The Wells Gardner 19K6400 Color X/Y monitor
or
Oh God, Not another color X/Y monitor!

Preface:

Twas the autumn of the First year, the divine beginning for some, when out from abyss of B&W came to be the 19K6100... and it was seen as good. Well, sort of. It was then, mere months later, out of the fell darkness, there came to be wrought the dread G-08 and a great new and cry was heard fall from the tongues of the embittered worshipers of the X/Y. Amidst the babble and throng was heard the call "Where's that damnable fire extinguisher?".

Of the false savior, the spawn of the Disciples of Amplifone, whose name shall not be uttered, naught is written, for it was a twisted beast whose heart was oft consumed in fire.

It then came to pass that the exalted Engineers of WG did bend their will and thought to bring forth into being a new X/Y monitor whose very heart and sinew was taken from its most highest parent, the K6100. After the Blessed Engineer's most arduous toil had ended they rested and did look down upon that which they had brought into being and their hearts did soar and near burst with gladness. Rejoicing, they were heard to proclaim in blinding voices which reverberated in to the Heavens...

"BEHOLD, THE 19K6400".

OK, seriously, if your like me you've heard of the Wells Gardner 19K6101/2, the Electrohome G-08 and the Amplifone (whatever) and probably worked on a few too. You also probably read Gregg Woodcock's EXCELLENT write up on them. If you haven't read the latest version of it (6.1) do so. Highly recommended! In this document are mentions of some revisions of the deflection, Hi-V and neck boards; boards numbered P322, P324 and P341, respectively. There are also hints at a model called the 19K6400. Since I had never seen a 6400 I had assumed that it was similar to the 6100 series and the boards would be swappable. It turns out that they are not.

The 19K6401 and 6402 are very similar to its predecessor but there are some important differences. First, and most important, is the fact that they are NOT plug compatible, physically or electrically. The main connector is only 12 pins, not 15. The RGB and associated returns are on this connector, as is the filament voltage and the AC input voltage. The X and Y signals come in on a separate 4 position connector. The X,Y and RGB signals are the same as the 6100 series but the AC input voltage is +/- 40 VAC, not +/- 25VAC!

Looking at the monitor you'd also notice that the power transistors for the X and Y deflection circuits are gone. They are no longer mounted to the chassis. Instead there are four vertically mounted aluminum heat sinks between the high voltage cage and the deflection board. There are also twice as many power transistors as before (more on this below).

The other physical differences are unimportant and won't be mentioned here except to say that the Hi-V cage is 'connector-ized' differently. The real differences can be found by looking at the schematics. I'll cover the changes (read improvements) in the circuits for each board separately.

---------- ELECTRICAL SPECIFICATIONS ----------

First here's a comparison of specifications taken from the manuals for both of these monitors. You'll note that there's more thorough specifications for the 6400.

Model 19K610x (from Atari manual TM-183 2nd printing)

A. INPUTS
1. Input Voltage
   25-0-25 VAC RMS center-tapped at nominal line for amplifier.
2. Input Voltage Range
   +10% to -15%
3. Input Power at 50 VAC
   150 watts AC (amplifiers at maximum deflection).
4. Signal Inputs (at maximum deflection).
   "X" horizontal: 16 volts P/P (+/-8 volts).
   "Y" vertical: 12 volts P/P (+/-6 volts).
   "Z" beam drive: 4.0 volts maximum brightness, 1.0 volt black level.
5. Input Impedance
   "X" = 2.5K ohms, "Y" = 2.8K ohms, "Z" = 1K ohms

B. WRITING RATE
   "X" amplifier = .05 inch per microsecond, "Y" amplifier = .0375 inch per microsecond.

C. Z BANDWIDTH
   5 MHz at -3db point.

D. HIGH VOLTAGE
   19.5KV at Ib=0; adjustable to +/- 2 1/2%. High voltage regulation restricted to 2% maximum (Ib 0 to 100 microamps)

C. CONTROLS
   Factory adjusted controls: high-voltage adjustment and Z tracking
   Operator adjustable controls: focus and brightness.

Model 19K640x (from 19K6400 CVM Service manual)

1. INPUT POWER REQUIREMENTS:
   Input Voltage
   40-0-40 VAC RMS @ 1.75 ARMS (Typical)
   6.6 VRMS @ 0.74A (Filament)
   Input Voltage Range: +10% to -10% for performance specifications.
   Input Power: 140W typical
   All secondary windings must be isolated from the power line.
2. SIGNAL INPUTS:
   "X" full deflection 8V P/P (+4V to -4V) - 15 inches
   "Y" full deflection 6V P/P (+3V to -3V) - 11.25 inches
   Red, Green and Blue Drive
   Blanking Level..... 1.0V
   CRT Cutoff..... 1.5V
   Low Beam..... 1.8V
   High Beam..... 3.6V
   Max Drive..... 4.0V
3. INPUT IMPEDANCE:
   "X"..... 1.3k ohms
   "Y"..... 1.3k ohms
   "Z"..... 1.0k ohms
4. WRITING DISTANCE VS. TIME:
   Measured maximum time durations per line segment @ -10% line.

