IN THE UNITED STATES DISTRICT COURT
DISTRICT OF DELAWARE

VISUAL EFFECT INNOVATIONS, LLC **Plaintiff,** **v.** **LG ELECTRONICS U.S.A., INC. and LG ELECTRONICS INC.,** **Defendants.**	**Civil Action No. 18-cv-00687-LPS-CJB** **JURY TRIAL DEMANDED**

SECOND AMENDED COMPLAINT FOR PATENT INFRINGEMENT

This is an action for patent infringement arising under the Patent Laws of the United States of America, 35 U.S.C. § 1 et seq. in which Plaintiff Visual Effect Innovations, LLC ("VEI" or "Plaintiff") brings this patent infringement action against Defendants LG Electronics U.S.A., Inc. ("LG USA") and LG Electronics Inc., its parent company ("LG Korea", together with LG USA, "LG" or "Defendants") and alleges as follows:

BACKGROUND

1. Plaintiff VEI is the assignee of all right, title, and interest in and to U.S. Patent No. 9,781,408, entitled "Faster state transitioning for continuous adjustable 3Deeps filter spectacles using multi-layered variable tint materials" ("the '408 Patent," attached as Exhibit A); and U.S. Patent No. 9,948,922, entitled "Faster State Transitioning For Continuous Adjustable 3deeps Filter Spectacles Using Multi-Layered Variable Tint Materials" ("the '922 Patent," attached as Exhibit B). VEI has the exclusive right to assert all causes of action arising under the Patents-in-Suit and the right to remedies for infringement thereof.

2. Plaintiff VEI is also the assignee of all right, title, and interest in and to U.S. Patent No. 9,699,444, entitled "Faster state transitioning for continuous adjustable 3Deeps filter

spectacles using multi-layered variable tint materials" ("the '444 Patent," attached as Exhibit C), U.S. Patent No. 9,716,874, entitled "Continuous adjustable 3Deeps Filter Spectacles for optimized 3Deeps stereoscopic viewing, control method and means therefor, and system and method of generating and displaying a modified video" ("the '874 Patent," attached as Exhibit D), and U.S. Patent No. 7,030,902 entitled "Eternalism, a method for creating an appearance of sustained three-dimensional motion-direction of unlimited duration, using a finite number of pictures" ("the '902 Patent," attached as Exhibit E) (collectively with the '408 and '922 Patents, the "Patents-in-Suit"). VEI has the exclusive right to assert all causes of action arising under the Patents-in-Suit and the right to remedies for infringement thereof.

3. The inventors on the Patents-in-Suit are Kenneth Martin Jacobs and Ronald Steven Karpf.

4. Mr. Jacobs is the Distinguished Professor Emeritus of Cinema at SUNY Binghamton. He is the recipient of the American Film Institute's Maya Deren Independent Film and Video Artists Award, and the winner of the Los Angeles Film Critic's Douglas Edwards Experimental/Independent Film/Video Award. He is also the recipient of the Guggenheim Award and a special Rockefeller Foundation grant; and his work has been featured in prominent museums including the New York Museum of Modern Art, the American House in Paris, the Arsenal Theater in Berlin, the Louvre in Paris, and at the Getty Center in Los Angeles.

5. Mr. Karpf is the Founding Partner of bioinformatics company ADDIS Informatics, and Founding Partner of technology security company Geo Codex LLC. Mr. Karpf has an MA and Ph.D. in Mathematical Sciences.

6. The inventions claimed in the Patents-in-Suit are directed to unconventional improvements in the technology for displaying moving pictures, which has application in films, television and other display technology. In particular, these inventions are directed to, among other things, improvements in how continuous movement is displayed on presentation devices. *See* '408 patent, col. 2, lns. 16-32; '922 patent, col. 2, lns. 18-34.

7. As explained in the specifications, the claimed inventions originated as ways to solve problems arising in the technology used to portray continuous movement in the technology used to display films or movies in theaters. The specifications explain the traditional or conventional methods of displaying continuous movement in films or movies, which included:

> The appearance of continuous movement, using only two substantially similar pictures, has been accomplished in live performance by simultaneous projection of both images onto a screen, wherein one picture may be slightly off-set from the other picture as they appear on the screen, and by rotating a two-bladed propeller, wherein the propeller blades are set off from one another by 180 degrees, in front of and between the two projectors such that the two images are made to both alternate and overlap in their appearances, with both images in turn alternating with an interval of complete darkness onscreen when both projections are blocked by the spinning propeller.

'408 patent, col. 4, lns. 42-53; '922 patent, col. 4, lns. 44-55. As further explained, this method produced "flicker," an unintended and undesirable effect of the transitions between film frames. *See, e.g.,* '408 patent, col. 50, lns. 58-64; '922 patent, col. 51, lns. 17-23. As the specifications also noted, in conventional video and computer-display "image-continuity depends likewise on this rapid on-off display," or "flicker," which was similarly disfavored. '408 patent, col. 50, lns. 47-64; '922 patent, col. 51, lns. 5-23.

8. The claimed inventions turn a negative into a positive and deliberately use "flicker" and the resulting "effects of emphatic flicker on the human optical/nervous system" to produce better visual results. '408 patent, col. 50, lns. 58-64; '922 patent, col. 51, lns. 17-23. In particular, the results include enhanced continuous movement, various artistic visual effects and depth illusions to be experienced by persons without properly functioning binocular vision. *See, e.g.,* '408 patent, col. 50, ln. 65- col. 51, ln. 23; '922 patent, col. 51, lns. 24-49.

9. One core technique initially invented to harness the power of "flicker" for this purpose included the use of a different "bridge frame" between two picture frames. As explained in the specification:

> The method of the present invention entails repetitive presentation to the viewer of at least two substantially similar image pictures alternating with a third visual interval or bridging picture that is

> substantially dissimilar to the other substantially similar pictures in order to create the appearance of continuous, seamless and sustained directional movement.

'408 patent, col. 8, lns. 50-56; '922 patent, col. 8, lns. 52-58.

10. As seen in the Patents-in-Suit and others in this family, this "bridge frame" could include a black frame or different solid color frame or a blended image (e.g., an image which is a partial picture and partial black or other solid color frame). Other nuances of and improvements to this unconventional technique are disclosed and claimed within this patent family, including in the Patents-in-Suit. In this regard, this technique – of adding a black frame or blended image between image frames -- also can be accomplished in a variety of ways, including not only by "black frame insertion" but also by "backlight scanning" – where the lighting behind the screen is dimmed, in whole or in part, in planned intervals so as to achieve the same result, of inserting a black or partially blackened "frame" between two images. These unconventional inventive techniques are claimed in the accused claims of the Patents-in-Suit.

11. These unconventional inventive techniques claimed in the patents-in-suit have application in any device that displays moving pictures, including not only devices that display film or movies in theaters, but also televisions, projectors, computer screens, gaming consoles and a variety of other applications.

12. By making, using, selling, offering for sale, and importing products including but not limited to LG televisions, LG is infringing the claims of the Patents-in-Suit.

PARTIES

13. VEI is a Texas Limited Liability Company with a principal place of business at 1400 Preston Road, Suite 400, Plano, Texas 75093.

14. On information and belief, LG is registered to do business in the State of Delaware and it may be served with process by delivering a summons and a true and correct copy of this complaint to its registered agent for receipt of service of process, Corporation Service Company, 251 Little Falls Drive, Wilmington, DE 19808.

15. On information and belief, Defendant LG Korea is a Korean corporation with its principal place of business in LG Twin Towers, 20, Yeouido-dong, Yeongdeungpo-gu, Seoul, Republic of Korea, Seoul, Republic of Korea.

JURISDICTION AND VENUE

16. This action arises under the patent laws of the United States, Title 35 of the United States Code. Accordingly, this Court has subject matter jurisdiction under 28 U.S.C. §§ 1331 and 1338(a).

17. Court has personal jurisdiction over LG because, among other reasons, LG has established minimum contacts with the forum state of Delaware.

18. Venue is proper in this District under 28 U.S.C. § 1400(b). LG Korea is a foreign corporation, while LG-USA is incorporated in this district. A substantial part of the infringement alleged in this Complaint has occurred and is occurring in this district, including the marketing, selling, and offering for sale of infringing products.

COUNT I

INFRINGEMENT OF U.S. PATENT NO. 9,781,408

(AGAINST BOTH LG USA AND LG KOREA)

19. Plaintiff incorporates by reference each of the allegations in the foregoing paragraphs, and further alleges as follows:

20. On October 3, 2017, the United States Patent and Trademark Office issued the ’408 Patent for inventions covering systems for producing an appearance of continuous movement using a finite number of images, *i.e.* as few as two images, which in one claimed embodiment comprise

a. a storage adapted to store one or more image frames; and

b. a processor adapted to obtain a first image frame from a first video stream;

c. expand the first image frame to generate a modified image frame, wherein the modified image frame is different from the first image frame;

d. generate a first altered image frame that includes first and second non-overlapping portions, wherein the first non-overlapping portion comprises a first portion of the modified image frame, wherein the first image frame does not include the second non-overlapping portion, wherein the modified image frame does not include the second non-overlapping portion; and

e. generate a second altered image frame that includes third and fourth non-overlapping portions wherein the third non-overlapping portion comprises a second portion of the modified image frame, the second portion of the modified image frame being different from the first portion of the modified image frame, wherein the first image frame does not include the fourth non-overlapping portion, wherein the modified image frame does not include the fourth non-overlapping portion.

21. A true and correct copy of the ’408 Patent is attached as Exhibit A.

22. LG has been and is now directly infringing one or more claims of the ’408 Patent, in this judicial District and elsewhere in the United States.

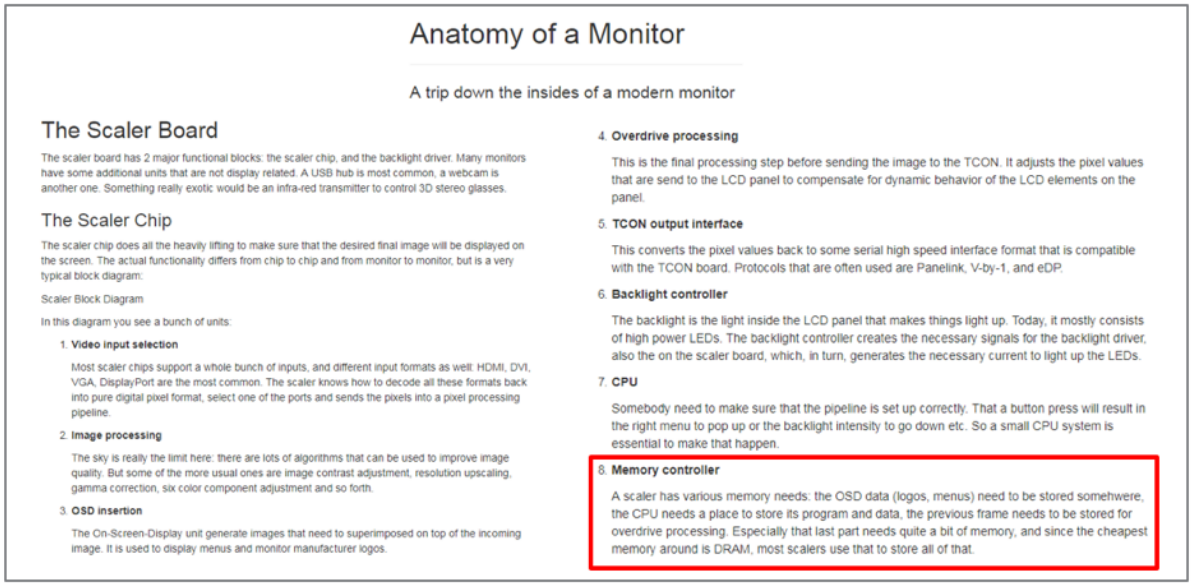
23. For example, LG directly infringes the ’408 Patent, including but not limited to claim 1, by making, using, selling, importing, and offering for sale LG televisions and monitors. The LG UNES8000 is representative of the products accused, which encompass other LG products having similar features, *e.g.*:

Figure 1 http://www.flatpanelshd.com/review.php?subaction=showfull&id=1338560188; http://www.lg.com/us/tvs/lg-84LM9600-led-tv)

LG's LM9600 range will be available in 55 and 84 inches called 55LM9600 and 84LM9600 (4K resolution) in the US. In Europe it will be available in 47, 55 and 84 inches called 47LM960V, 55LM960V and 84LM960V.

24. LG televisions and monitors comprise a storage adapted to store one or more image frames. For example, the LG LM9600/LM960V is an LED monitor, and accordingly must include a storage for the monitor instructions to be stored on as well as being capable of storing one or more image frames.

Figure 2 (Source: http://monitorinsider.com/monitor_anatomy/)



Anatomy of a Monitor

A trip down the insides of a modern monitor

The Scaler Board

The scaler board has 2 major functional blocks: the scaler chip, and the backlight driver. Many monitors have some additional units that are not display related. A USB hub is most common, a webcam is another one. Something really exotic would be an infra-red transmitter to control 3D stereo glasses.

The Scaler Chip

The scaler chip does all the heavily lifting to make sure that the desired final image will be displayed on the screen. The actual functionality differs from chip to chip and from monitor to monitor, but is a very typical block diagram:

Scaler Block Diagram

In this diagram you see a bunch of units:

1. **Video input selection**

   Most scaler chips support a whole bunch of inputs, and different input formats as well: HDMI, DVI, VGA, DisplayPort are the most common. The scaler knows how to decode all these formats back into pure digital pixel format, select one of the ports and sends the pixels into a pixel processing pipeline.

