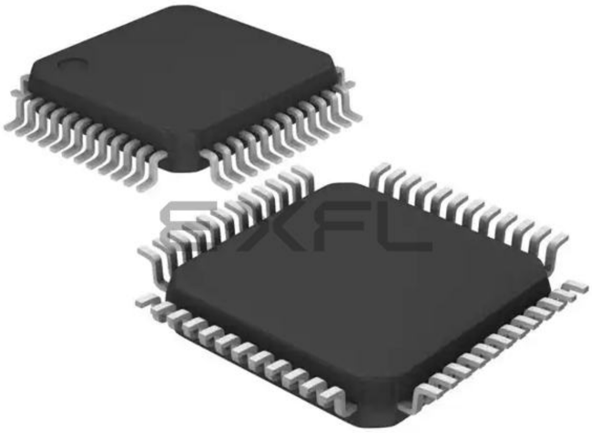

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"Embedded - Microcontrollers" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable 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®-M0
Core Size	32-Bit Single-Core
Speed	50MHz
Connectivity	CANbus, I²C, Microwire, SPI, SSI, SSP, UART/USART
Peripherals	Brown-out Detect/Reset, POR, WDT
Number of I/O	36
Program Memory Size	16KB (16K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	8K x 8
Voltage - Supply (Vcc/Vdd)	1.8V ~ 3.6V
Data Converters	A/D 8x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	48-LQFP
Supplier Device Package	48-LQFP (7x7)
Purchase URL	https://www.e-xfl.com/product-detail/nxp-semiconductors/lpc11c22fbd48-301

6. Pinning information

6.1 Pinning

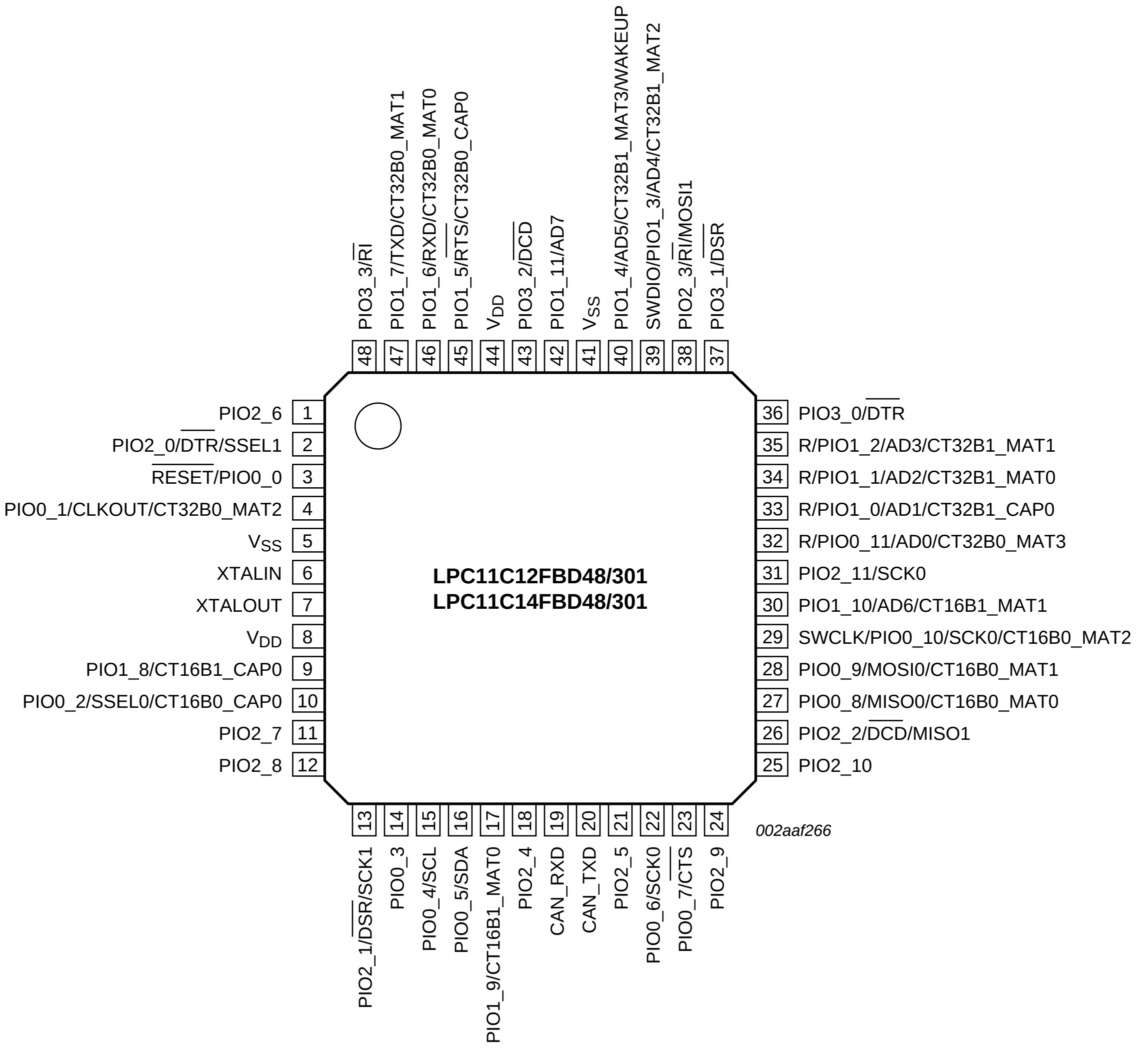


Fig 2. Pin configuration (LPC11C12/C14)

Table 3. LPC11C12/C14 pin description table

Symbol	Pin	Start logic inputs	Type	Reset state [1]	Description
PIO3_0/$\overline{\text{DTR}}$	36[3]	no	I/O	I; PU	**PIO3_0 —** General purpose digital input/output pin.
			O	-	**$\overline{\text{DTR}}$ —** Data Terminal Ready output for UART.
PIO3_1/$\overline{\text{DSR}}$	37[3]	no	I/O	I; PU	**PIO3_1 —** General purpose digital input/output pin.
			I	-	**$\overline{\text{DSR}}$ —** Data Set Ready input for UART.
PIO3_2/$\overline{\text{DCD}}$	43[3]	no	I/O	I; PU	**PIO3_2 —** General purpose digital input/output pin.
			I		**$\overline{\text{DCD}}$ —** Data Carrier Detect input for UART.
PIO3_3/$\overline{\text{RI}}$	48[3]	no	I/O	I; PU	**PIO3_3 —** General purpose digital input/output pin.
			I	-	**$\overline{\text{RI}}$ —** Ring Indicator input for UART.
CAN_RXD	19[6]	no	I	I; IA	**CAN_RXD —** C_CAN receive data input.
CAN_TXD	20[6]	no	O	I; IA	**CAN_TXD —** C_CAN transmit data output.
V_{DD}	8; 44	-	I	-	Supply voltage to the internal regulator, the external rail, and the ADC. Also used as the ADC reference voltage.
XTALIN	6[7]	-	I	-	Input to the oscillator circuit and internal clock generator circuits. Input voltage must not exceed 1.8 V.
XTALOUT	7[7]	-	O	-	Output from the oscillator amplifier.
V_{SS}	5; 41	-	I	-	Ground.

