AN10302

Using the Philips LPC2000 Flash utility with the Keil MCB2100 and IAR LPC210x Kickstart evaluation boards

Rev. 04 — 12 October 2006

Application note

Document information

Info	Content
Keywords	LPC2000, Flash utility, Keil MCB2100, IAR LPC210x
Abstract	Application information for the Philips LPC2000 Flash utility with the Keil MCB2100 and IAR LPC210x Kickstart evaluation boards



Revision history

Rev	Date	Description
04	20061012	 Fourth version Updated <u>Figure 2</u>.
03	20040610	Third version
02	20040512	Second version
01	20040430	Initial version

Contact information

For additional information, please visit: http://www.nxp.com

For sales office addresses, please send an email to: salesaddresses@nxp.com

AN10302_4

Application note

1. Introduction

In-System programming (ISP) is a method of programming and erasing the on-chip flash or RAM memory using the boot loader software and a serial port. The part may reside in the end-user system. The flash boot loader provides an In-System Programming interface for programming the on-chip flash or RAM memory. This boot loader is located in the upper 8 kB of flash memory, it can be read but not written to or erased.

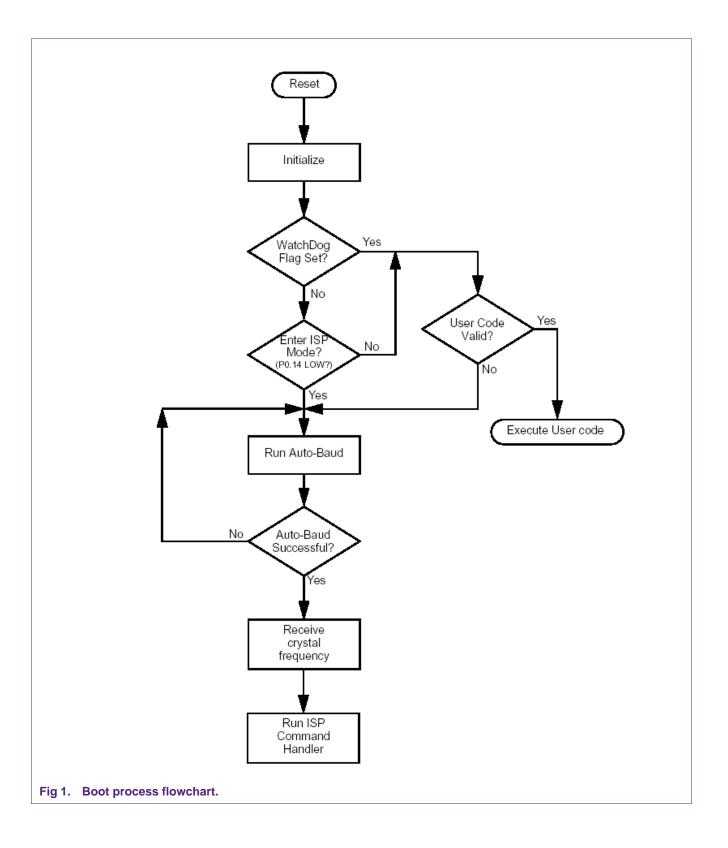
2. LPC2000 ISP overview

The flash boot loader code is executed every time the part is powered on or reset. The loader can execute the ISP command handler or pass execution to the user application code.

A LOW level, after reset, at the P0.14 pin is considered as the external hardware request to start the ISP command handler. The boot loader samples this pin during reset. Assuming that proper signal is present on X1 pin when the rising edge on RST pin is generated, it may take up to 3 ms before P0.14 is sampled and the decision on whether to continue with user code or ISP handler is made. If P0.14 is sampled LOW and the watchdog overflow flag is set, the external hardware request to start the ISP command handler is ignored. If there is no request for the ISP command handler execution (P0.14 is sampled HIGH after reset), a search is made for a valid user program. If a valid user program is found then the execution control is transferred to it. If a valid user program is not found, the auto-baud routine is invoked.

