Home

# OS-9® for GraphicsMaster Board Guide

# Version 4.7

RadiSys

THE POWER OF WE

www.radisys.com
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# Chapter 1: Installing and Configuring OS-9®

This chapter describes installing and configuring OS-9® on the GraphicsMaster board. It includes the following sections:

- **Requirements and Compatibility**
- **Target Hardware Setup**
- **Connecting the Target to the Host**
- **Building the OS-9 ROM Image**
- **Creating a Startup File**
- **Optional Procedures**

# Requirements and Compatibility

## Host Hardware Requirements (PC Compatible)

Your host PC should have the following hardware installed:

- a minimum of 32MB of free disk space (An additional 235MB of free disk space is required to run PersonalJava Solution for OS-9.)
- an Ethernet network card
- a PCMCIA card reader/writer
- the recommended amount of RAM for your particular operating system.

**Note**

If you are a PersonalJava Solution for OS-9 licensee and you plan to use the Java JCC to pre-load your Java classes, you may need as much as 64MB of RAM. Refer to the document ***Using JavaCodeCompact*** for a complete discussion of using the JCC.

## Host Software Requirements (PC Compatible)

Your host PC should have the following software installed:

- Windows 95/98 or Windows NT/2000
- a terminal emulation program (such as Hyperterminal, which comes with Microsoft Windows)

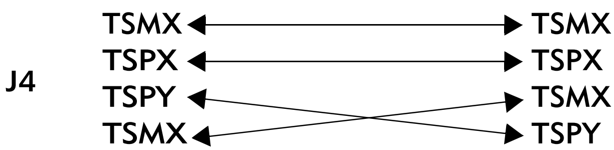
# Target Hardware Requirements

Your reference board requires the following hardware:

- an enclosure or chassis with power supply
- an RS-232 null modem serial cable
- an LCD screen, keyboard, and mouse (for use with MAUI®)

The J4 connector controls the touch panel on the GraphicsClient. OS-9 does not allow the swapping of positive (P) and negative (M) connectors, or the swapping of X and Y pairs. To ensure a proper connection, use the following connector pinouts:

**Figure 1-1 J4 Connector Pinout Diagram**




## Java Hardware Requirements

The following is required of your reference board to run PersonalJava Solution for OS-9:

- 16MB of RAM
- 4MB of FLASH (Boot)
- LCD Display

## For More Information

The ***GraphicsMaster User's Manual*** is provided by Applied Data Systems, Inc. You can download a copy of this document from www.flatpanels.com.

# Target Hardware Setup

## Configure Board Switch Settings

Set the jumpers according to the ***GraphicsMaster User's Manual*** or ***GraphicsMaster Plus User's Manual*** supplied by Applied Data Systems.

**Note**

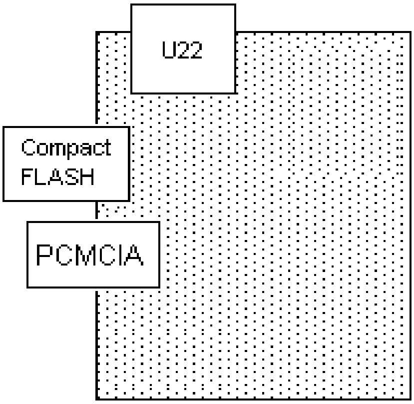
In most cases, you can use the default factory jumper settings.

## Installing the Flash Device

The first stage in configuring your reference board is to burn the pre-configured coreboot image located in the following directory to the 128k boot Flash device:

```
MWOS\<OS>\ARMV4\PORTS\GRAPHICSMASTER\BOOTS\SYSTEMS\PORTBOOT
```

**Figure 1-2 Installing the Flash Devices**



**Note**

If you need to create new flash devices, see the **Creating a New OS-9 Coreboot Image in Flash Memory** section.

## Configuring the ATA Card

You can use your ATA card to validate that your reference board is operational without requiring the connection to the host machine:

To configure the ATA card, complete the following steps:

Step 1. From a DOS prompt on the host machine, navigate to the following directory:

```
MWOS\OS9000\ARMV4\PORTS\GRAPHICSMASTER\BOOTS\SYSTEMS\PORTBOOT
```

and run `os9make`.

Step 2. On the host machine, copy the file into the root directory of the ATA card:

```
MWOS\OS9000\ARMV4\PORTS\GRAPHICSMASTER\BOOTS\SYSTEMS\PORTBOOT\os9kboot
```

Step 3. With the board powered off, install the ATA card in the single PCMCIA socket on the reference board.

# Connecting the Target to the Host

Connect an RS-232 null modem cable from the reference board to the serial port of a Windows 95, Windows 98, or Windows NT, or 2000 system.

Step 1. Connect the serial cable to the J10 connector (or the DB9 connector that connects to J10) on the reference board. The J10 connector is the SA11X0 serial port 3 (SP3).

Step 2. Connect the other end of the serial cable to the Host PC.

Step 3. On the Windows desktop, click on the `Start` button and select `Programs -> Accessories -> Hyperterminal`.

Step 4. Once Hyperterminal is open, enter a name for your Hyperterminal session.

Step 5. Select an icon for the new Hyperterminal session. A new icon is created with the name of your session. Click `OK`.

Step 6. In the **Phone Number** dialog, go to the **Connect Using** box and select the communications port to be used to connect to the reference board.

The port selected is the same port that you connected to the serial cable from the reference board. Click `OK`.

Step 7. In the **Port Settings** tab, enter the following settings:

Bits per second = `19200`

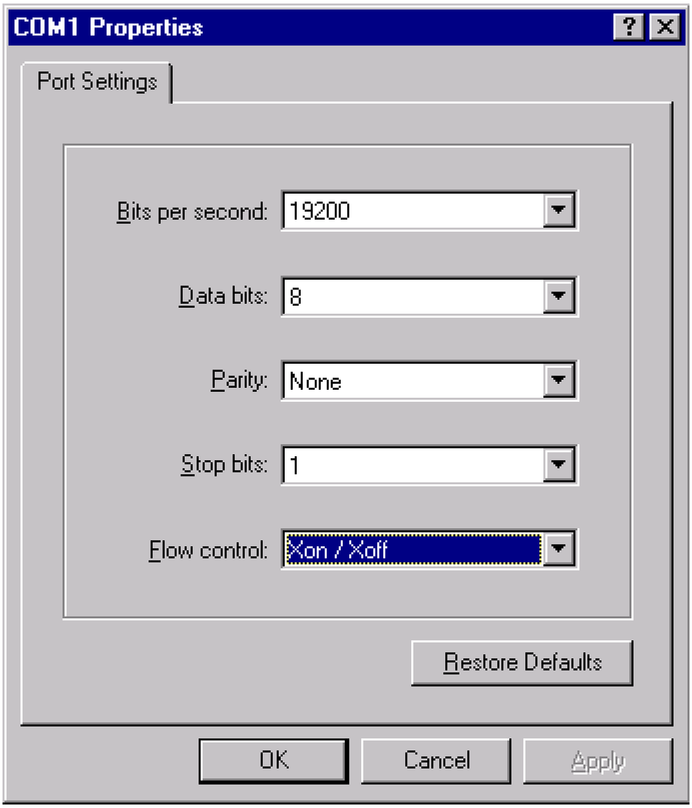
Data Bits = `8`

Parity = `None`

Stop bits = `1`

Flow control = `XOn/XOff`

**Figure 1-3  Port Settings**




Step 8. Click OK. A connection should be established.

## Note

If the word connected does not appear in the lower left corner of the window, click `Call -> Connect` to establish the connection.

Step 9. Apply power to the board. The OS-9 bootstrap message is displayed.

# Building the OS-9 ROM Image

## Overview

The OS-9 ROM image is a set of files and modules that collectively make up the OS-9 operating system. The specific ROM Image contents can vary from system to system depending on hardware capabilities and user requirements.

To simplify the process of loading and testing OS-9, the ROM Image is generally divided into two parts—the low-level image, called `coreboot`; and the high-level image, called `bootfile`.

### Coreboot

The coreboot image is generally responsible for initializing hardware devices and locating the high-level (or bootfile) image as specified by its configuration. For example from a FLASH part, a harddisk, or Ethernet. It is also responsible for building basic structures based on the image it finds and passing control to the kernel to bring up the OS-9 system.

### Bootfile

The bootfile image contains the kernel and other high-level modules (initialization module, file managers, drivers, descriptors, applications). The image is loaded into memory based on the device you select from the boot menu. The bootfile image normally brings up an OS-9 shell prompt, but can be configured to automatically start an application.

RadiSys provides a Configuration Wizard to create a coreboot image, a bootfile image, or an entire OS-9 ROM image. The Qizard can also be used to modify an existing image. The Configuration Wizard is automatically installed on your host PC during the OS-9 installation process.

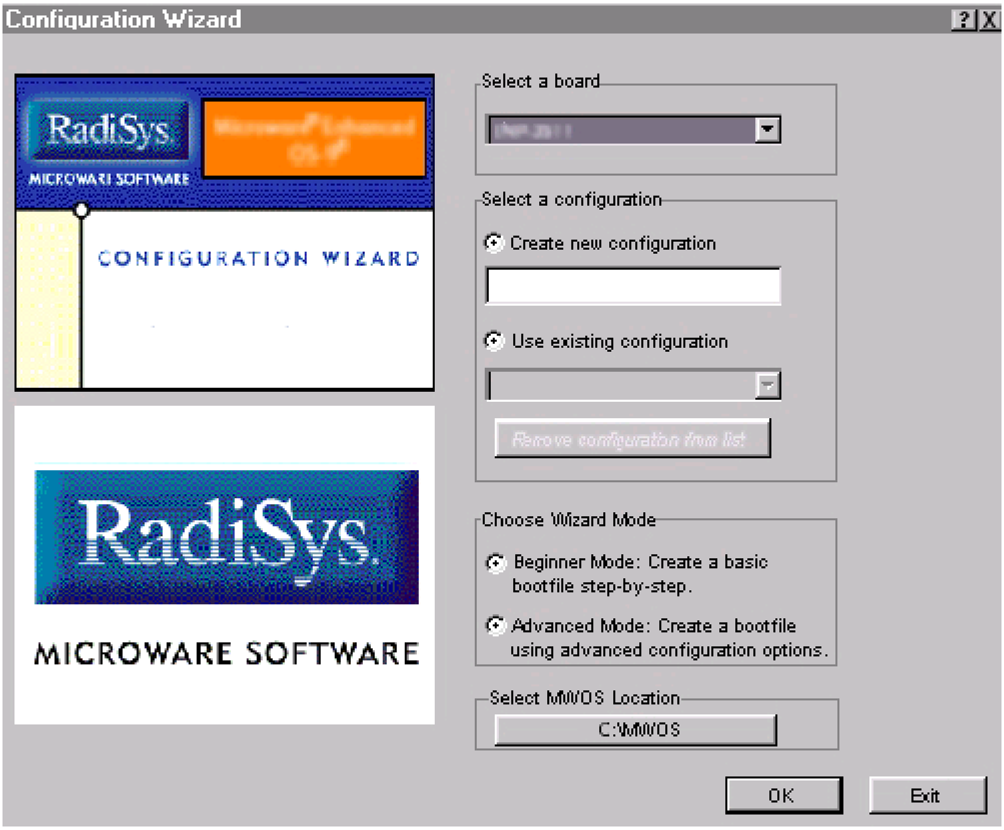
## Starting the Configuration Wizard

**Note**
Microware OS-9 for StrongARM supports ATA Flash cards.

The Configuration Wizard is the application used to build the coreboot bootfile image. To start the Configuration Wizard, perform the following steps:

Step 1. From the Windows desktop, select `Start` -> `RadiSys` -> `Microware OS-9 for <your product>` -> `Configuration Wizard`. You should see the following opening screen:

**Figure 1-4 Configuration Wizard Opening Screen**

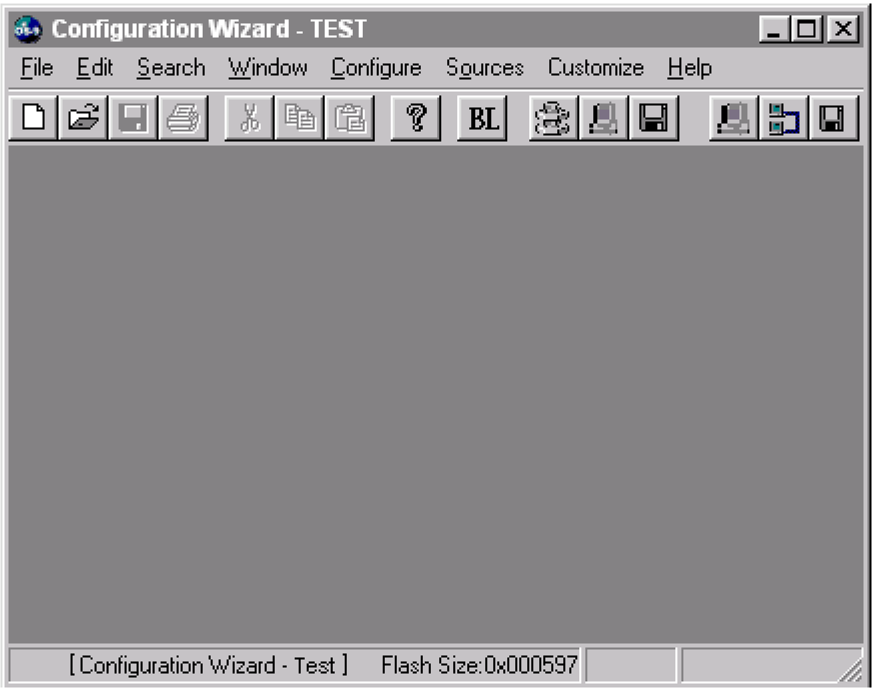



Step 2. Select your target board from the **Select a board** pull-down menu.

