1. Introduction

Purpose

This document provides information and procedures for testing, disassembling, repairing and assembling the Game Boy Advance.

Application
These procedures apply to Game Boy Advance devices produced in Brazil, but also serve products produced in North America.

Index

2. Theory of Operation

2.1 Description
The Game Boy Advance (GBA) is a portable and compact video game system. It is composed of a Central Processing Unit (CPU), Film Transistors, a Liquid Crystal Display (LCD) and related circuits. The device can be used with the 128 Bit Video Game, Game Cube, as a discrete control, as well as being compatible with the Game Boy and Game Boy Color games. Inputs from control are parallel and are read directly by the CPU. The L and R buttons are new to the systems Nintendo's portable video games and have been added to provide a wide variety of operations and gameplay.

2.2 Power
When the Power switch is set to the ON position, the 3 VDC voltage supplied by the 2 AA batteries or through the AC adapter arrive at the device circuit. The input voltage is converted by the U4 power IC to supply the system with 5 voltage operation that feed various components, such as: CPU, LCD, Cartridge, Sound Amplifier and WRAM.

POWER VOLTAGE	GBA MODE	GBC MODE
CPU	3.3 VDC	5.0VDC
CPU PERIPHERAL CIRCUITS	2.5 VDC	2.5VDC
SOUND AMPLIFIER	3.0 VDC (VCC)	3.0 VDC (VCC)
REGULATOR	3.0 VDC (VCC)	3.0 VDC (VCC)
EXTERNAL WRAM	2.5 VDC	2.5 VDC
EXPANSION CONNECTOR	3.3 VDC	5.0 VDC
LCD	13.6 VDC, -15 VDC	13.6 VDC, -15 VDC
CARTRIDGE	3.3 VDC	5 VDC

The GBA has a bicolor LED that indicates the battery life. The green LED indicates that the battery charge it is fine, but when the battery voltage drops below 2.35 VDC, the red LED is activated. The GBA also has a shutdown function that is triggered when the battery voltage is below 1.7 VDC.

2.3 CPU
The GBA CPU is basically composed of 2 processors in 1: A 32-bit RISC CPU, which processes all GBA game functions and an 8-bit CISC CPU that processes the functions GB and GBC games. The CPU searches and decodes the instructions recorded in the ROM, reads the entries controls, generates priorities and controls the entire graph, decodes the audio data and sends it to the audio amplifier.

2.4 System Timer
The system's timer section includes an oscillator and discrete components that provide a 4.194MHz master clock signal to the CPU. The CPU multiplies this signal by 4 to operate on the GBA mode (16,776MHz), or multiplies by 2 for GB / GBC mode (8,388MHz).

2.5 Display section
The display section consists of a 2.9 inch (240x160 pixels) reflective LCD display, segments that are mounted internally to the LCD and a regulating IC. Each pixel in the GBA can show 1 of the 32 levels of red, green or blue, making a total of 32,768 colors. The number total colors that can be shown, depends on the number of objects and the screen background.

2.6 Audio section

The audio section includes part of the CPU, an audio amplifier IC, speaker and headphone jack heard. There are 4 channels for GB Color compatible audio, plus two DMA channels used in the GB Advance mode to provide continuous playback.

Audio 1 (Sound 1): Allows the generation of rectangular waveforms with scanning functions (frequency variation) and envelope (volume variation).
Audio 2 (Sound 2): Allows the generation of rectangular waveforms with envelope functions.
Audio 3 (Sound 3): It allows the reproduction of any waveform recorded in RAM.
Audio 4 (Sound 4): Can generate white noise with envelope functions.
Direct Audio A and B: Allows playback of 8-bit linear audio data.

2.7 Cartridge Interface

For the cartridge interface, a 32-pin connector is used. A key has been incorporated into this connector to determine how the system should be started (GBA or GBC).

2.8 Controls Input

The CPU processes the parallel data, directly from the controls. Each control is connected to the ground through an open contact on the PCI. When the key is pressed, a conductive blanket is pressed against the open contact, closing the circuit.

3.0 Hardware Overview

3.1 Central Processing Unit (CPU)
Custom 32-bit RISC CPU (GBA)
8-bit CISC CPU (GBC)
Generation of stereo sound plus 2 PCM channels for wave data
16K System ROM (+ 2K for GBC system ROM)
32K internal working RAM
96K video ram
64x128 Object Attribute Memory (OAM)
16x512 RAM Pallete (256 colors per object; 256 colors per background)

3.2 Memory
256K external working memory

3.3 Display
2.9 inch color reflective LCD
240x160 RGB dots
32768 colors shown simultaneously
Segment and grid drivers
Buffer amplifier for LCD

3.4 Audio
4 Audio signals (corresponding to the GBC sound) plus 2 audio signals generated directly by the CPU (PCM format).
Audio amplifier IC (U6) to reinforce the outputs.

