

## Atari Quantum - Main Game Board - Pincushion Correction

### Introduction:

The monitors most commonly used with the Atari Quantum game board are the WGK6100 and Amplifone color vector monitors. Though the Quantum game board will work with either one of these monitors, there are physical differences between them such as their physical geometry and their response to the drawing signals provided by the game board. These differences influence the position of the electron beam as it traverses the screen and thus the picture will appear differently depending on which type of monitor is used. An ideal picture is one that draws all horizontal and vertical lines (vectors) such that they appear visibly perfectly straight. Drawing lines on a cathode ray tube (CRT or picture tube) is a very complex task. It is made even more complex due to the requirement that the lines drawn end up appearing straight despite the non-linear geometric shape of the CRT face and the non-linear change in beam travel with respect to beam angle. In order to draw a straight line (vector), the game board circuitry must automatically compensate for the specific type of monitor used. To achieve this, the game board includes *pincushion correction* circuits in the video signal generator. The correction circuitry works by adding (or subtracting) a fraction of the magnitude of the X signal to (or from) the Y signal and vice-versa. *Pincushion* is the term that describes lines that bend inward toward the center of the screen. *Barrel* is the term that describes lines that bend outward away from the center of the screen.

The overall quality of the picture is determined by viewing the square grid test pattern. Ideally, all of the horizontal and vertical lines appear as straight as possible. To get an ideal picture, it is necessary to adjust the values of specific resistors on the game board in the pincushion correction circuits of the video generator.

There are two pairs of resistors that can be used to adjust the overall pincushion and/or barrel correction, R48-R49 and R75-R76. The original Atari Quantum schematic indicates these parts as populated, or not, as follows:

PCB Ref	Populated	Value	Comments
R48	No	100k	R48 is connected in parallel with R49. Determines amount of X (Horizontal, short axis) to apply to Y (Vertical, long axis). Effects appearance of lines across the screen.
R49	No	1.5k	
R75	No	-	R75 is connected in parallel with R76. Determines amount of Y (Vertical, long axis) to apply to X (Horizontal, short axis). Effects appearance of lines up and down the screen.
R76	Yes	1.2k	

The resistor configuration shown above was applied to both a WGK6100 monitor and an Amplifone monitor and the result was unsatisfactory on both of them. To fix the problem, both monitors were tested with a few different configurations of resistors. Everything boils down to determining the most appropriate values for the resistors R49 and R76 to install on the game PCB. All of the test results are shown in the last section.

### The best picture for each monitor was achieved using the following configurations:

Monitor	R48	R49	R75	R76
WGK6100	open	1.5k	open	open
Amplifone	open	4.7k	open	open

### To make it easy to select the desired type of monitor whenever needed, populate the board as follows:

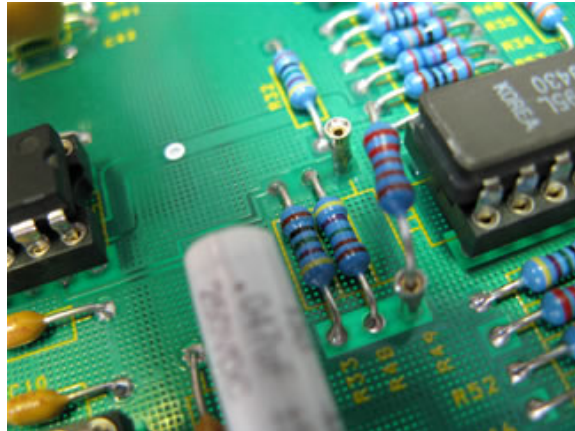
- Install the 4.7k resistor at R48. This sets the default value for the board to Amplifone.
- Install machined pin sockets in the holes of R49. You can knock a couple of pin sockets out of any typical "machined pin" DIP socket.
- Note that to work with the WGK6100 monitor another resistor value must be connected in parallel to the 4.7k resistor to produce a net value of 1.5k. The required value is 2.2k.
- Bend a 2.2k resistor and cut the leads short such that it will plug into the pin-sockets.

