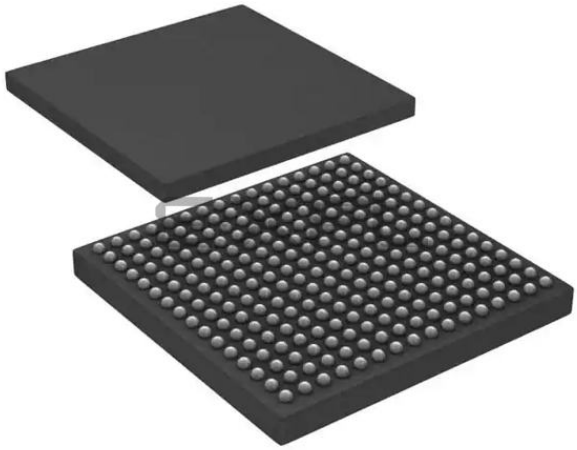

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What is "Embedded - Microcontrollers"?

"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	ARM® Cortex®-M3
Core Size	32-Bit Single-Core
Speed	180MHz
Connectivity	CANbus, EBI/EMI, Ethernet, I²C, IrDA, Microwire, QEI, SD, SPI, SSI, SSP, UART/USART, USB, USB OTG
Peripherals	Brown-out Detect/Reset, DMA, I²S, LCD, POR, PWM, WDT
Number of I/O	164
Program Memory Size	-
Program Memory Type	ROMless
EEPROM Size	-
RAM Size	200K x 8
Voltage - Supply (Vcc/Vdd)	2.2V ~ 3.6V
Data Converters	A/D 8x10b; D/A 1x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	256-LBGA
Supplier Device Package	256-LBGA (17x17)
Purchase URL	https://www.e-xfl.com/product-detail/nxp-semiconductors/lpc1850fet256-551

- Ultra-low power RTC crystal oscillator.
- Three PLLs allow CPU operation up to the maximum CPU rate without the need for a high-frequency crystal. The second PLL is dedicated to the High-speed USB, the third PLL can be used as audio PLL.
- Clock output.

- Configurable digital peripherals:
  - State Configurable Timer (SCTimer/PWM) subsystem on AHB.
  - Global Input Multiplexer Array (GIMA) allows to cross-connect multiple inputs and outputs to event driven peripherals like timers, SCTimer/PWM, and ADC0/1.
- Serial interfaces:
  - Quad SPI Flash Interface (SPIFI) with 1-, 2-, or 4-bit data at rates of up to 52 MB per second.
  - 10/100T Ethernet MAC with RMII and MII interfaces and DMA support for high throughput at low CPU load. Support for IEEE 1588 time stamping/advanced time stamping (IEEE 1588-2008 v2).
  - One High-speed USB 2.0 Host/Device/OTG interface with DMA support and on-chip high-speed PHY (USB0).
  - One High-speed USB 2.0 Host/Device interface with DMA support, on-chip full-speed PHY and ULPI interface to an external high-speed PHY (USB1).
  - USB interface electrical test software included in ROM USB stack.
  - Four 550 UARTs with DMA support: one UART with full modem interface; one UART with IrDA interface; three USARTs support UART synchronous mode and a smart card interface conforming to ISO7816 specification.
  - Up to two C_CAN 2.0B controllers with one channel each. Use of C_CAN controller excludes operation of all other peripherals connected to the same bus bridge See Figure 1 and Ref. 2.
  - Two SSP controllers with FIFO and multi-protocol support. Both SSPs with DMA support.
  - One Fast-mode Plus I^2C-bus interface with monitor mode and with open-drain I/O pins conforming to the full I^2C-bus specification. Supports data rates of up to 1 Mbit/s.
  - One standard I^2C-bus interface with monitor mode and standard I/O pins.
  - Two I^2S interfaces with DMA support, each with one input and one output.
- Digital peripherals:
  - External Memory Controller (EMC) supporting external SRAM, ROM, NOR flash, and SDRAM devices.
  - LCD controller with DMA support and a programmable display resolution of up to 1024 H $\times$ 768 V. Supports monochrome and color STN panels and TFT color panels; supports 1/2/4/8 bpp Color Look-Up Table (CLUT) and 16/24-bit direct pixel mapping.
  - Secure Digital Input Output (SD/MMC) card interface.
  - Eight-channel General-Purpose DMA controller can access all memories on the AHB and all DMA-capable AHB slaves.
  - Up to 164 General-Purpose Input/Output (GPIO) pins with configurable pull-up/pull-down resistors.
  - GPIO registers are located on the AHB for fast access. GPIO ports have DMA support.

Table 3. Pin description

LCD, Ethernet, USB0, and USB1 functions are not available on all parts. See Table 2.

Symbol	LBGA256	TFBGA180	TFBGA100	LQFP144		Reset state [1]	Type	Description
Multiplexed digital pins								
P0_0	L3	K3	G2	32	[2]	N; PU	I/O	**GPIO0[0] —** General purpose digital input/output pin.
							I/O	**SSP1_MISO —** Master In Slave Out for SSP1.
							I	**ENET_RXD1 —** Ethernet receive data 1 (RMII/MII interface).
							-	**R —** Function reserved.
							-	**R —** Function reserved.
							-	**R —** Function reserved.
							I/O	**I2S0_TX_WS —** Transmit Word Select. It is driven by the master and received by the slave. Corresponds to the signal WS in the *I^2S-bus specification*.
							I/O	**I2S1_TX_WS —** Transmit Word Select. It is driven by the master and received by the slave. Corresponds to the signal WS in the *I^2S-bus specification*.
P0_1	M2	K2	G1	34	[2]	N; PU	I/O	**GPIO0[1] —** General purpose digital input/output pin.
							I/O	**SSP1_MOSI —** Master Out Slave in for SSP1.
							I	**ENET_COL —** Ethernet Collision detect (MII interface).
							-	**R —** Function reserved.
							-	**R —** Function reserved.
							-	**R —** Function reserved.
								ENET_TX_EN — Ethernet transmit enable (RMII/MII interface).
							I/O	**I2S1_TX_SDA —** I^2S1 transmit data. It is driven by the transmitter and read by the receiver. Corresponds to the signal SD in the *I^2S-bus specification*.
P1_0	P2	L1	H1	38	[2]	N; PU	I/O	**GPIO0[4] —** General purpose digital input/output pin.
							I	**CTIN_3 —** SCTimer/PWM input 3. Capture input 1 of timer 1.
							I/O	**EMC_A5 —** External memory address line 5.
							-	**R —** Function reserved.
							-	**R —** Function reserved.
							I/O	**SSP0_SSEL —** Slave Select for SSP0.
							-	**R —** Function reserved.
							-	**R —** Function reserved.

