0064	00014083 07FF00FF 1E071FF7 100F900F 00000D00 00001000 00011000 10204083 _H	AA
XMC1402-Q048X0128	00014083 07FF00FF 1E071FF7 100F900F 00000D00 00001000 00021000 10204083 _H	AA
XMC1402-Q048X0200	00014083 07FF00FF 1E071FF7 100F900F 00000D00 00001000 00033000 10204083 _H	AA
XMC1402-Q064X0064	00014093 07FF00FF 1E071FF7 100F900F 00000D00 00001000 00011000 10204083 _H	AA
XMC1402-Q064X0128	00014093 07FF00FF 1E071FF7 100F900F 00000D00 00001000 00021000 10204083 _H	AA
XMC1402-Q064X0200	00014093 07FF00FF 1E071FF7 100F900F 00000D00 00001000 00033000 10204083 _H	AA
XMC1402-F064X0064	000140A3 07FF00FF 1E071FF7 100F900F 00000D00 00001000 00011000 10204083 _H	AA
XMC1402-F064X0128	000140A3 07FF00FF 1E071FF7 100F900F 00000D00 00001000 00021000 10204083 _H	AA
XMC1402-F064X0200	000140A3 07FF00FF 1E071FF7 100F900F 00000D00 00001000 00033000 10204083 _H	AA
XMC1403-Q040X0064	00014043 07CF00FF 1E071FF7 00B00000 00000D00 00001000 00011000 10204083 _H	AA
XMC1403-Q040X0128	00014043 07CF00FF 1E071FF7 00B00000 00000D00 00001000 00021000 10204083 _H	AA
XMC1403-Q040X0200	00014043 07CF00FF 1E071FF7 00B00000 00000D00 00001000 00033000 10204083 _H	AA
XMC1403-Q048X0064	00014083 07CF00FF 1E071FF7 00B00000 00000D00 00001000 00011000 10204083 _H	AA
XMC1403-Q048X0128	00014083 07CF00FF 1E071FF7 00B00000 00000D00 00001000 00021000 10204083 _H	AA
XMC1403-Q048X0200	00014083 07CF00FF 1E071FF7 00B00000 00000D00 00001000 00033000 10204083 _H	AA
XMC1403-Q064X0064	00014093 07CF00FF 1E071FF7 00B00000 00000D00 00001000 00011000 10204083 _H	AA
XMC1403-Q064X0128	00014093 07CF00FF 1E071FF7 00B00000 00000D00 00001000 00021000 10204083 _H	AA

General Device Information
Table 5 Package Pin Mapping (cont'd)

Function	LQFP 64, VQFN 64	VQFN 48	VQFN 40	TSSOP 38	Pad Type	Notes
P2.8	17	11	9	5	STD_IN/AN	
P2.9	18	12	10	6	STD_IN/AN	
P2.10	19	13	11	7	STD_INOUT /AN	
P2.11	20	14	12	8	STD_INOUT /AN	
P2.12	21	15	-	-	STD_INOUT /AN	
P2.13	22	16	-	-	STD_INOUT /AN	
P3.0	36	28	-	-	STD_INOUT	
P3.1	37	-	-	-	STD_INOUT	
P3.2	38	-	-	-	STD_INOUT	
P3.3	39	-	-	-	STD_INOUT	
P3.4	40	-	-	-	STD_INOUT	
P4.0	59	-	-	-	STD_INOUT	
P4.1	60	-	-	-	STD_INOUT	
P4.2	61	-	-	-	STD_INOUT	
P4.3	62	-	-	-	STD_INOUT	
P4.4	63	47	-	-	STD_INOUT	
P4.5	64	48	-	-	STD_INOUT	
P4.6	3	1	-	-	STD_INOUT	
P4.7	4	2	-	-	STD_INOUT	
P4.8	5	-	-	-	STD_INOUT	
P4.9	6	-	-	-	STD_INOUT	
P4.10	7	-	-	-	STD_INOUT	
P4.11	8	-	-	-	STD_INOUT	
VSS	23	17	13	9	Power	Supply GND, ADC reference GND

2.2.3 Port I/O Function Description

The following general building block is used to describe the I/O functions of each PORT pin:

Table 7 Port I/O Function Description

Function	Outputs		Inputs	
	ALT1	ALTn	Input	Input
P0.0		MODA.OUT	MODC.INA	
Pn.y	MODA.OUT		MODA.INA	MODC.INB

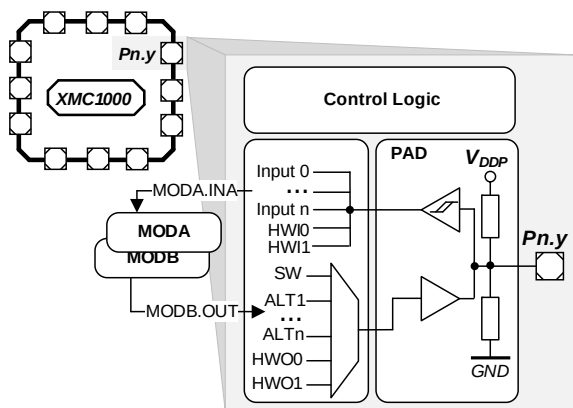


Figure 10 Simplified Port Structure

Pn.y is the port pin name, defining the control and data bits/registers associated with it. As GPIO, the port is under software control. Its input value is read via Pn_IN.y, Pn_OUT defines the output value.