3.5 Controls
Parallel inputs connected directly to the CPU
L and R buttons (first used on the Nintendo handheld system)

3.6 External Communications
6-pin I / O port that can communicate in 5 different modes:

A. Normal mode, for normal GBC and GBA system functions.
B. Normal 8/32 bit communication mode
C. 16-bit Multi-Player Mode
D. General mode
E. Joy bus mode for communication with the Game Cube
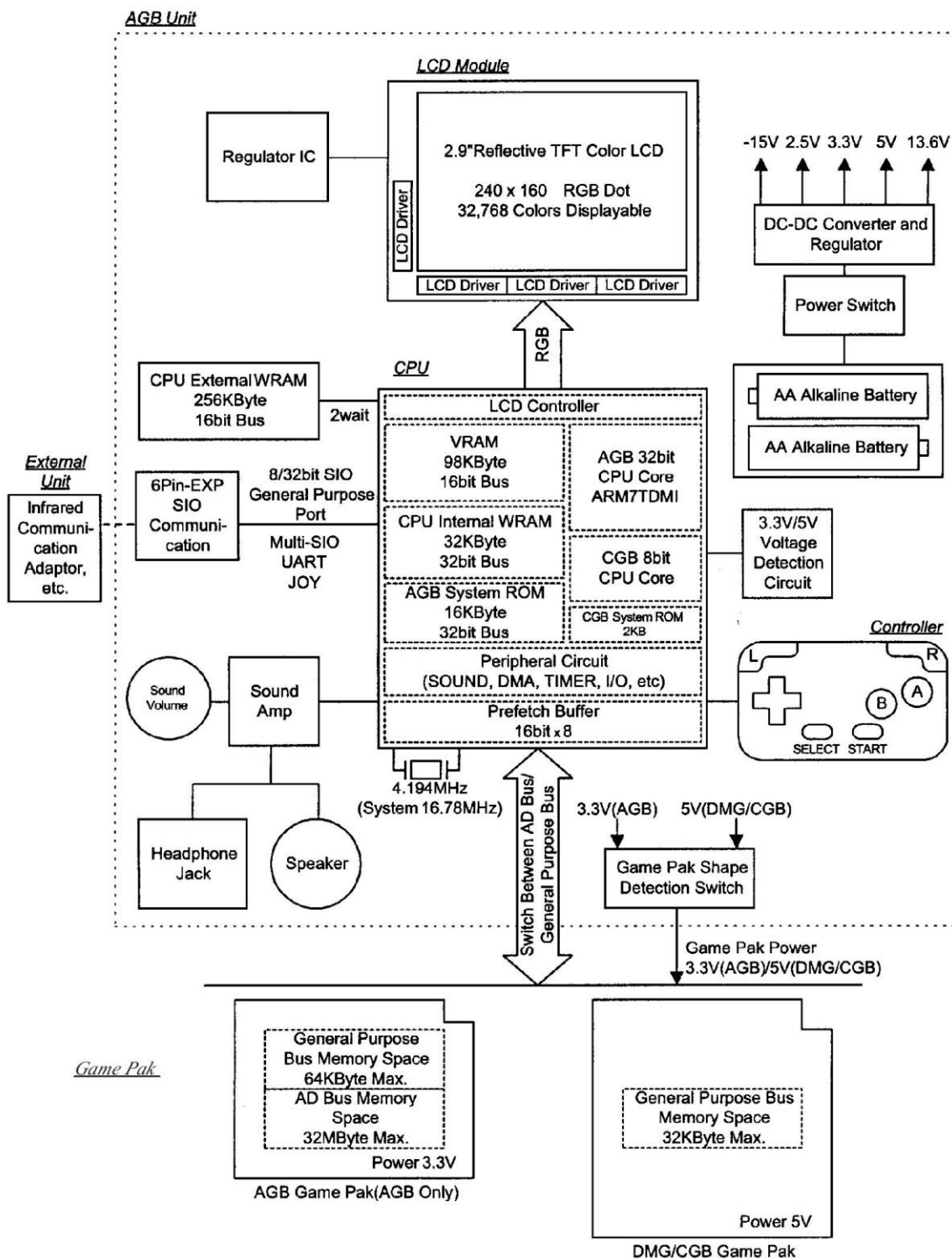
4.0 Block Diagram

AGB Unit

LCD Module

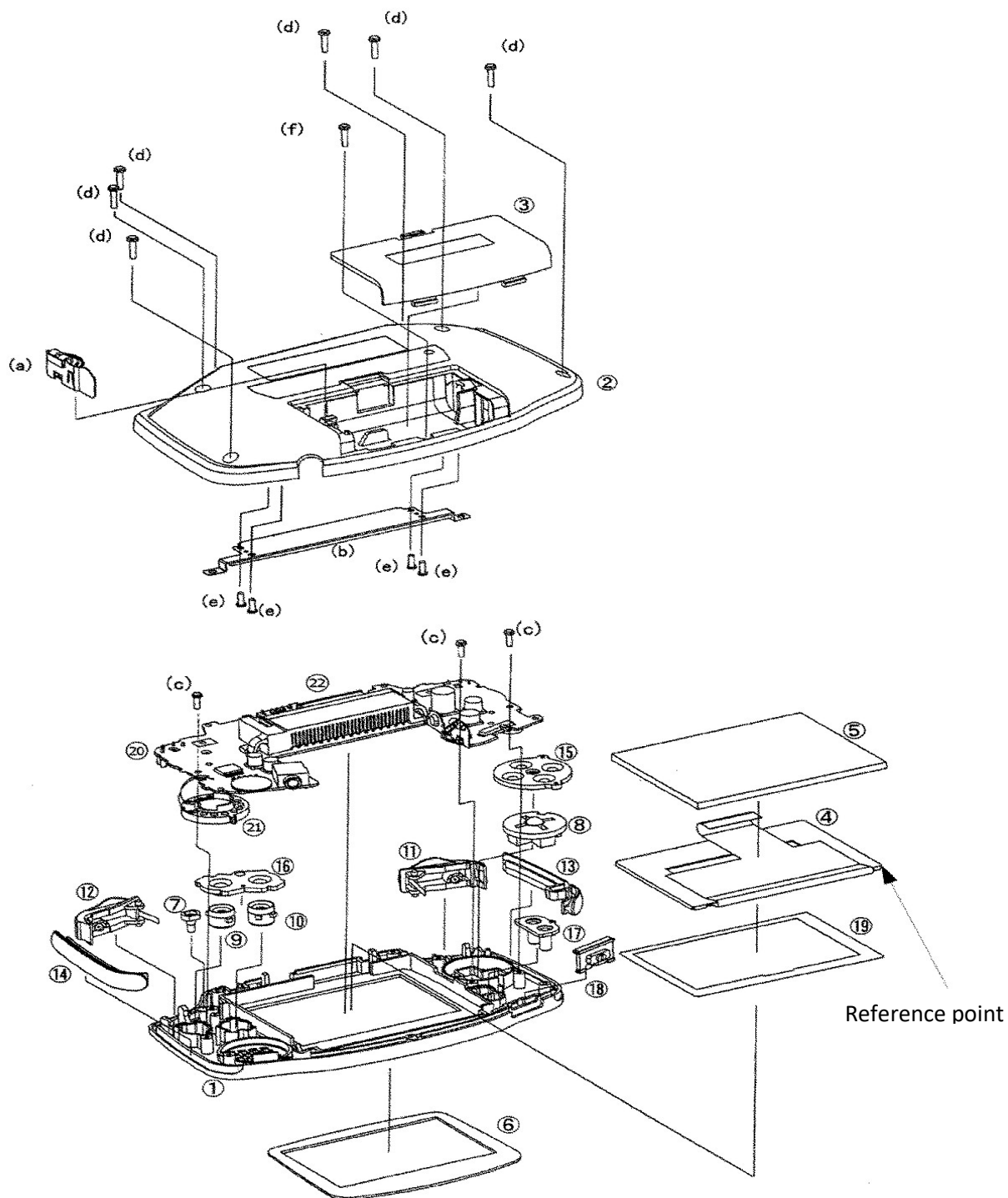Regulator IC

2.9"Reflective TFT Color LCD

240 x 160   RGB Dot
32,768 Colors Displayable

LCD Driver

LCD Driver | LCD Driver | LCD Driver

-15V 2.5V 3.3V 5V 13.6V

DC-DC Converter and Regulator

Power Switch

AA Alkaline Battery

AA Alkaline Battery

CPU External WRAM
256KByte
16bit Bus

2wait

RGB

CPU

LCD Controller

VRAM
98KByte
16bit Bus

AGB 32bit
CPU Core
ARM7TDMI

External Unit

Infrared Communi-cation Adaptor, etc.