Pin P0.14 is used as hardware request for ISP requires special attention. Since P0.14 is in high impedance mode after reset, it is important that the user provides external hardware (a pull-up resistor or other device) to put the pin in a defined state. Otherwise unintended entry into ISP mode may occur.

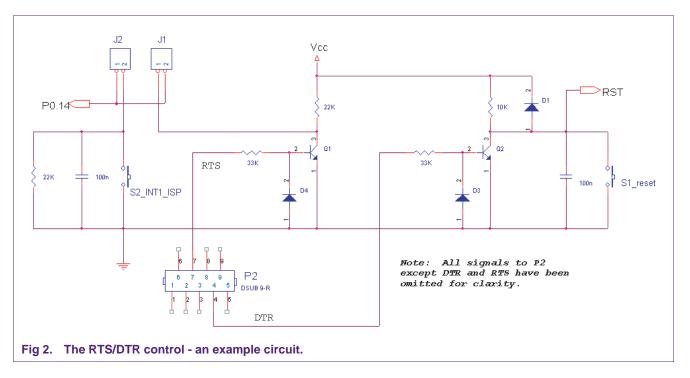
Figure 1 shows the boot sequence of the LPC210x devices.



3. Details of the Philips LPC2000 Flash utility

This flash utility is available for free download from the Philips website. This software, in combination with the hardware described below, allows for hands-off erasure, uploading, and execution of code.

The Philips LPC2000 Flash utility utilizes two, otherwise unused, signals (RTS and DTR) of the PC serial port to control the microcontroller reset and P0.14 pins. The port pin P0.14, if LOW during reset, puts the microcontroller into In System Programming (ISP) mode; this pin has the alternate functions of external interrupt one and general purpose I/O (GPIO). Some details on the associated circuitry will help in understanding how this works.



3.1 Manual entry into ISP mode

With jumper J1 removed and jumper J2 in place ISP mode will be entered manually by holding S2 while pressing and releasing S1 (reset). This can become cumbersome and so it is advantageous to use RTS/DTR control of these signals.

3.2 ISP mode entry using DTR/RTS

With jumper J1 inserted and jumper J2 removed the reset and P0.14 signals may be controlled by the previously un-used RTS/DTR signals of the PC serial port. In this application both these signals are active HIGH. When RTS is asserted Q2 is turned on and the microcontroller reset is pulled LOW. While the micro is held in reset, DTR is asserted and P0.14 is held LOW. RTS is then brought LOW and so Q2 is turned off. The 10K pull-up resistor releases the RESET signal by pulling it HIGH. The microcontroller is now running in ISP mode.

This sequence of ISP mode entry is performed for every operation offered by the Philips LPC2000 Flash Utility.

AN10302 4

Flash Programming	Erase / Blank	Communication
Filena C:\Documents and Settings\rsoennic\De	skti Blank Check	Connected To Por COM1: COM1:
Upload to Flash		Start Sector: 0 9600
Compare Flash 2 Manual	Erase	End Sector: 7
Device		Use DTR/RTS
Device: LPC2129	Read Part ID:	Boot Loader Selection
XTAL Freq. [kHz]: 12000	Device ID Boot Loader ID:	7

The main screen of the Flash Utility provides access to most if its functionality. When the "use DTR/RTS..." box (1) is checked then control of reset and P0.14 is done by the utility as described above. If this box is unchecked then ISP mode must be entered manually. If the "execute code after upload" is checked then, after code is programmed into the flash, an extra reset pulse is sent to the microcontroller to reset the part. Since, at this time, P0.14 will be HIGH, the part will execute code in flash after this reset.

When the utility connects to the MCB2100 it will attempt to connect at the selected baud rate. The highest baud rate achievable will depend mostly on the frequency of the crystal. Using standard baud rate crystals (e.g. 14.7456 MHz) will increase the maximum baud rate achievable.