Up to nine alternate output functions (ALT1 to ALT9) can be mapped to a single port pin, selected by Pn_IOC.R.PC. The output value is directly driven by the respective module, with the pin characteristics controlled by the port registers (within the limits of the connected pad).

The port pin input can be connected to multiple peripherals. Most peripherals have an input multiplexer to select between different possible input sources.

The input path is also active while the pin is configured as output. This allows to feedback an output to on-chip resources without wasting an additional external pin.

Please refer to the [Port I/O Functions](#) table for the complete Port I/O function mapping.

Port I/O Function Table

Table 9 Port I/O Functions

Function	Outputs									Inputs											
	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6	ALT7	ALT8	ALT9	Input	Input	Input	Input	Input	Input	Input	Input	Input	Input	Input	Input
P0.0	ERU0.P DOUT0	LEDTS0 .LINE7	ERU0.G OUT0	CCU40. OUT0	CCU80. OUT00	USIC0_ CH0.SE LO0	USIC0_ CH1.SE LO0	CCU81. OUT00	USIC1_ CH1.DO UT0	BCCU0. TRAPIN B	CCU40.I N0AC					USIC1_ CH1.DX 0A	USIC0_ CH0.D X2A		USIC0_ CH1.DX 2A		
P0.1	ERU0.P DOUT1	LEDTS0 .LINE6	ERU0.G OUT1	CCU40. OUT1	CCU80. OUT01	BCCU0. OUT8	SCU.VD ROP	USIC1_ CH1.SC LKOUT	USIC1_ CH1.DO UT0		CCU40.I N1AC					USIC1_ CH1.DX 0B	USIC1_ CH1.D X1A				
P0.2	ERU0.P DOUT2	LEDTS0 .LINE5	ERU0.G OUT2	CCU40. OUT2	CCU80. OUT02	VADC0. EMUX02	CCU80. OUT10	USIC1_ CH0.SC LKOUT	USIC1_ CH0.DO UT0		CCU40.I N2AC					USIC1_ CH0.DX 0A	USIC1_ CH0.D X1A				
P0.3	ERU0.P DOUT3	LEDTS0 .LINE4	ERU0.G OUT3	CCU40. OUT3	CCU80. OUT03	VADC0. EMUX01	CCU80. OUT11	USIC1_ CH1.SC LKOUT	USIC1_ CH0.DO UT0		CCU40.I N3AC					USIC1_ CH0.DX 0B					
P0.4	BCCU0. OUT0	LEDTS0 .LINE3	LEDTS0 .COL3	CCU40. OUT1	CCU80. OUT13	VADC0. EMUX00	WWDT. SERVIC E_OUT	USIC1_ CH1.SE LO0	CAN.N0 _TXD			CCU41.I N0AB	CCU80.I N0AB							CAN.N0 _RXDA	
P0.5	BCCU0. OUT1	LEDTS0 .LINE2	LEDTS0 .COL2	CCU40. OUT0	CCU80. OUT12	ACMP2. OUT	CCU80. OUT01	VADC0. EMUX10	CAN.N0 _TXD			CCU41.I N1AB	CCU80.I N1AB							CAN.N0 _RXDB	
P0.6	BCCU0. OUT2	LEDTS0 .LINE1	LEDTS0 .COL1	CCU40. OUT0	CCU80. OUT11	USIC0_ CH1.MC LKOUT	USIC0_ CH1.DO UT0	VADC0. EMUX11	CCU41. OUT0		CCU40.I N0AB	CCU41.I N2AB						USIC0_ CH1.DX 0C			
P0.7	BCCU0. OUT3	LEDTS0 .LINE0	LEDTS0 .COL0	CCU40. OUT1	CCU80. OUT10	USIC0_ CH0.SC LKOUT	USIC0_ CH1.DO UT0	VADC0. EMUX12	CCU41. OUT1		CCU40.I N1AB	CCU41.I N3AB				USIC0_ CH0.D X1C	USIC0_ CH1.DX 0D	USIC0_ CH1.DX 1C			
P0.8/ RTC_XTAL1	BCCU0. OUT4	LEDTS1 .LINE0	LEDTS0 _OUT2	CCU40. OUT20	CCU80. OUT20	USIC0_ CH0.SC LKOUT	USIC0_ CH1.SC LKOUT	CCU81. OUT20	CCU41. OUT2		CCU40.I N2AB					USIC0_ CH0.D X1B		USIC0_ CH1.DX 1B			
P0.9/ RTC_XTAL2	BCCU0. OUT5	LEDTS1 .LINE1	LEDTS0 _OUT3	CCU40. OUT3	CCU80. OUT21	USIC0_ CH0.SE LO0	USIC0_ CH1.SE LO0	CCU81. OUT21	CCU41. OUT3		CCU40.I N3AB					USIC0_ CH0.D X2B		USIC0_ CH1.DX 2B			
P0.10/ XTAL1	BCCU0. OUT6	LEDTS1 .LINE2	LEDTS0 _COL5	ACMP0. OUT	CCU80. OUT22	USIC0_ CH0.SE LO1	USIC0_ CH1.SE LO1	CCU81. OUT22				CCU80.I N2AB	CCU81.I N2AB			USIC0_ CH0.D X2C		USIC0_ CH1.DX 2C			
P0.11/ XTAL2	BCCU0. OUT7	LEDTS1 .LINE3	LEDTS0 _COL4	USIC0_ CH0.MC LKOUT	CCU80. OUT23	USIC0_ CH0.SE LO2	USIC0_ CH1.SE LO2	CCU81. OUT23								USIC0_ CH0.D X2D		USIC0_ CH1.DX 2D			
P0.12	BCCU0. OUT6	LEDTS1 .LINE4	LEDTS0 _COL3	LEDTS1 _COL3	CCU80. OUT33	USIC0_ CH0.SE LO3	CCU80. OUT20		CAN.N1 _TXD	BCCU0. TRAPIN A	CCU40.I N0AA	CCU40.I N1AA	CCU40.I N2AA	CCU81.I N0AU	CCU40.I N3AA	CCU80.I N0AA	USIC0_ CH0.D X2E	CCU80.I N1AA	CCU80.I N2AA	CAN.N1 _RXDA	CCU80.I N3AA

