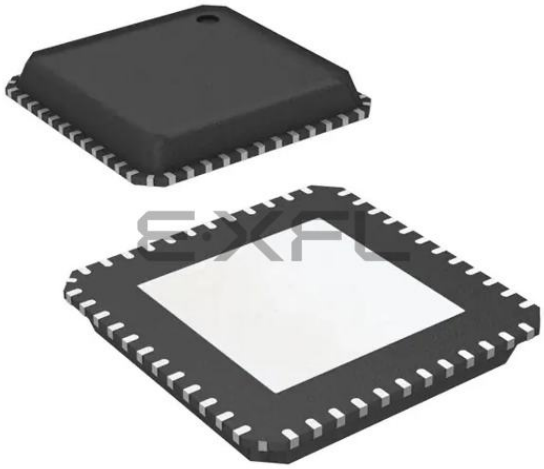
Infineon Technologies - XMC4200Q48K256ABXUMA1 Datasheet



Welcome to E-XFL.COM

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	Discontinued at Digi-Key
Core Processor	ARM® Cortex®-M4
Core Size	32-Bit Single-Core
Speed	80MHz
Connectivity	CANbus, I²C, LINbus, SPI, UART/USART, USB
Peripherals	DMA, I²S, LED, POR, PWM, WDT
Number of I/O	21
Program Memory Size	256KB (256K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	40K x 8
Voltage - Supply (Vcc/Vdd)	3.13V ~ 3.63V
Data Converters	A/D 16x12b; D/A 2x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Surface Mount
Package / Case	48-VFQFN Exposed Pad
Supplier Device Package	PG-VQFN-48-54
Purchase URL	https://www.e-xfl.com/product-detail/infineon-technologies/xmc4200q48k256abxuma1

About this Document

This Data Sheet is addressed to embedded hardware and software developers. It provides the reader with detailed descriptions about the ordering designations, available features, electrical and physical characteristics of the XMC4[12]00 series devices.

The document describes the characteristics of a superset of the XMC4[12]00 series devices. For simplicity, the various device types are referred to by the collective term XMC4[12]00 throughout this manual.

XMC4000 Family User Documentation

The set of user documentation includes:

- **Reference Manual**
  – decribes the functionality of the superset of devices.
- **Data Sheets**
  – list the complete ordering designations, available features and electrical characteristics of derivative devices.
- **Errata Sheets**
  – list deviations from the specifications given in the related Reference Manual or Data Sheets. Errata Sheets are provided for the superset of devices.

Attention: Please consult all parts of the documentation set to attain consolidated knowledge about your device.

Application related guidance is provided by **Users Guides** and **Application Notes**.

Please refer to **http://www.infineon.com/xmc4000** to get access to the latest versions of those documents.

Table 6 SRAM Memory Ranges

Total SRAM Size	Program SRAM	System Data SRAM
40 Kbytes	1FFF C000$_H$ – 1FFF FFFF$_H$	2000 0000$_H$ – 2000 5FFF$_H$
20 Kbytes	1FFF E000$_H$ – 1FFF FFFF$_H$	2000 0000$_H$ – 2000 2FFF$_H$

Table 7 ADC Channels[1)]

Package	VADC G0	VADC G1
LQFP-64, TQFP-64	CH0, CH3..CH7	CH0, CH1, CH3, CH6
PG-VQFN-48	CH0, CH3..CH7	CH0, CH1, CH3

1) Some pins in a package may be connected to more than one channel. For the detailed mapping see the Port I/O Function table.

1.6 Identification Registers

The identification registers allow software to identify the marking.