6Pin-EXP SIO Communi-cation

8/32bit SIO General Purpose Port

Multi-SIO
UART
JOY

CPU Internal WRAM
32KByte
32bit Bus

CGB 8bit
CPU Core

3.3V/5V
Voltage
Detection
Circuit

AGB System ROM
16KByte
32bit Bus

CGB System ROM
2KB

Controller

Peripheral Circuit
(SOUND, DMA, TIMER, I/O, etc)

L   R

Sound Volume

Sound Amp

Prefetch Buffer
16bit x 8

B (A)

SELECT START

4.194MHz
(System 16.78MHz)

Switch Between AD Bus/General Purpose Bus

3.3V(AGB)   5V(DMG/CGB)

Headphone Jack

Speaker

Game Pak Shape Detection Switch

Game Pak Power
3.3V(AGB)/5V(DMG/CGB)

Game Pak

General Purpose
Bus Memory Space
64KByte Max.

AD Bus Memory
Space
32MByte Max.

Power 3.3V

AGB Game Pak(AGB Only)

General Purpose Bus
Memory Space
32KByte Max.

Power 5V

DMG/CGB Game Pak

Figure 1

5.0 Exploded View

Reference point

Figure 2

5.1 Mounting the Front Panel
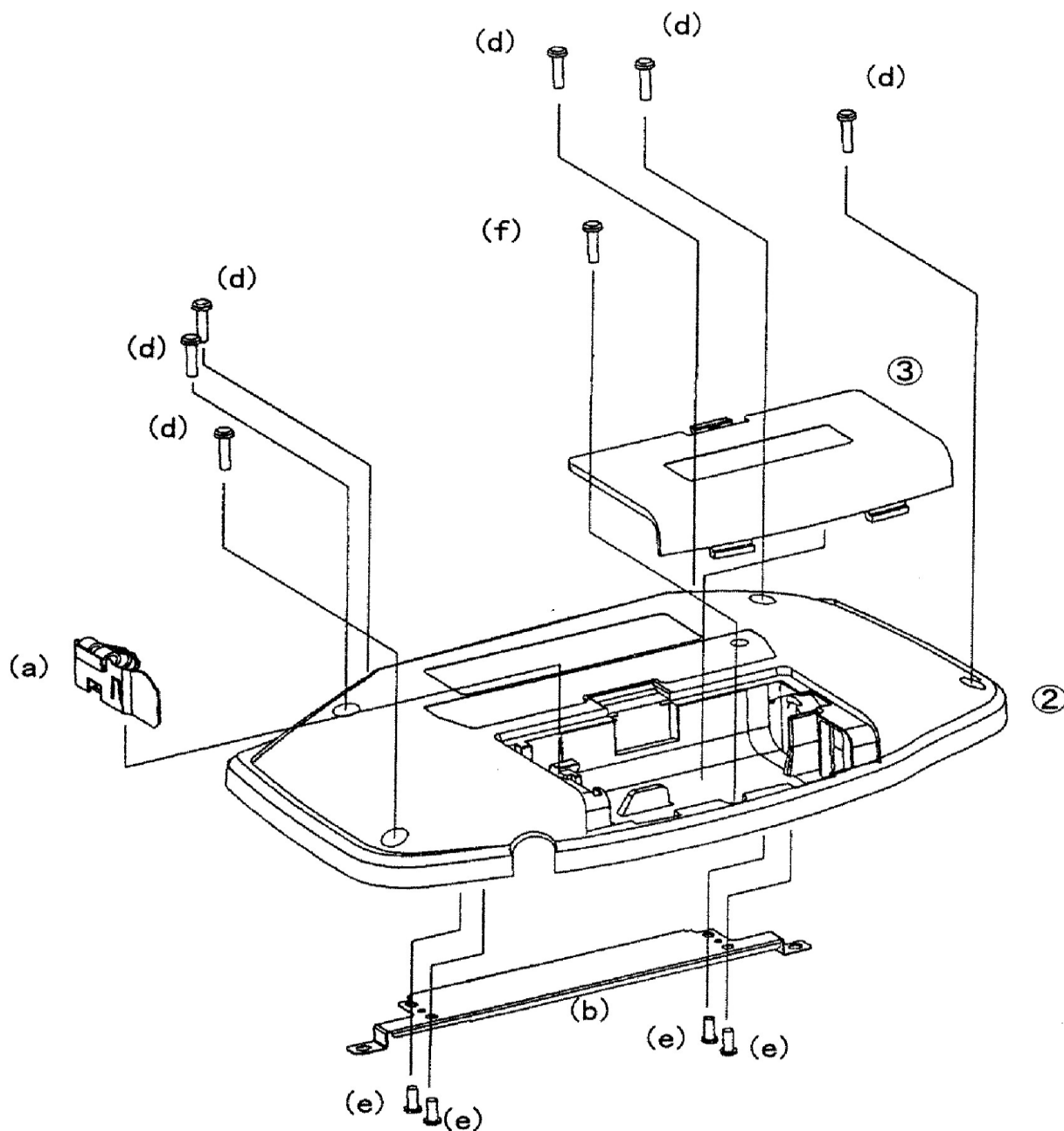

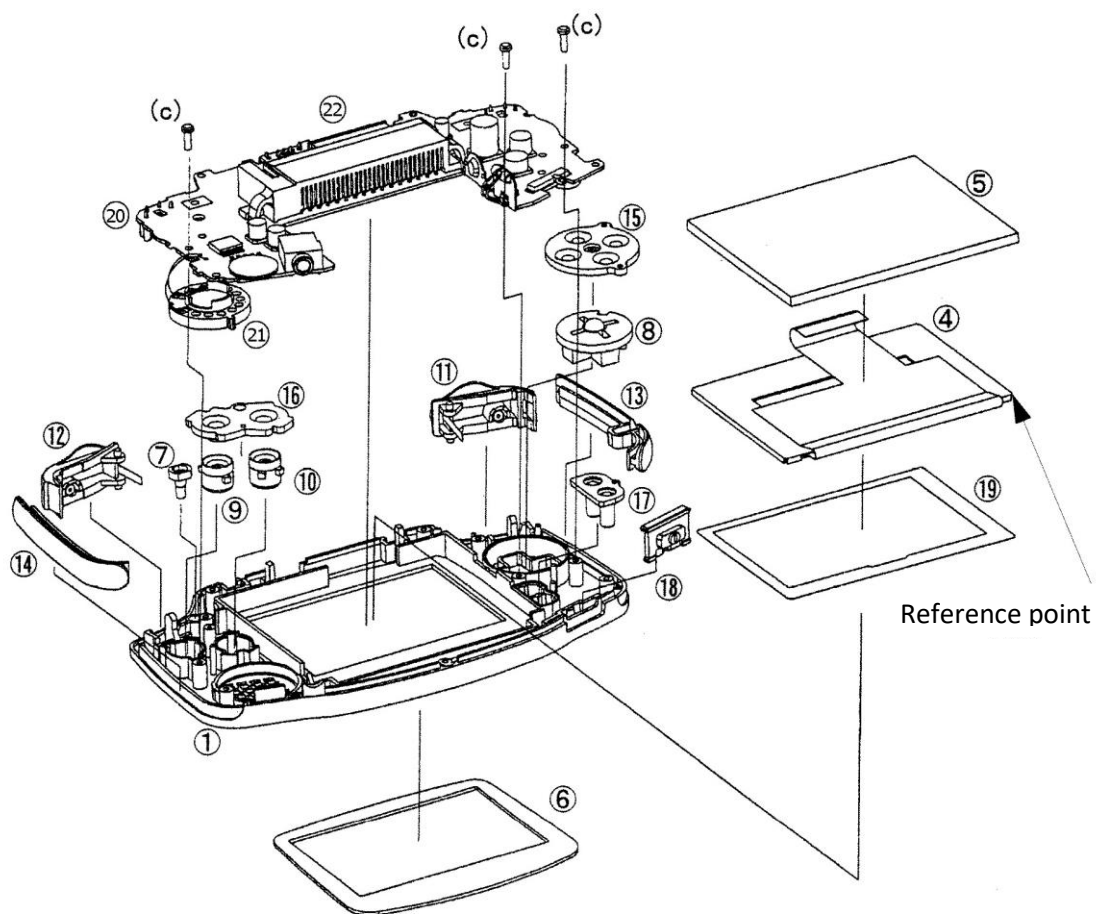
Figure 3

5.3 Front part

Figure 4

Reference point

6.0 General Precautions
All of the following precautions must be followed when maintaining the Game Boy Advance.

6.1 ESD control
Use a good electrostatic discharge (ESD) prevention and control system during Maintaining the LCD Unit and Main PCI

6.2 Non-Reusable Parts
As a rule, the parts described below should not be reused even if they appear to be in good state.

Screen Protector
If the screen protector is placed in a front case and then removed, do not reuse it as it may not stick properly.

Battery Contact
If contact W battery (position "a" in the exploded view) was installed in the rear case and then removed, do not reuse it as the material may have suffered fatigue and cause bad contact.

LCD foam
If the LCD backing foam needs to be removed, do not reuse it.

6.3 Use of Solvent
The use of alcohol (e.g., methanol, ethanol, IPA) is prohibited. To clean the appliance, use a small amount of glass cleaner.

6.4 Torque Value