2. **Image processing**

   The sky is really the limit here: there are lots of algorithms that can be used to improve image quality. But some of the more usual ones are image contrast adjustment, resolution upscaling, gamma correction, six color component adjustment and so forth.

3. **OSD insertion**

   The On-Screen-Display unit generate images that need to superimposed on top of the incoming image. It is used to display menus and monitor manufacturer logos.

4. **Overdrive processing**

   This is the final processing step before sending the image to the TCON. It adjusts the pixel values that are send to the LCD panel to compensate for dynamic behavior of the LCD elements on the panel.

5. **TCON output interface**

   This converts the pixel values back to some serial high speed interface format that is compatible with the TCON board. Protocols that are often used are Panelink, V-by-1, and eDP.

6. **Backlight controller**

   The backlight is the light inside the LCD panel that makes things light up. Today, it mostly consists of high power LEDs. The backlight controller creates the necessary signals for the backlight driver, also the on the scaler board, which, in turn, generates the necessary current to light up the LEDs.

7. **CPU**

   Somebody need to make sure that the pipeline is set up correctly. That a button press will result in the right menu to pop up or the backlight intensity to go down etc. So a small CPU system is essential to make that happen.

8. **Memory controller**

   A scaler has various memory needs: the OSD data (logos, menus) need to be stored somehwere, the CPU needs a place to store its program and data, the previous frame needs to be stored for overdrive processing. Especially that last part needs quite a bit of memory, and since the cheapest memory around is DRAM, most scalers use that to store all of that.

In the illustrations, in general red boxes, arrows, text and lines have been added by VEI to illustrate points or to draw the Court's attention to relevant portions of the reproduced image. Some of the original material features red elements (e.g., an LG logo). Context should make those instances obvious.

25. LG televisions and monitors include a processor adapted to obtain a first image frame from a first video stream. For example, the LG LM9600/LM960V includes processors capable of obtaining a first image frame from a first video stream via any of its video input connections. The video stream could come from a cable box, DVD/Blu-Ray player, computer, or one of many other sources, *e.g.*:

Figure 3 (Source: http://www.hardwarezone.com/review-lg-lm9600-55-inch-cinema-3d-smart-tv-full-assault; http://www.lg.com/us/tvs/lg-84LM9600-led-tv)

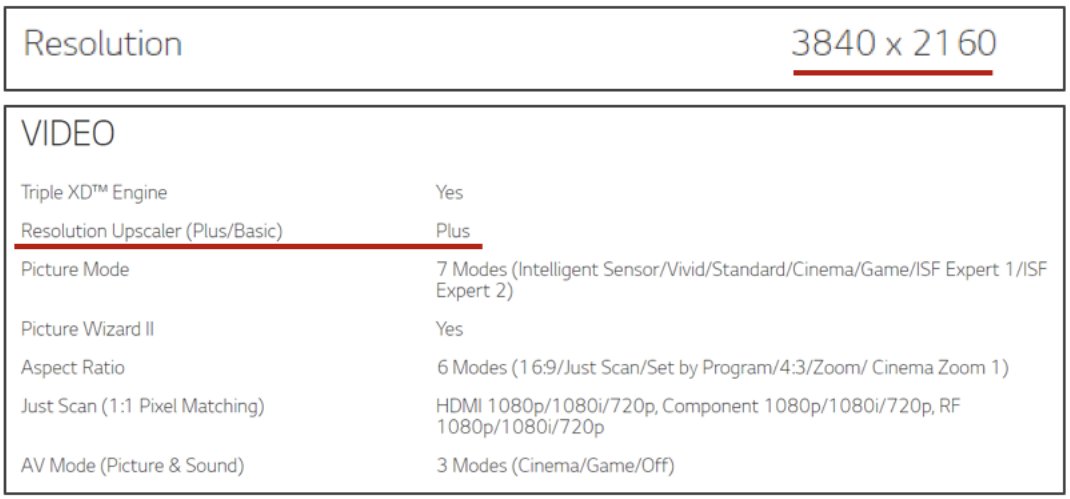
It's good to know that LG hasn't rested on their laurels either. The LM9600 flaunts a very zippy Motion Clarity Index of 1,000Hz (via frame interpolation and scanning backlights dubbed as TruMotion) with an equally impressive native refresh rate of 400Hz. Picture quality wise, LG has improved on their scaling algorithms for lower resolution videos, plus a 10,000,000 to 1 contrast ratio rating. That said, we'll regard the latter specification with a pinch of salt and revisit this later after our through analysis of the TV in the following pages. At the 3D end, LG latest passive 3D TV continues its assault on the active-shutter faction with more tweaks of its own. Some of the new features include 3D Depth-Control, and Color Correction - designed to correct the possibility of mismatched colors due to separate cameras used for left and right eye images. Powered by a dual-core central processor and a quad-core graphics processing unit, this model possesses the chops to meet Samsung's flagship ES8000 on the warpath as well. There are more new features, of course, like the reworked Magic remote which we'll update you along the course of our review. The LM9600 has form, but will it offer the same cool finesse too? If you're ready, it's time to visit this Cinema 3D set in detail to find out!

AV INPUTS/OUTPUTS

RF In (Antenna/Cable)	1 (Rear)
AV In	1 (Rear w/Gender)
Component Video In(Y, Pb, Pr + Audio)	1 (Rear w/Gender)
HDMI™/HDCP Input	4 (Side)
Digital Audio Out (Optical)	1 (Rear)
RGB In (D-Sub 15 Pin) - PC	1 (Rear)
PC Audio Input	1 (Rear)
USB 2.0	3 (Side /1:Hub)
LAN	1 (Rear)

26. LG televisions and monitors expand the first image frame to generate a modified image frame, wherein the modified image frame is different from the first image frame. For example, the LG LM9600/LM960V has a screen resolution of 3,840 x 2,160 pixels. It has an Upscaler, which in real-time expands the received image frames (most often 720p or 1080i) to a modified image frame with the screen's resolution (3,840 x 2,160). As the first image frame and the modified image frame are different sizes, the modified image frame is different from the first image frame, *e.g.*:

Figure **4**. (Source: http://www.lg.com/us/tvs/lg-84LM9600-led-tv)



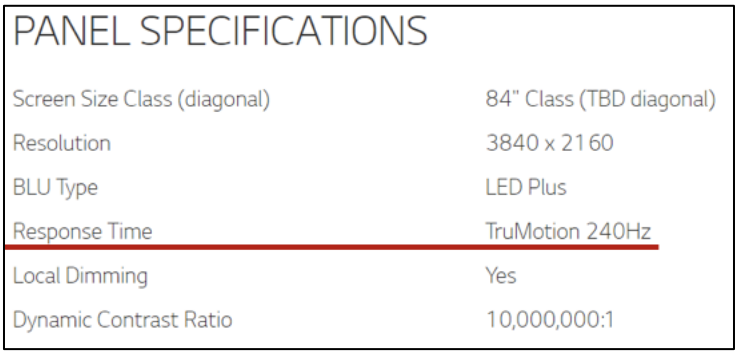
Resolution	3840 x 2160

VIDEO

Triple XD™ Engine	Yes
Resolution Upscaler (Plus/Basic)	Plus
Picture Mode	7 Modes (Intelligent Sensor/Vivid/Standard/Cinema/Game/ISF Expert 1/ISF Expert 2)
Picture Wizard II	Yes
Aspect Ratio	6 Modes (16:9/Just Scan/Set by Program/4:3/Zoom/ Cinema Zoom 1)
Just Scan (1:1 Pixel Matching)	HDMI 1080p/1080i/720p, Component 1080p/1080i/720p, RF 1080p/1080i/720p
AV Mode (Picture & Sound)	3 Modes (Cinema/Game/Off)

27. LG televisions generate a first altered image frame that includes first and second non-overlapping portions. For example, the LM9600/LM960V features LG's TruMotion 240Hz with Clear Plus technology, *e.g.*:

Figure **5**. (Source: http://www.lg.com/us/tvs/lg-84LM9600-led-tv)



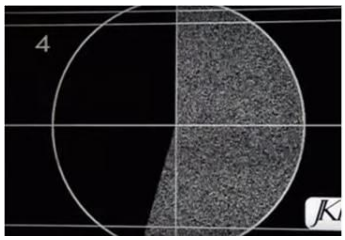
PANEL SPECIFICATIONS

Screen Size Class (diagonal)	84" Class (TBD diagonal)
Resolution	3840 x 2160
BLU Type	LED Plus
Response Time	TruMotion 240Hz
Local Dimming	Yes
Dynamic Contrast Ratio	10,000,000:1

28. LG televisions generate a first altered image frame that includes first and second non-overlapping portions, where the first non-overlapping portion is a first portion of the modified image frame, wherein the first image frame does not include the second non-overlapping portion, wherein the modified image frame does not include the second non-overlapping portion. For example, the following are screenshots from a recording of an LM9600/LM960V television showing how backlight scanning generate a first and second altered image frame that includes first and second non-overlapping portions, *e.g.*:

Figure **6**.

Still from high speed video recording of LG 47LM960V with "Trumotion" turned **off**. This illustrates how the modified image is generated with Trumotion Clear Plus turned on.

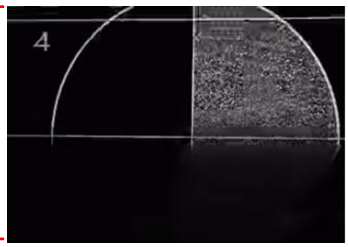


Modified image frame

(Source: https://www.youtube.com/watch?v=p8BE8NmjJok)

Still from high speed video recording of LG 47LM960V with "Trumotion Clear Plus" turned **on**

a first altered image frame that includes first and second non-overlapping portions,



first non-overlapping portion comprises a first portion of the modified image frame

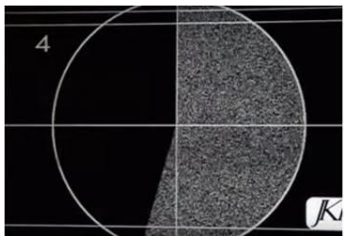
a second non-overlapping portion wherein the second non-overlapping portion is not include in the modified image frame or in the first image frame

(Source:https://www.youtube.com/watch?v=Jo4b2jEePg0)

29. LG televisions generate a second altered image frame that includes third and fourth non-overlapping portions wherein the third non-overlapping portion comprises a second portion of the modified image frame, the second portion of the modified image frame being different from the first portion of the modified image frame, wherein the first image frame does not include the fourth non-overlapping portion, wherein the modified image frame does not include the fourth non-overlapping portion, *e.g.*:

Figure **7**.

Still from high-speed video recording of LG 47LM960V with "Trumotion" turned **off.** This illustrates how the modified image is generated with Trumotion Clear Plus turned on.

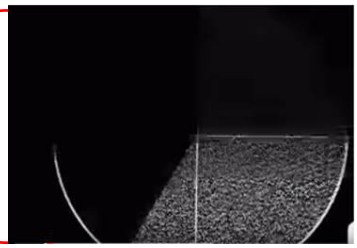


Modified image frame

(Source: https://www.youtube.com/watch?v=p8BE8NmjJok)

Stills from high-speed video recording of LG 47LM960V with "Trumotion Clear Plus" turned **on**

a second altered image frame that includes third and fourth non-overlapping portions,



a fourth non-overlapping portion, wherein the fourth non-overlapping portion is not included in the modified image frame or in the first image

a third non-overlapping portion comprises a second portion of the modified image frame, the second portion of the modified image frame being different from the first portion of the modified image frame

(Source: https://www.youtube.com/watch?v=Jo4b2jEePg0)

30. By making, using, selling, importing, and offering for sale LG televisions and other similar products, LG is infringing the claims of the ’408 Patent, including but not limited to claim 1. LG has committed these acts of infringement without license or authorization.

31. LG has injured VEI and is liable to VEI for direct infringement of the claims of the ’408 Patent pursuant to 35 U.S.C. § 271(a), (b), and (c).

32. As a result of Defendants’ infringement of the ’408 Patent, VEI has suffered harm and seeks monetary damages in an amount adequate to compensate for infringement, but in no event less than a reasonable royalty for the use made of the invention by LG, together with interest and costs as fixed by the Court.

COUNT II

INFRINGEMENT OF U.S. PATENT NO. 9,948,922

(AGAINST BOTH LG USA AND LG KOREA)

33. Plaintiff incorporates by reference each of the allegations in the foregoing paragraphs, and further alleges as follows:

34. On April 17, 2018, the United States Patent and Trademark Office issued the '922 Patent for inventions covering an apparatus which in one claimed embodiment comprises

a. a storage adapted to store one or more image frames;

b. a processor adapted to obtain a first image frame and a second image frame from a first video stream;

c. generate a first modified image frame by expanding the first image frame, wherein the first modified image frame is different from the first image frame;

d. generate a second modified image frame by expanding the second image frame, wherein the second modified image frame is different from the second image frame;

e. generate a bridge frame, wherein the bridge frame is a solid color, wherein the bridge frame is different from the first image frame and different from the second image frame;

f. display the first modified image frame;

g. display the bridge frame; and

h. display the second modified image frame.

