Developer Note

Workgroup Server 9150

June 1995

About This Developer Note

This developer note describes the differences between Workgroup Server 9150 systems (the Workgroup Server 9150/80, introduced in April 1994, and the Workgroup Server 9150/120, introduced in April 1995) and Power Macintosh 8100 series computers. Use this note in conjunction with the following documents, which provide general information about the Power Macintosh computers:

- *Macintosh Developer Note Number 8*
- *Developer Note: Enhanced Power Macintosh Computers*
- *Developer Note: Power Macintosh 8100/110 Computer*

This note is intended for professional hardware and software engineers who are familiar with Macintosh technology, including NuBus™ and the Apple RISC technology based on the PowerPC™ microprocessor. For a list of recommended reading materials about Macintosh technology, see "Supplementary Documents" in *Macintosh Developer Note Number 8.*

This note uses the same typographical conventions and abbreviations used in *Macintosh Developer Note Number 8.*

Machine Identification

Workgroup Server 9150 systems have a unique CPU identification that is different from the CPU identification for Power Macintosh 8100 series computers. By using the Gestalt Manager with the identifier `gestaltMachineType`, an application or expansion card firmware can determine the model type of the user's system. Power Macintosh computers also set the 3 low bits of the 32-bit register at address $5FFF FFFC to a machine identification code. Table 1 lists the gestalt and register values that identify the Workgroup Server 9150 systems.

Table 1   CPU identification

Model	Gestalt value	Register value
Workgroup Server 9150/80	$27	100
Workgroup Server 9150/120	$39	100

Clock Speeds

To optimize performance, the 601 CPU clock frequency is an integer multiple of the system bus clock frequency in the Power Macintosh architecture. The frequencies of these clocks for Power Macintosh 8100 series computers and Workgroup Server 8150 and 9150 systems are listed in Table 2.

Table 2   CPU clock speeds

System	CPU clock frequency (MHz)	System bus clock frequency (MHz)
Power Macintosh 8100/80	80	40
Workgroup Server 8150/80	80	40
Power Macintosh 8100/100*	100	33.333
Power Macintosh 8100/110	110	36.667
Workgroup Server 8150/110	110	36.667
Workgroup Server 9150/80	80	40
Workgroup Server 9150/120	120	40

* No Workgroup Server counterpart.

Level 2 Cache

A 512 KB and a 1 MB Level 2 cache are available for Workgroup Server 8150 and 9150 systems that are not available for the Power Macintosh 8100 series computers. Since the cache controller is contained within the high-speed memory controller (HMC), the 512 KB and the 1 MB cache designs are an extension of the 256 KB Level 2 cache design used in Power Macintosh 8100 series computers.

The 512 KB and 1 MB cache SIMMs identify themselves to the memory controller through the cache size bits 0 and 1. Table 3 shows the cache mapping.

Table 3   Level 2 cache mapping

Cache size bit 1	Cache size bit 0	SIMM size
1	1	512 KB
1	0	256 KB
0	1	1 MB
0	0	No L2 cache

NuBus Support

The BART NuBus controller chip provides the data bridge between NuBus and the CPU bus and can act as a bus master. It is compliant with the IEEE Standard 1196 listed in "Supplementary Documents" in *Macintosh Developer Note Number 8*. For further information about NuBus in Power Macintosh computers, see "NuBus Interface" in Chapter 4 of *Macintosh Developer Note Number 8*, and *Macintosh Hardware Technical Notes*. The NuBus controller versions for Power Macintosh 8100 series computers and Workgroup Server 8150 and 9150 systems are listed in Table 4.

Table 4   NuBus controller versions

System version	NuBus controller
Power Macintosh 8100/80	BART 4
Workgroup Server 8150/80	BART 4
Power Macintosh 8100/100	BART 21
Power Macintosh 8100/110	BART 21
Workgroup Server 8150/110	BART 21
Workgroup Server 9150/80	BART 4
Workgroup Server 9150/120	BART 21

The BART 21 NuBus controller chip has replaced the BART 4 NuBus controller chip on the Workgroup Server 9150/120 and the Workgroup Server 8150/110 main circuit board. BART 21 provides improved compatibility with NuBus cards and some isolated performance improvements:

NuBus expansion chassis   The BART 21 controller supports use of a NuBus expansion chassis, which makes it possible to expand the number of NuBus slots beyond the number of internal NuBus slots on the machine.

