SEGA SATURN TECHNICAL BULLETIN #47
(PRELIMINARY)

To: **Sega and Third Party Developers**

From: **Developer Technical Support**

Date: **October 1, 1996**

Re: **SEGASaturn Extended RAM Cartridge Manual Ver. 1.02**

1   Outline

This extended RAM cartridge is used by connecting it to an A-Bus slot in SEGASaturn's main unit. It is mounted with the 8 Mbit portion (configuration : 4 Mbit x 2) of DRAM. It can be expanded to the maximum of 32 Mbit.

2   Restriction on Use (Must be rigidly adhered to):

Only data can be transferred to the extended RAM cartridge. Inclusion of program code is strictly prohibited whether it is for direct execution or after-transfer execution.

3   Memory Map

Since 22400000h - 227FFFFFnh on SEGASATURN's memory map is allocated to this cartridge, the usable area is divided into DRAM0 and DRAM1 as shown below:

Table 1 . Memory Map

	8M bit		32M bit
22400000h			
2247FFFFh	DRAM0		DRAM0
22600000h			
2267FFFFh	DRAM1		DRAM1
227FFFFFh			

4   Initialization

Write "1" to the address: 257EFFFEh (W/O) in word size.
Note: Be sure to set up with "1". If you use any other data, ~~it would not work well.~~ the results are undefined.

5   ~~About~~ Cartridge ID

The external cartridge's ID address 24FFFFFFh (R/O) is the same as the "Power Memory"'s. ~~You should consider the future expendability of ID and make it work with a 32Mbit cartridge as well by verifying it with both "8MBit=5Ah" and "32Mbit=5Ch."~~ Consideration should given to future expandability by verifying both 8Mbit (ID 5Ah) and 32Mbit (ID 5Ch).

- If only 8Mbit is verified, SEGASaturn may not work with a 32Mbit cartridge.

Table 2 . Cartridge ID

Address=24FFFFFFh (R/O)	
Cartridge Capacity	Extended RAM Cartridge ID
8Mbit	5Ah
32Mbit	5Ch (Reserved)

6   Corresponding Peripheral-Character Code

~~Describe~~ Include "W" in SYSTEM ID's "Corresponding peripheral (start address: 50~~H~~h)."

Example: When SEGASATURN Standard Pat+data cartridges are used.
"JW△△△△△△△△△△△△△△△△^^^^^^^^^^^^^^^" ("△" represents a space (~~0x20H~~20h))

~~•~~ Reference: Binder "Programmer's Guide Vol. 1 ~~Vol. 1~~" Disk Format Standard Specifications/4. Boot System/p23 CD-ROM /sega/c/c03/non/p028.htm

7   Usable Mode

Read ~~out~~ from Extended RAM Cartridge
- From normal access, you can use BYTEREAD, WORDREAD, LONGWORD ACCESS, and BURSTREAD. If BYTE, WORD, or LONGWORD is used, CPU will do 32-bit READ.
- As for DMA, you can use either SH2 DMA or SCU DMA.

Write to Extended RAM Cartridge
- In normal access, you can use BYTEWRITE, WORDWRITE, and LONGWORD
WRITE but not BURSTWRITE.
- As for DMA, you can use SH2 DMA but not SCU DMA.

Access Speed
It will take approximately four times the amount of time required for WORKRAM.

8   A-Bus Set Register, A-Bus Refresh Register

Regarding A-Bus set register, setting of both CS0 space and CS1 space is the same. A precharge insert bit is "1" and the internal weight value is set at "3" in both normal and burst cycles. As for A-Bus refresh register, effective bit is set at "1," and internal weight number at "3". Setting of CS2 space and reserved space is prohibited. (Setting by users is prohibited because values set by BOOT RAM are being used here.)

Table 3. A Table of Registers Set by A-Bus

A-Bus set register address	25FE0080h		25FE0084h	
Set Contents	CS0 space	CS1 space	CS2 space	Res space
After-WRITE precharge insert bit	OFF(0)	OFF(0)		
After-READ precharge insert bit	O N(1)	OFF(0)		
Externally weighted effective bit	OFF(0)	O N(1)		
Burst cycle weighted effective bit	0 0 1 1	1 1 1 1	Setting Prohibited	
Normal cycle weighted number set bit	0 0 1 1	1 1 1 1		
Burst length set bit	0 0	0		
Burst size set bit	0 (16bit)	0 (16bit)		

Register's Set Value
Specifically, please set the following values:
- A-Bus set register (25FE0080h) = 2330 1FF0h (only CS0, CS1 spaces are set)
- A-Bus refresh register (25FE0033h) = 0000 0013h

Reference: Binder ["Hardware Manual Vol. 1]) SCU Users Manual/A-Bus set register/per '[illegible]123 CD-ROM/SEGA/a/a04/non/p0[illegible] 13.htm.

