picoFlash

User's Manual

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Table of Contents

Limited Warranty ii
Table of Contents iii
Overview 1
Features 1
Operation 2
Getting Started 3
Hardware 5
- Memory Configuration 5
- I/O Configuration 5
- Digital I/O Ports 5
  - Table 1: Memory Map Configuration Register 5
- Driving Loads with the I/O Ports 6
  - Table 2: I/O Configuration Register 6
- Programming the I/O Ports 7
- Asynchronous Serial Ports 8
- RS-485 Configuration 8
- Console Serial Port 9
- Watchdog Timer 9
- Ethernet 10
  - Table 3: Watchdog timeout configuration 11
- DiskOnChip 11
- Jumpers 11
  - JP1 - Serial Port 0 Select, RS-485 Termination 11
  - JP2 - Socket Memory Type / Boot Memory Location 12
- Cables and Connectors 12
  - Table 4a: Power Pinout 13
  - Table 4d: Serial 0 Pinout 13
  - Table 4b: Port A&B Pinout 13
  - Table 4e: Serial 1 Pinout 13
  - Table 4c: Debug & PortC Pinout 13
  - Table 4h: Ethernet Pinout 13
  - Table 4f: JTAG & Port D Pinout 13
  - Table 4g: RS-485 Pinout 13

Software 14
- Supported PC BIOS Functions 14
- Driver Library 14
- Programming Languages 14
- QuickBASIC/PowerBASIC Console I/O 15

Utilities 16
- UP.COM 16
- DOWN.COM 16
- FORMAT.COM 17
- EDIT.COM 17

DOS 18
XDOS Command Reference 18
Specifications 21
Contact Information 22

Overview

The picoFlash single board computer is based on the RDC R8822 microcomputer. The R8822 is a high performance, 16-bit, single-chip microcomputer that is software compatible with the 80C186 family of microprocessors. DOS compatibility allows development in a familiar environment with a wide range of tools. High endurance flash memory eliminates EPROM programming without worry of damaging the onboard non-volatile memory with repeated program cycles. Applications are uploaded directly into the flash disk. Expansion options provide high capacity flash storage eliminating the size and reliability problems associated with electro-mechanical storage devices.

Software development for the picoFlash is remarkably simple and quick. Programs are written on a PC compatible computer in the language of your choice. After your application has been compiled or assembled and linked into .EXE or .COM form, it is uploaded to the picoFlash's flash disk with your favorite telecommunications program using the X-Modem protocol. The application can then be tested and debugged through the serial console. When the application is running to your satisfaction, the startup batch file can be modified so that the application will load and execute upon reset or powerup.

Features

40MHz RDC R8822 Processor (x186 Compatible)
5V regulated DC power
512k Bytes DRAM Memory (16 bit data path)
512k Bytes Flash Memory
10 BASE-T Ethernet, NE2000 Compatible
High Speed Serial Ports (2):
- 115200 baud with RS-232 output levels
- 1 RS-232 Port with Handshake (TxD, RxD, DCD, RTS, CTS, GND)
  - Jumper Configurable as RS-232, TTL RS-232 or RS-485
- 1 RS-232 Port (3 wire)

Debug Serial Port (3 wire RS-232, 9600 baud console only)
16 Digital I/O Lines
Hardware Clock/Calendar
2 - 16 bit timer channels
Watchdog timer (generates internal processor reset)
32Pin Dip Socket to accept M-Systems DiskOnChip.
Compact Size, 3.75" x 2.5" (95mm x 63.5mm), 1.8oz (51gm)
Driver Library (C and Basic) - Serial ports, PIO, and alpha-numeric LCD

Operation

The picoFlash is configured with two 'disk drives' A: and B:. Drive A: contains DOS, the BIOS, and utility programs essential to the operation of the picoFlash. Drive A: is read-only. Drive B: is read/write and contains optional utility programs and is available for user files and applications.

The default serial console port for the picoFlash is the Serial 1 port on the R8822, wired to J5. The port is configured for 9600 baud, 8 data bits, 1 stop bit and no parity. This is the primary mode of communicating with the picoFlash. DOS and the BIOS treat this port as the logical devices STDIN and STDOUT, in place of a keyboard and monitor. The console can be relocated to Serial 0 or the Debug port (freeing up both hardware serial ports). When the console is located on a hardware serial port, the default baudrate can be also be changed. Configuring the console port is described later in this manual.