Table 9 Port I/O Functions (cont'd)

Function	Outputs									Inputs											
	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6	ALT7	ALT8	ALT9	Input	Input	Input	Input	Input	Input	Input	Input	Input	Input	Input	Input
P2.2										ACMP2.I NN	VADC0. G0CH7		ORC0.A N	USIC1_ CH0.DX 5E		USIC0_ CH0.DX 3A	USIC0_ CH0.D X4A	USIC0_ CH1.DX 5A			ERU0.0 B1
P2.3												VADC0. G1CH5	ORC1.A N	USIC1_ CH0.DX 3E	USIC1_ CH0.DX 4E	USIC1_ CH0.DX 5C	USIC0_ CH0.D X5B	USIC0_ CH1.DX 3C	USIC0_ CH1.DX 4C		ERU0.1 B1
P2.4												VADC0. G1CH6	ORC2.A N	USIC1_ CH1.DX 3C	USIC1_ CH1.DX 4C	USIC0_ CH0.DX 3B	USIC0_ CH0.D X4B	USIC1_ CH0.DX 5F	USIC0_ CH1.DX 5B		ERU0.0 A1
P2.5												VADC0. G1CH7	ORC3.A N	USIC1_ CH1.DX 5D		USIC0_ CH0.DX 5D		USIC0_ CH1.DX 3E	USIC0_ CH1.DX 4E		ERU0.1 A1
P2.6										ACMP1.I NN	VADC0. G0CH0		ORC4.A N	USIC1_ CH1.DX 3E	USIC1_ CH1.DX 4E	USIC0_ CH0.DX 3E	USIC0_ CH0.D X4E	USIC0_ CH1.DX 5D			ERU0.2 A1
P2.7										ACMP1.I NP		VADC0. G1CH1	ORC5.A N	USIC1_ CH1.DX 5E		USIC0_ CH0.DX 5C		USIC0_ CH1.DX 3D	USIC0_ CH1.DX 4D		ERU0.3 A1
P2.8										ACMP0.I NN	VADC0. G0CH1	VADC0. G1CH0	ORC6.A N			USIC0_ CH0.DX 3D	USIC0_ CH0.D X4D	USIC0_ CH1.DX 5C			ERU0.3 B1
P2.9										ACMP0.I NP	VADC0. G0CH2	VADC0. G1CH4	ORC7.A N			USIC0_ CH0.DX 5A		USIC0_ CH1.DX 3B	USIC0_ CH1.DX 4B		ERU0.3 B0
P2.10	ERU0.P DOUT1	CCU40. OUT2	ERU0.G OUT1	LEDTS1 .COL4	CCU80. OUT30	ACMP0. OUT	USIC0_ CH1.DO UT0		CAN.N1 _TXD		VADC0. G0CH3	VADC0. G1CH2				USIC0_ CH0.DX 3C	USIC0_ CH0.D X4C	USIC0_ CH1.DX 0F		CAN.N1 _RXDE	ERU0.2 B0
P2.11	ERU0.P DOUT0	CCU40. OUT3	ERU0.G OUT0	LEDTS1 .COL3	CCU80. OUT31	USIC0_ CH1.SC LKOUT	USIC0_ CH1.DO UT0		CAN.N1 _TXD	ACMP.R EF	VADC0. G0CH4	VADC0. G1CH3						USIC0_ CH1.DX 0E	USIC0_ CH1.DX 1E	CAN.N1 _RXDF	ERU0.2 B1
P2.12	BCCU0. OUT3	VADC0. EMUX00	USIC1_ CH0.SC LKOUT	USIC1_ CH1.SC LKOUT		ACMP2. OUT	USIC1_ CH1.DO UT0	LEDTS2 .COL6		ACMP3.I NN						USIC1_ CH0.DX 3A	USIC1_ CH0.D X4A	USIC1_ CH1.DX 0C	USIC1_ CH1.DX 1B		ERU1.3 A2
P2.13	BCCU0. OUT4	CCU40. OUT3	USIC1_ CH0.MC LKOUT	CCU81. OUT31		VADC0. EMUX01	USIC1_ CH1.DO UT0	CCU81. OUT33	CCU41. OUT3	ACMP3.I NP						USIC1_ CH0.DX 5A		USIC1_ CH1.DX 0D			ERU1.3 A3
P3.0	BCCU0. OUT0	USIC1_ CH1.DO UT0	USIC1_ CH1.SC LKOUT	LEDTS2 .COLA	CCU80. OUT21	ACMP1. OUT	USIC1_ CH0.SE LO1	CCU81. OUT21	CCU41. OUT0	BCCU0. TRAPIN C	CCU41.I N0AA	CCU41.I N1AA	CCU41.I N2AA	CCU41.I N3AA	CCU81.I N0AA	CCU81.I N1AA	CCU81. IN2AA	USIC1_ CH1.DX 0E	USIC1_ CH1.DX 1D	CCU81.I N3AA	ERU1.0 A1
P3.1	BCCU0. OUT1	USIC1_ CH1.DO UT0		LEDTS2 .COL0	CCU80. OUT20	ACMP3. OUT	USIC1_ CH0.SE LO0	CCU81. OUT20	CCU41. OUT1								USIC1_ CH0.D X2F	USIC1_ CH1.DX 0F			ERU1.1 A1