Table 3. Pin description *…continued*

LCD, Ethernet, USB0, and USB1 functions are not available on all parts. See Table 2.

Symbol	LBGA256	TFBGA180	TFBGA100	LQFP144		Reset state [1]	Type	Description
P1_1	R2	N1	K2	42	[2]	N; PU	I/O	**GPIO0[8] —** General purpose digital input/output pin. Boot pin (see Table 5).
							O	**CTOUT_7 —** SCTimer/PWM output 7. Match output 3 of timer 1.
							I/O	**EMC_A6 —** External memory address line 6.
							-	**R —** Function reserved.
							-	**R —** Function reserved.
							I/O	**SSP0_MISO —** Master In Slave Out for SSP0.
							-	**R —** Function reserved.
							-	**R —** Function reserved.
P1_2	R3	N2	K1	43	[2]	N; PU	I/O	**GPIO0[9] —** General purpose digital input/output pin. Boot pin (see Table 5).
							O	**CTOUT_6 —** SCTimer/PWM output 6. Match output 2 of timer 1.
							I/O	**EMC_A7 —** External memory address line 7.
							-	**R —** Function reserved.
							-	**R —** Function reserved.
							I/O	**SSP0_MOSI —** Master Out Slave in for SSP0.
							-	**R —** Function reserved.
							-	**R —** Function reserved.
P1_3	P5	M2	J1	44	[2]	N; PU	I/O	**GPIO0[10] —** General purpose digital input/output pin.
							O	**CTOUT_8 —** SCTimer/PWM output 8. Match output 0 of timer 2.
							-	**R —** Function reserved.
							O	**$\overline{\text{EMC\_OE}}$ —** LOW active Output Enable signal.
							O	**USB0_IND1 —** USB0 port indicator LED control output 1.
							I/O	**SSP1_MISO —** Master In Slave Out for SSP1.
							-	**R —** Function reserved.
							O	**SD_RST —** SD/MMC reset signal for MMC4.4 card.
P1_4	T3	P2	J2	47	[2]	N; PU	I/O	**GPIO0[11] —** General purpose digital input/output pin.
							O	**CTOUT_9 —** SCTimer/PWM output 9. Match output 3 of timer 3.
							-	**R —** Function reserved.
							O	**$\overline{\text{EMC\_BLS0}}$ —** LOW active Byte Lane select signal 0.
							O	**USB0_IND0 —** USB0 port indicator LED control output 0.
							I/O	**SSP1_MOSI —** Master Out Slave in for SSP1.
							-	**R —** Function reserved.
							O	**SD_VOLT1 —** SD/MMC bus voltage select output 1.

Table 3. Pin description *…continued*

LCD, Ethernet, USB0, and USB1 functions are not available on all parts. See Table 2.

Symbol	LBGA256	TFBGA180	TFBGA100	LQFP144		Reset state [1]	Type	Description
P1_20	M10	J10	K10	70	[2]	N; PU	I/O	**GPIO0[15] —** General purpose digital input/output pin.
							I/O	**SSP1_SSEL —** Slave Select for SSP1.
							-	**R —** Function reserved.
							O	**ENET_TXD1 —** Ethernet transmit data 1 (RMII/MII interface).
							I	**T0_CAP2 —** Capture input 2 of timer 0.
							-	**R —** Function reserved.
							-	**R —** Function reserved.
							-	**R —** Function reserved.
P2_0	T16	N14	G10	75	[2]	N; PU	-	**R —** Function reserved.
							O	**U0_TXD —** Transmitter output for USART0.
							I/O	**EMC_A13 —** External memory address line 13.
							O	**USB0_PPWR —** VBUS drive signal (towards external charge pump or power management unit); indicates that VBUS must be driven (active high). Add a pull-down resistor to disable the power switch at reset. This signal has opposite polarity compared to the USB_PPWR used on other NXP LPC parts.
							I/O	**GPIO5[0] —** General purpose digital input/output pin.
							-	**R —** Function reserved.
							I	**T3_CAP0 —** Capture input 0 of timer 3.
							O	**ENET_MDC —** Ethernet MIIM clock.
P2_1	N15	M13	G7	81	[2]	N; PU	-	**R —** Function reserved.
							I	**U0_RXD —** Receiver input for USART0.
							I/O	**EMC_A12 —** External memory address line 12.
							I	**USB0_PWR_FAULT —** Port power fault signal indicating overcurrent condition; this signal monitors over-current on the USB bus (external circuitry required to detect over-current condition).
							I/O	**GPIO5[1] —** General purpose digital input/output pin.
							-	**R —** Function reserved.
							I	**T3_CAP1 —** Capture input 1 of timer 3.
							-	**R —** Function reserved.

Table 3. Pin description *…continued*

LCD, Ethernet, USB0, and USB1 functions are not available on all parts. See Table 2.