Table 8 XMC4200 Identification Registers

Register Name	Value	Marking
SCU_IDCHIP	0004 2001$_H$	EES-AA, ES-AA
SCU_IDCHIP	0004 2002$_H$	ES-AB, AB
SCU_IDCHIP	0004 2003$_H$	BA
JTAG IDCODE	101D D083$_H$	EES-AA, ES-AA
JTAG IDCODE	201D D083$_H$	ES-AB, AB
JTAG IDCODE	301D D083$_H$	BA

Table 11 Package Pin Mapping (cont'd)

Function	LQFP-64 TQFP-64	VQFN-48	Pad Type	Notes
P0.11	59	-	A1+	
P1.0	52	40	A1+	
P1.1	51	39	A1+	
P1.2	50	38	A1+	
P1.3	49	37	A1+	
P1.4	48	36	A1+	
P1.5	47	35	A1+	
P1.7	55	-	A1+	
P1.8	54	-	A1+	
P1.9	53	-	A1+	
P1.15	46	-	A1+	
P2.0	34	26	A1+	
P2.1	33	25	A1+	After a system reset, via HWSEL this pin selects the DB.TDO function.
P2.2	32	24	A1+	
P2.3	31	23	A1+	
P2.4	30	22	A1+	
P2.5	29	21	A1+	
P2.6	36	-	A1+	
P2.7	35	-	A1+	
P2.8	28	-	A1+	
P2.9	27	-	A1+	
P2.14	26	-	A1+	
P2.15	25	-	A1+	
P3.0	5	-	A1+	
P14.0	20	16	AN/DIG_IN	
P14.3	19	15	AN/DIG_IN	
P14.4	18	14	AN/DIG_IN	
P14.5	17	13	AN/DIG_IN	
P14.6	16	12	AN/DIG_IN	
P14.7	15	11	AN/DIG_IN	
P14.8	24	20	AN/DAC/DIG_IN	

Table 11 Package Pin Mapping (cont'd)

Function	LQFP-64 TQFP-64	VQFN-48	Pad Type	Notes
P14.9	23	19	AN/DAC/DIG_IN	
P14.14	14	-	AN/DIG_IN	
USB_DP	7	4	special	
USB_DM	6	3	special	
HIB_IO_0	10	7	A1 special	At the first power-up and with every reset of the hibernate domain this pin is configured as open-drain output and drives "0". As output the medium driver mode is active.
TCK	45	34	A1	Weak pull-down active.
TMS	44	33	A1+	Weak pull-up active. As output the strong-soft driver mode is active.
$\overline{\text{PORST}}$	43	32	special	Strong pull-down controlled by EVR. Weak pull-up active while strong pull-down is not active.
XTAL1	39	29	clock_IN	
XTAL2	40	30	clock_O	
RTC_XTAL1	11	8	clock_IN	
RTC_XTAL2	12	9	clock_O	
VBAT	13	10	Power	When VDDP is supplied VBAT has to be supplied as well.
VDDA/VAREF	22	18	AN_Power/AN_ Ref	Shared analog supply and reference voltage pin.
VSSA/VAGND	21	17	AN_Power/AN_ Ref	Shared analog supply and reference ground pin.
VDDC	9	6	Power	
VDDC	42	31	Power	
VDDP	8	5	Power	
VDDP	38	28	Power	
VDDP	56	41	Power	
VSS	37	27	Power	

Table 13 Port I/O Functions (cont'd)

Function	Output					Input								
	ALT1	ALT2	ALT3	ALT4	HWO0	HWI0	Input	Input	Input	Input	Input	Input	Input	Input
P14.9					DAC. OUT_1			VADC. G1CH1						
P14.14								VADC. G1CH6					G1ORC6	
USB_DP														
USB_DM														
HIB_IO_0	HIBOUT	WWDT. SERVICE_OUT					WAKEUPA			USB. VBUSDETECT C				
TCK						DB.TCK/ SWCLK								
TMS					DB.TMS/ SWDIO									
$\overline{\text{PORST}}$														
XTAL1							U0C0. DX0F	U0C1. DX0F	U1C0. DX0F	U1C1. DX0F				
XTAL2														
RTC_XTAL1									ERU0. 1B1					
RTC_XTAL2														

3 Electrical Parameters

3.1 General Parameters

3.1.1 Parameter Interpretation

The parameters listed in this section partly represent the characteristics of the XMC4[12]00 and partly its requirements on the system. To aid interpreting the parameters easily when evaluating them for a design, they are marked with an two-letter abbreviation in column “Symbol”:

- **CC**
  Such parameters indicate **C**ontroller **C**haracteristics, which are a distinctive feature of the XMC4[12]00 and must be regarded for system design.
- **SR**
  Such parameters indicate **S**ystem **R**equirements, which must be provided by the application system in which the XMC4[12]00 is designed in.

