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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	e200z0h
Core Size	32-Bit Single-Core
Speed	64MHz
Connectivity	CANbus, LINbus, SPI, UART/USART
Peripherals	DMA, POR, PWM, WDT
Number of I/O	49
Program Memory Size	1MB (1M x 8)
Program Memory Type	FLASH
EEPROM Size	64K x 8
RAM Size	80K x 8
Voltage - Supply (Vcc/Vdd)	4.5V ~ 5.5V
Data Converters	A/D 16x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Surface Mount
Package / Case	100-LQFP
Supplier Device Package	100-LQFP (14x14)
Purchase URL	https://www.e-xfl.com/product-detail/stmicroelectronics/spc56ap60l3cefay

Table 1. Device summary

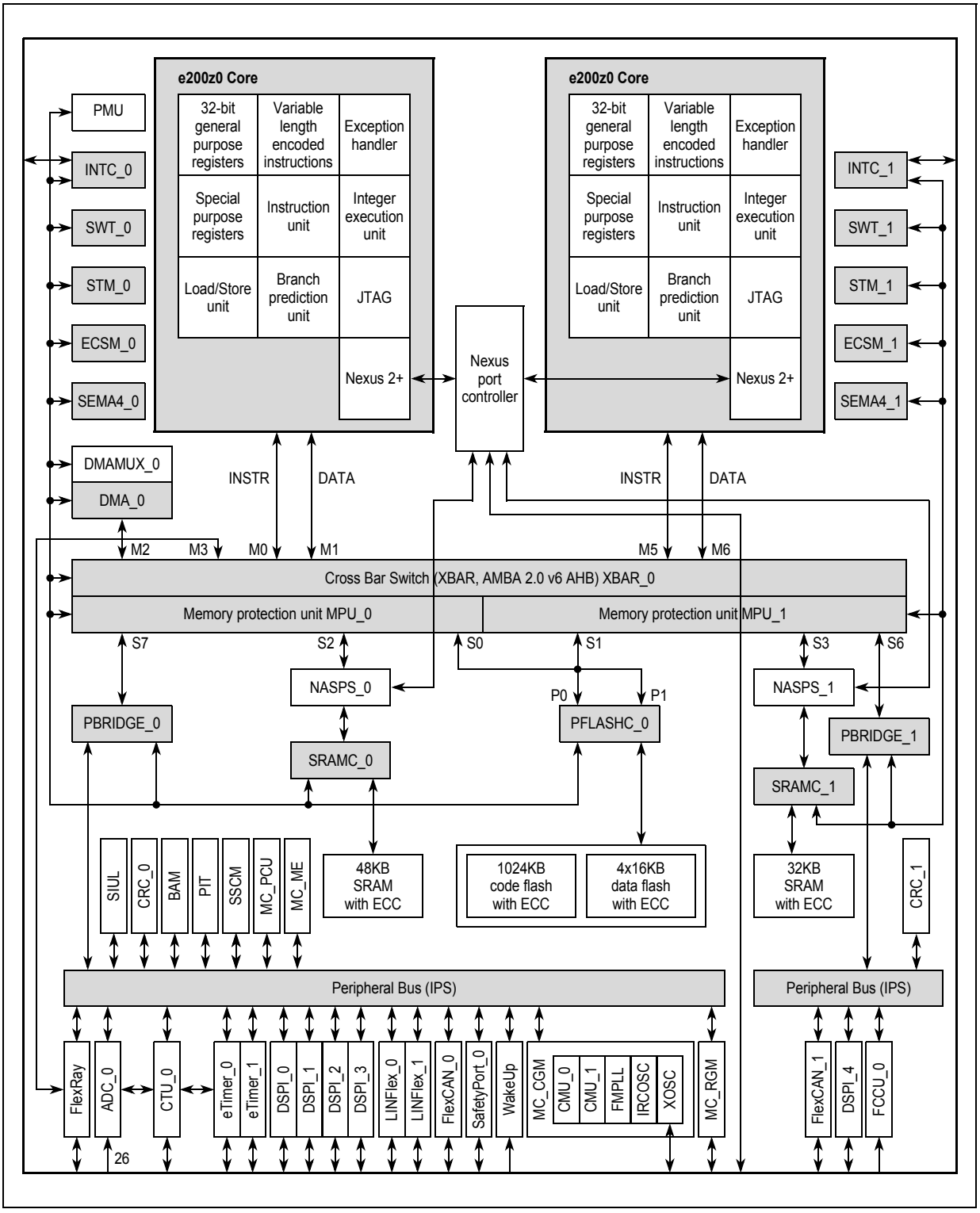
Package	Part number	
	768 KB Flash	1 MB Flash
LQFP144	SPC560P54L5 SPC56AP54L5	SPC560P60L5 SPC56AP60L5
LQFP100	SPC560P54L3 SPC56AP54L3	SPC560P60L3 SPC56AP60L3

Table 2. SPC56xP54x/SPC56xP60x device comparison (continued)

Feature		SPC560P54	SPC560P60	SPC56AP54	SPC56AP60
Enhanced DMA (direct memory access) channels		16			
FlexRay		Yes (64 message buffer)			
FlexCAN (controller area network)		3(1),(2)			
Safety port		Yes (via third FlexCAN module)			
FCCU (fault collection and control unit)		Yes(3)			
CTU (cross triggering unit)		Yes			
eTimer channels		2 × 6			
FlexPWM (pulse-width modulation) channels		No			
Analog-to-digital converters (ADC)		One (10-bit, 27-channel)(4)			
LINFlex modules		2 (1 × Master/Slave, 1 × Master only)(5)			
DSPI (deserial serial peripheral interface) modules		5(6)			
CRC (cyclic redundancy check) units		2(7)			
JTAG interface		Yes			
Nexus port controller (NPC)		Yes (Level 2+)(8)			
Supply	Digital power supply(9)	3.3 V or 5 V single supply with external transistor			
	Analog power supply	3.3 V or 5 V			
	Internal RC oscillator	16 MHz			
	External crystal oscillator	4–40 MHz			
Packages		LQFP100 LQFP144			LQFP100 LQFP144 LQFP176(10)
Temperature	Standard ambient temperature	–40 to 125 °C			

1. Each FlexCAN module has 32 message buffers.
2. One FlexCAN module can act as a Safety Port with a bit rate as high as 7.5 Mbit/s.
3. Enhanced FCCU version.
4. Same amount of ADC channels as on SPC560P44/50 not considering the internally connected ones. 26 channels on LQFP144 and 16 channels on LQFP100.
5. LinFlex_1 is Master Only.
6. Increased number of CS for DSPI_1.
7. Upgraded specification with addition of 8-bits polynomial (CRC-8 VDA CAN) support and 3rd context.
8. Improved debugging capability with data trace capability and increased Nexus throughput available on emulation package.
9. 3.3 V range and 5 V range correspond to different orderable parts.
10. Software development package only. Not available for production.

Figure 1. SPC56xP54x/SPC56xP60x block diagram



The crossbar provides the following features:

- 6 master ports:
  - 2 e200z0 core complex Instruction ports
  - 2 e200z0 core complex Load/Store Data ports
  - eDMA
  - FlexRay
- 6 slave ports:
  - 2 Flash memory (code flash and data flash)
  - 2 SRAM (48 KB + 32 KB)
  - 2 PBRIDGE
- 32-bit internal address, 32-bit internal data paths
- Fixed Priority Arbitration based on Port Master
- Temporary dynamic priority elevation of masters

1.5.3 Enhanced direct memory access (eDMA)

The enhanced direct memory access (eDMA) controller is a second-generation module capable of performing complex data movements via 16 programmable channels, with minimal intervention from the host processor. The hardware micro architecture includes a DMA engine which performs source and destination address calculations, and the actual data movement operations, along with an SRAM-based memory containing the transfer control descriptors (TCD) for the channels. This implementation is utilized to minimize the overall block size.

