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# Memory Map

The Game Boy has a 16-bit address bus, which is used to address ROM, RAM, and I/O.

Start	End	Description	Notes
0000	3FFF	16 KiB ROM bank 00	From cartridge, usually a fixed bank
4000	7FFF	16 KiB ROM Bank 01~NN	From cartridge, switchable bank via <a href="#">mapper</a> (if any)
8000	9FFF	8 KiB Video RAM (VRAM)	In CGB mode, switchable bank 0/1
A000	BFFF	8 KiB External RAM	From cartridge, switchable bank if any
C000	CFFF	4 KiB Work RAM (WRAM)	
D000	DFFF	4 KiB Work RAM (WRAM)	In CGB mode, switchable bank 1~7
E000	FDFE	Mirror of C000~DDFF (ECHO RAM)	Nintendo says use of this area is prohibited.
FE00	FE9F	<a href="#">Sprite attribute table (OAM)</a>	
FEA0	FEFF	Not Usable	Nintendo says use of this area is prohibited
FF00	FF7F	<a href="#">I/O Registers</a>	
FF80	FFFE	High RAM (HRAM)	
FFFF	FFFF	<a href="#">Interrupt</a> Enable register (IE)	

## Jump Vectors in first ROM bank

The following addresses are supposed to be used as jump vectors:

- RST instructions: 0000, 0008, 0010, 0018, 0020, 0028, 0030, 0038
- Interrupts: 0040, 0048, 0050, 0058, 0060

However, this memory area (0000-00FF) may be used for any other purpose in case that your program doesn't use any (or only some) [rst](#) instructions or interrupts. `rst` is a 1-byte instruction that works similarly to the 3-byte `call` instruction, except that the destination address is restricted. Since it is 1-byte sized, it is also slightly faster.

## Cartridge Header in first ROM bank

The memory area at 0100-014F contains the [cartridge header](#). This area contains information about the program, its entry point, checksums, information about the used MCU chip, the ROM and RAM sizes, etc. Most of the bytes in this area are required to be specified correctly.

## External Memory and Hardware

The areas from 0000-7FFF and A000-BFFF address external hardware on the cartridge, which is essentially an expansion board. Typically this is a ROM and SRAM or, more often [Memory Bank Controller \(MBC\)](#). The RAM area can be read from and written to normally; writes to the ROM area control the MBC. Some MBCs allow mapping of other hardware in the RAM area in this way.

Cartridge RAM is often battery buffered to hold saved game positions, high score tables, and other information when the Game Boy is turned off. For specific information read the chapter about [Memory Bank Controllers](#).

## Echo RAM

The range E000-FDFE is mapped to WRAM, but only the lower 13 bits of the address lines are connected, with the upper bits on the upper bank set internally in the memory control by a bank swap register. This causes the address to effectively wrap around. All reads and writes to this range have the same effect as reads and writes to C000-DDFF.

Nintendo prohibits developers from using this memory range. The behavior is confirmed on all official hardware. Some emulators (such as VisualBoyAdvance <1.8) don't emulate Echo RAM. In some flash cartridges, echo RAM interferes with SRAM normally at A000-BFFF. Software can check if Echo RAM is properly emulated by writing to RAM (avoid values 00 and FF) and checking if said value is mirrored in Echo RAM and not cart SRAM.

# I/O Ranges

The Game Boy uses the following I/O ranges:

Start	End	First appeared	Purpose
\$FF00		DMG	<a href="#">Joypad input</a>
\$FF01	\$FF02	DMG	<a href="#">Serial transfer</a>
\$FF04	\$FF07	DMG	<a href="#">Timer and divider</a>
\$FF10	\$FF26	DMG	<a href="#">Sound</a>
\$FF30	\$FF3F	DMG	<a href="#">Wave pattern</a>
\$FF40	\$FF4B	DMG	<a href="#">LCD Control</a> , <a href="#">Status</a> , <a href="#">Position</a> , <a href="#">Scrolling</a> , and <a href="#">Palettes</a>
\$FF4F		CGB	<a href="#">VRAM Bank Select</a>
\$FF50		DMG	Set to non-zero to disable boot ROM
\$FF51	\$FF55	CGB	<a href="#">VRAM DMA</a>
\$FF68	\$FF69	CGB	<a href="#">BG / OBJ Palettes</a>
\$FF70		CGB	<a href="#">WRAM Bank Select</a>

## FEA0-FEFF range

Nintendo indicates use of this area is prohibited. This area returns \$FF when OAM is blocked, and otherwise the behavior depends on the hardware revision.

- On DMG, MGB, SGB, and SGB2, reads during OAM block trigger [OAM corruption](#). Reads otherwise return \$00.
- On CGB revisions 0-D, this area is a unique RAM area, but is masked with a revision-specific value.
- On CGB revision E, AGB, AGS, and GBP, it returns the high nibble of the lower address byte twice, e.g. FFAx returns \$AA, FFBx returns \$BB, and so forth.