Symbol	LBGA256	TFBGA180	TFBGA100	LQFP144		Reset state [1]	Type	Description
P8_3	J3	H3	-	-	[2]	N; PU	I/O	**GPIO4[3] —** General purpose digital input/output pin.
							I/O	**USB1_ULPI_D2 —** ULPI link bidirectional data line 2.
							-	**R —** Function reserved.
							O	**LCD_VD12 —** LCD data.
							O	**LCD_VD19 —** LCD data.
							-	**R —** Function reserved.
							-	**R —** Function reserved.
							O	**T0_MAT3 —** Match output 3 of timer 0.
P8_4	J2	H2	-	-	[2]	N; PU	I/O	**GPIO4[4] —** General purpose digital input/output pin.
							I/O	**USB1_ULPI_D1 —** ULPI link bidirectional data line 1.
							-	**R —** Function reserved.
							O	**LCD_VD7 —** LCD data.
							O	**LCD_VD16 —** LCD data.
							-	**R —** Function reserved.
							-	**R —** Function reserved.
							I	**T0_CAP0 —** Capture input 0 of timer 0.
P8_5	J1	H1	-	-	[2]	N; PU	I/O	**GPIO4[5] —** General purpose digital input/output pin.
							I/O	**USB1_ULPI_D0 —** ULPI link bidirectional data line 0.
							-	**R —** Function reserved.
							O	**LCD_VD6 —** LCD data.
							O	**LCD_VD8 —** LCD data.
							-	**R —** Function reserved.
							-	**R —** Function reserved.
							I	**T0_CAP1 —** Capture input 1 of timer 0.
P8_6	K3	J3	-	-	[2]	N; PU	I/O	**GPIO4[6] —** General purpose digital input/output pin.
							I	**USB1_ULPI_NXT —** ULPI link NXT signal. Data flow control signal from the PHY.
							-	**R —** Function reserved.
							O	**LCD_VD5 —** LCD data.
							O	**LCD_LP —** Line synchronization pulse (STN). Horizontal synchronization pulse (TFT).
							-	**R —** Function reserved.
							-	**R —** Function reserved.
							I	**T0_CAP2 —** Capture input 2 of timer 0.

- Two AHB bus masters for transferring data. These interfaces transfer data when a DMA request goes active. Master 1 can access memories and peripherals, master 0 can access memories only.
- 32-bit AHB master bus width.
- Incrementing or non-incrementing addressing for source and destination.
- Programmable DMA burst size. The DMA burst size can be programmed to more efficiently transfer data.
- Internal four-word FIFO per channel.
- Supports 8, 16, and 32-bit wide transactions.
- Big-endian and little-endian support. The DMA Controller defaults to little-endian mode on reset.
- An interrupt to the processor can be generated on a DMA completion or when a DMA error has occurred.
- Raw interrupt status. The DMA error and DMA count raw interrupt status can be read prior to masking.

7.13.3 SPI Flash Interface (SPIFI)

The SPI Flash Interface allows low-cost serial flash memories to be connected to the ARM Cortex-M3 processor with little performance penalty compared to parallel flash devices with higher pin count.

After a few commands configure the interface at startup, the entire flash content is accessible as normal memory using byte, halfword, and word accesses by the processor and/or DMA channels. Simple sequences of commands handle erasing and programming.

Many serial flash devices use a half-duplex command-driven SPI protocol for device setup and initialization and then move to a half-duplex, command-driven 4-bit protocol for normal operation. Different serial flash vendors and devices accept or require different commands and command formats. SPIFI provides sufficient flexibility to be compatible with common flash devices and includes extensions to help insure compatibility with future devices.

7.13.3.1 Features

- Interfaces to serial flash memory in the main memory map.
- Supports classic and 4-bit bidirectional serial protocols.
- Half-duplex protocol compatible with various vendors and devices.
- Quad SPI Flash Interface (SPIFI) with 1-, 2-, or 4-bit data at rates of up to 52 MB per second.
- Supports DMA access.

7.13.4 SD/MMC card interface

The SD/MMC card interface supports the following modes:

- Secure Digital memory (SD version 3.0)
- Secure Digital I/O (SDIO version 2.0)
- Consumer Electronics Advanced Transport Architecture (CE-ATA version 1.1)

- MultiMedia Cards (MMC version 4.4)

7.13.5 External Memory Controller (EMC)

The LPC1850/30/20/10 EMC is a Memory Controller peripheral offering support for asynchronous static memory devices such as RAM, ROM, and NOR flash. In addition, it can be used as an interface with off-chip memory-mapped devices and peripherals.

7.13.5.1 Features

- Dynamic memory interface support including single data rate SDRAM. SDRAM maximum frequency of up to 120 MHz.
- Asynchronous static memory device support including RAM, ROM, and NOR flash, with or without asynchronous page mode.
- Low transaction latency.
- Read and write buffers to reduce latency and to improve performance.
- 8/16/32 data and 24 address lines-wide static memory support. On parts LPC1820/10 only 8/16 data lines are available.
- 16-bit and 32-bit wide chip select SDRAM memory support.
- Static memory features include:
  - Asynchronous page mode read
  - Programmable Wait States
  - Bus turnaround delay
  - Output enable and write enable delays
  - Extended wait
- Four chip selects for synchronous memory and four chip selects for static memory devices.
- Power-saving modes dynamically control EMC_CKEOUT and EMC_CLK signals to SDRAMs.
- Dynamic memory self-refresh mode controlled by software.
- Controller supports 2048 (A0 to A10), 4096 (A0 to A11), and 8192 (A0 to A12) row address synchronous memory parts. Those are typically 512 MB, 256 MB, and 128 MB parts, with 4, 8, 16, or 32 data bits per device.
- Separate reset domains allow auto-refresh through a chip reset if desired.
- SDRAM clock can run at full or half the Cortex-M4 core frequency.

Note: Synchronous static memory devices (synchronous burst mode) are not supported.

7.13.6 High-speed USB Host/Device/OTG interface (USB0)

Remark: USB0 is available on parts LPC1850/30/20 (see Table 2).

The USB OTG module allows the part to connect directly to a USB host such as a PC (in device mode) or to a USB device in host mode.

7.13.6.1 Features

- On-chip UTMI+ compliant high-speed transceiver (PHY).
- Complies with *Universal Serial Bus specification 2.0*.