Step 3. Select the `Create new configuration` radio button from the **Select a configuration** menu and type in the name you want to give your ROM image in the supplied text box. This names your new configuration, which can later be accessed by selecting the **Use existing configuration** pull down menu.

Step 4. Select the Advanced Mode radio button from the **Choose Wizard Mode** field and click OK. The Wizard's main window is displayed. This is the dialog from which you will proceed to build your image. An example is shown in **Figure 1-5**.

**Figure 1-5 Configuration Wizard Main Window**




If you intend on using the target board across a network, proceed to the next step. If not, go directly to step eight.

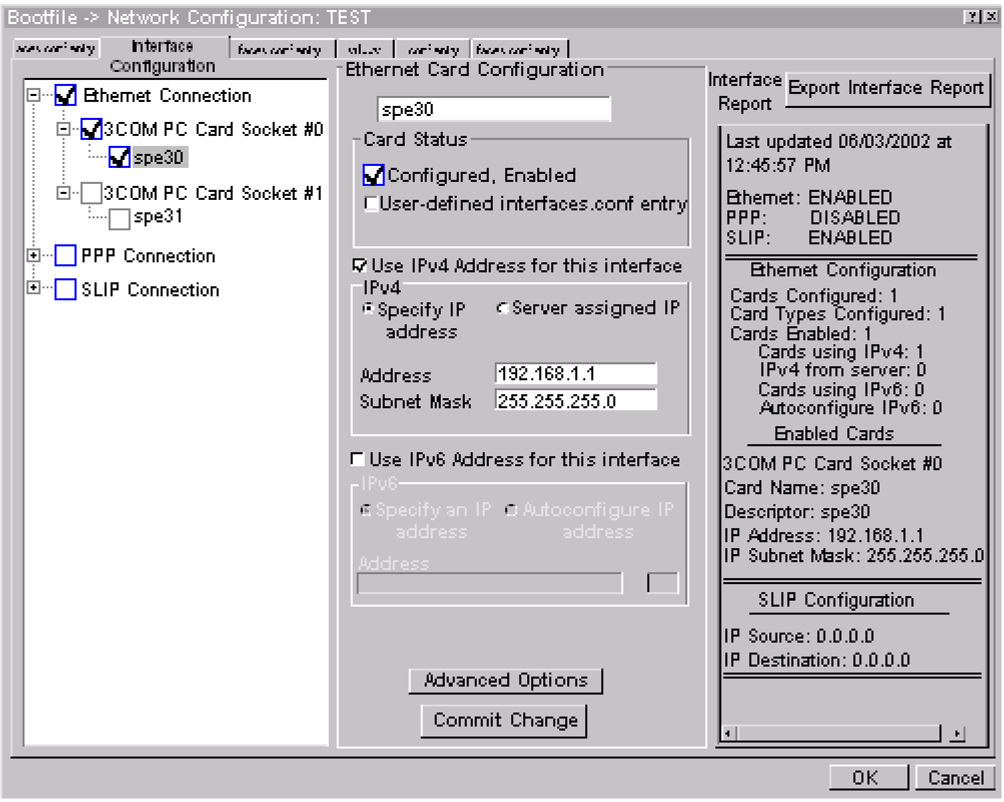
## Note

If you intend to use the target board across a network, you need to configure the network settings.

Step 5. If you want to use the target board across a network, you will need to configure the Ethernet settings within the Configuration Wizard. To do this, select `Configure -> Bootfile -> Network Configuration` from the Wizard's main menu.

Step 6. From the **Network Configuration** dialog, select the `Interface Configuration` tab. From here you can select and enable the interface. For example, you can select the appropriate Ethernet card from the list of options on the left and specify whether you would like to enable IPv4 or IPv6 addressing. **Figure 1-6** shows an example of the **Interface Configuration** tab.

**Figure 1-6 Bootfile -> Network Configuration -> Interface Configuration**



## For More Information

To learn more about IPv4 and IPv6 functionalities, refer to the ***Using LAN*** manual, included with this product CD.

## For More Information

Contact your system administrator if you do not know the network values for your board.

Step 7. Once you have made your settings in the **Network Configuration** dialog, click `OK`.

Step 8. Select `Configure -> Build Image` to display the **Master Builder** window. If networking is desired, make sure the **SoftStax® (SPF) Support** box is checked.

Step 9. Click `Build`. This will build a boot image that can be placed on the PCMCIA card.

Step 10. Make sure the board is powered off and insert the PCMCIA IDE card into the PCMCIA slot of your computer.

## WARNING

Damage may occur to the PCMCIA card if it is inserted or removed while power is applied to the board.

Step 11. Click `Save As` to save the file `os9kboot` to the root directory of the PCMCIA IDE card.

Step 12. Remove the PCMCIA IDE card from the computer.

Step 13. Position the PCMCIA card so that the end with the connector holes is facing the PCMCIA socket and the label is facing up.

Step 14. Slide the card into the socket of the reference board until the card snaps onto the connector pins.

### Note

The GraphicsMaster design does not provide enough current for the TypeIII PCMCIA (double height).

Step 15. Apply power to the board. The reference board will boot from the IDE PCMCIA card and you should see the "$" prompt.

### Note

After the reference board is booted using the PCMCIA card, you can move the boot image to Flash and boot from there. To move the boot image to Flash, enter the following command at the OS-9 prompt:

```
$ pflash -i -f=/mhc1/os9kboot
```

Once the boot image has been moved to Flash, you no longer need the PCMCIA card to boot the reference board to an OS-9 prompt.

# Creating a Startup File

When the Configuration Wizard is set to use a hard drive or another fixed drive, such as a PC Flash Card as the default device, it can set up the init module to call the `startup` file in the `SYS` directory in the target (For example: `/h0/SYS/startup`, `/mhc1/SYS/startup`). However, this directory and file will not exist until you create it. To create the startup file, complete the following steps:

Step 1. Create a `SYS` directory on the target machine where the `startup` file will reside (for example: `makdir /h0/SYS`, `makdir /dd/SYS`).

Step 2. On the host machine, navigate to the following directory:

```
MWOS/OS9000/SRC/SYS
```

In this directory, you will see several files. The files related to this section are listed below:

- `motd`: Message of the day file
- `password`: User/password file
- `termcap`: Terminal description file
- `startup`: Startup file

Step 3. Transfer all files to the newly created `SYS` directory on the target machine. (You can use Kermit, or FTP in ASCII mode to transfer these files.)

Step 4. Since the files are still in DOS format, you will be required to convert them into the OS-9 format with the `cudo` utility. The following command is an example:

```
cudo -cdo password
```

This will convert the `password` file from DOS to OS-9 format.

### For More Information

For a complete description of all the `cudo` command options, refer to the ***Utilities Reference Manual*** located on the Microware OS-9 CD.

Step 5. Since the command lines in the startup file are system-dependent, it may be necessary to modify this file to fit your system configuration. It is recommended that you modify the file before transferring it to the target machine.

## Example Startup File

Below is the example startup file as it appears in the `MWOS/OS9000/SRC/SYS` directory:

```
-tnxnp
tmode -w=1 nopause
*
*OS-9 - Version 3.0
*Copyright 2001 by Microware Systems Corporation
*The commands in this file are highly system dependent and
*should be modified by the user.
*
*setime </term                ;* start system clock
setime -s                     ;* start system clock
link mshell csl               ;* make "mshell" and "csl" stay in memory
* iniz r0 h0 d0 t1 p1 term    ;* initialize devices
* load utils                  ;* make some utilities stay in memory
* tsmon /term /t1 &           ;* start other terminals
list sys/motd
setenv TERM vt100
tmode -w=1 pause
mshell<>>>/term -l&
```

## For More Information

Refer to the **Making a Startup File** section in Chapter 9 of the ***Using OS-9*** manual for more information on startup files.

# Optional Procedures

The following sections detail optional procedures you may perform once you have installed and configured OS-9.

## Connecting the Reference Board to an Ethernet Network

Microware OS-9 for StrongARM supports using the onboard SMC91C94 or a 3COM Etherlink III - LAN PC Card for SoftStax® TCP/IP connections. Also, Microware OS-9 for StrongARM provides system level support for telnet, FTP, and NFS.

To use Ethernet networking, you must create a bootfile that has the Ethernet options enabled and insert an Ethernet PCMCIA card into the reference board if you choose to use a PCMCIA Ethernet card.

Step 1. Click the `Start` button on the Windows desktop.

Step 2. From the Windows desktop, select `Start` -> `RadiSys` -> `Microware OS-9 for <product>` -> `Configuration Wizard`.

Step 3. Once the Wizard is open, open the configuration you created in the previous section by clicking `OK`. The configuration screen is displayed.

Step 4. Select `Configure` -> `Bootfile` -> `Network Configuration`. The **Network Configuration** dialog box appears.

Step 5. Change the network settings as needed.

Step 6. Create a new bootfile by following the directions in the **Building the OS-9 ROM Image** section.

Step 7. Turn off the power to the reference board.

**WARNING**
Damage may occur to the PCMCIA card if it is inserted or removed while power is applied to the board.

Step 8. Position the PCMCIA IDE card so that the end with the PCMCIA female connector is facing PCMCIA socket and the label is facing up.

Slide the PCMCIA IDE card into the socket until the card snaps onto the pins.

Step 9. Connect the 10 Base T connector into J9 if using the onboard Ethernet.

-OR-

Position the Ethernet PCMCIA card so that the end with the PCMCIA female connector is facing the PCMCIA socket and the label is facing up. Then, slide the PCMCIA Ethernet card into the socket until the card snaps onto the pins.

Step 10. Apply power to your reference board.

Step 11. Test the Ethernet connection by pinging the reference board. If the ping operation fails, the following scenarios should be evaluated:

- Is the board connected to a live Ethernet port?
- Is the Ethernet cable defective?
- Are the network settings for the reference board correct?

## Pinging the Reference Board

Windows 95, Windows 98, and Windows NT include a ping command that can be used to test the Ethernet connection for the reference board.

Step 1. Go to the DOS prompt.

Step 2. Type `ping <IP Address>`.

The IP Address is the address you assigned to the evaluation board in either the coreboot or the bootfile module. The address is typed without the <> brackets.

If the ping was successful, you will see the following response:

```
Reply from <IP Address>: bytes=xx time =xms TTL= xx
```

If the ping was unsuccessful, you will see the following response:

```
Request timed out.
```

**Note**

Windows 95, 98, and NT do not support IPv6.