## To select the desired monitor :

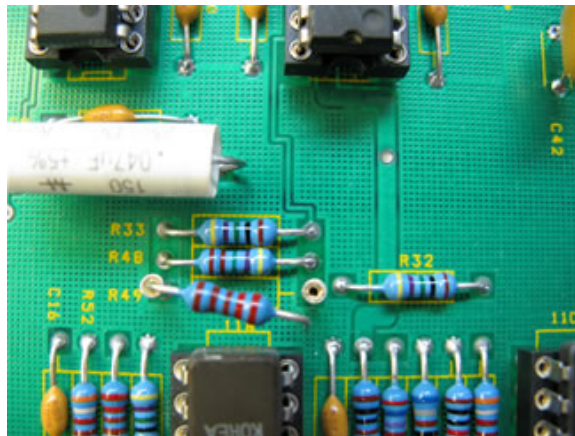
**WGK6100:** Plug the 2.2k resistor into the pin sockets at R49.

**Amplifone:** Remove either end of the 2.2k resistor from its pin socket. Leave the resistor hanging by one pin such that the free pin is not touching anything. If you are not comfortable leaving it this way, simply remove the resistor entirely. Just remember, someone may need it again to switch back to the WGK6100 in the future so it might be best to leave the resistor hanging on the board.

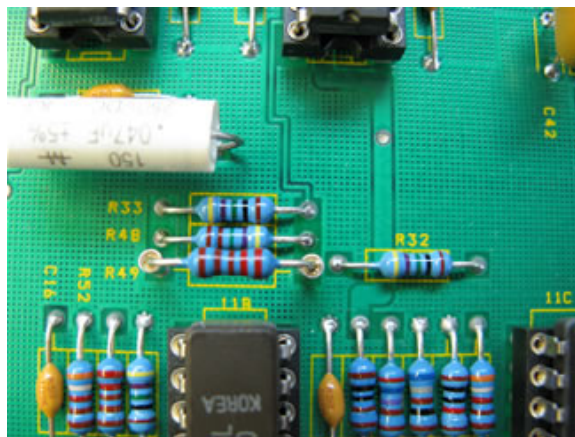
Amplifone:  
R49 disconnected



Amplifone:  
R49 disconnected



WGK6100:  
R49 connected



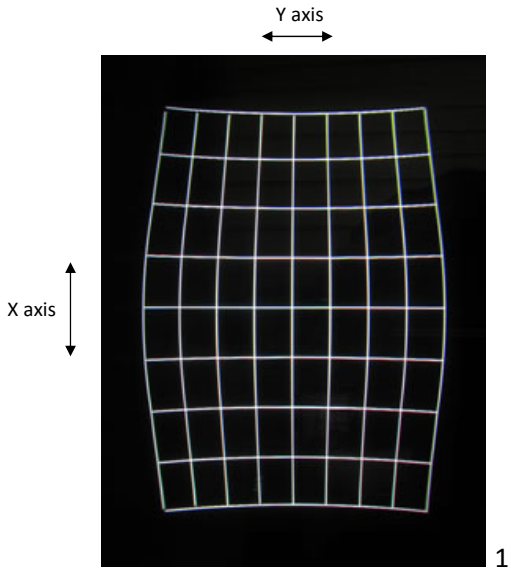
Note 1: The resistor shown at R48 = 4.75k, colors: yellow, violet, green, brown.

Note 2: The resistor shown at R49 = 2.21k, colors: red, red, brown, brown.

**Test Results:**

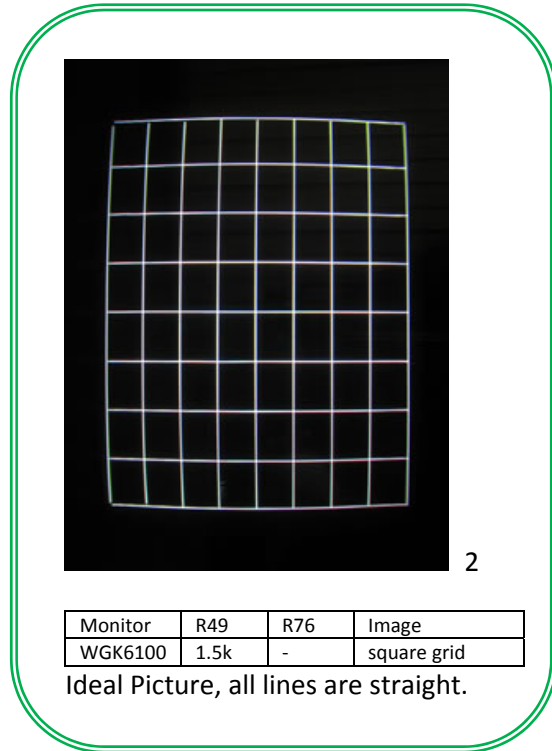
The following photos show the effects of populating the resistors in different configurations on both the WGK6100 and Amplifone monitors. The pictures are live screen shots taken of a working Quantum machine. Note that some slight geometric distortion may be caused by the relative angle of the camera to the monitor and by the camera itself. Such distortion is typical of many wide angle camera lenses.