The eDMA module provides the following features:

- 16 channels support independent 8, 16 or 32-bit single value or block transfers
- Supports variable sized queues and circular queues
- Source and destination address registers are independently configured to post-increment or remain constant
- Each transfer is initiated by a peripheral, CPU, or eDMA channel request
- Each eDMA channel can optionally send an interrupt request to the CPU on completion of a single value or block transfer
- DMA transfers possible between system memories, DSPIs, ADC, eTimer and CTU
- Programmable DMA Channel Multiplexer for assignment of any DMA source to any available DMA channel with up to 30 potential request sources
- eDMA abort operation through software

1.5.4 On-chip flash memory with ECC

The SPC56xP54x/SPC56xP60x provides up to 1024 KB of programmable, non-volatile, flash memory. The non-volatile memory (NVM) can be used for instruction and/or data storage. The flash memory module interfaces the system bus to a dedicated flash memory array controller. It supports a 32-bit data bus width at the system bus port, and a 128-bit read data interface to flash memory. The module contains a four-entry, 4x128-bit prefetch buffers. Prefetch buffer hits allow no-wait responses. Normal flash memory array accesses are registered and are forwarded to the system bus on the following cycle, incurring 2 wait states.

1.5.13 Software watchdog timer (SWT)

The SWT has the following features:

- Fault tolerant output
- Safe internal RC oscillator as reference clock
- Windowed watchdog
- Program flow control monitor with 16-bit pseudorandom key generation

The SWT module is replicated for each processor.

1.5.14 Fault collection and control unit (FCCU)

The FCCU provides an independent fault reporting mechanism even if the CPU is exhibiting unstable behaviors. The FCCU module has the following features:

- Redundant collection of hardware checker results
- Redundant collection of error information and latch of faults from critical modules on the device
- Collection of self-test results
- Configurable and graded fault control
  - Internal reactions (no internal reaction, IRQ)
  - External reaction (failure is reported to the external/surrounding system via configurable output pins)

1.5.15 System integration unit (SIUL)

The SPC56xP54x/SPC56xP60x SIUL controls MCU pad configuration, external interrupts, general purpose I/O (GPIO) pin configuration, and internal peripheral multiplexing.

The pad configuration block controls the static electrical characteristics of I/O pins. The GPIO block provides uniform and discrete input/output control of the I/O pins of the MCU.

The SIUL provides the following features:

- Centralized general purpose input output (GPIO) control of input/output pins and analog input-only pads (package dependent)
- All GPIO pins can be independently configured to support pull-up, pull down, or no pull
- Reading and writing to GPIO supported both as individual pins and 16-bit wide ports
- All peripheral pins (except ADC channels) can be alternatively configured as both general purpose input or output pins
- ADC channels support alternative configuration as general purpose inputs
- Direct readback of the pin value is supported on all pins through the SIU
- Configurable digital input filter that can be applied to some general purpose input pins for noise elimination
  - Up to 4 internal functions can be multiplexed onto one pin

1.5.16 Boot and censorship

Different booting modes are available in the SPC56xP54x/SPC56xP60x:

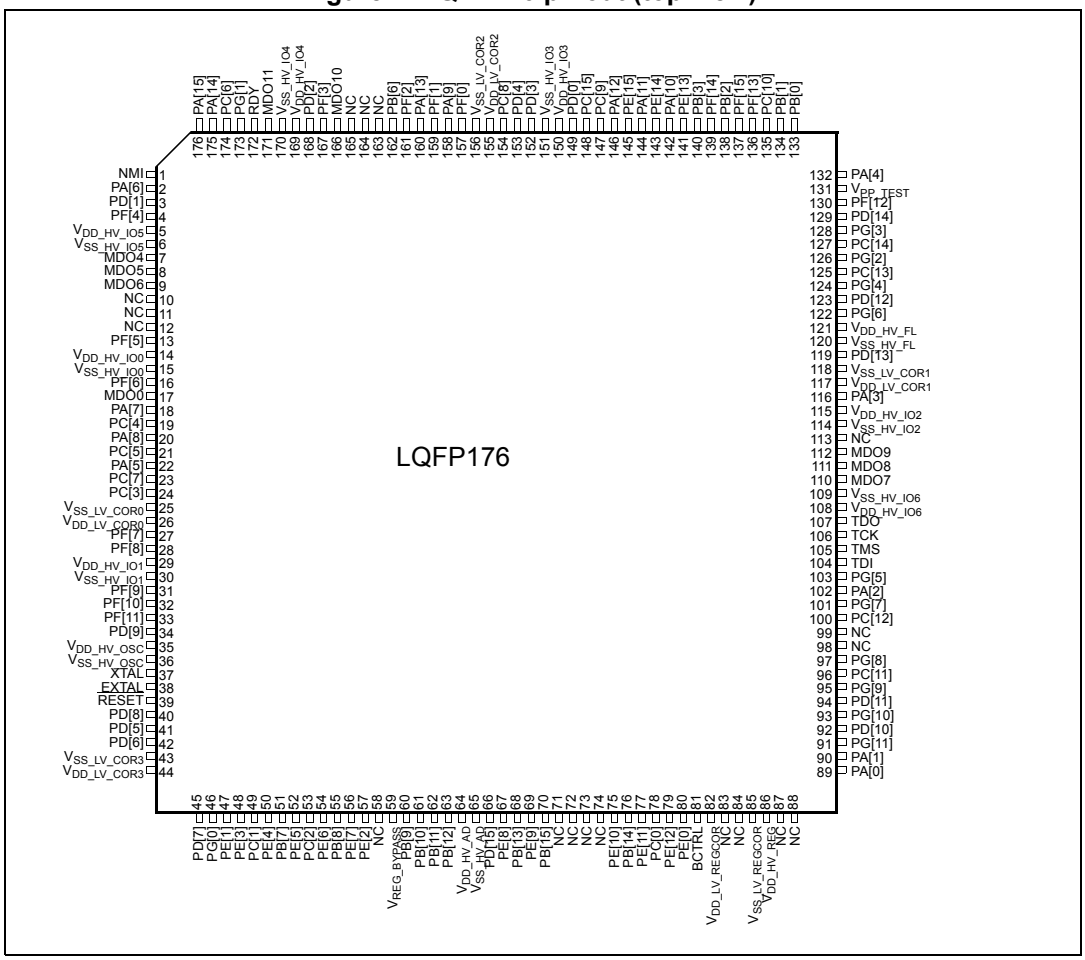
- From internal flash memory
- Via a serial link

2 Package pinouts and signal descriptions

2.1 Package pinouts

The LQFP pinouts are shown in the following figures.

Figure 2. LQFP176 pinout (top view)[b]



b. Software development package only. Not available for production.