# Creating a New OS-9 Coreboot Image in Flash Memory

If you want to use ROM Ethernet services such as System State Debugging, you must create a new coreboot image. The coreboot image that was shipped with the reference board does not allow you to perform System State Debugging because the IP address in Flash ROM is set to “0.0.0.0”. You can create the coreboot image with an EPROM programmer.

**Note**

Re-creating the coreboot image is required only when system state debugging is desired.

## Making a Coreboot Image with an EPROM Programmer

This section describes creating the coreboot image. When you are done creating the coreboot image, please refer to your EPROM programmer's instructions to learn how to load the coreboot image into the EPROM.

Step 1. Click the `Start` button on the Windows desktop.

Step 2. From the Windows desktop, select `Start` -> `RadiSys` -> `Microware OS-9 for <product>` -> `Configuration Wizard`. The opening screen is displayed.

Step 3. Give the boot image a name, then select `Advanced Mode` and click `OK`. The main window is displayed.

Step 4. Select `Configure` -> `Build Image` to display the **Master Builder** screen.

Step 5. Select the `Coreboot Only Image` setting and click `Build`.

Step 6. Click `Save As` to save the coreboot image to a directory of your choosing. If you do not have that directory on the drive, you can create it.

Step 7. Transfer the coreboot image to the EPROM with the EPROM programmer. You will need to follow the documentation for the EPROM programmer to complete this step.

# Configuring GraphicsMaster with TrueFFS

**Note**
You must purchase the TrueFFS add-on package to access this feature.

Below is a list of instructions used to configure a GraphicsMaster with a TrueFFS flash disk and how to reserve space for a bootfile.

## Rebuilding the Descriptor (30MB TrueFFS Only)

If you are using a 30MB TrueFFS flash disk, you will need to rebuild the `rrf0` descriptor for the board. To do this, complete the following steps:

Step 1. Locate the `GRAPHICSMASTER/RBF/RBFTL/config.des` file.

Step 2. Change the `FLASH_SIZE_OVERRIDE` definition on line 140 to `0x01e00000`.

Step 3. Type `os9make` in the `GRAPHICSMASTER/RBF/RBFTL/DESC` directory. This should rebuild the `rrf0` descriptor.

## Building the Image

To build the coreboot and bootfile images for TrueFFS, complete the following steps in Microware's Configuration Wizard:

Step 1. From the Configuration Wizard opening window, select `Expert Mode` and click `OK`. The main Configuration Wizard screen is displayed.

Step 2. Select `Configure -> Sys -> Select System Type` from the Wizard menu.

Step 3. Select the **ROM Memory List** tab.

Step 4. From the **Settings Based On** pull down area, select `TrueFFS (30M) + bootfile(2)`. This will properly configure the memory lists to search for a 2MB bootfile at the end of the flash part.

**Note**

For a 14M flash disk, select `TrueFFS (14M) + bootfile(2)`.

Step 5. Select `Configure -> Coreboot -> Main Configuration` from the Wizard menu.

Step 6. In the **Define Other Boot Options** tab, click on the **Ir auto boot** check box.

Step 7. Select the **Ethernet** tab. Make sure the following areas contain the correct values:

- IP Address
- IP Broadcast
- Subnet Mask
- IP Gateway
- MAC Address

**Note**

Contact your system administrator if you do not know the appropriate Ethernet values for your setup.

Step 8. Select `Configure -> Bootfile -> Disk Configuration` from the Wizard menu.

Step 9. From the **RAM Disk** tab, select the **map RAM disk as /dd** radio button.

Step 10. Click on the **Init Options** tab and select the **/dd** radio button.

Step 11. Minimize the Configuration Window and navigate to the following directory:
`OS9000/ARMV4/PORTS/GRAPHICSMASTER/BOOTS/INSTALL/PORTBOOT/user.ml`

Once in the `user.ml` file, add the `rbftl` driver and descriptor by pasting in the following lines:

```
../../../CMDS/BOOTOBJS/rbftl
../../../CMDS/BOOTOBJS/DESC/RBFTL/rrf0
```

Step 12. Restore the Configuration Window and select `Configure -> Build Image` from the menu.

Step 13. Select the **Coreboot Only Image** radio button. Click `Build`. Allow time for the coreboot image to be created.

Step 14. Click the **Bootfile Only Image** radio button. Make sure the following check boxes are selected:

- Rom Utility Set
- User State Debugging Modules
- Disk Support
- Disk Utilities
- SoftStax (SPF) Support
- MAUI Support
- User Modules

Click `Build` to build the image.

## Note

The resulting bootfile should be less than 2097152 bytes (2MB). If your resulting bootfile is more than 2MB, you may wish to remove the MAUI demos.

The final steps for configuring your build includes burning the image onto the EPROM device and placing `os9kboot` on a PCMCIA disk. Once you have done this, place the following files on the PCMCIA disk: (These are used one time for TrueFFS disk setup.)

```
/MWOS/OS9000/ARMV4/CMDS/ftformat
/MWOS/OS9000/ARMV4/CMDS/ftdefrag
/MWOS/OS9000/ARMV4/CMDS/ftcheck
```

## Setting up the Flash Disk

To set up the TrueFFS flash disk, complete the following steps:

Step 1. At the OS-9 shell prompt (`$`) on the target window, type the following command:

```
ftformat /rrf0
```

The following information is displayed:

```
This utility will perform a low-level format of a
flash volume /rrf0@ for use with the rbftl TrueFFS
flash file system driver. This operation can run for
up to 35 seconds for each megabyte of flash being
formatted. This formatting will destroy all file and
low-level state information, including wear-leveling
information, if there is any, stored in the flash.
```

Step 2. A prompt will then appear, asking if you would like to continue. Click `y` to continue. The following information is displayed:

```
The low-level format of /rrf0@ has completed
successfully. Be sure to perform a format or pcformat
of /rrf0 before attempting file operations (answer n
to requests for physical format and physical verify
in format).
```

Step 3. At the next prompt, type the following disk format utility:

```
$ format -npnv -v=OS9_TrueFFS -r /rrf0
```

Information about your format parameters is displayed and the flash memory is now available for use.

### Programming the Bootfile into Flash (30MB Flash Disk)

To program a bootfile into flash for a 30MB flash disk, make sure the bootfile (`os9kboot`) is less than 2097152 bytes and then type the following command:

```
$ pflash -i -u -f=/mhc1/os9kboot -s=0x0ae00000
```

### Programming the Bootfile into Flash (14MB Flash Disk)

To program a bootfile into flash for a 14MB flash disk, make sure the bootfile (os9kboot) is less than 2097152 bytes and type the following command:

```
$ pflash -i -u -f=/mhc1/os9kboot -s=0x09e00000
```

## Compressing the Bootfile Image

OS-9 bootfiles can be compressed to allow more modules to be loaded into a bootfile; this can be useful if you plan on storing your image on a small FLASH part or a floppy disk.

**Note**

The bootfile compression utility performs the compression at approximately a 2.5:1 ratio.

Complete the following steps to compress your image:

Step 1. Verify that your coreboot contains the `uncompress` module. This module can be found in the pre-built ROM and coreboot images that were shipped with your Microware OS-9 product.

**Note**

The `uncompress` module must be included in order for the compression to execute properly.

Step 2. Open the Configuration Wizard and select `Configure -> Coreboot -> Main Configuration` from the main menu.

Step 3. Select the `Bootfile Compression` tab. Verify that the **Include bootfile uncompress module** box is checked and select OK.

Step 4. When you are ready to build the image, open the **Master Builder** dialog. Verify that the **Compress Bootfile** box is checked and then press `Build` to begin the installing the image.

# Chapter 2: Board-Specific Reference

This chapter contains information that is specific to the GraphicsMaster reference board. It includes the following sections:

- **Boot Options**
- **The Fastboot Enhancement**
- **OS-9 Vector Mappings**
- **GPIO Usage**
- **Port Specific Utilities**

## For More Information

For general information on porting OS-9, see the ***OS-9 Porting Guide.***

# Boot Options

Following are the default boot options for the reference board. You can select these by hitting the space bar when the “Now Trying to Override Autobooters” message appears on the console port when booting.

You can configure these booters by altering the `default.des` file at the following location:

`MWOS/OS9000/ARMV4/PORTS/GRAPHICSMASTER/ROM`

Booters can be configured to be either menu or auto booters. The auto booters automatically try and boot in order from each entry in the auto booter array. Menu booters from the defined menu booter array are chosen interactively from the console command line after getting the boot menu.

## Booting from FLASH

When the `romcnfg.h` has a ROM search list defined the options `ro` and `lr` appear in the boot menu. If no search list is defined N/A appears in the boot menu. If an OS-9 bootfile is programmed into flash in the address range defined in ports default.des file the system can boot and run from flash.

| | |
|---|---|
| `ro` | rom boot—the system runs from the FLASH bank. |
| `lr` | load to ram—the system copies the flash image into ram and runs from there. |

## Booting from PCMCIA ATA Card

The system can boot from a PC formatted PCMCIA hard card which resides in the PCMCIA slot.

| | |
|---|---|
| `ide0` | The file os9kboot is searched for in slot 0. If found it is copied to system RAM and runs from there. |
| `ide1` | compact flash |

## Booting from PCMCIA Ethernet Card

The system can boot using the BootP protocol using an Ethernet card and `eb` option.

| | |
|---|---|
| `eb` | Ethernet boot—a PCMCIA card which supports ethernet will use the bootp protocol to transfer in a bootfile into RAM and the systems runs from there. |

## Restart Booter

The restart booter allows a way to restart the bootstrap sequence.

| | |
|---|---|
| `q` | quit—quit and attempt to restart the booting process. |

# Break Booter

The break booter allows entry to the system level debugger (if one exists). If the debugger is not in the system the system will reset.

| | |
|---|---|
| `break` | break—break and enter the system level debugger rombug. |

Example boot session and message.

```
OS-9 Bootstrap for the ARM

ATA IDE disk found in socket 00
Now trying to Override autobooters.

BOOTING PROCEDURES AVAILABLE ------------- <INPUT>

Boot embedded OS-9 in-place -------------- <N/A>
Copy embedded OS-9 to RAM and boot ------- <N/A>
Boot from PCMCIA-1 IDE ------------------- <ide1>
Boot from PCMCIA-0 IDE ------------------- <ide0>
Load bootfile via kermit Download -------- <ker>
Restart the System ----------------------- <q>
Enter system debugger -------------------- <break>

Select a boot method from the above menu: ide0


Wait for IDE drive ready.
IDE Model                  :       ATA_FLASH
Number Heads               : 0x0002
Total Cylinders            : 0x03d8
Sectors Per Track          : 0x0020

Checking Partitions        : 0
Fat Type                   : 0x16
File Name                  : OS9KBOOT
File Size                  : 0x000fdeb0
Start Cluster              : 0x00003a57
Reading Bootfile....

Boot Address               : 0xc002c850
Boot Size                  : 0x000fdeb0

OS-9 kernel was found.
A valid OS-9 bootfile was found.
$
```

# The Fastboot Enhancement

The Fastboot enhancements to OS-9 provide faster system bootstrap performance to embedded systems. The normal bootstrap performance of OS-9 is attributable to its flexibility. OS-9 handles many different runtime configurations to which it dynamically adjusts during the bootstrap process.

The Fastboot concept consists of informing OS-9 that the defined configuration is static and valid. These assumptions eliminate the dynamic searching OS-9 normally performs during the bootstrap process and enables the system to perform a minimal amount of runtime configuration. As a result, a significant increase in bootstrap speed is achieved.

## Overview

The Fastboot enhancement consists of a set of flags that control the bootstrap process. Each flag informs some portion of the bootstrap code that a particular assumption can be made and that the associated bootstrap functionality should be omitted.

The Fastboot enhancement enables control flags to be statically defined when the embedded system is initially configured as well as dynamically altered during the bootstrap process itself. For example, the bootstrap code could be configured to query dip switch settings, respond to device interrupts, or respond to the presence of specific resources which would indicate different bootstrap requirements.

In addition, the Fastboot enhancement's versatility allows for special considerations under certain circumstances. This versatility is useful in a system where all resources are known, static, and functional, but additional validation is required during bootstrap for a particular instance, such as a resource failure. The low-level bootstrap code may respond to some form of user input that would inform it that additional checking and system verification is desired.

