Freescale Semiconductor
Application Note

Document Number: AN2207
Rev. 2, 09/2006

Using the MPMC8245 Card in Standalone Mode

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This application note describes the modifications performed to convert the MPMC8245 Unity MPMC or MPMC8241 UnityLC MPMC cards in a Sandpoint system to a standalone operation. An MPMC card normally resides in a Sandpoint motherboard, but for COP emulator debugging, benchmarking, or other evaluation purposes, the card can be removed and operated without a sandpoint motherboard by making a few simple changes to the board. To locate any published errata or updates for this document, refer to the web site on the back cover of this document.

Contents

1 Introduction

The sandpoint microprocessor evaluation system uses MPMC mezzanine cards to allow easy system customization for various processors. The MPMC8245 Unity provides an MPC8245 32-bit embedded PowerPC™ processor and an integrated memory and PCI interface. These features are also supplied on the MPMC8241 UnityLC module, which is similar enough to the MPMC8245 that it is not discussed in this document (standalone operation is identical for both). These are standard features of most MPMC cards, but the MPC8245 also provides a serial port, reset controller, and oscillator. With these components, an MPMC8245 contains most of the features needed for a standalone embedded system:

- MPC8245, 300 MHz
- 64–256 MB SDRAM @ 100–133 MHz
- 1 MB + 4 MB flash memory @ 90 ns
- Serial port
- CPU core power supply
- Reset controller
- PCI interface (optional use)

Figure 1 shows the features on the MPMC board available for an embedded system.

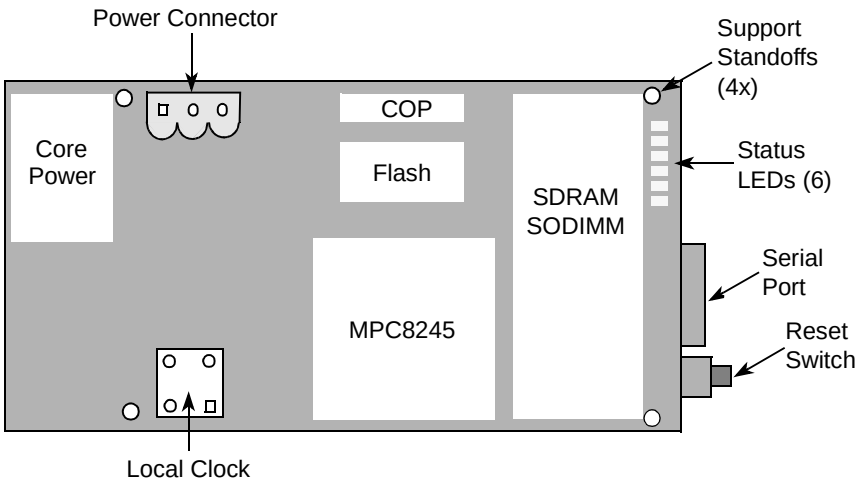

Figure 1. MPMC8245 Features

NOTE

This application note describes the steps to convert an MPMC8245 to standalone operation. The changes require some soldering experience and should not be attempted by inexperienced personnel. In addition, these changes void the warranty of the board. However, the changes are fairly trivial and easy.

This application note does not generally apply to the MPMC8240 board. Because the MPC8240 does not have an internal UART, the ability to run interesting software may be severely restricted.

2 Required Components

The components listed in Table 1 are required to convert or operate an MPMC8245 board in standalone mode. The parts are not supplied with the Sandpoint system and must be obtained or created by the user.