3.1.2 Absolute Maximum Ratings

Stresses above the values listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions may affect device reliability.

Table 14 Absolute Maximum Rating Parameters

Parameter	Symbol		Values			Unit	Note / Test Condition
			Min.	Typ.	Max.		
Storage temperature	T_{ST}	SR	-65	–	150	°C	–
Junction temperature	T_J	SR	-40	–	150	°C	–
Voltage at 3.3 V power supply pins with respect to V_{SS}	V_{DDP}	SR	–	–	4.3	V	–
Voltage on any Class A and dedicated input pin with respect to V_{SS}	V_{IN}	SR	-1.0	–	V_{DDP} + 1.0 or max. 4.3	V	whichever is lower
Voltage on any analog input pin with respect to V_{AGND}	V_{AIN} V_{AREF}	SR	-1.0	–	V_{DDP} + 1.0 or max. 4.3	V	whichever is lower
Input current on any pin during overload condition	I_{IN}	SR	-10	–	+10	mA	
Absolute maximum sum of all input circuit currents for one port group during overload condition[1)]	ΣI_{IN}	SR	-25	–	+25	mA	
Absolute maximum sum of all input circuit currents during overload condition	ΣI_{IN}	SR	-100	–	+100	mA	

1) The port groups are defined in **Table 18**.

3.2.3 Digital to Analog Converters (DACx)

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

Table 27 DAC Parameters (Operating Conditions apply)

Parameter	Symbol		Values			Unit	Note / Test Condition
			Min.	Typ.	Max.		
RMS supply current	I_{DD}	CC	–	2.5	4	mA	per active DAC channel, without load currents of DAC outputs
Resolution	RES	CC	–	12	–	Bit	
Update rate	f_{URATE_A}	CC	–		2	Msample/s	data rate, where DAC can follow 64 LSB code jumps to ± 1LSB accuracy
Update rate	f_{URATE_F}	CC	–		5	Msample/s	data rate, where DAC can follow 64 LSB code jumps to ± 4 LSB accuracy
Settling time	t_{SETTLE}	CC	–	1	2	µs	at full scale jump, output voltage reaches target value ± 20 LSB
Slew rate	SR	CC	2	5	–	V/µs	
Minimum output voltage	V_{OUT_MIN}	CC	–	0.3	–	V	code value unsigned: 000_H; signed: 800_H
Maximum output voltage	V_{OUT_MAX}	CC	–	2.5	–	V	code value unsigned: FFF_H; signed: $7FF_H$
Integral non-linearity[1)]	INL	CC	-5.5	±2.5	5.5	LSB	$R_L \geq 5$ kOhm, $C_L \leq 50$ pF
Differential non-linearity	DNL	CC	-2	±1	2	LSB	$R_L \geq 5$ kOhm, $C_L \leq 50$ pF