"X"	"Y"
6.0us for 0.5"	6.0us for 0.5"
8.0us for 1.0"	8.0us for 1.0"
16.0us for 2.0"	21.0us for 2.0"
30.0us for 4.0"	42.0us for 4.0"
62.0us for 8.0"	94.0us for 8.0"
110.0us for 14.5"	131.0us for 10.5"

5. X-Y DEFLECTION AMPLIFIER DUTY CYCLE:
   The maximum duty cycle of deflection, in any one direction off center, is 60% of the frame time for full deflection. Amplifier protection circuitry will activate if this level is exceeded.
6. X-Y DEFLECTION DELAY WITH RESPECT TO Z:
   1.5us maximum
7. DRIFT WITH TEMPERATURE:
   Pattern shift after stabilization,0.15 inch max.(25C to 55C).
8. HIGH VOLTAGE:
   19.5KV +/- 0.5kV @ 0 beam.
   Regulation...2.0%
9. PINCUSHION DISTORTION: 15 x 11.25 inch rectangle
   N-S 1.5% max.
   E-W 1.5% max.
10. LINEARITY DISTORTION: Crosshatch Pattern Largest Square vs. Smallest square
   X axis 10% max.
   Y axis 10% max.
11. CONTROLS [not listed in manual but I'll add them here]
   X GAIN, X LINEARITY, X CENTERING,
   Y GAIN, Y LINEARITY, Y CENTERING.

NOTE: The above controls are part of the Interface PC Board P325

Due to the minimal specs for the 6100's writing rate you can't really do a true comparison on the relative speeds.

---------- CIRCUIT COMPONENT COMPARISON ----------

This section describes the differences in the actual components in the two monitors. The PC boards themselves are different to allow for the two new connectors on the deflection board assembly, the brightness control parts on the neck board and the slightly different power connector for the Hi-V board.

Unless otherwise noted: all resistors are 1/4 Watt 5% Tolerance, all capacitor values in uF (microfarads)

I) P322 - THE DEFLECTION / DC VOLTAGE / SPOT KILLER BOARD ----------

a) DC voltage Supply

For the most part the design of this board is similar to the P327 board. Here the supply was designed to output +/-47 VDC where it use to be +/- 28V. Value changes are listed below.

	19K610x (P314)	19K640x (P322)
Q100	MPSA06	MPSU57
Q101	MPSA56	MPSU07
Q102	2N3716	2N3716X
Q103	2N3792	2N3792X
D100-103	S5A2	SAME
D104,105	1N914B	1N4004
ZD100,101	ZENER 28V,1W,5%	46V,1W,5%
C100,101	4700uF 50V	4700uF 63V
C102,103	470uF 35V	330uF 50V
C104,105	0.1uF 50V	SAME
R100,101	15ohm 1/2W 5%	SAME
R102,103	330ohm	1K

b) Spot Killer Circuit

Only resistor value changes here to compensate for the higher rails.

Q800	2N3906	
Q801,Q802		
D800	LED,red	SAME
D801,802	1N914	
D803,804		
C800-803	0.47uF	1.0uF 50V
R800	4.7Kohm	10K
R801	15Kohm	33K
R802	1.2Kohm 1/2W	2.2K 2W
R803	33Kohm	SAME
R804,805	750Kohm	1.5MEG
R806,807	220ohm	SAME
R808,809	680ohm 1/2W	270ohm 1/2W

c) Deflection Amps

The design of this section is mostly the same. The difference is in the transistors Q605,606,705,706. Each of these is replaced with A PAIR of transistors and two low resistance emitter resistors. These are now mounted on large (~4" X 4") aluminum finned heat sinks.

Q600-602,700-702	TPS98	SAME
Q603,703	MPSU57	SAME
Q604,704	MPSU07	SAME
D600,601,700,701	1N914B	SAME
D602,702	1N4001	SAME
C600,601,700,701	0.001uF	.001/-/-/.001
C602,702	0.22uF	SAME
C603,703	0.47uF 100V	SAME
C604,704	0.1uF 50V	SAME
R600,700	1.2K 2%	0 OHM
R601	1.6K 2%	NOT USED
R701	1.3K 2%	NOT USED
R602,603,702,703, 607,707	390ohm	470ohm
R604,704	2.7K 1/2W	3.6K 1/2W
R605,705	91ohm	SAME
R606	2.2K 1/2W	8.2K 1/2W
R706	2.2K 1/2W	4.7K 1/2W
R608,708	100ohm	SAME
R609,709	15ohm	24ohm
R610,710	1.5ohm 10W NON-IND	SAME
R611,711	10ohm	39ohm
R612,613,712,713 [See text below for circuit change]	3.3ohm 1/2W	68ohm 2W/unused/unused/68ohm 2W
R614	1.2K 1/2W	SAME
R714	1.6K 1/2W	1.3K 1/2W

Deflection Transistors

Q605	2N3716	2N3716/2N3716/two 0.39ohm 1W 5%
Q705	2N3716	2N3716/2N3716/two 0.39ohm 1W 5%
Q606	2N3792	2N3792X/2N3792X/two 0.39ohm 1W 5%
Q706	2N3792X	2N3792/2N3792/two 0.39ohm 1W 5%

Circuit change
In an effort to decouple the delfection pre-drivers from the power drivers the circuit has been changed here slightly. Note the absence of R613 & R712.