The torque value for the screws used during product assembly must be 14.7 ± 2.0 N-cm (1.5 ± 0.2kgf-cm).

6.5 Beware of the Carbon Pile
Do not use carbon batteries in the AGB. Carbon batteries have a higher internal resistance than alkaline batteries. The higher resistance causes a sudden voltage drop in the system which may result in the following problems:

1. Sudden shutdown of the system during the game. In games that use flash memory this can cause loss of recorded data.
2. Audio noise on the speaker (especially on headphones).

7.0 Disassembly and Maintenance

7.1 Changing the screen protector
These steps are only used when the AGB is not being disassembled.

1. Insert a thin, flat tool (e.g., stylus) between the upper left corners of the screen protector and the front case, carefully making a lever.

Caution: Carefully leverage to prevent damage to the front case and the LCD.

2. Remove any remaining adhesive from the front case

3. Remove dust or other foreign material using an air jet before applying the new protector of screen. Check that the LCD is perfectly aligned before applying the new screen protector.

4. Check that the front screen trim does not appear in the visible area of the screen.

5. Install the screen protector in the case without removing the protective film. Press it firmly to low pressing all over the area to ensure good fixation.

6. Remove the protective film from the installed screen.

7.2 Disassembling the Unit

1. Remove the battery cover and all batteries.

2. Using the proper key, remove the six security screws Y.
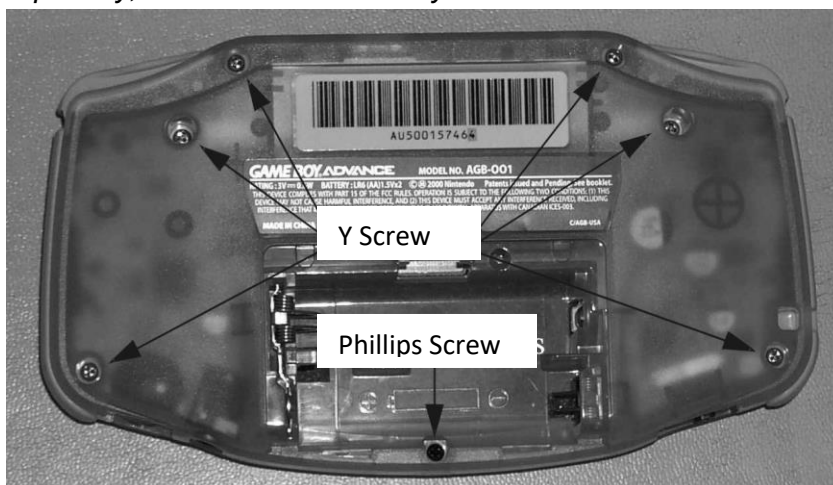
Figure 5

3. Remove the Phillips screw, located under the battery cover.

4. Remove the rear case, taking care not to damage the battery contacts.

5. Release the flat cable from the display, from its connector on the Main PCI, releasing the 2 black locks, pushing them up.
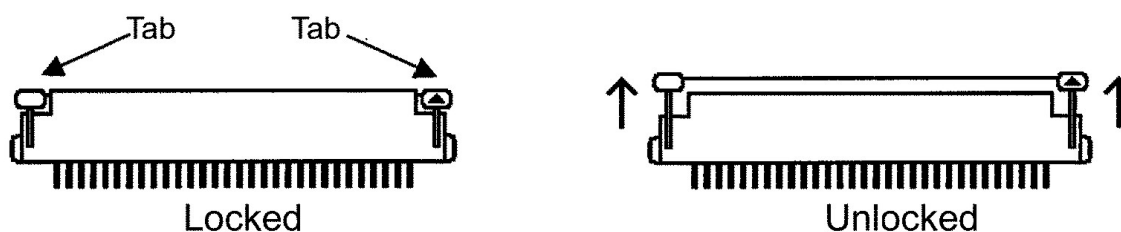
Caution: Pay attention to avoid breaking the locks.