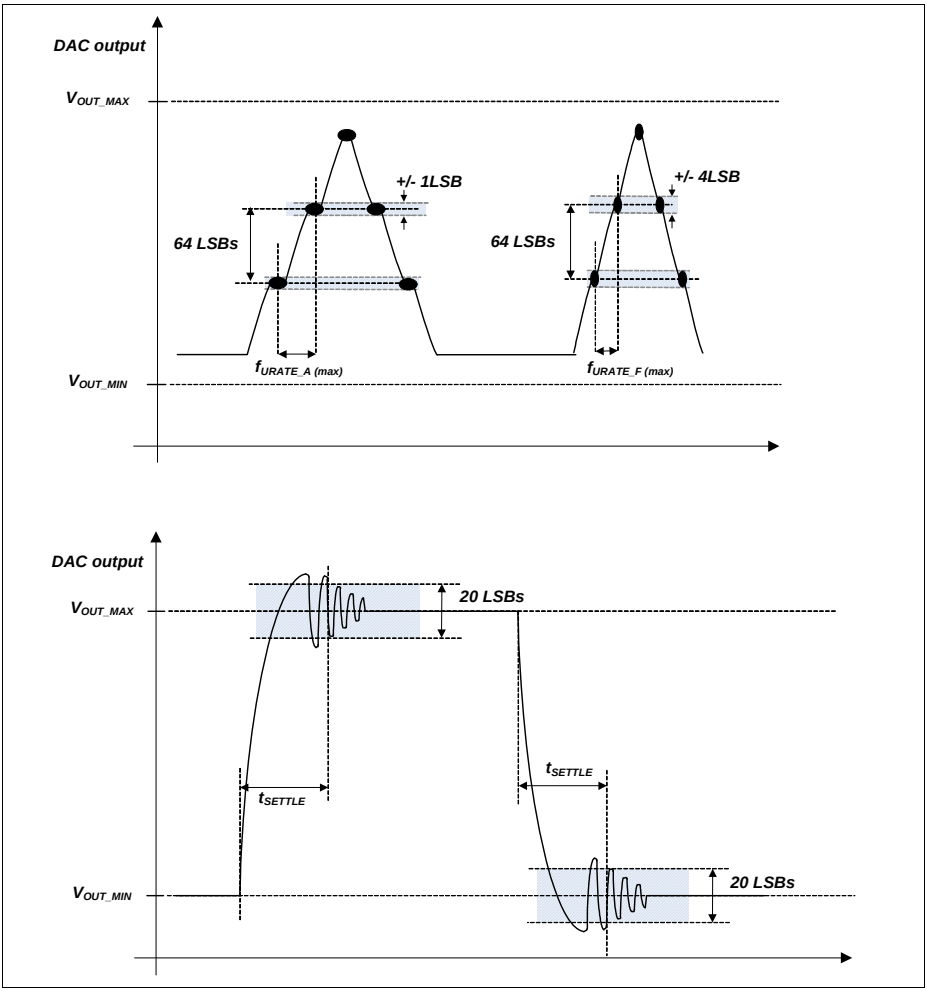


Figure 15 DAC Conversion Examples

3.2.5 High Resolution PWM (HRPWM)

The following chapters describe the operating conditions, characteristics and timing requirements, for all the components inside the HRPWM module. Each description is given for just one sub unit, e.g., one CSG or one HRC.

All the timing information is related to the module clock, f_{hrpwm}.

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

3.2.5.1 HRC characteristics

Table 29 summarizes the characteristics of the HRC units.

Table 29 HRC characteristics (Operating Conditions apply)

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
High resolution step size[1)2)]	t_{HRS} CC	–	150	–	ps	
Startup time (after reset release)	t_{start} CC	–	–	2	µs	

1) The step size for clock frequencies equal to 180, 120 and 80 MHz is 150 ps.

2) The step size for clock frequencies different from 180, 120 and 80 MHz but within the range from 180 to 64 MHz can be between 118 to 180 ps (fixed over process and operating conditions)

3.2.5.2 CMP and 10-bit DAC characteristics

The **Table 30** summarizes the characteristics of the CSG unit.

The specified characteristics require that the setup of the HRPWM follows the initialization sequence as documented in the Reference Manual.

Table 30 CMP and 10-bit DAC characteristics (Operating Conditions apply)

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
DAC Resolution	*RES* CC		10		bits	
DAC differential nonlinearity	*DNL CC*	-1	–	1.5	LSB	Monotonic behavior, See **Figure 18**
DAC integral nonlinearity	*INL* CC	-3	–	3	LSB	See **Figure 18**

3.2.8 USB Device Interface DC Characteristics

The Universal Serial Bus (USB) Interface is compliant to the USB Rev. 2.0 Specification. High-Speed Mode is not supported.