Table 7. Pin muxing[1] (continued)

Port pin	PCR No.	Alternate function[2], [3]	Functions	Peripheral [4]	I/O direction [5]	Pad speed[6]		Pin		
						SRC = 0	SRC = 1	LQFP 100	LQFP 144	LQFP 176[7]
Port C										
C[0]	PCR[32]	ALT0 ALT1 ALT2 ALT3 —	GPIO[32] — — — AN[19]	SIUL — — — ADC_0	Input Only	—	—	45	66	78
C[1]	PCR[33]	ALT0 ALT1 ALT2 ALT3 —	GPIO[33] — — — AN[2]	SIUL — — — ADC_0	Input Only	—	—	28	41	49
C[2]	PCR[34]	ALT0 ALT1 ALT2 ALT3 —	GPIO[34] — — — AN[3]	SIUL — — — ADC_0	Input Only	—	—	30	45	53
C[3]	PCR[35]	ALT0 ALT1 ALT2 ALT3 —	GPIO[35] CS1_0 ETC[4] TXD EIRQ[21]	SIUL DSPI_0 eTimer_1 LINFlex_1 SIUL	I/O O I/O O I	Slow	Medium	10	16	24
C[4]	PCR[36]	ALT0 ALT1 ALT2 ALT3 —	GPIO[36] CS0_0 — DEBUG[4] EIRQ[22]	SIUL DSPI_0 — SSCM SIUL	I/O I/O — — I	Slow	Medium	5	11	19
C[5]	PCR[37]	ALT0 ALT1 ALT2 ALT3 —	GPIO[37] SCK_0 SCK_4 DEBUG[5] EIRQ[23]	SIUL DSPI_0 DSPI_4 SSCM SIUL	I/O I/O I/O — I	Slow	Medium	7	13	21
C[6]	PCR[38]	ALT0 ALT1 ALT2 ALT3 —	GPIO[38] SOUT_0 — DEBUG[6] EIRQ[24]	SIUL DSPI_0 — SSCM SIUL	I/O O — — I	Slow	Medium	98	142	174

Table 7. Pin muxing[1] (continued)

Port pin	PCR No.	Alternate function[2], [3]	Functions	Peripheral [4]	I/O direction [5]	Pad speed[6]		Pin		
						SRC = 0	SRC = 1	LQFP 100	LQFP 144	LQFP 176[7]
D[7]	PCR[55]	ALT0 ALT1 ALT2 ALT3 —	GPIO[55] CS3_1 — CS4_0 SIN_3	SIUL DSPI_1 — DSPI_0 DSPI_3	I/O O — O I	Slow	Medium	26	37	45
D[8]	PCR[56]	ALT0 ALT1 ALT2 ALT3	GPIO[56] CS2_1 RDY CS5_0	SIUL DSPI_1 nexus_0 DSPI_0	I/O O O O	Slow	Medium	21	32	40
D[9]	PCR[57]	ALT0 ALT1 ALT2 ALT3	GPIO[57] — TXD CS6_1	SIUL — LINFlex_1 DSPI_1	I/O — O O	Slow	Medium	15	26	34
D[10]	PCR[58]	ALT0 ALT1 ALT2 ALT3	GPIO[58] — CS0_3 —	SIUL — DSPI_3 —	I/O — I/O —	Slow	Medium	53	76	92
D[11]	PCR[59]	ALT0 ALT1 ALT2 ALT3	GPIO[59] — CS1_3 SCK_3	SIUL — DSPI_3 DSPI_3	I/O — O I/O	Slow	Medium	54	78	94
D[12]	PCR[60]	ALT0 ALT1 ALT2 ALT3 —	GPIO[60] — — CS7_1 RXD	SIUL — — DSPI_1 LINFlex_1	I/O — — O I	Slow	Medium	70	99	123
D[13]	PCR[61]	ALT0 ALT1 ALT2 ALT3	GPIO[61] — CS2_3 SOUT_3	SIUL — DSPI_3 DSPI_3	I/O — O O	Slow	Medium	67	95	119
D[14]	PCR[62]	ALT0 ALT1 ALT2 ALT3 —	GPIO[62] — CS3_3 — SIN_3	SIUL — DSPI_3 — DSPI_3	I/O — O — I	Slow	Medium	73	105	129
D[15]	PCR[63]	ALT0 ALT1 ALT2 ALT3 —	GPIO[63] — — — AN[20]	SIUL — — — ADC_0	Input Only	—	—	41	58	66

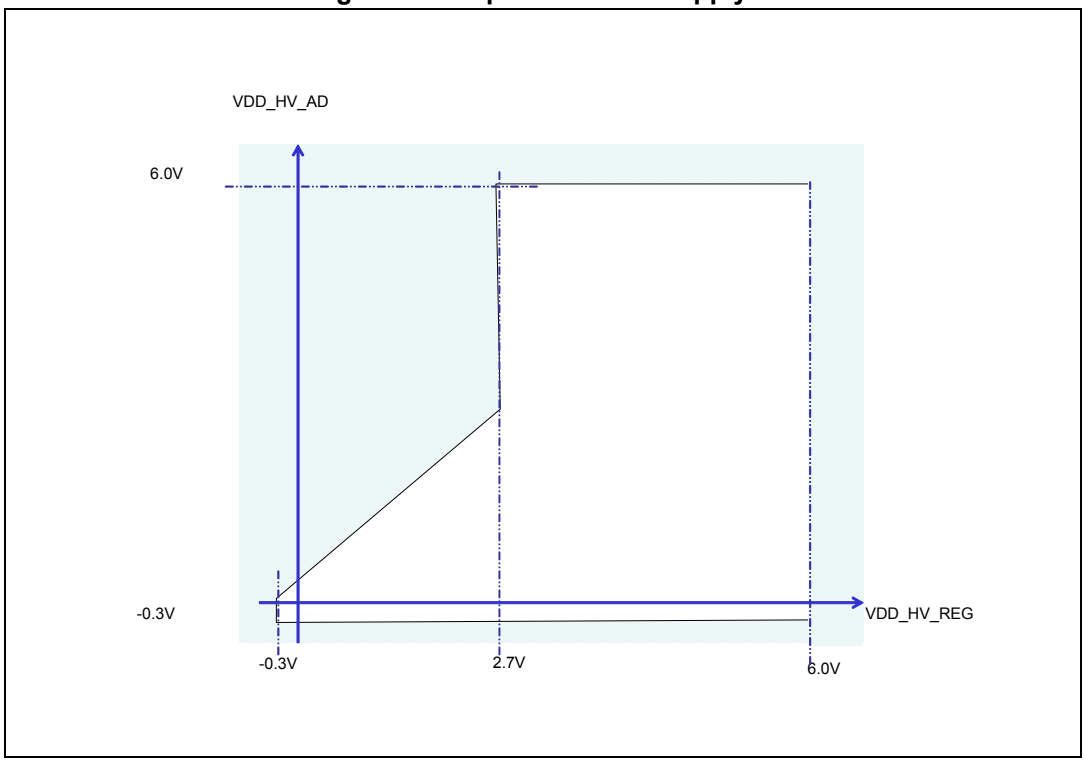
Table 7. Pin muxing[1] (continued)