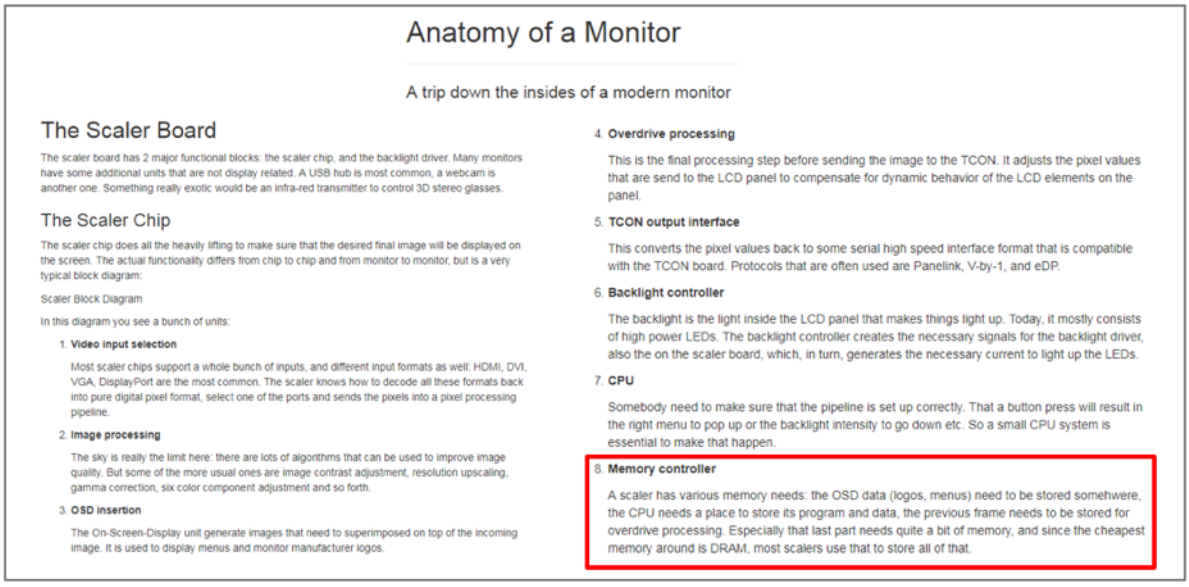
35. A true and correct copy of the '922 Patent is attached as Exhibit B.

36. LG has been and is now directly infringing one or more claims of the '922 Patent, in this judicial District and elsewhere in the United States. For example, LG directly infringes the '922 Patent, including but not limited to claim 1, by making, using, selling, importing, and offering for sale LG monitors. The LG 38UC99-W is representative of the products accused, which encompass other LG products having similar features, *e.g.*:

Figure **8**. (Source: http://www.lg.com/us/monitors/lg-38UC99-W-ultrawide-monitor; https://www.displayspecifications.com/en/model/65bf6db)

37. LG televisions and monitors comprise a storage adapted to store one more image frames. For example, the LG 38UC99-W is an LED monitor that must include a storage capable of storing one or more image frames.

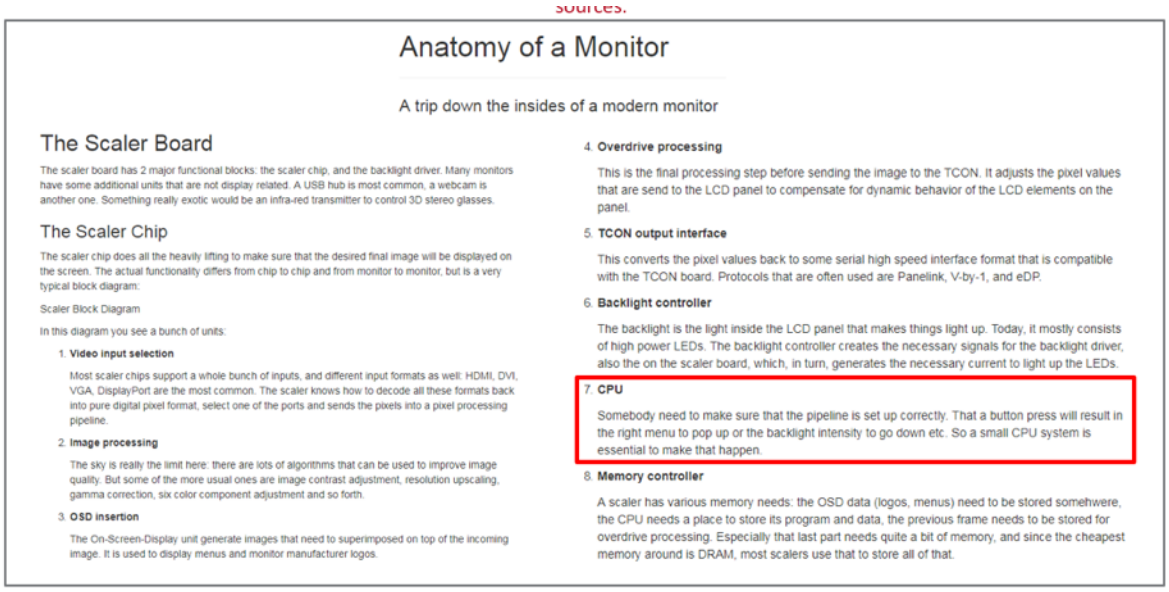
Figure 9 (Source: http://monitorinsider.com/monitor_anatomy)



38. LG televisions and monitors comprise a processor adapted to obtain a first image frame and a second image frame from a first video stream. For example, the LG 38UC99-W includes a processor capable of obtaining a first image frame and a second image frame from a

first video stream via any of its video input connections. The video stream could come from a cable box, DVD/Blu-Ray player, computer, or one of many other sources., *e.g.*:

Figure 10 (Source: Source: http://monitorinsider.com/monitor_anatomy)



Anatomy of a Monitor

A trip down the insides of a modern monitor

The Scaler Board

The scaler board has 2 major functional blocks: the scaler chip, and the backlight driver. Many monitors have some additional units that are not display related. A USB hub is most common, a webcam is another one. Something really exotic would be an infra-red transmitter to control 3D stereo glasses.

The Scaler Chip

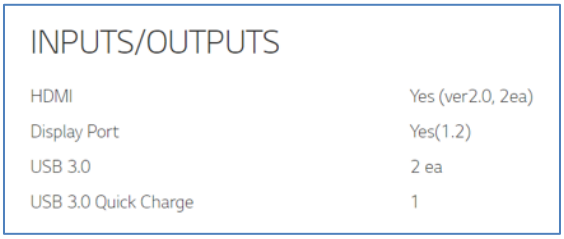
The scaler chip does all the heavily lifting to make sure that the desired final image will be displayed on the screen. The actual functionality differs from chip to chip and from monitor to monitor, but is a very typical block diagram:

Scaler Block Diagram

In this diagram you see a bunch of units:

1. **Video input selection**
   Most scaler chips support a whole bunch of inputs, and different input formats as well: HDMI, DVI, VGA, DisplayPort are the most common. The scaler knows how to decode all these formats back into pure digital pixel format, select one of the ports and sends the pixels into a pixel processing pipeline.
2. **Image processing**
   The sky is really the limit here: there are lots of algorithms that can be used to improve image quality. But some of the more usual ones are image contrast adjustment, resolution upscaling, gamma correction, six color component adjustment and so forth.
3. **OSD insertion**
   The On-Screen-Display unit generate images that need to superimposed on top of the incoming image. It is used to display menus and monitor manufacturer logos.
4. **Overdrive processing**
   This is the final processing step before sending the image to the TCON. It adjusts the pixel values that are send to the LCD panel to compensate for dynamic behavior of the LCD elements on the panel.
5. **TCON output interface**
   This converts the pixel values back to some serial high speed interface format that is compatible with the TCON board. Protocols that are often used are Panelink, V-by-1, and eDP.
6. **Backlight controller**
   The backlight is the light inside the LCD panel that makes things light up. Today, it mostly consists of high power LEDs. The backlight controller creates the necessary signals for the backlight driver, also the on the scaler board, which, in turn, generates the necessary current to light up the LEDs.
7. **CPU**
   Somebody need to make sure that the pipeline is set up correctly. That a button press will result in the right menu to pop up or the backlight intensity to go down etc. So a small CPU system is essential to make that happen.
8. **Memory controller**
   A scaler has various memory needs: the OSD data (logos, menus) need to be stored somehwere, the CPU needs a place to store its program and data, the previous frame needs to be stored for overdrive processing. Especially that last part needs quite a bit of memory, and since the cheapest memory around is DRAM, most scalers use that to store all of that.

Figure 11 (Source: https://www.youtube.com/watch?v=4-rSki4p828; http://www.lg.com/us/monitors/lg-38UC99-W-ultrawide-monitor)



39. LG televisions and monitors generate a first modified image frame by expanding the first image frame. For example, the LG 38UC99-W performs upscaling (as evidenced through its use of Super+ Resolution) which expands the input frame in real-time to a modified image frame matching the screen resolution. Since the image frame and the first modified image frame are different sizes (*e.g.*, achieved through interpolation), the first modified image frame is different

from the first image frame.

Figure 12 (Source: http://www.lg.com/us/monitors/lg-38UC99-W-ultrawide-monitor; http://www.lg.com/hk_en/monitor/lg-E1951T-home)

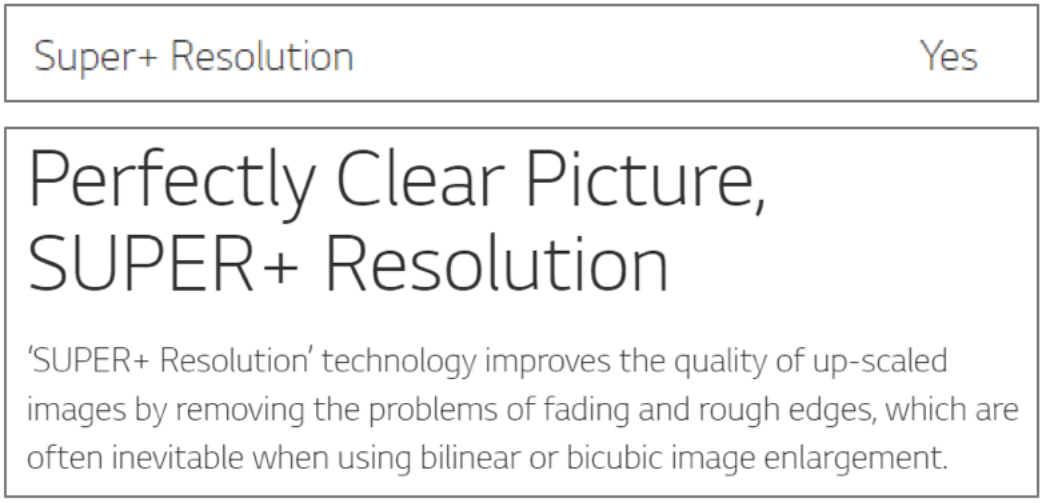


Figure 13 (Source: http://www.lg.com/us/support/video-tutorials/CT10000018-1432737109927-trumotion)

40. LG televisions and monitors generate a second modified image frame by expanding the second image frame. For example, the LG 38UC99-W performs upscaling which expands the input frame in real-time to a modified image frame matching the screen resolution. Since the second image frame and the second modified image frame are different sizes (*e.g.*, achieved through interpolation), the second modified image frame is different from the second image frame, *e.g.*:

Figure 14 (Source: http://www.lg.com/us/monitors/lg-38UC99-W-ultrawide-monitor; http://www.lg.com/hk_en/monitor/lg-E1951T-home)

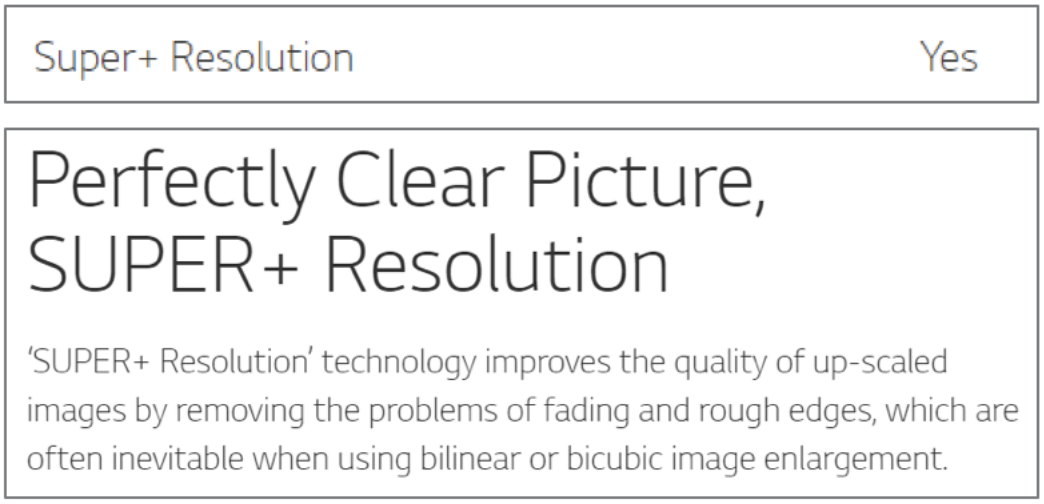


Figure 15 (Source: http://www.lg.com/us/support/video-tutorials/CT10000018-1432737109927-trumotion)