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

Table 35 USB Device Data Line (USB_DP, USB_DM) Parameters (Operating Conditions apply)

Parameter	Symbol		Values			Unit	Note / Test Condition
			Min.	Typ.	Max.		
Input low voltage	V_{IL}	SR	–	–	0.8	V	
Input high voltage (driven)	V_{IH}	SR	2.0	–	–	V	
Input high voltage (floating) [1]	V_{IHZ}	SR	2.7	–	3.6	V	
Differential input sensitivity	V_{DIS}	CC	0.2	–	–	V	
Differential common mode range	V_{CM}	CC	0.8	–	2.5	V	
Output low voltage	V_{OL}	CC	0.0	–	0.3	V	1.5 kOhm pull-up to 3.6 V
Output high voltage	V_{OH}	CC	2.8	–	3.6	V	15 kOhm pull-down to 0 V
DP pull-up resistor (idle bus)	R_{PUI}	CC	900	–	1 575	Ohm	
DP pull-up resistor (upstream port receiving)	R_{PUA}	CC	1 425	–	3 090	Ohm	
Input impedance DP, DM	Z_{INP}	CC	300	–	–	kOhm	$0\ V \le V_{IN} \le V_{DDP}$
Driver output resistance DP, DM	Z_{DRV}	CC	28	–	44	Ohm	

1) Measured at A-connector with 1.5 kOhm ± 5% to 3.3 V ± 0.3 V connected to USB_DP or USB_DM and at B-connector with 15 kOhm ± 5% to ground connected to USB_DP and USB_DM.

3.2.9 Oscillator Pins

Note: It is strongly recommended to measure the oscillation allowance (negative resistance) in the final target system (layout) to determine the optimal parameters for the oscillator operation. Please refer to the limits specified by the crystal or ceramic resonator supplier.

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

The oscillator pins can be operated with an external crystal (see **Figure 21**) or in direct input mode (see **Figure 22**).