Port pin	PCR No.	Alternate function[2], [3]	Functions	Peripheral [4]	I/O direction [5]	Pad speed[6]		Pin		
						SRC = 0	SRC = 1	LQFP 100	LQFP 144	LQFP 176[7]
E[7]	PCR[71]	ALT0 ALT1 ALT2 ALT3 —	GPIO[71] — — — AN[10]	SIUL — — — ADC_0	Input Only	—	—	—	48	56
E[8]	PCR[72]	ALT0 ALT1 ALT2 ALT3 —	GPIO[72] — — — AN[22]	SIUL — — — ADC_0	Input Only	—	—	—	59	67
E[9]	PCR[73]	ALT0 ALT1 ALT2 ALT3 —	GPIO[73] — — — AN[23]	SIUL — — — ADC_0	Input Only	—	—	—	61	69
E[10]	PCR[74]	ALT0 ALT1 ALT2 ALT3 —	GPIO[74] — — — AN[24]	SIUL — — — ADC_0	Input Only	—	—	—	63	75
E[11]	PCR[75]	ALT0 ALT1 ALT2 ALT3 —	GPIO[75] — — — AN[25]	SIUL — — — ADC_0	Input Only	—	—	—	65	77
E[12]	PCR[76]	ALT0 ALT1 ALT2 ALT3 —	GPIO[76] — — — AN[26]	SIUL — — — ADC_0	Input Only	—	—	—	67	79
E[13]	PCR[77]	ALT0 ALT1 ALT2 ALT3 —	GPIO[77] SCK_3 — — EIRQ[25]	SIUL DSPI_3 — — SIUL	I/O I/O — — I	Slow	Medium	—	117	141
E[14]	PCR[78]	ALT0 ALT1 ALT2 ALT3 —	GPIO[78] SOUT_3 — — EIRQ[26]	SIUL DSPI_3 — — SIUL	I/O O — — I	Slow	Medium	—	119	143

Table 7. Pin muxing[1] (continued)

Port pin	PCR No.	Alternate function[2], [3]	Functions	Peripheral [4]	I/O direction [5]	Pad speed[6]		Pin		
						SRC = 0	SRC = 1	LQFP 100	LQFP 144	LQFP 176[7]
Port G										
G[0]	PCR[96]	ALT0 ALT1 ALT2 ALT3 —	GPIO[96] F[0] — — EIRQ[30]	SIUL FCCU — — SIUL	I/O O — — I	Slow	Medium	—	38	46
G[1]	PCR[97]	ALT0 ALT1 ALT2 ALT3 —	GPIO[97] F[1] — — EIRQ[31]	SIUL FCCU — — SIUL	I/O O — — I	Slow	Medium	—	141	173
G[2]	PCR[98]	ALT0 ALT1 ALT2 ALT3 —	GPIO[98] — — — SIN_4	SIUL — — — DSPI_4	I/O — — — I	Slow	Medium	—	102	126
G[3]	PCR[99]	ALT0 ALT1 ALT2 ALT3	GPIO[99] — SOUT_4 —	SIUL — DSPI_4 —	I/O — O —	Slow	Medium	—	104	128
G[4]	PCR[100]	ALT0 ALT1 ALT2 ALT3	GPIO[100] — SCK_4 —	SIUL — DSPI_4 —	I/O — I/O —	Slow	Medium	—	100	124
G[5]	PCR[101]	ALT0 ALT1 ALT2 ALT3	GPIO[101] — CS0_4 —	SIUL — DSPI_4 —	I/O — I/O —	Slow	Medium	—	85	103
G[6]	PCR[102]	ALT0 ALT1 ALT2 ALT3	GPIO[102] — CS1_4 —	SIUL — DSPI_4 —	I/O — O —	Slow	Medium	—	98	122
G[7]	PCR[103]	ALT0 ALT1 ALT2 ALT3	GPIO[103] — CS2_4 —	SIUL — DSPI_4 —	I/O — O —	Slow	Medium	—	83	101

Figure 6. Independent ADC supply[e]



3.4 Recommended operating conditions

Table 10. Recommended operating conditions (5.0 V)

Symbol		Parameter	Conditions	Min	Max[1]	Unit
V_{SS_HV}	SR	Digital ground	—	0	0	V
$V_{DD\_HV\_IOx}$[2]	SR	5.0 V input/output supply voltage	—	4.5	5.5	V
$V_{SS\_HV\_IOx}$	SR	Input/output ground voltage	—	0	0	V
$V_{DD\_HV\_FL}$	SR	5.0 V code and data flash memory supply voltage	—	4.5	5.5	V
			Relative to $V_{DD\_HV\_IOx}$	$V_{DD\_HV\_IOx}$ – 0.1	$V_{DD\_HV\_IOx}$ + 0.1	
$V_{SS\_HV\_FL}$	SR	Code and data flash memory ground	—	0	0	V
$V_{DD\_HV\_OSC}$	SR	5.0 V crystal oscillator amplifier supply voltage	—	4.5	5.5	V
			Relative to $V_{DD\_HV\_IOx}$	$V_{DD\_HV\_IOx}$ – 0.1	$V_{DD\_HV\_IOx}$ + 0.1	
$V_{SS\_HV\_OSC}$	SR	5.0 V crystal oscillator amplifier reference voltage	—	0	0	V

e. Device design targets the removal of this conditions. To be confirmed by design during device validation.

Table 11. Recommended operating conditions (3.3 V) (continued)

Symbol		Parameter	Conditions	Min	Max(1)	Unit
$V_{DD\_HV\_REG}$	SR	3.3 V voltage regulator supply voltage	—	3.0	3.6	V
			Relative to $V_{DD\_HV\_IOx}$	$V_{DD\_HV\_IOx}$ – 0.1	$V_{DD\_HV\_IOx}$ + 0.1	
$V_{DD\_HV\_AD}$	SR	3.3 V ADC supply and high reference voltage	—	3.0	5.5	V
			Relative to $V_{DD\_HV\_REG}$	$V_{DD\_HV\_REG}$ – 0.1	5.5	
$V_{SS\_HV\_AD}$	SR	ADC ground and low reference voltage	—	0	0	V
$V_{DD\_LV\_REGCOR}$(3),(4)	SR	Internal supply voltage	—	—	—	V
$V_{SS\_LV\_REGCOR}$(3)	SR	Internal reference voltage	—	0	0	V
$V_{DD\_LV\_CORx}$(3),(4)	SR	Internal supply voltage	—	—	—	V
$V_{SS\_LV\_CORx}$(3)	SR	Internal reference voltage	—	0	0	V
T_A	SR	Ambient temperature under bias	—	–40	125	°C

1. Parametric figures can be out of specification when voltage drops below 4.5 V, however, guaranteeing the full functionality. In particular, ADC electrical characteristics and I/Os DC electrical specification may not be guaranteed.
2. The difference between each couple of voltage supplies must be less than 100 mV, $|V_{DD\_HV\_IOy} – V_{DD\_HV\_IOx}| < 100$ mV.
3. To be connected to emitter of external NPN. Low voltage supplies are not under user control—these are produced by an on-chip voltage regulator—but for the device to function properly the low voltage grounds ($V_{SS\_LV\_xxx}$) must be shorted to high voltage grounds ($V_{SS\_HV\_xxx}$) and the low voltage supply pins ($V_{DD\_LV\_xxx}$) must be connected to the external ballast emitter.
4. The low voltage supplies ($V_{DD\_LV\_xxx}$) are not all independent.
$V_{DD\_LV\_COR1}$ and $V_{DD\_LV\_COR2}$ are shorted internally via double bonding connections with lines that provide the low voltage supply to the data flash memory module. Similarly, $V_{SS\_LV\_COR1}$ and $V_{SS\_LV\_COR2}$ are internally shorted.
$V_{DD\_LV\_REGCOR}$ and $V_{DD\_LV\_REGCORx}$ are physically shorted internally, as are $V_{SS\_LV\_REGCOR}$ and $V_{SS\_LV\_CORx}$.

Figure 7 shows the constraints of the different power supplies.