Bursting on a per-slot basis   The BART 21 controller supports bursting on a per-slot basis. Most older NuBus cards are not capable of bursting. With the BART 4 controller, if a total of three NuBus cards were installed in a Power Macintosh and two of these cards were capable of bursting but one was not, bursting would not be possible on any of the cards, since the BART 4 controller does not support bursting on a per-slot basis. However, with the BART 21 controller, bursting would be possible on any card that was capable of bursting, regardless of the bursting capabilities of the other cards installed.

Clock input   To perform NuBus master burst reads, the BART 4 controller requires a clock input that is synchronous with the system clock. The BART 21 controller does not have this restriction.

Table 5 summarizes usage and feature differences between BART 4 and BART 21 controllers.

Table 5   Differences between BART 4 and BART 21 controllers

Power Macintosh configurations	BART 4	BART 21	NuBus master burst reads	Bursting enabled per slot	Allows NuBus slot expansion
Power Macintosh 8100/80	•		Yes	No	No
Power Macintosh 8100/100		•	Yes	Yes	Yes
Power Macintosh 8100/110		•	Yes	Yes	Yes
Workgroup Server 8150/80	•		Yes	No	No
Workgroup Server 9150/80	•		Yes	No	No
Workgroup Server 8150/110		•	Yes	Yes	Yes
Workgroup Server 9150/120		•	Yes	Yes	Yes

Note: You can determine the BART controller version number by reading the BART chip's 4-byte ID register. Follows these steps:

1. Press the Programmer Interrupt switch to bring up the Debug window.

2. Type `dm f0000008`
    The register will display `4318 4001` for a BART 4 controller, or `4318 4003` for a BART 21 controller.

Interrupt Handling

Traditional Macintosh software is designed for the seven-level interrupt structure of the Motorola MC68000 family of processors. The PowerPC™ 601 processor, however, has only a single interrupt line and service routine. The AMIC chip resolves this difference by emulating the MC68000 interrupt structure and accepting interrupts through the traditional VIA channels.

The process of handling VIA1 and VIA2 interrupts in the Workgroup Server 9150/80 and 9150/120 is diagrammed in Figure 1. This diagram is very similar to the corresponding diagram for Power Macintosh 8100 series computers; however, note the addition of "SLT4 ENA" and "SLT5 ENA." This difference occurs because Power Macintosh 8100 series computers have three NuBus slots, whereas Workgroup Server 9150 systems have four NuBus slots. The fourth slot uses slot address $A. In order to accommodate another interrupt line for this new slot, the I/O controller (AMIC) used in 8100 series computers has been modified for Workgroup Server 9150 systems. The new controller is named *FAT AMIC* and uses the same address map as the original AMIC controller.

There are slight differences between the FAT AMIC controllers for the Workgroup Server 9150/80 (FAT AMIC-1) and the 9150/120 (FAT AMIC-2). The FAT AMIC-2 controller changes affect the timing of some SCSI DMA handshake signals. Although SCSI performance remains the same, the changes result in better SCSI compatibility.
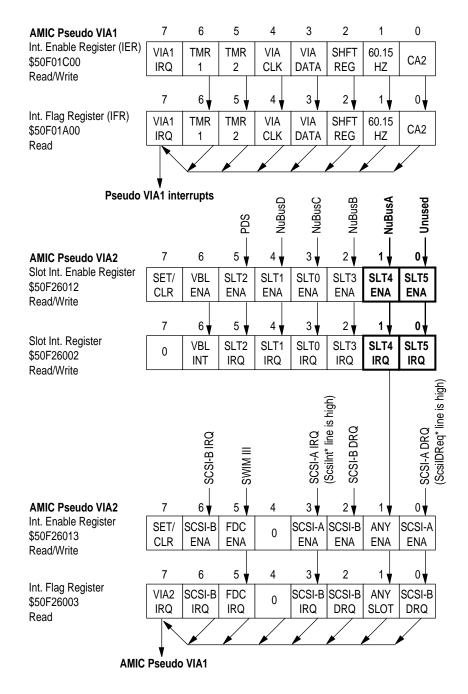
You can determine which version of the FAT AMIC controller is installed in your Workgroup Server by reading FAT AMIC registers. Use the debugger (MacsBug) to display the data bytes at address $50f32008 and $50f32009 (SCSI A/B DMA control registers). From MacsBug, enter

```
'db 50f32008' (return)
'db 50f32009' (return)
```

If bit 5 of the returned data is 0 in each of these bytes, then the FAT AMIC-1 controller is installed. If bit 5 is 1 in each byte, then the FAT AMIC-2 controller is installed.

For further information about interrupt handling through the VIA channels, see *Inside Macintosh: Processes*.