# Implementation Overview

The Fastboot configuration flags have been implemented as a set of bit fields. An entire 32-bit field has been dedicated for bootstrap configuration. This four-byte field is contained within the set of data structures shared by the ModRom sub-components and the kernel. Hence, the field is available for modification and inspection by the entire set of system modules (high-level and low-level). Currently, there are six bit flags defined with eight bits reserved for user-definable bootstrap functionality. The reserved user-definable bits are the high-order eight bits (31-24). This leaves bits available for future enhancements. The currently defined bits and their associated bootstrap functionality are listed below:

## B_QUICKVAL

The `B_QUICKVAL` bit indicates that only the module headers of modules in ROM are to be validated during the memory module search phase. This causes the CRC check on modules to be omitted. This option is a potential time saver, due to the complexity and expense of CRC generation. If a system has many modules in ROM, where access time is typically longer than RAM, omitting the CRC check on the modules will drastically decrease the bootstrap time. It is rare that corruption of data will ever occur in ROM. Therefore, omitting CRC checking is usually a safe option.

## B_OKRAM

The `B_OKRAM` bit informs both the low-level and high-level systems that they should accept their respective RAM definitions without verification. Normally, the system probes memory during bootstrap based on the defined RAM parameters. This allows system designers to specify a possible RAM range, which the system validates upon startup. Thus, the system can accommodate varying amounts of RAM. In an embedded system where the RAM limits are usually statically defined and presumed to be functional, however, there is no need to validate the defined RAM list. Bootstrap time is saved by assuming that the RAM definition is accurate.

## B_OKROM

The B_OKROM bit causes acceptance of the ROM definition without probing for ROM. This configuration option behaves like the B_OKRAM option, except that it applies to the acceptance of the ROM definition.

## B_1STINIT

The B_1STINIT bit causes acceptance of the first init module found during cold-start. By default, the kernel searches the entire ROM list passed up by the ModRom for init modules before it accepts and uses the init module with the highest revision number. In a statically defined system, time is saved by using this option to omit the extended init module search.

## B_NOIRQMASK

The B_NOIRQMASK bit informs the entire bootstrap system that it should not mask interrupts for the duration of the bootstrap process. Normally, the ModRom code and the kernel cold-start mask interrupts for the duration of the system startup. However, some systems that have a well defined interrupt system (i.e. completely calmed by the sysinit hardware initialization code) and also have a requirement to respond to an installed interrupt handler during system startup can enable this option to prevent the ModRom and the kernel cold-start from disabling interrupts. This is particularly useful in power-sensitive systems that need to respond to “power-failure” oriented interrupts.

---

**Note**

Some portions of the system may still mask interrupts for short periods during the execution of critical sections.

---

## B_NOPARITY

If the RAM probing operation has not been omitted, the `B_NOPARITY` bit causes the system to not perform parity initialization of the RAM. Parity initialization occurs during the RAM probe phase. The `B_NOPARITY` option is useful for systems that either require no parity initialization at all or systems that only require it for “power-on” reset conditions. Systems that only require parity initialization for initial “power-on” reset conditions can dynamically use this option to prevent parity initialization for subsequent “non-power-on” reset conditions.

# Implementation Details

This section describes the compile-time and runtime methods by which the bootstrap speed of the system can be controlled.

## Compile-time Configuration

The compile-time configuration of the bootstrap is provided by a pre-defined macro (`BOOT_CONFIG`), which is used to set the initial bit-field values of the bootstrap flags. You can redefine the macro for recompilation to create a new bootstrap configuration. The new over-riding value of the macro should be established by redefining the macro in the `rom_config.h` header file or as a macro definition parameter in the compilation command.

The `rom_config.h` header file is one of the main files used to configure the ModRom system. It contains many of the specific configuration details of the low-level system. Below is an example of how you can redefine the bootstrap configuration of the system using the `BOOT_CONFIG` macro in the `rom_config.h` header file:

```
#define BOOT_CONFIG (B_OKRAM + B_OKROM + B_QUICKVAL)
```

Below is an alternate example showing the default definition as a compile switch in the compilation command in the makefile:

```
SPEC_COPTS = -dNEWINFO -dNOPARITYINIT -dBOOT_CONFIG=0x7
```

This redefinition of the `BOOT_CONFIG` macro results in a bootstrap method that accepts the RAM and ROM definitions without verification, and also validates modules solely on the correctness of their module headers.

## Runtime Configuration

The default bootstrap configuration can be overridden at runtime by changing the `rinf->os->boot_config` variable from either a low-level P2 module or from the `sysinit2()` function of the `sysinit.c` file. The runtime code can query jumper or other hardware settings to determine what user-defined bootstrap procedure should be used. An example P2 module is shown below.

### Note

If the override is performed in the `sysinit2()` function, the effect is not realized until after the low-level system memory searches have been performed. This means that any runtime override of the default settings pertaining to the memory search must be done from the code in the P2 module code.

```
#define NEWINFO
#include <rom.h>
#include <types.h>
#include <const.h>
#include <errno.h>
#include <romerrno.h>
#include <p2lib.h>

error_code p2start(Rominfo rinf, u_char *glbls)
{
    /* if switch or jumper setting is set… */
    if (switch_or_jumper == SET) {
        /* force checking of ROM and RAM lists */
        rinf->os->boot_config &= ~(B_OKROM+B_OKRAM);
    }
    return SUCCESS;
}
```

# OS-9 Vector Mappings

This section contains the vector mappings for the OS-9 GraphicsMaster implementation of the SA1110.

The ARM standard defines exceptions 0x0-0x8. The OS-9 system maps these one to one. External interrupts from vector 0x6 are expanded to the virtual vector rage shown below by the irq1100 module.

## Note

Vectors can be virtually remapped from a ROM at physical address 0, into DRAM at virtual address 0. This speeds up interrupt response time and is enabled by defining the first cache list entry as a sub 1MB size.

## For More Information

See the 1100/1110 hardware documentation for more information on individual sources.

**Table 2-1** and **Table 2-2** show the OS9 IRQ assignment for the target board.

**Table 2-1 IRQ Assignments and ARM Functions**

| OS9 IRQ # | ARM Function |
|---|---|
| 0x0 | Processor Reset |
| 0x1 | Undefined Instruction |
| 0x2 | Software Interrupt |
| 0x3 | Abort on Instruction Prefetch |
| 0x4 | Abort on Data Access |
| 0x5 | Unassigned/Reserved |
| 0x6 | External Interrupt |
| 0x7 | Fast Interrupt |
| 0x8 | Alignment error |

**Table 2-2 IRQ Assignments and processor Specific Functions**

| OS9 IRQ # | SA11X0 Specific Function (pic) |
|---|---|
| 0x40 | GPIO[0] Edge Detect (IRQ Input from the board’s PIC.) |
| 0x41 | GPIO[1] Edge Detect |
| 0x42 | GPIO[2] Edge Detect |

**Table 2-2 IRQ Assignments and processor Specific Functions**

| OS9 IRQ # | SA11X0 Specific Function (pic) |
|---|---|
| 0x43 | GPIO[3] Edge Detect |
| 0x44 | GPIO[4] Edge Detect |
| 0x45 | GPIO[5] Edge Detect |
| 0x46 | GPIO[6] Edge Detect |
| 0x47 | GPIO[7] Edge Detect |
| 0x48 | GPIO[8] Edge Detect |
| 0x49 | GPIO[9] Edge Detect |
| 0x4a | GPIO[10] Edge Detect |
| 0x4b | OR of GPIO edge detects 27 - 11 |
| 0x4c | LCD controller service request |
| 0x4d | UDC service request (0) |
| 0x4e | SDLC service request (1a) |
| 0x4f | UART service request (1b) (SP1) |
| 0x50 | UART/IrDA service request (SP2) |
| 0x51 | UART service request (3) (SP3) |
| 0x52 | MCP service request (4a) |
| 0x53 | SSP service request (4b) |

**Table 2-2 IRQ Assignments and processor Specific Functions**

| OS9 IRQ # | SA11X0 Specific Function (pic) |
|---|---|
| 0x54 | DMA controller channel 0 |
| 0x55 | DMA controller channel 1 |
| 0x56 | DMA controller channel 2 |
| 0x57 | DMA controller channel 3 |
| 0x58 | DMA controller channel 4 |
| 0x59 | DMA controller channel 5 |
| 0x5a | OS timer 0 |
| 0x5b | OS timer 1 |
| 0x5c | OS timer 2 |
| 0x5d | OS timer 3 |
| 0x5e | One Hz clock tick |
| 0x5f | RTC als alarm register |
| 0x60 | GPIO[11] Edge Detect (the vector 0x4b OR is broken out here to make each one distinct) |
| 0x61 | GPIO[12] Edge Detect |
| 0x62 | GPIO[13] Edge Detect |
| 0x63 | GPIO[14] Edge Detect |
| 0x64 | GPIO[15] Edge Detect |

**Table 2-2 IRQ Assignments and processor Specific Functions**

| OS9 IRQ # | SA11X0 Specific Function (pic) |
|---|---|
| 0x65 | GPIO[16] Edge Detect |
| 0x66 | GPIO[17] Edge Detect |
| 0x67 | GPIO[18] Edge Detect |
| 0x68 | GPIO[19] Edge Detect |
| 0x69 | GPIO[20] Edge Detect |
| 0x6a | GPIO[21] Edge Detect |
| 0x6b | GPIO[22] Edge Detect |
| 0x6c | GPIO[23] Edge Detect |
| 0x6d | GPIO[24] Edge Detect |
| 0x6e | GPIO[25] Edge Detect |
| 0x6f | GPIO[26] Edge Detect |
| 0x70 | GPIO[27] Edge Detect |

Table 2-3 shows the board's Pic functions.

**Table 2-3 Pic Functions**

| OS9 IRQ # | Function (Board Pic) |
|---|---|
| 0xb1 | RESERVED SA 1111 IRQ |
| 0xb2 | RESERVED UART A IRQ |

**Table 2-3 Pic Functions (continued)**

| OS9 IRQ # | Function (Board Pic) |
| --- | --- |
| 0xb3 | RESERVED UART B IRQ |
| 0xb4 | RESERVED UART C IRQ |
| 0xb5 | IRQ CAN1, (GraphicsMaster Plus version) |
| 0xb6 | RESERVED UART 4 IRQ |
| 0xb7 | RESERVED |
| 0xb8 | RESERVED |
| 0xb9 | UCB 1200 |
| 0xba | SMC 91C94 Ethernet |
| 0xbb | RESERVED |
| 0xbc | RESERVED |
| 0xbd | RESERVED |
| 0xbe | Board Switch |
| 0xbf | IRQ SSP |
| 0xc0 | IRQ BAT FAULT |

## Note

***Fast Interrupt Vector (0x7)***

The ARM4 defined fast interrupt (FIQ) mapped to vector 0x7 is handled differently by the OS-9 interrupt code and can not be used as freely as the external interrupt mapped to vector 0x6. To make fast interrupts as quick as possible for extremely time critical code, no context information is saved on exception and FIQs are never masked. This requires any exception handler to save and restore its necessary context if the FIQ mechanism is to be used. This requirement means that a FIQ handler's entry and exit points must be in assembly, as the C compiler will make assumptions about context. In addition, no system calls are possible unless a full C ABI context save has been done first. The OS-9 IRQ code for the SA11X0 has assigned all interrupts as normal external interrupts and the user must re-define a source as an FIQ to make use of this feature.

Table 2-4 shows the OS-9 SA1111 specific functions.