Table 23. Supply current (3.3 V, NVUSRO[PAD3V5V]=1)

Symbol		Parameter		Conditions		Value		Unit
						Typ	Max	
$I_{DD\_LV\_CORE}$	T	Supply current	RUN — Maximum Mode(1)	$V_{DD\_LV\_CORE}$ externally forced at 1.3 V ADC Freq = 32 MHz PLL Freq = 64 MHz	64 MHz	90	120	mA
			RUN - Platform consumption, single core(2)	VDD_LV_CORE externally forced to 1.3V	16 MHz	21	37	
					40 MHz	35	55	
					64 MHz	48	72	
			RUN - Platform consumption, dual core(3)		16 MHz	24	41	
					40 MHz	42	64	
					64 MHz	58	85	
	P		RUN — Maximum Mode(4)	$V_{DD\_LV\_CORE}$ externally forced at 1.3 V	64 MHz	85	113	
			HALT Mode(5)	$V_{DD\_LV\_CORE}$ externally forced at 1.3 V	—	5.5	15	
			STOP Mode(6)	$V_{DD\_LV\_CORE}$ externally forced at 1.3 V	—	4.5	13	
I_{DD_FLASH}	D		Flash memory supply current during read	$V_{DD\_HV\_FL}$ at 3.3 V	—	—	14	
			Flash memory supply current during erase operation on 1 flash memory module	$V_{DD\_HV\_FL}$ at 3.3 V	—	—	42	
I_{DD_ADC}	T		ADC supply current — Maximum Mode	$V_{DD\_HV\_AD}$ at 3.3 V ADC Freq = 16 MHz	—	3	4	
I_{DD_OSC}	T		OSC supply current	V_{DD_OSC} at 3.3 V	8 MHz	2.4	3	

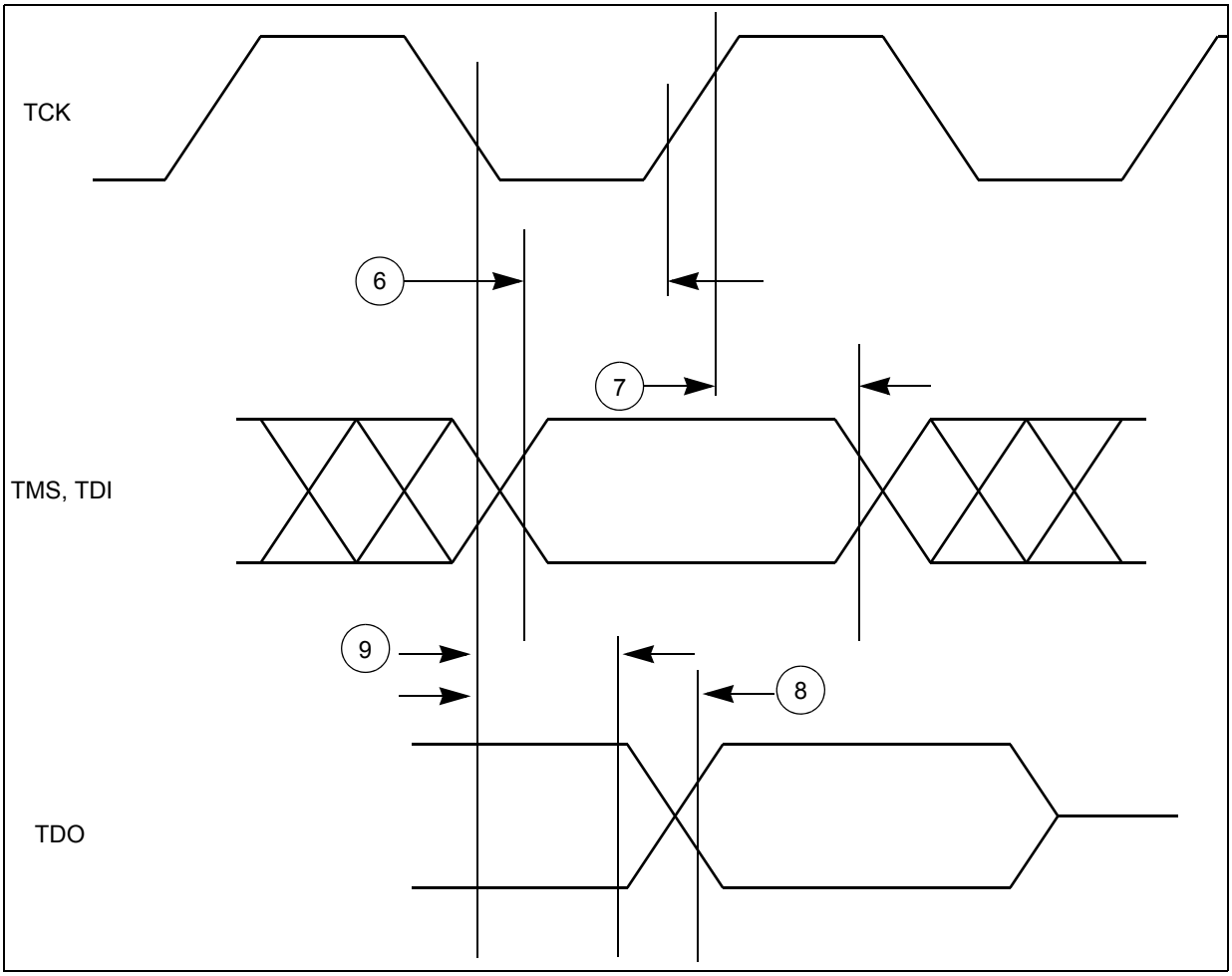
1. Maximum mode configuration: Code fetched from Flash executed by dual core, SIUL, PIT, ADC_0, eTimer_0/1, LINFlex_0/1, STM, INTC_0/1, DSPI_0/1/2/3/4, FlexCAN_0/1, FlexRay (static consumption), CRC_0/1, FCCU, SRAM enabled. I/O supply current excluded.
2. RAM, Code and Data Flash powered, code fetched from Flash executed by single core, all peripherals gated; IRC16MHz on, PLL64MHz OFF (except for code running at 64 MHz).
Code is performing continuous data transfer from Flash to RAM.
3. RAM, Code and Data Flash powered, code fetched from Flash executed by dual core, all peripherals gated; IRC16MHz on, PLL64MHz OFF (except for code running at 64 MHz).
Code is performing continuous data transfer from Flash to RAM.
4. Maximum mode configuration: Code fetched from RAM executed by dual core, SIUL, PIT, ADC_0, eTimer_0/1, LINFlex_0/1, STM, INTC_0/1, DSPI_0/1/2/3/4, FlexCAN_0/1, FlexRay (static consumption), CRC_0/1, FCCU, SRAM enabled. I/O supply current excluded.
5. HALT mode configuration, only for the “P” classification: Code Flash memory in low power mode, data Flash memory in power down mode, OSC/PLL are OFF, FIRC is ON, Core clock gated, all peripherals are disabled.
6. STOP mode configuration, only for the “P” classification: Code and data Flash memories in power down mode, OSC/PLL are OFF, FIRC is ON, Core clock gated, all peripherals are disabled.

