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"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, I²C, IrDA, Microwire, SD, SPI, SSI, SSP, UART/USART, USB, USB OTG
Peripherals	Brown-out Detect/Reset, DMA, I²S, Motor Control PWM, POR, PWM, WDT
Number of I/O	83
Program Memory Size	512KB (512K x 8)
Program Memory Type	FLASH
EEPROM Size	16K x 8
RAM Size	104K 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 ~ 105°C (TA)
Mounting Type	Surface Mount
Package / Case	144-LQFP
Supplier Device Package	144-LQFP (20x20)
Purchase URL	https://www.e-xfl.com/product-detail/nxp-semiconductors/lpc1823jbd144e

Table 3. Pin description *…continued*

Pin name	LBGA256	TFBGA100	LQFP144	LQFP208		Reset state [1]	Type	Description
P1_20	M10	K10	70	100	[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.
							I/O	**EMC_D11 —** External memory data line 11.
P2_0	T16	G10	75	108	[2]	N; PU	-	**R —** Function reserved.
							O	**U0_TXD —** Transmitter output for USART0. See Table 4 for ISP mode.
							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	G7	81	116	[2]	N; PU	-	**R —** Function reserved.
							I	**U0_RXD —** Receiver input for USART0. See Table 4 for ISP mode.
							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*

Pin name	LBGA256	TFBGA100	LQFP144	LQFP208		Reset state [1]	Type	Description
P2_5	K14	D10	91	131	[3]	N; PU	-	**R —** Function reserved.
							I	**CTIN_2 —** SCTimer/PWM input 2. Capture input 2 of timer 0.
							I	**USB1_VBUS —** Monitors the presence of USB1 bus power. **Note:** This signal must be HIGH for USB reset to occur.
							I	**ADCTRIG1 —** ADC trigger input 1.
							I/O	**GPIO5[5] —** General purpose digital input/output pin.
							-	**R —** Function reserved.
							O	**T3_MAT2 —** Match output 2 of timer 3.
							O	**USB0_IND0 —** USB0 port indicator LED control output 0.
P2_6	K16	G9	95	137	[2]	N; PU	-	**R —** Function reserved.
							I/O	**U0_DIR —** RS-485/EIA-485 output enable/direction control for USART0.
							I/O	**EMC_A10 —** External memory address line 10.
							O	**USB0_IND0 —** USB0 port indicator LED control output 0.
							I/O	**GPIO5[6] —** General purpose digital input/output pin.
							I	**CTIN_7 —** SCTimer/PWM input 7.
							I	**T3_CAP3 —** Capture input 3 of timer 3.
							O	**EMC_BLS1 —** LOW active Byte Lane select signal 1.
P2_7	H14	C10	96	138	[2]	N; PU	I/O	**GPIO0[7] —** General purpose digital input/output pin. ISP entry pin. If this pin is pulled LOW at reset, the part enters ISP mode or boots from an external source (see Table 4 and Table 5).
							O	**CTOUT_1 —** SCTimer/PWM output 1. Match output 3 of timer 3.
							I/O	**U3_UCLK —** Serial clock input/output for USART3 in synchronous mode.
							I/O	**EMC_A9 —** External memory address line 9.
							-	**R —** Function reserved.
							-	**R —** Function reserved.
							O	**T3_MAT3 —** Match output 3 of timer 3.
							-	**R —** Function reserved.

Table 3. Pin description *…continued*

Pin name	LBGA256	TFBGA100	LQFP144	LQFP208		Reset state [1]	Type	Description
P6_11	H12	C9	101	143	[2]	N; PU	I/O	**GPIO3[7] —** General purpose digital input/output pin.
							-	**R —** Function reserved.
							-	**R —** Function reserved.
							O	**EMC_CKEOUT0 —** SDRAM clock enable 0.
							-	**R —** Function reserved.
							O	**T2_MAT3 —** Match output 3 of timer 2.
							-	**R —** Function reserved.
							-	**R —** Function reserved.
P6_12	G15	-	103	145	[2]	N; PU	I/O	**GPIO2[8] —** General purpose digital input/output pin.
							O	**CTOUT_7 —** SCTimer/PWM output 7. Match output 3 of timer 1.
							-	**R —** Function reserved.
							O	**EMC_DQMOUT0 —** Data mask 0 used with SDRAM and static devices.
							-	**R —** Function reserved.
							-	**R —** Function reserved.
							-	**R —** Function reserved.
							-	**R —** Function reserved.
P7_0	B16	-	110	158	[2]	N; PU	I/O	**GPIO3[8] —** General purpose digital input/output pin.
							O	**CTOUT_14 —** SCTimer/PWM output 14. Match output 2 of timer 3.
							-	**R —** Function reserved.
							O	**LCD_LE —** Line end signal.
							-	**R —** Function reserved.
							-	**R —** Function reserved.
							-	**R —** Function reserved.
							-	**R —** Function reserved.
P7_1	C14	-	113	162	[2]	N; PU	I/O	**GPIO3[9] —** General purpose digital input/output pin.
							O	**CTOUT_15 —** SCTimer/PWM output 15. Match output 3 of timer 3.
							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*.
							O	**LCD_VD19 —** LCD data.
							O	**LCD_VD7 —** LCD data.
							-	**R —** Function reserved.
							O	**U2_TXD —** Transmitter output for USART2.
							-	**R —** Function reserved.