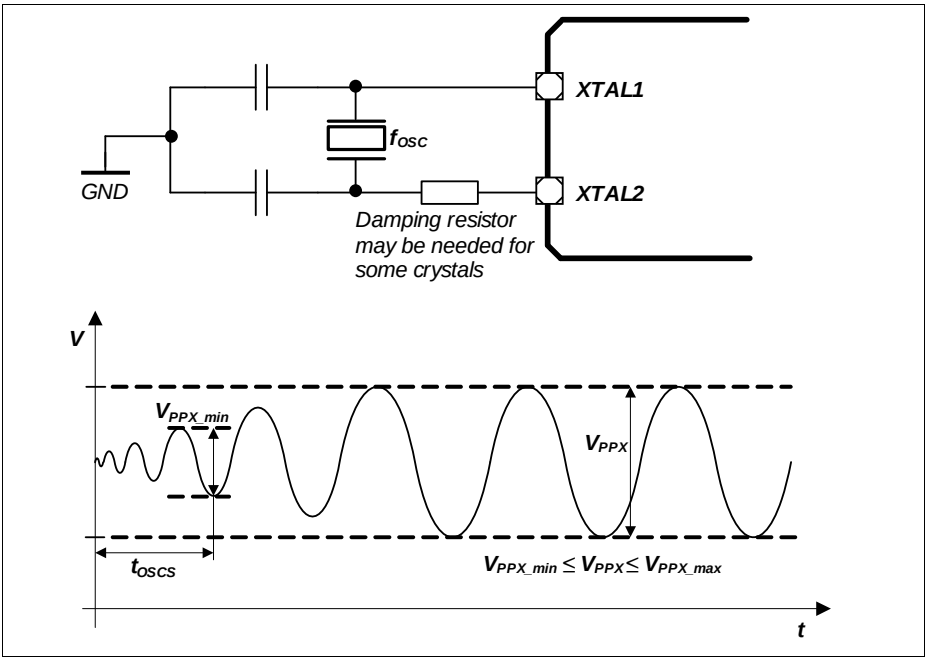


Figure 21 Oscillator in Crystal Mode

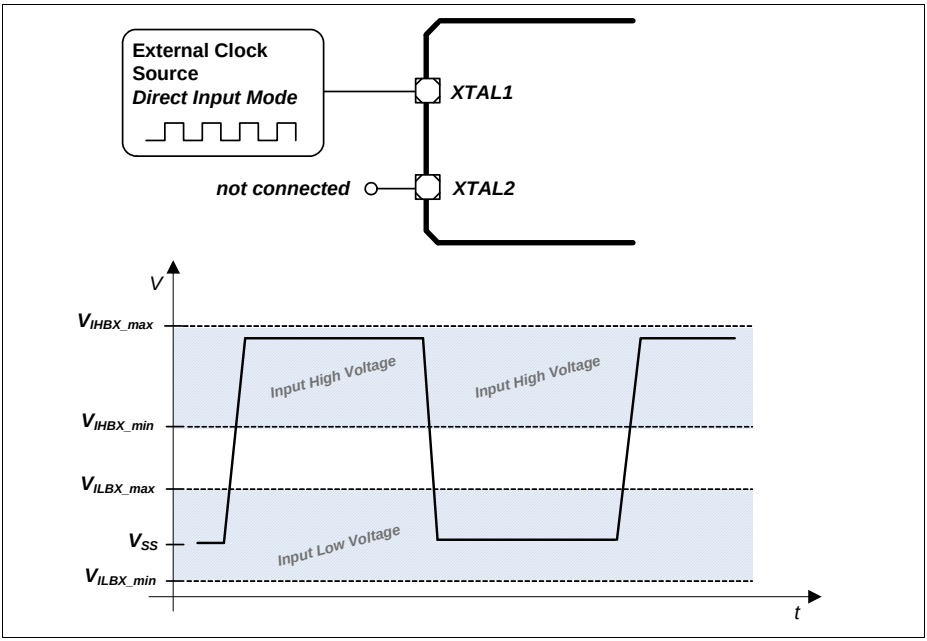


Figure 22 Oscillator in Direct Input Mode

Table 37 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)3)]	t_{OSCS} CC	–	–	5	s	
Input voltage at RTC_XTAL1	V_{IX} SR	-0.3	–	V_{BAT} + 0.3	V	
Input amplitude (peak-to-peak) at RTC_XTAL1[2)4)]	V_{PPX} SR	0.4	–	–	V	
Input high voltage at RTC_XTAL1[5)]	V_{IHBX}SR	0.6 × V_{BAT}	–	V_{BAT} + 0.3	V	
Input low voltage at RTC_XTAL1[5)]	V_{ILBX} SR	-0.3	–	0.36 × V_{BAT}	V	
Input Hysteresis for RTC_XTAL1[5)6)]	V_{HYSX} CC	0.1 × V_{BAT}		–	V	3.0 V ≤ V_{BAT} < 3.6 V
		0.03 × V_{BAT}		–	V	V_{BAT} < 3.0 V
Input leakage current at RTC_XTAL1	I_{ILX1} CC	-100	–	100	nA	Oscillator power down 0 V ≤ V_{IX} ≤ V_{BAT}

1) t_{OSCS} is defined from the moment the oscillator is enabled by the user with SCU_OSCULCTRL.MODE until the oscillations reach an amplitude at RTC_XTAL1 of 400 mV.

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) For a reliable start of the oscillation in crystal mode it is required that $V_{BAT} \geq 3.0$ V. A running oscillation is maintained across the full V_{BAT} voltage range.

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

5) If the shaper unit is bypassed, dedicated DC-thresholds have to be met.

6) Hysteresis is implemented to avoid metastable states and switching due to internal ground bounce. It can not be guaranteed that it suppresses switching due to external system noise.

Table 40 Flash Memory Parameters

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Data Retention Time, User Configuration Block (UCB)[3)4)]	t_{RTU} CC	20	–	–	years	Max. 4 erase/program cycles per UCB
Endurance on 64 Kbyte Physical Sector PS4	N_{EPS4} CC	10000	–	–	cycles	BA-marking devices only! Cycling distributed over life time[5)]

1) In case the Program Verify feature detects weak bits, these bits will be programmed once more. The reprogramming takes an additional time of 5.5 ms.

2) The following formula applies to the wait state configuration: FCON.WSPFLASH × (1 / f_{CPU}) ≥ t_a.

3) Storage and inactive time included.

4) Values given are valid for an average weighted junction temperature of T_J = 110°C.

5) Only valid with robust EEPROM emulation algorithm, equally cycling the logical sectors. For more details see the Reference Manual.