3.15.2 ADC conversion characteristics

Table 32. ADC conversion characteristics

Symbol		Parameter	Conditions[1]	Value			Unit
				Min	Typ	Max	
V_{INAN}	SR	Analog input voltage[2]	—	$V_{SS\_HV\_AD}$ – 0.3	—	$V_{SS\_HV\_AD}$ + 0.3	V
f_{CK}	SR	ADC Clock frequency (depends on ADC configuration) (The duty cycle depends on AD_clk[3] frequency)	—	3[4]	—	60	MHz
f_s	SR	Sampling frequency	—	—	—	1.53	MHz
t_{ADC_S}	D	Sample time[5]	f_{ADC} = 20 MHz, INPSAMP = 3	125	—	—	ns
			f_{ADC} = 9 MHz, INPSAMP = 255	—	—	28.2	µs
t_{ADC_C}	P	Conversion time[6]	f_{ADC} = 20 MHz[7], INPCMP = 1	0.650	—	—	µs
C_S[8]	D	ADC input sampling capacitance	—	—	—	2.5	pF
C_{P1}[8]	D	ADC input pin capacitance 1	—	—	—	3	pF
C_{P2}[8]	D	ADC input pin capacitance 2	—	—	—	1	pF
C_{P3}[8]	D	ADC input pin capacitance 3	—	—	—	1	pF
R_{SW1}[8]	D	Internal resistance of analog source	$V_{DD\_HV\_AD}$ = 5 V ±10%	—	—	0.6	kΩ
			$V_{DD\_HV\_AD}$ = 3.3 V ±10%	—	—	3	kΩ
R_{SW2}[8]	D	Internal resistance of analog source	$V_{DD\_HV\_AD}$ = 5 V ±10%	—	—	2.15	kΩ
			$V_{DD\_HV\_AD}$ = 3.3 V ±10%	—	—	3.6	kΩ
R_{AD}[8]	D	Internal resistance of analog source	—	—	—	2	kΩ
I_{INJ}	T	Input current injection	Current injection on one ADC input, different from the converted one. Remains within TUE spec.	–5	—	5	mA
INL	P	Integral Non Linearity	No overload	—	±1.5	—	LSB
DNL	P	Differential Non Linearity	No overload	–1.0	—	1.0	LSB
OFS	T	Offset error	—	—	±1	—	LSB
GNE	T	Gain error	—	—	±1	—	LSB
TUE	P	Total unadjusted error without current injection	16 precision channels	–2.5	—	2.5	LSB

Figure 27. Nexus TDI, TMS, TDO timing



3.18.4 External interrupt timing (IRQ pin)

Table 40. External interrupt timing[1]

No.	Symbol		C	Parameter	Conditions	Min	Max	Unit
1	t_{IPWL}	CC	D	IRQ pulse width low	—	4	—	t_{CYC}
2	t_{IPWH}	CC	D	IRQ pulse width high	—	4	—	t_{CYC}
3	t_{ICYC}	CC	D	IRQ edge to edge time[2]	—	4 + N [3]	—	t_{CYC}

1. IRQ timing specified at f_{SYS} = 64 MHz and $V_{DD\_HV\_IOx}$ = 3.0 V to 5.5 V, $T_A = T_L$ to T_H, and CL = 200pF with SRC = 0b00.
2. Applies when IRQ pins are configured for rising edge or falling edge events, but not both.
3. N= ISR time to clear the flag.