3.3 Flash buffer operations

The flash buffer operation screen (accessible from the "buffer" pull-down menu) allows functions such as loading a HEX file, downloading from flash, uploading to flash, filling the buffer, saving the HEX file and calculation of the checksum "valid code" vector¹. There is also the ability to fill the buffer with a particular value¹ and program this buffer to flash.

AN10302 4

^{1.} The valid code vector at 0x14 is merely the two's complement of the sum of the vector table. By assigning it this value the checksum for the entire vector table is 0x00 which indicates valid flash code. After reset the bootloader will examine this location and, if the value is correct (an indication of valid user code in flash), will execute code out of flash. If the value is not correct the bootloader will enter ISP mode. The Philips LPC2000 Flash Utility will automatically calculate and program this value during an upload to flash. Alternatively the vector calculation may be performed on the contents of flash buffer as shown in the screen-shot below.

at 0000 0000 FF FF	LPC2000 Fla	asirodi	it.y -	riasi	T DUI	ier															_	414
84+0000 0010 FF FF	&H0000 0000	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	UUUUU	UUUI	JUUU	UUUU	
8H0000 0030 FF FF	&H0000 0010	FF	FF	FF	FF	07	00	00	00	FF	FF	FF	FF	FF	FF	FF	FF					
8H0000 0040 FF FF	&H0000 0020	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	ŬŬŬŬŬ	yyyi	JUUU	ÿÿÿÿ	
8H0000 0050 FF FF	&H0000 0030	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	<u> </u>	yyyy	JYYY	yyyy	
840000 0060 FF FF	&H0000 0040	FF	FF			FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	<u>yyyyy</u>	yyyy	JUUU	ÿÿÿÿ	
8H0000 0070 FF FF	&H0000 0050	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	<u>yyyyy</u>	yyyy	JYYY.	yyyy	
&H0000 0080 FF FF																		<u>yyyyy</u>	yyyy	JYYY.	yyyy	
&H0000 0030 FF FF																			/ / / _		/////	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $																						
&H0000 00B0 FF FF																						
&H0000 00C0 FF FF																						
kH0000 0DD0 FF FF												FF										
&H0000 00E0 FF FF																						
&H0000 00F0 FF FF							FF					FF										
&H0000 0100 FF FF							FF					FF										
&H0000 0110 FF FF							FF															
&H0000 0120 FF FF							FF															
&H0000 0130 FF FF																						
&H0000 0140 FF FF		FF	FF	FF	FF	FF	FF	FF	FF	FF	FF		FF	FF	FF	FF						
&H0000 0150 FF FF		FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF					
&H0000 0160 FF FF	&H0000 0150	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF					
&H0000 0170 FF FF	&H0000 0160	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF					
&H0000 0190 FF FF	&H0000 0170	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF					
&H0000 01A0 FF FF	&H0000 0180	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	<u>yyyyy</u>	UUUU	JUUU	ÿÿÿÿ	
&H0000 01B0 FF FF	&H0000 0190	FF	FF	FF		FF	FF	FF		FF	FF	FF	FF	FF	FF	FF	FF	<u>yyyyy</u>	yyyy	JUUU	yyyy	
&H0000 01C0 FF FF							FF											<u>yyyyy</u>	yyyy	JYYY.	yyyy	
&H0000 01D0 FF FF																		<u>yyyyy</u>	yyyy	JYYY	yyyy	
&H0000 01E0 FF FF																		<u>yyyyy</u>	yyyı	JYYY.	yyyy	
&H0000 01F0 FF FF																						
Load Hex File Vector Calc Upload to Flash Download Flash Save Hex File Fill Buffer Code Execution Address Range Fill Value: Fill Value:																						
Code Execution Address Range Fill Value:	«H0000 01F0	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	rr	FF	FF	FF	FF	FF	99999	9999	,999	9999	ŀ
C Selected Parage Start &H0000000	Load Hex	File		Vec	tor Ca	alc		Upl	oad to) Flash		De	ownlo	ad Fla:	sh		Save	Hex File		Fill B	Buffer	
C Selected Parece Start: \$H0000000	Code Executio	on	_					ΓA	ddres	s Rang	je –				_					Fill V	alue:	22
		1	2.1	00000	1000		-		Sel	ected I	Rang	je	9	Start:	&H0	0000	000					
Bun from Address O Thumb • ABM C Entire Buffer End: &H0003DFFF	Run from Ac	ddress				ARM		0) Ent	ire Bufi	fer			End:	&H0	003D	FFF					
LPC2000 Flash Utility								L	PC	200	0	Fla	ash	Ut	ility	у						
alculation of LPC200 Start Checksum Vector Succeeded	alculation of LP	200 St	art Cl	hecks	um V	ector (Succ									-						_

