



## Galaga Renewal Kit

Galaga is one of the most popular video games of all times. It is also one of the more difficult games to keep running. The problems run through one of four general areas: Bad CPU chips, bad sockets, bad resistor packs, and corroded custom chip pins.

This kit contains enough sockets to replace the CPU sockets, EPROM/ROM sockets, and the custom chip sockets. It also contains enough SIP packaged resistor networks to replace every one of the troublesome SIP resistor packs too.

It does not contain any CPU chips or custom chips. Odds are your custom chips are working, that is once their legs have been cleaned and any broken pins repaired.

First, disassemble the board set. The CPU board will be done first. CAREFULLY remove the chips from the sockets to be replaced and place them on a piece of anti-static foam. Arrange them in the order removed to allow for easier reassembly. Be especially careful with the EPROMs and custom Namco chips.

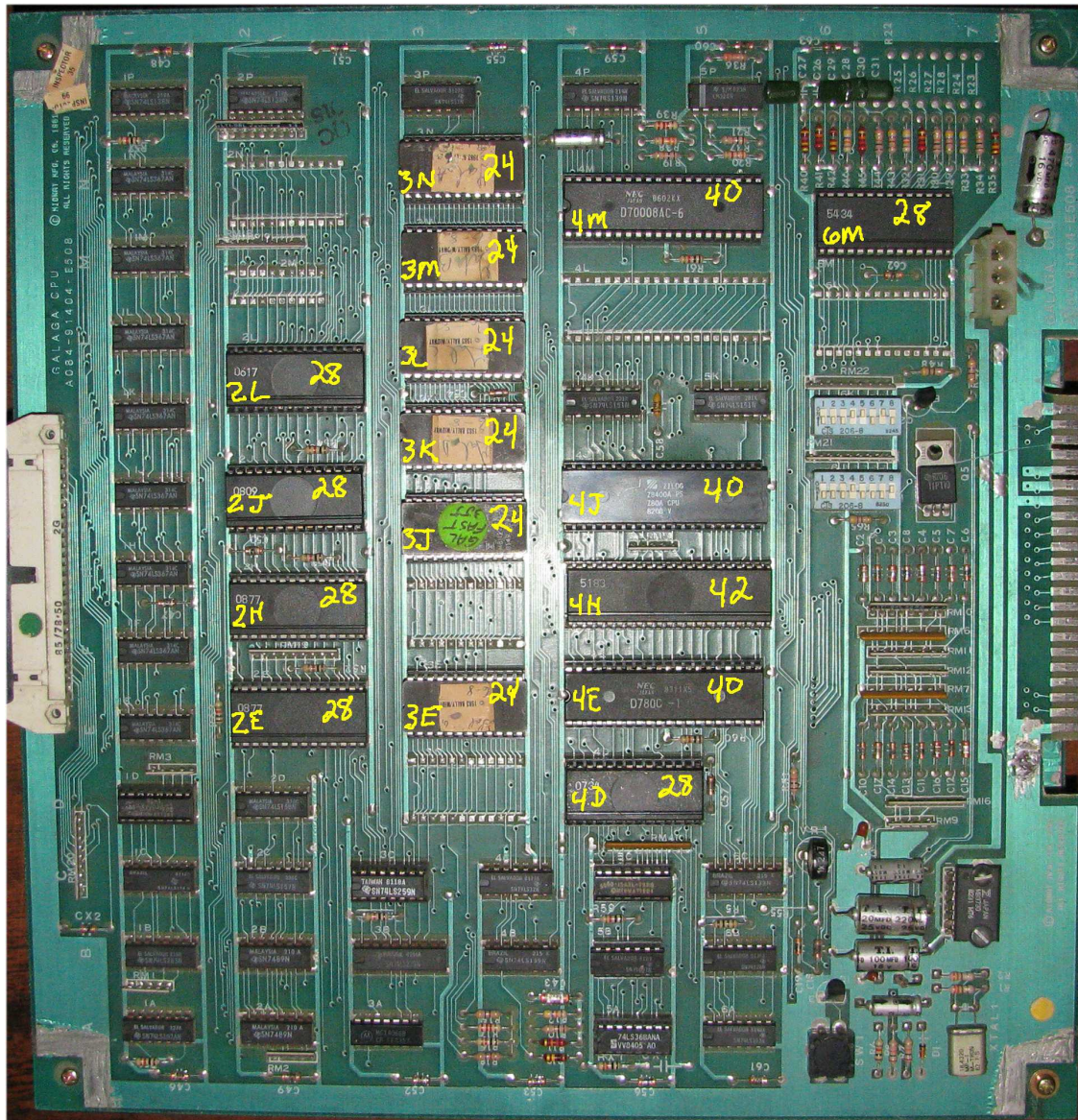
The EPROMs listed in this document are by the Midway part numbers. Namco versions will be labeled differently. Do not mix up the EPROMs as they must go back in the proper socket for the game to work. You will find that many are labeled poorly and if they get mixed up you'll need an EPROM programmer to figure out which ones go in which socket later.

