

Application Note 20101

In-System Programming of P87LPC76x Microcontrollers

This application note describes how the P87LPC76x series of microcontrollers Philips Semiconductors may be programmed in-circuit using the dedicated JTAG/ISP connector on the Pin-Master 48 universal programmer. The programming cable, the design of the target board, and programming procedures are described.

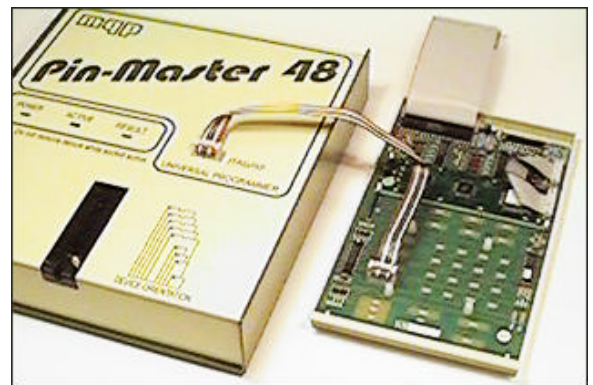
INTRODUCTION

The P87LPC76x series consists of a number of low pincount microcontrollers. They are available in various packages. With proper attention to circuit design they can be serially programmed while in the end users target system.

In system programming reduces the number of times the parts have to be handled during the manufacturing process and allows the latest or custom software to be loaded just prior to shipping.

As a result of the short programming time, the use of a single site programmer with a dedicated ISP connector on a production line becomes an attractive and low-cost alternative to a separate gang programming operation.

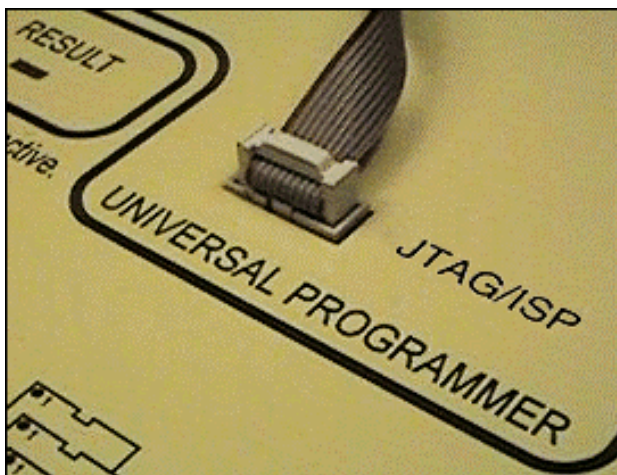
The serial interface between the programmer and target board is made up of two lines for clock and data, and three lines for power, ground and the programming voltage .



Production Programming using Pin-Master 48

The Pin-Master 48 universal programmer has a dedicated JTAG/ISP connector fitted to the top of the unit. A cable made up to the users own requirements connects the socket to the target board.

The requirements of in-system programming affects the circuit design of the target board. Aspects of the design which must be considered are explained in detail later in this application note.



JTAG/ISP SOCKET

The socket is a standard 10 way 0.1" header. A diagram of the socket is shown below:

Viewed from top, front of programmer

2	4	6	8	10
MODE	GND	GND	GND	GND
1	3	5	7	9
DET	VDD	DATA	CLK	VPP

1	DET	Cable Detect
2	MODE	Programming Mode
3	VDD	Voltage Supply (VDD)
4	GND	Ground (VSS)
5	DATA	Data I/O (PDA)
6	GND	Ground (VSS)
7	CLK	Clock input (PCL)
8	GND	Ground(VSS)
9	VPP	Prog. voltage (VPP)
10	GND	Ground(VSS)

CABLE

A ribbon cable with alternate wires connected to ground is used between the Pin-Master 48 and the target board. The cable should be kept as short as possible (maximum length 1.5m).

TARGET BOARD

CONNECTOR

The target board should be equipped with a suitable connector. This could be most simply achieved with a similar connector and pin layout to that used at the programmer end of the cable.

- **GND Pins 4, 6, 8 and 10**

Connect these four pins to the target system ground.

- **MODE and DET pins**

The MODE and DET pins must be connected together on the target board. The presence of the link is detected by the programmer to confirm that the cable has been plugged into the target board.

The MODE pin is connected to ground at the programmer end of the cable. This signal may be utilised by the target board to switch the circuit into programming mode.

- **CLK**

Pin 7 of the ISP connector must be connected to the CLOCK pin (P0.5 / PCL) of the P87LPC76x. Any other circuit connected to P0.5 / PCL for normal operation must have a minimum impedance of 10K when in the programming mode. This ensures that the logic level margins are maintained. It may be achieved by a series resistor, or by the intrinsic high impedance of the connected circuit (e.g. a logic input).

- **DATA**

Pin 5 of the ISP connector must be connected to the DATA pin (P0.4 / PDA) of the P87LPC76x. Any other circuit connected to P0.4 / PDA for normal operation must have a minimum impedance of 10K when in the programming mode (see comments under CLK above).

- **VDD**

The VDD pin of the ISP connector must be directly connected to the VDD pin of the P87LPC76x. The design of the target board must be such that the programmer can control the supply to the P87LPC76x without being affected by any other circuits on the board.

The maximum current that should be drawn from the programmer is 150mA at +5V. The maximum capacitance allowed on the VDD line is 10µF.

The target board may be completely powered from the programmer if its total requirements do not exceed those specified above.

In the event that the programmer VDD cannot be used to power the target board then the cable VDD connection could be left unconnected, and the target board powered by a separate PSU at 5V +/- 0.5V.

- **VPP**

Pin 9 of the ISP connector must be connected to the VPP pin of the P87LPC76x.

During programming the programmer applies a high voltage, typically 10.75V, to the VPP pin.

The programming specification requires a fast rise time for the VPP signal. We do not recommend more than 10nF capacitance directly connected to the VPP pin. Also VPP must not be allowed to pull VDD high, through the reset circuit. A 1K resistor is required between the VPP pin and the reset circuit.

P87LPC76x I/O PINS

Please note that during programming I/O pins are in the reset (high impedance) state.

DEVICE PIN-OUTS

TABLE 1 - Device Pin-outs

Device Type: P87LPC76x

PACKAGE	VSS	VDD	VPP (P1.5)	PCL (P0.5)	PDA (P0.4)
PDIP etc	5	15	4	16	17

Device Type: P85LPC76x

PACKAGE	VSS	VDD	VPP (P1.5)	PCL (P0.5)	PDA (P0.4)
PLCC	1, 10	23, 31	8	37	38

PROGRAMMING PROCEDURE

To avoid earth potential differences, if the target board is powered separately, the programmer and target board should be connected to a common mains supply.

- Connect the cable to the target board and the programmer.
- Power up the target board, if necessary, and proceed with programming in the normal way.
- If there are any other devices to be programmed on the board move the cable and repeat the procedure. This could be simplified by using a 'Script' (batch file) which would automatically change the device type and instruct the operator where to plug in the cable.

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