**Table 2-4 SA1111 Specific Functions**

| OS-9 IRQ # | SA1111 Specific Function |
|---|---|
| 0x71 | GPIOA[0] (GPIOA) |
| 0x72 | GPI0A[1] (GPIOA) |
| 0x73 | GPIOA[2] (GPIOA) |
| 0x74 | GPIOA[3] (GPIOA) |
| 0x75 | GPIOB[0] (GPIOB) |
| 0x76 | GPIOB[1] (GPIOB) |
| 0x77 | GPIOB[2] (GPIOB) |
| 0x78 | GPIOB[3] (GPIOB) |
| 0x79 | GPIOB[4] (GPIOB) |
| 0x7a | GPIOB[5] (GPIOB) |
| 0x7b | GPIOC[0] (GPIOC) |
| 0x7c | GPIOC[1] (GPIOC) |
| 0x7d | GPIOC[2] (GPIOC) |
| 0x7e | GPIOC[3] (GPIOC) |
| 0x7f | GPIOC[4] (GPIOC) |
| 0x80 | GPIOC[5] (GPIOC) |

Table 2-4 SA1111 Specific Functions (continued)

| OS-9 IRQ # | SA1111 Specific Function |
|---|---|
| 0x81 | GPIOC[6] (GPIOC) |
| 0x82 | GPIOC[7] (GPIOC) |
| 0x83 | MsTxint (PS2 Mouse) |
| 0x84 | MsRxint (PS2 Mouse) |
| 0x85 | MsStopErrint (PS2 Mouse) |
| 0x86 | TpxInt (PS2 Trackpad) |
| 0x87 | TpRxInt (PS2 Trackpad) |
| 0x88 | TpStopErrint (PS2 Trackpad) |
| 0x89 | SspXmitint (SSP) |
| 0x8a | SspRcvint (SSP) |
| 0x8b | SspROR (SSP) |
| 0x8c | reserved |
| 0x8d | reserved |
| 0x8e | reserved |
| 0x8f | reserved |
| 0x90 | reserved |
| 0x91 | AudXmtDmaDoneA (AUDIO) |

**Table 2-4 SA1111 Specific Functions (continued)**

| OS-9 IRQ # | SA1111 Specific Function |
|---|---|
| 0x92 | AudRcvDmaDoneA (AUDIO) |
| 0x93 | AudXmtDmaDoneB (AUDIO) |
| 0x94 | AudRcvDmaDoneB (AUDIO) |
| 0x95 | AudTFSR (AUDIO) |
| 0x96 | AudRFSR (AUDIO) |
| 0x97 | AudTUR (AUDIO) |
| 0x98 | AudROR (AUDIO) |
| 0x99 | AudDTS (AUDIO) |
| 0x9a | AudRDD (AUDIO) |
| 0x9b | AudSTO (AUDIO) |
| 0x9c | USBPwr (AUDIO) |
| 0x9d | nIrqHciM (USB) |
| 0x9e | IrqHciBuffAcc (USB) |
| 0x9f | IrqHciRmtWkp (USB) |
| 0xa0 | nHciMFClr (USB) |
| 0xa1 | USB port resume (USB) |
| 0xa2 | S0Readynint (PCMCIA) |

**Table 2-4 SA1111 Specific Functions (continued)**

| OS-9 IRQ # | SA1111 Specific Function |
|---|---|
| 0xa3 | S1Readynint (PCMCIA) |
| 0xa4 | S0CDValid (PCMCIA) |
| 0xa5 | S1CDValid (PCMCIA) |
| 0xa6 | S0_Bvd1Stschg (PCMCIA) |
| 0xa7 | S1_Bvd1Stschg (PCMCIA) |
| 0xa8 | reserved |
| 0xa9 | reserved |
| 0xaa | reserved |
| 0xab | reserved |
| 0xac | reserved |
| 0xad | reserved |
| 0xae | reserved |
| 0xaf | reserved |
| 0xb0 | reserved |

# GPIO Usage

**Table 2-5** shows GPIO usage of the target board in an OS-9 system.

## For More Information

See the ADS ***GraphicsMaster User's Manual*** for available alternate pin functions.

**Table 2-5 GPIO Usage of the Board**

| GPIO | Signal Name | Direct | Description |
|---|---|---|---|
| GPIO0 | `/IRQ` | Input | Falling edge interrupt from external peripheral |
| GPIO1 | `SWITCH` | Input | External signal to wake processor up during sleep mode. |
| GPIO2 | `GREEN3` | Output | LCD Green bit 3 in 16 bit color mode=20 |
| GPIO3 | `GREEN4` | Output | LCD Green bit 4 in 16 bit color mode |
| GPIO4 | `GREEN5` | Output | LCD Green bit 5 in 16 bit color mode |
| GPIO5 | `RED0` | Output | LCD Red bit 0 in 16 bit color mode |

Table 2-5 GPIO Usage of the Board (continued)

| GPIO | Signal Name | Direct | Description |
|---|---|---|---|
| GPIO6 | RED1 | Output | LCD Red bit 1 in 16 bit color mode |
| GPIO7 | RED2 | Output | LCD Red bit 2 in 16 bit color mode |
| GPIO8 | RED3 | Output | LCD Red bit 3 in 16 bit color mode |
| GPIO9 | RED4 | Output | LCD Red bit 4 in 16 bit color mode |
| GPIO10 | SSP_TXD | Output | SSP Port transmit |
| GPIO11 | SSP_RXD | Input | SSP Port Receive |
| GPIO12 | SSP_SCLK | Output | SSP Port Clock |
| GPIO13 | SSP_SFRM | Output | SSP Port Frame |
| GPIO14 | CTS1 | Input | CTS SA1100 uart 1 (not needed) |
| GPIO15 | RTS1 | Output | RTS SA1100 uart 1 (not needed) |
| GPIO16 | CTS2 | Input | CTS SA1100 uart 2 (not needed) |
| GPIO17 | RTS2 | Output | RTS SA1100 uart 2 (not needed) |
| GPIO18 | CTS3 | Input | CTS SA1100 uart 3 (not needed) |

**Table 2-5 GPIO Usage of the Board (continued)**

| GPIO | Signal Name | Direct | Description |
|---|---|---|---|
| GPIO19 | `RTS3` | Output | RTS SA11X0 uart 3 (not needed) |
| GPIO20 | `LED0` | Output | SMD LED D3 on board |
| GPIO21 | `MBGNT` | Output | SAIIII Memory Request Bus Grant |
| GPIO22 | `MBREQ` | Input | SAIIII Memory Bus Request |
| GPIO23 | `IRDA ON` | Output | 0 IRDA On, 1 IRDA Off |
| GPIO24 | `LED4/PNL_ENA` | In/Out | External GPIO on J7, P38, Panel Enable |
| GPIO25 | `LED1(Amber)` | Out | External GPIO on J7, P32 |
| GPIO26 | `LED2(Red)` | Out | External GPIO on J7, P34 |
| GPIO27 | `LED7` | Output | Clock Source for SAIIII |

## GPIO Interrupt Polarity

When GPIO's are used as interrupt sources, the _PIC_ENABLE() function will set default polarity to rising edge (GRER) along with enabling the interrupt at the SA11X0 PIC. If falling edge is required, software must assert the appropriate bit in the GFER and negate the corresponding bit in the GRER.

# Port Specific Utilities

The following port specific utilities are included:

- `pcmcia`
- `pflash`
- `touch_cal`
- `ucbtouch`

# pcmcia

## Syntax

```
pcmcia [<opts>]
```

## options

| | |
|---|---|
| `-s=` | socket: socket [default all sockets] |
| `-d` | de-iniz socket(s) |
| `-i` | iniz socket(s) |
| `-v` | verbose mode |
| `-x` | dump CIS/Config information |
| `-?` | Print this help message |

## Description

`pcmcia` provides the ability to initilize or deinitilize a PCMCIA card after the system has booted. It also displays a PCMCIA cards CIS structure.

## Example

```
$ pcmcia -x -s=0
ATA IDE disk found in socket0
Dump CIS Window for Socket #0
  Addr     0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F   0 2 4 6 8 A C E
--------  -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --  -----------------
28000000  01 03 d9 01 ff 1c 04 03 d9 01 ff 18 02 df 01 20   ...............
28000020  04 01 4e 00 01 15 2b 04 01 56 49 4b 49 4e 47 20  ..N...+..VIKING
28000040  43 4f 4d 50 4f 4e 45 4e 54 53 20 20 20 20 20 20  COMPONENTS
28000060  20 20 00 43 46 20 41 54 41 20 00 56 2e 31 30 32  .CF ATA .V.102
28000080  00 ff 21 02 04 01 22 02 01 01 22 03 02 04 5f 1a   ..!..."..."..._.
280000a0  05 01 03 00 02 0f 1b 09 c0 40 a1 21 55 55 08 00   .........@.!UU..
280000c0  22 1b 06 00 01 21 b5 1e 35 1b 0b c1 41 99 21 55   "....!..5...A.!U
280000e0  55 64 f0 ff ff 22 1b 06 01 01 21 b5 1e 35 1b 0d  Ud..."....!..5..
28000100  82 41 98 ea 61 f0 01 07 f6 03 01 ee 22 1b 06 02   .A..a......."...
28000120  01 21 b5 1e 35 1b 0d 83 41 98 ea 61 70 01 07 76   .!..5...A..ap..v
28000140  03 01 ee 22 1b 06 03 01 21 b5 1e 35 14 00 ff ff   ..."....!..5....
28000160  ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff   ................
28000180  ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff   ................
280001a0  ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff   ................
280001c0  ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff   ................
280001e0  ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff   ................
Dump Config Window for Socket #0
  Addr     0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F   0 2 4 6 8 A C E
--------  -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --  -----------------
28000200  43 00 02 00 00 00 00 00 00 00 00 00 00 00 00 00  C...............
28000220  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ...............
28000240  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
28000260  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
28000280  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
280002a0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
280002c0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
280002e0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
28000300  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
28000320  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
28000340  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
28000360  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
28000380  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
280003a0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
280003c0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
280003e0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
```

## `pflash` Program Strata Flash

### Syntax

```
pflash [options]
```

### Options

| | |
|---|---|
| `-f[=]filename` | input filename |
| `-eu` | erase used space only (default) |
| `-ew` | erase whole flash |
| `-ne` | don't erase flash |
| `-r` | program resident flash (default) |
| `-p0` | program PCMCIA slot 0 |
| `-p1` | program PCMCIA slot 1 |
| `-ncis` | don't emit cis for PCMCIA flash cards |
| `-b[=]addr` | specify base address of flash (hex) for part identification (replaces -r,-p0,-p1) |
| `-s[=]addr` | specify write/erase address of flash(hex) defaults to base address) |
| `-u` | leave flash unlocked |
| `-i` | print out information on flash |
| `-nv` | don't verify erase or write |
| `-q` | no progress indicator |

### Description

The pflash utility allows the programming of Intel Strata Flash parts. The primary use will be in the burning of the OS-9 ROM image into the on-board flash parts at U25/U26. This allows for booting using the lr/bo booters and allows for booting with out a PCMCIA card. The `pflash` utility also can be used to burn OS-9 ROM images into Intel Value Series PCMCIA cards, which internally use StrataFlash parts. This allows for booting using a PCMCIA slot and the f0 booter.

## Example

In this example an OS-9 ROM image was built and placed on an ATA PCMCIA card. After booting using the PCMCIA card, the image can be burned into the on-board Flash.

```
$ pflash -f=/mhc1/os9kboot
Unlocking Device
Erasing
Programming
Locking Device
$

<<< Reset the Board via SW1 >>>

OS-9 Bootstrap for the ARM (Edition 65)

ATA IDE disk found in socket 00
Now trying to Override autobooters.

Press the spacebar for a booter menu


BOOTING PROCEDURES AVAILABLE ---------- <INPUT>

Boot embedded OS-9 in-place ----------- <bo>
Copy embedded OS-9 to RAM and boot ---- <lr>
Boot from PCMCIA-0 IDE ---------------- <ide0>
Restart the System -------------------- <q>

Select a boot method from the above menu: lr

Now searching memory ($08000000 - $08ffffff) for an OS-9
Kernel...

An OS-9 kernel was found at $08000000
A valid OS-9 bootfile was found.
$
```

## `touch_cal` Touchscreen Calibration Program

### Syntax

```
touch_cal <options>
```

### Options

| | |
|---|---|
| `-f[=]<name>` | Output filename |
| `-c` | Only run calibration if output filename does not exist |
| `-m[=]<font_module>` | Use given UCM font module to display text |

### Description

The `touch_cal` utility will present a text message on the LCD screen as well as points for the user to press. After the points are pressed, the protocol module `mp_ucb1200` will be updated with the new calibration information.