The Namco custom chips on the Galaga boards are sorted by numbers. The important numbers are the first 2. The last 2 can be any number and swap out just fine. A 0809 will operate identical and swap out with a 0877. These numbers are simply stated as 08xx in this document and the rest of the Namco custom chips are listed according to their first 2 numbers.

If pins on any custom chips break they will need to be repaired by soldering on a replacement leg to the partial leg that is left on the chip. A bad EPROM is always a good source for a donor leg.

If they are tarnished, then clean the pins on the custom chips. This can be done in a variety of different ways: wire brush in a Dremel, scraped with a knife, steel wool, and many more. The key is to get rid of any corrosion or rust. It is very difficult to clean these legs without breaking one. If that happens, clean the pin to have a good surface to solder to then solder on a donor leg.

Look at the layout of the CPU board:



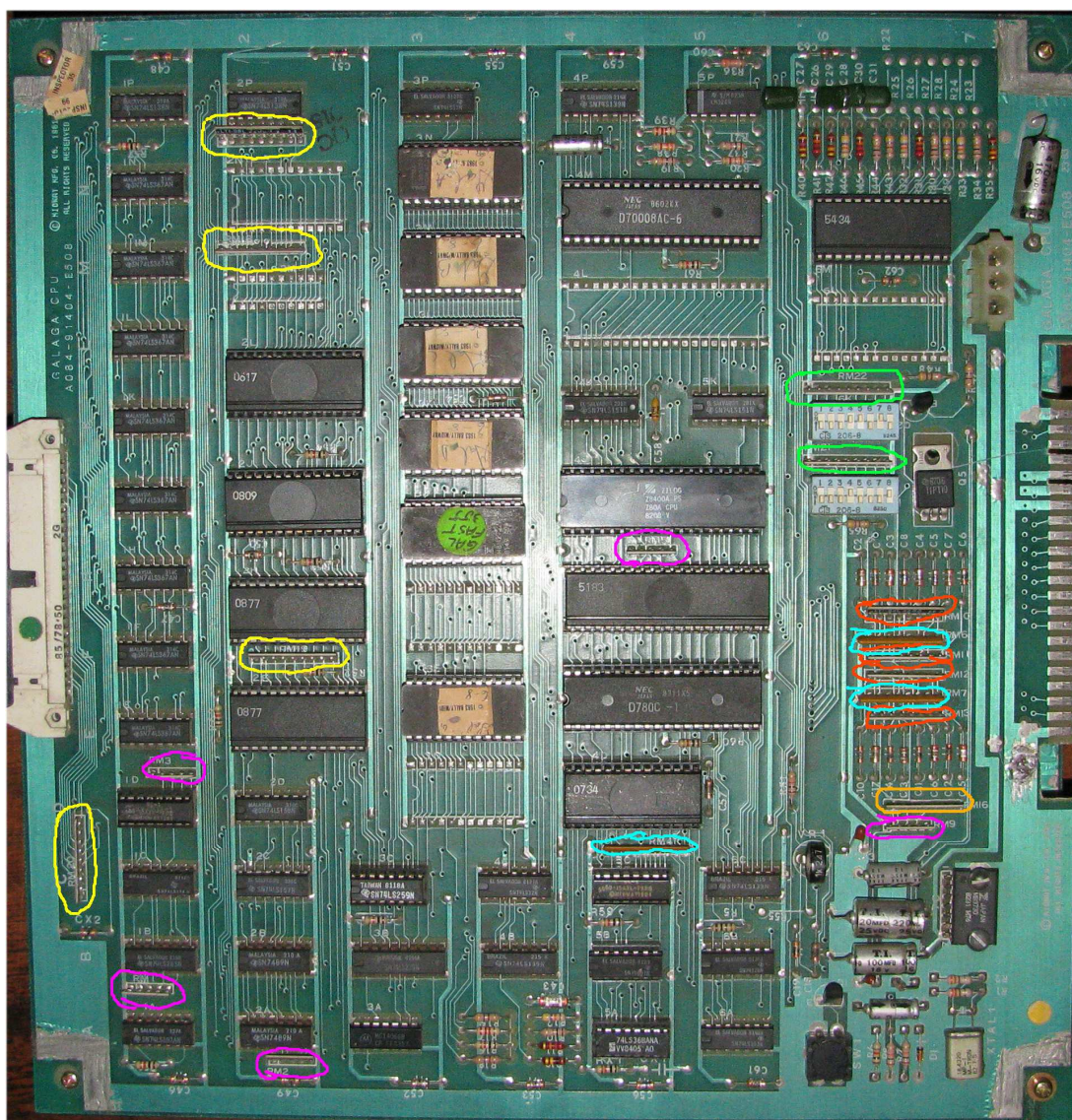
Replace the 24 pin sockets at location 3N, 3M, 3L, 3K, 3J, and 3E. Replace the 28 pin sockets at location 2L, 2J, 2H, 2E, 4D, and 6M. Then replace the 40 pin sockets at location 4M, 4J, and 4E along with the 42 pin socket at location 4H.