Figure 1 Emulated interrupt handling

DAV Interface

The information in the section "DAV Interface" in Chapter 4, "Expansion Capabilities," of *Macintosh Developer Note Number 8* does not apply to the Workgroup Server 9150. DAV interface operation has not been verified with Workgroup Server 9150 systems.

AudioVision Monitor Support

The information in the section "AudioVision Monitor Support" in Chapter 3, "Input and Output Interfaces," of *Macintosh Developer Note Number 8* does not apply to Workgroup Server 9150 systems. The AudioVision HDI–45 monitor connector is not implemented on Workgroup Server 9150 systems. The HDI–45 connector has been replaced with the standard DB–15 video monitor connector on the Workgroup Server 9150 main circuit board.
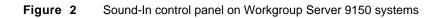
Apple Technical Note 326 provides complete information about connecting various monitors to Macintosh computers, including Power Macintosh models. This information includes details of ID codes assigned to Apple and some third-party monitors, plus hard-wire connections that let monitors assert their ID codes and therefore support automatic system configuration during startup. *Apple Technical Note 144* contains additional information about color monitors. *Technical Note 326* and *Technical Note 144* are both described in "Supplementary Documents" in *Macintosh Developer Note Number 8*.
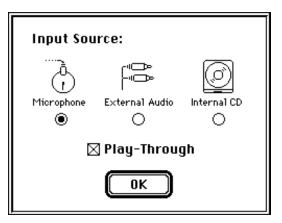
Sound-In Microphone

Unlike Power Macintosh 8100 series computers, Workgroup Server 9150 systems do not support speech recognition. Since the Workgroup Server 9150 logic board sound-in miniplug receptacle does not provide power, the Workgroup Server 9150 sound-in channel cannot accommodate the PlainTalk microphone, which is required for speech recognition. The older-style disc microphone that was used with the Macintosh Quadra 900 and Quadra 950 computers should be used with Workgroup Server 9150 systems. Although Workgroup Server administrators can attempt speech recognition with these older, monaural disc microphones, the recognition success rate will be very low (or nonexistent) since the disc microphones have an almost flat frequency response and no directivity.

Note: The microphone receptacle needed to support speech recognition is too tall to fit on the Workgroup Server 9150 logic board without modifications to the enclosure. Such modification would have violated the goal of offering a "logic-board-only" upgrade path for Macintosh Quadra 900 and Quadra 950 computers.

Because of the change in microphone support, the microphone icon in the Sound-In control panel on Workgroup Server 9150 systems (shown in Figure 2) is different from the one that appears in this control panel on Power Macintosh 8100 series computers.

Figure 2   Sound-In control panel on Workgroup Server 9150 systems

Sound-In RCA Line Level

Workgroup Server 9150 systems offer an additional sound input path that is not available on Power Macintosh 8100 series computers. Workgroup Server 9150 systems provide line-level input ports (right and left) for stereo sound input through phono (RCA-type) connectors. This feature is similar to the sound input path for Macintosh Quadra 900 and Quadra 950 computers. The Sound-In control panel for Workgroup Server 9150 systems differs from that of Power Macintosh 8100 series computers; as shown in Figure 2 in the preceding section, on Workgroup Server 9150 systems, the External Audio option replaces the External AV Connector option that appears in the Sound-In control panel on Power Macintosh 8100 series computers.

Power Supply

The power supply used with Workgroup Server 9150 systems is different from that used in Power Macintosh 8100 series computers. Workgroup Server 9150 systems use the same power supply used in Macintosh Quadra 900, Macintosh Quadra 950, and Apple Workgroup Server 95 systems. Table 6 shows the specifications for this power supply.

Table 6   Workgroup Server 9150 power-supply DC outputs

Load	+5V	+5V TRICKLE	+12V	−12V	Total power
Minimum Load	5.0 A	1 mA	150 mA	50 mA	27.5 W
Maximum Load	33.0 A	1.25 A	10.0 A	1.0 A	292 W
Peak Load	33.0 A	1.25 A	18.0 A*	1.0 A	424 W

* For a period of 12 seconds maximum.

The +5 V TRICKLE is active whenever the unit has AC power applied, so +5 V TRICKLE is always on whenever the unit is plugged into an outlet. This current is used to power the parameter RAM, the power-on logic, and the standby power for the NuBus controller. The +12 V peak load is rated high to allow all peripherals to power up at the same time when the computer is turned on. The power supply also includes a 120mm fan (which provides quiet cooling for the entire system) and a switched convenience receptacle output to power a monitor.