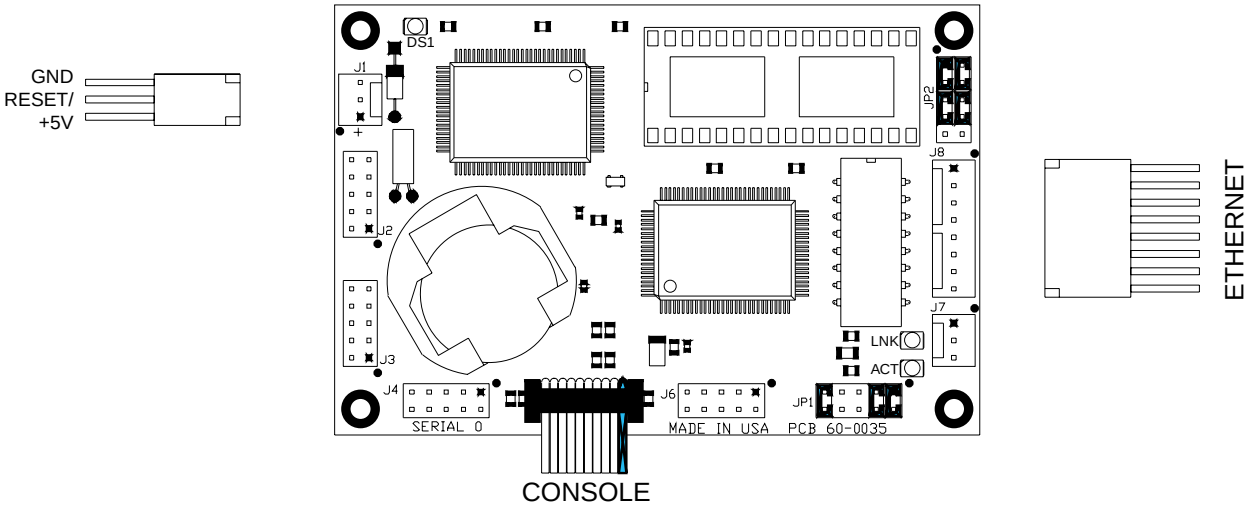
When power is applied to the picoFlash or when it is reset, the board goes through its initialization procedure and then starts DOS. A simple (read-only) `AUTOEXEC.BAT` file is executed and then the board is ready to use. The batch file performs several functions before the user is given control. The DOS search path is set, the DOS prompt is set, the CNTL-C flag (discussed later in this manual) is checked and finally, an attempt is made to execute a file named STARTUP on the B: drive. This provides a convenient way for user applications to execute immediately after initialization of the picoFlash. If you wish to have your application start automatically, create a batch file named `STARTUP.BAT` that invokes the program. Renaming your application `STARTUP.EXE` or `STARTUP.COM` is *not* recommended. If this is done and the program locks up, typing CNTL-C at bootup may not break the program and exit to the DOS prompt.

Although the flash memory devices used have a guaranteed lifetime of over 10,000 write cycles, it is possible for an application to quickly wear them out. The flash memory is intended to store programs, and setup data which is normally not changed. Avoid storing data or frequently changed information on the flash disk.

To reduce the possibility of an unexpected powerdown corrupting the flash disk, it is strongly recommended that flash file writes be done as quickly as possible. After the file write, close the file and issue a Disk Reset, Int 21h function 0Dh. For more information, see the Application Note on Flash Disk Reliability, http://www.jkmicro.com/documentation#app_notes

Getting Started

To begin development with the picoFlash, you will need a PC compatible computer with a telecommunications program and a free serial port. Connect the picoFlash's Debug/Console Port to the PC's serial port with a 9-pin serial cable (straight through wiring). Run the telecommunications program and configure the serial port for 9600 baud, 8 data bits, 1 stop bit and no parity. A tutorial for hyperterminal users is available on the DevKit CD and from the documentation page of our website. Apply power to the picoFlash, using our A/C adapter PN 88-0004 or a source of regulated 5 volt DC, capable of supplying 2 Watts. Observe the polarity indicated on the board silkscreen.



The picoFlash should respond with a welcome message and a B: prompt. Enter `DIR` to look at the directory of drive B:. If you do not get a welcome message or echo of the characters that you type, you need to check your serial port setup. To test everything but the picoFlash, remove the serial cable from J5 and short pins 3 and 5. If characters sent to the picoFlash are not echoed, the problem is with your setup. You must resolve the problem before you can continue.

If you were able to do a `DIR`, take a few minutes to explore the contents of the picoFlash's file system. You will find all of the essential utilities on drive A: and some optional programs on drive B:. Drive A: is write-protected and cannot be altered. Drive B: is read/write and can be changed or reformatted.

After you have looked at the programs on the picoFlash, the next step is to try to upload a file. This is the procedure for getting a file from your PC to the picoFlash. On the picoFlash, type the command `UP` followed by the name of the file you wish to upload. The picoFlash will begin sending characters to your PC polling it for the file.

On your PC, start the transfer, usually by pressing the PgUp key. The telecomm program should respond by requesting the file name and protocol. Enter the file name and select X-Modem for the protocol. The transfer should start and when it is complete, you should get a new B: prompt

on the screen. If the transfer does not work, there are two things to check. First, verify that the terminal program does not have handshaking or flow control enabled. Second, the Carrier Detect signal (pin 1 on the DB-9 connector) into the PC could be sensed as low or false. Make sure that the signal is at least +3 volts into your PC if you are not able to transfer files.

If the transfer terminated without problems, you have a working development environment for the picoFlash controller. To transfer files from the picoFlash to the development PC, use the DOWN command described in the Utilities section of this manual.

Depending on your application, *all* of the files on the B: drive are optional. The only file, in addition to your application and STARTUP.BAT, that may be needed in a production environment is the ethernet packet driver. All of the remaining files are pre-loaded in the hope that they will be useful development tools. The files present on the B: drive are archived on the development CD in the \JKmicro\picoFlash\Drive_B_Files\ directory.

The picoFlash has a hardware clock calendar. The time and date can be set from the DOS prompt with the following commands:

`B:\>TIME 13:30:00`	Sets the time to 1:30 pm
`B:\>DATE 11-29-2003`	Sets the date to November 29, 2003

When power is applied to the picoFlash, one of the first things the BIOS initialization code does is check for a CNTL-C character received by either the Console serial port or the Debug serial port. If this character is typed as soon as the board is powered up or reset, a flag is set which overrides some of the initialization process. When DOS runs its AUTOEXEC.BAT file on drive A:, the state of the CNTL-C flag is also checked and any user application set to run on drive B: is not loaded. This insures that a hung application or quiet console can always be interrupted.