8. Limiting values

Table 6. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).[1]

Symbol	Parameter	Conditions		Min	Max	Unit
$V_{DD(REG)(3V3)}$	regulator supply voltage (3.3 V)	on pin VDDREG		−0.5	3.6	V
$V_{DD(IO)}$	input/output supply voltage	on pin VDDIO		−0.5	3.6	V
$V_{DDA(3V3)}$	analog supply voltage (3.3 V)	on pin VDDA		−0.5	3.6	V
V_{BAT}	battery supply voltage	on pin VBAT		−0.5	3.6	V
$V_{prog(pf)}$	polyfuse programming voltage	on pin VPP		−0.5	3.6	V
V_I	input voltage	only valid when the $V_{DD(IO)} \geq 2.2$ V	[2]			
		5 V tolerant I/O pins		−0.5	5.5	V
		ADC/DAC pins and digital I/O pins configured for an analog function		−0.5	$V_{DDA(3V3)}$	V
		USB0 pins USB0_DP; USB0_DM;USB0_VBUS		−0.3	5.25	V
		USB0 pins USB0_ID; USB0_RREF		−0.3	3.6	V
		USB1 pins USB1_DP and USB1_DM		−0.3	5.25	V
I_{DD}	supply current	per supply pin	[3]	-	100	mA
I_{SS}	ground current	per ground pin	[3]	-	100	mA
I_{latch}	I/O latch-up current	$-(0.5V_{DD(IO)}) < V_I < (1.5V_{DD(IO)})$; $T_j < 125$ °C		-	100	mA
T_{stg}	storage temperature		[4]	−65	+150	°C
$P_{tot(pack)}$	total power dissipation (per package)	based on package heat transfer, not device power consumption		-	1.5	W
V_{ESD}	electrostatic discharge voltage	human body model; all pins	[5]	−2000	+2000	V

[1] The following applies to the limiting values:

a) This product includes circuitry designed for the protection of its internal devices from the damaging effects of excessive static charge. Nonetheless, it is suggested that conventional precautions be taken to avoid applying greater than the rated maximum.

b) Parameters are valid over operating temperature range unless otherwise specified. All voltages are with respect to V_{SS} unless otherwise noted.

[2] Including voltage on outputs in 3-state mode.

[3] The peak current is limited to 25 times the corresponding maximum current.

[4] Dependent on package type.

[5] Human body model: equivalent to discharging a 100 pF capacitor through a 1.5 kΩ series resistor.

Table 10. Static characteristics *…continued*
T_{amb} = −40 °C to +85 °C unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ[1]	Max	Unit
I_{OL}	LOW-level output current	V_{OL} = 0.4 V		6	-	-	mA
I_{OHS}	HIGH-level short-circuit output current	drive HIGH; connected to ground	[12]	-	-	86.5	mA
I_{OLS}	LOW-level short-circuit output current	drive LOW; connected to $V_{DD(IO)}$	[12]	-	-	76.5	mA
I_{pd}	pull-down current	V_I = 5 V	[14] [15] [16]	-	93	-	μA
I_{pu}	pull-up current	V_I = 0 V	[14] [15] [16]	-	−62	-	μA
		$V_{DD(IO)} < V_I \leq 5$ V		-	10	-	μA
R_S	series resistance	on I/O pins with analog function; analog function enabled			200		Ω
I/O pins - high drive strength							
C_I	input capacitance			-	-	5.2	pF
I_{LL}	LOW-level leakage current	V_I = 0 V; on-chip pull-up resistor disabled		-	3	-	nA
I_{LH}	HIGH-level leakage current	$V_I = V_{DD(IO)}$; on-chip pull-down resistor disabled		-	3	-	nA
		V_I = 5 V		-	-	20	nA
I_{OZ}	OFF-state output current	V_O = 0 V to $V_{DD(IO)}$; on-chip pull-up/down resistors disabled; absolute value		-	3	-	nA
V_I	input voltage	pin configured to provide a digital function; $V_{DD(IO)} \geq 2.2$ V		0	-	5.5	V
		$V_{DD(IO)}$ = 0 V		0	-	3.6	V
V_O	output voltage	output active		0	-	$V_{DD(IO)}$	V
V_{IH}	HIGH-level input voltage			0.7 × $V_{DD(IO)}$	-	5.5	V
V_{IL}	LOW-level input voltage			0	-	0.3 × $V_{DD(IO)}$	V
V_{hys}	hysteresis voltage			0.1 × $V_{DD(IO)}$	-	-	V
I_{pd}	pull-down current	$V_I = V_{DD(IO)}$	[14] [15] [16]	-	62	-	μA
I_{pu}	pull-up current	V_I = 0 V	[14] [15] [16]	-	−62	-	μA
		$V_{DD(IO)} < V_I \leq 5$ V		-	10	-	μA