Be VERY careful when removing the old sockets. Galaga boards have weak traces and it's easy to accidentally pull a trace from the top side of the board when you remove the sockets. Make sure that all of the solder has been removed from each pin to minimize the risk of pulling traces.

Solder in the sockets and double-check your work, but don't repopulate the board yet with the chips that you pulled. The resistor packs need to be replaced before the board gets reassembled.

There are 6 different types of resistor packs on the Galaga CPU board, represented by different colors on the following picture:

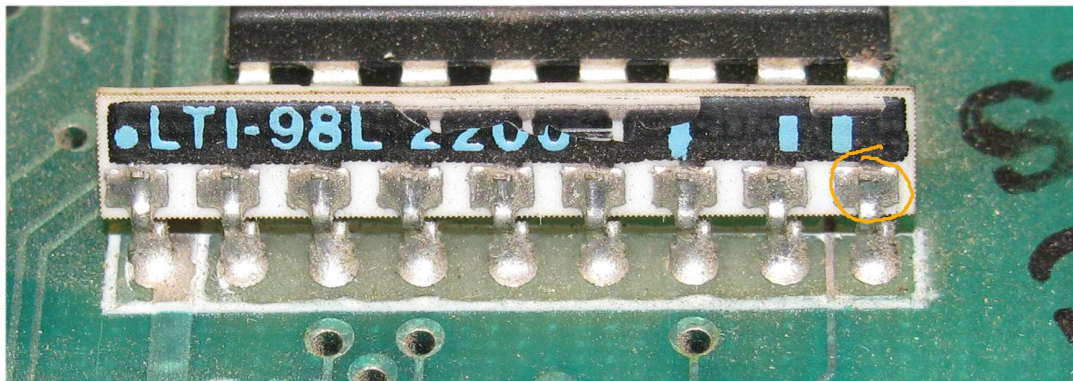




- 8 pin, 220 ohm, isolated – Orange – RM16
- 5 pin 1000 ohm, bussed – Purple – RM1, RM2, RM3, RM5, RM9
- 9 pin 1000 ohm, bussed – Cyan – RM4, RM6, RM7
- 8 pin, 2.2k ohm, isolated – Red – RM10, RM11, RM12, RM13
- 9 pin, 2.2k ohm, bussed – Yellow – RM17, RM18, RM19, RM20
- 9 pin, 4.7k ohm, bussed – Green – RM21, RM22

The manufacturer used two different types of resistor packs on the Galaga game boards. Some boards are a mixture of the two types while others have all of one kind or another.