Table 3. Pin description *…continued*

Pin name	LBGA256	TFBGA100	LQFP144	LQFP208		Reset state [1]	Type	Description
P8_4	J2	-	-	39	[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	-	-	40	[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	-	-	43	[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.
P8_7	K1	-	-	45	[2]	N; PU	I/O	**GPIO4[7] —** General purpose digital input/output pin.
							O	**USB1_ULPI_STP —** ULPI link STP signal. Asserted to end or interrupt transfers to the PHY.
							-	**R —** Function reserved.
							O	**LCD_VD4 —** LCD data.
							O	**LCD_PWR —** LCD panel power enable.
							-	**R —** Function reserved.
							-	**R —** Function reserved.
							I	**T0_CAP3 —** Capture input 3 of timer 0.

Table 3. Pin description *…continued*

Pin name	LBGA256	TFBGA100	LQFP144	LQFP208		Reset state [1]	Type	Description
PF_9	D6	-	-	203	[5]	N; PU	-	**R —** Function reserved.
							I/O	**U0_DIR —** RS-485/EIA-485 output enable/direction control for USART0.
							O	**CTOUT_1 —** SCTimer/PWM output 1. Match output 3 of timer 3.
							-	**R —** Function reserved.
							I/O	**GPIO7[23] —** General purpose digital input/output pin.
							-	**R —** Function reserved.
							-	**R —** Function reserved.
							-	**R —** Function reserved.
							AI	**ADC1_2 —** ADC1 and ADC0, input channel 2. Configure the pin as GPIO input and use the ADC function select register in the SCU to select the ADC.
PF_10	A3	-	-	205	[5]	N; PU	-	**R —** Function reserved.
							O	**U0_TXD —** Transmitter output for USART0.
							-	**R —** Function reserved.
							-	**R —** Function reserved.
							I/O	**GPIO7[24] —** General purpose digital input/output pin.
							-	**R —** Function reserved.
							I	**SD_WP —** SD/MMC card write protect input.
							-	**R —** Function reserved.
							AI	**ADC0_5 —** ADC0 and ADC1, input channel 5. Configure the pin as GPIO input and use the ADC function select register in the SCU to select the ADC.
PF_11	A2	-	-	207	[5]	N; PU	-	**R —** Function reserved.
							I	**U0_RXD —** Receiver input for USART0.
							-	**R —** Function reserved.
							-	**R —** Function reserved.
							I/O	**GPIO7[25] —** General purpose digital input/output pin.
							-	**R —** Function reserved.
							O	**SD_VOLT2 —** SD/MMC bus voltage select output 2.
							-	**R —** Function reserved.
							AI	**ADC1_5 —** ADC1 and ADC0, input channel 5. Configure the pin as GPIO input and use the ADC function select register in the SCU to select the ADC.
Clock pins								

Table 4. Boot mode when OTP BOOT_SRC bits are programmed

Boot mode	BOOT_SRC bit 3	BOOT_SRC bit 2	BOOT_SRC bit 1	BOOT_SRC bit 0	Description
USB0	0	1	1	0	Boot from USB0.
USB1	0	1	1	1	Boot from USB1.
SPI (SSP)	1	0	0	0	Boot from SPI flash connected to the SSP0 interface on P3_3 (function SSP0_SCK), P3_6 (function SSP0_SSEL), P3_7 (function SSP0_MISO), and P3_8 (function SSP0_MOSI)[1].
USART3	1	0	0	1	Enter ISP mode using USART3 functions on pins P2_3 and P2_4.

[1] The boot loader programs the appropriate pin function at reset to boot using either SSP0 or SPIFI.
Remark: Pin functions for SPIFI and SSP0 boot are different.

Table 5. Boot mode when OPT BOOT_SRC bits are zero

Boot mode	Pins				Description
	P2_9	P2_8	P1_2	P1_1	
USART0	LOW	LOW	LOW	LOW	Enter ISP mode using USART0 pins P2_0 and P2_1.
SPIFI	LOW	LOW	LOW	HIGH	Boot from Quad SPI flash connected to the SPIFI interface on P3_3 to P3_8[1].
EMC 8-bit	LOW	LOW	HIGH	LOW	Boot from external static memory (such as NOR flash) using CS0 and an 8-bit data bus.
EMC 16-bit	LOW	LOW	HIGH	HIGH	Boot from external static memory (such as NOR flash) using CS0 and a 16-bit data bus.
EMC 32-bit	LOW	HIGH	LOW	LOW	Boot from external static memory (such as NOR flash) using CS0 and a 32-bit data bus.
USB0	LOW	HIGH	LOW	HIGH	Boot from USB0
USB1	LOW	HIGH	HIGH	LOW	Boot from USB1.
SPI (SSP)	LOW	HIGH	HIGH	HIGH	Boot from SPI flash connected to the SSP0 interface on P3_3 (function SSP0_SCK), P3_6 (function SSP0_SSEL), P3_7 (function SSP0_MISO), and P3_8 (function SSP0_MOSI)[1].
USART3	HIGH	LOW	LOW	LOW	Enter ISP mode using USART3 pins P2_3 and P2_4.

[1] The boot loader programs the appropriate pin function at reset to boot using either SSP0 or SPIFI.
Remark: Pin functions for SPIFI and SSP0 boot are different.