Table 1. Required Components

Component	Description	Vendors
Clock	3.3-V DIP-8 oscillator can	FOX Electronic: H5C-2E3-33.000 (33 MHz) H5C-2E3-66.000 (66 MHz)
		Ecliptek: EC1300HSTS-33.000M (33 MHz) EC1300HSTS-66.000M (66 MHz)
		Pletronics: SQ3345V-33.000 MHZ (33 MHz) SQ3345V-66.000 MHZ (66 MHz)
Socket	4-pin DIP-8 socket (recommended)	Astron: AT-SMSK-04-3
		FCI: DIP308001B
		Molex
Serial cable	DB9 male to IDC10	ramelectronics.net: IDC-11016
		Several other vendors
Power connector	3-pin power header	Wieland Part No. 25.330.3353.1.1
		Amp
Power	Power supplies (5 and 3.3 V)	Any multi-output lab bench supply
		Any ATX computer power supply
ATX connector	Connector for ATX power supply (if needed)	Molex: 39-29-3206
Support	Standoffs or rubber feet	Various

3 Standalone Software

The standalone system needs initialization (boot) software to run. Most Sandpoint systems are shipped already configured to run the DINK debugger residing in the socketed flash device on the sandpoint motherboard. This flash is accessible from PCI, but in the standalone mode, neither PCI nor the boot flash are available to the MPMC card. Instead, the flash memory devices on the local MPC8245 memory bus must be used.

This application note assumes the use of a special version of DINK called standalone DINK (SADINK). If using another startup code, such as PPCBoot, the same general principles should be followed.

DINK normally uses the facilities of the Sandpoint motherboard to calculate the speed of the CPU, memory, and PCI bus by performing timing measurements using the National Semiconductor serial port and real time clock (RTC). Because these facilities are not available in a standalone environment, another method must be used to set the MPC8245 serial port baud rate clock (which is derived from the bus clock).

For the standalone mode, therefore, it is generally easier to create a special version of DINK (SADINK) that gets this configuration information from another source. One option is to set the bus speed at a

constant, which is simple but prevents the board from running at other speeds, making performance measurements more difficult.

Instead, SADINK determines the bus speed by querying the 'ID' I^2C EEPROM standard on all MPMC boards (I^2C EEPROM address 0x57, offset decimal 99). By storing the bus speed in the EEPROM, the serial port baud rate can be properly set, and DINK can resume normal execution. By changing the information before resetting at a new speed, the bus speed and UART will track.

For DINK to become SADINK, the software must be changed as follows:

1. Set the 'board type' to PMCSA instead of PMC_8240.
2. Read the I^2C EEPROM to get the system bus speed.
3. Setup the on-board serial port at 9600 baud using bus-speed information.
4. Prohibit access to PCI (including: NVRAM, RTC, COM1/COM2, parallel, and IDE) (optional).
5. Enable the PCI arbiter and park the PCI bus.

The standalone version of DINK is available starting with version 12.3 and thereafter, and a prebuilt S-record file is available on the Freescale web site. To build a custom version, obtain the source code through any Freescale sales engineer and edit the file `config.h`, defining the configuration parameter 'STANDALONE_PMC' as follows:

```
//------------------------------------------------------------------------
// Define 'STANDALONE_PMC' to build a version which runs on the MPMC8245.
#define STANDALONE_PMC
```

Then use a MPC8245-compatible cross-compiler to create the standalone version of DINK. In addition, there is an optional configuration parameter for SADINK:

```
#undef STANDALONE_PMC_PCI
```

If enabled, this allows the MPMC to perform PCI cycles. PCI is still not required or used to startup SADINK, but this allows the MPMC to passively monitor or initiate PCI cycles.

4 Programming Software

Before the MPMC card can be used as a standalone card, the boot code must be stored in the local flash memory. One method is to continue with the conversion process outlined in this application note and then use a COP controller to download and program the flash with the SADINK user code. Another method is to store the image into flash using (normal) DINK on the Sandpoint motherboard. Before removing the MPMC8245 from the Sandpoint system, use DINK to program SADINK in the local memory by following these steps:

1. Set the SW2 options switch on the MPMC8245 board to the following settings:

   ```
   UP DN UP DN UP UP DN UP                    (UP = toward the 'ON' switch)
   ```

   Also refer to the MPMC8245 configuration guide for details.
2. Download the custom DINK/user code to memory:

   ```
   DINK32[MPC8245] {1} >> dl -k -o 100000          (send s-record file now)
   ```
3. Program the custom DINK/user code to memory:

```
DINK32[MPC8245] {2} >> fu -l 100000 ff000000 7ff00          (program code now)
```

4. Program the standalone bus speed:

```
DINK32[MPC8245] {3} >> id -i
...                                                    (skip other questions)
STANDALONE BUS SPEED: 100                                  (or 66, 133, etc.)
...                                                    (skip other questions)
writing I2C @100
DINK32[MPC8245] {4} >>                                 (wait for EEPROM write)
```

5. Set the SW2 options switch on the MPMC8245 board to the following settings:

```
DN DN UP DN DN UP DN UP                          (UP = toward the 'ON' switch)
```

Now, remove the MPMC board from the Sandpoint MPMC slot and continue with the conversion process.

5 Clock

The MPMC cards normally receive their clocks from the PCI clock on the PMC header. For a standalone board, an on-board clock source is required. The MPMC8245 boards supports a location to install a 3.3 V oscillator, which should be installed at Y1. The oscillator may be any valid PCI bus frequency, but 33 and 66 MHz are the fastest two standard speeds.

If the MPMC is ever reinstalled in a Sandpoint system (for example, to reprogram the local flash using the Sandpoint-based DINK), the oscillator must be removed or the Sandpoint system does not work, and components on either board may be damaged. Using a socket is the easiest solution. The socket and oscillator are installed as shown in Figure 2. Note the orientation of pin 1 and install appropriately.

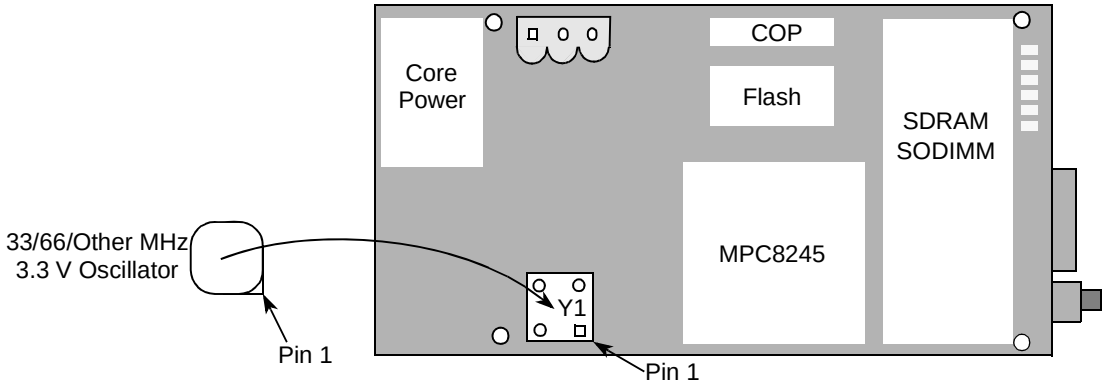

Figure 2. Oscillator Installation

6 Serial Header

Due to height restrictions on the PMC/PrPMC form factor, the MPC8245 board does not have a standard 9-pin DB9 connector for the serial port. Instead, a 10-pin right-angle connector allows the installation of a standard serial extension cable. These cables are a quasi-standard created for the older 'AT' computer systems, which had no room for serial ports on the motherboard. These cables can be obtained from

computer or surplus stores. If the cable is not readily found, a custom one can be created by making the connections shown in Figure 3.