Table 10. Static characteristics *…continued*
T_{amb} = −40 °C to +85 °C unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ[1]	Max	Unit
I/O pins - high drive strength: standard drive mode							
I_{OH}	HIGH-level output current	$V_{OH} = V_{DD(IO)} - 0.4$ V		−4	-	-	mA
I_{OL}	LOW-level output current	$V_{OL} = 0.4$ V		4	-	-	mA
I_{OHS}	HIGH-level short-circuit output current	drive HIGH; connected to ground	[12]	-	-	32	mA
I_{OLS}	LOW-level short-circuit output current	drive LOW; connected to $V_{DD(IO)}$	[12]	-	-	32	mA
I/O pins - high drive strength: medium drive mode							
I_{OH}	HIGH-level output current	$V_{OH} = V_{DD(IO)} - 0.4$ V		−8	-	-	mA
I_{OL}	LOW-level output current	$V_{OL} = 0.4$ V		8	-	-	mA
I_{OHS}	HIGH-level short-circuit output current	drive HIGH; connected to ground	[12]	-	-	65	mA
I_{OLS}	LOW-level short-circuit output current	drive LOW; connected to $V_{DD(IO)}$	[12]	-	-	63	mA
I/O pins - high drive strength: high drive mode							
I_{OH}	HIGH-level output current	$V_{OH} = V_{DD(IO)} - 0.4$ V		−14	-	-	mA
I_{OL}	LOW-level output current	$V_{OL} = 0.4$ V		14	-	-	mA
I_{OHS}	HIGH-level short-circuit output current	drive HIGH; connected to ground	[12]	-	-	113	mA
I_{OLS}	LOW-level short-circuit output current	drive LOW; connected to $V_{DD(IO)}$	[12]	-	-	110	mA
I/O pins - high drive strength: ultra-high drive mode							
I_{OH}	HIGH-level output current	$V_{OH} = V_{DD(IO)} - 0.4$ V		−20	-	-	mA
I_{OL}	LOW-level output current	$V_{OL} = 0.4$ V		20	-	-	mA
I_{OHS}	HIGH-level short-circuit output current	drive HIGH; connected to ground	[12]	-	-	165	mA
I_{OLS}	LOW-level short-circuit output current	drive LOW; connected to $V_{DD(IO)}$	[12]	-	-	156	mA
I/O pins - high-speed							
C_I	input capacitance			-	-	2	pF
I_{LL}	LOW-level leakage current	$V_I = 0$ V; on-chip pull-up resistor disabled		-	3	-	nA
I_{LH}	HIGH-level leakage current	$V_I = V_{DD(IO)}$; on-chip pull-down resistor disabled		-	3	-	nA
		$V_I = 5$ V		-	-	20	nA

Table 11. Peripheral power consumption

Peripheral	Branch clock	$I_{DD(REG)(3V3)}$ in mA	
		Branch clock frequency = 48 MHz	Branch clock frequency = 96 MHz
ETHERNET	CLK_M3_ETHERNET	1.05	2.09
UART0	CLK_M3_UART0, CLK_APB0_UART0	0.3	0.38
UART1	CLK_M3_UART1, CLK_APB0_UART1	0.27	0.48
UART2	CLK_M3_UART2, CLK_APB2_UART2	0.27	0.47
UART3	CLK_M3_USART3, CLK_APB2_UART3	0.29	0.49
TIMER0	CLK_M3_TIMER0	0.07	0.14
TIMER1	CLK_M3_TIMER1	0.07	0.14
TIMER2	CLK_M3_TIMER2	0.07	0.15
TIMER3	CLK_M3_TIMER3	0.06	0.11
SDIO	CLK_M3_SDIO, CLK_SDIO	0.79	1.37
SCTimer/PWM	CLK_M3_SCT	0.52	1.05
SSP0	CLK_M3_SSP0, CLK_APB0_SSP0	0.12	0.21
SSP1	CLK_M3_SSP1, CLK_APB2_SSP1	0.15	0.28
DMA	CLK_M3_DMA	1.88	3.71
WWDT	CLK_M3_WWDT	0.05	0.08
QEI	CLK_M3_QEI	0.33	0.68
USB0	CLK_M3_USB0, CLK_USB0	1.46	3.32
USB1	CLK_M3_USB1, CLK_USB1	2.83	5.03
RITIMER	CLK_M3_RITIMER	0.04	0.08
EMC	CLK_M3_EMC, CLK_M3_EMC_DIV	3.6	6.97
SCU	CLK_M3_SCU	0.09	0.23
CREG	CLK_M3_CREG	0.37	0.72

[9] A Fast-mode I^2C-bus device can be used in a Standard-mode I^2C-bus system but the requirement $t_{SU;DAT}$ = 250 ns must then be met. This will automatically be the case if the device does not stretch the LOW period of the SCL signal. If such a device does stretch the LOW period of the SCL signal, it must output the next data bit to the SDA line $t_{r(max)} + t_{SU;DAT}$ = 1000 + 250 = 1250 ns (according to the Standard-mode I^2C-bus specification) before the SCL line is released. Also the acknowledge timing must meet this set-up time.

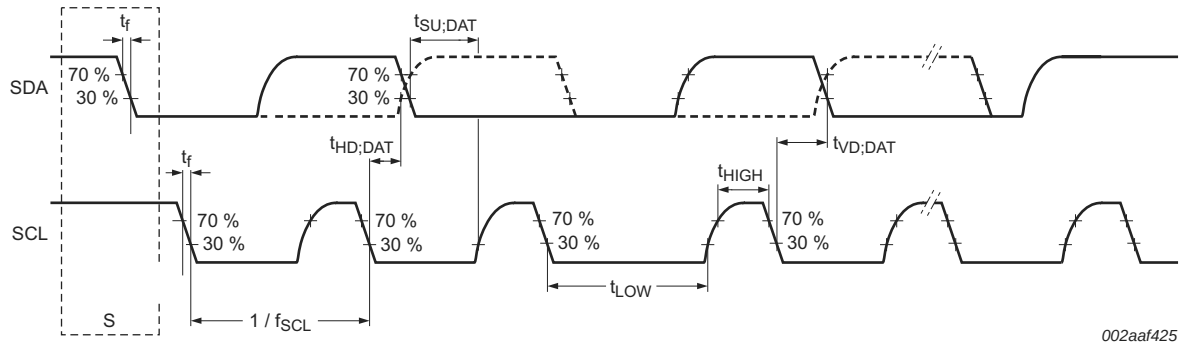


Fig 26. I^2C-bus pins clock timing

11.9 I^2S-bus interface

Table 21. Dynamic characteristics: I^2S-bus interface pins

T_{amb} = 25 °C; 2.2 V ≤ $V_{DD(REG)(3V3)}$ ≤ 3.6 V; 2.7 V ≤ $V_{DD(IO)}$ ≤ 3.6 V; C_L = 20 pF. Conditions and data refer to I2S0 and I2S1 pins. Simulated values.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
common to input and output							
t_r	rise time			-	4	-	ns
t_f	fall time			-	4	-	ns
t_{WH}	pulse width HIGH	on pins I2Sx_TX_SCK and I2Sx_RX_SCK		36	-	-	ns
t_{WL}	pulse width LOW	on pins I2Sx_TX_SCK and I2Sx_RX_SCK		36	-	-	ns
output							
$t_{v(Q)}$	data output valid time	on pin I2Sx_TX_SDA	[1]	-	4.4	-	ns
		on pin I2Sx_TX_WS		-	4.3	-	ns
input							
$t_{su(D)}$	data input set-up time	on pin I2Sx_RX_SDA	[1]	-	0	-	ns
		on pin I2Sx_RX_WS			0.20		ns
$t_{h(D)}$	data input hold time	on pin I2Sx_RX_SDA	[1]	-	3.7	-	ns
		on pin I2Sx_RX_WS		-	3.9	-	ns