41. LG televisions and monitors generate a solid color bridge frame that is different from the first image frame and the second image frame. For example, the LG 38UC99-W uses black frame insertion ("BFI"). BFI creates a solid black frame that is different from the first frame and different from the second image frame, *e.g.*:

Figure 16 (Source: http://www.lg.com/us/monitors/lg-38UC99-W-ultrawide-monitor; http://www.lg.com/in/monitors/lg-24GM79G)

Figure 17 (Source: http://www.lg.com/in/monitors/lg-24GM79G)

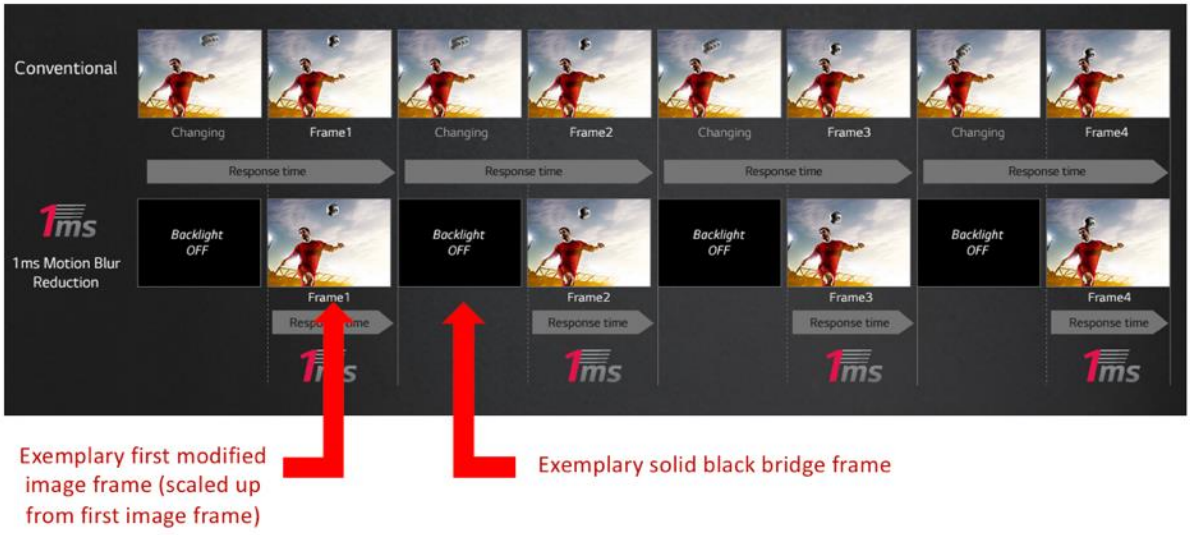
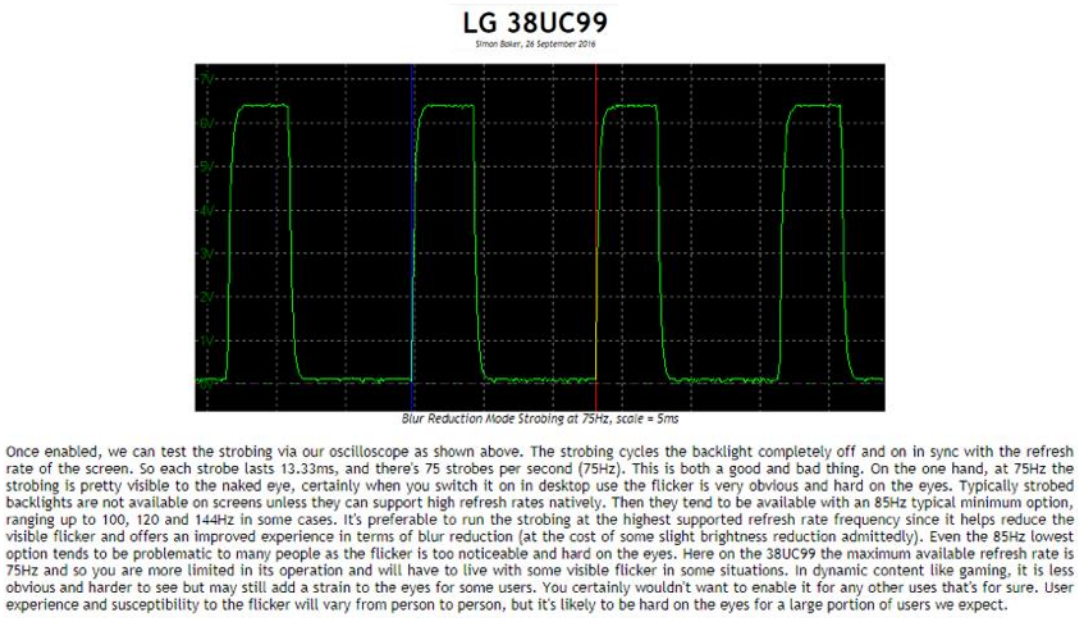
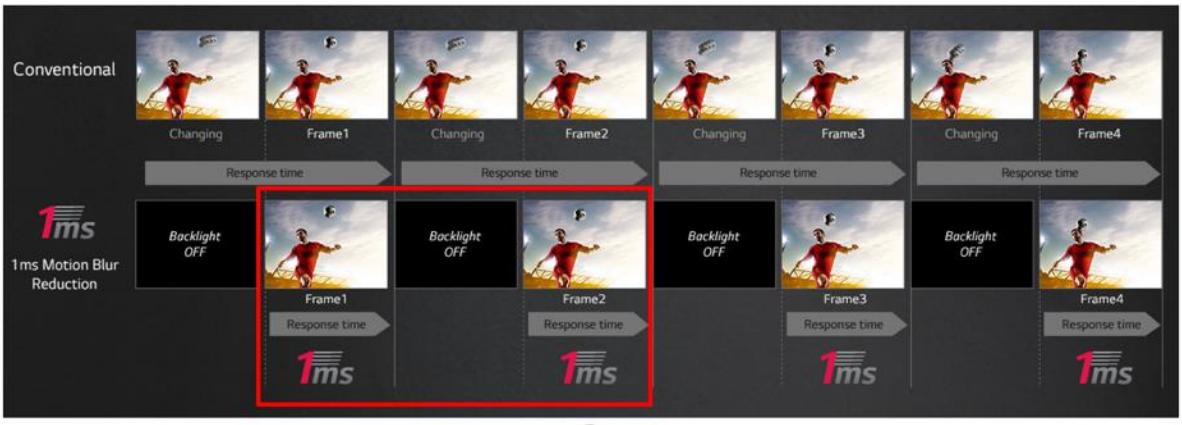


Figure 18 (Source: http://www.tftcentral.co.uk/reviews/lg_38uc99.htm)



42. LG televisions and monitors display the first modified image frame, display the bridge fame, and display the second modified image frame. For example, the LG 38UC99-W processor is adapted to display the first modified image frame (i.e., first upscaled image), the bridge frame (*i.e.*, black frame), and the second modified image frame (i.e., second upscaled image), *e.g.*:

Figure 19 (Source: http://www.lg.com/in/monitors/lg-24GM79G)



43. By making, using, selling, offering for sale, and importing the subject monitors, LG is infringing the claims of the '922 Patent, including but not limited to claim 1. LG has committed these acts of infringement without license or authorization.

44. LG has injured VEI and is liable to VEI for direct infringement of the claims of the '922 Patent pursuant to 35 U.S.C. § 271(a), (b), and (c).

45. As a result of LG's infringement of the '922 Patent, VEI has suffered harm and seeks monetary damages in an amount adequate to compensate for infringement, but in no event less than a reasonable royalty for the use made of the invention by LG, together with interest and costs as fixed by the Court.

COUNT III

INFRINGEMENT OF U.S. PATENT NO. 9,699,444

(AGAINST LG KOREA ONLY)

46. Plaintiff incorporates by reference the foregoing paragraphs and further alleges as follows:

47. On July 4, 2017, the United States Patent and Trademark Office issued the '444 Patent for inventions covering an apparatus, which in one claimed embodiment comprises a storage adapted to: store one or more image frames; and a processor adapted to: obtain a first image frame from a first video stream; generate a modified image frame by performing at least one of expanding the first image frame, shrinking the first image frame, removing a portion of the first image frame, stitching together the first image frame with a second image frame, inserting a selected image into the first image frame, and reshaping the first image frame, wherein the modified image frame is different from the first image frame; generate a bridge frame, wherein the bridge frame is a solid color, wherein the bridge frame is different from the first image frame and different from the modified image frame; display the modified image frame; and display the bridge frame. A true and correct copy of the '444 Patent is attached as Exhibit C.

48. LG Korea has been and is now directly infringing one or more claims of the '444 Patent, in this judicial District and elsewhere in the United States.

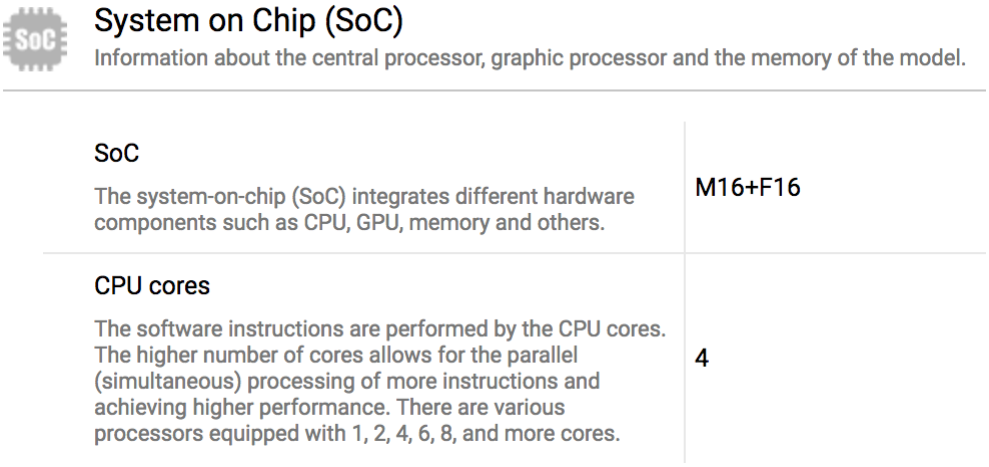
49. For example, LG Korea directly infringes the '444 Patent, including but not limited to claim 1 and 26, by making, using, selling, offering for sale, selling and importing LG Korea TVs. The LG Korea products discussed herein are representative of the products accused, which encompass other LG Korea products having similar features.

Figure 20

http://www.lg.com/us/tvs/lg-65UH8500-4k-uhd-tv

50. LG Korea TV's include a storage adapted to store one or more image frames. For example, the LG 65UH8500 uses a SoC which will include a storage capable of storing one or more image frames, e.g.:

Figure 21



System on Chip (SoC)

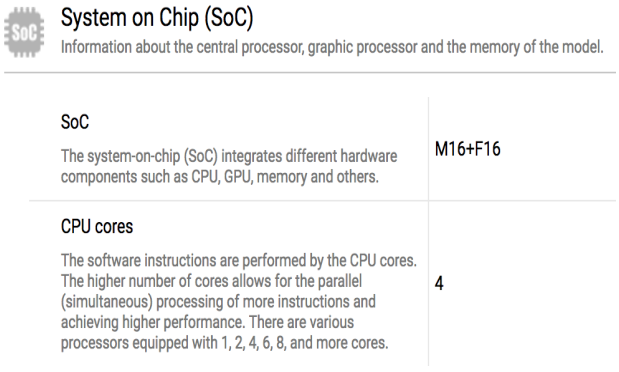
Information about the central processor, graphic processor and the memory of the model.

SoC The system-on-chip (SoC) integrates different hardware components such as CPU, GPU, memory and others.	M16+F16
CPU cores The software instructions are performed by the CPU cores. The higher number of cores allows for the parallel (simultaneous) processing of more instructions and achieving higher performance. There are various processors equipped with 1, 2, 4, 6, 8, and more cores.	4

http://www.displayspecifications.com/en/model/7ed33c6

51. LG Korea TV's include a processor adapted to obtain a first image frame from a first video stream. For example, the LG 65UH8500 uses a SoC which includes a quad core CPU and memory capable of obtaining a first image frame from a first video stream via any of its video input connections. The video stream could come from a cable box, DVD/Blu-Ray player, computer, or one of many other sources, e.g.:

Figure 22



System on Chip (SoC)

Information about the central processor, graphic processor and the memory of the model.