When the console is on a hardware port (Serial 0 or Serial 1), CNTL-C character(s) should be sent to the port at the configured baudrate for the console. If the console is on the Debug port, CNTL-C character(s) must be sent at 9600 baud, 8-N-1. This method allows for convenience during development as well as a fail-safe break method.

The most reliable method of breaking the boot process using CNTL-C is to connect the console and start your communications program. Press and *hold* CNTL-C. Then apply power to the controller. Using this approach, a stream of break characters will be received by the controller as it powers up. The Debug port will always be checked for the break character. If console functionality has been moved to the Debug port, Serial 1 will not be checked for the break.

If the CNTL-C flag is not set, the AUTOEXEC file will attempt to transfer control to a file named STARTUP on drive B:. DOS also looks for and, if present, loads CONFIG.SYS from drive B:.

Hardware

Memory Configuration

The R8822 processor is configured in real mode with a physical address space of 1 megabyte. The DRAM is located between 00000h and 7FFFFh, the flash is between 80000h and FFFFFh. A 32-pin DIP socket is provided for additional flash, RAM, or EPROM. This memory can be accessed by reprogramming the chip select unit.

During the boot process the BIOS is copied from flash into the top of RAM. The BIOS then executes out of RAM. When a request for data on drive A: or B: is processed, the flash is mapped into the top 512k of memory, the drive access is performed, then mapped out again. If present, the DiskOnChip occupies a 64k block of memory starting at segment E000h. The memory regions enabled for the onboard flash and the DIP socket are controlled by the Memory Map register located at I/O port 607h. The table below outlines the bits of the map register.

Memory Map Configuration Register, I/O Port 607 hex

BITS 1 & 0	Onboard Flash	DIP Socket
00	80000h - FFFFFh	OFF
01	F0000h - FFFFFh	E0000h - EFFFFh
10	OFF	80000h - FFFFFh
11	OFF	OFF

Table 1: Memory Map Configuration Register

In I/O space, the CPLD ports are located between 600h and 607h, the Ethernet controller is at 300h-30Fh. R8822 configuration and control registers are located from FF00h to FFFFh.

The PicoFlash uses Timer0 for the DOS timer tick and Timer2 as the timer tick prescaler. Timer1 is available for user applications.

I/O Configuration

The R8822 internal peripherals (UARTs, counter/timers, and interrupt controller) are not PC compatible nor are they located at their traditional I/O port addresses.

For addressing and programming the peripherals specific to the R8822, please refer to the RDC R8822 Microcontroller User's Manual. The manual is available in PDF format on the Development Kit CD or from our web site at http://www.jkmicro.com/documentation.

Digital I/O Ports

The picoFlash has a total of 16 bits of I/O generated by a CPLD. The board is also equipped with an LED that can be used as a status indicator.

Ports A - D, 16 bits of I/O, are controlled by a CPLD. The I/O from the CPLD is grouped into 4-bit ports. Each of the four ports may be configured as either inputs or outputs. The following tables show the port registers, addresses, and configuration bits.

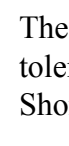
Register	Address
600h	Port A
601h	Port B
602h	Port C
603h	RESERVED
604h	Port D
605h	Clock/Calendar
606h	I/O Config Register

I/O Configuration Register, READ/WRITE (I/O Port 606 hex)

Function	BIT							
	7	6	5	4	3	2	1	0
Bit is Clear 0 (default)	Disable Port 605h Clock Access	Enable I/O Port C on J3	Connect J6-6 to Port D bit 2	Connect J6-8 to Port D bit 3	Port D Input	Port C Input	Port B Input	Port A Input
Bit is Set 1	Enable Port 605h Clock Access	RESERVED	Connect J6-6 to CPU TMROUT1	Connect J6-8 to CPU INT2	Port D Output	Port C Output	Port B Output	Port A Output

Table 2: I/O Configuration Register

Ports A through D each have a single data register that is read/write. Data read from the port represents the current state of the port, data written to the port will be present on the port pins, if the port is configured as an output. Each port may be configured as either an input or an output. Write a 0 to the appropriate bit in the direction register to configure the port as an input, write a 1 to configure it as an output. All ports default to inputs.



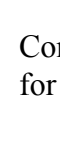
The CPLD is a low power device that operates from 3.3 Volts. Although the inputs are 5V tolerant, care must be taken to avoid exceeding the current specifications for the device. Shorting an input to 5V will damage the CPLD.

LED, the LED at location DS1 is controlled by bit 10 of the PDATA1 register at 0FF7Ah. Set the bit to turn the LED off, Clear the bit to turn the LED on.

Driving Loads with the I/O Ports

The ports on the picoFlash are capable of driving small loads or interfacing to TTL logic devices. These ports can only source/sink a few milliamps. In order to interface with many loads, additional circuitry, such as a transistor or relay, will be required. Designing the interface between an output pin and a higher current load can present a challenge, especially if high speed is required or the load is inductive in nature.

Switching inductive loads such as relays, solenoids and motors can generate transient voltages many times larger than the steady-state operating voltage of the load. For example, turning off a 12 volt solenoid can easily create a negative spike of 200 volts. Worst case, these transients can destroy your controller. In milder cases, they can cause program failures and flash memory corruption. In the case of high current, high inductance devices, the spike need not even be directly connected to the controller to cause damage or program failure.



Controllers damaged by inductive spikes are considered to be abused and are not eligible for warranty repair.

A detailed study of dealing with inductive spikes is beyond the scope of this manual. For more information, a good starting point is The Art Of Electronics, 2nd Ed. (Horwitz and Hill, 1989) pages 52-53.