[1] Clock to the I^2S-bus interface BASE_APB1_CLK = 150 MHz; peripheral clock to the I^2S-bus interface PCLK = BASE_APB1_CLK / 12. I^2S clock cycle time $T_{cy(clk)}$ = 79.2 ns; corresponds to the SCK signal in the *I^2S-bus specification*.

Table 23. Dynamic characteristics: SSP pins in SPI mode

T_{amb} = −40 °C to +85 °C; 2.2 V ≤ $V_{DD(REG)(3V3)}$ ≤ 3.6 V; 2.7 V ≤ $V_{DD(IO)}$ ≤ 3.6 V; C_L = 20 pF. Sampled at 10 % and 90 % of the signal level; EHS = 1 for all pins. Simulated values.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
t_d	delay time	continuous transfer mode SPI mode; CPOL = 0; CPHA = 0		-	$0.5 \times T_{cy(clk)}$	-	ns
		SPI mode; CPOL = 0; CPHA = 1		-	n/a	-	ns
		SPI mode; CPOL = 1; CPHA = 0		-	$0.5 \times T_{cy(clk)}$	-	ns
		SPI mode; CPOL = 1; CPHA = 1		-	n/a	-	ns
		synchronous serial frame mode		-	$T_{cy(clk)}$	-	ns
		microwire frame format		-	n/a	-	ns
SSP slave							
PCLK	Peripheral clock frequency			-	-	180	MHz
$T_{cy(clk)}$	clock cycle time		[2]	$1/(11 \times 10^6)$	-	-	s
t_{DS}	data set-up time	in SPI mode		1.15	-	-	ns
t_{DH}	data hold time	in SPI mode		0.5	-	-	ns
$t_{v(Q)}$	data output valid time	in SPI mode		-	-	[4 × (1/PCLK)] + 3	ns
$t_{h(Q)}$	data output hold time	in SPI mode		5.1	-	-	ns
t_{lead}	lead time	continuous transfer mode SPI mode; CPOL = 0; CPHA = 0		$T_{cy(clk)} + 2.2$	-	-	ns
		SPI mode; CPOL = 0; CPHA = 1		$0.5 \times T_{cy(clk)} + 2.2$	-	-	ns
		SPI mode; CPOL = 1; CPHA = 0		$T_{cy(clk)} + 2.2$	-	-	ns
		SPI mode; CPOL = 1; CPHA = 1		$0.5 \times T_{cy(clk)} + 2.2$	-	-	ns
		synchronous serial frame mode		$0.5 \times T_{cy(clk)} + 2.2$	-	-	ns
		microwire frame format		$T_{cy(clk)} + 2.2$	-	-	ns

Table 23. Dynamic characteristics: SSP pins in SPI mode

T_{amb} = −40 °C to +85 °C; 2.2 V ≤ $V_{DD(REG)(3V3)}$ ≤ 3.6 V; 2.7 V ≤ $V_{DD(IO)}$ ≤ 3.6 V; C_L = 20 pF. Sampled at 10 % and 90 % of the signal level; EHS = 1 for all pins. Simulated values.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
t_{lag}	lag time	continuous transfer mode SPI mode; CPOL = 0; CPHA = 0		$0.5T_{cy(clk)}$ + 0.2	-	-	ns
		SPI mode; CPOL = 0; CPHA = 1		$T_{cy(clk)}$ + 0.2	-	-	ns
		SPI mode; CPOL = 1; CPHA = 0		0.5 × $T_{cy(clk)}$ + 0.2	-	-	ns
		SPI mode; CPOL = 1; CPHA = 1		$T_{cy(clk)}$ + 0.2	-	-	ns
		synchronous serial frame mode		$T_{cy(clk)}$ + 0.2	-	-	ns
		microwire frame format		0.5 × $T_{cy(clk)}$	-	-	ns
t_d	delay time	continuous transfer mode SPI mode; CPOL = 0; CPHA = 0		-	0.5 × $T_{cy(clk)}$	-	ns
		SPI mode; CPOL = 0; CPHA = 1		-	n/a	-	ns
		SPI mode; CPOL = 1; CPHA = 0		-	0.5 × $T_{cy(clk)}$	-	ns
		SPI mode; CPOL = 1; CPHA = 1		-	n/a	-	ns
		synchronous serial frame mode		-	$T_{cy(clk)}$	-	ns
		microwire frame format		-	n/a	-	ns

[1] $T_{cy(clk)}$ = (SSPCLKDIV × (1 + SCR) × CPSDVSR) / f_{main}. The clock cycle time derived from the SPI bit rate $T_{cy(clk)}$ is a function of the main clock frequency f_{main}, the SSP peripheral clock divider (SSPCLKDIV), the SSP SCR parameter (specified in the SSP0CR0 register), and the SSP CPSDVSR parameter (specified in the SSP clock prescale register).

[2] $T_{cy(clk)} \geq 12 \times T_{cy(PCLK)}$.

