

USER'S MANUAL FOR

ARM7 LPC2148 DEVELOPEMET BOARD

Manufactured By

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INTRODUCTION & OVERVIEW OF ARM7 LPC2148 DVK

Logsun's ARM7 LPC2148-DVK is 32-bit LPC2148 Microcontroller based evaluation module. ARM7 LPC2148-DVK is a general-purpose development board for ARM Controller. ARM7 LPC2148-DVK can be used extensively to test and validate programs. This provides advance features like ISP, I2C and IAP. The micro controller has 12 KB internal flash memory and 32 KB on-chip RAM. The development board comes with RS-232 interface to allow user to programme microcontroller directly from PC. ARM7 LPC2148-DVK board and related software routines help the system designers to rapidly design and prototype their designs based on ARM Core. It provides a complete development platform with different modules interface that accelerates the task of designers to run application software on target ARM Controller hardware, thus providing a platform to benchmark their system, save time & expense of building their own application test board and enabling them to get their designs to market quickly. ARM7 LPC2148-DVK is a unique hardware and software combination, providing designers the tool to develop most advanced ARM series Microcontroller applications. The ARM7 LPC2148-DVK hardware reference and software application programs also simplify ARM based hardware and software development.

SPECIFICATION:

1. LPC2148 microcontroller
2. On board Serial & USB Connector for Programming
3. Internal ADC interface
4. On board 16x2 LCD
5. On board I²C EEPROM interface
6. On board 7-segment display
7. On board DC Motor Driver
8. On board Stepper Motor Driver
9. On board Relay Buzzer & LED interface
10. On board SD-Card Slot
11. Internal RTC interface
12. On board 4x4 Matrix Keypad
13. Internal DAC interface

Getting Started:

LGS –ARM7 LPC2148 Development Board Includes:

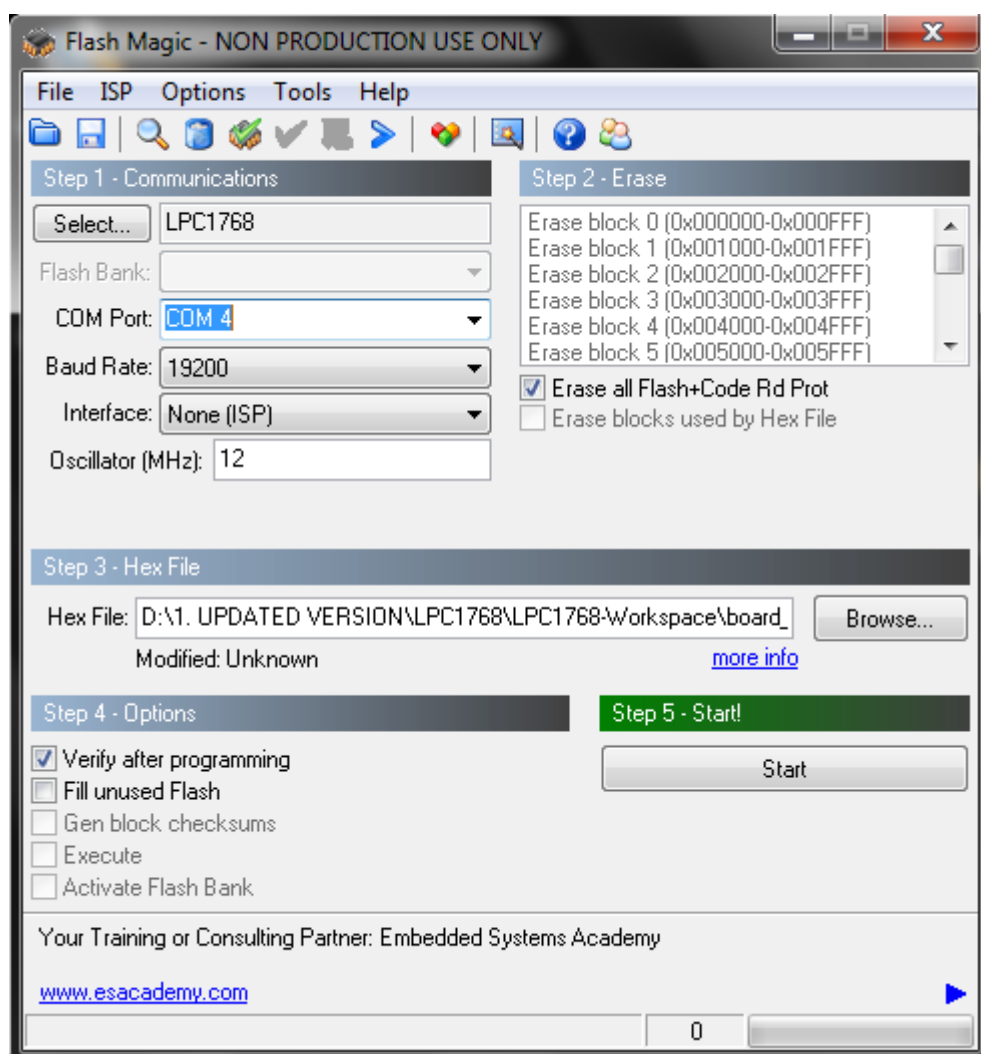
1. Male to Female Straight Cable (DB-9) or USB to Serial Converter or A-B USB Cable.
2. 12V Power Adapter.
4. User's Manual
5. Compact Disc Containing:
 - a) Flash Utility for IC
 - b) Required Software (Keiluvision Evaluation Version) (16K Code Size)
 - c) Sample Codes for development
 - c) Circuit diagram and layout.
 - d) Data sheet