Table 10 Hardware I/O Controlled Functions

Function	Outputs HWO0	Outputs HWO1	Inputs HWI0	Inputs HWI1	Pull Control HW0_PD	Pull Control HW0_PU	Pull Control HW1_PD	Pull Control HW1_PU
P1.3		USIC0_CH0.DOUT3		USIC0_CH0.HWIN3	BCCU0.OUT5	BCCU0.OUT5		
P1.4					BCCU0.OUT6	BCCU0.OUT6		
P1.5					BCCU0.OUT7	BCCU0.OUT7		
P1.6					BCCU0.OUT8	BCCU0.OUT8		
P1.7								
P1.8								
P2.0					BCCU0.OUT1	BCCU0.OUT1		
P2.1					BCCU0.OUT6	BCCU0.OUT6		
P2.2					BCCU0.OUT0	BCCU0.OUT0	CCU40.OUT3	CCU40.OUT3
P2.3					ACMP2.OUT	ACMP2.OUT		
P2.4					BCCU0.OUT8	BCCU0.OUT8		
P2.5					ACMP1.OUT	ACMP1.OUT		
P2.6					BCCU0.OUT2	BCCU0.OUT2	CCU40.OUT3	CCU40.OUT3
P2.7					BCCU0.OUT8	BCCU0.OUT8	CCU40.OUT3	CCU40.OUT3
P2.8					BCCU0.OUT1	BCCU0.OUT1	CCU40.OUT2	CCU40.OUT2
P2.9					BCCU0.OUT7	BCCU0.OUT7	CCU40.OUT2	CCU40.OUT2
P2.10					BCCU0.OUT4	BCCU0.OUT4		
P2.11					BCCU0.OUT5	BCCU0.OUT5		
P2.12					BCCU0.OUT3	BCCU0.OUT3	CCU41.OUT0	CCU41.OUT0
P2.13					BCCU0.OUT4	BCCU0.OUT4	CCU41.OUT2	CCU41.OUT2
P3.0								
P3.1		USIC1_CH0.DOUT3		USIC1_CH0.HWIN3				
P3.2		USIC1_CH0.DOUT2		USIC1_CH0.HWIN2				
P3.3		USIC1_CH0.DOUT1		USIC1_CH0.HWIN1				
P3.4		USIC1_CH0.DOUT0		USIC1_CH0.HWIN0				
P4.0								
P4.1								
P4.2								
P4.3								

Electrical Parameter
Table 17 ADC Characteristics (Operating Conditions apply)¹⁾ (cont'd)

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gain settings	G_{IN} CC	1			–	GNCTRxz.GAINy = 00 _B (unity gain)
		3			–	GNCTRxz.GAINy = 01 _B (gain g1)
		6			–	GNCTRxz.GAINy = 10 _B (gain g2)
		12			–	GNCTRxz.GAINy = 11 _B (gain g3)
Sample Time	t_{sample} CC	5	–	–	1 / f_{ADC}	$V_{DD} = 5.0$ V, $f_{ADCI} = 48$ MHz
		3	–	–	1 / f_{ADC}	$V_{DD} = 5.0$ V, $f_{ADCI} = 32$ MHz
		3	–	–	1 / f_{ADC}	$V_{DD} = 3.3$ V, $f_{ADCI} = 32$ MHz
		30	–	–	1 / f_{ADC}	$V_{DD} = 2.0$ V, $f_{ADCI} = 32$ MHz
Conversion time in fast compare mode	t_{CF} CC	9			1 / f_{ADC}	³⁾
Conversion time in 12-bit mode	t_{C12} CC	20			1 / f_{ADC}	³⁾
Maximum sample rate in 12-bit mode ⁴⁾	f_{C12} CC	–	–	$f_{ADC} / 42.5$	–	1 sample pending
		–	–	$f_{ADC} / 62.5$	–	2 samples pending
Conversion time in 10-bit mode	t_{C10} CC	18			1 / f_{ADC}	³⁾
Maximum sample rate in 10-bit mode ⁴⁾	f_{C10} CC	–	–	$f_{ADC} / 40.5$	–	1 sample pending
		–	–	$f_{ADC} / 58.5$	–	2 samples pending
Conversion time in 8-bit mode	t_{C8} CC	16			1 / f_{ADC}	³⁾