[1] Pin state at reset for default function: I = Input; O = Output; PU = internal pull-up enabled (pins pulled up to full V_{DD} level); IA = inactive, no pull-up/down enabled.

[2] 5 V tolerant pad. $\overline{\text{RESET}}$ functionality is not available in Deep power-down mode. Use the WAKEUP pin to reset the chip and wake up from Deep power-down mode. An external pull-up resistor is required on this pin for the Deep power-down mode. See Figure 27 for the reset pad configuration.

[3] 5 V tolerant pad providing digital I/O functions with configurable pull-up/pull-down resistors and configurable hysteresis (see Figure 26).

[4] I^2C-bus pads compliant with the I^2C-bus specification for I^2C standard mode and I^2C Fast-mode Plus.

[5] 5 V tolerant pad providing digital I/O functions with configurable pull-up/pull-down resistors, configurable hysteresis, and analog input. When configured as a ADC input, digital section of the pad is disabled and the pin is not 5 V tolerant (see Figure 26).

[6] 5 V tolerant digital I/O pad without pull-up/pull-down resistors.

[7] When the system oscillator is not used, connect XTALIN and XTALOUT as follows: XTALIN can be left floating or can be grounded (grounding is preferred to reduce susceptibility to noise). XTALOUT should be left floating.

Table 4. LPC11C22/C24 pin description table

Symbol	Pin	Start logic inputs	Type	Reset state [1]	Description
PIO0_0 to PIO0_11					**Port 0 —** Port 0 is a 12-bit I/O port with individual direction and function controls for each bit. The operation of port 0 pins depends on the function selected through the IOCONFIG register block.
$\overline{\text{RESET}}$/PIO0_0	3[2]	yes	I	I; PU	**$\overline{\text{RESET}}$ —** External reset input with 20 ns glitch filter. A LOW-going pulse as short as 50 ns on this pin resets the device, causing I/O ports and peripherals to take on their default states, and processor execution to begin at address 0.
			I/O	-	**PIO0_0 —** General purpose digital input/output pin with 10 ns glitch filter.

7. Functional description

7.1 ARM Cortex-M0 processor

The ARM Cortex-M0 is a general purpose, 32-bit microprocessor, which offers high performance and very low power consumption.

7.2 On-chip flash program memory

The LPC11Cx2/Cx4 contain 32 kB (LPC11C14/C24) or 16 kB (LPC11C12/C22) of on-chip flash program memory.

7.3 On-chip SRAM

The LPC11Cx2/Cx4 contain a total of 8 kB on-chip static RAM data memory.

7.4 Memory map

The LPC11Cx2/Cx4 incorporates several distinct memory regions, shown in the following figures. Figure 4 shows the overall map of the entire address space from the user program viewpoint following reset. The interrupt vector area supports address remapping.

The AHB peripheral area is 2 megabyte in size, and is divided to allow for up to 128 peripherals. The APB peripheral area is 512 kB in size and is divided to allow for up to 32 peripherals. Each peripheral of either type is allocated 16 kilobytes of space. This allows simplifying the address decoding for each peripheral.

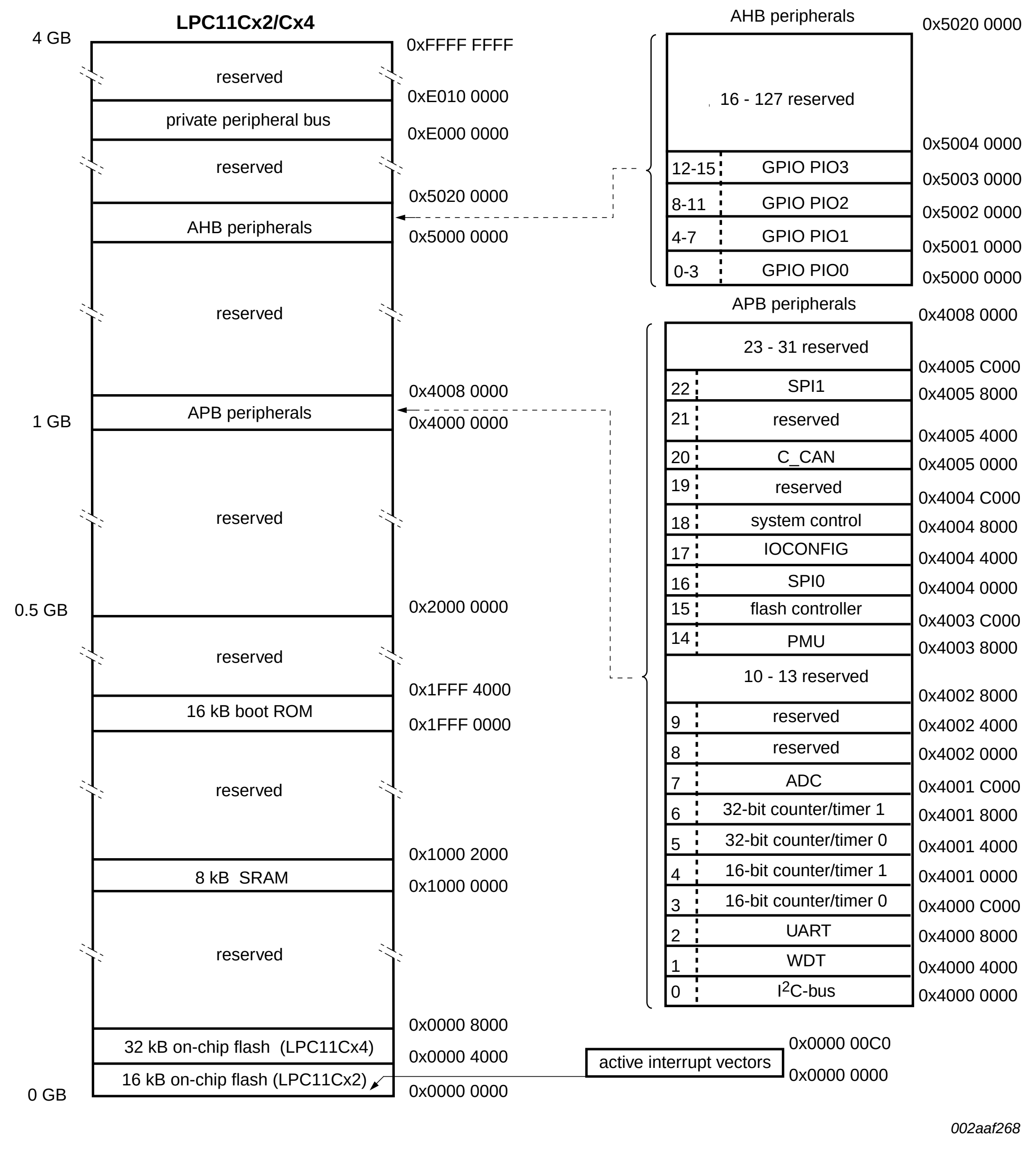


Fig 4. LPC11Cx2/Cx4 memory map

7.5 Nested Vectored Interrupt Controller (NVIC)

The Nested Vectored Interrupt Controller (NVIC) is an integral part of the Cortex-M0. The tight coupling to the CPU allows for low interrupt latency and efficient processing of late arriving interrupts.