The following items should be considered when driving inductive loads:

A) When driving a DC inductive load, place a diode in parallel with the load. In most cases, the diode can be a general purpose power diode such as a 1N4002. The cathode (banded end) of the diode should connect to the positive side of the load. Locate the diode as physically close to the load as possible. This applies to a small relay driven by a port pin, as well as a larger inductive load connected to the contacts of a relay.

B) If you are using a relay to switch an AC-powered inductive load, put a varistor in parallel with the load. The varistor voltage rating should be about 2 times the RMS (1.5 times the peak-to-peak) steady-state voltage of the load.

C) Relays switching an inductive load may require a capacitor placed across their contacts. 0.1µF to 1.0µF is a good starting point. If the relays are switching an AC load, place a 100 ohm resistor in series with the capacitor.

D) Do not use the controller's ground or power conductors to carry current from switched inductive loads. Isolate these signals and route then directly to and from the power supply and as far away from the controller as possible. A separate power source for large inductive loads is strongly recommended. In the case of very large inductive loads, a separate enclosure for the controller may be required.

Programming the I/O Ports

The I/O ports are located in the processor I/O space. Using the ports requires the use of functions unique to the x86 family of processors. Creating a pointer to the location may seem logical, but that reference would be in memory space, not I/O space. The Borland C functions `inport(`*`port`*`)` and `outport(`*`port,value`*`)` are 16 bit (word) instructions, `inportb(`*`port`*`)` and `outportb(`*`port,value`*`)` are 8 bit (byte) instructions. These functions are part of the `dos.h` header file. Similar functions (and header files) are available for other C compilers and languages. The following code illustrates the use of `inportb()` and `outportb()`.

```
unsigned char port;
port = inportb(PORT_DIR);                       /* get value of dir. reg */
port |= PORT_DIR_MASK;                          /* set dir. bit for input */
outportb(PORT_DIR, port);                       /* write value to dir. reg */
printf("PORT: 0x%X\n", (int)inportb(PORT));     /* read & print port value */
```

When changing any bit value in the R8822 PIO registers, it is essential that all of the other bit values be preserved. You must read the 16-bit register, modify the desired bit(s), and write the new value to the register.

Asynchronous Serial Ports

The picoFlash has 2 serial ports, Serial 0 and Serial 1. Both ports are internal to the R8822. These UARTs are *not* compatible with the 16450 UARTs on a PC. The maximum data rate is 115k Baud at RS-232 levels.

Serial 0 is wired as Data Terminal Equipment (DTE) for connection to a peripheral such as a modem. This port is jumper configurable to be either RS-232, TTL level RS-232 (RxD, TxD) or half-duplex RS-485. When configured to use RS-232 levels, this is port implements the RTS, CTS handshaking, and DCD control lines.

Serial 1 is wired as Data Communications Equipment (DCE) for direct connection to a computer or terminal. This port is configured as a 3 wire RS-232 port implementing RxD and TxD.

The Serial Debug port does not make use of a hardware UART. It is intended for console and debugging purposes only and should not be used in a design requiring high data throughput. Its design generates an interrupt for each *bit* of serial data, and puts a large load on the processor when data is being received. The port speed is fixed at 9600 baud.

Driver functions are available for Serial 0 and Serial 1 in the `CSPD.COM` TSR and related `CSPD***.LIB` and `.h` files located in the `picoFlash/drivers` subdirectory on the utilities CD.

Please refer to the RDC R8822 data sheet for specific information on the serial ports and their configuration.

RS-485 Configuration

The Serial 0 port of the picoFlash can be configured and used for RS-485 communications. To configure Serial 0 as RS-485, move the jumper on JP1 to the 5-6 location. RS-485 signals are present on J7. The RTS line on Serial 0 is used to control the RS-485 transmitter.

Library functions are available for use with RS-485 in the supplied driver.

The RS-485 driver is internally looped back. Characters transmitted will appear in the UART receiver. This condition is inerrant to the RS-485 implementation and may present user application implications.

Console Serial Port

As shipped, the default console port is Serial 1 at 9600 baud. To allow maximum flexibility, the console can be located on either of the 2 hardware serial ports at a number of baudrates, or the Debug port. When developing applications that require both hardware serial ports, it may be helpful to move the console functions to the Debug Serial port. The Debug port (as described previously) is implemented in software and has a fixed speed of 9600 baud.

To relocate the Console or change it's baudrate, use the `console.com` utility and specify the desired port, and if applicable, the baudrate. After a power cycle (or reset), the BIOS will use the new console settings. See the examples below.

```
B:\>console 1 19200
Changes will take effect when board is rebooted
```

or

```
B:\>console D
Changes will take effect when board is rebooted
```

To see a usage message, do not specify any arguments.

```
B:\>console
PicoFlash Console Configuration V1.0

Usage: console port baudrate
 Valid port ------> 0 1 D
 Valid baudrates -> 300 600 1200 1800 2400 4800
 For Ports          7200 9600 19200 28800 38400
 0 and 1            57600 76800 115200 153600

Baudrate for debug port is fixed at 9600
B:\>
```

Debug port signals are on J3 and require a special cable (PN: 86-0040) for connection to a PC.

! The debug serial port is intended only for use as a development tool. While it is receiving data, there is a high interrupt load. Other drivers that use interrupts (CSPD serial, Ethernet, etc.) may cause disruptions with (or be disrupted by) the debug port.

Watchdog Timer

The R8822 is equipped with a watchdog timer that can be configured to generate either an NMI or a processor reset. When enabled, software must keep the watchdog from timing out, indicating proper operation. If the watchdog timer expires, the configured action will be taken. The watchdog signal is not available external to the R8822, so a full board reset is not possible.