HOW TO USE FLASH MAGIC?

LPC2148 is used as Main Microcontroller in ARM7 DVK. Flash magic software by NXP is used to upload the firmware to the target board. To install the Flash Magic software, run the setup provided in the CD.

Programme Uploading Steps using Flash Magic:

- Connect the Power adaptor to the board.
- Connect the supplied serial cable or USB to serial converter between the microcontroller board & computer.
- Open Flash Magic Software.



- In **Step 1 – Communications**: select the following parameters:
 - **Select**: LPC1768 (As per requirement)
 - **COM Port**: COM1/COM2 (As per COM detected by PC)
 - **Baud Rate**: 19200 (As per requirement)
 - **Interface**: None (ISP)
 - **Oscillator (MHz)**: 12
- In **Step 2 – Erase**: select the following parameters:
 - Click on **Erase all Flash+Code Rd Prot**
- In **Step 3 – Firmware**: select the following parameters:
 - Using the **Browse** button, load the appropriate *.HEX file provided in CD.
- In **Step 5 – Start**
 - Set **S6**switch to **DOWN** position to put LPC2148 in **PROGRAMMING** Mode & Press **Reset** Switch.
 - Click on **Start**.
- At the right bottom of Flah Magic window, you can see the progress of program downloading in graphical format and at left bottom you can see the process. Wait until it shows “**Finished**” to finish downloading process.
- Now Set **S6**switch to **UP** position to put LPC2148 in **RUN** mode
- Press the **RESET** Key on board & you can see/ observe the corresponding output.

EXPERIMENT NO.1

AIM: - Interfacing of 16 x2 LCD (8Bit) with LPC2148.

REQUIREMENT: -ARM7 LPC2148-DVK, 12V Power Adaptor, 10 pin FRC (2 Qty.), Serial or USB Cable.

PROCEDURE:-

- 1) Connect the 12V Power Adaptor to LPC2148 DVK.
- 2) Connect the serial or USB cable between LPC2148 DVK & PC.
- 3) Open the Flash Magic software and make settings as mentioned above.
- 4) Make sure that switch (**S6**) on LPC2148 is at DOWN position during programming.
- 5) Upload the Hex file to LPC2148 Board.
- 6) Connect 10 pin FRC from J5 (P1.16-P1.23) to J7 (LCD Data) & J6 (P1.24-P1.31) to J8 (LCD CMD) of LCD section.
- 7) Make sure that slide switch is on 5V.
- 8) Now toggle switch (S6) to UP position to put LPC2148 in RUN mode & Press Reset Switch.
- 9) Output will be displayed on LCD as

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LPC2148

PIN DESCRIPTION: -

J5 (P1.16-P1.23)	J7 (LCD Data)
5V	5V
GND	GND
P1.16	Data0
P1.17	Data1
P1.18	Data2
P1.19	Data3
P1.20	Data4
P1.21	Data5
P1.22	Data6
P1.23	Data7

J6 (P1.24-P1.31)	J8 (LCD CMD)
5V	5V
GND	GND
P1.24	NC
P1.25	NC
P1.26	NC
P1.27	RS
P1.28	RW
P1.29	EL
P1.30	NC
P1.31	NC

EXPERIMENT NO. 2

AIM: - Interfacing of 16 x2 LCD & 4x4 Matrix Keypad with LPC2148.