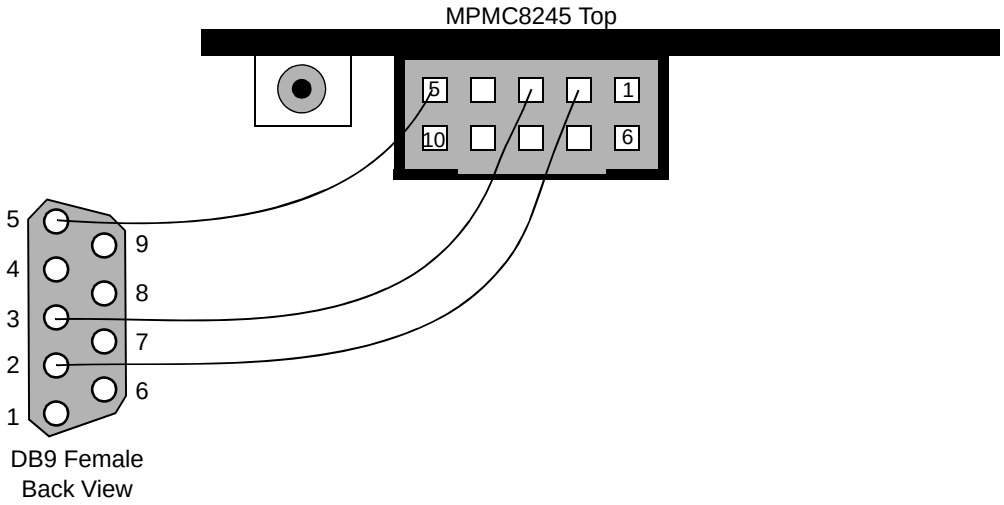

Figure 3. Serial Header

As shown in Figure 3, there is a one-to-one correspondence between the header pins and the serial connector pins. Most cables are made using ribbon cable, and this is an easy way to make a custom connector.

Insert the cable into the end of the MPMC8245 board, key side down, and then connect to a 'null-modem' cable, then to a computer running a terminal program (kterm, SmartComm, or HyperTerm). By default, DINK will communicate at 9600 baud, with 8N1 settings and no flow control.

7 Power Connection

The MPMC8245 has a location reserved for a Weiland 3-pin power connector, allowing easy connection of the external power supplies needed. It is also possible to just connect wires to the remote power supplies. Whichever method is used, follow the guidelines in Figure 4 to connect to the power source.

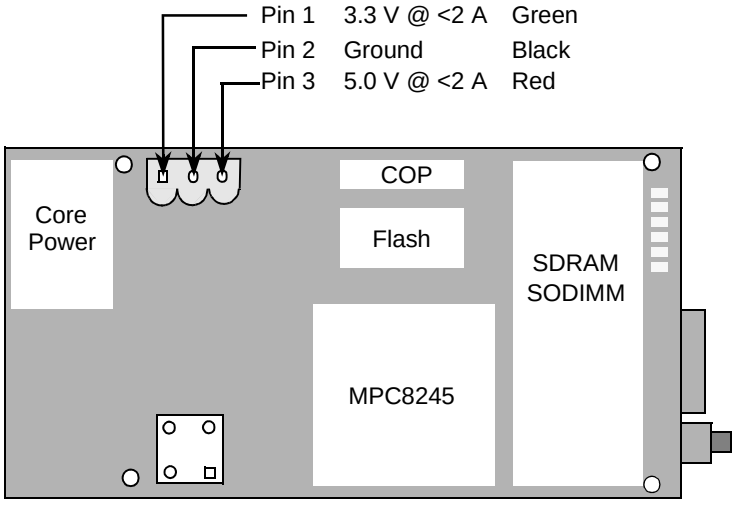

Figure 4. Power Installation

A readily available power source for 3.3 and 5 V power is a standard ATX chassis power supply. Using a matching connector allows easy connection, and power supplies can be borrowed from surplus or obsolete computers.