The watchdog control register is a word located at FFE6h. To Initialize the watchdog, first reset the counter register by writing two words to the configuration register. Write an AAAAh followed by a 5555h to the control register. Next, unlock the register by writing a 3333h followed by a CCCCh to the control register. Finally, write the enable command to the watchdog configuration register. The enable command is one word, with the high byte of C0h (enable watchdog to generate system reset) and a low byte from the table below that represents the

	0x01	0x02	0x04	0x08	0x10	0x20	0x40	0x80
Timeout	25uS	26mS	52mS	104mS	209mS	419mS	838mS	1.67S

Table 3: Watchdog timeout configuration

timeout interval. Software will then periodically reset the timer by writing two words to the configuration register: AAAAh followed by 5555h. More details are available in the RDC R8822 Users Manual.

```
/* Watchdog Configuration Example */
  #define WDTCON 0xFFE6

  outport(WDTCON, 0xAAAA);          /* reset the watchdog timer */
  outport(WDTCON, 0x5555);
  outport(WDTCON, 0x3333);          /* unlock the control register */
  outport(WDTCON, 0xCCCC);
  outport(WDTCON, 0xC080);          /* set timeout of 1.67 seconds */
```

Ethernet

The Ethernet port is a 8-bit design that supports direct connection to a 10BASE-T network, jumperless configuration, and NE2000 software compatibility. The controller has a base address of 300h and processor interrupt 0, using full duplex twisted pair wiring supporting link detect.

The Ethernet controller requires a software driver to interface with network software or other programs. The supplied packet driver (PICOPKT.COM) configures the chip interrupt, base address and other necessary parameters.

To install the packet driver, type:

```
B:\> PICOPKT
```

The driver will install using INT 0, I/O base address 300h and will locate the MAC (Media Access Control) number stored in the on board configuration EEPROM. Acess to the driver will be through software interrupt 60h. When the driver has loaded, it will indicate the MAC number, port address, hardware and software interrupts.

```
B:\>PICOPKT
PicoFlash Ethernet Packet Driver v1.0
MAC=00:90:C2:40:13:C3 IO=300 HwInt=0 SwInt=0x60
```

After the driver has been installed, network software will be able to communicate with the Ethernet adapter and the network. Users will probably want to modify their STARTUP.BAT file to automatically load the packet driver.

The board has two LEDs that indicated the status of the Ethernet link. The LNK LED indicates the status of the Ethernet. When illuminated, the picoFlash is receiving the Ethernet 'heartbeat' and is connected to a live network. If this LED is not illuminated, there is a problem with the Ethernet wiring or the network. The ACT LED indicates activity on the network. The LED will flash when a data packet is received or transmitted.

DiskOnChip

M-Systems' DiskOnChip is a high performance single-chip Flash Disk. The DiskOnChip has become the standard Flash Disk module for Embedded Single Board Computers. The DiskOnChip is a Flash Disk in a standard 32-pin DIP package that has built-in TrueFFS (True Flash File System) technology, allowing full read/write disk emulation.

The picoFlash currently supports the 8Meg Millennium DiskOnChip (MD2800-D08) with version 4.2 (or earlier) firmware. Other DiskOnChip capacities will function if they are loaded with the correct firmware, however M-Systems will not guarantee that the older firmware will continue to be supported on parts other than the MD2800.

Install the DiskOnChip module in the memory expansion socket U6. Note the location of pin 1. Set the Memory Type jumpers (JP2) for Flash memory. If the DiskOnChip is installed and functioning, there will be an installation message that is displayed during the boot process and a C: drive will be available to DOS.

```
picoFlash Bios Version 1.0
DOC Socket Services - Version 0.2
(C) Copyright 1992-1996, M-Systems Ltd.

TrueFFS-BIOS -- Version 3.3.9 for DiskOnChip 2000 (V4.2)
Copyright (C) M-Systems, 1992-2000

DOS Version 3.3e for JK microsystems Products
(C) HBS Corp and JK microsystems 1991-2002


B:\>
```

If, after the installation of a DiskOnChip, DOS fails to return a prompt, the DiskOnChip probably has incompatible firmware and must be reformatted and it's firmware reloaded.

Remove the DiskOnChip, reboot the board, and upload the file `DOC.EXE` from the utilities CD. Power down the board, reinstall the DiskOnChip, and apply power while holding CNTL-C down. Find the file `DOC.EXE` and execute it. It will extract 3 files. Execute the batch file `FMT_DOC.BAT` and answer the prompts. This will format your DiskOnChip and load compatible firmware. You may delete the 3 files after the operation is complete.

Jumpers

JP1 - Serial Port 0 Select, RS-485 Termination

This jumper selects the drivers and header that will be used for the Serial 0 signals and enables or disables the RS-485 termination and biasing resistors. RS-485 termination is controlled by the jumpers on pins 1-2 and 3-4. Install the jumpers to terminate the RS-485 signals and bias them to the space state. Serial 0 can be jumpered as half-duplex RS-485, TTL RS-232 (Rx and Tx), or RS-232 (Rx, Tx, RTS, CTS, DCD). Install the jumper at location 5-6 for RS-485 signals on J7, 7-8 for TTL RS-232 signals on J3 or 9-10 for RS-232 signals on J4.

Default position: 1-2 & 3-4, RS-485 termination enabled.
9-10, RS-232 Levels on J4.

NOTE: Only 1 jumper may be installed on JP1 pins 5-10.