3.4 RAM buffer operations

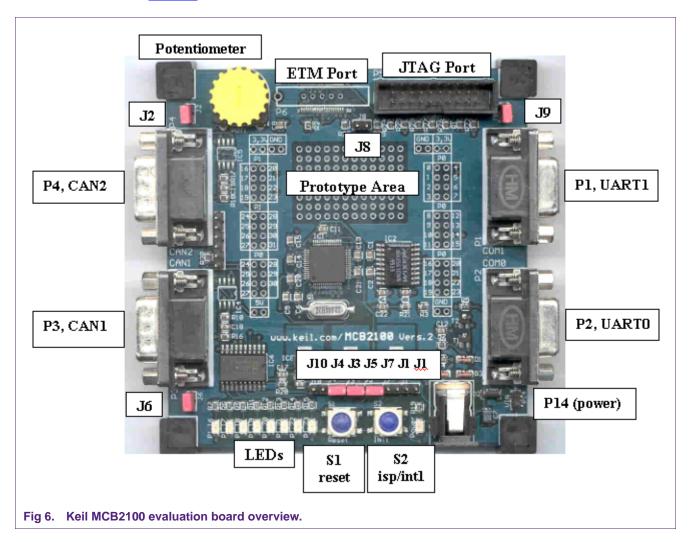
Ram buffer operations (accessible from the "buffer" pull-down menu) are similar to flash buffer operations including the uploading of HEX files etc.

&H4000(FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	UUUUUU			
&H4000 (FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	ÿÿÿÿÿÿ			
&H4000 (FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	yyyyyy			
&H4000 (FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	999999			
&H4000 (FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	yyyyyy			
&H4000 (FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	999999			<u>.</u>
¥4000 (&H4000 (0060	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	999999			
		FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	999999			<u> </u>
&H4000(FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	yyyyyy		333333	<u>.</u>
&H4000(FF FF	FF FF	FF FF	FF FF	FF FF	FF FF	FF FF	FF FF	FF FF	FF FF	FF FF	FF FF	FF FF	FF	FF FF	FF FF	yyyyyy			
&H4000(FF	FF					FF				FF		FF		FF	yyyyyy			
&H4000(FF FF	FF	FF	FF FF	FF FF	FF FF	FF FF	FF	FF FF	FF FF	FF	FF	FF FF	FF FF	FF FF	FF	999999			<u> </u>
&H4000 (FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF FF	FF	FF	FF	FF	FF	999999			
&H4000(FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	999999			
&H4000(FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	999999			
&H4000(FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	999999	2222		<u> </u>
&H4000 (FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	999999			
&H4000 (FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	999999 000000			<u> </u>
&H4000 (FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	9999995 9999999			<u> </u>
&H4000 (FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	000000		333333	<u>.</u>
&H4000 (FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	000000			<u> </u>
&H4000 (FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	000000			
&H4000 (FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	UUUUUU			<u> </u>
&H4000 (FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	UUUUUU			<u> </u>
&H4000(0190	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	ÜÜÜÜÜÜ			<u> </u>
&H4000 (01A0	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	UUUUUU			<u> </u>
&H4000(D1B0	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	ΰΰΰΰΰ			<u> </u>
&H4000(D1C0	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	ΰΰΰΰΰ			
&H4000(01D0	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	ÛÛÛÛÛÛ			
&H4000 (D1E0	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	ΰΰΰΰΰ			
&H4000 (D1FO	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	ŢŶŶŶŶŶ	IJIJIJIJ	<u>yyyyy</u>	;
Load	l Hex Fil	le						Upl	oad te	o RAM		D	ownlo	ad RA	м	/	Savel	Hex File		Fill Buffer	
- Code Exe	ocution								ddroo	s Ranı						<u></u>					
CODELA	scution			1000	0000		_			⊙ Se	-	d Rar	nge		Start:	&H	40000	000	1	Fill Value:	156
Run fro	om Addr	ess	1	4000 Thun		ARM					tire Bi					· ·	400031				
									PC	200	0	Fla	heh	1.1+]		
										200	0		ISI		mty	y					