3.3.4 Phase Locked Loop (PLL) Characteristics

Main and USB PLL

Table 43 PLL Parameters

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Accumulated Jitter	D_P CC	–	–	±5	ns	accumulated over 300 cycles f_{SYS} = 80 MHz
Duty Cycle[1)]	D_{DC} CC	46	50	54	%	Low pulse to total period, assuming an ideal input clock source
PLL base frequency	$f_{PLLBASE}$ CC	30	–	140	MHz	
VCO input frequency	f_{REF} CC	4	–	16	MHz	
VCO frequency range	f_{VCO} CC	260	–	520	MHz	
PLL lock-in time	t_L CC	–	–	400	µs	

1) 50% for even K2 divider values, 50±(10/K2) for odd K2 divider values.

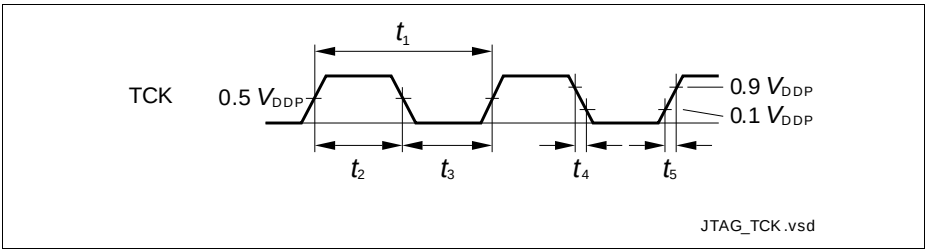


Figure 28 Test Clock Timing (TCK)

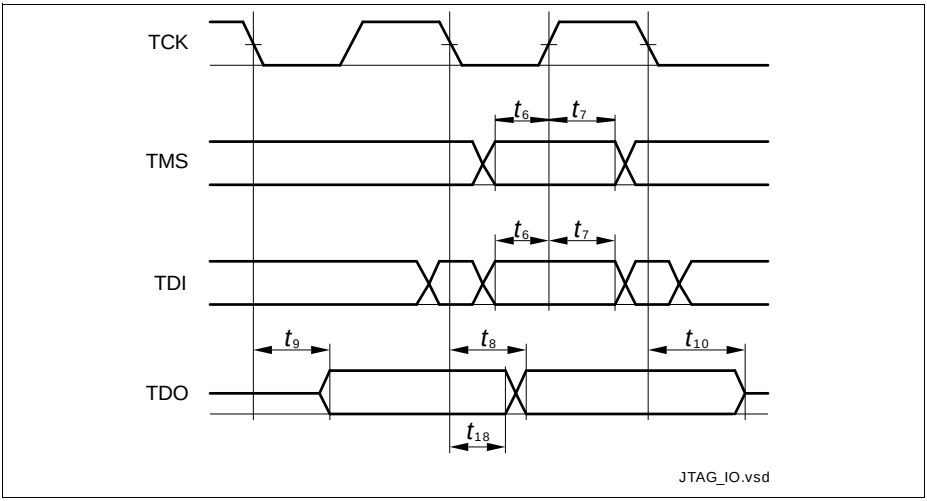


Figure 29 JTAG Timing

3.3.8 Peripheral Timing

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

Note: Operating conditions apply.

3.3.8.1 Synchronous Serial Interface (USIC SSC) Timing

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

Note: Operating Conditions apply.

Table 48 USIC SSC Master Mode Timing

Parameter	Symbol		Values			Unit	Note / Test Condition
			Min.	Typ.	Max.		
SCLKOUT master clock period	t_{CLK}	CC	40	–	–	ns	
Slave select output SELO active to first SCLKOUT transmit edge	t_1	CC	t_{SYS} - 6.5[1]	–	–	ns	
Slave select output SELO inactive after last SCLKOUT receive edge	t_2	CC	t_{SYS} - 8.5[1]	–	–	ns	
Data output DOUT[3:0] valid time	t_3	CC	-6	–	8	ns	
Receive data input DX0/DX[5:3] setup time to SCLKOUT receive edge	t_4	SR	23	–	–	ns	
Data input DX0/DX[5:3] hold time from SCLKOUT receive edge	t_5	SR	1	–	–	ns	

1) $t_{SYS} = 1 / f_{PB}$

4.2 Package Outlines

The availability of different packages for different devices types is listed in **Table 1**, specific packages for different device markings are listed in **Table 2**.