7.12 Memory mapping

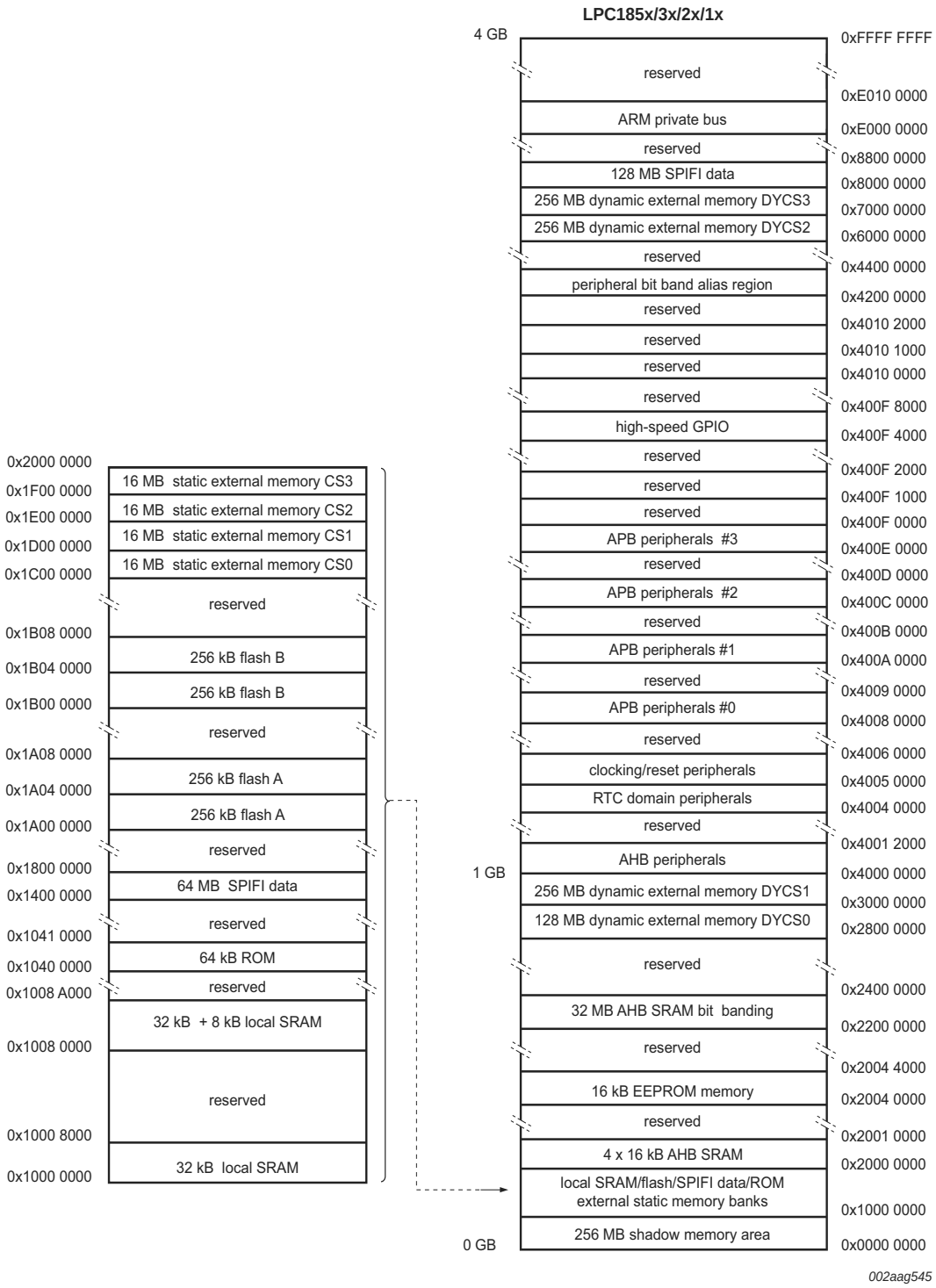


Fig 7. LPC185x/3x/2x/1x Memory mapping (overview)

7.15.4 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).

7.15.5 External Memory Controller (EMC)

Remark: The EMC is available on all LPC185x/3x/2x/1x parts. The following memory bus widths are supported:

- LBGA256 packages: 32 bit
- TFBGA100 packages: 8 bit
- LQFP208 packages: 16 bit
- LQFP144 packages: 16 bit

The LPC185x/3x/2x/1x 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.

Table 6. EMC pinout for different packages

Function	LBGA256	TFBGA100	LQFP208	LQFP144
A	EMC_A[23:0]	EMC_A[13:0]	EMC_A[23:0]	EMC_A[15:0]
D	EMC_D[31:0]	EMC_D[7:0]	EMC_D[15:0]	EMC_D[15:0]
$\overline{BLS}$	$\overline{EMC\_BLS[3:0]}$	$\overline{EMC\_BLS0}$	$\overline{EMC\_BLS[1:0]}$	$\overline{EMC\_BLS[1:0]}$
$\overline{CS}$	$\overline{EMC\_CS[3:0]}$	$\overline{EMC\_CS0}$	$\overline{EMC\_CS[1:0]}$	$\overline{EMC\_CS[1:0]}$
$\overline{OE}$	$\overline{EMC\_OE}$	$\overline{EMC\_OE}$	$\overline{EMC\_OE}$	$\overline{EMC\_OE}$
$\overline{WE}$	$\overline{EMC\_WE}$	$\overline{EMC\_WE}$	$\overline{EMC\_WE}$	$\overline{EMC\_WE}$
CKEOUT	EMC_ CKEOUT[3:0]	EMC_ CKEOUT[1:0]	EMC_ CKEOUT[1:0]	EMC_ CKEOUT[1:0]
CLK	EMC_CLK[3:0]; EMC_CLK01, EMC_CLK23	EMC_CLK0, EMC_CLK3; EMC_CLK01, EMC_CLK23	EMC_CLK0, EMC_CLK3; EMC_CLK01, EMC_CLK23	EMC_CLK0, EMC_CLK3; EMC_CLK01, EMC_CLK23
DQMOUT	EMC_ DQMOUT[3:0]	-	EMC_ DQMOUT[1:0]	EMC_ DQMOUT[1:0]
$\overline{DYCS}$	$\overline{EMC\_DYCS[3:0]}$	$\overline{EMC\_DYCS[1:0]}$	$\overline{EMC\_DYCS[1:0]}$	$\overline{EMC\_DYCS[1:0]}$
$\overline{CAS}$	$\overline{EMC\_CAS}$	$\overline{EMC\_CAS}$	$\overline{EMC\_CAS}$	$\overline{EMC\_CAS}$
$\overline{RAS}$	$\overline{EMC\_RAS}$	$\overline{EMC\_RAS}$	$\overline{EMC\_RAS}$	$\overline{EMC\_RAS}$