4. Hardware

4.1 Keil MCB2100 evaluation board

Figure 6 shows an overview of the Keil MCB2100 evaluation board.



JTAG port — Connection to JTAG emulator (e.g. Keil ULink). This is a standard JTAG port as outlined in ARM documentation.

ETM (Embedded Trace Macrocell) port — Provides interface to emulators with trace capability.

P3 and P4, CAN ports — These provide access to the CAN ports (On boards that feature a microcontroller with CAN interfaces).

P1 and P2, UARTS — Access to UART0 and UART1.

S1 reset — Microcontroller reset.

S2 ISP/INT1 — This button pulls the P0.14 pin of the microcontroller LOW, providing either an external interrupt or manual entry into ISP mode.

LEDs — buffered with a 74LVC octal buffer, enabled by J6.

Potentiometer — Configured as a voltage divider with its output connected to AIN0 via jumper J2.

Table 1. Keil MCB2100 jumper functions

Jumper	Function
J1	Configures P0.14 for DTR/RTS control of ISP (see ISP section below)
J2	Potentiometer/ADC Connect
J3[1]	3.3 V enable
J4 <mark>[1]</mark>	1.8 V enable
J5	3.3 V analog voltage supply enable
J6	LED enable
J7	Configures P0.14 for external interrupt or manual ISP entry
J8	ETM Pins Enable (Pulls TraceSync LOW)
J9	JTAG Debug Pins Enable (Pulls RTCK LOW)
J10 ^[2]	Configures RESET for DTR/RTS control of ISP (see ISP section below)

[1] These jumpers supply the voltages to the microcontroller and must be in for normal operation.

[2] Remove this jumper when not using ISP.

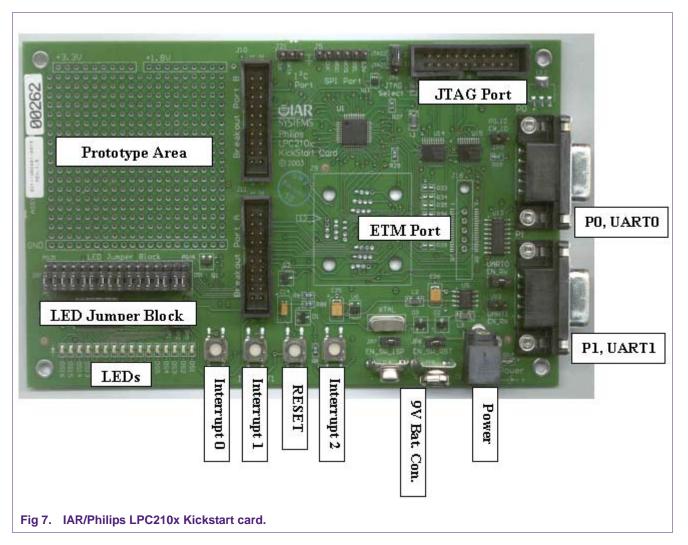
4.1.1 Enabling ISP mode with the MCB2100

The Keil MCB2100 evaluation board was designed to utilize the RTS/DTR control of reset and P0.14 as featured in the Philips LPC2000 Flash utility.