SoC The system-on-chip (SoC) integrates different hardware components such as CPU, GPU, memory and others.	M16+F16
CPU cores The software instructions are performed by the CPU cores. The higher number of cores allows for the parallel (simultaneous) processing of more instructions and achieving higher performance. There are various processors equipped with 1, 2, 4, 6, 8, and more cores.	4

http://www.displayspecifications.com/en/model/7ed33c6

INPUTS	
HDMI	3 (HDCP 2.2)
USB	3
RF In (Antenna/Cable)	1
Composite In	1
Component In	1 (shared with composite)
Ethernet	1
Optical	1
RS232C (Mini Jack)	1

http://www.lg.com/us/support/products/documents/UH8500_Series_Spec_Sheet_Updated_10112016.pdf

52. LG Korea TV's expand the first image frame to generate a modified image frame, wherein the modified image frame is different from the first image frame. For example, the LG 65UH8500 has a screen resolution of 3840 x 2160 pixels. It has an Upscaler which in real-time expands the input frame to a modified image frame with the screen resolution. The Image processor Upscales by expanding the image frame to a modified image frame. Since the image frame and the modified image frame are on different sizes, the modified image frame is different from the first image frame, e.g.:

Figure 23

PICTURE QUALITY
Ultra HD (3,840 x 2,160)
TruMotion 240Hz
Quantum Display
IPS Panel
Super Mastering Engine
HDR Super w/ Dolby Vision™
Tru Black Panel
Ultra Luminance
4K Upscaler
Local Dimming

http://www.lg.com/us/support/products/documents/UH8500_Series_Spec_Sheet_Updated_10112016.pdf

53. LG Korea TV's generate a bridge frame (e.g., partially lit backlight frame created by use of local dimming), wherein the bridge frame is a non-solid color, wherein the bridge fame is different from the first image and different from the modified image frame. For example, the LG 65UH8500 uses Local Dimming. Local Dimming is a non-solid color backlight. So, the TV

uses a bridge frame that is a non-solid color and is different from the first frame and different from the modified (expanded) image frame, e.g.:

Figure 24

PICTURE QUALITY
Ultra HD (3,840 x 2,160)
TruMotion 240Hz
Quantum Display
IPS Panel
Super Mastering Engine
HDR Super w/ Dolby Vision™
Tru Black Panel
Ultra Luminance
4K Upscaler
Local Dimming

http://www.lg.com/us/support/products/documents/UH8500_Series_Spec_Sheet_Updated_10112016.pdf

What is local dimming on a TV?

Local dimming is a feature on LED TVs that dims the backlight behind parts of the screen that are displaying black. This makes blacks appear deeper and darker on those parts of the screen, which can be a big bonus for people who watch video with darker scenes, like movies and **TV** shows. Jun 1, 2016

https://www.google.com/search?q=what+is+local+dimming+on+a+tv&rlz=1C5CHFA_enUS519US519&oq=what+is+local+dimming+on+a+tv&aqs=chrome..69i57j0.3840j0j7&sourceid=chrome&ie=UTF-8#safe=off&q=local+dimming

substantially similar. In electronic media, the bridge-picture may simply be a timed unlit-screen pause between serial re-appearances of the two or more similar image pictures. The rolling movements of

15/217,612 specification

54. LG Korea TV's generate a bridge frame (e.g., partially lit backlight frame created by use of local dimming), wherein the bridge frame is a non-solid color, wherein the bridge fame is different from the first image and different from the modified image frame. For example, the LG 65UH8500 uses Local Dimming. Local Dimming is a non-solid color backlight. So, the TV

uses a bridge frame that is a non-solid color and is different from the first frame and different from the modified (expanded) image frame, e.g.:

LED Local Dimming

Maximizes the contrast ratio by making the bright side of the screen brighter and the dark side of the screen darker.

Off: Disables the LED Local Dimming function.

Low / **Medium** / **High:** Changes the contrast ratio.

LED Local Dimming technology, controlling sectors of backlight, is meant at enhancing contrast ratio and energy efficiency. Each sector controlled by picture analysis algorithm produces a seamless image under normal circumstances. However, in darker scenes it tends to be intrusive so best to disable Local Dimming feature.

http://www.lg.com/uk/support/product-help/CT00008334-1436495191346-others; http://www.lg.com/ca_en/support/product-help/CT20098005-20150226846632-poor-picture-quality-or-poor-color;

55. LG Korea's TVs, such as the LG 65UH8500, generate a blended modified image frame (i.e., the image perceived by the user) by blending the LCD layer (i.e., the modified image frame) with a partially lit backlight (i.e., the bridge frame). The Upscaler creates a modified image frame on the LCD layer and the Local Dimming feature generates a non-solid color bridge frame using the backlight. Together, the modified image frame and bridge frame generate a blended modified image frame. This blended modified image frame is then displayed on the LG 65UH8500's screen, e.g.:

Figure 25

PICTURE QUALITY
Ultra HD (3,840 x 2,160)
TruMotion 240Hz
Quantum Display
IPS Panel
Super Mastering Engine
HDR Super w/ Dolby Vision™
Tru Black Panel
Ultra Luminance
4K Upscaler
Local Dimming

http://www.lg.com/us/support/products/documents/UH8500_Series_Spec_Sheet_Updated_10112016.pdf

What is local dimming on a TV?

Local dimming is a feature on LED TVs that dims the backlight behind parts of the screen that are displaying black. This makes blacks appear deeper and darker on those parts of the screen, which can be a big bonus for people who watch video with darker scenes, like movies and **TV** shows. Jun 1, 2016

https://www.google.com/search?q=what+is+local+dimming+on+a+tv&rlz=1C5CHFA_enUS519US519&oq=what+is+local+dimming+on+a+tv&aqs=chrome..69i57j0.3840j0j7&sourceid=chrome&ie=UTF-8#safe=off&q=local+dimming

56. LG Korea also infringes claim 26 of the '444 Patent by making, using, selling, offering for sale and importing LG monitors. The LG Korea products discussed herein, such as the LG 38UC99-W, are representative of the products accused, which encompass other LG Korea products having similar features.

Figure 26

Brand, series, model

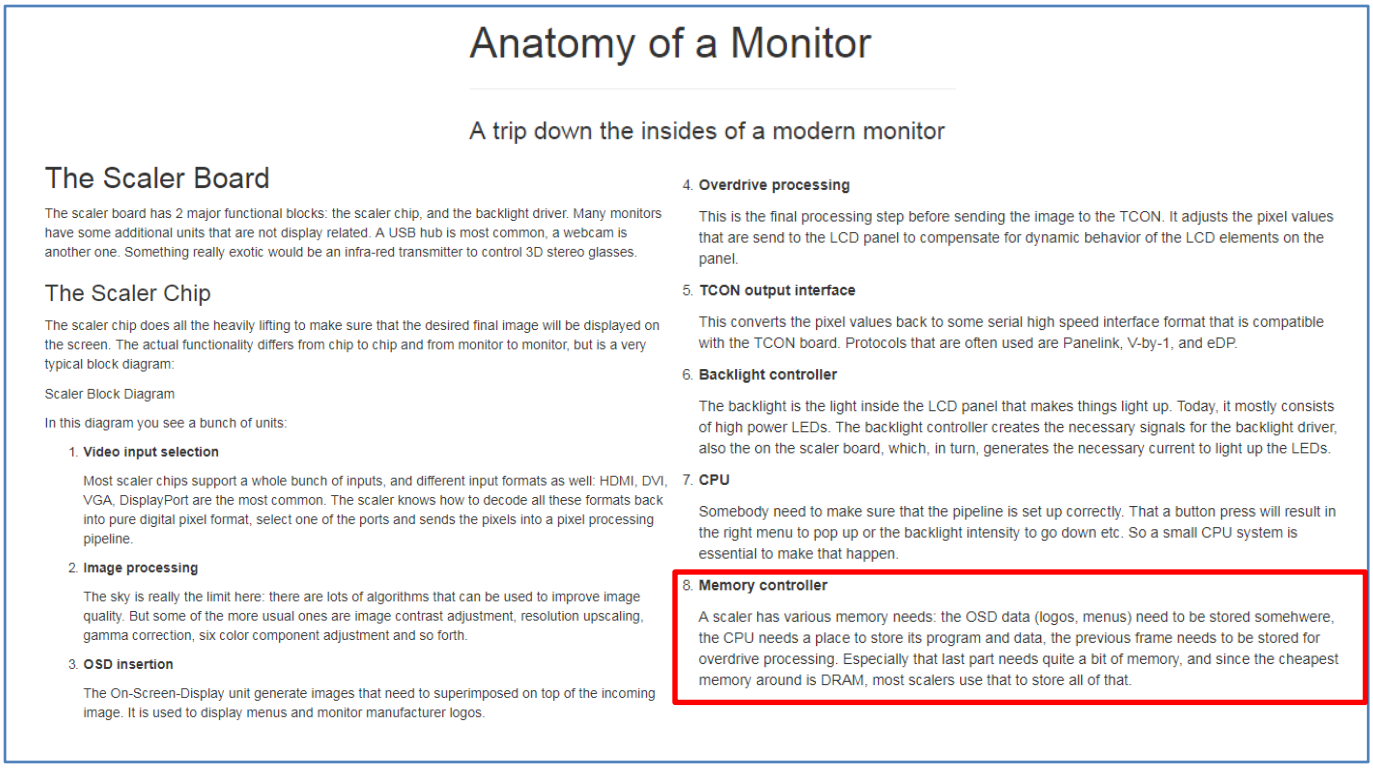
Information about the brand, series, model and model aliases.

Brand Name of the company-manufacturer.	LG
Model Designation of the model.	38UC99
Model alias Other known designations of the model.	38UC99-W

http://www.lg.com/us/monitors/lg-38UC99-W-ultrawide-monitor; https://www.displayspecifications.com/en/model/65bf6db

57. LG Korea monitors comprise a storage adapted to store one or more image frames. For example, the LG 38UC99-W is an LED monitor, and accordingly must include a storage for the monitor instructions to be stored on as well as being capable of storing one or more image frames, e.g.:

Figure 27



Anatomy of a Monitor

A trip down the insides of a modern monitor

The Scaler Board

The scaler board has 2 major functional blocks: the scaler chip, and the backlight driver. Many monitors have some additional units that are not display related. A USB hub is most common, a webcam is another one. Something really exotic would be an infra-red transmitter to control 3D stereo glasses.

The Scaler Chip

The scaler chip does all the heavily lifting to make sure that the desired final image will be displayed on the screen. The actual functionality differs from chip to chip and from monitor to monitor, but is a very typical block diagram:

Scaler Block Diagram

In this diagram you see a bunch of units:

1. **Video input selection**

   Most scaler chips support a whole bunch of inputs, and different input formats as well: HDMI, DVI, VGA, DisplayPort are the most common. The scaler knows how to decode all these formats back into pure digital pixel format, select one of the ports and sends the pixels into a pixel processing pipeline.

2. **Image processing**

   The sky is really the limit here: there are lots of algorithms that can be used to improve image quality. But some of the more usual ones are image contrast adjustment, resolution upscaling, gamma correction, six color component adjustment and so forth.

3. **OSD insertion**

   The On-Screen-Display unit generate images that need to superimposed on top of the incoming image. It is used to display menus and monitor manufacturer logos.

4. **Overdrive processing**

   This is the final processing step before sending the image to the TCON. It adjusts the pixel values that are send to the LCD panel to compensate for dynamic behavior of the LCD elements on the panel.

5. **TCON output interface**

   This converts the pixel values back to some serial high speed interface format that is compatible with the TCON board. Protocols that are often used are Panelink, V-by-1, and eDP.

6. **Backlight controller**

   The backlight is the light inside the LCD panel that makes things light up. Today, it mostly consists of high power LEDs. The backlight controller creates the necessary signals for the backlight driver, also the on the scaler board, which, in turn, generates the necessary current to light up the LEDs.

7. **CPU**

   Somebody need to make sure that the pipeline is set up correctly. That a button press will result in the right menu to pop up or the backlight intensity to go down etc. So a small CPU system is essential to make that happen.

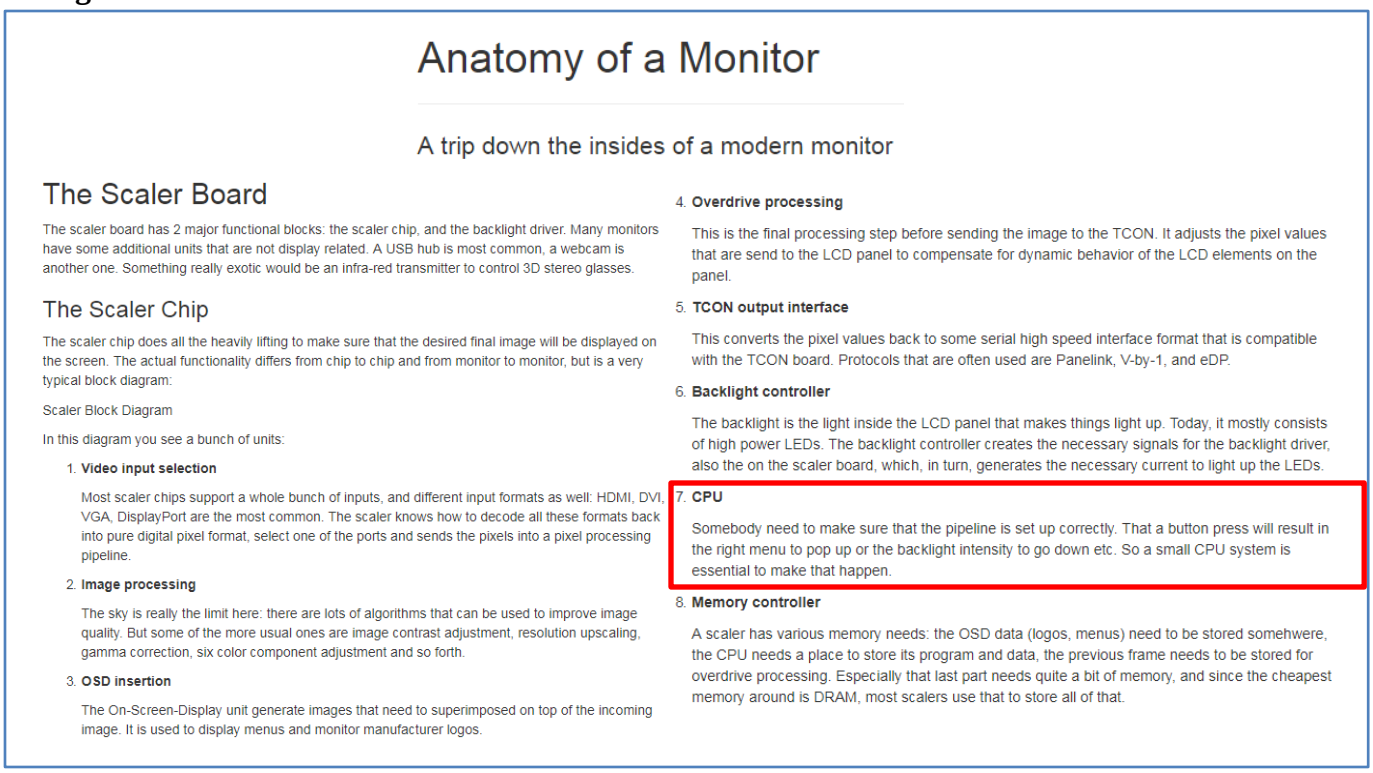
8. **Memory controller**

   A scaler has various memory needs: the OSD data (logos, menus) need to be stored somehwere, the CPU needs a place to store its program and data, the previous frame needs to be stored for overdrive processing. Especially that last part needs quite a bit of memory, and since the cheapest memory around is DRAM, most scalers use that to store all of that.