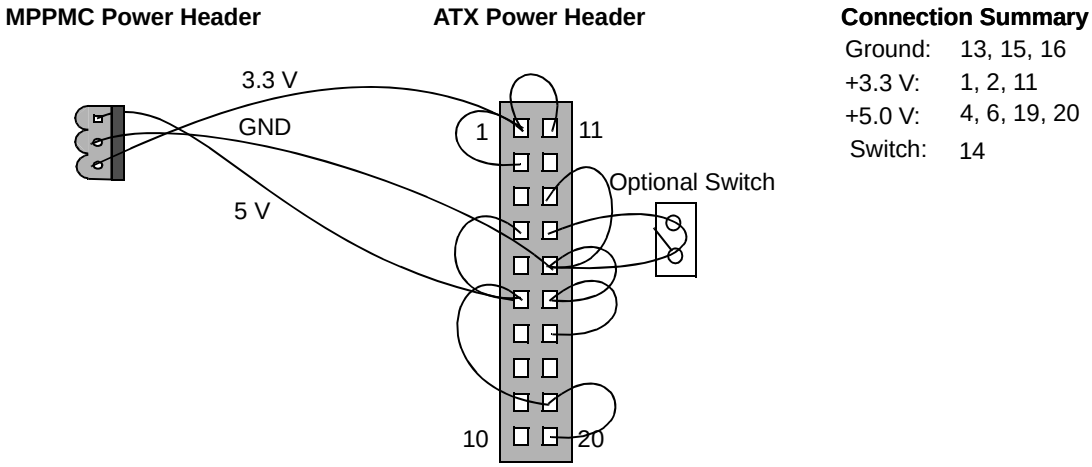

Figure 5. ATX Power Connection

Note that in Figure 5, pin 14 is not ground, but the pin is $\overline{\text{PS\_ON}}$ (power supply on). This signal must be tied to ground to allow the power supply to be turned on. A switch between pin 14 and ground can be used to turn the power supply on and off.

8 Mechanical Standoffs

Although not required, it is usually desirable to add four supports to the MPMC board to give it more mechanical stability. The standoffs on the Sandpoint motherboad can be used, though that requires removing the board from the chassis. Figure 1 shows the locations of the four standard PMC/PrPMC mounting holes. The support can be anything from adhesive feet (of at least 1 cm) or aluminum standoffs mounted with a screw (2 mm or less) through the four standard PMC mounting holes. Note that the SODIMM may have to be removed to install screws in the two forward mounting holes.

9 Operating the Board

After all the components are installed and power applied, the system is ready to start. Apply power and look for the SADINK prompt (or whatever user code was stored in the flash). As SADINK executes from the on-board flash, the ROM status LED shows a flurry of activity. After initialization completes, the DINK banner appears:

```
Memory Enabled: [ 128MB at CL=3 ]
Caches Enabled: [ L1-ICache L1-DCache ]
Register Inits: [ 32 GPRs, 32 FPRs, 286 SPRs ]
Assembler Init: [ 286 opcodes ]
                  ##  ##            ##
                  ##  ##            ##
                  ##                ##
```

```
                 #######  ##  #######   ##    ##
                ##    ##  ##  ##    ##  ##   ##
                ##    ##  ##  ##    ##  ######
                ##    ##  ##  ##    ##  ##   ##
                 ######   ##  ##    ##  ##    ##
      Version : 13.0.0, GCC Build
     Released : OCt 31, 2002
   Written by : Freescale's RISC Applications Group, Austin, TX
       System : PMC824X Evaluation Board
    Processor : MPC8245 V1.2 @ 300 MHz, Memory @ 100 MHz
       Memory : Map B (CHRP), 128 MB at 3/1/1/1
Copyright Freescale Inc. 1993-2002
Refer to 'history.c' for release info, changes, errata and fixes.
DINK32 [MPC8245 ] {1} >>
```

Now the system is ready to use.

10 References

Reference materials shown in Table 2 may be useful to the designer. To locate the documents, visit the web site listed on the back cover of this document.

Table 2. Reference Material

Title
*MPC8245 Integrated Processor Hardware Specifications (*MPC8245EC)
MPMC8245 Unity X4 Schematics
MPMC8245 Unity X4 Configuration Guide

11 Revision History

Table 3 provides a revision history for this application note.

Table 3. Document Revision History

Rev. No.	Substantive Change(s
0	Initial release.
1	Added MPMC8241 references.
	Corrected SW3 to SW2.
2	Updated template and added PowerPC trademark information.

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Document Number: AN2207
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