7.5.1 Features

- Controls system exceptions and peripheral interrupts.
- In the LPC11Cx2/Cx4, the NVIC supports 32 vectored interrupts including 13 inputs to the start logic from individual GPIO pins.

The I^{2}C-bus is bidirectional for inter-IC control using only two wires: a Serial CLock line (SCL) and a Serial DAta line (SDA). Each device is recognized by a unique address and can operate as either a receiver-only device (e.g., an LCD driver) or a transmitter with the capability to both receive and send information (such as memory). Transmitters and/or receivers can operate in either master or slave mode, depending on whether the chip has to initiate a data transfer or is only addressed. The I^{2}C is a multi-master bus and can be controlled by more than one bus master connected to it.

7.10.1 Features

- The I^{2}C-interface is a standard I^{2}C-bus compliant interface with open-drain pins. The I^{2}C-bus interface also supports Fast-mode Plus with bit rates up to 1 Mbit/s.
- Easy to configure as master, slave, or master/slave.
- Programmable clocks allow versatile rate control.
- Bidirectional data transfer between masters and slaves.
- Multi-master bus (no central master).
- Arbitration between simultaneously transmitting masters without corruption of serial data on the bus.
- Serial clock synchronization allows devices with different bit rates to communicate via one serial bus.
- Serial clock synchronization can be used as a handshake mechanism to suspend and resume serial transfer.
- The I^{2}C-bus can be used for test and diagnostic purposes.
- The I^{2}C-bus controller supports multiple address recognition and a bus monitor mode.

7.11 C_CAN controller

Controller Area Network (CAN) is the definition of a high performance communication protocol for serial data communication. The C_CAN controller is designed to provide a full implementation of the CAN protocol according to the CAN Specification Version 2.0B. The C_CAN controller allows to build powerful local networks with low-cost multiplex wiring by supporting distributed real-time control with a very high level of security.

On-chip C_CAN drivers provide an API for initialization and communication using CAN and CANopen standards.

7.11.1 Features

- Conforms to protocol version 2.0 parts A and B.
- Supports bit rate of up to 1 Mbit/s.
- Supports 32 Message Objects.
- Each Message Object has its own identifier mask.
- Provides programmable FIFO mode (concatenation of Message Objects).
- Provides maskable interrupts.
- Supports Disabled Automatic Retransmission (DAR) mode for time-triggered CAN applications.
- Provides programmable loop-back mode for self-test operation.

7.16.1.3 Watchdog oscillator

The watchdog oscillator can be used as a clock source that directly drives the CPU, the watchdog timer, or the CLKOUT pin. The watchdog oscillator nominal frequency is programmable between 7.8 kHz and 1.7 MHz. The frequency spread over processing and temperature is ±40 % (see Table 16).

7.16.2 System PLL

The PLL accepts an input clock frequency in the range of 10 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, so there is 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 may be set to divide by 2, 4, 8, or 16 to produce the output clock. The PLL output frequency must be lower than 100 MHz. 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 and may be enabled by software. 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.

7.16.3 Clock output

The LPC11Cx2/Cx4 features a clock output function that routes the IRC oscillator, the system oscillator, the watchdog oscillator, or the main clock to an output pin.

7.16.4 Wake-up process

The LPC11Cx2/Cx4 begin operation at power-up and when awakened from Deep power-down mode by using the 12 MHz IRC oscillator as the clock source. This allows chip operation to resume quickly. If the system oscillator or the PLL is needed by the application, software will need to enable these features and wait for them to stabilize before they are used as a clock source.

7.16.5 Power control

The LPC11Cx2/Cx4 support a variety of power control features. There are three special modes of processor power reduction: Sleep mode, Deep-sleep mode, and Deep power-down mode. The CPU clock rate may also be controlled as needed by changing clock sources, reconfiguring PLL values, and/or altering the CPU clock divider value. This allows a trade-off of power versus processing speed based on application requirements. In addition, a register is provided for shutting down the clocks to individual on-chip peripherals, allowing fine tuning of power consumption by eliminating all dynamic power use in any peripherals that are not required for the application. Selected peripherals have their own clock divider which provides even better power control.

7.16.5.1 Sleep mode

When Sleep mode is entered, the clock to the core is stopped. Resumption from the Sleep mode does not need any special sequence but re-enabling the clock to the ARM core.

In Sleep mode, execution of instructions is suspended until either a reset or interrupt occurs. Peripheral functions continue operation during Sleep mode and may generate interrupts to cause the processor to resume execution. Sleep mode eliminates dynamic power used by the processor itself, memory systems and related controllers, and internal buses.

7.16.5.2 Deep-sleep mode

In Deep-sleep mode, the chip is in Sleep mode, and in addition all analog blocks are shut down. As an exception, the user has the option to keep the watchdog oscillator and the BOD circuit running for self-timed wake-up and BOD protection. Deep-sleep mode allows for additional power savings.

Up to 13 pins total, see Table 3, serve as external wake-up pins to a dedicated start logic to wake up the chip from Deep-sleep mode.

Unless the watchdog oscillator is selected to run in Deep-sleep mode, the clock source should be switched to IRC before entering Deep-sleep mode, because the IRC can be switched on and off glitch-free.

7.16.5.3 Deep power-down mode

In Deep power-down mode, power is shut off to the entire chip with the exception of the WAKEUP pin. The LPC11Cx2/Cx4 can wake up from Deep power-down mode via the WAKEUP pin.

When entering Deep power-down mode, an external pull-up resistor is required on the WAKEUP pin to hold it HIGH. The $\overline{\text{RESET}}$ pin must also be held HIGH to prevent it from floating while in Deep power-down mode.

7.17 System control

7.17.1 Start logic

The start logic connects external pins to corresponding interrupts in the NVIC. Each pin shown in Table 3 as input to the start logic has an individual interrupt in the NVIC interrupt vector table. The start logic pins can serve as external interrupt pins when the chip is running. In addition, an input signal on the start logic pins can wake up the chip from Deep-sleep mode when all clocks are shut down.