7.15.5.1 Features

- Dynamic memory interface support including single data rate SDRAM.
- Asynchronous static memory device support including RAM, ROM, and NOR flash, with or without asynchronous page mode.
- Low transaction latency.

- Increments/decrements depending on direction.
- Programmable for 2× or 4× position counting.
- Velocity capture using built-in timer.
- Velocity compare function with “less than” interrupt.
- Uses 32-bit registers for position and velocity.
- Three position-compare registers with interrupts.
- Index counter for revolution counting.
- Index compare register with interrupts.
- Can combine index and position interrupts to produce an interrupt for whole and partial revolution displacement.
- Digital filter with programmable delays for encoder input signals.
- Can accept decoded signal inputs (clk and direction).

7.17.4 Repetitive Interrupt (RI) timer

The repetitive interrupt timer provides a free-running 32-bit counter which is compared to a selectable value, generating an interrupt when a match occurs. Any bits of the timer compare function can be masked such that they do not contribute to the match detection. The repetitive interrupt timer can be used to create an interrupt that repeats at predetermined intervals.

7.17.4.1 Features

- 32-bit counter. Counter can be free-running or be reset by a generated interrupt.
- 32-bit compare value.
- 32-bit compare mask. An interrupt is generated when the counter value equals the compare value, after masking. This mechanism allows for combinations not possible with a simple compare.

7.17.5 Windowed WatchDog Timer (WWDT)

The purpose of the watchdog is to reset the controller if software fails to periodically service it within a programmable time window.

7.17.5.1 Features

- Internally resets chip if not periodically reloaded during the programmable time-out period.
- Optional windowed operation requires reload to occur between a minimum and maximum time period, both programmable.
- Optional warning interrupt can be generated at a programmable time prior to watchdog time-out.
- Enabled by software but requires a hardware reset or a watchdog reset/interrupt to be disabled.
- Incorrect feed sequence causes reset or interrupt if enabled.
- Flag to indicate watchdog reset.
- Programmable 24-bit timer with internal prescaler.

output frequency. The output frequency can be set as a multiple of the sampling frequency f_s to $32 \times f_s$, $64 \times f_s$, $128 \times f_s$, $256 \times f_s$, $384 \times f_s$, $512 \times f_s$ and the sampling frequency f_s can range from 16 kHz to 192 kHz (16, 22.05, 32, 44.1, 48, 96,192) kHz. Many other frequencies are possible as well using the integrated fractional divider.

7.20.7 System PLL1

The PLL1 accepts an input clock frequency from an external oscillator in the range of 1 MHz to 25 MHz. The input frequency is multiplied up to a high frequency with a Current Controlled Oscillator (CCO). The multiplier can be an integer value from 1 to 32. The CCO operates in the range of 156 MHz to 320 MHz. This range is possible through an additional divider in the loop to keep the CCO within its frequency range while the PLL is providing the desired output frequency. The output divider can be set to divide by 2, 4, 8, or 16 to produce the output clock. Since the minimum output divider value is 2, it is insured that the PLL output has a 50 % duty cycle. The PLL is turned off and bypassed following a chip reset. After reset, software can enable the PLL. The program must configure and activate the PLL, wait for the PLL to lock, and then connect to the PLL as a clock source. The PLL settling time is 100 μs.

7.20.8 Reset Generation Unit (RGU)

The RGU allows generation of independent reset signals for individual blocks and peripherals.

7.20.9 Power control

The LPC185x/3x/2x/1x feature several independent power domains to control power to the core and the peripherals (see Figure 9). The RTC and its associated peripherals (the alarm timer, the CREG block, the OTP controller, the back-up registers, and the event router) are located in the RTC power-domain. The main regulator or a battery supply can power the RTC. A power selector switch ensures that the RTC block is always powered on.

Table 11. Static characteristics *…continued*
T_{amb} = −40 °C to +105 °C, unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ[1]	Max	Unit
$I_{DD(IO)}$	I/O supply current	deep sleep mode		-	< 0.1	-	µA
		power-down mode		-	< 0.1	-	µA
		deep power-down mode		-	< 0.1	-	µA
I_{DDA}	Analog supply current	on pin VDDA; deep sleep mode	[9]	-	0.4	-	µA
		power-down mode	[9]	-	0.4	-	µA
		deep power-down mode	[9]	-	0.007	-	µA
$\overline{\text{RESET}}$ pin							
V_{IH}	HIGH-level input voltage		[8]	$0.8 \times (V_{ps} - 0.35)$	-	5.5	V
V_{IL}	LOW-level input voltage		[8]	0	-	$0.3 \times (V_{ps} - 0.1)$	V
V_{hys}	hysteresis voltage		[8]	$0.05 \times (V_{ps} - 0.35)$	-	-	V
Standard I/O pins - normal drive strength							
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; T_{amb} = 25 °C		-	0.5	-	nA
		V_I = 5 V; T_{amb} = 105 °C		-	40	-	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; $V_{DD(IO)} \geq 2.4$ 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			$0.7 \times V_{DD(IO)}$	-	5.5	V
V_{IL}	LOW-level input voltage			0	-	$0.3 \times V_{DD(IO)}$	V
V_{hys}	hysteresis voltage			$0.1 \times V_{DD(IO)}$	-	-	V
V_{OH}	HIGH-level output voltage	I_{OH} = −6 mA		$V_{DD(IO)} - 0.4$	-	-	V
V_{OL}	LOW-level output voltage	I_{OL} = 6 mA		-	-	0.4	V
I_{OH}	HIGH-level output current	$V_{OH} = V_{DD(IO)} - 0.4$ V		−6	-	-	mA