REQUIREMENT: - ARM7 LPC2148-DVK, 12V Power Adaptor, 10 pin FRC (3 Qty.), Serial or USB Cable.

PROCEDURE: -

- 1) Connect the 12V Power Adaptor to LPC2148 DVK.
- 2) Connect the serial or USB cable between LPC2148 DVK & PC.
- 3) Open the Flash Magic software and make settings as mentioned above.
- 4) Make sure that switch (S6) on LPC2148 is at DOWN position during programming.
- 5) Upload the Hex file to LPC2148 Board.
- 6) Connect 10 pin FRC from J1 (P0.0-P0.7) to J7 (LCD Data) & J2 (P0.8-P0.15) to J8 (LCD CMD) of LCD section.
- 7) Connect J5 (P1.16-P1.23) to J11 (Keypad Section).
- 8) Make sure that slide switch is on 5V.
- 9) Now toggle switch (S6) to UP position to put LPC2148 in RUN mode & Press Reset Switch.
- 10) Respective Key Pressed will be displayed on LCD as Output.

PIN DESCRIPTION: -

J1 (P0.0-P0.7)	J7 (LCD Data)
5V	5V
GND	GND
P0.0	Data0
P0.1	Data1
P0.2	Data2
P0.3	Data3
P0.4	Data4
P0.5	Data5
P0.6	Data6
P0.7	Data7

J2 (P0.8-P0.15)	J7 (LCD CMD)
5V	5V
GND	GND
P0.8	NC
P0.9	NC
P0.10	NC
P0.11	RS
P0.12	RW
P0.13	EL
P0.14	NC
P0.15	NC

J5 (P1.16-P1.23)	J11 (KEYPAD)
5V	NC
GND	GND
P1.16	R0
P1.17	R1
P1.18	R2
P1.19	R3
P1.20	C0
P1.21	C1
P1.22	C2
P1.23	C3

EXPERIMENT NO. 3

AIM: - Interfacing of 7-Segment Display with LPC2148.

REQUIREMENT: - ARM7 LPC2148-DVK, 12V Power Adaptor, 10 pin FRC (2 Qty.), Serial or USB Cable.

PROCEDURE:-

- 1) Connect the 12V Power Adaptor to LPC2148 DVK.
- 2) Connect the serial or USB cable between LPC2148 DVK & PC.
- 3) Open the Flash Magic software and make settings as mentioned above.
- 4) Make sure that switch (S6) on LPC2148 is at DOWN position during programming.
- 5) Upload the Hex file to LPC2148 Board.
- 6) Connect 10 pin FRC from J1 (P0.0-P0.7) to J9 (7-SEG Data) & J2 (P0.8-P0.15) to J10 (7-SEG CMD) of 7 Segment section.
- 7) Now toggle switch (S6) to UP position to put LPC2148 in RUN mode & Press Reset Switch.
- 8) 0 to F Count will be displayed on 7 Segment as Output.

PIN DESCRIPTION: -

J1 (P0.0-P0.7)	J9 (7-SEG Data)
5V	5V
GND	GND
P0.0	A
P0.1	B
P0.2	C
P0.3	D
P0.4	E
P0.5	F
P0.6	G
P0.7	DP

J2 (P0.8-P0.15)	J10 (7-SEG CMD)
5V	5V
GND	GND
P0.8	T1
P0.9	T2
P0.10	T3
P0.11	T4
P0.12	NC
P0.13	NC
P0.14	NC
P0.15	NC

EXPERIMENT NO. 4

AIM: - Interfacing of 7-Segment & 4x4 Matrix Keypad with LPC2148.

REQUIREMENT: - ARM7 LPC2148-DVK, 12V Power Adaptor, 10 pin FRC (3 Qty.), Serial or USB Cable.

PROCEDURE:-

- 1) Connect the 12V Power Adaptor to LPC2148 DVK.
- 2) Connect the serial or USB cable between LPC2148 DVK & PC.
- 3) Open the Flash Magic software and make settings as mentioned above.
- 4) Make sure that switch (**S6**) on LPC2148 is at DOWN position during programming.
- 5) Upload the Hex file to LPC2148 Board.
- 6) Connect 10 pin FRC from J1 (P0.0-P0.7) to J9 (7-SEG Data) & J2 (P0.8-P0.15) to J10 (7-SEG CMD) of 7 Segment section.
- 7) Connect J5 (P1.16-P1.23) to J11 (Keypad Section).
- 8) Now toggle switch (S6) to UP position to put LPC2148 in RUN mode & Press Reset Switch.
- 9) Respective Key Pressed will be displayed on 7 Segment as Output.