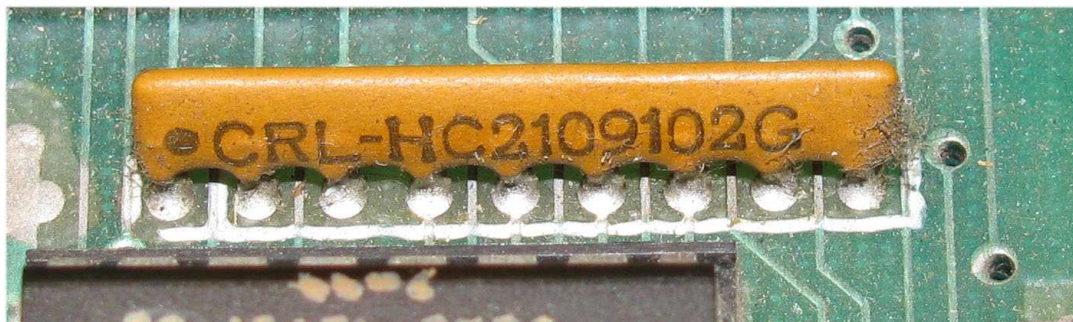
The first type is a flat ceramic substrate with a resistive film laid on it. The legs are soldered to the substrate. This type is VERY prone to damage and is the type you want to replace on the Galaga board. If the device is pushed or moved over to the side, the solder point will break off the substrate resulting in no connection on any pins that break loose.



Note the circled pin. This is the area that will break loose from the white ceramic substrate. The pin in this picture is making good contact but the device should be replaced to ensure trouble free operation.

Problems with these resistor packs causes symptoms ranging from dead boards to intermittent boards, odd graphics problems, no sound, and other types of issues.

The second type is similar in construction but is conformal coated. This type is much less likely to suffer from the broken pin problems of the other type.



The resistor packs supplied in the kit are of the second type in construction.

Be very careful when desoldering these SIP type resistors from the board. You are better off breaking off the device and desoldering individual pins from the board. Solder tends to stick on the top of the hole and hold the device in place. This will cause traces to be pulled off the board when the device is removed. By desoldering individual pins, these trace pulling problems can be minimized.

Once the resistor packs have been replaced, double-check your work then insert the chips back into their sockets and set the CPU board to the side. The custom chips are placed as follows:

- 06xx – 2L
- 07xx – 4D
- 08xx – 2J, 2H, 2E
- 51xx – 4H
- 54xx – 6M

The EPROMs are inserted in this order:

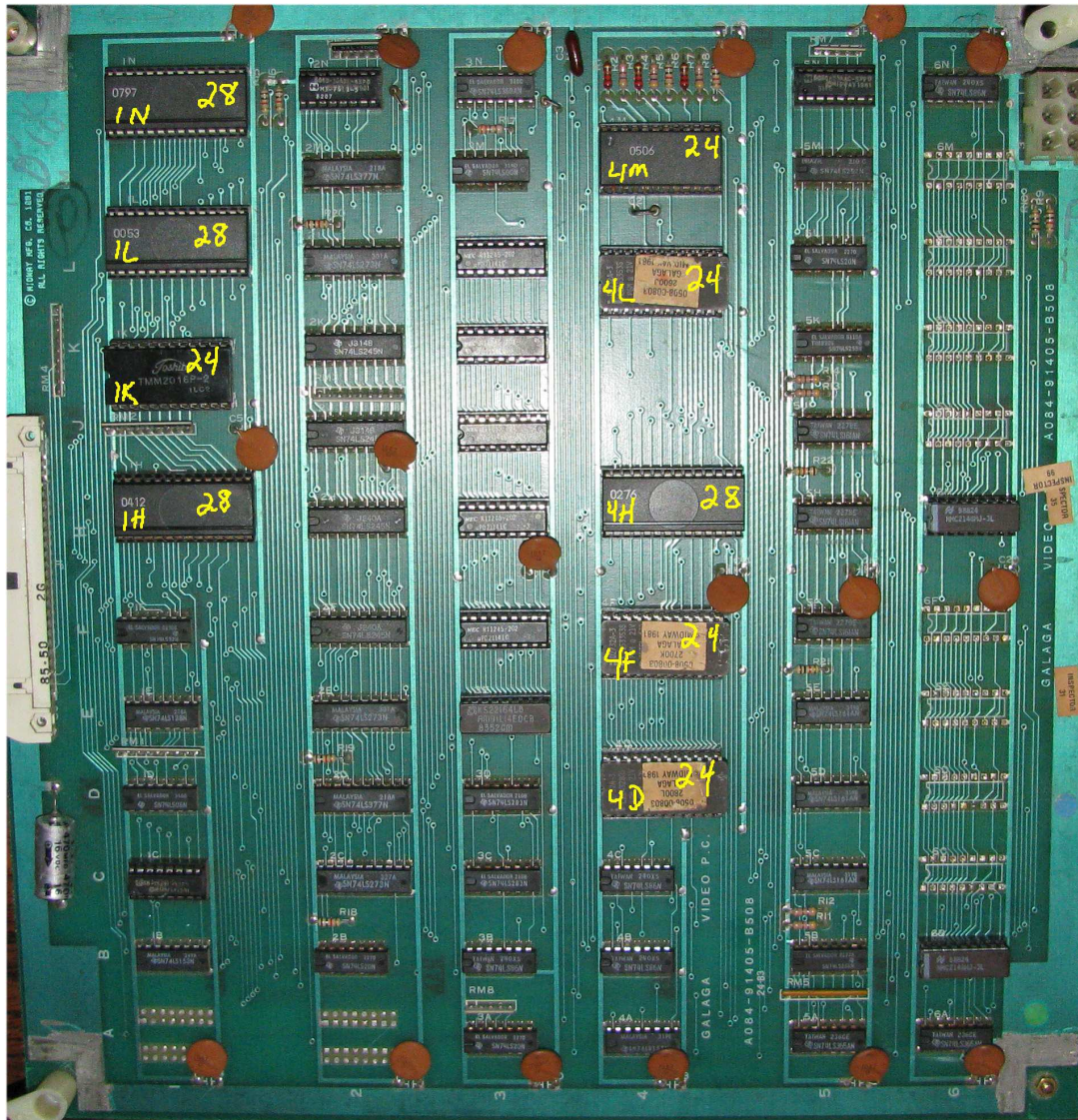
- 3200A – 3N
- 3300B – 3M
- 3400C – 3L
- 3500D – 3K
- 3600E – 3J (Sometimes replaced with a “Gal Fast” labeled EPROM)
- 3700G – 3E

It's now time to work on the Video board.

Remove the 24 and 28 pin socketed chips then replace the 24 pin sockets at location 1K, 4M, 4L, 4F, and 4D. Next, replace the 28 pin sockets at location 1N, 1L, 1H, and 4H.

Clean up any corroded or tarnished pins on the custom chips then set all the pulled chips aside on anti-static foam. Repair any broken pins on the custom chips.