Figure 30. DSPI classic SPI timing — master, CPHA = 1

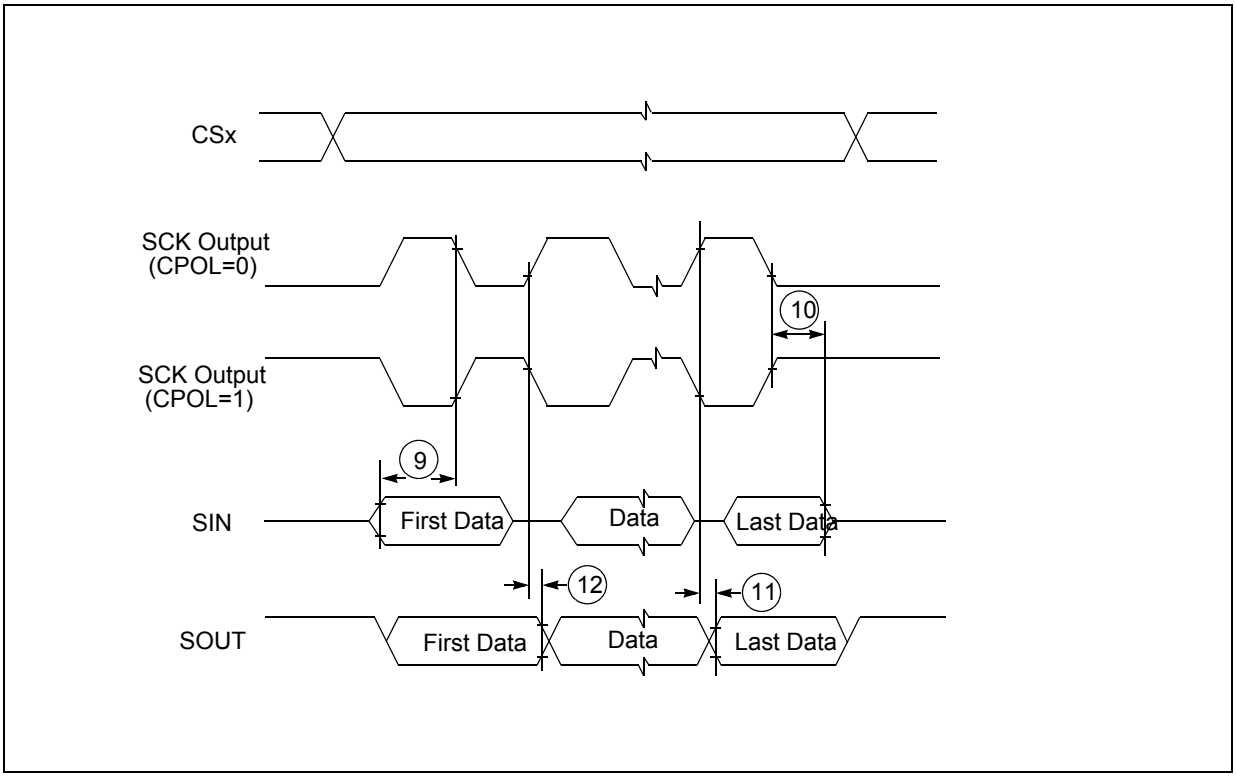


Figure 31. DSPI classic SPI timing — slave, CPHA = 0

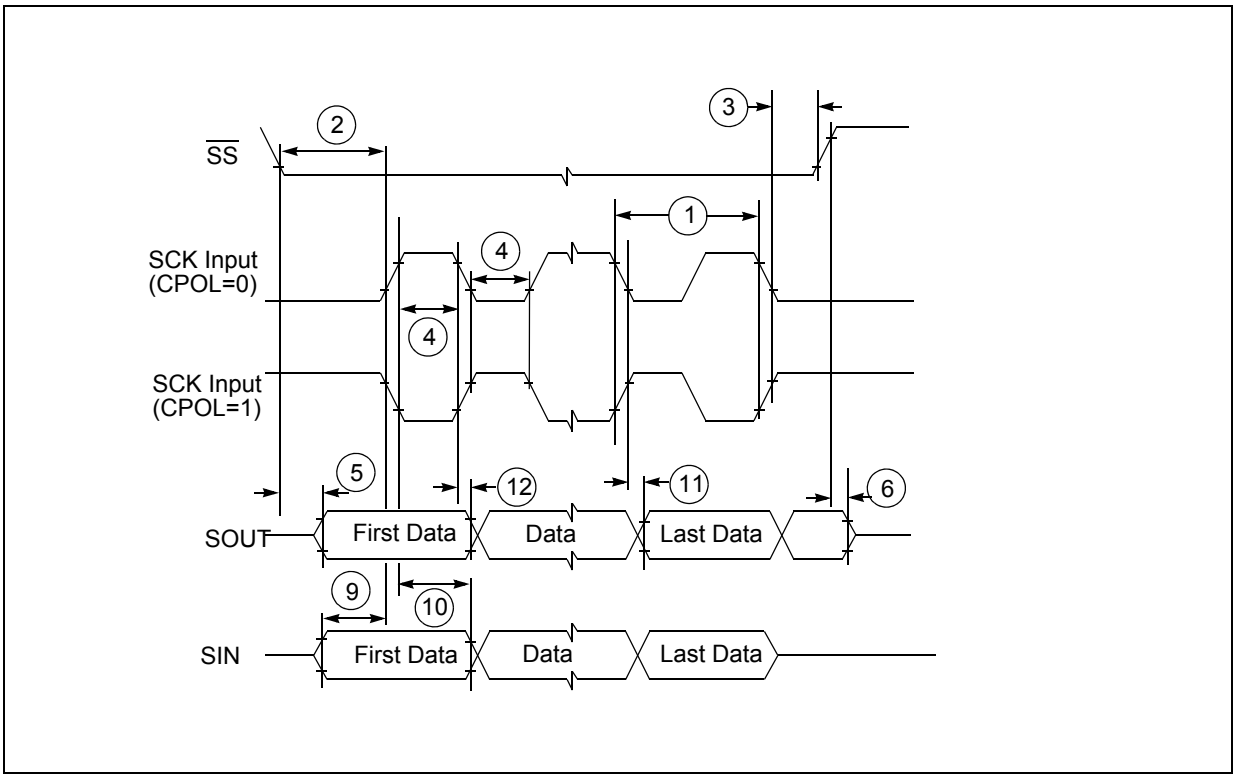


Figure 34. DSPI modified transfer format timing — master, CPHA = 1

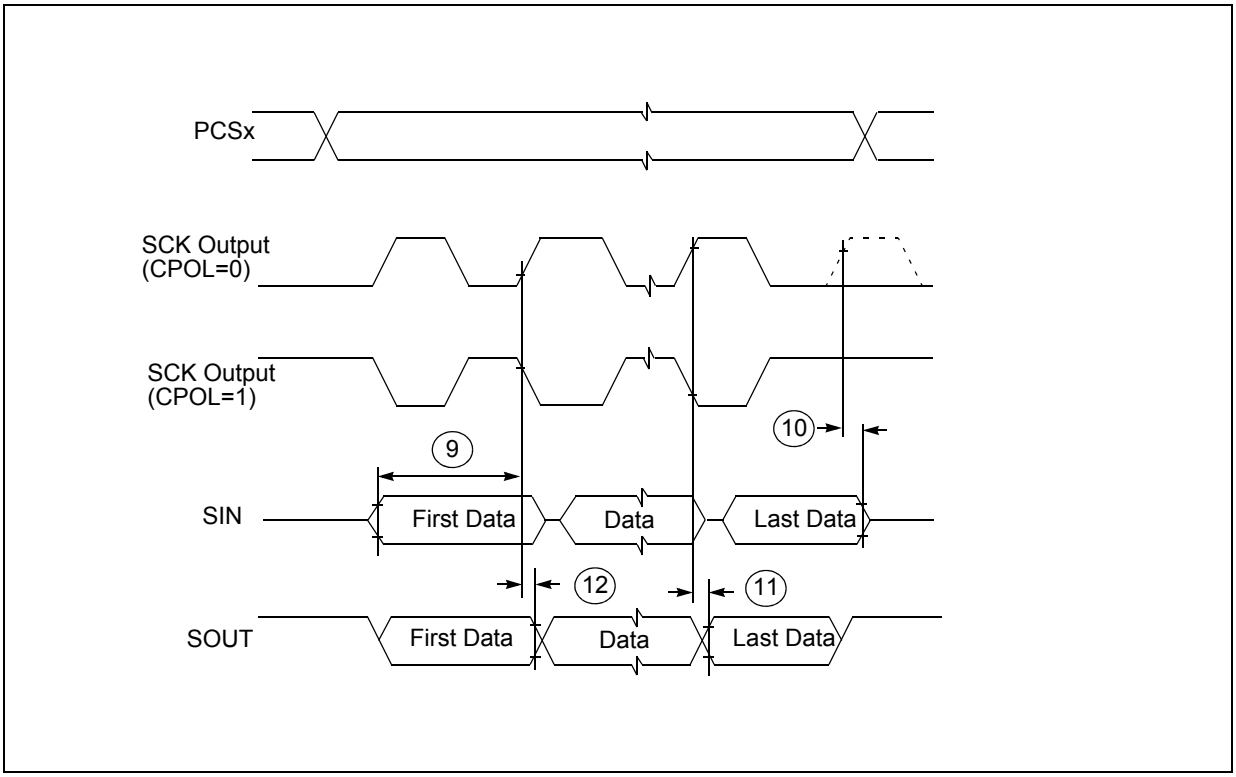


Figure 35. DSPI modified transfer format timing — slave, CPHA = 0

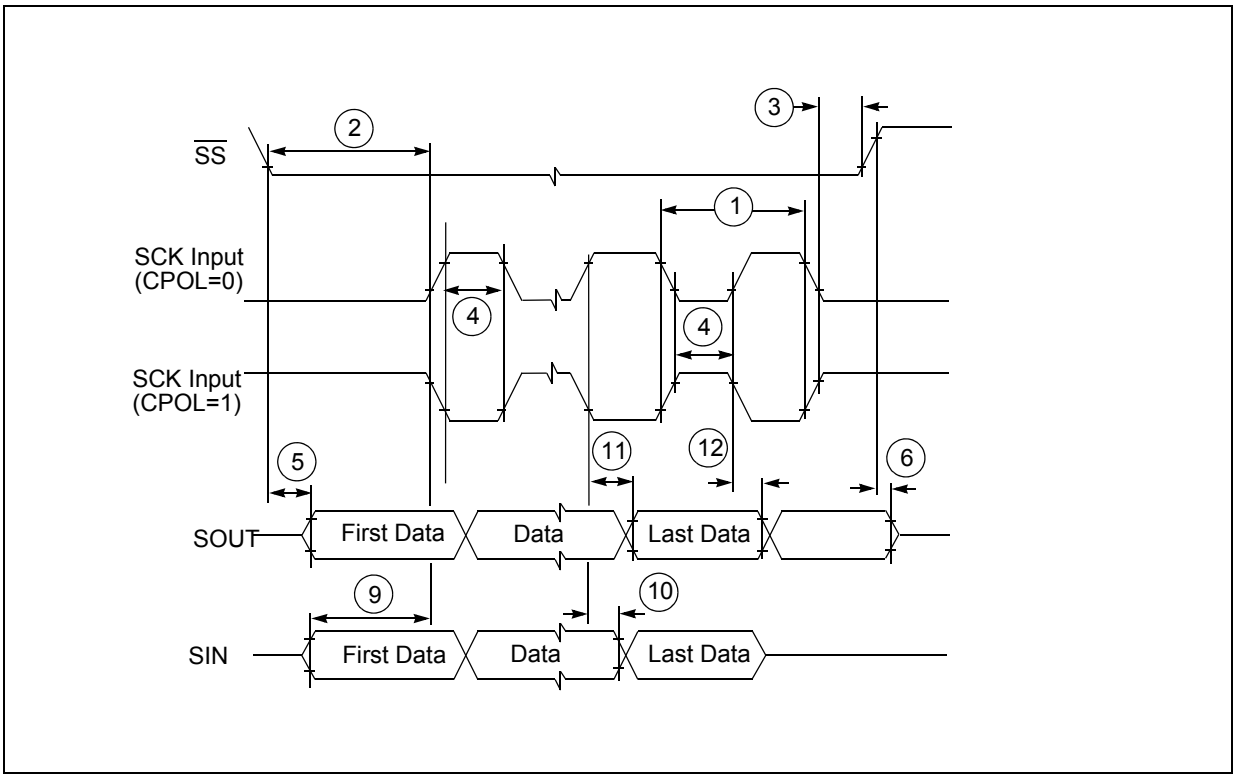


Table 42. LQFP144 mechanical data

Symbol	mm			inches[1]		
	Min	Typ	Max	Min	Typ	Max
A	—	—	1.600	—	—	0.0630
A1	0.050	—	0.150	0.0020	—	0.0059
A2	1.350	1.400	1.450	0.0531	0.0551	0.0571
b	0.170	0.220	0.270	0.0067	0.0087	0.0106
c	0.090	—	0.200	0.0035	—	0.0079
D	21.800	22.000	22.200	0.8583	0.8661	0.8740
D1	19.800	20.000	20.200	0.7795	0.7874	0.7953
D3	—	17.500	—	—	0.6890	—
E	21.800	22.000	22.200	0.8583	0.8661	0.8740
E1	19.800	20.000	20.200	0.7795	0.7874	0.7953
E3	—	17.500	—	—	0.6890	—
e	—	0.500	—	—	0.0197	—
L	0.450	0.600	0.750	0.0177	0.0236	0.0295
L1	—	1.000	—	—	0.0394	—
k	0.0 °	3.5 °	7.0°	3.5 °	0.0 °	7.0 °
ccc[2]	0.080			0.0031		

1. Values in inches are converted from mm and rounded to 4 decimal digits.
2. Tolerance.

4.2.2 LQFP100 mechanical outline drawing

Figure 39. LQFP100 package mechanical drawing

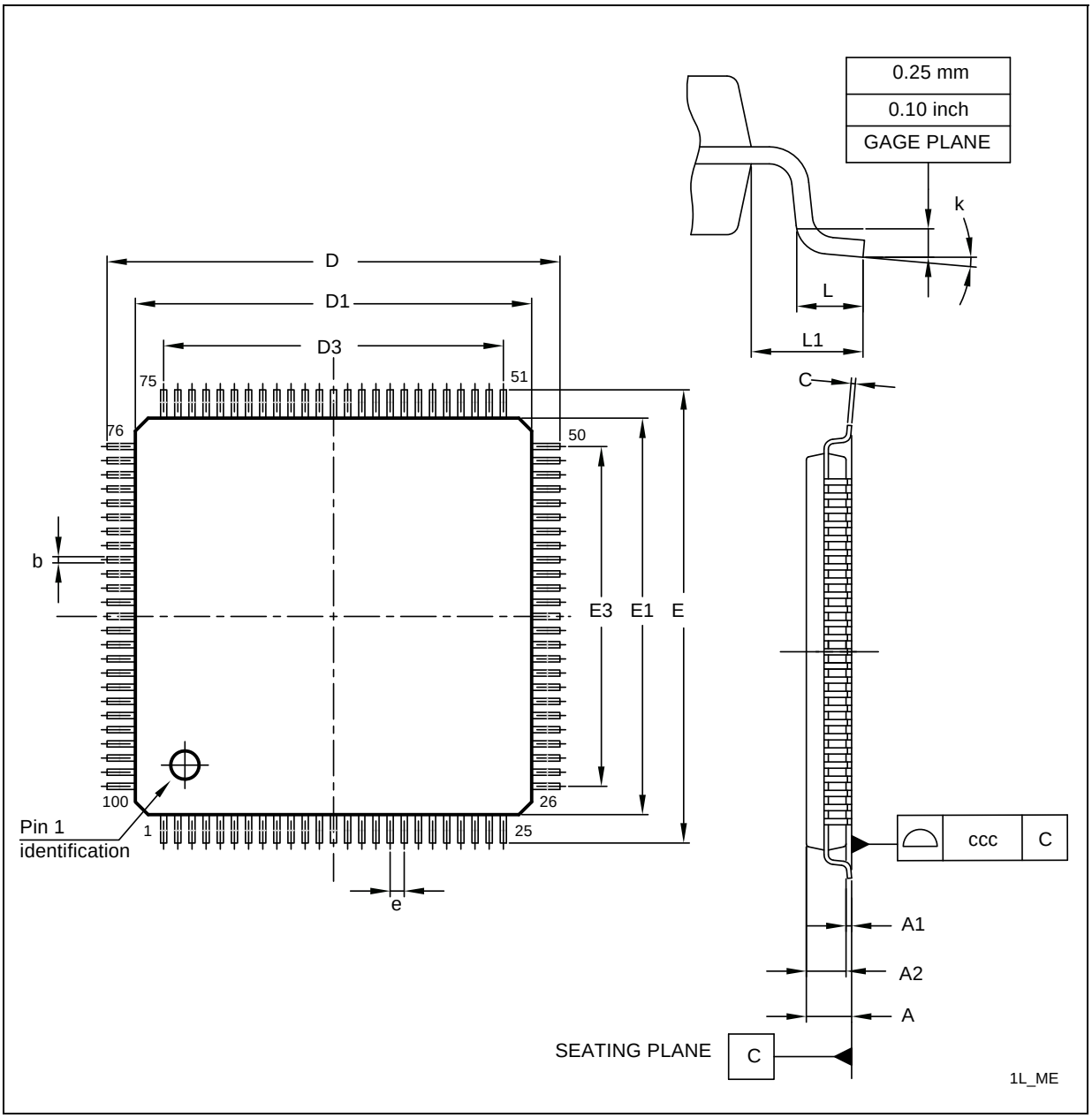


Table 43. LQFP100 mechanical data

Symbol	mm			inches[1]		
	Min	Typ	Max	Min	Typ	Max
A	—	—	1.600	—	—	0.0630
A1	0.050	—	0.150	0.0020	—	0.0059
A2	1.350	1.400	1.450	0.0531	0.0551	0.0571

Table 44. Document revision history (continued)