Figure 6
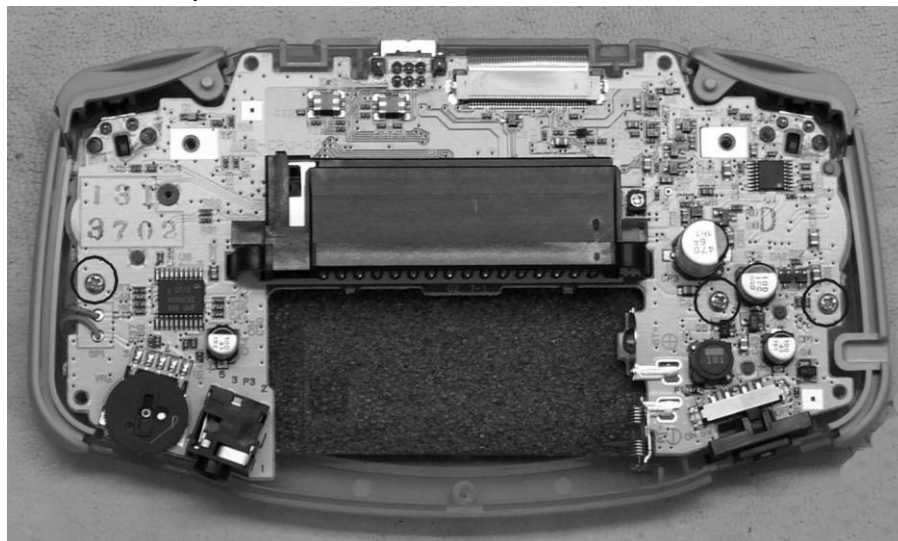
6. Remove the three Phillips screws that secure the PCI.

Figure 7

7. Lift and remove the PCI.
Note*: If the rear case needs to be replaced, remember to keep the metal shield and install it in the new rear case.*

7.3 Replacing the LCD
To perform the replacement of the LCD, the procedure "7.2 Disassembling the Unit" must be performed previously.
Note*: When the LCD is replaced, the flicker adjustment must be performed as described in the section*
"8.3 Flicker Adjustment".

1. Gently insert a flat screwdriver or other flat-tipped tool between the trim of the front screen and the opening of the LCD unit in the area under the flat cable, and then pry gently use the key to separate the LCD from the front case.
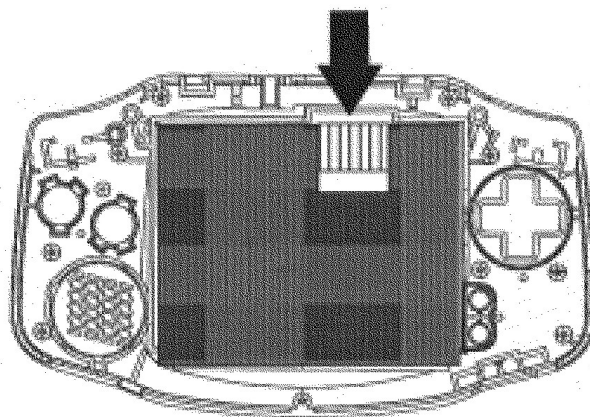
Figure 8

2. *Push the screen protector from the inside of the front case to eject it. Apply pressure simultaneously on the four corners of the protector, or until one of the corners of the screen protector get up and it is possible to hold and pull the protector until it is completely removed.*

3. *Remove any old adhesive from the front case.*

4. *Reset the front screen trim. Gently press all the way around so they don't occur fold or wrinkle problems.*

Note*: Prevent foreign materials from sticking to the trim before installation.*

Trim
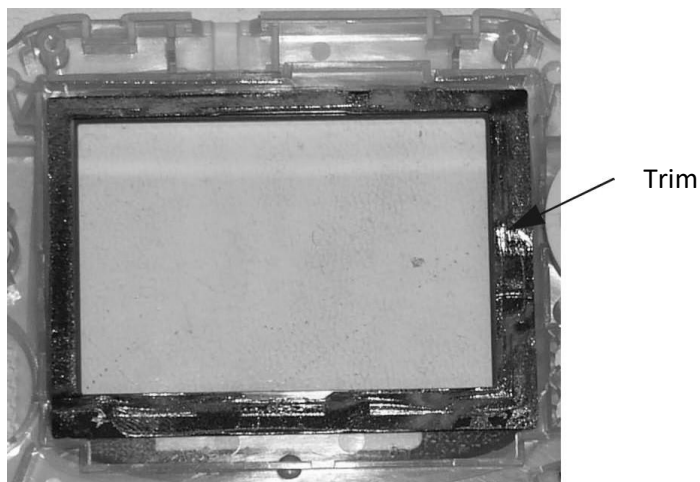
Figure 9

5.0 Use the lower right corner, seen from the rear as a reference, (see reference point in section "5.3 Mounting the Front Panel" on page 6) when installing the LCD so that it is correctly assembled.

Caution*: The bottom frame on the LCD unit's installation frame is lower than the other three sides. Be careful to prevent incorrect installation. The LCD can slide up the frame bottom. In addition, the select / start buttons may be stuck in the unit's installation frame LCD. That is why it is recommended to install the select / start buttons after the LCD and the backing foam have been installed.*

6. *Carefully install LCD foam support, so that it is perfectly aligned with the LCD.*

Note*: When installing the LCD foam holder, completely cover the exposed glass part the LCD.*
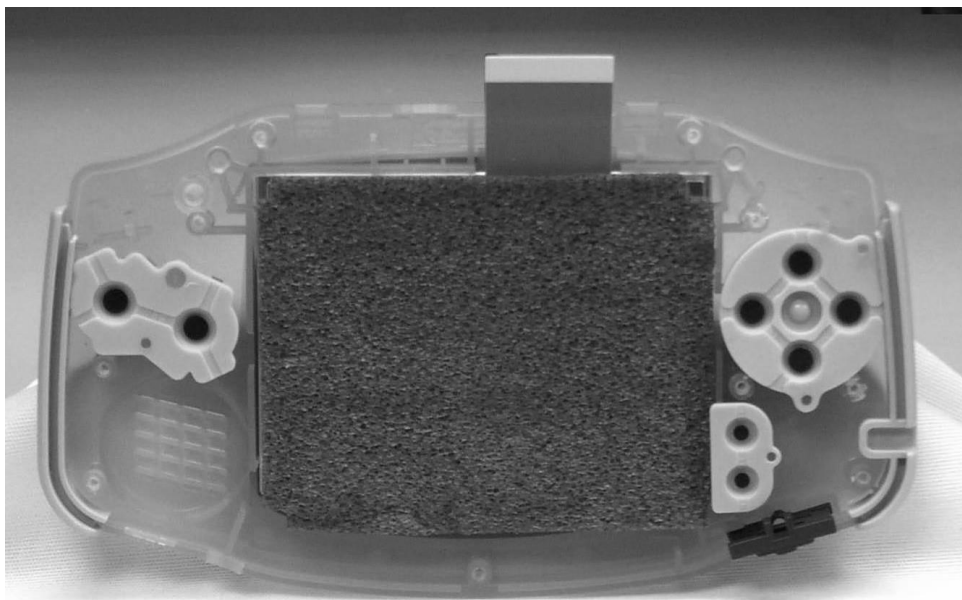
Figure 10

7. Remove dust and other foreign material using an air jet before applying the protector of the screen. Check the alignment of the LCD unit before applying the screen protector.