9   Access Procedure

Please follow the following steps from the initialization of the extended RAM cartridge to memory access:

1. Verify the cartridge ID. (in the case of 8Mbit, this is "5Ah") - also remember to do the same for a 32Mbit(ID=5Ch) cartridge as well. If verification is done only with 8Mbit (ID=5An), in future, when the 32Mbit extended RAM cartridge becomes available on the market, you will find that it will not work with this application. Refer to the previous cartridge ID section.

2. If the cartridge ID cannot be verified, please display a message prompting its connection.

The extended RAM cartridge is not inserted properly.

Please turn off power and reinsert the extended RAM cartridge.
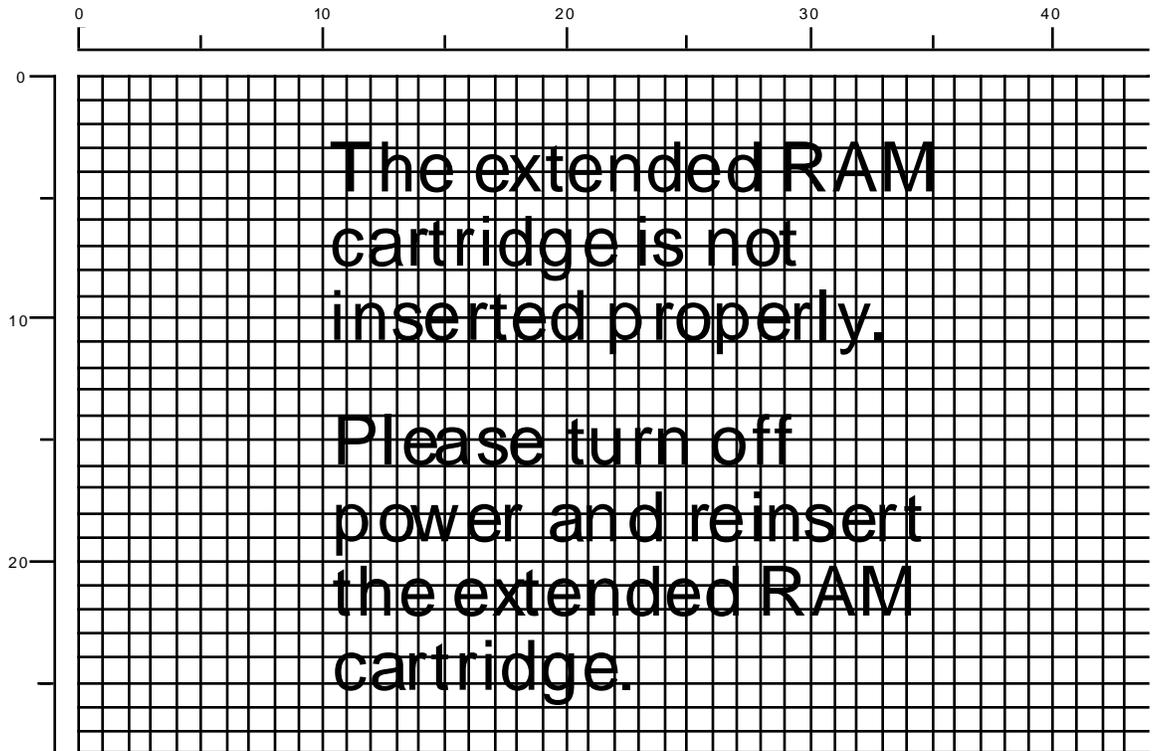
---For the layout of the error message, see the attached material.
[Should the error example follow this section, rather than fall on the last page??]

3. Write "1" in word size on the initialization address 257EFFFEh (W/O).

    • –Be sure to set "1" in word size. (this must be rigidly adhered to)

4. Set the A-Bus set register and A-Bus refresh register. See above. (Register's set value)

5. Once theNow that the connection is complete, access to the external RAM cartridge is possible.

    • –Check above (regarding a mode which can be used) before proceeding before
    proceeding with READ/WRITE of data.

10   Others

Switching of System Clock
When you changed a system clock using the SYS_CHGSYSCK() function, "the contents in the "extended RAM cartridge" cannot guaranteed. In such a case, initialize the cartridge and retransfer the data.

When Using Programming ~~BOX~~Box ~~, Bear in Mind the Following:~~ When SIMM is packaged with the programming box, its address is duplicated in the "expanded RAM cartridge. The~~cartridge." Detach SIMM using the following method: A Method of detaching SIMM: Write 0 in address 257FFFCh in LONGWORD.~~The SIMM may be disabled with a LONGWORD write "0" to address 257FFFCh.

* Attention : Use this program with a debugger, and do not incorporate it into the commercial version.

* Supplement : When ~~PROGRAMMING BOX'S~~Programming Box ~~dipsw2~~DIP switch 2 "SIMMCART" is turned off, the system is unable to read ID.