11. Dynamic characteristics

11.1 Flash/EEPROM memory

Table 15. Flash characteristics

T_{amb} = −40 °C to +105 °C, unless otherwise specified. $V_{DD(REG)(3V3)}$ = 2.4 V to 3.6 V for read operations; $V_{DD(REG)(3V3)}$ = 2.7 V to 3.6 V for erase/program operations.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
N_{endu}	endurance	sector erase/program	[1]	10000	-	-	cycles
		page erase/program; page in large sector		1000	-	-	cycles
		page erase/program; page in small sector		10000	-	-	cycles
t_{ret}	retention time	powered		10	-	-	years
		unpowered		10	-	-	years
t_{er}	erase time	page, sector, or multiple consecutive sectors		-	100	-	ms
t_{prog}	programming time		[2]	-	1	-	ms

[1] Number of erase/program cycles.

[2] Programming times are given for writing 512 bytes from RAM to the flash. Data must be written to the flash in blocks of 512 bytes.

Table 16. EEPROM characteristics

T_{amb} = −40 °C to +105 °C; $V_{DD(REG)(3V3)}$ = 2.7 V to 3.6 V.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
f_{clk}	clock frequency			800	1500	1600	kHz
N_{endu}	endurance			100 000	-	-	cycles
t_{ret}	retention time	T_{amb} = −40 °C to +85 °C		20	-	-	years
		85 °C < T_{amb} ≤ 105 °C		10	-	-	years
t_a	access time	read		-	120	-	ns
		erase/program; f_{clk} = 1500 kHz		-	1.99	-	ms
		erase/program; f_{clk} = 1600 kHz		-	1.87	-	ms
t_{wait}	wait time	read; RPHASE1	[1]	35	-	-	ns
		read; RPHASE2	[1]	70	-	-	ns
		write; PHASE1	[1]	20	-	-	ns
		write; PHASE2	[1]	40	-	-	ns
		write; PHASE3	[1]	10	-	-	ns

[1] See the LPC18xx user manual how to program the wait states for the different read (RPHASEx) and erase/program phases (PHASEx)

11.13 External memory interface

Table 28. Dynamic characteristics: Static asynchronous external memory interface

C_L = 22 pF for EMC_Dn C_L = 20 pF for all others; T_{amb} = −40 °C to +105 °C; 2.4 V ≤ $V_{DD(REG)(3V3)}$ ≤ 3.6 V; 2.7 V ≤ $V_{DD(IO)}$ ≤ 3.6 V; values guaranteed by design; the values in the table have been calculated with WAITTURN = 0x0 in STATICWAITTURN register.Timing parameters are given for single memory access cycles. In a normal read operation, the EMC changes the address while CS is asserted which results in multiple memory accesses.

Symbol	Parameter[1]	Conditions		Min	Typ	Max	Unit
Read cycle parameters							
t_{CSLAV}	$\overline{CS}$ LOW to address valid time			−3.1	-	1.6	ns
t_{CSLOEL}	$\overline{CS}$ LOW to $\overline{OE}$ LOW time		[2]	−0.6 + $T_{cy(clk)}$ × WAITOEN	-	1.3 + $T_{cy(clk)}$ × WAITOEN	ns
$t_{CSLBLSL}$	$\overline{CS}$ LOW to $\overline{BLS}$ LOW time	PB = 1		−0.7	-	1.8	ns
t_{OELOEH}	$\overline{OE}$ LOW to $\overline{OE}$ HIGH time		[2]	−0.6 + (WAITRD − WAITOEN + 1) × $T_{cy(clk)}$	-	−0.4 + (WAITRD − WAITOEN + 1) × $T_{cy(clk)}$	ns
t_{am}	memory access time			-	-	−16 + (WAITRD − WAITOEN +1) × $T_{cy(clk)}$	ns
$t_{h(D)}$	data input hold time			−16	-	-	ns
$t_{CSHBLSH}$	$\overline{CS}$ HIGH to $\overline{BLS}$ HIGH time	PB = 1		−0.4	-	1.9	ns
t_{CSHOEH}	CS HIGH to $\overline{OE}$ HIGH time			−0.4	-	1.4	ns
t_{OEHANV}	$\overline{OE}$ HIGH to address invalid	PB = 1		−2.0	-	2.6	ns
t_{CSHEOR}	$\overline{CS}$ HIGH to end of read time		[3]	−2.0	-	0	ns
t_{CSLSOR}	$\overline{CS}$ LOW to start of read time		[4]	0	-	1.8	ns
Write cycle parameters							
t_{CSLAV}	$\overline{CS}$ LOW to address valid time			−3.1	-	1.6	ns
t_{CSLDV}	$\overline{CS}$ LOW to data valid time			−3.1	-	1.5	ns
t_{CSLWEL}	$\overline{CS}$ LOW to $\overline{WE}$ LOW time	PB = 1		−1.5 + (WAITWEN + 1) × $T_{cy(clk)}$	-	0.2 + (WAITWEN + 1) × $T_{cy(clk)}$	ns
$t_{CSLBLSL}$	$\overline{CS}$ LOW to $\overline{BLS}$ LOW time	PB = 1		−0.7	-	1.8	ns
t_{WELWEH}	$\overline{WE}$ LOW to $\overline{WE}$ HIGH time	PB = 1	[2]	−0.6 + (WAITWR − WAITWEN + 1) × $T_{cy(clk)}$	-	−0.4 + (WAITWR − WAITWEN + 1) × $T_{cy(clk)}$	ns
t_{WEHDNV}	$\overline{WE}$ HIGH to data invalid time	PB = 1	[2]	−0.9 + $T_{cy(clk)}$	-	2.3 + $T_{cy(clk)}$	ns
t_{WEHEOW}	$\overline{WE}$ HIGH to end of write time	PB = 1	[2] [5]	−0.4 + $T_{cy(clk)}$	-	−0.3 + $T_{cy(clk)}$	ns
$t_{CSLBLSL}$	$\overline{CS}$ LOW to $\overline{BLS}$ LOW	PB = 0		−0.7 + (WAITWEN + 1) × $T_{cy(clk)}$	-	1.8 + (WAITWEN + 1) × $T_{cy(clk)}$	ns