8. Check that no part of the front screen trim appears on the visible part of the screen.

9. Install the screen protector without removing its protective film. Press down firmly on the entire area of the adhesive, to ensure perfect bonding.

10. Mount the unit using the steps in section "7.5 Reassembling the Unit" on the next page, or perform other repair procedures as necessary.

11. Remove the protective film from the screen protector.

7.4 Replacing Actuators and Contact Blankets
To perform these steps, you must first perform the steps in section "7.2 Disassembling the unit" on page 9.

1. Change actuators and contact pads as needed. All actuators and contact blankets are designed to be mounted in one direction.
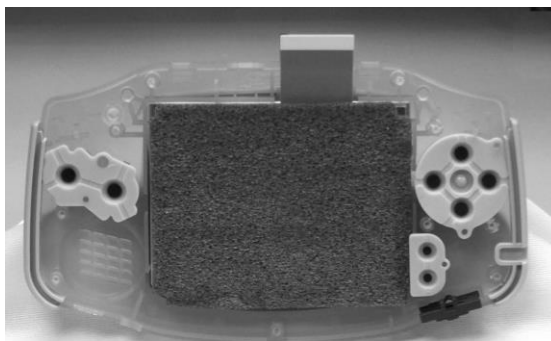

Figure 11

2. Visually check that the blankets are correctly fitted.

3. Visually inspect the Led guide to ensure it is still in good condition and it has no mark.

4. Install the spring (metal section) of the L / R buttons between the front case and the PCI, after the PCI Main have been installed in the front cabinet. Check that the rubber contact on the push switch is correctly in place.

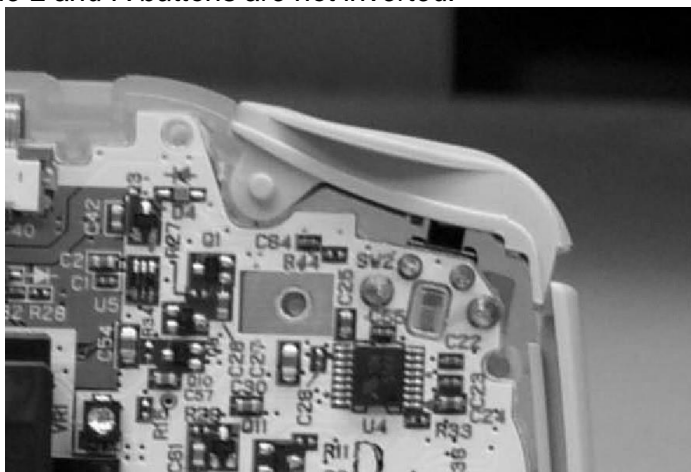**Note**: Make sure the L and R buttons are not inverted.

Figure 12

5. Mount the unit using the steps in section "7.5 Reassembling the Unit" on this page or carry out any other necessary repair procedures.

7.5 Reassembling the Unit

1. Check that the actuators and contact pads are correctly aligned and positioned before installing the PCI.

2. Check that there are no foreign metal materials attached to the speaker magnet.

3. Insert the PCI.

Caution: Make sure that the speaker is properly positioned in the front cabinet.

4. Tighten the screws that secure the PCI to the front case, taking care to use the correct screws.
5. Pull the speaker cables (as shown in the figure), so that they are not crushed when fitting the front and rear cabinets.
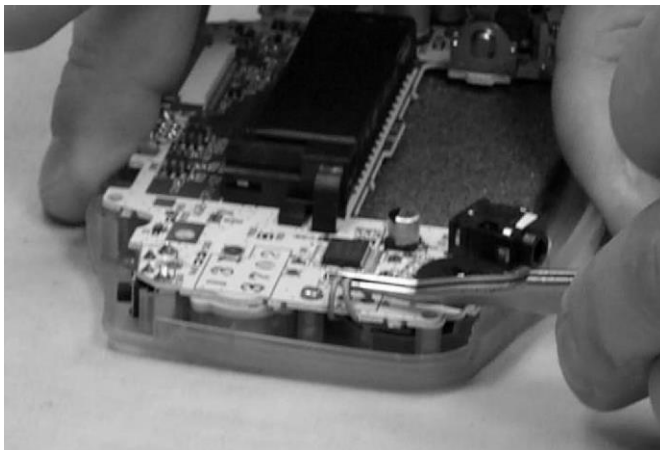
Figure 13

6. Insert the Flat Cable into the connector and lock it by sliding its latches down.

7. If the LCD has been replaced, perform the flicker test as per section 8.3 Flicker adjustment and adjustment if required.

8. Install the rear case, taking care not to damage the battery contacts. Replace the six Y screws and the single Phillips screw.

***Caution**: Do not place the security screw Y in the screw hole of the battery compartment. Y screws are longer and can cause damage to the front case.*

8.0 Test Procedures

8.1 General Notes on Test Procedures

When test cartridges are used, they generate several different graphics tests. Some of these tests are completed the instant Button A is pressed, others will take a while. While the test is running, pressing Button A will have no effect and will not will cause the test to be skipped.

8.2 GBA mode test cartridge

1. Use 2 AA alkaline batteries, or AGB AC Adapter and Power Connector.
2. Insert the GBA test cartridge.
3. Turn on the device.
4. Confirm that the power led lights up.
5. The "Self-test" should be performed automatically.
Note: If the program does not automatically start in Self-test mode, turn off the GBA and restart the device, while simultaneously pressing the L and R buttons for the test program menu appear on the GBA screen. Select and run the Self-test option.
*6. There are about 50 different graphic tests in the first part of the Self-Test (see Appendix B for details). Press **Button A** to advance through the graph test, or press **Button B** to return to the previous test. Confirm that there is no defective image on the LCD, as well as no image is frozen on the screen, scrambled graphics, missing lines, wrong colors, or pixel defects.*
7. Music will play during the Self-Test, listen and confirm that there are no sound defects such as low volume, "pops," or garbled sound.
8. After all graphic tests, the memory, LCD drivers, timer and DMA.
9. Test the functions of the controller by pressing the buttons in the order indicated on the screen.
10. The test will be completed and a PASS (passed) or FAIL (failed) message will be shown on the screen.