JP2 - Socket Memory Type / Boot Memory Location

This jumper selects the type of memory in the expansion socket. Available choices are SRAM or Flash. Other memory types may be supported if their pinout is compatible with standard SRAM or Flash chips. Jumper pins 1-2 and 3-4 for SRAM or pins 1-3 and 2-4 for Flash. This jumper also allows the board to boot from the expansion socket. This is useful when performing field updates of the on-board Flash memory or when using an operating system other than DOS. Jumper pins 5-7 and 6-8 to boot from the on-board memory or jumper pins 7-9 and 8-10 to boot from the expansion socket.

Default position: 1-3 and 2-4, Flash memory expansion.
5-7 and 6-8, Boot from on-board flash.

Cables and Connectors

The following tables show the signal name (direction) for each connector pin.

NOTE: N/C indicates no connection and PULLUP indicates a 1k ohm pullup resistor to Vcc. Outputs are driven by the board and received by a peripheral. Inputs are driven by a peripheral and received by the board.

Serial 0 is configured as a DTE port, and is generally used to communicate with a peripheral device. Serial 1 is configured as a DCE port, generally being used to connect the picoFlash to another computer.

J1	Power
Vcc	1
RESET/	2
GND	3

Table 4a: Power Pinout

J2			Port A & B
PB.0	1	2	PA.0
PB.1	3	4	PA.1
PB.2	5	6	PA.2
PB.3	7	8	PA.3
+5V	9	10	GND

Table 4b: Port A&B Pinout

J3			Debug & Port C
Vcc	1	2	PC.0
PC.1	3	4	PC.2
PC.3	5	6	TTL TX
DBG RX	7	8	TTL RX
DBG TX	9	10	GND

Table 4c: Debug & PortC Pinout

J4			Serial 0
DCD (in)	1	2	DSR (in)
RxD (in)	3	4	RTS (out)
TxD (out)	5	6	CTS (in)
DTR (out)	7	8	N/C
GND	9	10	N/C

Table 4d: Serial 0 Pinout

J5			Serial 1
PULLUP	1	2	N/C
TxD (out)	3	4	PULLUP
RxD (in)	5	6	PULLUP
N/C	7	8	PULLUP
GND	9	10	N/C

Table 4e: Serial 1 Pinout

J6		JTAG & Port D	
JTAG IN	1	2	PD.0
JTAG OUT	3	4	PD.1
JTAG CLK	5	6	PD.2
JTAG RST	7	8	PD.3
+3.3V	9	10	GND

Table 4f: JTAG & Port D Pinout

J7	RS-485
DATA +	1
GND	2
DATA -	3

Table 4g: RS-485 Pinout

J8	Straight Through (to Hub)		picoFlash Signal Name	Cross-Over (to PC)	
	RJ-45 Pin #	Color (86-0018)		RJ-45 Pin #	Color (86-0018)
1	1	BLU	TxD +	3	BLK
2	2	ORG	TxD -	6	YEL
3	3	BLK	RxD +	1	BLU
4	6	YEL	RxD -	2	ORG
5			LNK LED +		
6			LNK LED -		
7			ACT LED +		
8			ACT LED -		

Table 4h: Ethernet Pinout

Pin numbering on RJ45 cable plug

To locate pin one of a connector, look for the following identifiers. Pin one has a square PCB pad and the others are round. This should be visible on the bottom of the PCB. Pin one will also be identified on the board silkscreen with a '1' and/or a dot. Dual row headers have ODD numbered pins on one side and EVEN numbered pins on the other. The dual row header numbering scheme follows the numbering for an IDC style ribbon cable. This may not be identical on connectors with discrete wires. Use caution when connecting cables to the picoFlash.

Software

Supported PC BIOS Functions

The picoFlash BIOS supports the following functions (software interrupts) common to PC compatible computers. Please refer to a DOS/PC reference for more information on DOS and BIOS software interrupts.

Int 10h, Video Driver, functions 9 and 0Eh
Int 11h, Get Equipment Configuration
Int 12h, Get Memory Size
Int 13h, Disk Driver, Functions 0-4
Int 14h, Serial Port Driver, Functions 0-3
Int 16h, Keyboard Driver, Functions 0 and 1
Int 19h, Boot System
Int 1Ch, Hook Timer Tick Interrupt

Driver Library

Drivers for the hardware serial ports and alphanumeric LCDs are supplied on the utilities CD in the `picoFlash\Drivers` subdirectory.

For implementation details, see the `README.TXT` files and the driver source code for the respective drivers.

Programming Languages

The picoFlash can be programmed in the language of your choice, as long as the compiler will generate 16-bit DOS executables (.exe or .com).

A tutorial for getting started with the Borland 4.52 IDE is available on the development CD (see `\QuickStart.html`) or from our website (http://www.jkmicro.com/documentation).

The WatTCP networking libraries are written in C and compiled with Borland 4.52. If you wish to use a different version of Borland C, the libraries will need to be regenerated using that compiler/linker/library manager.

QuickBASIC/PowerBASIC Console I/O

Some of the code produced by Microsoft QuickBASIC compiler does not execute properly on the picoFlash. In the case of console I/O, we believe that QuickBASIC is generating code for specific hardware and software not present on the picoFlash.