**WGK6100:**



Monitor	R49	R76	Image
WGK6100	-	1.2k	square grid

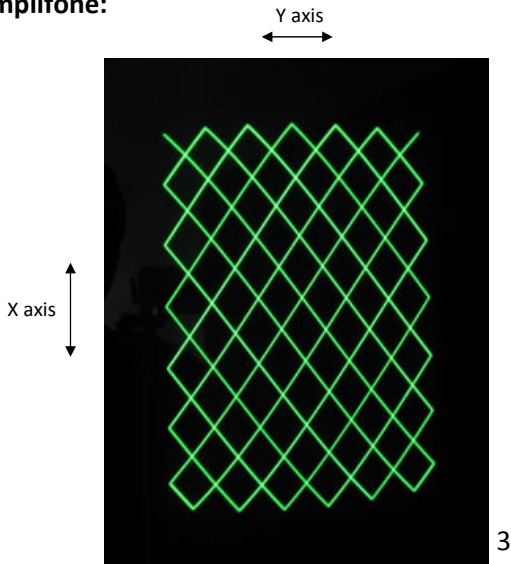
Barreling in X, pincushion in Y.



Monitor	R49	R76	Image
WGK6100	1.5k	-	square grid

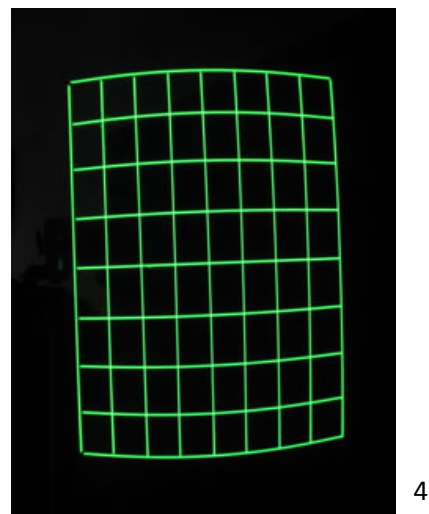
Ideal Picture, all lines are straight.

**Amplifone:**



Monitor	R49	R76	Image
Amplifone	1.5k	-	diamond grid

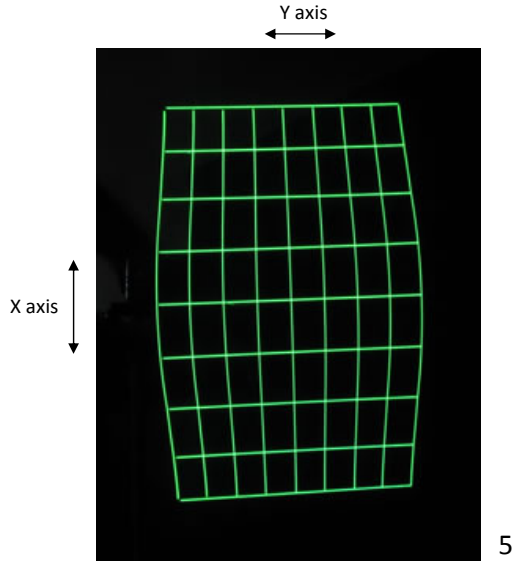
Not bad in X, barreling in Y.



Monitor	R49	R76	Image
Amplifone	1.5k	-	square grid

Not bad in X, barreling in Y.

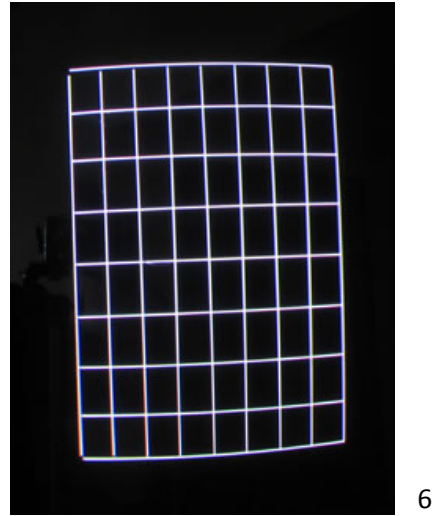
Amplifone continued...