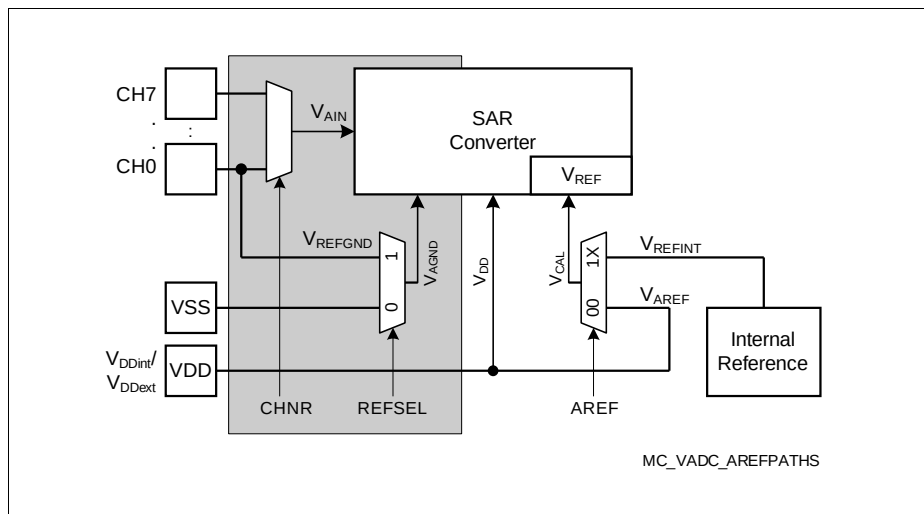


Figure 12 ADC Voltage Supply

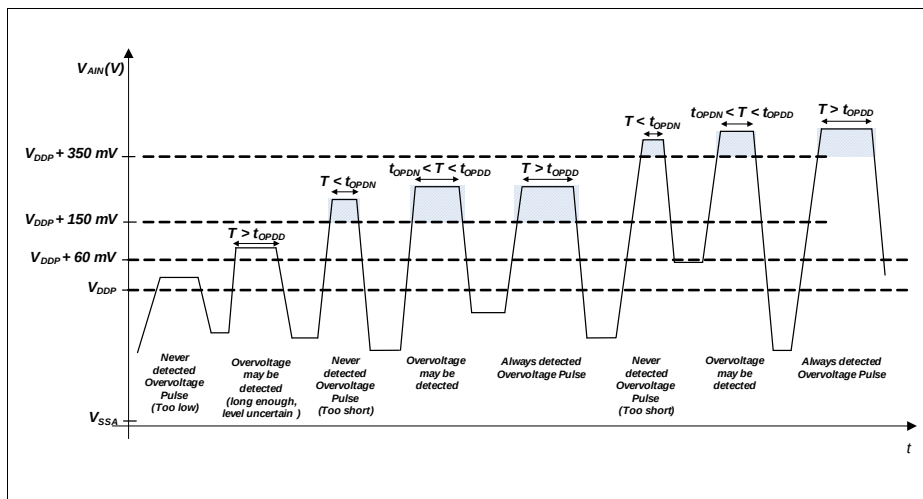


Figure 14 ORC Detection Ranges

3.2.4 Analog Comparator Characteristics

Table 19 below shows the Analog Comparator characteristics.

Note: These parameters are not subject to production test, but verified by design and/or characterization.

Table 19 Analog Comparator Characteristics (Operating Conditions apply)

Parameter	Symbol		Limit Values			Unit	Notes/ Test Conditions
			Min.	Typ.	Max.		
Input Voltage	V_{CMP}	SR	-0.05	—	$V_{DDP} + 0.05$	V	
Input Offset	V_{CMPOFF}	CC	—	+/-3	—	mV	High power mode $\Delta V_{CMP} < 200$ mV
Propagation Delay ¹⁾	t_{PDELAY}	CC	—	25	—	ns	High power mode, $\Delta V_{CMP} = 100$ mV
			—	80	—	ns	High power mode, $\Delta V_{CMP} = 25$ mV
			—	250	—	ns	Low power mode, $\Delta V_{CMP} = 100$ mV
			—	700	—	ns	Low power mode, $\Delta V_{CMP} = 25$ mV
Current Consumption	I_{ACMP}	CC	—	100	—	μA	First active ACMP in high power mode, $\Delta V_{CMP} > 30$ mV
			—	66	—	μA	Each additional ACMP in high power mode, $\Delta V_{CMP} > 30$ mV
			—	10	—	μA	First active ACMP in low power mode
			—	6	—	μA	Each additional ACMP in low power mode
Input Hysteresis	V_{HYS}	CC	—	+/-15	—	mV	
Filter Delay ¹⁾	t_{FDELAY}	CC	—	5	—	ns	

1) Total Analog Comparator Delay is the sum of Propagation Delay and Filter Delay.