http://monitorinsider.com/monitor_anatomy/

58. LG Korea monitors comprise a processor adapted to obtain a first image frame from a first video stream. For example, the LG 38UC99-W is an LED monitor that accordingly must include a processor for processing stored instructions for the monitor functionality and is also capable of obtaining a first image frame from a first video stream via any of its video input connections (e.g., from a cable box, DVD/Blu-Ray player, computer, or one of many other sources), e.g.:

Figure 28



Anatomy of a Monitor

A trip down the insides of a modern monitor

The Scaler Board

The scaler board has 2 major functional blocks: the scaler chip, and the backlight driver. Many monitors have some additional units that are not display related. A USB hub is most common, a webcam is another one. Something really exotic would be an infra-red transmitter to control 3D stereo glasses.

The Scaler Chip

The scaler chip does all the heavily lifting to make sure that the desired final image will be displayed on the screen. The actual functionality differs from chip to chip and from monitor to monitor, but is a very typical block diagram:

Scaler Block Diagram

In this diagram you see a bunch of units:

1. **Video input selection**

   Most scaler chips support a whole bunch of inputs, and different input formats as well: HDMI, DVI, VGA, DisplayPort are the most common. The scaler knows how to decode all these formats back into pure digital pixel format, select one of the ports and sends the pixels into a pixel processing pipeline.

2. **Image processing**

   The sky is really the limit here: there are lots of algorithms that can be used to improve image quality. But some of the more usual ones are image contrast adjustment, resolution upscaling, gamma correction, six color component adjustment and so forth.

3. **OSD insertion**

   The On-Screen-Display unit generate images that need to superimposed on top of the incoming image. It is used to display menus and monitor manufacturer logos.

4. **Overdrive processing**

   This is the final processing step before sending the image to the TCON. It adjusts the pixel values that are send to the LCD panel to compensate for dynamic behavior of the LCD elements on the panel.

5. **TCON output interface**

   This converts the pixel values back to some serial high speed interface format that is compatible with the TCON board. Protocols that are often used are Panelink, V-by-1, and eDP.

6. **Backlight controller**

   The backlight is the light inside the LCD panel that makes things light up. Today, it mostly consists of high power LEDs. The backlight controller creates the necessary signals for the backlight driver, also the on the scaler board, which, in turn, generates the necessary current to light up the LEDs.

7. **CPU**

   Somebody need to make sure that the pipeline is set up correctly. That a button press will result in the right menu to pop up or the backlight intensity to go down etc. So a small CPU system is essential to make that happen.

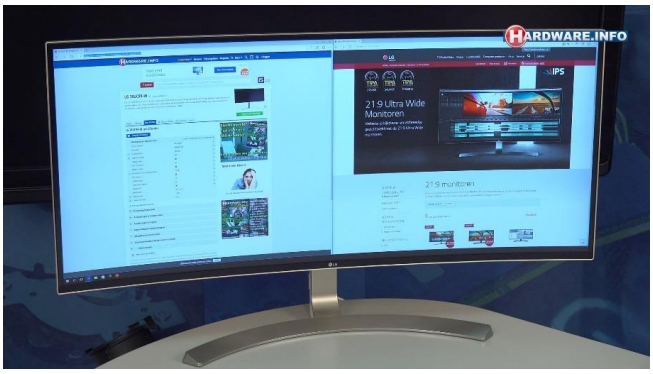
8. **Memory controller**

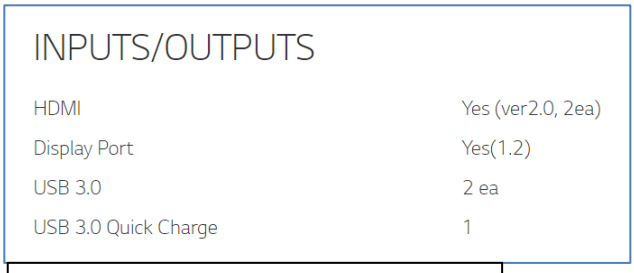
   A scaler has various memory needs: the OSD data (logos, menus) need to be stored somehwere, the CPU needs a place to store its program and data, the previous frame needs to be stored for overdrive processing. Especially that last part needs quite a bit of memory, and since the cheapest memory around is DRAM, most scalers use that to store all of that.

http://monitorinsider.com/monitor_anatomy/

59. LG Korea monitors comprise a processor adapted to obtain a first image frame from a first video stream. For example, the LG 38UC99-W is an LED monitor that accordingly must include a processor for processing stored instructions for the monitor functionality and is also capable of obtaining a first image frame from a first video stream via any of its video input connections (e.g., from a cable box, DVD/Blu-Ray player, computer, or one of many other sources), e.g.:

Figure 29





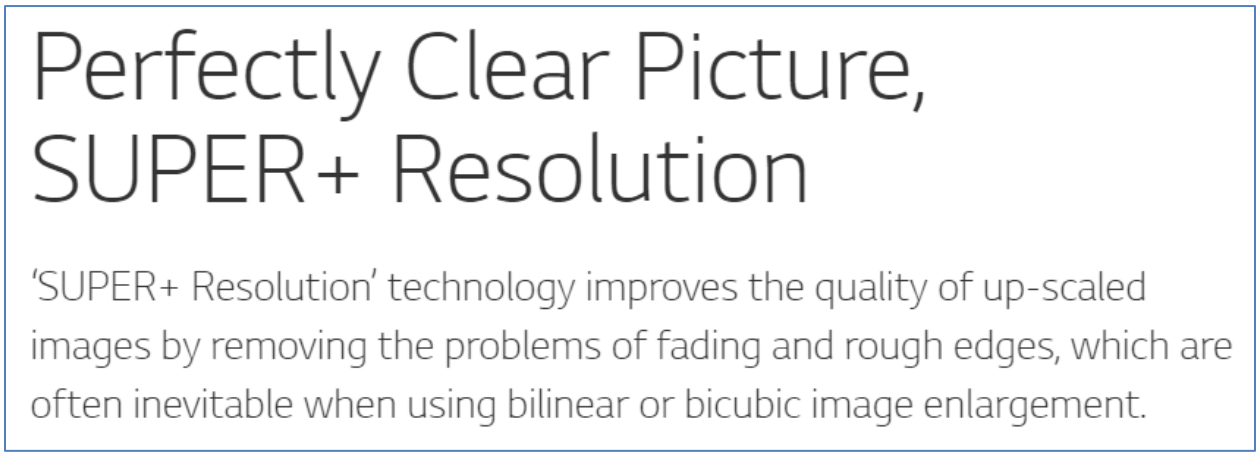
INPUTS/OUTPUTS

HDMI	Yes (ver2.0, 2ea)
Display Port	Yes(1.2)
USB 3.0	2 ea
USB 3.0 Quick Charge	1

Source: https://www.youtube.com/watch?v=4-rSki4p828; http://www.lg.com/us/monitors/lg-38UC99-W-ultrawide-monitor

60. LG Korea monitors generate a modified image frame by performing at least an expanding of the first image frame. For example, the LG 38UC99-W performs upscaling (as evidenced though its use of Super+ Resolution) which expands the input frame in real-time to a modified image frame matching the native resolution. Since the image frame and the modified image frame are different sizes, the modified image frame is different from the first image frame, e.g.:

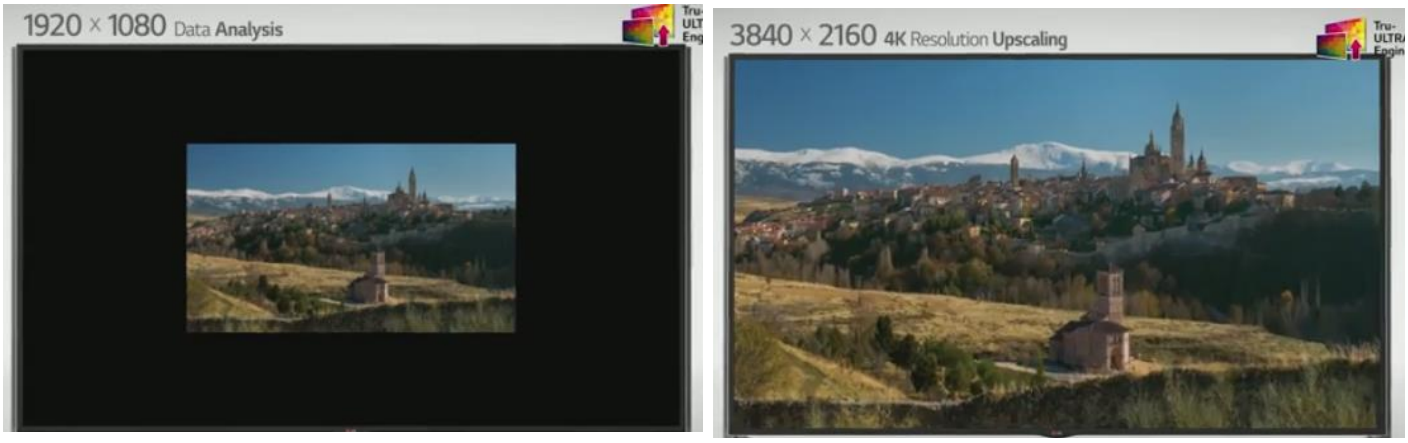
Figure 30



http://www.lg.com/us/monitors/lg-38UC99-W-ultrawide-monitor; http://www.lg.com/hk_en/monitor/lg-E1951T-home

61. LG Korea monitors generate a modified image frame by performing at least an expanding of the first image frame. For example, the LG 38UC99-W performs upscaling (as evidenced though its use of Super+ Resolution) which expands the input frame in real-time to a modified image frame matching the native resolution. Since the image frame and the modified image frame are different sizes, the modified image frame is different from the first image frame, e.g.:

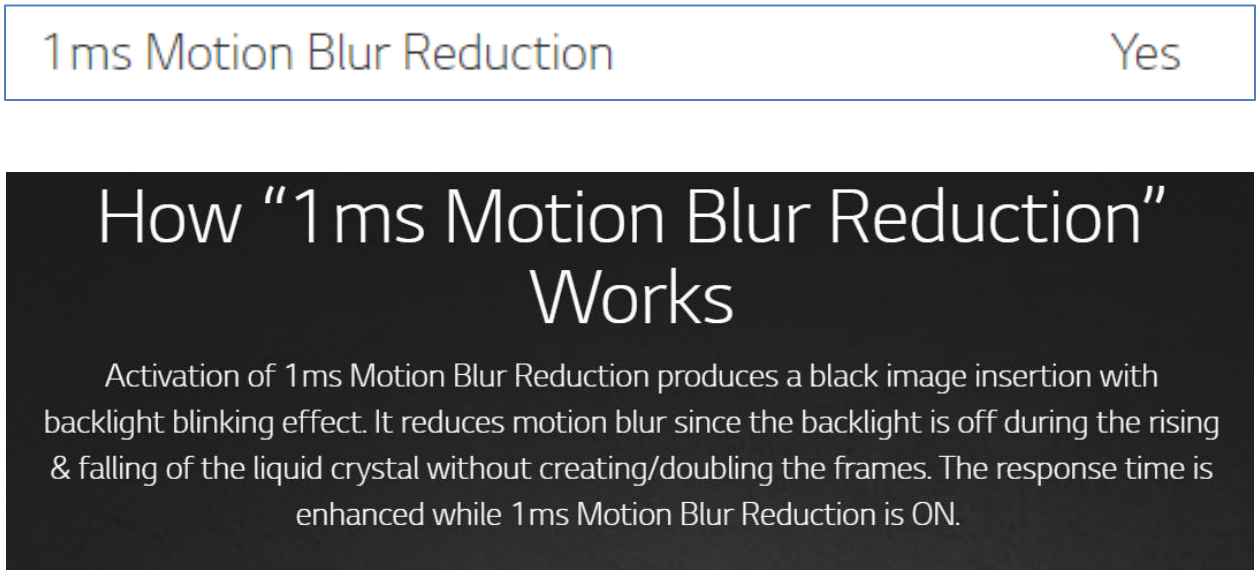
Figure 31



http://www.lg.com/us/support/video-tutorials/CT10000018-1432737109927-trumotion

62. LG Korea monitors generate a bridge frame, wherein the bridge frame is a solid color (e.g., backlight off), wherein the bridge frame is different from the first image frame and different from the modified image frame. For example, the LG 38UC99-W generates a solid black bridge frame, which is different from the first image and first modified image frames, and inserts the black bridge frame between series of similar image frames (including the first modified image frame), e.g.:

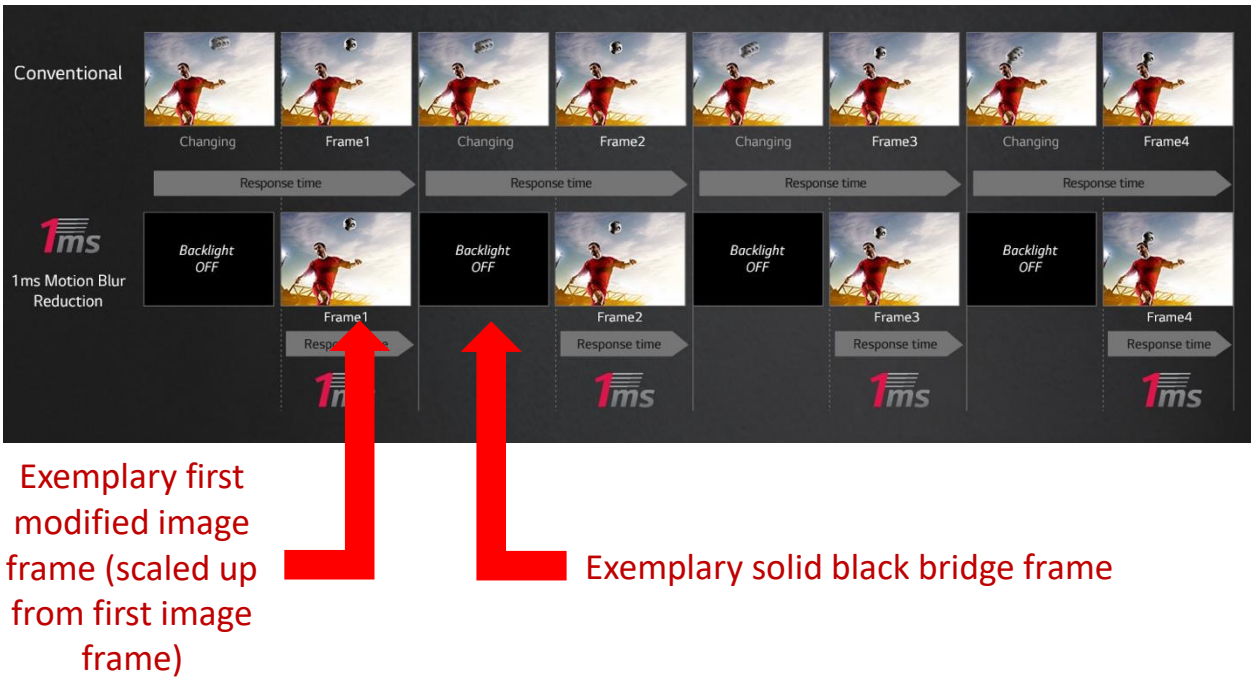
Figure 32



http://www.lg.com/us/monitors/lg-38UC99-W-ultrawide-monitor; http://www.lg.com/in/monitors/lg-24GM79G

63. LG Korea monitors generate a bridge frame, wherein the bridge frame is a solid color (e.g., backlight off), wherein the bridge frame is different from the first image frame and different from the modified image frame. For example, the LG 38UC99-W generates a solid black bridge frame, which is different from the first image and first modified image frames, and inserts the black bridge frame between series of similar image frames (including the first modified image frame), e.g.:

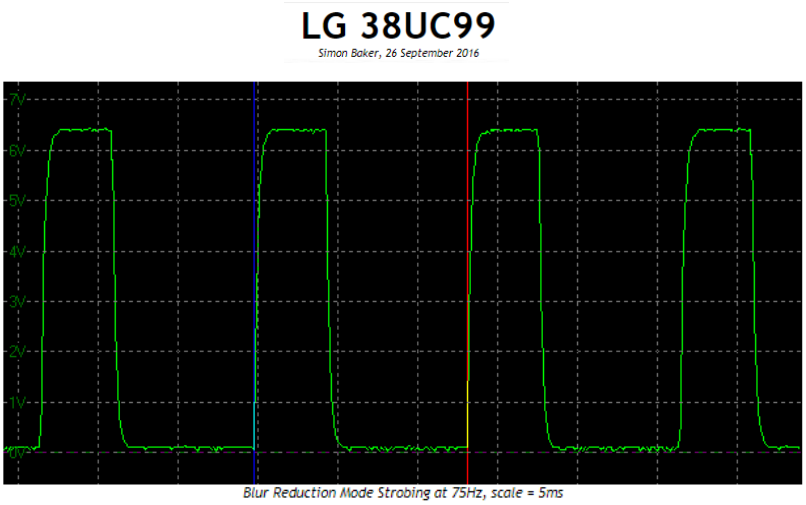
Figure 33



http://www.lg.com/in/monitors/lg-24GM79G

64. LG Korea monitors generate a bridge frame, wherein the bridge frame is a solid color (e.g., backlight off), wherein the bridge frame is different from the first image frame and different from the modified image frame. For example, the LG 38UC99-W generates a solid black bridge frame, which is different from the first image and first modified image frames, and inserts the black bridge frame between series of similar image frames (including the first modified image frame), e.g.:

Figure 34



Blur Reduction Mode Strobing at 75Hz, scale = 5ms

Once enabled, we can test the strobing via our oscilloscope as shown above. The strobing cycles the backlight completely off and on in sync with the refresh rate of the screen. So each strobe lasts 13.33ms, and there's 75 strobes per second (75Hz). This is both a good and bad thing. On the one hand, at 75Hz the strobing is pretty visible to the naked eye, certainly when you switch it on in desktop use the flicker is very obvious and hard on the eyes. Typically strobed backlights are not available on screens unless they can support high refresh rates natively. Then they tend to be available with an 85Hz typical minimum option, ranging up to 100, 120 and 144Hz in some cases. It's preferable to run the strobing at the highest supported refresh rate frequency since it helps reduce the visible flicker and offers an improved experience in terms of blur reduction (at the cost of some slight brightness reduction admittedly). Even the 85Hz lowest option tends to be problematic to many people as the flicker is too noticeable and hard on the eyes. Here on the 38UC99 the maximum available refresh rate is 75Hz and so you are more limited in its operation and will have to live with some visible flicker in some situations. In dynamic content like gaming, it is less obvious and harder to see but may still add a strain to the eyes for some users. You certainly wouldn't want to enable it for any other uses that's for sure. User experience and susceptibility to the flicker will vary from person to person, but it's likely to be hard on the eyes for a large portion of users we expect.

http://www.tftcentral.co.uk/reviews/lg_38uc99.htm

65. LG Korea monitors display a modified image frame and display the bridge frame. For example, both the modified image frame and bridge frame are displayed on the LG 38UC99-W screen, e.g.:

Figure 35

http://www.lg.com/in/monitors/lg-24GM79G

66. LG Korea also infringes claim 26 of the '444 Patent by making, using, selling, offering for sale and importing LG laser projectors. The LG Korea products discussed herein, such as the LG HECTO, are representative of the products accused, which encompass other LG Korea products having similar features.

Figure 36

http://www.lg.com/ae/projectors/lg-HECTO

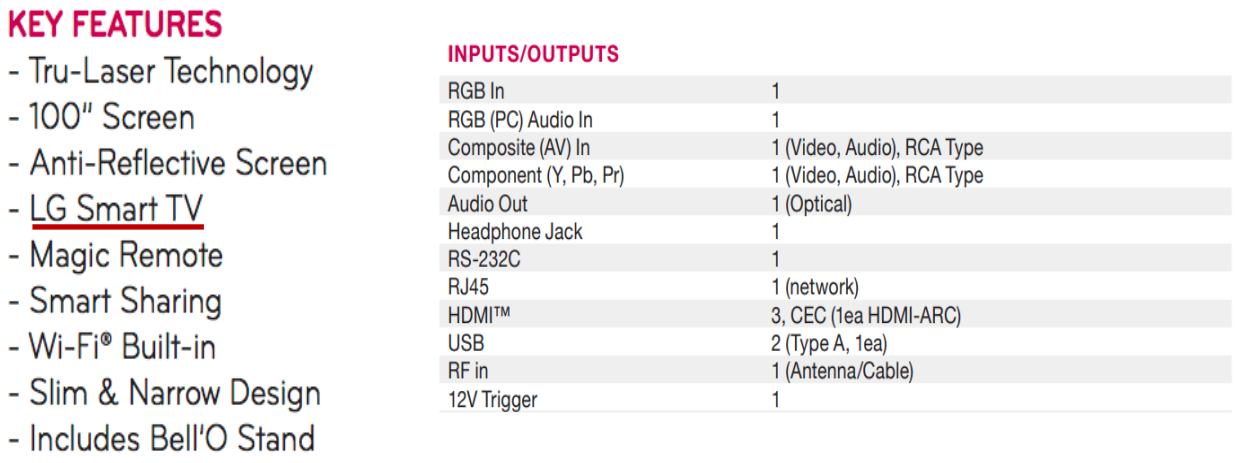
67. LG Korea laser projectors comprise a storage adapted to store one or more image frames. For example, the LG Hecto is a Smart TV that accordingly must include a storage for the Smart TV instructions to be stored on as well as being capable of storing one or more image frames, e.g.:

Figure 37

http://www.projectorcentral.com/pdf/projector_spec_7324.pdf

68. LG Korea laser projectors comprise a processor to obtain a first image frame from a first video stream. For example, the LG Hecto is a Smart TV that accordingly must include a processor for processing stored instructions for the Smart TV functionality and is also capable of obtaining a first image frame from a first video stream via any of its video input connections. The video stream could come from a cable box, DVD/Blu-Ray player, computer, or one of many other sources, e.g.:

Figure 38



KEY FEATURES

- Tru-Laser Technology
- 100" Screen
- Anti-Reflective Screen
- LG Smart TV
- Magic Remote
- Smart Sharing
- Wi-Fi® Built-in
- Slim & Narrow Design
- Includes Bell'O Stand

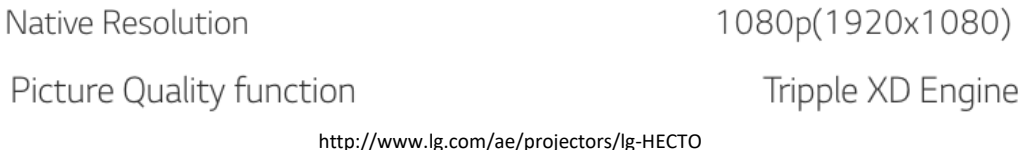
INPUTS/OUTPUTS

RGB In	1
RGB (PC) Audio In	1
Composite (AV) In	1 (Video, Audio), RCA Type
Component (Y, Pb, Pr)	1 (Video, Audio), RCA Type
Audio Out	1 (Optical)
Headphone Jack	1
RS-232C	1
RJ45	1 (network)
HDMI™	3, CEC (1ea HDMI-ARC)
USB	2 (Type A, 1ea)
RF in	1 (Antenna/Cable)
12V Trigger	1

http://www.projectorcentral.com/pdf/projector_spec_7324.pdf

69. LG Korea laser projectors generate a modified image frame by performing at least an expanding of the first image frame. For example, the LG Hecto has a native resolution of 1920 x 1080 pixels. It performs upscaling which expands the input frame in real-time to a modified image frame matching the native resolution. Since the image frame and the modified image frame are different sizes, the modified image frame is different from the first image frame, e.g.:

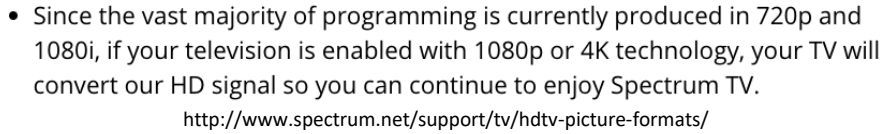
Figure 39



Native Resolution 1080p(1920x1080)

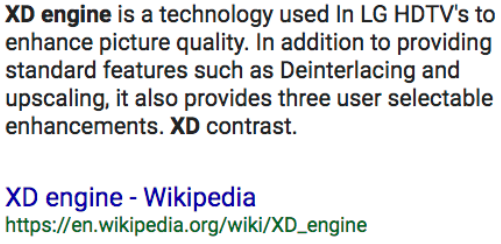
Picture Quality function Tripple XD Engine

http://www.lg.com/ae/projectors/lg-HECTO



- Since the vast majority of programming is currently produced in 720p and 1080i, if your television is enabled with 1080p or 4K technology, your TV will convert our HD signal so you can continue to enjoy Spectrum TV.