PIN DESCRIPTION: -

J1 (P0.0-P0.7)	J9 (7-SEG Data)
5V	5V
GND	GND
P0.0	A
P0.1	B
P0.2	C
P0.3	D
P0.4	E
P0.5	F
P0.6	G
P0.7	DP

J2 (P0.8-P0.15)	J10 (7-SEG CMD)
5V	5V
GND	GND
P0.8	T1
P0.9	T2
P0.10	T3
P0.11	T4
P0.12	NC
P0.13	NC
P0.14	NC
P0.15	NC

J5 (P1.16-P1.23)	J11 (KEYPAD)
5V	NC
GND	GND
P1.16	R0
P1.17	R1
P1.18	R2
P1.19	R3
P1.20	C0
P1.21	C1
P1.22	C2
P1.23	C3

EXPERIMENT NO. 5

AIM: - Interfacing of Relay, Buzzer & LEDs with LPC2148.

REQUIREMENT: - ARM7 LPC2148-DVK, 12V Power Adaptor, 10 pin FRC (1 Qty.), Serial or USB Cable.

PROCEDURE:-

- 1) Connect the 12V Power Adaptor to LPC2148 DVK.
- 2) Connect the serial or USB cable between LPC2148 DVK & PC.
- 3) Open the Flash Magic software and make settings as mentioned above.
- 4) Make sure that switch (**S6**) on LPC2148 is at DOWN position during programming.
- 5) Upload the Hex file to LPC2148 Board.
- 6) Connect 10 pin FRC from J1 (P0.0-P0.7) to J13 (Relay Buzzer Section).
- 7) Now toggle switch (S6) to UP position to put LPC2148 in RUN mode & Press Reset Switch.
- 8) Press Switches in Relay Buzzer Section to change the Output Pattern.

PIN DESCRIPTION: -

J1 (P0.0-P0.7)	J13 (Relay Buzzer)
5V	5V
GND	GND
P0.0	Q1(RELAY)
P0.1	SW1
P0.2	Q2(BUZZER)
P0.3	SW2
P0.4	LD1
P0.5	LD2
P0.6	LD3
P0.7	LD4

EXPERIMENT NO. 6

AIM: - Interfacing of DC Motor with LPC2148.

REQUIREMENT: - ARM7 LPC2148-DVK, 12V Power Adaptor, 10 pin FRC (2 Qty.), Serial or USB Cable, BS2 Cable (1 Qty.).

PROCEDURE:-

- 1) Connect the 12V Power Adaptor to LPC2148 DVK.
- 2) Connect the serial or USB cable between LPC2148 DVK & PC.
- 3) Open the Flash Magic software and make settings as mentioned above.
- 4) Make sure that switch (**S6**) on LPC2148 is at DOWN position during programming.
- 5) Upload the Hex file to LPC2148 Board.
- 6) Connect 10 pin FRC from J1 (P0.0-P0.7) to J14 (EN-IN) & J2 (P0.8-P0.15) to J15 (Start Stop) of DC Motor section.
- 7) Take +12V Power from BS2 Pin near switch via BS2 cable & connect it to BS2 pin in DC motor section.
- 8) Make both Jumper Setting as 1&2 Short & Connect DC Motor.
- 9) Now toggle switch (S6) to UP position to put LPC2148 in RUN mode & Press Reset Switch.
- 10) Press Switches in DC motor section to change Speed & Direction of DC Motor.

PIN DESCRIPTION: -

NOTE: - JUMPER JP6 & JP7 → 1&2 SHORT

J1 (P0.0- P0.7)	J14 (DC Motor EN-IN)
5V	5V
GND	GND
P0.0	EN1
P0.1	EN2
P0.2	IN1
P0.3	IN2
P0.4	IN3
P0.5	IN4
P0.6	NC
P0.7	NC

J2 (P0.8- P0.15)	J15 (DC Motor Start Stop)
5V	5V
GND	GND
P0.8	START
P0.9	REV
P0.10	INC
P0.11	DCR
P0.12	STOP
P0.13	NC
P0.14	NC
P0.15	NC

EXPERIMENT NO. 7

AIM: - Interfacing of Stepper Motor with LPC2148.