The exposed die pad dimensions are listed in **Table 55**.

Table 56 Differences PG-LQFP-64-19 to PG-TQFP-64-19

Change	PG-LQFP-64-19	PG-TQFP-64-19
Thermal Resistance Junction Ambient ($R_{\Theta JA}$)	30 K/W	23.4 K/W
Package thickness	$1.4^{\pm 0.05}$ mm	$1.0^{\pm 0.05}$ mm
	1.6 mm MAX	1.2 mm MAX
Exposed Die Pad size	5.8 mm × 5.8 mm	5.7 mm × 5.7 mm

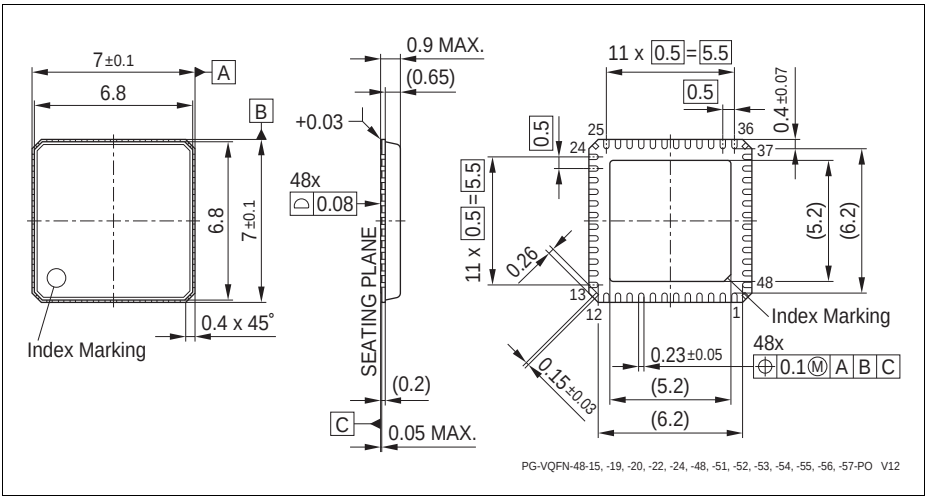


Figure 38 **PG-VQFN-48-53** (Plastic Green Very Thin Profile Flat Non Leaded Package)

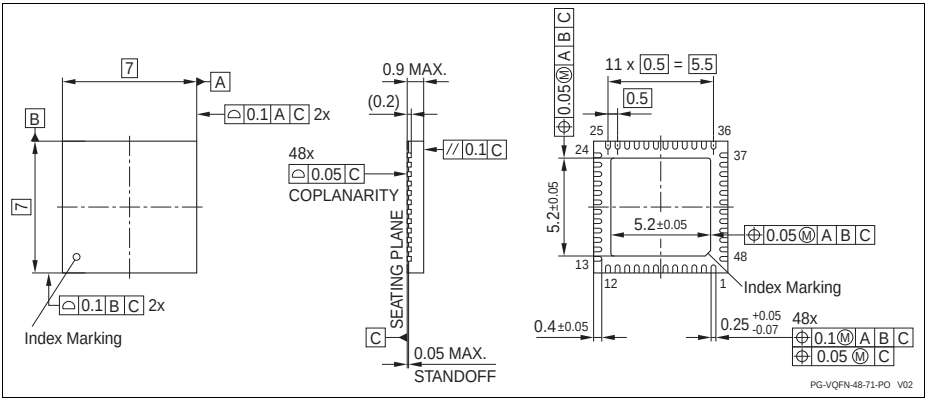


Figure 39 **PG-VQFN-48-71** (Plastic Green Very Thin Profile Flat Non Leaded Package)

All dimensions in mm.

You can find complete information about Infineon packages, packing and marking in our Infineon Internet Page “Packages”: **http://www.infineon.com/packages**