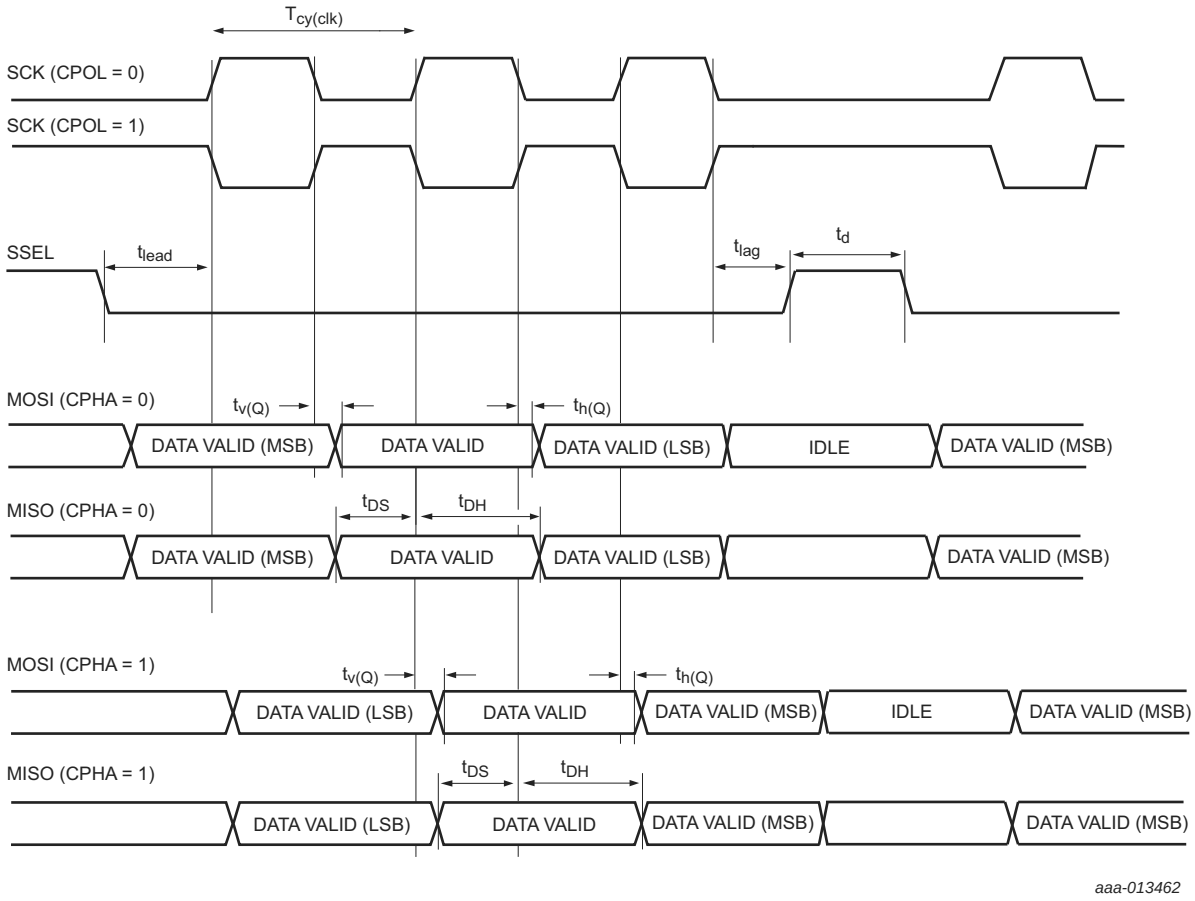
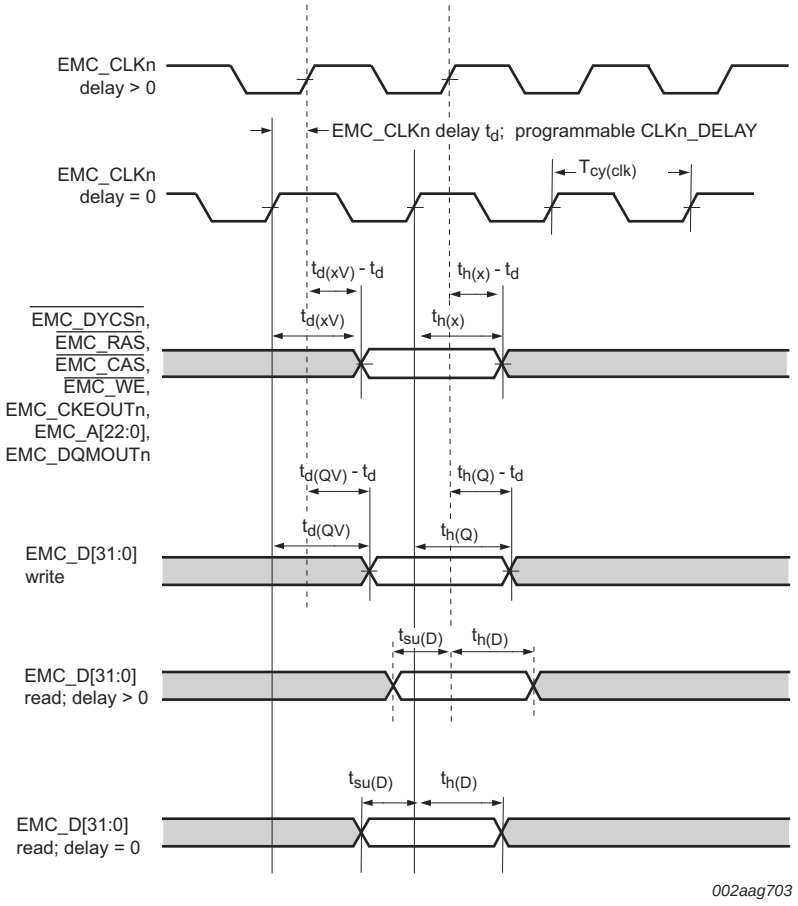