REQUIREMENT: - ARM7 LPC2148-DVK, 12V Power Adaptor, 10 pin FRC (2 Qty.), Serial or USB Cable, BS2 Cable (1 Qty.).

PROCEDURE:-

- 1) Connect the 12V Power Adaptor to LPC2148 DVK.
- 2) Connect the serial or USB cable between LPC2148 DVK & PC.
- 3) Open the Flash Magic software and make settings as mentioned above.
- 4) Make sure that switch (**S6**) on LPC2148 is at DOWN position during programming.
- 5) Upload the Hex file to LPC2148 Board.
- 6) Connect 10 pin FRC from J1 (P0.0-P0.7) to J14 (EN-IN) & J2 (P0.8-P0.15) to J15 (Start Stop) of Stepper Motor section.
- 7) Take +12V Power from BS2 Pin near switch via BS2 cable & connect it to BS2 pin in Stepper motor section.
- 8) Make both Jumper Setting as 2&3 Short & Connect Stepper Motor.
- 9) Now toggle switch (S6) to UP position to put LPC2148 in RUN mode & Press Reset Switch.
- 10) Press Switches in Stepper motor section to change Speed & Direction of Stepper Motor.

PIN DESCRIPTION: -

NOTE: - JUMPER JP6 & JP7 → 2&3 SHORT

J1 (P0.0- P0.7)	J14 (Stepper Motor EN-IN)
5V	5V
GND	GND
P0.0	EN1
P0.1	EN2
P0.2	IN1
P0.3	IN2
P0.4	IN3
P0.5	IN4
P0.6	NC
P0.7	NC

J2 (P0.8- P0.15)	J15 (Stepper Motor Start Stop)
5V	5V
GND	GND
P0.8	START
P0.9	REV
P0.10	INC
P0.11	DCR
P0.12	STOP
P0.13	NC
P0.14	NC
P0.15	NC

EXPERIMENT NO. 8

AIM: - Interfacing of Internal ADC with LPC2148.

REQUIREMENT: - ARM7 LPC2148-DVK, 12V Power Adaptor, 10 pin FRC (2 Qty.), Serial or USB Cable.

PROCEDURE:-

- 1) Connect the 12V Power Adaptor to LPC2148 DVK.
- 2) Connect the serial or USB cable between LPC2148 DVK & PC.
- 3) Open the Flash Magic software and make settings as mentioned above.
- 4) Make sure that switch (**S6**) on LPC2148 is at DOWN position during programming.
- 5) Upload the Hex file to LPC2148 Board.
- 6) Connect 10 pin FRC from J1 (P0.0-P0.7) to J7 (LCD Data) & J2 (P0.8-P0.15) to J8 (LCD CMD) of 7 LCD section.
- 7) Short AD0.7 & 3.3V pin in ADC channel via Jumper.
- 8) Now toggle switch (S6) to UP position to put LPC2148 in RUN mode & Press Reset Switch.
- 9) Output can be seen on LCD by varying ADC Pot.

PIN DESCRIPTION: -

NOTE: - AD0.7 & 3.3V SHORT IN ADC CHANNEL

J1 (P0.0-P0.7)	J7 (LCD Data)
5V	5V
GND	GND
P0.0	Data0
P0.1	Data1
P0.2	Data2
P0.3	Data3
P0.4	Data4
P0.5	Data5
P0.6	Data6
P0.7	Data7

J6 (P0.8-P0.15)	J8 (LCD CMD)
5V	5V
GND	GND
P0.8	NC
P0.9	NC
P0.10	NC
P0.11	RS
P0.12	RW
P0.13	EL
P0.14	NC
P0.15	NC

EXPERIMENT NO. 9

AIM:- Interfacing of I2C EEPROM with LPC2148.

REQUIREMENT:- - ARM7 LPC2148-DVK, 12V Power Adaptor, 10 pin FRC (3 Qty.), Serial or USB Cable.