11.16 SD/MMC

Table 34. Dynamic characteristics: SD/MMC

T_{amb} = −40 °C to +105 °C, 2.4 V ≤ $V_{DD(REG)(3V3)}$ ≤ 3.6 V; 2.7 V ≤ $V_{DD(IO)}$ ≤ 3.6 V, C_L = 20 pF. Simulated values. SAMPLE_DELAY = 0x9, DRV_DELAY = 0x6 in the SDDELAY register sampled at 90 % and 10 % of the signal level, EHS = 1 for SD_CLK pin, EHS = 0 for SD_DATn and SD_CMD pins. Simulated values.

Symbol	Parameter	Conditions	Min	Max	Unit
f_{clk}	clock frequency	on pin SD_CLK; data transfer mode	-	52	MHz
$t_{su(D)}$	data input set-up time	on pins SD_DATn as inputs	5.2	-	ns
		on pins SD_CMD as inputs	7	-	ns
$t_{h(D)}$	data input hold time	on pins SD_DATn as inputs	0.2	-	ns
		on pins SD_CMD as inputs	−1	-	ns
$t_{d(QV)}$	data output valid delay time	on pins SD_DATn as outputs	-	15.7	ns
		on pins SD_CMD as outputs	-	15.9	ns
$t_{h(Q)}$	data output hold time	on pins SD_DATn as outputs	3.5	-	ns
		on pins SD_CMD as outputs	3.5	-	ns

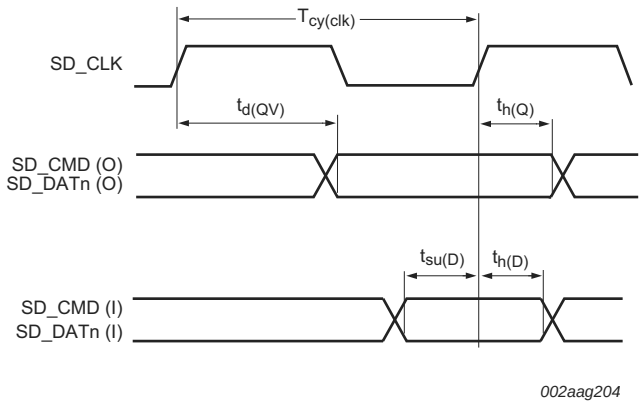


Fig 37. SD/MMC timing

11.17 LCD

Table 35. Dynamic characteristics: LCD

T_{amb} = −40 °C to 105 °C; 2.4 V ≤ $V_{DD(REG)(3V3)}$ ≤ 3.6 V; 2.7 V ≤ $V_{DD(IO)}$ ≤ 3.6 V; C_L = 20 pF. Simulated values.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
f_{clk}	clock frequency	on pin LCD_DCLK	-	50	-	MHz
$t_{d(QV)}$	data output valid delay time		-	-	17	ns
$t_{h(Q)}$	data output hold time		8.5	-	-	ns

13. Application information

13.1 LCD panel signal usage

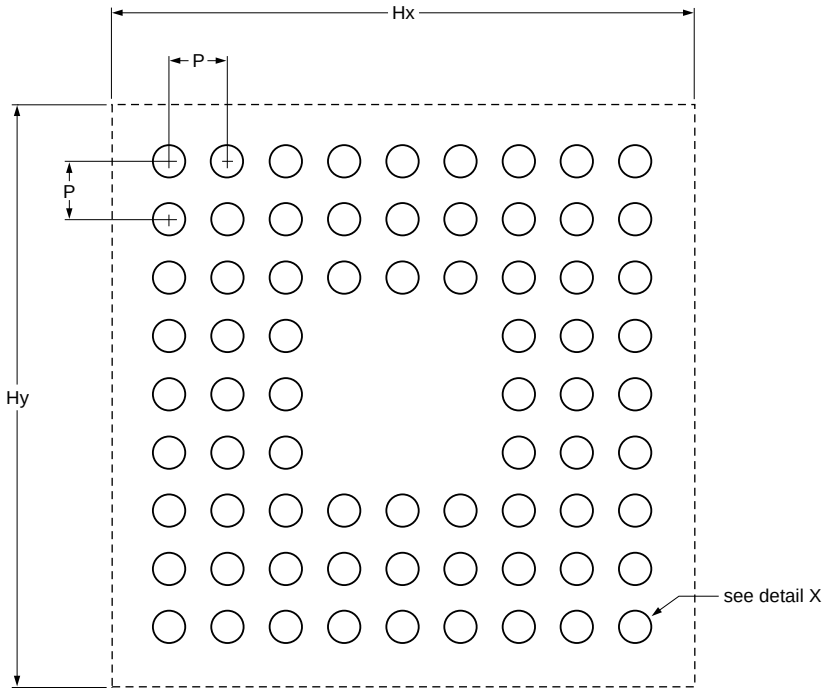
Table 39. LCD panel connections for STN single panel mode