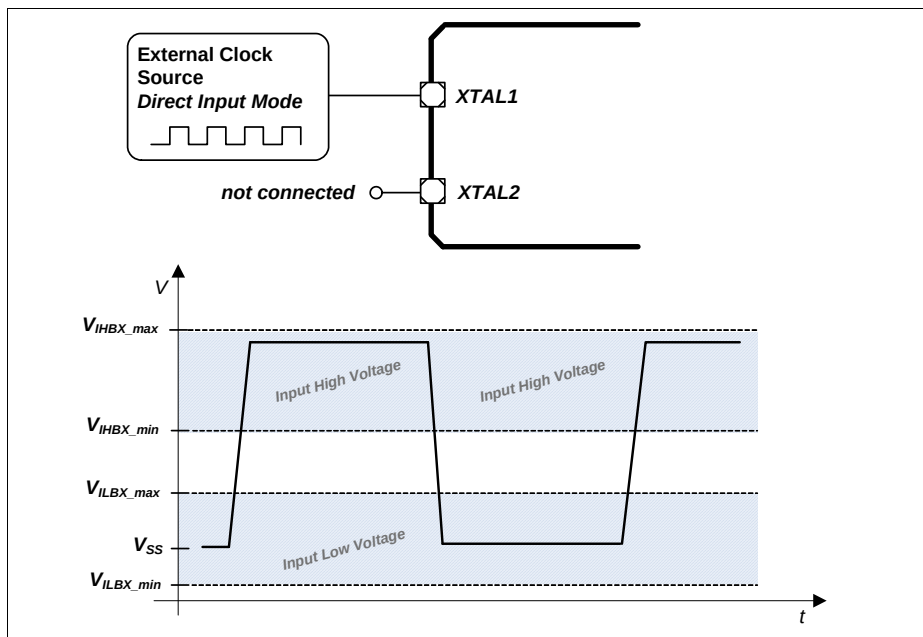


Figure 16 Oscillator in Direct Input Mode

Table 22 RTC_XTAL Parameters

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input frequency	f_{OSC} SR	–	32.768	–	kHz	
Oscillator start-up time ¹⁾²⁾	t_{OSCS} CC	–	–	5	s	
Input voltage at RTC_XTAL1	V_{IX} SR	-0.3	–	1.5	V	
Input amplitude (peak-to-peak) at RTC_XTAL1 ²⁾³⁾	V_{PPX} SR	0.2	–	1.2	V	

1) t_{OSCS} is defined from the moment the oscillator is enabled by the user with SCU_ANAOSCLPCTRL.MODE until the oscillations reach an amplitude at RTC_XTAL1 of $0.9 * V_{PPX}$.

2) The external oscillator circuitry must be optimized by the customer and checked for negative resistance and amplitude as recommended and specified by crystal suppliers.

3) If the shaper unit is enabled and not bypassed.

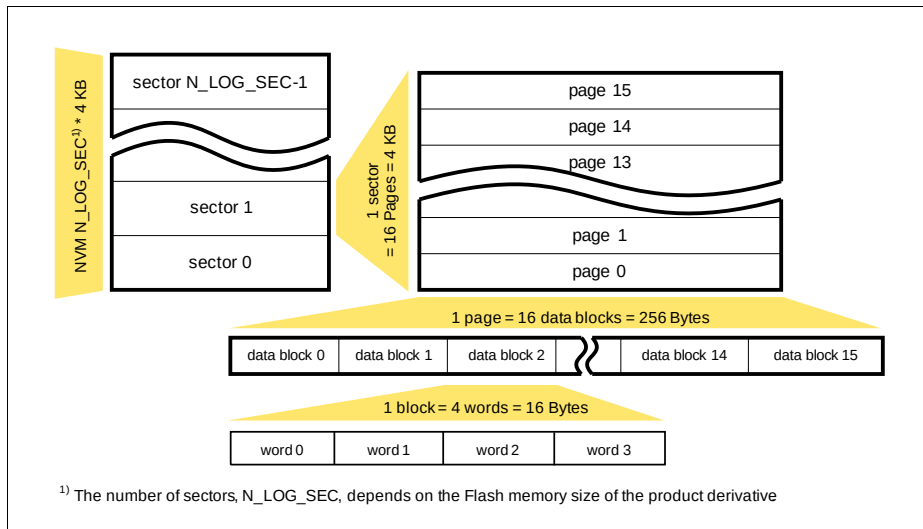


Figure 19 Logical Structure of the Flash

3.3.3 On-Chip Oscillator Characteristics

Table 27 provides the characteristics of the 96 MHz digital controlled oscillator DCO1.

Note: These parameters are not subject to production test, but verified by design and/or characterization.

Table 27 96 MHz DCO1 Characteristics (Operating Conditions apply)

Parameter	Symbol		Limit Values			Unit	Test Conditions
			Min.	Typ	Max.		
Nominal frequency	f_{NOM}	CC	–	96	–	MHz	under nominal conditions ¹⁾ after trimming
Accuracy with adjustment based on XTAL as reference	Δf_{LTX}	CC	-0.3	–	0.3	%	with respect to $f_{\text{NOM}}(\text{typ})$, over temperature (-40 °C to 105 °C)
Accuracy	Δf_{LT}	CC	-1.7	–	3.4	%	with respect to $f_{\text{NOM}}(\text{typ})$, over temperature (0 °C to 85 °C)
			-3.9	–	4.0	%	with respect to $f_{\text{NOM}}(\text{typ})$, over temperature (-40 °C to 105 °C)

1) The deviation is relative to the factory trimmed frequency at nominal V_{DDC} and $T_{\text{A}} = + 25\text{ °C}$.