The start logic must be configured in the system configuration block and in the NVIC before being used.

7.17.2 Reset

Reset has four sources on the LPC11Cx2/Cx4: the $\overline{\text{RESET}}$ pin, the Watchdog reset, power-on reset (POR), and the BrownOut Detection (BOD) circuit. The $\overline{\text{RESET}}$ pin is a Schmitt trigger input pin. Assertion of chip reset by any source, once the operating voltage attains a usable level, starts the IRC and initializes the flash controller.

When the internal Reset is removed, the processor begins executing at address 0, which is initially the Reset vector mapped from the boot block. At that point, all of the processor and peripheral registers have been initialized to predetermined values.

An external pull-up resistor is required on the $\overline{\text{RESET}}$ pin if Deep power-down mode is used.

9. Static characteristics

Table 6. Static characteristics

T_{amb} = −40 °C to +85 °C, unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ[1]	Max	Unit
V_{DD}	supply voltage (core and external rail)	on pins V_{DD}		1.8	3.3	3.6	V
I_{DD}	supply current	Active mode; code `while(1){}` executed from flash					
		system clock = 12 MHz V_{DD} = 3.3 V	[2][3][4][5][6][7]	-	3	-	mA
		system clock = 50 MHz V_{DD} = 3.3 V	[2][3][6][5][7][8]	-	9	-	mA
		Sleep mode; system clock = 12 MHz V_{DD} = 3.3 V	[2][3][4][5][6][7]	-	2	-	mA
		Deep-sleep mode; V_{DD} = 3.3 V	[2][3][5][9]	-	6	-	μA
		Deep power-down mode; V_{DD} = 3.3 V	[2][10]	-	220	-	nA
Standard port pins, $\overline{\text{RESET}}$							
I_{IL}	LOW-level input current	V_I = 0 V; on-chip pull-up resistor disabled		-	0.5	10	nA
I_{IH}	HIGH-level input current	V_I = V_{DD}; on-chip pull-down resistor disabled		-	0.5	10	nA
I_{OZ}	OFF-state output current	V_O = 0 V; V_O = V_{DD}; on-chip pull-up/down resistors disabled		-	0.5	10	nA
V_I	input voltage	$V_{DD} \geq 1.8$ V	[11][12]	0	-	5.0	V
		V_{DD} = 0 V		0	-	3.6	V
V_O	output voltage	output active		0	-	V_{DD}	V
V_{IH}	HIGH-level input voltage			$0.7V_{DD}$	-	-	V
V_{IL}	LOW-level input voltage			-	-	$0.3V_{DD}$	V
V_{hys}	hysteresis voltage			-	0.4	-	V
V_{OH}	HIGH-level output voltage	2.0 V ≤ V_{DD} ≤ 3.6 V; I_{OH} = −4 mA		V_{DD} − 0.4	-	-	V
		1.8 V ≤ V_{DD} < 2.0 V; I_{OH} = −3 mA		V_{DD} − 0.4	-	-	V

Table 6. Static characteristics *…continued*
T_{amb} = −40 °C to +85 °C, unless otherwise specified.

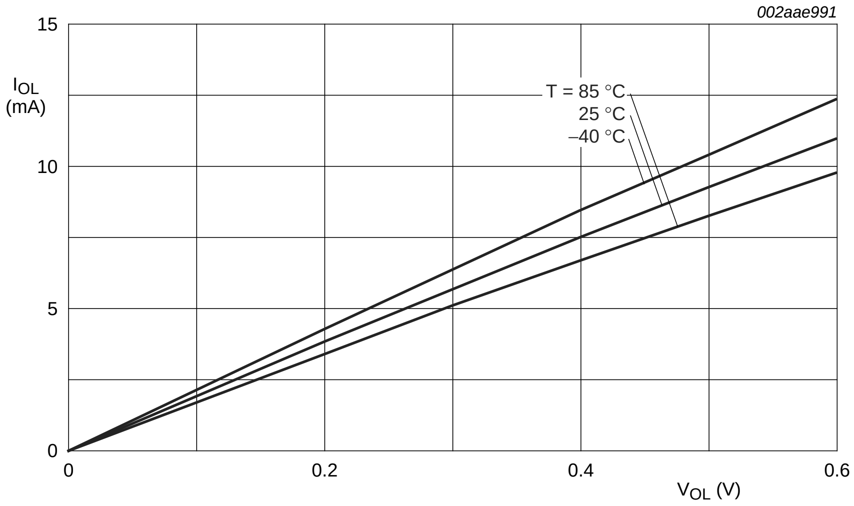
Symbol	Parameter	Conditions	Min	Typ[1]	Max	Unit
V_{OL}	LOW-level output voltage	2.0 V ≤ V_{DD} ≤ 3.6 V; I_{OL} = 4 mA	-	-	0.4	V
		1.8 V ≤ V_{DD} < 2.0 V; I_{OL} = 3 mA	-	-	0.4	V
I_{OH}	HIGH-level output current	V_{OH} = V_{DD} − 0.4 V; 2.5 V ≤ V_{DD} ≤ 3.6 V	20	-	-	mA
		1.8 V ≤ V_{DD} < 2.5 V	12	-	-	mA
I_{OL}	LOW-level output current	V_{OL} = 0.4 V 2.0 V ≤ V_{DD} ≤ 3.6 V	4	-	-	mA
		1.8 V ≤ V_{DD} < 2.0 V	3	-	-	mA
I_{OLS}	LOW-level short-circuit output current	V_{OL} = V_{DD} [13]	-	-	50	mA
I_{pd}	pull-down current	V_I = 5 V	10	50	150	μA
I_{pu}	pull-up current	V_I = 0 V 2.0 V ≤ V_{DD} ≤ 3.6 V	−15	−50	−85	μA
		1.8 V ≤ V_{DD} < 2.0 V	−10	−50	−85	μA
		V_{DD} < V_I < 5 V	0	0	0	μA
I²C-bus pins (PIO0_4 and PIO0_5)						
V_{IH}	HIGH-level input voltage		0.7V_{DD}	-	-	V
V_{IL}	LOW-level input voltage		-	-	0.3V_{DD}	V
V_{hys}	hysteresis voltage		-	0.05V_{DD}	-	V
I_{OL}	LOW-level output current	V_{OL} = 0.4 V; I²C-bus pins configured as standard mode pins 2.0 V ≤ V_{DD} ≤ 3.6 V	3.5	-	-	mA
		1.8 V ≤ V_{DD} < 2.0 V	3	-	-	
I_{OL}	LOW-level output current	V_{OL} = 0.4 V; I²C-bus pins configured as Fast-mode Plus pins 2.0 V ≤ V_{DD} ≤ 3.6 V	20	-	-	mA
		1.8 V ≤ V_{DD} < 2.0 V	16	-	-	
I_{LI}	input leakage current	V_I = V_{DD} [14]	-	2	4	μA
		V_I = 5 V	-	10	22	μA
Oscillator pins						
$V_{i(xtal)}$	crystal input voltage		−0.5	1.8	1.95	V
$V_{o(xtal)}$	crystal output voltage		−0.5	1.8	1.95	V

[1] Typical ratings are not guaranteed. The values listed are at room temperature (25 °C), nominal supply voltages.