### Example

```
$ touch_cal
Found touch screen device '/ucb_touch/mp_ucb1200'
```

## ucbtouch

### Syntax

```
ucbtouch &lt;&gt;
```

### Description

The ucbtouch utility prints the raw x,y and pressure values at a set sample rate.

Press the touch screen and observe the output on your console. The utility is helpful in determining whether your touch screen is connected properly.

### Example

```
$ ucbtouch
Touch[00000]: Touch=0x30c3 X1=00328 Y1=00321 P= 28 X=329 Y=322
Touch[00001]: Touch=0x30c3 X1=00329 Y1=00325 P= 28 X=330 Y=326
Touch[00002]: Touch=0x30c3 X1=00329 Y1=00321 P= 28 X=330 Y=322
Touch[00003]: Touch=0x30c3 X1=00329 Y1=00321 P= 29 X=330 Y=322
Touch[00004]: Touch=0x30c3 X1=00329 Y1=00319 P= 29 X=330 Y=320
Touch[00005]: Touch=0x30c3 X1=00329 Y1=00321 P= 28 X=330 Y=322
Touch[00006]: Touch=0x30c3 X1=00329 Y1=00327 P= 28 X=330 Y=328
Touch[00007]: Touch=0x30c3 X1=00329 Y1=00321 P= 28 X=330 Y=322
Touch[00008]: Touch=0x30c3 X1=00329 Y1=00321 P= 29 X=330 Y=322
Touch[00009]: Touch=0x30c3 X1=00329 Y1=00322 P= 28 X=330 Y=323
Touch[00010]: Touch=0x30c3 X1=00329 Y1=00319 P= 28 X=0 Y=0
Touch[00011]: Touch=0x30c3 X1=00328 Y1=00321 P= 28 X=-1 Y=2
Touch[00012]: Touch=0x30c3 X1=00329 Y1=00315 P= 28 X=0 Y=-4
Touch[00013]: Touch=0x30c3 X1=00329 Y1=00322 P= 29 X=0 Y=3
```

# Appendix A: Board-Specific Modules

This chapter describes the modules specifically written for the target board. It includes the following sections:

- **Low-Level System Modules**
- **High-Level System Modules**

# Low-Level System Modules

## For More Information

For a complete list of OS-9 modules common to all boards, see the ***OS-9 Device Descriptor and Configuration Module Reference*** manual.

The following low-level system modules are tailored specifically for the GraphicsMaster platform. The functionality of these modules can be altered through changes to the configuration data module (`cnfgdata`).

**Table A-1** provides a list and brief description of the modules.

These modules can be found in the following directory:

`MWOS/OS9000/ARMV4/PORTS/GRAPHICSMASTER/CMDS/BOOTOBJS/ROM`

**Table A-1 Board-Specific Low-Level System Modules**

| Module Name | Description |
|---|---|
| `cnfgdata` | Contains the low-level configuration data. |
| `cnfgfunc` | Provides access services to cnfgdata data. |
| `commcnfg` | Inits communication port defined in cnfgdata. |
| `conscnfg` | Inits console port defined in cnfgdata. |
| `ide` | IDE boot support module. PCMCIA compatible. |
| `io1100` | Provides polled serial driver support for the low-level system. |

**Table A-1 Board-Specific Low-Level System Modules (continued)**

| Module Name | Description |
|---|---|
| `llcis` | Inits the PCMCIA interface including cards. |
| `lle509` | Provides low-level ethernet services via 3COM PCMCIA card. |
| `ll91c94` | board specific ethernet module |
| `portmenu` | Inits booters defined in the cnfgdata. |
| `romcore` | Board specific initialization code. |
| `splash` | Provides way to init LCD screen with a compressed image. |
| `tmr1_1100` | Provides low-level timer services via time base register. |
| `usedebug` | Inits low-level debug interface to RomBug, SNDP, or none. |
| `dbinit` | initializes SAIIII |

The following low-level system modules provide generic services for OS-9 Modular ROM. Table A-2 provides a list and brief description of the modules.

These modules can be found in the following directory:

`MWOS/OS9000/ARMV4/CMDS/BOOTOBJS/ROM`

**Table A-2 Generic Services Low-Level System Modules**

| Module Name | Description |
|---|---|
| `bootsys` | Booter registration service module. |
| `console` | Provides console services. |
| `dbgentry` | Inits debugger entry point for system use. |
| `dbgserv` | Provides debugger services. |
| `excption` | Provides low-level exception services. |
| `flshcach` | Provides low-level cache management services. |
| `hlproto` | Provides user level code access to protoman. |
| `llbootp` | Booter which provides bootp services. |
| `llip` | Provides low-level IP services. |
| `llslip` | Provides low-level SLIP services. |
| `lltcp` | Provides low-level TCP services. |
| `lludp` | Provides low-level UDP services. |
| `notify` | Provides state change information for use with LL and HL drivers. |

**Table A-2 Generic Services Low-Level System Modules (continued)**

| Module Name | Description |
|---|---|
| `override` | Booter which allows choice between menu and auto booters. |
| `parser` | Provides argument parsing services. |
| `pcman` | Booter which reads MS-DOS file system. |
| `protoman` | Protocol management module. |
| `restart` | Booter which cause a soft reboot of system. |
| `romboot` | Booter which allows booting from ROM. |
| `rombreak` | Booter which calls the installed debugger. |
| `rombug` | Low-level system debugger. |
| `sndp` | Provides low-level system debug protocol. |
| `srecord` | Booter which accepts S-Records. |
| `swtimer` | Provides timer services via software loops. |

# High-Level System Modules

The following OS-9 system modules are tailored specifically for the GraphicsMaster boards and peripherals. Unless otherwise specified, each module is located in a file of the same name in the following directory:

`MWOS/OS9000/ARMV4/PORTS/GRAPHICSMASTER/CMDS/BOOTOBJS`

## CPU Support Modules

These files are located in the following directory:

`MWOS/OS9000/ARMV4/CMDS/BOOTOBJS`

| | |
|---|---|
| `kernel` | The kernel provides all basic services for the OS-9 system. |
| `cache` | Provides cache control for the CPU cache hardware. The cache module is in the file `cach1100`. |
| `fpu` | Provides software emulation for floating point instructions. |
| `ssm` | The System Security Module provides support for the Memory Management Unit (MMU) on the CPU. |
| `vectors` | Provides interrupt service entry and exit code. The vectors module is found in the file `vect110`. |

### System Configuration Module

These files are located in the following directory:

`MWOS/OS9000/ARMV4/PORTS/GRAPHICSMASTER/CMDS/BOOTOBJS/INITS`

| | |
|---|---|
| `init` | Descriptor module with high level system initialization information. |
| `nodisk` | Same as init, but used in a disk-less system. |

## Interrupt Controller Support

This module provides extensions to the vectors module by mapping the single interrupt generated by an interrupt controller into a range of pseudo vectors which are recognized by OS-9 as extensions to the base CPU exception vectors.

| | |
|---|---|
| `irq1100` | P2module that provides interrupt acknowledge and dispatching support for the SA1100 pic. |
| `irqtc` | P2module that provides interrupt acknowledge and dispatching support for the board pic (vector range 0xB1-0xC0). |
| `irq1111` | p2 module that provides interrupt acknowledge and dispatching support for the SAIIII pic (vector range 0x71-0xb0). |

## Real Time Clock

| | |
|---|---|
| `rtc1100` | Driver that provides OS-9 access to the SA1100 on-board real time clock. |

## Ticker

| | |
|---|---|
| `tk1100` | Driver that provides the system ticker based on the SA11X0 Operating System Timer. |

# Abort Handler

| | |
|---|---|
| `abort` | P2module which provides a way to enter the system-state debugger via the GPIO[0] interrupt triggered by the board's switch S1, 1. |

# Generic IO Support modules (File Managers)

These files are located in the following directory:

`MWOS/OS9000/ARMV4/CMDS/BOOTOBJS`

| | |
|---|---|
| `ioman` | Provides generic I/O support for all IO device types. |
| `scf` | Provides generic character device management functions. |
| `rbf` | Provides generic block device management functions for OS-9 specific format. |
| `pcf` | Provides generic block device management functions for MS-DOS FAT format. |
| `spf` | Provides generic protocol device management function support. |
| `mfm` | Provides generic graphics device support for MAUI. |
| `pipeman` | Provides a memory FIFO buffer for communication. |

# Pipe Descriptor

This file is located in the following directory:

`MWOS/OS9000/ARMV4/PORTS/GRAPHICSMASTER/CMDS/BOOTOBJS/DESC`

| | |
|---|---|
| `pipe` | Pipeman descriptor that provides a RAM based FIFO which can be used for process communication. |

# RAM Disk Support

| | |
|---|---|
| `ram` | RBF driver which provides a RAM based virtual block device. |

## Descriptors for Use with RAM

These files are located in the following directory:

`MWOS/OS9000/ARMV4/PORTS/GRAPHICSMASTER/CMDS/BOOTOBJS/DESC/RAM`

| | |
|---|---|
| `r0` | RBF descriptor which provides access to a ram disk. |
| `r0.dd` | Same as r0 except with module name dd (for use as the default device). |

# Serial and Console Devices

| | |
|---|---|
| sc1100 | SCF driver which provides serial support the SA11X0's SP1 and SP3 ports when configured as UARTS. |

## Descriptors for Use with sc1100

`term1/t1` Descriptor modules for use with sc11X0 and SP1.

| | |
|---|---|
| Board header: | J7 |
| Default Baud Rate: | 19200 |
| Default Parity: | None |
| Default Data Bits: | 8 |
| Default Handshake: | Software |

`term3/t3` Descriptor modules for use with sc11X0 and SP3.

| | |
|---|---|
| Board header: | J10 |
| Default Baud Rate: | 115200 |
| Default Parity: | None |
| Default Data Bits: | 8 |
| Default Handshake: | Software |

`term2/t2` Descriptor modules for use with sc11X0 and SP2

| | |
|---|---|
| Board header: | J7 |
| Default Baud Rate: | 115200 |
| Default Parity: | None |
| Default Data Bits: | 8 |
| Default Handshake: | Software |

`sc16550` SCF driver which provides serial supports a 16550 compatible modem card.

## Descriptors for use with sc16550

`t0m` Descriptor modules for use with the external PCMCIA card

sc16550

| | |
|---|---|
| Board header: | J11 PCMCIA slot |
| Default Baud Rate: | 9600 |
| Default Parity: | None |
| Default Data Bits: | 8 |
| Default Handshake: | Software |

## Descriptors for Use with scllio

`vcons/term` Descriptor modules for use with scllio in conjunction with a low-level serial driver. Port configuration and set up follows what is configured in cnfgdata for the console port.

It is possible for scllio to communicate with a true low-level serial device driver like io1100, or with an emulated serial interface provided by iovcons.

# PCMCIA Support for IDE Type Devices

`rb1003` RBF/PCF driver that provides driver support for IDE/EIDE devices. This driver is used to provide disk support for PCMCIA ATA FLASH.

### Descriptors for Use with rb1003

`hc1/hc1fmt` and `hc1.dd`

RBF Descriptor modules for use\
with PCMCIA slot #0

| | |
|---|---|
| Board header: | J11 |
| hc1fmt: | format enabled |
| hc1.dd: | module name of dd |

`mhc1/mhc1.dd`

PCF Descriptor modules for use with PCMCIA slot #0

| | |
|---|---|
| Board header: | J11 |
| mhc1.dd: | module name of dd |

## PCMCIA Support for 3COM Ethernet card

These files are located in the following directory:

`MWOS/OS9000/ARMV4/PORTS/GRAPHICSMASTER/CMDS/BOOTOBJS/SPF`

`spe509_pcm` SPF driver to support ethernet for a 3COM EtherLink III PCMCIA card.