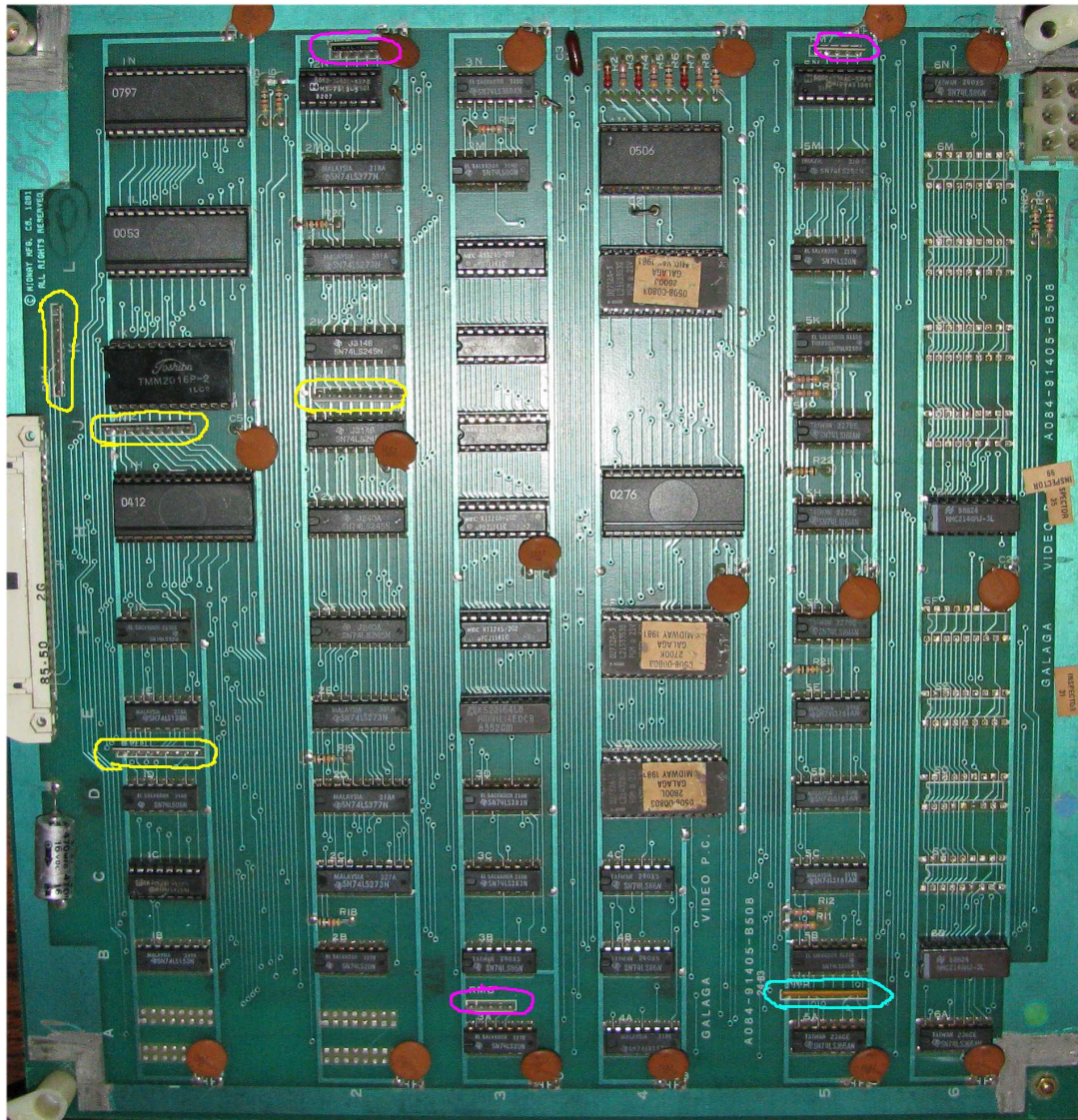




Next, replace the SIP resistor packs on the video board. There are only 8 to replace on the Video board.

- 5 pin 1000 ohm, bussed – Purple – RM6, RM7, RM8
- 9 pin 1000 ohm, bussed – Cyan – RM5
- 9 pin, 2.2k ohm, bussed – Yellow – RM1, RM2, RM3, RM4





When finished, inspect your work then reinsert the chips back into their proper place on the video board. The custom chips are inserted as follows:

- 00xx – 1L
- 02xx – 4H
- 04xx – 1H
- 05xx – 4M
- 07xx – 1N

The EPROMs are inserted in this order:

- 2600J – 4L
- 2700K – 4F
- 2800L – 4D

It's time to reassemble the board! If all was done right and you started with a working board you should end up with a working board. If the board was dead to begin with, you have a good chance at having a working board when finished. If not, it's time to start troubleshooting.

Dead board? Check for dead CPUs, bad ROMs, or bad 2114 SRAMs. If the VSYNC\* signal from 4D isn't making it to the reset circuit then the reset line will be flipping up/down constantly. Make sure there are no bent pins on 4D and no traces were lifted when replacing the socket.

Board dies after warming up? Make sure you have a Z80A CPU in 4M, NOT a plain Z80. (The A is rated for faster clock speeds and is needed at 4M)

Board goes through the self test then plays the explosion sound and immediately reboots: Check for a dead CPU at 4J or 4E or bad EPROMs at 3J or 3E. This can also be caused by Switch 5 at board location 6J being set to On.

Vertical lines in the graphics? Then you have one or more bad SRAMs on the video board at location 6M through 6B.

There are more troubleshooting tips available on the following web sites:

<http://newlifegames.net/nlg/index.php?topic=153.0> (Our repair logs for Midway games)

And:

<http://www.arcadeshop.com/galaga/galaga.htm>

<http://www.arcadeshop.com/gal-tips.htm>

<http://www.mikesarcade.com/arcade/repairs/galaga.html>