[2] T_{amb} = 25 °C.

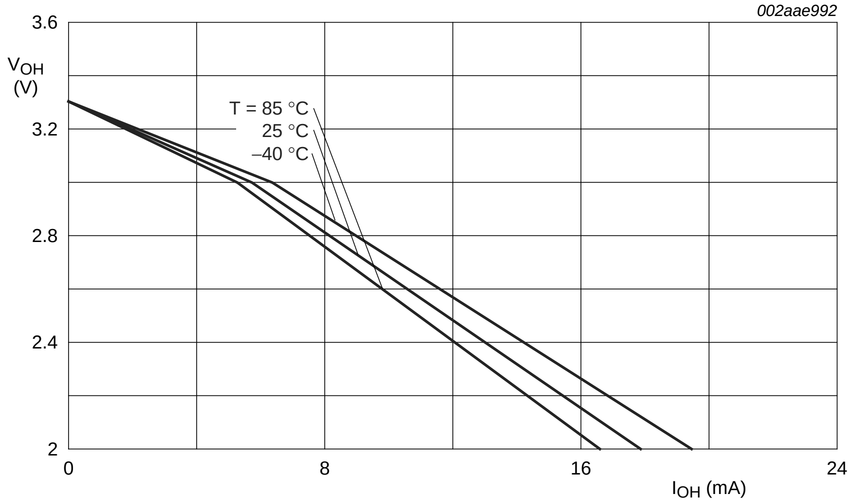
[3] I_{DD} measurements were performed with all pins configured as GPIO outputs driven LOW and pull-up resistors disabled.

[4] IRC enabled; system oscillator disabled; system PLL disabled.



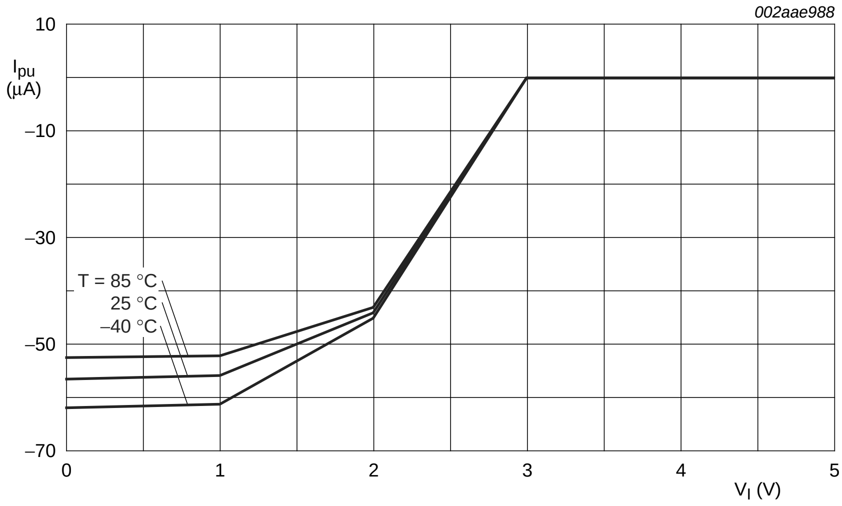
Conditions: V_{DD} = 3.3 V; standard port pins and PIO0_7.

Fig 14. Typical LOW-level output current I_{OL} versus LOW-level output voltage V_{OL}



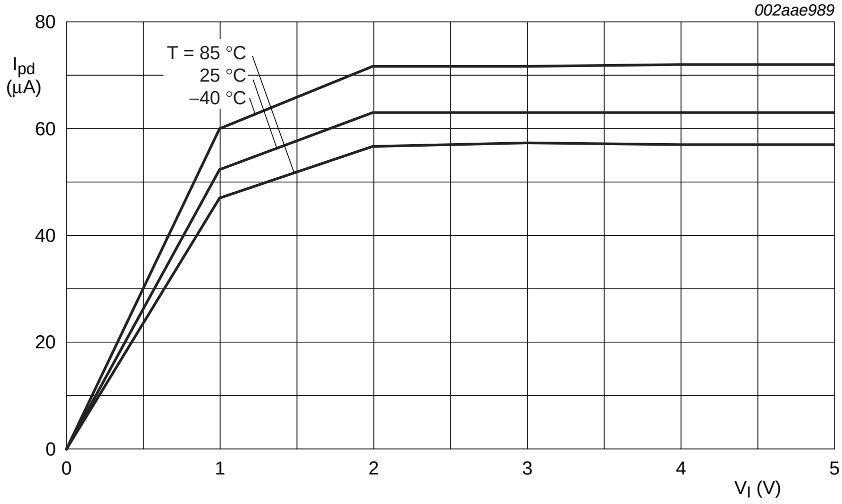
Conditions: V_{DD} = 3.3 V; standard port pins.

Fig 15. Typical HIGH-level output voltage V_{OH} versus HIGH-level output source current I_{OH}



Conditions: V_{DD} = 3.3 V; standard port pins.

Fig 16. Typical pull-up current I_{pu} versus input voltage V_I



Conditions: V_{DD} = 3.3 V; standard port pins.

Fig 17. Typical pull-down current I_{pd} versus input voltage V_I

10. Dynamic characteristics

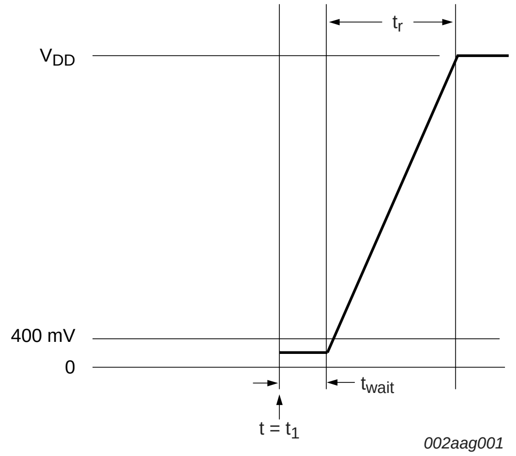
10.1 Power-up ramp conditions

Table 12. Power-up characteristics
T_{amb} = –40 °C to +85 °C.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
t_r	rise time	at t = t_1: 0 < V_I ≤ 400 mV	[1]	0	-	500	ms
t_{wait}	wait time		[1][2]	12	-	-	µs
V_I	input voltage	at t = t_1 on pin V_{DD}		0	-	400	mV

[1] See Figure 18.

[2] The wait time specifies the time the power supply must be at levels below 400 mV before ramping up.