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Monitor	R49	R76	Image
Amplifone	-	1.2k	square grid

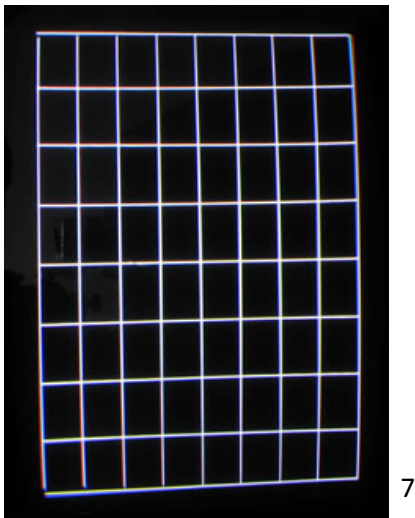
Severe barreling in X, not bad in Y.



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Monitor	R49	R76	Image
Amplifone	3.3k	-	square grid

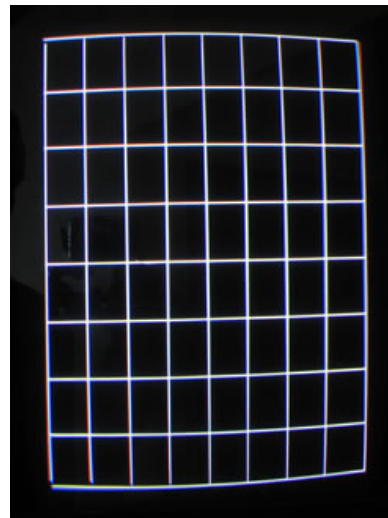
Close to ideal, slight barreling in Y.



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Monitor	R49	R76	Image
Amplifone	-	-	square grid

Slight barreling X, slight pincushion in Y.

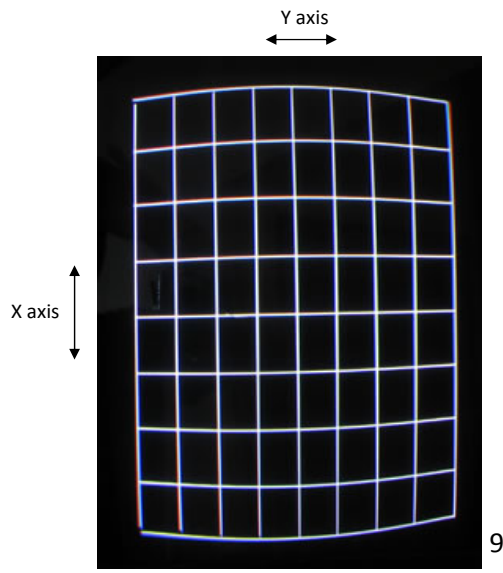


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Monitor	R49	R76	Image
Amplifone	3.3k	-	square grid

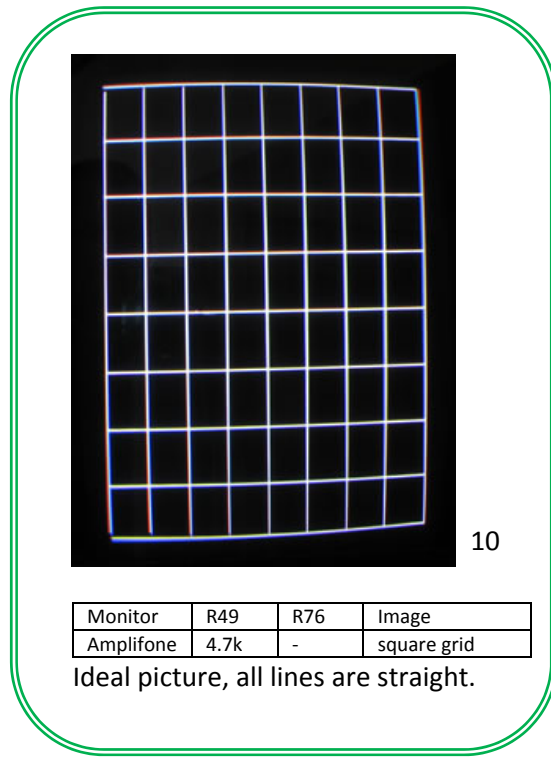
Close to ideal, slight barreling in Y.  
This is the same as picture 6 except size is increased to full screen.

## Amplifone continued...



Monitor	R49	R76	Image
Amplifone	1.5k	-	square grid

Not too bad in X, barreling in Y.  
This is the same as picture 4 except  
size is increased to full screen.



Monitor	R49	R76	Image
Amplifone	4.7k	-	square grid

Ideal picture, all lines are straight.