External pin	4-bit mono STN single panel		8-bit mono STN single panel		Color STN single panel	
	LPC18xx pin used	LCD function	LPC18xx pin used	LCD function	LPC18xx pin used	LCD function
LCD_VD[23:8]	-	-	-	-	-	-
LCD_VD7	-	-	P8_4	UD[7]	P8_4	UD[7]
LCD_VD6	-	-	P8_5	UD[6]	P8_5	UD[6]
LCD_VD5	-	-	P8_6	UD[5]	P8_6	UD[5]
LCD_VD4	-	-	P8_7	UD[4]	P8_7	UD[4]
LCD_VD3	P4_2	UD[3]	P4_2	UD[3]	P4_2	UD[3]
LCD_VD2	P4_3	UD[2]	P4_3	UD[2]	P4_3	UD[2]
LCD_VD1	P4_4	UD[1]	P4_4	UD[1]	P4_4	UD[1]
LCD_VD0	P4_1	UD[0]	P4_1	UD[0]	P4_1	UD[0]
LCD_LP	P7_6	LCDLP	P7_6	LCDLP	P7_6	LCDLP
LCD_ENAB/ LCDM	P4_6	LCDENAB/ LCDM	P4_6	LCDENAB/ LCDM	P4_6	LCDENAB/ LCDM
LCD_FP	P4_5	LCDFP	P4_5	LCDFP	P4_5	LCDFP
LCD_DCLK	P4_7	LCDDCLK	P4_7	LCDDCLK	P4_7	LCDDCLK
LCD_LE	P7_0	LCDLE	P7_0	LCDLE	P7_0	LCDLE
LCD_PWR	P7_7	CDPWR	P7_7	LCDPWR	P7_7	LCDPWR
GP_CLKIN	PF_4	LCDCLKIN	PF_4	LCDCLKIN	PF_4	LCDCLKIN

Table 40. LCD panel connections for STN dual panel mode

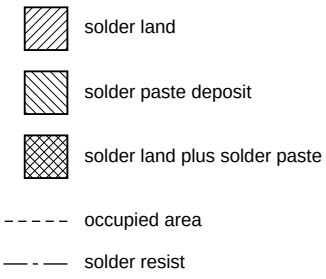
External pin	4-bit mono STN dual panel		8-bit mono STN dual panel		Color STN dual panel	
	LPC18xx pin used	LCD function	LPC18xx pin used	LCD function	LPC18xx pin used	LCD function
LCD_VD[23:16]	-	-	-	-	-	-
LCD_VD15	-	-	PB_4	LD[7]	PB_4	LD[7]
LCD_VD14	-	-	PB_5	LD[6]	PB_5	LD[6]
LCD_VD13	-	-	PB_6	LD[5]	PB_6	LD[5]
LCD_VD12	-	-	P8_3	LD[4]	P8_3	LD[4]
LCD_VD11	P4_9	LD[3]	P4_9	LD[3]	P4_9	LD[3]
LCD_VD10	P4_10	LD[2]	P4_10	LD[2]	P4_10	LD[2]
LCD_VD9	P4_8	LD[1]	P4_8	LD[1]	P4_8	LD[1]
LCD_VD8	P7_5	LD[0]	P7_5	LD[0]	P7_5	LD[0]
LCD_VD7	-	-		UD[7]	P8_4	UD[7]
LCD_VD6	-	-	P8_5	UD[6]	P8_5	UD[6]
LCD_VD5	-	-	P8_6	UD[5]	P8_6	UD[5]
LCD_VD4	-	-	P8_7	UD[4]	P8_7	UD[4]
LCD_VD3	P4_2	UD[3]	P4_2	UD[3]	P4_2	UD[3]

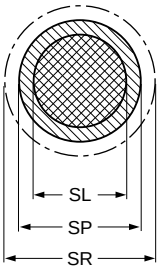
Footprint information for reflow soldering of TFBGA100 package **SOT926-1**