8.3 Flicker adjustment

To make this adjustment, you will need to use a fluorescent lamp with a brightness of 2,000 ~ 3,000 lux (roughly equivalent to a 23 watt, 50/60 hertz fluorescent lamp) and a ceramic slit.
1. Turn on the lamp and place the GBA under the light.
2. Place the test cartridge in the GBA.
3. Power on the GBA.
***Note**: To use the AC adapter or batteries, you must mount the rear case.*
4. Hold Buttons L and R, and turn on the device.
*5. Use the Control Pad to select the "Flicker Test" option from the menu, and press **Button A** to start the test. The flicker adjustment pattern (shown below) will appear on the screen.*
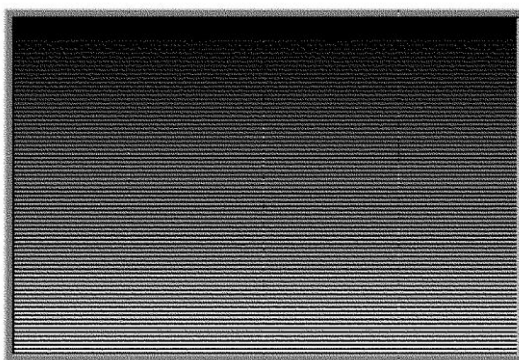***Note**: The flicker adjustment can be done using the first screen of the self-test (see section 8.2, step 6).*

Figure 14

6. Using a ceramic screwdriver, turn the adjustment pot so that the flicker (flicker) is minimized on the GBA screen.
***Note**: The flicker adjustment pot is covered by the product data label when the cabinet is completely assembled.*
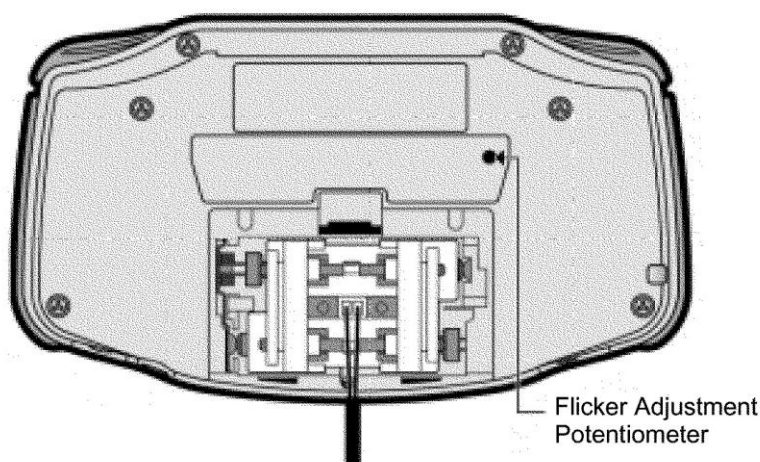

Flicker Adjustment
Potentiometer

Figure 15

8.4 GBC Mode Test Cartridge
1. Use two AA batteries or the GBA AC Adapter and Power Connector.
2. Insert the GBC mode test cartridge.
3. Power on the GBA.
4. Confirm that the power led lights up.
*5. There are five different test charts in the first part of the Self Test (see Appendix C for specifications). Press **Button A** to proceed to the next test. Confirm that there are no LCD image defects, such as missing image, frozen screen, scrambled graphics, lines missing, wrong colors, or pixel defects.*
6. Music will play during the Self-Test, listen and confirm that there are no sound defects such as low volume, "pops," or garbled sound.
7. After all graphic tests, the memory, LCD drivers, timer and DMA.
8. The test will be completed and a PASS (passed) or FAIL (failed) message will be shown on the screen.