Table 28 provides the characteristics of the 32 kHz digital controlled oscillator DCO2.

Table 28 32 kHz DCO2 Characteristics (Operating Conditions apply)

Parameter	Symbol		Limit Values			Unit	Test Conditions
			Min.	Typ.	Max.		
Nominal frequency	f_{NOM}	CC	–	32.75	–	kHz	under nominal conditions ¹⁾ after trimming
Accuracy	Δf_{LT}	CC	-1.7	–	3.4	%	with respect to $f_{\text{NOM}}(\text{typ})$, over temperature (0 °C to 85 °C)
			-3.9	–	4.0	%	with respect to $f_{\text{NOM}}(\text{typ})$, over temperature (-40 °C to 105 °C) ¹⁾

1) The deviation is relative to the factory trimmed frequency at nominal V_{DDC} and $T_{\text{A}} = + 25\text{ °C}$.

3.3.4 Serial Wire Debug Port (SW-DP) Timing

The following parameters are applicable for communication through the SW-DP interface.

Note: These parameters are not subject to production test, but verified by design and/or characterization.

Table 29 SWD Interface Timing Parameters(Operating Conditions apply)

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
SWDCLK high time	t_1 SR	50	—	500000	ns	—
SWDCLK low time	t_2 SR	50	—	500000	ns	—
SWDIO input setup to SWDCLK rising edge	t_3 SR	10	—	—	ns	—
SWDIO input hold after SWDCLK rising edge	t_4 SR	10	—	—	ns	—
SWDIO output valid time after SWDCLK rising edge	t_5 CC	—	—	68	ns	$C_L = 50$ pF
		—	—	62	ns	$C_L = 30$ pF
SWDIO output hold time from SWDCLK rising edge	t_6 CC	4	—	—	ns	

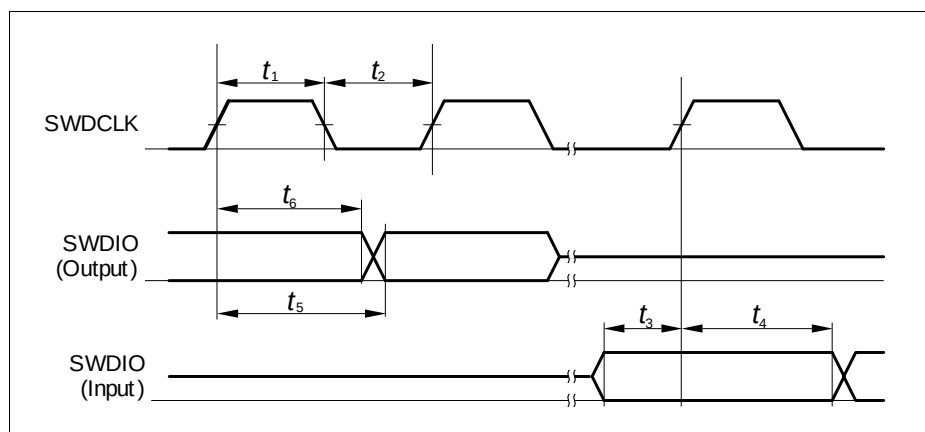


Figure 24 SWD Timing

3.3.6.2 Inter-IC (IIC) Interface Timing

The following parameters are applicable for a USIC channel operated in IIC mode.

Note: Operating Conditions apply.

Table 33 USIC IIC Standard Mode Timing¹⁾

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Fall time of both SDA and SCL	t_1 CC/SR	-	-	300	ns	
Rise time of both SDA and SCL	t_2 CC/SR	-	-	1000	ns	
Data hold time	t_3 CC/SR	0	-	-	μs	
Data set-up time	t_4 CC/SR	250	-	-	ns	
LOW period of SCL clock	t_5 CC/SR	4.7	-	-	μs	
HIGH period of SCL clock	t_6 CC/SR	4.0	-	-	μs	
Hold time for (repeated) START condition	t_7 CC/SR	4.0	-	-	μs	
Set-up time for repeated START condition	t_8 CC/SR	4.7	-	-	μs	
Set-up time for STOP condition	t_9 CC/SR	4.0	-	-	μs	
Bus free time between a STOP and START condition	t_{10} CC/SR	4.7	-	-	μs	
Capacitive load for each bus line	C_b SR	-	-	400	pF	

1) Due to the wired-AND configuration of an IIC bus system, the port drivers of the SCL and SDA signal lines need to operate in open-drain mode. The high level on these lines must be held by an external pull-up device, approximately 10 kOhm for operation at 100 kbit/s, approximately 2 kOhm for operation at 400 kbit/s.