Generic footprint pattern

Refer to the package outline drawing for actual layout





detail X

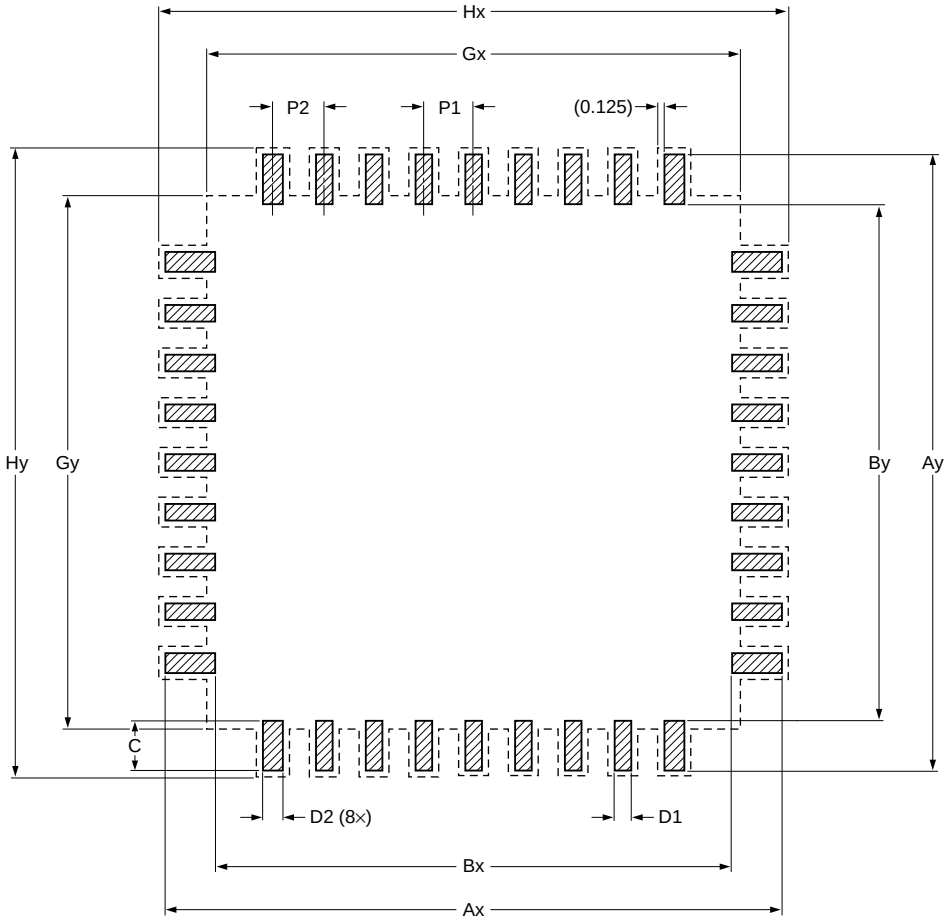
DIMENSIONS in mm

P	SL	SP	SR	Hx	Hy
0.80	0.330	0.400	0.480	9.400	9.400

sot926-1_fr

Fig 54. Reflow soldering for the TFBGA100 package

Footprint information for reflow soldering of LQFP144 package **SOT486-1**



Generic footprint pattern

Refer to the package outline drawing for actual layout

solder land

occupied area

DIMENSIONS in mm

P1	P2	Ax	Ay	Bx	By	C	D1	D2	Gx	Gy	Hx	Hy
0.500	0.560	23.300	23.300	20.300	20.300	1.500	0.280	0.400	20.500	20.500	23.550	23.550

sot486-1_fr

Fig 56. Reflow soldering for the LQFP144 package

18. Revision history

Table 45. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
LPC185X_3X_2X_1X v.5.2	20160308	Product data sheet	-	LPC185X_3X_2X_1X v.5.1
Modifications:	• Updated Table 29 “Dynamic characteristics: Dynamic external memory interface”: Read cycle parameters $t_{h(D)}$ min value is 2.2 ns and max value is “-”.			
LPC185X_3X_2X_1X v.5.1	20151117	Product data sheet	2015110041	LPC185X_3X_2X_1X v.5
Modifications:	• Updated Table 2 “Ordering options”; TFBGA100 packages do not support ULPI interface. • Updated SSP slave and SSP master values in Table 27 “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 11.7 “GPCLKIN” and Table 22 “Dynamic characteristic: GPCLKIN”.			
LPC185X_3X_2X_1X v.5	20150429	Product data sheet	-	LPC185X_3X_2X_1X v.4.1

Table 45. Revision history *…continued*

Document ID	Release date	Data sheet status	Change notice	Supersedes
LPC1857_53 v.3.1	20120904	Preliminary data sheet	-	LPC1857_53 v.3
Modifications:	• SSP0 boot pin functions added in Table 5 and Table 4. Pin P3_3 = SSP0_SCK, pin P3_6 = SSP0_SSEL, pin P3_7 = SSP0_MISO, pin P3_8 = SSP0_MOSI. • Peripheral power consumption data added in Table 12. • BOD de-assertion levels add in Table 13. • Minimum value for all supply voltages changed to -0.5 V n Table 7.			
LPC1857_53 v.3	20120711	Preliminary data sheet	-	LPC1857_53 v.2
Modifications:	• Data sheet status changed to preliminary. • AES removed. Available on parts LPC18Sxx only. • Minimum value of V_I for conditions “USB0 pins USB0_DP; USB0_DM; USB0_VBUS”, “USB0 pins USB0_ID; USB0_RREF”, and “USB1 pins USB1_DP and USB1_DM” changed to −0.3 V in Table 6. • Dynamic characteristics of the SD/MMC controller updated in Table 29. • Dynamic characteristics of the LCD controller updated in Table 30. • Dynamic characteristics of the SSP controller updated in Table 22. • Section 10.2 added. • Table 8 “Thermal resistance value (BGA packages)” added. • Description of pins USB1_DP and USB1_DM updated in Table 3. • Editorial updates. • Parameters I_{IL} and I_{IH} renamed to I_{LL} and I_{LH} in Table 9.			
LPC1857_53 v.2	20120515	Objective data sheet	-	LPC1857_53 v.1
LPC1857_53 v.1	20111214	Objective data sheet	-	-

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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