The deflection power transistors, as mentioned above, are now two transistors with their bases connected together and thier collectors connected together. Each emitter is connected to a 0.39ohm 1W 5% resistor with the other ends of the resistor tied together. Collectors and bases are connected as before and the resistors are now connected to where the emitter use to be on the 6100. Each transistor pair is now mounted on a hefty (~4" x 4") aluminum finned heat sink. The four heat sink assemblies are stacked together and are mounted to the chassis between the Hi-V cage and the deflection board.

The RCA picture tube 19VLTP22 is used in the 19K6402 model monitor and requires the WG #9A2825-001 deflection yoke. The Rauland picture tube, type 19VNJP22, which is used in the model 19K6401, requires a 9A2819-001 yoke.

d) Degauss Circuit
P.T.C.,D106,D107,C106 - unchanged

R106	22ohm 2W 10%	22ohm 3W 10%

II) P324 - THE HIGH VOLTAGE BOARD ----------

IMHO, this change alone makes the monitor 2X as reliable as it's predecessor. In the original design, if one side of the power supply died, which it often did, there was a fair chance that the Hi-V circuit could be over-stressed. I'm not implying that this was the major cause of failures, just one of them. In the 6400 design the Hi-V module is powered by +48VDC. There are very few other differences in the design.

Component value changes (components not mentioned remain unchanged)

	19K610x (P316)	19K640x (P324)
C901	100uF 35V	100uF 100V
C902	100uF 35V	SHORT (note 1)
C905	33uF 150V	33uF 63V
R901	2.2ohm 2W 5%	3.9ohm 3W 10%
R907	2.2ohm 2W 5%	UNUSED

Note 1 - By shorting out capacitor C902 what use to be B- is now GND.

III) P341 - THE NECK BOARD ----------

At first glance the P341 looks very much like the P315. Comparing the CRT socket pinouts, however, shows otherwise. The 19VLTP22 pinout is very different from the 19VLUP22. While physically you could plug the P341 in place of a 315; all the connectors would fit, you'd probably destroy both board and tube.

Component value changes (components not mentioned remain unchanged)

	19K610x (P315)	19K640x (P341)
ZD501	ZENER 13V 1W 5%	18V 1W 5%
C503	33uF 250V	2.2uF 350V
R525	3.3M 1/2W 10%	22M 1/2W
R526	510ohm 1W	1K 2W
R527	470ohm 1/2W	33ohm 1/2W

Circuit change -
Capacitors C500-502 are now connected to the wipers of R507-509. The brightness control circuit is made up of an additional four resistors, one potentiometer and a cap.

IV) P325 INTERFACE & IPC BOARD ----------

This is a new board which accepts the X & Y signals along with +/- 40VDC and output modified X & Y signals. The first stage of the board is an adjustable gain circuit with a nominal value of X2. The next stage provides input protection for the deflection amplifiers. Lastly there is linearity and centering adjustments. It's not clear from the manual just where the board is actually located but it sounds as if it plugs directly into two new connectors on the deflection board (P602 and P702) and is at a right angle to it. Doesn't sound like it's very easy to get at the pots.

---------- SUMMARY ----------

I'm posting this article simply to distribute information that's not widely available. The 19K640x has obvious improvements over the 19K610x but I'm not trying to say that it's a better monitor overall. I have no idea if WG had intended this to be the next generation color X/Y monitor or if it was a response to Electrohome's G08. It obviously wasn't widely used. The only game that I know used it is Aztarac and we know how many of those there are ;-)

You're probably wondering if some of the improvements could be used to upgrade our beloved K610x's. The answer is a resounding 'Maybe'. The three major improvements, I think, are: the dual deflection transistors, the Hi-V supply's unipolar supply input and the new Interface board (Very handy if this display were to be used with the Sega stuff). The method of transistor heat sinking could definitely be applied but it's up in the air whether the dual XSTR design can be applied (I'm leaning toward a yes here). The Interface board could certainly be used but without a PC board it would be too much work to make. Lastly, the Hi-V supply mod is probably not possible. However if one was to use an external 48V supply...

Dave Fish Melrose, MA USA dfish@bev.etn.com (work) dfish@nyx.cs.du.edu (/work)	"We want...Information. INFORMATION You won't get it! By hook or by crook we will" _The Prisoner_