Condition: 0 < V_I ≤ 400 mV at start of power-up (t = t_1)

Fig 18. Power-up ramp

10.2 Flash memory

Table 13. Flash characteristics
T_{amb} = –40 °C to +85 °C, unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
N_{endu}	endurance		[1]	10000	100000	-	cycles
t_{ret}	retention time	powered		10	-	-	years
		unpowered		20	-	-	years
t_{er}	erase time	sector or multiple consecutive sectors		95	100	105	ms
t_{prog}	programming time		[2]	0.95	1	1.05	ms

[1] Number of program/erase cycles.

[2] Programming times are given for writing 256 bytes from RAM to the flash. Data must be written to the flash in blocks of 256 bytes.

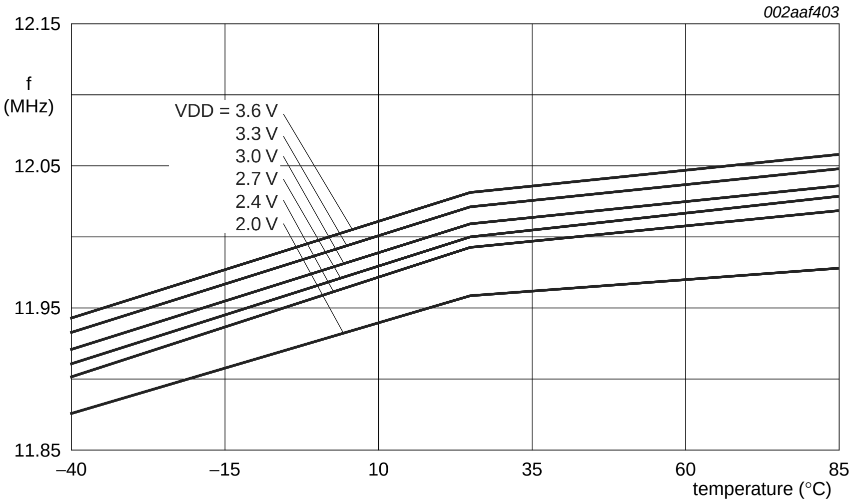
10.4 Internal oscillators

Table 15. Dynamic characteristic: internal oscillators
T_{amb} = −40 °C to +85 °C; 2.7 V ≤ V_{DD} ≤ 3.6 V.[1]

Symbol	Parameter	Conditions	Min	Typ[2]	Max	Unit
$f_{osc(RC)}$	internal RC oscillator frequency	-	11.88	12	12.12	MHz

[1] Parameters are valid over operating temperature range unless otherwise specified.

[2] Typical ratings are not guaranteed. The values listed are at room temperature (25 °C), nominal supply voltages.



Conditions: Frequency values are typical values. 12 MHz ± 1 % accuracy is guaranteed for 2.7 V ≤ V_{DD} ≤ 3.6 V and T_{amb} = −40 °C to +85 °C. Variations between parts may cause the IRC to fall outside the 12 MHz ± 1 % accuracy specification for voltages below 2.7 V.

Fig 20. Internal RC oscillator frequency versus temperature

Table 16. Dynamic characteristics: Watchdog oscillator

Symbol	Parameter	Conditions	Min	Typ[1]	Max	Unit
$f_{osc(int)}$	internal oscillator frequency	DIVSEL = 0x1F, FREQSEL = 0x1 in the WDTOSCCTRL register; [2][3]	-	7.8	-	kHz
		DIVSEL = 0x00, FREQSEL = 0xF in the WDTOSCCTRL register [2][3]	-	1700	-	kHz

[1] Typical ratings are not guaranteed. The values listed are at room temperature (25 °C), nominal supply voltages.

[2] The typical frequency spread over processing and temperature (T_{amb} = −40 °C to +85 °C) is ±40 %.

[3] See the *LPC11Cx user manual*.

[6] The maximum t_f for the SDA and SCL bus lines is specified at 300 ns. The maximum fall time for the SDA output stage t_f is specified at 250 ns. This allows series protection resistors to be connected in between the SDA and the SCL pins and the SDA/SCL bus lines without exceeding the maximum specified t_f.

[7] In Fast-mode Plus, fall time is specified the same for both output stage and bus timing. If series resistors are used, designers should allow for this when considering bus timing.

[8] The maximum $t_{HD;DAT}$ could be 3.45 μs and 0.9 μs for Standard-mode and Fast-mode but must be less than the maximum of $t_{VD;DAT}$ or $t_{VD;ACK}$ by a transition time (see *UM10204*). This maximum must only be met if the device does not stretch the LOW period (t_{LOW}) of the SCL signal. If the clock stretches the SCL, the data must be valid by the set-up time before it releases the clock.

[9] tSU;DAT is the data set-up time that is measured with respect to the rising edge of SCL; applies to data in transmission and the acknowledge.

[10] A Fast-mode I^{2}C-bus device can be used in a Standard-mode I^{2}C-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^{2}C-bus specification) before the SCL line is released. Also the acknowledge timing must meet this set-up time.

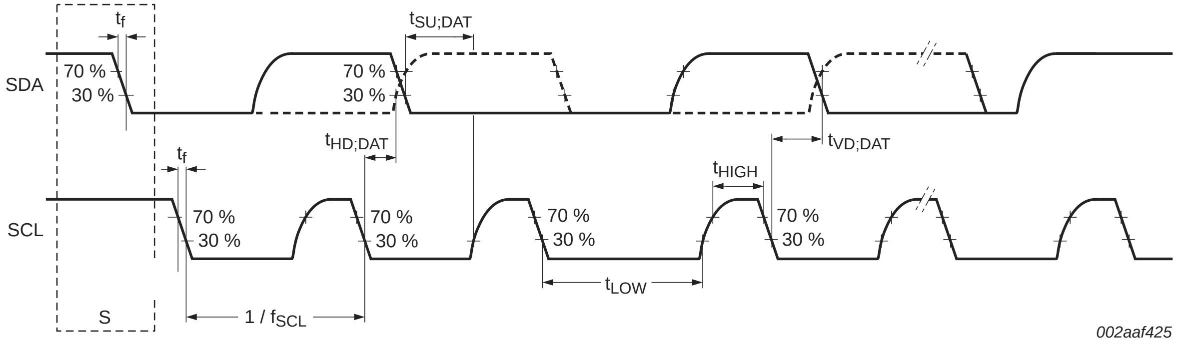


Fig 21. I^{2}C-bus pins clock timing

10.7 SPI interfaces

Table 19. Dynamic characteristics of SPI pins in SPI mode

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
SPI master (in SPI mode)						
$T_{cy(clk)}$	clock cycle time	full-duplex mode [1]	50	-	-	ns
		when only transmitting [1]	40			ns
t_{DS}	data set-up time	in SPI mode [2] 2.4 V ≤ V_{DD} ≤ 3.6 V	15	-	-	ns
		2.0 V ≤ V_{DD} < 2.4 V [2]	20			ns
		1.8 V ≤ V_{DD} < 2.0 V [2]	24	-	-	ns
t_{DH}	data hold time	in SPI mode [2]	0	-	-	ns
$t_{v(Q)}$	data output valid time	in SPI mode [2]	-	-	10	ns
$t_{h(Q)}$	data output hold time	in SPI mode [2]	0	-	-	ns
SPI slave (in SPI mode)						
$T_{cy(PCLK)}$	PCLK cycle time		20	-	-	ns