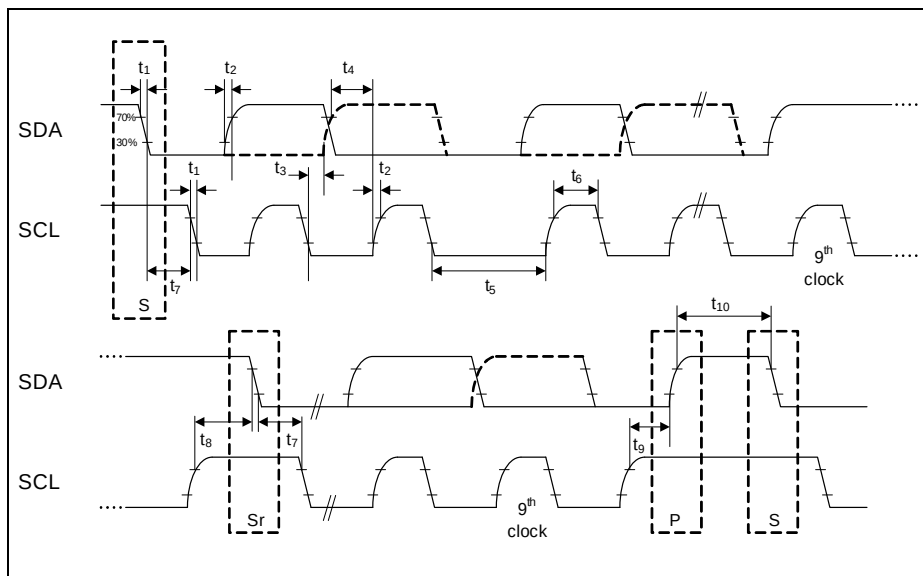


Figure 26 USIC IIC Timing

3.3.6.3 Inter-IC Sound (IIS) Interface Timing

The following parameters are applicable for a USIC channel operated in IIS mode.

Note: Operating Conditions apply.

Table 35 USIC IIS Master Transmitter Timing

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Clock period	t_1 CC	$4/f_{MCLK}$	-	-	ns	
Clock HIGH	t_2 CC	$0.35 \times t_{1min}$	-	-	ns	
Clock Low	t_3 CC	$0.35 \times t_{1min}$	-	-	ns	
Hold time	t_4 CC	0	-	-	ns	
Clock rise time	t_5 CC	-	-	$0.15 \times t_{1min}$	ns	

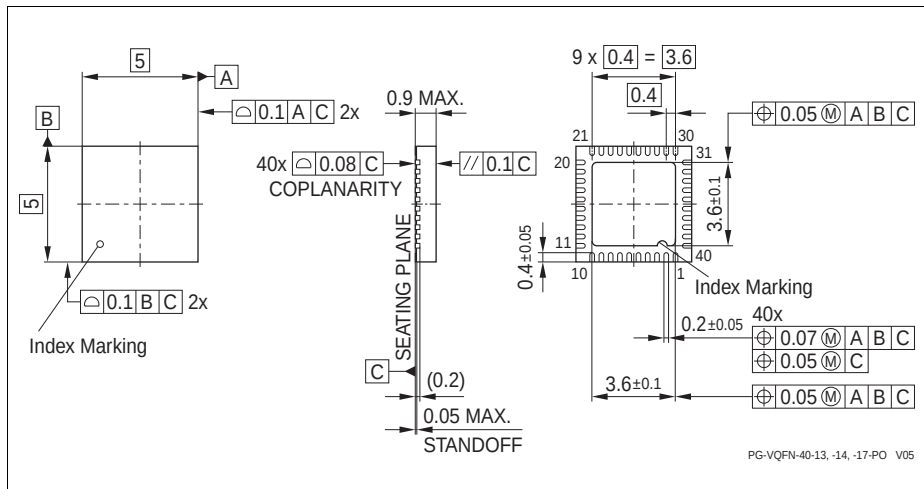


Figure 30 PG-VQFN-40-17

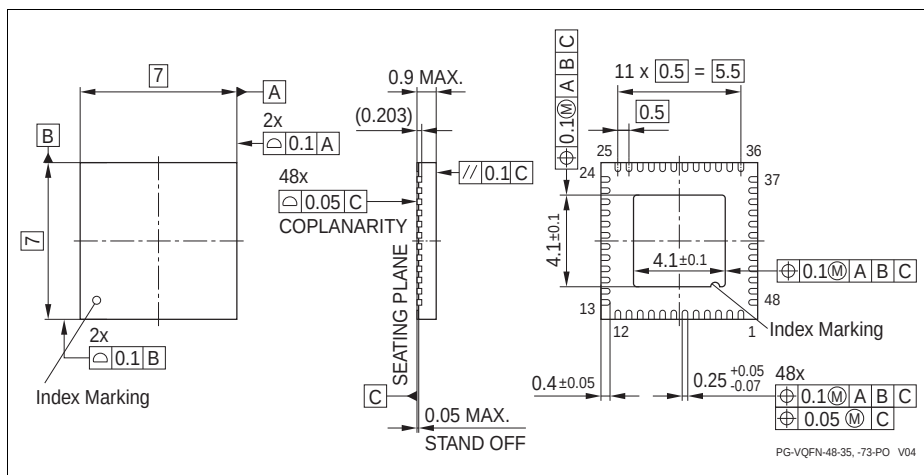


Figure 31 PG-VQFN-48-73