9.0 Electrical Schematics
9.1 CPU

9.2 Power
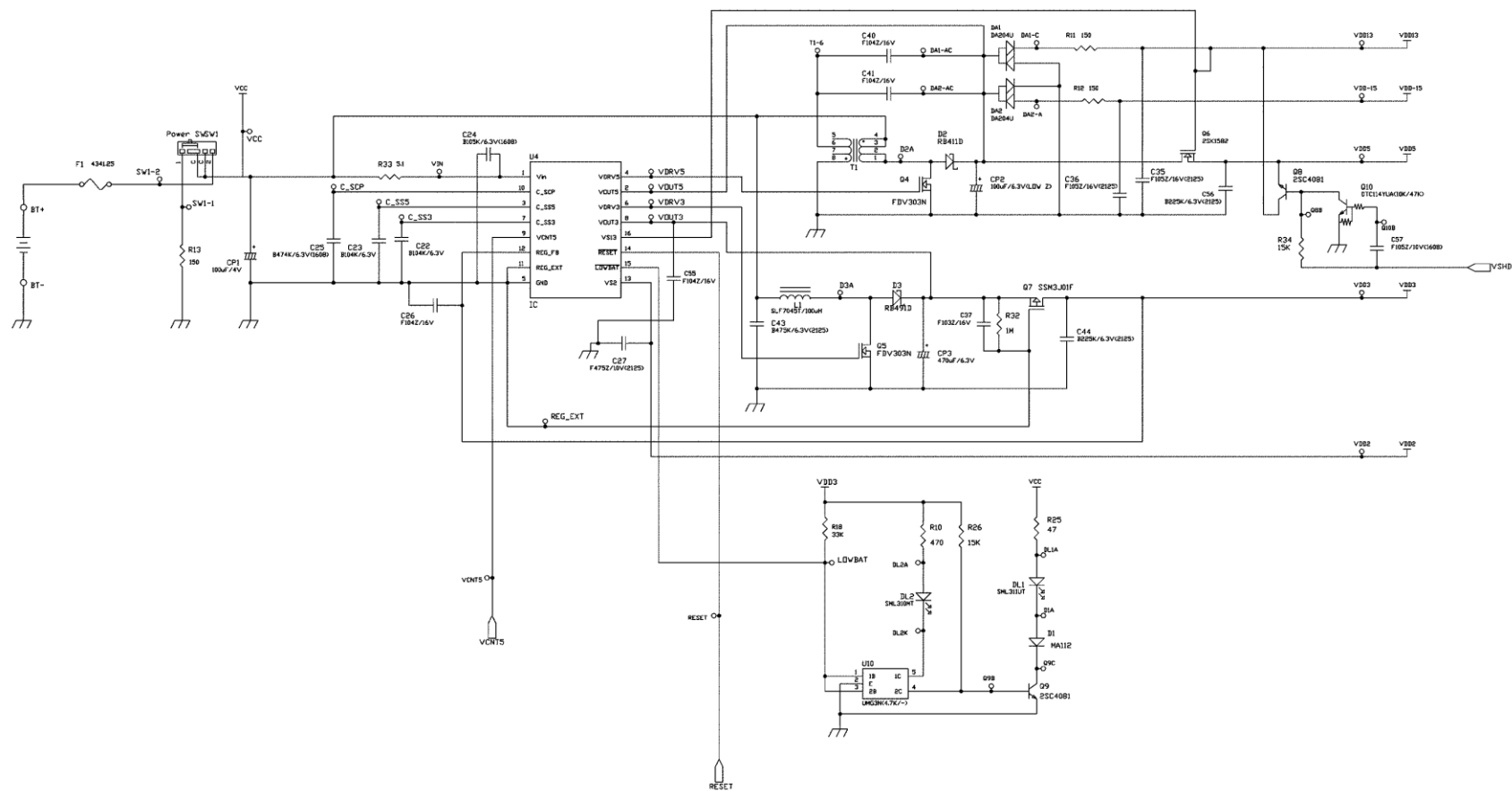
10.0 Accessories

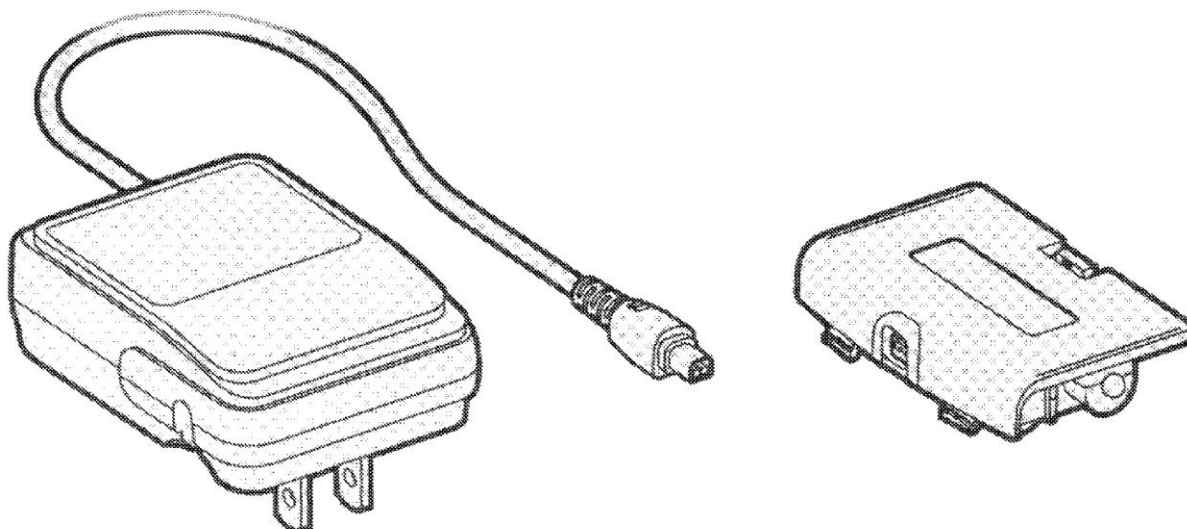### 10.1 GBA AC adapter / Power connector

Figure 16

The GBA AC Adapter and power connector are maintenance-free parts. Do not maintenance these parts as there will be no replacement components and they should be exchanged for a new product. For out-of-warranty items, an accessory must be budgeted new.
If the AC Adapter is not supplying power to the GBA, turn it off, disconnect the AC Adapter from the outlet and leave without power for two minutes. After this time, plug the AC adapter into the power outlet and turn on the GBA. If it does not turn on and is a unit known to be in good working order, then the AC Adapter is defective and needs to be replaced.
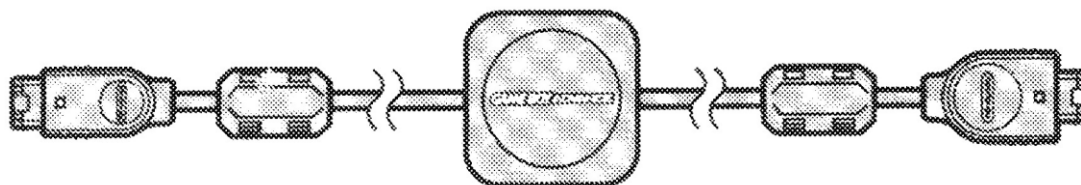
10.2 GBA Game Link Cable

Figure 17

GBA Game Link Cable does not accept maintenance. Do not maintain this part as there will be no replacement components and they must be replaced with a new product. To those out of warranty a new accessory budget must be made.
Multiplayer gaming at GBA is possible using the Game Link Cable. Multiplayer mode can be done in 2 ways, depending on how the game was designed.
***Method 1** - Player 1 has a game cartridge in his GBA and players 2, 3, and / or 4 can download the game to their respective GBAs.*
***Method 2** - All players have the same game cartridge in their GBA.*

Note: The Cartridge Manual, as well as its packaging, provides information on how to proceed to use multiplayer mode.
Multiple Game Link Cables can be connected together to allow a maximum of four players playing simultaneously (See diagram below).
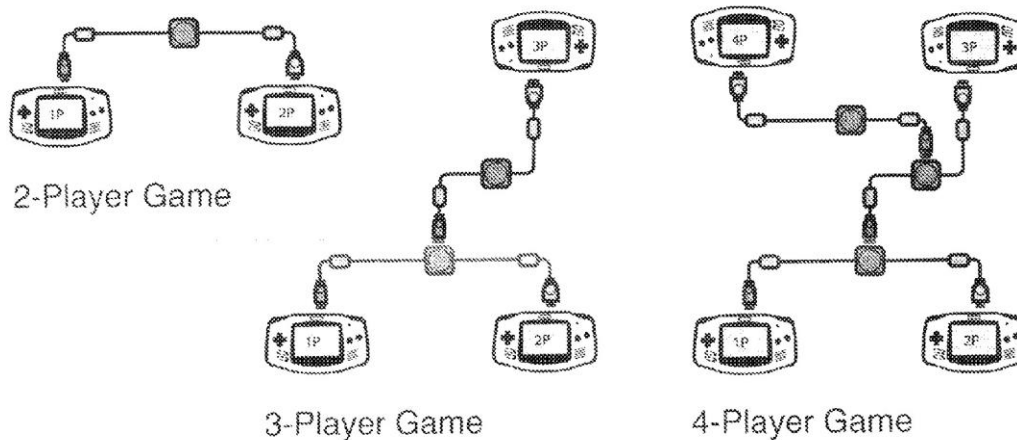

Figure 16