Date	Revision	Substantive changes
21-Nov-2012	4	In the cover page, replaced “64 MHz, dual issue, 32-bit CPU core complex” with “64 MHz, single issue, 32-bit CPU core complex” *Table 9: Absolute maximum ratings*, updated TV_{DD} entry *Table 22: DC electrical characteristics (3.3 V, NVUSRO[PAD3V5V]=1)*: Updated conditions value of V_{OL_F} to 11 mA Updated conditions value of V_{OH_F} to – 11 mA *Table 24: Peripherals supply current (5 V and 3.3 V)*: Replaced all occurrences of I_{DD_BV} in this table with I_{DD_HV} Replaced all occurrences of VDD_BV in this table with VDD_HV_REG. *Figure 40: Ordering information scheme*, fixed typo in the footnote.
18-Sep-2013	5	Updated Disclaimer.
15-Jun-2016	6	Added “AEC-Q10x qualified” in *Features* section. In *Table 2: SPC56xP54x/SPC56xP60x device comparison* added footnote “LinFlex_1 is Master Only.” related to row “LINFlex modules” Updated *Table 3: SPC56xP54x/SPC56xP60x device configuration difference* *Figure 2: LQFP176 pinout (top view)*: – Changed PB[4] to TDO – Changed PB[5] to TDI – Changed pins 71,72 to NC – Changed pins 87,88 to NC In *Section 1.5.27: Nexus development interface (NDI)*, added note “At least one TCK clock is necessary for the EVTI signal to be recognized by the MCU.” for EVTI pin. In *Table 7: Pin muxing*: – Replaced “PCR register” with “PCR No.” – Updated “CS3” with “CS3_4” function related to A[2] port pin – In column “I/O direction”, added “O” for “DSPI_1” peripheral – In “Functions” column related to D[12] port pin, changed DS7_1 to CS7_1