There are two problems with console I/O. The first is that a PRINT statement will not send output to the console port. To output text to the console, open "cons:" as a file and print to it. The second problem is that an INPUT statement will not echo the data entered by the user. Workarounds for both of these problems can be found in the program BAS_INP.BAS on the utilities CD /Example subdirectory and shown here:

```
start:
      OPEN "o", 1, "cons:"
      PRINT #1, ""
      PRINT #1, "Quickbasic/PowerBasic Input Program"

      PRINT #1, "  Enter a string.........> ";
      GOSUB linein
      InputString$ = linein$
      PRINT #1, InputString$

      PRINT #1, "  Enter a numeric value..> ";
      GOSUB linein
      InputNumber = VAL(linein$)
      PRINT #1, InputNumber

      CLOSE 1
      END

linein:
      linein$ = ""
linemore:
      a$ = INKEY$
      IF a$ = "" THEN GOTO linemore
      IF a$ = CHR$(13) THEN GOTO linedone
      IF a$ <> CHR$(8) THEN GOTO getchar
      PRINT #1, CHR$(8); CHR$(32); CHR$(8);
      linein$=left$(linein$,(len(linein$)-1))
      GOTO linemore
getchar:
      PRINT #1, a$;
      linein$ = linein$ + a$
      GOTO linemore
linedone:
      PRINT #1, ""
      RETURN
```

Utilities

The picoFlash comes preloaded with several utilities to aid system development. These utilities are located on drive A: of the picoFlash and/or the development CD.

UP.COM

This utility facilitates uploading files to the picoFlash via the console port using the X-MODEM transfer protocol. The utility requires the user to supply the name of the incoming file. Unless otherwise specified, the file is placed in the active directory of the current drive. A write-protect error will occur if UP tries to write to the read-only A: drive.

```
B:\>up

Upload file with X-MODEM Protocol
Usage: up file...
Version 3.0 for JK microsystems 186 products

B:\>up test.exe

Ready, start X-modem upload now,
 Press CNTL-C to abort...
CCCC
B:\>
```

DOWN.COM

This utility facilitates downloading files from the picoFlash via the console port using the X-MODEM transfer protocol. The utility requires the user to supply the name of the file to transmit.

```
B:\>down

Download file with X-MODEM Protocol
Usage: down file...
Version 3.0 for JK microsystems 186 products

B:\>down test.exe

Ready, start X-modem download now,
B:\>
```

FORMAT.COM

If it becomes necessary to reformat the B: drive, FORMAT provides this function. CAUTION, all information on the drive will be lost during the formatting process.

```
B:\>format
picoFlash FLASH Drive Format Program -Version 3.0
System will reboot after successful format...

 Press 1 to initialize Drive B as 418 KB disk
 Press ESC to exit with no changes

>1
Flash Drive is now formatted
 Rebooting system...
```

EDIT.COM

A simple line editor is included to allow quick creation and modification of batch files or other text files. EDIT is similar to Microsoft's EDLIN provided in earlier versions of MS-DOS. It allows list, insert, delete, and modify. Upon exit, a backup of the original file is created (`filename.BAK`) and the edits are saved. If a backup file with the same name already exists, it is overwritten. A list of commands and their usage is available by entering 'h' at the edit prompt (>>). The name of the file to edit must be supplied following the command EDIT on the command line.

```
B:\>edit test.bat
FlashLite Line Editor v1.0
Enter h for help

New File: test.bat
>> iz
    0: @echo Batch file being processed...
    1: mytsr
    2: myapp
    3: ^Z
>> l
    0: @echo Batch file being processed...
    1: mytsr
->  2: myapp

>> q
Save before exit (Y,n): y
File Saved
B:\>
```

DOS

JK microsystems' controllers use XDOS, a compact operating system for embedded applications. The XDOS command structure is nearly identical to MS/PC DOS version 3.3. The switches for the DIR command have been changed and expanded. XDOS does not support redirected input or output with the use of < and >, but does support pipes (|). None of the external DOS commands are available due to size constraints. XDOS does not support installable file system functions.

XDOS Command Reference

In the list below, XDOS commands are followed by a function description and their format including available parameters and switches. Items in boldface type must be entered. Capitals or lowercase letters may be used. Items in italics are parameters. Those in boldface italics must be entered, those in [ ] are optional. All switches are optional. They are shown as [/X]. Spaces and punctuation are to be included. An ellipsis ... following items means that you may repeat the items as often as needed. Do not enter the ellipsis or the square brackets. Most XDOS commands allow the use of wildcards in filenames and extensions. When wildcards (?=one character, *=any character or characters) are used, the command is executed once for each matching file.

Common parameters are:

[*d:*]	drive specification - a letter followed by a colon (:), e.g. A:, if no drive is specified, the default drive is used.
[*path*]	the path DOS must take in traveling from one directory to another; directory names are separated by a backslash (\).
[*filename*]	up to 8 characters used to name a file.
[.*ext*]	a three character extension may be added to a filename; an extension is separated from a filename by a period.

CD / CHDIR

Function: Changes the current directory
Format: **CD** or **CHDIR** [[*d:*]*path*]

COPY

Function: Copies a file, combines two or more files into one file
Format: **COPY** [*d:*][*path*]*filename*[.*ext*][*switches*]
[+[*d:*][*path*]*filename*[.*ext*][*switches*]
[*d:*][*path*][*filename*[.*ext*]][*switches*]
Switches: /V - verify the contents of new file
/A - copy file in ASCII format
/B - copy file in binary format

DATE

Function: Displays or changes the current DOS date.
Format: **DATE** [*mm-dd-yyyy*]

DEL / ERASE

Function: Deletes (erases) one or more files from a disk
Format: **DEL** or **ERASE** [*d:*][*path*][*filename*[.*ext*]]

DIR

Function: Lists directory entries
Format: **DIR** [*d:*][*path*][*filename*[*.ext*]][*switches*]
Switches: /a - display file attributes
/b - sort by file size (in bytes)
/d - sort entries by date and time
/f - display entries by alphabetic file name order
/n - display entries in directory order (do not sort)
/s - include system and hidden files in output
/p - stop at end of each page
/w - display only the file name
/h - display Help screen (any invalid key)