11. Application information

11.1 ADC usage notes

The following guidelines show how to increase the performance of the ADC in a noisy environment beyond the ADC specifications listed in Table 7:

- The ADC input trace must be short and as close as possible to the LPC11Cx2/Cx4 chip.
- The ADC input traces must be shielded from fast switching digital signals and noisy power supply lines.
- Because the ADC and the digital core share the same power supply, the power supply line must be adequately filtered.
- To improve the ADC performance in a very noisy environment, put the device in Sleep mode during the ADC conversion.

11.2 XTAL input

The input voltage to the on-chip oscillators is limited to 1.8 V. If the oscillator is driven by a clock in slave mode, it is recommended that the input be coupled through a capacitor with C_i = 100 pF. To limit the input voltage to the specified range, choose an additional capacitor to ground C_g which attenuates the input voltage by a factor $C_i/(C_i + C_g)$. In slave mode, a minimum of 200 mv (RMS) is needed.

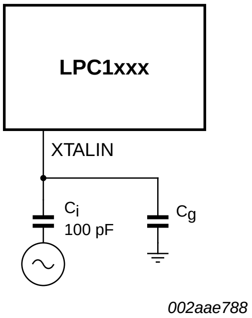


Fig 24. Slave mode operation of the on-chip oscillator

In slave mode the input clock signal should be coupled by means of a capacitor of 100 pF (Figure 24), with an amplitude between 200 mv (RMS) and 1000 mv (RMS). This corresponds to a square wave signal with a signal swing of between 280 mV and 1.4 V. The XTALOUT pin in this configuration can be left unconnected.

External components and models used in oscillation mode are shown in Figure 25 and in Table 20 and Table 21. Since the feedback resistance is integrated on chip, only a crystal and the capacitances C_{X1} and C_{X2} need to be connected externally in case of fundamental mode oscillation (the fundamental frequency is represented by L, C_L and R_S). Capacitance C_P in Figure 25 represents the parallel package capacitance and should not be larger than 7 pF. Parameters F_{OSC}, C_L, R_S and C_P are supplied by the crystal manufacturer (see Table 20).

order to keep the noise coupled in via the PCB as small as possible. Also parasitics should stay as small as possible. Values of C_{x1} and C_{x2} should be chosen smaller accordingly to the increase in parasitics of the PCB layout.

11.4 Standard I/O pad configuration

Figure 26 shows the possible pin modes for standard I/O pins with analog input function:

- Digital output driver
- Digital input: Pull-up enabled/disabled
- Digital input: Pull-down enabled/disabled
- Digital input: Repeater mode enabled/disabled
- Analog input