### Descriptors for Use with spe509_pcm

`spe30` SPF descriptor module for use with PCMCIA slot #0 (J11)

### Network Configuration Modules

`inetdb/inetdb2/rpcdb`

# SMC91C94 Ethernet Support

These files are located in the following directory:

`MWOS/OS9000/ARMV4/PORTS/GRAPHICSMASTER/CMDS/BOOTOBJS/SPF`

| | |
|---|---|
| `sp91c94` | SPF driver to support ethernet for the SMC91C94 chip. |

## Descriptor for Use with sp91c94

| | |
|---|---|
| `spsm0` | SPF descriptor module for use with SMC91C94 at J8. |

## Network Configuration Modules

`inetdb/inetdb2/rpcdb`

# UCB1200 Support modules.

These files are located in the following directory:

`MWOS/OS9000/ARMV4/PORTS/GRAPHICSMASTER/CMDS/BOOTOBJS/SPF`

| | |
|---|---|
| `spucb1200` | SPF driver that supports the on-board Phillips UCB1200 chip. This device communicates to the SA11X0 over SP4 using MCP. The `spucb1200` will work with UCB1100, UCB1200, and UCB1300 devices. |

## Descriptors for Use with spucb1200

| | |
|---|---|
| `ucb` | SPF descriptor module that provides access to UCB1200. |
| `ucb_touch` | SPF descriptor module used with the touch screen. |

# Maui Graphical Support Modules

These files are located in the following directory:

`MWOS/OS9000/ARMV4/PORTS/GRAPHICSMASTER/CMDS/BOOTOBJS/MAUI`

| | |
|---|---|
| `gx_sa1100` | MFM MAUI driver module with support for the board's LCD panel. |

## Descriptors for Use with gx_sa1100

| | |
|---|---|
| `gfx` | MFM MAUI descriptor module for the board's LCD. |
| `sd_ucb 1200` | MFM MAUI driver module that provides PCM/mu-law sound support via the ucb1200. |

## Descriptors for Use with sd_ucb1200

| | |
|---|---|
| `snd` | MFM MAUI descriptor module for UCB1200 sound functions. |

## MAUI configuration modules

| | |
|---|---|
| `cdb` | MAUI configuration data base module. |
| `cdb_ptr` | Serial mouse configuration data base module. |
| `cdb_touch` | Touch screen configuration data base module. |

## MAUI protocol modules

| | |
|---|---|
| `mp_kybrd` | Keyboard protocol module |
| `mp_msptr` | Serial mouse protocol module. |
| `mp_ucb1200` | ucb1200 protocol module. |

## Using Alternate Display Devices

Drivers and descriptors can be created and used for the following alternate displays:

- GraphicsMaster 16-Bit Color LM12S49 Dual-scan LCD panel
- Sharp LM8V30/31 Dual Passive VGA(640x480) LCD panel
- Kyrocera kcb104VG2BA-A03 640x480 LCD panel
- 16-Bit Color LG Phillips LP104V2 LCD panel

**Note**

The modules and sources for these alternate displays are unsupported; they are merely provided as examples.

When using a display device other than the standard GraphicsMaster board, you must modify the `splash` module so that it corresponds with the high-level descriptor set in `maui.ml`. (The `splash` module is a low-level module that initializes screen display size.) To perform this task, complete the following steps:

Step 1. Open the `makefile` file in the following location:

```
<MWOS>/OS9000/ARMV4/PORTS/GRAPHICSMASTER/ROM/SPLASH
```

Step 2. Edit `makefile` so that the `MODULE` line of code corresponds to your LCD panel. Below is an example:

```
MODULE        =      splash_lp104v2
```

Step 3. From the `SPLASH` directory, run `os9make`.

Step 4. Open the `coreboot.ml` file in the following location:

```
<MWOS>/OS9000/ARMV4/GRAPHICSMASTER/BOOTS/INSTALL/PORTBOOT/
```

Step 5. Edit `coreboot.ml` by removing the asterisk from the name of your `splash` module and placing one in front of the following line:

```
../../../CMDS/BOOTOBJS/ROM/splash
```

Step 6. Open the `maui.ml` file in the following location:

`<MWOS>/OS9000/ARMV4/GRAPHICSMASTER/BOOTS/INSTALL/PORTBOOT`

Step 7. Edit `maui.ml` by removing the asterisk from the `gfx` module for your LCD and placing one in front of the following line:

`../../../CMDS/BOOTOBJS/MAUI/gfx`

Step 8. Use the Configuration Wizard to build a new ROM image.

# Appendix B: MAUI Driver Descriptions

This chapter provides MAUI driver descriptions. It includes the following sections:

- **GraphicsMaster Objects**
- **GX_SA1100 LCD Graphic Driver Specification**
- **SD_UCB1200 Sound Driver Specification**
- **SPUCB1200 driver for the UCB1200 Codec**
- **MP_UCB1200 MAUI Touch screen Protocol Module**

# GraphicsMaster Objects

This package provides object-level support for the Intel GraphicsMaster reference board. The port directory is at the following location:

`MWOS/OS9000/ARMV4/PORTS/GRAPHICSMASTER`

## MAUI objects

| | |
|---|---|
| `cdb` | Lists the devices on the system. |
| `mp_msptr` | Serial mouse protocol module. |
| `mp_ucb1200` | Touch screen protocol module for the UCB1200. |
| `gfx` and `gx_sa1100` | LCD graphics descriptor and driver. |

# GX_SA1100 LCD Graphic Driver Specification

This section describes the hardware specification of the StrongARM SA11X0 LCD driver (named gx_sa1100) and descriptor (named gfx). The hardware sub-type defines the board configuration. This specification should be used with the MAUI Graphics Device API.

## Board Ports

This driver is used in the following example board StrongArm ports.

The GraphicsMaster board uses a Sharp LQ64D341 18 bpp color (16 used), TFT, with a resolution of 640x480 single panel. This panel is connected to the GraphicsMaster with one of several possible cables:

- 8 bpp - most common to date
- RGB 565 - next most common
- RGB 655
- RGB 556

The SideArm board can support an LCD panel, but does not typically ship with one. For this reason the SideArm port does not build this driver. If the user did connect a LCD panel to this board, simply copy the makefiles from one of the other ports into the SideArm port.

# Device Capabilities

Information about the hardware capabilities is determined by calling `gfx_get_dev_cap()`. The hardware sub-type defines the board configuration. This function returns a data structure formatted as shown in **Table B-1**. See `GFX_DEV_CAP` for more information about this data structure.

**Table B-1 gfx_get_dev_cap() Data Structure**

| Member Name | Description | Value |
|---|---|---|
| `hw_type` | Hardware type (embedded in driver) | SA1100 LCD Controller |
| `hw_subtype` | Hardware subtype (embedded in descriptor) | GraphicsMaster 8 bit color LCD, or GraphicsMaster 16 bit color LCD |
| `sup_vpmix` | Supports viewport mixing | FALSE |
| `sup_extvid` | Supports external video as a backup | FALSE |
| `sup_bkcol` | Supports background color | FALSE |
| `sup_vptrans` | Supports viewport transparency | FALSE |
| `sup_vpinten` | Supports viewport intensity | FALSE |
| `sup_sync` | Supports retrace synchronization | FALSE |

**Table B-1 gfx_get_dev_cap() Data Structure (continued)**

| Member Name | Description | Value |
|---|---|---|
| `num_res` | Number of display resolutions | 1 |
| `res_info` | Array of display resolution information | See Display Resolution table |
| `dac_depth` | Depth of the DAC in bits | 12 |
| `num_cm` | Number of coding methods | 1 |
| `cm_info` | Array of coding method information | See Coding Methods table |
| `sup_viddecode` | Supports video decoding into a drawmap | FALSE |

# Display Resolution

The display resolution is configured by the descriptor and can be changed to support LCD panels of different sizes. The driver is only designed to support one resolution at a time. That resolution is specified by the descriptor. Modify the `DEFAULT_RES` macro in `mfm_desc.h` to change the resolution. If you change the resolution, you must also change all of the LCD timing fields as well.

**Table B-2 Display Specifications**

| Board | Width | Height | Refresh Rate | Interlace Mode | Aspect Ratio X:Y |
|---|---|---|---|---|---|
| Graphics-Client | 640 | 480 | 0* | `GFX_INTL_OFF` | 1:1 |

*Refresh rate is determined by timing specified in descriptor. The devcap is not automatically update to reflect this.

# Coding Methods

The coding method is also configured by the descriptor and can be changed to support b/w and color LCD panels. The coding method can be selected in the descriptor by simply specifying the coding method in the `DEFAULT_CM` macro in `mfm_desc.h`.

This driver was verified on the GraphicsMaster with both a 8-bit and 565 cables. The maximal coding method supported by SA11X0 LCD Controller is 16 bpp.

**Table B-3 Coding Method Description**

| Board | Coding Method | CLUT Based | X,Y Multipliers | Palette Color Types |
|---|---|---|---|---|
| Graphics-Master w/8 bit cable | `GFX_CM_8BIT` | TRUE | 1,1 | GFX_COLOR_RGB |
| Graphics-Master w/16 bit cable | `GFX_CM_565`, `GFX_CM_655`, or `GFX_CM_556` | FALSE | 1,1 | NA |
| No current hardware implementati on available | `GFX_CM_4BIT` | TRUE | 1,1 | GFX_COLOR_RGB |

# Viewport Complexity

The driver supports one active viewport at a time. The application can create multiple viewports and stack them. The viewport must be aligned with, and the same size as the display. Display drawmaps must be the same size as the viewport.

# Memory

Applications are expected to request graphics memory from the driver. The driver allocates memory from the system as needed. It requests this memory from color 0x80. This memory (specified in the init module) is located at the bottom of 16 MB DRAM address space and is marked as non cached.

# Location

This driver's source is located in:

`SRC/DPIO/MFM/DRVR/GX_SA1100`

This driver's makefiles are located in:

`OS9000/ARMV4/PORTS/GRAPHICSMASTER/MAUI/GX_SA1100`

This directory contains the makefiles and descriptor header file to build the descriptor(s) and driver(s) (not all packages include driver source) for the StrongARM reference platform. This directory contains:

| | |
|---|---|
| `makefile` | Calls each of the other makefiles in this directory |
| `drvr.mak` | Builds the driver |
| `desc.mak` | Builds the descriptor(s) |
| `mfm_desc.h` | Defines values for all modifiable fields of the descriptor(s) |

## Build the Driver

The driver source is located in `SRC/DPIO/MFM/DRVR/GX_SA1100`. To build the driver, use the following commands:

```
cd OS9000/ARMV4/PORTS/GRAPHICSMASTER/MAUI/GX_SA1100
os9make -f drvr.mak
```

## Build the Descriptor

To build a new descriptor, modify `mfm_desc.h`, and use the following commands to compile:

```
cd OS9000/ARMV4/PORTS/GRAPHICSMASTER/MAUI/GX_SA1100
```

```
os9make -f desc.mak
```

To build both the driver and the descriptor you can specify `os9make` with no parameters.

# SD_UCB1200 Sound Driver Specification

This section describes the hardware specifications for the Philips UCB1200 driver sd_ucb1200. The hardware sub-type defines the board configuration. This specification should be used in conjunction with the MAUI Sound Driver Interface.

This driver works in conjunction with the spucb1200 driver.

## Device Capabilities

Information about the hardware capabilities is determined by calling _os_gs_snd_devcap(). This function returns a data structure formatted as in the following table. See SND_DEV_CAP for more information about this data structure.