To setup the MCB2100 for ISP programming **set** the jumpers: **J1**, **J3**, **J4**, **J5**, **J7** and **J10**. Connect the PC serial port to COM0 of the MCB2100 and start the LPC2000 Flash Utility. Check the "Use DTR/RTS......" box and continue.

4.2 The IAR/Philips LPC210x Kickstart card

This evaluation board is populated with an LPC2106 microcontroller and features 2 serial ports, 2 user-defined buttons, 16 fully configurable LEDs, 20-pin JTAG interface connector as well as breakout headers for all pins.



JTAG port — Connection to JTAG emulator (e.g. JLink). This is a standard JTAG port as outlined in ARM documentation.

ETM (Embedded Trace Macrocell) port — Provides interface to emulators with trace capability.

P0 and P1, UARTS — Access to UART0 and UART1.

RESET — Microcontroller reset.

Interrupt0 — This button provides a source for interrupt zero.

Interrupt1 — This button pulls the P0.14 pin of the microcontroller LOW, providing either an external interrupt or manual entry into ISP mode.

Interrupt2 — This button provides a source for interrupt two.

LED jumper block — enables/disables individual LEDs.

LEDs — buffered with a LVT16244.

Table 2.	ARAFINIPS Rickstart card jumper functions
Jumper	Function
JP1	Enables external interrupt zero via the push-button
JP2	Enables ISP and external interrupt one ^[1]
JP3	Connects P0.9/RxD1 (UART1) to the MAX3232
JP4	Connects P0.1/RxD0 (UART0) to the MAX3232
JP5	Enables external interrupt zero via the push-button
JP6	Primary/Secondary JTAG select ^[2]
JP7	Enable DTR/RTS control of P0.14
JP8	Enable DTR/RTS control of RESET

Table 2. IAR/Philips Kickstart card jumper functions

[1] P0.14 and external interrupt one share the same pin; therefore this button may also be used for manual entry into ISP mode by pressing it during a reset.

[2] This jumper, when in the JTAG1 position, will cause the microcontroller to enter JTAG debug mode after reset. Therefore, when using ISP, this jumper must be removed or placed in the JTAG2 position.

4.2.1 Enabling ISP mode with the IAR/Philips Kickstart card

The Kickstart Card evaluation board was designed to utilize the RTS/DTR control of reset and P0.14 as featured in the Philips LPC2000 Flash utility.

To setup the Kickstart Card for ISP programming set the jumpers: JP7, JP8, JP2 and JP4. Remove jumper JP6. Connect the PC serial port to P0 (UART0) of the Kickstart Card and start the LPC2000 Flash Utility. Check the "Use DTR/RTS......" box and continue.

AN10302

5. Legal information

5.1 Definitions

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

5.2 Disclaimers

General — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information.

Right to make changes — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use — NXP Semiconductors products are not designed, authorized or warranted to be suitable for use in medical, military, aircraft, space or life support equipment, nor in applications where failure or malfunction of a NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors accepts no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

5.3 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

6. Contents

1	Introduction 3
2	LPC2000 ISP overview
3	Details of the Philips LPC2000 Flash utility 5
3.1	Manual entry into ISP mode 5
3.2	ISP mode entry using DTR/RTS 5
3.3	Flash buffer operations 6
3.4	RAM buffer operations 7
4	Hardware 9
4.1	Keil MCB2100 evaluation board 9
4.1.1	Enabling ISP mode with the MCB2100 10
4.2	The IAR/Philips LPC210x Kickstart card 10
4.2.1	Enabling ISP mode with the IAR/Philips Kickstart
	card 12
5	Legal information 13
5.1	Definitions 13
5.2	Disclaimers
5.3	Trademarks
6	Contents 14

Please be aware that important notices concerning this document and the product(s) described herein, have been included in section 'Legal information'.

© NXP B.V. 2006.



For more information, please visit: http://www.nxp.com For sales office addresses, please send an email to: salesaddresses@nxp.com

Date of release: 12 October 2006 Document identifier: AN10302_4

All rights reserved.