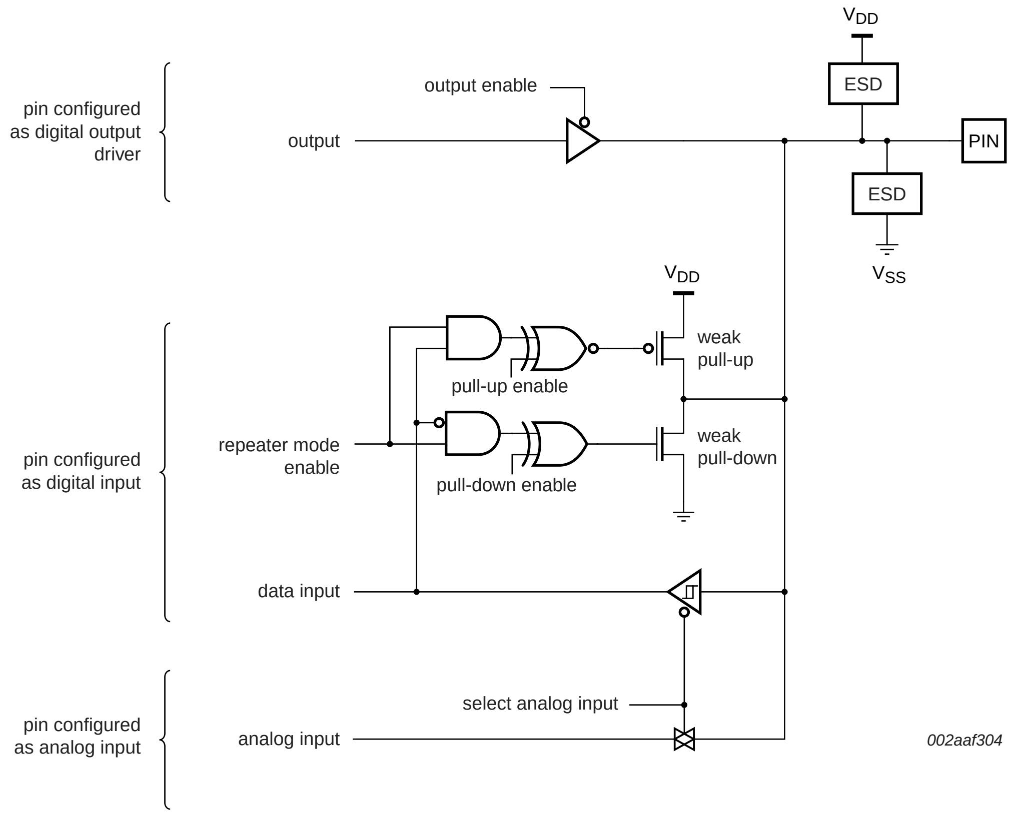


Fig 26. Standard I/O pad configuration

11.5 Reset pad configuration

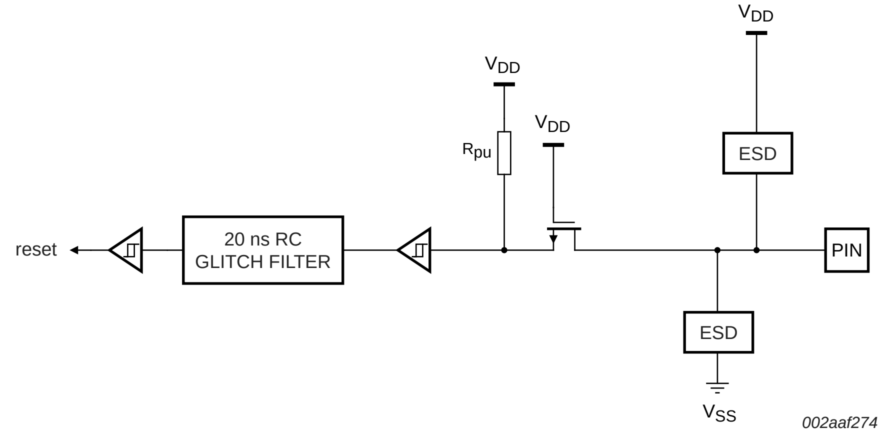


Fig 27. Reset pad configuration

11.6 C_CAN with external transceiver (LPC11C12/C14 only)

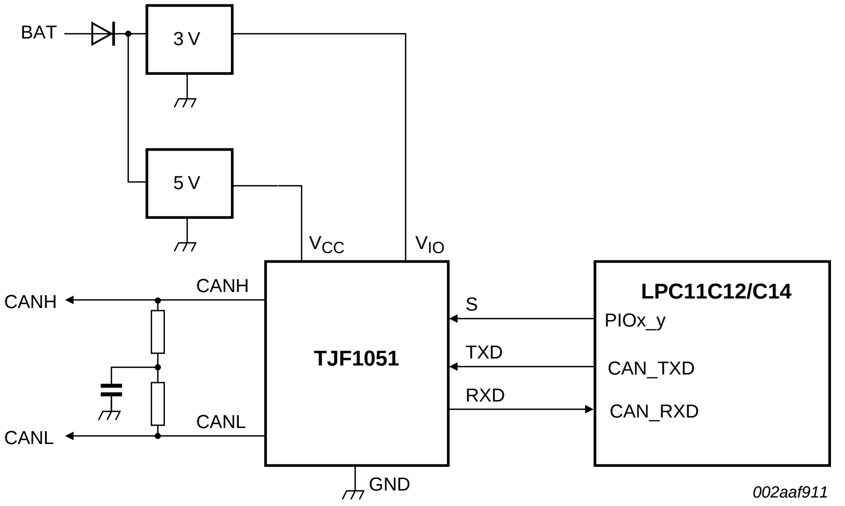


Fig 28. Connecting the C_CAN to an external transceiver (LPC11C12/C14)

Table 23. Revision history *…continued*

Document ID	Release date	Data sheet status	Change notice	Supersedes
Modifications:	• Parts LPC11C22 and LPC11C24 added. • Pin description for parts LPC11C22 and LPC11C24 added (Table 4). • Static characteristics for CAN transceiver added (Table 8). • Description of high-speed, on-chip CAN transceiver added (LPC11C22/C24). See Section 7.11.2. • Application diagram for connecting the C_CAN to an external transceiver added (Section 11.6). • Application diagram for high-speed, on-chip CAN transceiver added (Section 11.7). • Typical value for parameter N_{endu} added in Table 12 “Flash characteristics”. • Description of $\overline{\text{RESET}}$ and WAKEKUP pins updated in Table 3. • PLL output frequency limited to < 100 MHz in Section 7.16.2 “System PLL”. • Parameter V_{hys} for I^2C bus pins: typical value corrected $V_{hys} = 0.05V_{DD}$ in Table 6.			
LPC11C12_C14 v.1	20100921	Product data sheet	-	-

18. Contents

1 General description 1
2 Features and benefits 1
3 Applications 2
4 Ordering information 3
4.1 Ordering options 3
5 Block diagram 4
6 Pinning information 5
6.1 Pinning 5
6.2 Pin description 7
7 Functional description 15
7.1 ARM Cortex-M0 processor 15
7.2 On-chip flash program memory 15
7.3 On-chip SRAM 15
7.4 Memory map. 15
7.5 Nested Vectored Interrupt Controller (NVIC) . 16
7.5.1 Features 16
7.5.2 Interrupt sources. 17
7.6 IOCONFIG block 17
7.7 Fast general purpose parallel I/O 17
7.7.1 Features 17
7.8 UART 18
7.8.1 Features 18
7.9 SPI serial I/O controller. 18
7.9.1 Features 18
7.10 I^{2}C-bus serial I/O controller 18
7.10.1 Features 19
7.11 C_CAN controller 19
7.11.1 Features 19
7.11.2 On-chip, high-speed CAN transceiver 20
7.11.2.1 Features 20
7.11.2.2 Normal mode 20
7.11.2.3 Silent mode. 20
7.11.2.4 Undervoltage protection 20
7.11.2.5 Thermal protection 20
7.11.2.6 Time-out function 21
7.12 10-bit ADC 21
7.12.1 Features 21
7.13 General purpose external event counter/timers. 21
7.13.1 Features 21
7.14 System tick timer 22
7.15 Watchdog timer. 22
7.15.1 Features 22
7.16 Clocking and power control 22
7.16.1 Crystal oscillators 22
7.16.1.1 Internal RC oscillator 23
7.16.1.2 System oscillator 23
7.16.1.3 Watchdog oscillator 24
7.16.2 System PLL 24
7.16.3 Clock output. 24
7.16.4 Wake-up process 24
7.16.5 Power control. 24
7.16.5.1 Sleep mode 24
7.16.5.2 Deep-sleep mode. 25
7.16.5.3 Deep power-down mode 25
7.17 System control 25
7.17.1 Start logic 25
7.17.2 Reset 25
7.17.3 Brownout detection 26
7.17.4 Code security (Code Read Protection - CRP) 26
7.17.5 Bootloader 27
7.17.6 APB interface 27
7.17.7 AHBLite 27
7.17.8 External interrupt inputs 27
7.18 Emulation and debugging 27
8 Limiting values 28
9 Static characteristics 29
9.1 ADC characteristics 32
9.2 C_CAN on-chip, high-speed transceiver characteristics 34
9.3 BOD static characteristics 36
9.4 Power consumption 36
9.5 Peripheral power consumption 40
9.6 Electrical pin characteristics. 41
10 Dynamic characteristics. 44
10.1 Power-up ramp conditions 44
10.2 Flash memory 44
10.3 External clock. 45
10.4 Internal oscillators 46
10.5 I/O pins 47
10.6 I^{2}C-bus. 47
10.7 SPI interfaces. 48
11 Application information 51
11.1 ADC usage notes. 51
11.2 XTAL input 51
11.3 XTAL Printed Circuit Board (PCB) layout guidelines. 52
11.4 Standard I/O pad configuration 53
11.5 Reset pad configuration 54
11.6 C_CAN with external transceiver (LPC11C12/C14 only) 54
11.7 C_CAN with on-chip, high-speed transceiver (LPC11C22/C24 only) 55
12 Package outline. 56

continued >>

13 Soldering 57
14 Abbreviations 58
15 Revision history 59
16 Legal information 61
16.1 Data sheet status 61
16.2 Definitions 61
16.3 Disclaimers 61
16.4 Trademarks 62
17 Contact information 62
18 Contents 63

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