PROCEDURE:-

- 1) Connect the 12V Power Adaptor to LPC2148 DVK.
- 2) Connect the serial or USB cable between LPC2148 DVK & PC.
- 3) Open the Flash Magic software and make settings as mentioned above.
- 4) Make sure that switch (**S6**) on LPC2148 is at DOWN position during programming.
- 5) Upload the Hex file to LPC2148 Board.
- 6) Connect 10 pin FRC from J3 (P0.16-P1.23) to J7 (LCD Data) & J5 (P1.16-P1.23) to J8 (LCD CMD) of 7 LCD section.
- 7) Connect 10 pin FRC from UEXT to J12 (I2C EEPROM Section).
- 8) Now toggle switch (S6) to UP position to put LPC2148 in RUN mode & Press Reset Switch.
- 9) Output will be displayed on LCD.

PIN DESCRIPTION: -

J3 (P0.16-P0.23)	J7 (LCD Data)
5V	5V
GND	GND
P0.16	Data0
P0.17	Data1
P0.18	Data2
P0.19	Data3
P0.20	Data4
P0.21	Data5
P0.22	Data6
P0.23	Data7

J5 (P1.16-P1.23)	J8 (LCD CMD)
5V	5V
GND	GND
P1.16	NC
P1.17	NC
P1.18	NC
P1.19	RS
P1.20	RW
P1.21	EL
P1.22	NC
P1.23	NC

UEXT (SPI0)	J12 (I2C EEPROM)
3.3V	3.3V
GND	GND
TXD0	NC
RXD0	NC
SCL0	SCL
SDA0	SDA
MISO0	MISO
MOSI0	MOSI
SCK0	SCK
SSEL0	CS

EXPERIMENT NO. 10

AIM: - Interfacing of Internal RTC with LPC2148.

REQUIREMENT: - ARM7 LPC2148-DVK, 12V Power Adaptor, 10 pin FRC (2 Qty.), Serial or USB Cable.

PROCEDURE:-

- 1) Connect the 12V Power Adaptor to LPC2148 DVK.
- 2) Connect the serial or USB cable between LPC2148 DVK & PC.
- 3) Open the Flash Magic software and make settings as mentioned above.
- 4) Make sure that switch (**S6**) on LPC2148 is at DOWN position during programming.
- 5) Upload the Hex file to LPC2148 Board.
- 6) Connect 10 pin FRC from J1 (P0.0-P0.7) to J7 (LCD Data) & J2 (P0.8-P0.15) to J8 (LCD CMD) of 7 LCD section.
- 7) Now toggle switch (S6) to UP position to put LPC2148 in RUN mode & Press Reset Switch.
- 8) Output can be seen on LCD.

PIN DESCRIPTION: -

J1 (P0.0-P0.7)	J7 (LCD Data)
5V	5V
GND	GND
P0.0	Data0
P0.1	Data1
P0.2	Data2
P0.3	Data3
P0.4	Data4
P0.5	Data5
P0.6	Data6
P0.7	Data7

J2 (P0.8-P0.15)	J8 (LCD CMD)
5V	5V
GND	GND
P0.8	NC
P0.9	NC
P0.10	NC
P0.11	RS
P0.12	RW
P0.13	EL
P0.14	NC
P0.15	NC

EXPERIMENT NO. 11

AIM: - Interfacing of SD Card with LPC2148.

REQUIREMENT: - ARM7 LPC2148-DVK, 12V Power Adaptor, 10 pin FRC (1 Qty.), Serial or USB Cable.

PROCEDURE:-

- 1) Connect the 12V Power Adaptor to LPC2148 DVK.
- 2) Connect the serial or USB cable between LPC2148 DVK & PC.
- 3) Open the Flash Magic software and make settings as mentioned above.
- 4) Make sure that switch (**S6**) on LPC2148 is at DOWN position during programming.
- 5) Upload the Hex file to LPC2148 Board.
- 6) Connect 10 pin FRC from UEXT (SPI0) to J12 (SD Card Section).
- 7) Now toggle switch (S6) to UP position to put LPC2148 in RUN mode & Press Reset Switch.
- 8) Open HyperTerminal and Select COM Port. Set Baud Rate to 9600.
- 9) Output will be displayed on Terminal.

PIN DESCRIPTION: -

UEXT (SPI0)	J12 (SD Card)
3.3V	3.3V
GND	GND
TXD0	NC
RXD0	NC
SCL0	SCL
SDA0	SDA
MISO0	MISO
MOSI0	MOSI
SCK0	SCK
SSEL0	CS

EXPERIMENT NO.12

AIM: - Interfacing of Internal ADC with LPC2148.

REQUIREMENT: -ARM7 LPC2148-DVK, 12V Power Adaptor, Serial or USB Cable.