MD / MKDIR

Function: Creates a subdirectory
Format: **MD** or **MKDIR** [*d:*]*path*

PATH

Function: Specifies directories DOS will search when trying to locate executable files
Format: **PATH** [[*d:*]*path*[*;*[*d:*]*path ...*]]

PROMPT

Function: Sets the DOS system prompt
Format: **PROMPT** [*text*]
Text: Resulting Character(s):
$t The current time stored by DOS
$d The current date stored by DOS
$p The current directory
$v The version of DOS being used
$n The default drive
$g The character >
$l The character <
$b The character |
$q The character =
$$ The character $
$_ Carriage return plus line feed

REN

Function: Renames a file
Format: **REN** [*d:*][*path*]*filename*[.*ext*] *filename*[.*ext*]

RD / RMDIR

Function: Deletes a subdirectory
Format: **RD** or **RMDIR** [*d:*]*path*

TIME

Function: Displays or changes the current DOS time
Format: **TIME** [*hh:mm:ss.xx*]

TYPE

Function: Display the contents of a file
Format: **TYPE** [*d:*][*path*]*filename*[.*ext*]

VER

Function: Displays the DOS version number
Format: **VER**

VOL

Function: Displays the volume label of specified drive
Format: **VOL** [*d:*]

Specifications

Power Supply: 5 VDC +/- 5% regulated, 2W (nominal)
Operating Temperature: -20 to +85 °C
Humidity: 5 - 90 % non-condensing

Port A,B,C,D:

Symbol	Parameter	MIN	MAX	Units	Condition
V_{IL}	Input Low	0	0.8	V	
V_{IH}	Input High	2.0	5.5	V	
V_{OL}	Output Low		0.4	V	I_{OL}= 8mA
V_{OH}	Output High	2.4		V	I_{OH}= -4mA

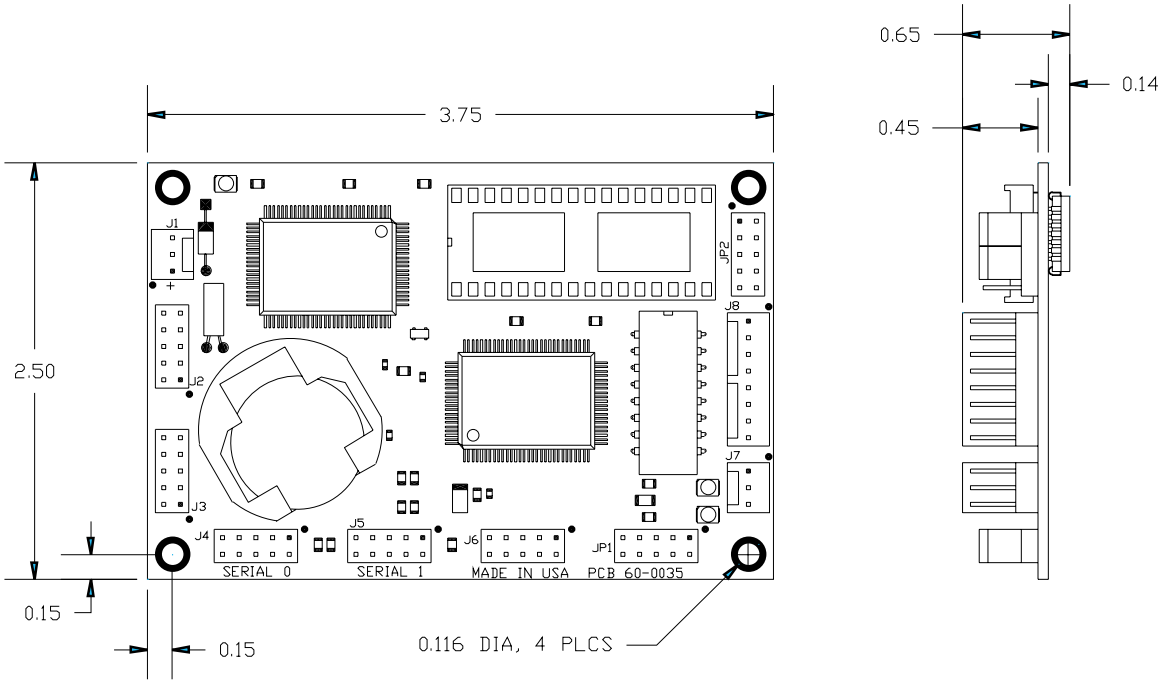
Mating Connectors:

Connector	Mfg	MFG P/N	Mfg	MFG P/N	JK micro P/N
2x5 Housing (J2- J6)	Molex	22-55-2101	Oupiin	4072-2X05H	28-0030
Pins	Molex	16-02-0096	Oupiin	404-PIN-10K	28-0033
1x3 Hou sing, Friction Lock (J1,7)	Molex	22-01-2031	Oupiin	4071-03H	28-0012
1x8 Housing, Friction Lock (J8)	Molex	22-01-2081	Oupiin	4071-08H	28-0037
Pins, Friction Lock Housings	Molex	08-50-0114	Oupiin	4071-PIN-T	28-0013

Mechanical:

Dimensions 3.75" x 2.50" x 0.65"
95mm x 63.5mm x 16.5mm

Weight 1.8oz (51gm)



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Rev	Date	Author	Changes
1.0	30NOV03	EW	First Issue
1.1	30JAN04	EW	Add note on flash writes Revise I/O tables, Add memory map config table