**Table B-4 Data Returned in SND_DEV_CAP**

| Member Name | Value | Description |
|---|---|---|
| hw_type | CS4231 | Hardware type |
| hw_subtype | CS4231A | Hardware sub-type |
| sup_triggers | SND_TRIG_ANY | Supported triggers |
| play_lines | SND_LINE_SPEAKER | Play gain/mix lines |
| record_lines | SND_LINE_MIC | Record gain/mix lines |
| sup_gain_cmds | SND_GAIN_CMD_MONO | Mask of supported gain commands |
| num_gain_caps | 2 | Number of SND_GAIN_CAPs |

**Table B-4 Data Returned in SND_DEV_CAP (continued)**

| Member Name | Value | Description |
|---|---|---|
| `gain_caps` | See Gain Capabilities Array | Pointer to `SND_GAIN_CAP` array |
| `num_rates` | 30 | Number of sample rates |
| `sample_rates` | See Sample Rates | Pointer to sample rate array |
| `num_chan_info` | 1 | Number of channel info entries |
| `channel_info` | See Number of Channels | Pointer to channel info array |
| `num_cm` | 3 | Number of coding methods |
| `cm_info` | See Encoding and Decoding Formats | Pointer to coding method array |

# Gain Capabilities Array

The following tables show the various gain capabilities for the Philips UCB1200. This information is pointed to by the gain_cap member of the SND_DEV_CAP data structure. See SND_GAIN_CAP for more information about this data structure. This driver allows control of following individual physical gain controls:

### Table B-5 Individual Gain Controls

| | |
|---|---|
| SND LINE SPEAKER | Output Attenuation |
| SND LINE MIC | Microphone Gain |

The following tables detail the various individual gain capabilities:

### Table B-6 Speaker Gain Enable

| Member Name | Value | Step | HW | Level | Comments |
|---|---|---|---|---|---|
| lines | SND_LINE_SPEAKER | 0-3 | 31 | -69 dB | default_level |
| sup_mute | TRUE | 4-7 | 30 | -66.8 dB | |
| default_type | SND_GAIN_CMD_MONO | 8-11 | 29 | -64.7 dB | |
| default_level | SND_LEVEL_MAX | 12-15 | 28 | -62.5 dB | |
| zero_level | SND_LEVEL_MIN | ... | ... | ... | |
| num_steps | 32 | 112-115 | 3 | -6.5 dB | |
| step_size | 216 | 116-119 | 2 | -4.3 dB | |
| mindb | -6900 | 120-123 | 1 | -2.2 dB | |
| maxdb | 0 | 124-127 | 0 | 0.0 dB | zero_level |

## Table B-7 Mic Gain Enable

| Member Name | Value | Step | HW | Level | Comments |
|---|---|---|---|---|---|
| lines | SND_LINE_MIC | 0-3 | 0 | 0 dB | zero_level |
| sup_mute | FALSE | 4-7 | 1 | 0.7 dB | |
| default_type | SND_GAIN_CMD_MONO | ... | ... | ... | ... |
| default_level | SND_LEVEL_MAX | 64-67 | 16 | 11.3 dB | default_leve l |
| zero_level | SND_LEVEL_MIN | ... | ... | ... | ... |
| num_steps | 32 | 112-115 | | 20.4 dB | |
| step_size | 70 | 116-119 | 29 | 21.1 dB | |
| mindb | 0 | 120-123 | 30 | 21.8 dB | |
| maxdb | 2250 | 124-127 | 31 | 22.5 dB | |

## Sample Rates

Following is an abbreviated list of the supported sample rates for the UCB1200. Below is a formula to derive valid sample rates:

sample_rate = 11981000/(32 * i), where 8 < i < 128

This information is pointed to by the `sample_rates` member of the `SND_DEV_CAP` data structure.

**Table B-8 Sample Rate (Hz)**

| | | | | |
|---|---|---|---|---|
| 2948 | 3941 | 4926 | 5942 | 6933 |
| 7966 | 8914 | 9852 | 10697 | 11700 |
| 12910 | 13866 | 14976 | 15600 | 17828 |
| 18720 | 19705 | 20800 | 22023 | 23400 |
| 24960 | 26743 | 28800 | 31200 | 34036 |
| 37440 | 41600 | 46801 | 53486 | 62401 |

## Number of Channels

The following table shows the different supported number of channels for the Philips UCB1200. The first entry in the table is the default number of channels. This information is pointed to by the `channel_info` member of the `SND_DEV_CAP` data structure.

**Table B-9 Number of Channels**

| Channels | Description |
|---|---|
| 1 | Mono |

# Encoding and Decoding Formats

The following table shows the supported encoding and decoding formats for the Philips UCB1200. The first entry in the table is the default format. This information is pointed to by the `cm_info` member of the `SND_DEV_CAP` data structure.

**Table B-10 Encoding and Decoding Formats**

| Coding Method | Sample Size | Boundary Size | Description |
|---|---|---|---|
| `SND_CM_PCM_ULAW` | 8 | 2 | 8 bit u-Law commanded |
| `SND_CM_PCM_SLINEAR` `SND_CM_LSBYTE1ST` | 16 | 4 | 16 bit Linear (two's complement) little- endian |
| `SND_CM_PCM_SLINEAR` | 16 | 4 | 16 bit Linear signed (two's complement) big-endian |

# SPUCB1200 driver for the UCB1200 Codec

This document describes the hardware specifications for the Philips UCB1200 driver. This is an SPF driver and works with the UCB1100, UCB1200, and UCB1300.

## Capabilities

The UCB1200 is capable of controlling a microphone/speaker, input/output telecommunications lines, resistive style touch screen, and 16 General Purpose Input/Output lines. This driver currently can only control the touch screen, and general purpose input/output lines. The microphone/speaker can be controlled with a MAUI Sound driver called `sd_ucb1200`. No driver has been written for the telecommunications part of the UCB1200.

## Descriptors

Table B-11 lists the UCB1200 descriptors.

**Table B-11**

| Name | Function |
|---|---|
| `ucb` | UCB1200 Chip Initialization |
| `ucb_audio` | Not Implemented |
| `ucb_touch` | Touch Screen |
| `ucb_gpio` | Control GPIO Lines |
| `ucb_telecom` | Not Implemented |

# UCB

Opening the /ucb device will perform basic chip initialization. Normally this is not necessary, unless another driver is written to control part of the UCB1200 functions. This is the case for audio. The MAUI Sound driver `sd_ucb1200` will open /ucb to perform chip initialization. In this way, the MAUI Sound driver play audio and this driver can control the touch screen at the same time.

# Audio

This portion of the driver is not implemented since the MAUI Sound driver `sd_ucb1200` already exists. `sd_ucb1200` and this driver can co-exist.

# Touch Screen

This portion of the driver controls the touch screen operation. When pressure is applied to the touch screen, a hardware interrupt is raised, and this driver's interrupt service routine will execute. A system state alarm, then, will fire at regular intervals to sample data from the touch screen. When pressure is removed, the alarm stops. This mechanism leaves the UCB1200 in a low power state until the user presses the touch screen. The alarm rate can be controlled in the `ucb_touch` descriptor.

Each sample contains an x, y coordinate as well as pressure information. The data is formatted into a six byte packet as defined in the table below. Each packet contains 10 bits of x, 10 bits of y, and 8 bits of pressure information.

**Table B-12 Touch Screen Descriptor Data**

| Byte number | Description |
|---|---|
| 0 | sync code - 0x80 |
| 1 | header:<br>bit 1: pendown<br>bit 2: penup<br>bit 3: penmove (may occur with pendown or penup) |
| 2 | bits 0..2: high 3 bits of x<br>bits 3..6: high 4 bits of pressure<br>bit 7: 0 |
| 3 | bits 0..6: low 7 bits of x<br>bit 7: 0 |

**Table B-12 Touch Screen Descriptor Data**

| Byte number | Description |
|---|---|
| 4 | bits 0..2: high 3 bits of y<br>bits 3..6: low 4 bits of pressure |
| 5 | bits 0..6: low bits of y<br>bit 7: 0 |

# GPIO

This section of the driver has basic GPIO line control, where lines 0..9 are connected to a 7 segment display or LED. Each line can be controlled with an `_os_write()` call. (Refer to the UCBHEX program in the TEST directory.)

# Telecom

This portion of the driver is not implemented.

# Supporting Modules

Before this driver can be used, the following modules must be in memory: `spf`, `sysmbuf`, `mbinstall`. `mbinstall` must also be run before use.

# MP_UCB1200 MAUI Touch screen Protocol Module

This document describes the function of the `mp_ucb1200` protocol module, as well as a high level discussion of the touch screen driver and calibration application.

## Overview

The protocol module converts the driver raw data into a `MAUI_MSG` structure. In this way, applications can remain somewhat ignorant of the details of the hardware since it deals with the MAUI Input layer. In this protocol module, the raw hardware data is converted into screen coordinates. In addition, some data filtering occurs to reduce the amount of erroneous data that the touch screen hardware can produce.

## Data Format

The touch screen driver sends a 6 byte packet that contains x, y, and pressure information. The exact format of this packet is described in the spucb1200 driver.

## Data Filter

This protocol module filters the data coming from the hardware in an attempt to reduce erroneous data. Two methods are implemented: data point averaging and low pressure point removal. The first method will average the last two points received from the driver. The data point will lag slightly behind the current position, then, but the average will reduce erroneous data points produced by the hardware. The second method throw out data points where the pressure below a certain threshold. It seems that extremely light touches will cause the data to become erratic, although the exact pressure threshold is hardware dependent.

## Raw Mode

An application can put this protocol module in a "raw" mode where data points are not filtered, averaged, or converted to screen coordinates. That is, the data from the hardware is passed directly up to the application.

The application can put this protocol module in a "raw" mode by calling: `inp_set_sim_meth(inpdev,RAW_MODE)`. After calibration, the program will need to put the protocol module back in NATIVE mode by calling: `inp_set_sim_meth(inpdev,DEFAULT_SIM_METH)`. There is a sample touch screen Calibration Application in the `TOUCH_CAL` directory.

When the protocol module is taken out of "raw" mode, it will try to read new calibration data points from the ucb1200.dat data module. After the data is read from the module, it is no longer needed.

## cdb.touch

The touch screen can be registered with MAUI by loading the `cdb.touch` module in memory before any programs using input are started. This will specify the spucb1200 as the driver, `cdb.touch` as the descriptor, and `mp_ucb1200` as the protocol module.

# Compile Time Options

Table B-13 shows compile time options used to control the default calibration settings and also the screen size. These options can be specified with a value in the `mp_ucb1200` makefile to modify the defaults.

### Table B-13 Compile Time Options

| Name | Purpose |
|---|---|
| SCREEN_WIDTH | Screen Width in Pixels |
| SCREEN_HEIGHT | Screen Weight in Pixels |
| DEFAULT_CALIBRATION_X | Left Calibration Hardware Point |
| DEFAULT_CALIBRATION_Y | Top Calibration Hardware Point |
| DEFAULT_CALIBRATION_WIDTH | Width of Screen In Hardware Points |
| DEFAULT_CALIBRATION_HEIGHT | Height of Screen In Hardware Points |
| JITTER_THRESHOLD | Minimum Pixel Change Required Before Points are Reported to the Application. |
| NUM_PTS | This allows you to choose how many successive data points to average in order to produce less erroneous screen coordinate data to the application. The default is 2, and valid choices are 1, 2, 4, 8, 16. |
| MIN_PRESSURE | Any pressure point less than this value will be ignored. This is another way to reduce erroneous data. This represents the 8 bit pressure value we get from the driver. The default is 40. |

# Calibration Application

There is a sample calibration application located in the `$(MWOS)/SRC/MAUI/MP/MP_UCB1200/TOUCH_CAL` directory. This application, called `touch_cal`, will present a text message on the screen as well as points for the user to press. After the points are pressed, the protocol module `mp_ucb1200` will be updated with the new calibration information.

## Assumptions/Dependencies

1. A Window Manager must be running before this application will operate.
2. A font module must be present to run the demo. `default.fnt` is the default module, or you can specify one on the command line.
3. `touch_cal` will open the first `CDB_TYPE_REMOTE` device in the cdb.

## Command Line Options

| | |
|---|---|
| `-f[=]<outfile>` | Specifies the filename of the calibration information module. This program will write the calibration information to this filename if it is specified. The file contains the calibration information as a data module, thus allowing the information to be stored on disk, nv RAM, flash, etc. for use the next time the hardware is rebooted. |
| `-c` | This option only works if `-f` is specified. This will cause the calibration program to run only if the filename specified with `-f` is not present. |
| `-m=<font module>` | Specifies the font module to use for displaying the text message on the screen. |

## Coordination with Protocol Module

The protocol module `mp_ucb1200` and the touch screen application `touch_cal` work together to provide the calibration functionality. `touch_cal` must first open the touch screen device, and then must set it into Raw Mode. After the user selects each calibration point, `touch_cal` computes the average of them. These averaged hardware points (as well as the screen resolution) are then stored in a data module called `ucb1200.dat`. When the input device is taken out of Raw Mode, the protocol module will link to `ucb1200.dat` and update itself with the new calibration information.

## Compiling

The makefile for touch_cal exists in the following directory:

`$(PORTS)/GRAPHICSMASTER/MAUI/MP_UCB1200/TOUCH_CAL`