PROCEDURE:-

- 1) Connect the 12V Power Adaptor to LPC2148 DVK.
- 2) Connect the serial or USB cable between LPC2148 DVK & PC.
- 3) Open the Flash Magic software and make settings as mentioned above.
- 4) Make sure that switch (S6) on LPC2148 is at DOWN position during programming.
- 5) Upload the Hex file to LPC2148 Board.
- 6) Connect DSO/CRO probe to pin P0.25 of J4 (P0.24-P0.31).
- 7) Connect pin AD0.7 to 3.3V of RL1 (ADC Channel Selection)
- 8) Now toggle switch (S6) to UP position to put LPC2148 in RUN mode & Press Reset Switch.
- 9) Output will be displayed on DSO/CRO.

PIN DESCRIPTION: -

J4 (P0.24-P0.31)	DSO/CRO
0.25	DSO/CRO
GND	GND

EXPERIMENT NO.13

AIM: - Interfacing of 16 x2 LCD (4 Bit) with LPC2148.

REQUIREMENT: -ARM7 LPC2148-DVK, 12V Power Adaptor, 10 pin FRC (1 Qty.), Serial or USB Cable.

PROCEDURE:-

- 1) Connect the 12V Power Adaptor to LPC2148 DVK.
- 2) Connect the serial or USB cable between LPC2148 DVK & PC.
- 3) Open the Flash Magic software and make settings as mentioned above.
- 4) Make sure that switch (**S6**) on LPC2148 is at DOWN position during programming.
- 5) Upload the Hex file to LPC2148 Board.
- 6) Connect 10 pin FRC from J3 (P0.16-P0.23) to J7 (LCD Data) Now toggle switch (S6) to UP position to put LPC2148 in RUN mode & Press Reset Switch.
- 7) Output will be displayed on LCD as
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4 BIT LCD TEST

PIN DESCRIPTION: -

J3 (P0.16-P0.23)	J7 (LCD Data)
5V	5V
GND	GND
P1.16	RS
P1.17	RW
P1.18	EL
P1.19	NC
P1.20	Data4
P1.21	Data5
P1.22	Data6
P1.23	Data7

FRC CONNECTION DETAILS

Sr. no.	Experiment	LPC2148 DVK	Interfacing Port
1	16x2 LCD (8 Bit)	J5 (P1.16-P1.23) J6 (P1.24-P1.31)	J7 (LCD Data) J8 (LCD CMD)
2	16x2 LCD & Keypad	J1 (P0.0-P0.7) J2 (P0.8-P0.15) J5 (P1.16-P1.23)	J7 (LCD Data) J8 (LCD CMD) J11 (Keypad)
3	7-Segment	J1 (P0.0-P0.7) J2 (P0.8-P0.15)	J9 (7-SEG Data) J10 (7-SEG CMD)
4	7-Segment & Keypad	J1 (P0.0-P0.7) J2 (P0.8-P0.15) J5 (P1.16-P1.23)	J9 (7-SEG Data) J10 (7-SEG CMD) J11 (Keypad)
5	Relay, Buzzer & LEDs	J1 (P0.0-P0.7)	J13(Relay Buzzer)
6	DC Motor (Short 1&2 of Jumper JP6 & JP7)	J1 (P0.0-P0.7) J2 (P0.8-P0.15)	J14 (DC Motor EN-IN) J15 (DC Motor Start Stop)
7	Stepper Motor (Short 2&3 of Jumper JP6 & JP7)	J1 (P0.0-P0.7) J2 (P0.8-P0.15)	J14 (Stepper Motor EN-IN) J15 (Stepper Motor Start Stop)
8	Internal ADC	J5 (P1.16-P1.23) J6 (P1.24-P1.31)	J7 (LCD Data) J8 (LCD CMD)
9	I2C EEPROM	UEXT J3 (P0.16-P0.23) J5 (P0.24-P0.31)	J12 (I2C EEPROM) J7 (LCD Data) J8 (LCD CMD)
10	Internal RTC	J1 (P0.0-P0.7) J2 (P0.8-P0.15)	J7(LCD Data) J8(LCD CMD)
11	SD card	UEXT	J12 (SD Card)
12	Internal DAC Connect pin AD0.7 to 3.3V of RL1 (ADC Channel Selection)	P0.25(J4)	DSO/CRO Probe
13	16x2 LCD (4 Bit)	J3 (P0.16-P0.23)	J7 (LCD Data)