Fig 30. SSP master timing in SPI mode

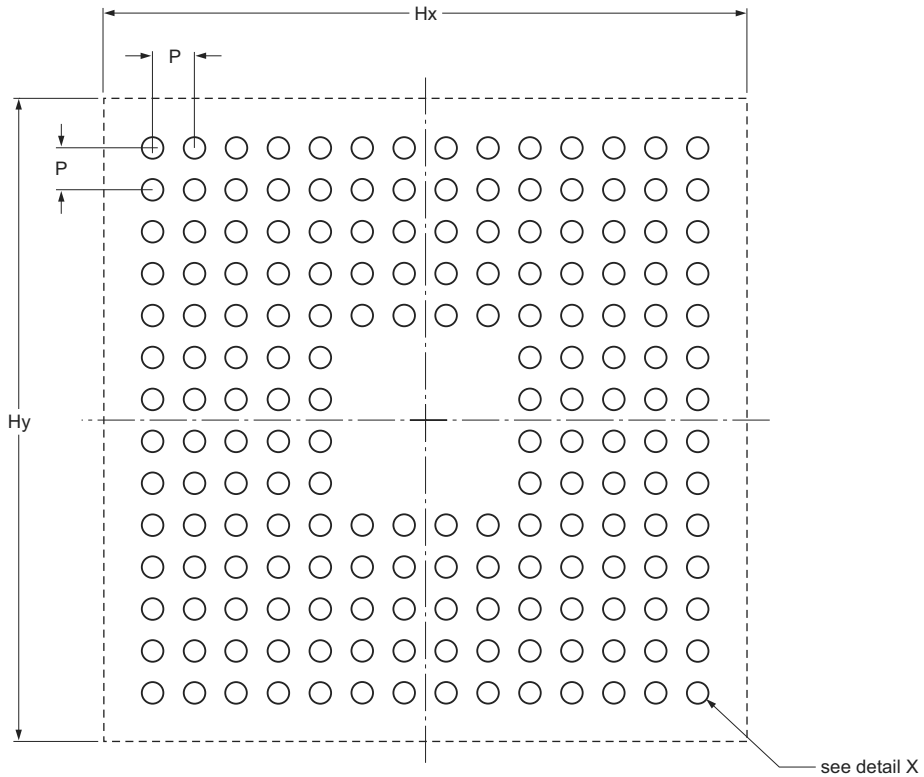


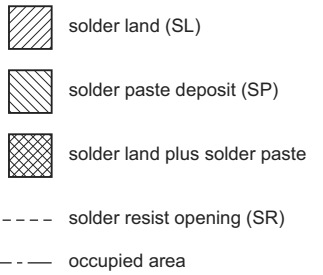
For the programmable EMC_CLK[3:0] clock delays CLKn_DELAY, see Table 26.

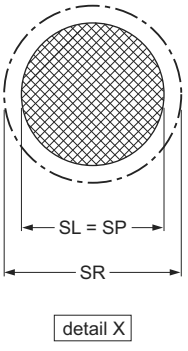
Remark: For SDRAM operation, set CLK0_DELAY = CLK1_DELAY = CLK2_DELAY = CLK3_DELAY in the EMCDELAYCLK register.

Fig 34. SDRAM timing

Footprint information for reflow soldering of TFBGA180 package **SOT570-3**







Dimensions in mm

P	SL	SP	SR	Hx	Hy
0.80	0.40	0.40	0.50	12.30	12.30

Issue date ~~14-01-30~~ 15-08-27

Recommend stencil thickness: 0.1 mm

sot570-3_fr

Fig 54. Reflow soldering of the TFBGA180 package

Table 40. Abbreviations *...continued*

Acronym	Description
USART	Universal Synchronous Asynchronous Receiver/Transmitter
USB	Universal Serial Bus
UTMI	USB 2.0 Transceiver Macrocell Interface

17. References

[1] LPC18xx User manual UM10430: http://www.nxp.com/documents/user_manual/UM10430.pdf

[2] LPC18X0 Errata sheet: http://www.nxp.com/documents/errata_sheet/ES_LPC18X0.pdf

18. Revision history

Table 41. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
LPC1850_30_20_10 v.6.7	20160314	Product data sheet	-	LPC1850_30_20_10 v.6.6
	• Updated Table 25 “Dynamic characteristics: Dynamic external memory interface”: Read cycle parameters $t_{h(D)}$ min value is 2.2 ns and max value is “-”.			
LPC1850_30_20_10 v.6.6	20151116	Product data sheet	2015110031	LPC1850_30_20_10 v.6.5
Modifications:	**Updated SSP slave and SSP master values in Table 23 “Dynamic characteristics: SSP pins in SPI mode”. Updated footnote 2 to: $T_{cy(clk)} \geq 12 \times T_{cy(PCLK)}$.** • **removed $t_{v(Q)}$, data output valid time in SPI mode, minimum value of 3 ´ (1/PCLK) from SSP slave mode.** • **added units to t_d, delay time, for SSP slave and master mode.** **Added GPCLKIN section and table. See Section 11.6 “GPCLKIN” and Table 18 “Dynamic characteristic: GPCLKIN”.**			
LPC1850_30_20_10 v.6.5	20150430	Product data sheet	-	LPC1850_30_20_10 v.6.4
Modifications:	• For WAKEUP pin description: Changed external pull-up to internal pull-up. See Table 3 “Pin description”. • Table note 2 corrected in Table 10. • Updated USART dynamic characteristics table. See Table 22. • Added SSP slave timing data. See Table 22. • Added USART timing diagram. See Figure 29. • Updated SD/MMC dynamic characteristics table. See Table 30. • Updated SPIFI dynamic characteristics table. See Table 32. • Updated Dynamic characteristics: USB0 and USB1 pins (full-speed). See Table 27. • Updated Table 2: Motor control PWM instead of PWM. • Added a remark to Table 27.			
LPC1850_30_20_10 v.6.4	20140818	Product data sheet	201408013F01	LPC1850_30_20_10 v.6.3

19. Legal information

19.1 Data sheet status

Document status[1][2]	Product status[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

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