http://www.spectrum.net/support/tv/hdtv-picture-formats/

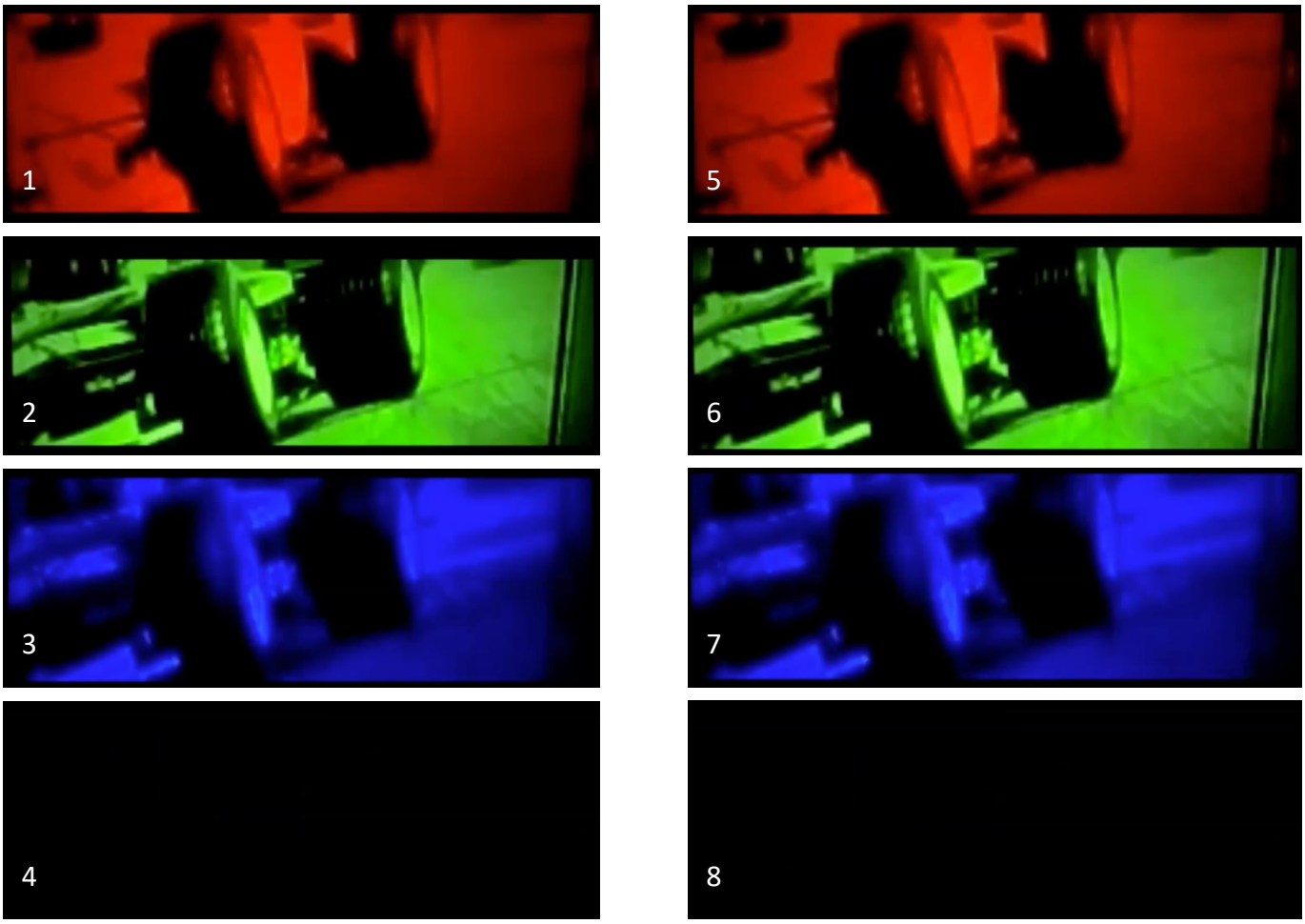


XD engine is a technology used In LG HDTV's to enhance picture quality. In addition to providing standard features such as Deinterlacing and upscaling, it also provides three user selectable enhancements. **XD** contrast.

XD engine - Wikipedia
https://en.wikipedia.org/wiki/XD_engine

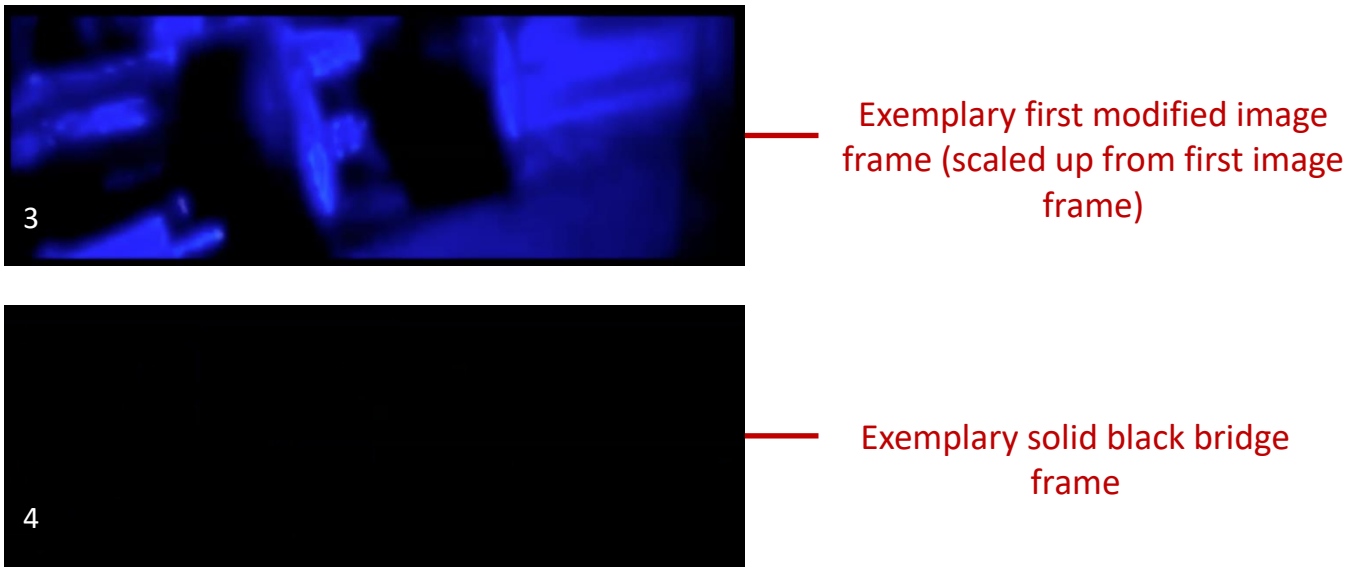
70. The evidence used in the following slides are screenshots from a video of an LG Hecto being filmed in ultra slow-motion to show each individual frame being displayed on the TV. Below are the first 8 frames displayed in said video, e.g.:

Figure 40



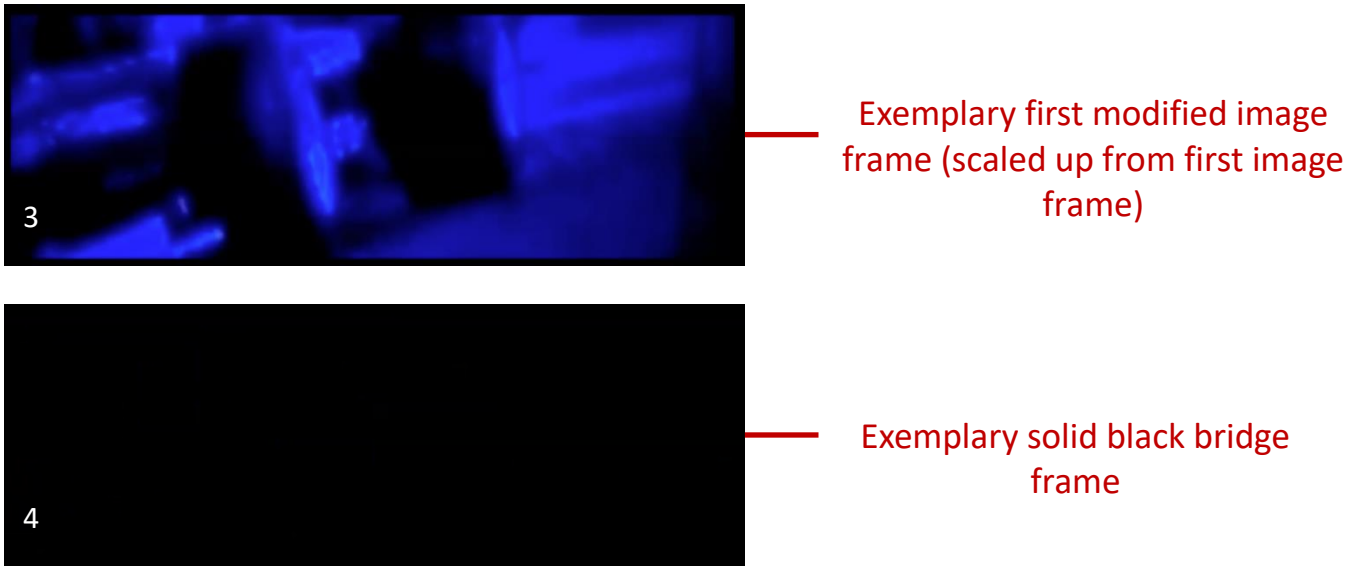
71. LG Korea laser projectors generate a bridge frame (solid black frame), wherein the bridge frame is a solid color, wherein the bridge frame is different from the first image frame and different from the modified image frame (e.g., upscaled image fame). For example, the LG Hecto generates a solid black bridge frame, which is different from the first image and first modified image frames, and inserts the black bridge frame between series of similar image frames (including the first modified image frame), e.g.:

Figure 41



72. LG Korea laser projectors display the modified image frame and display the bridge frame. For example, both the modified image frame and bridge frame are displayed on the LG Hecto screen, e.g.:

Figure 42



73. By making using, selling, offering for sale, and importing LG Korea TVs, monitors, laser projectors, and other similar products, LG Korea is infringing the claims of the

’444 Patent, including but not limited to claims 1 and 26. LG Korea has committed these acts of infringement without license or authorization.

74. LG Korea has injured VEI and is liable to VEI for direct infringement of the claims of the ’444 Patent pursuant to 35 U.S.C. § 271(a), (b), and (c).

75. As a result of Defendant’s infringement of the ’444 Patent, VEI has suffered harm and seeks monetary damages in an amount adequate to compensate for infringement, but in no event less than a reasonable royalty for the use made of the invention by LG Korea, together with interest and costs as fixed by the Court.

COUNT IV

INFRINGEMENT OF U.S. PATENT NO. 9,716,874

(AGAINST LG KOREA ONLY)

76. Plaintiff incorporates by reference each of the allegations in the foregoing paragraphs, and further alleges as follows:

77. On July 25, 2017, the United States Patent and Trademark Office issued the ’874 Patent for inventions covering A method for generating and displaying modified video, the method comprising; (1) acquiring a source video comprising a sequence of image frames; (2) obtaining a first image frame based on a selected one of the image frames of the source video; (3) generating a modified image frame by performing one of: (i) expanding the first image frame; (ii) removing a first portion of the first image frame; and (iii) stitching together the first image frame with a second portion of a second image frame; and (4) generating a first altered image frame that includes first and second non-overlapping portions, wherein the first non-overlapping portion comprises a first selected portion of the modified image frame, wherein the first image frame does not include the second non-overlapping portion, wherein the modified image frame does not include the second non-overlapping portion; and (5) generating a second altered image frame that includes third and fourth non-overlapping portions, wherein the third non-overlapping portion comprises a second selected portion of the modified image frame, the second selected portion of the modified image frame being different from the first selected portion of the modified image frame, wherein

the first image frame does not include the fourth non-overlapping portion, wherein the modified image frame does not include the fourth non-overlapping portion. A true and correct copy of the '874 Patent is attached as Exhibit D.

78. LG Korea has been and is now directly infringing one or more claims of the '874 Patent, in this judicial District and elsewhere in the United States.

79. For example, directly infringes the '874 Patent, including but not limited to claim 1, by making, using, selling, offering for sale and importing LG Korea TVs. The LG Korea products discussed herein (e.g. LM9600/LM960V) are representative of the products accused, which encompass other LG Korea products having similar features.

Figure 43

LG LM9600 / LM960V

LG's LM9600 range will be available in 55 and 84 inches called 55LM9600 and 84LM9600 (4K resolution) in the US. In Europe it will be available in 47, 55 and 84 inches called 47LM960V, 55LM960V and 84LM960V.

http://www.flatpanelshd.com/review.php?subaction=showfull&id=1338560188; http://www.lg.com/us/tvs/lg-84LM9600-led-tv

80. LG Korea TVs acquire a source video comprising a sequence of image frames. For example, the LM9600/LM960V acquires a source video from one of its plurality of video inputs, such as an HDMI input from a computer or cable box, e.g.:

Figure 44

AV INPUTS/OUTPUTS

RF In (Antenna/Cable)	1 (Rear)
AV In	1 (Rear w/Gender)
Component Video In(Y, Pb, Pr + Audio)	1 (Rear w/Gender)
HDMI™/HDCP Input	4 (Side)
Digital Audio Out (Optical)	1 (Rear)
RGB In (D-Sub 15 Pin) - PC	1 (Rear)
PC Audio Input	1 (Rear)
USB 2.0	3 (Side /1 : Hub)
LAN	1 (Rear)

81. Most programming is produced in 720p or 1080i resolution. As such, when the video source is a cable box, the Product obtains a first image frame in 720p or 1080i resolution from the source video, e.g.:

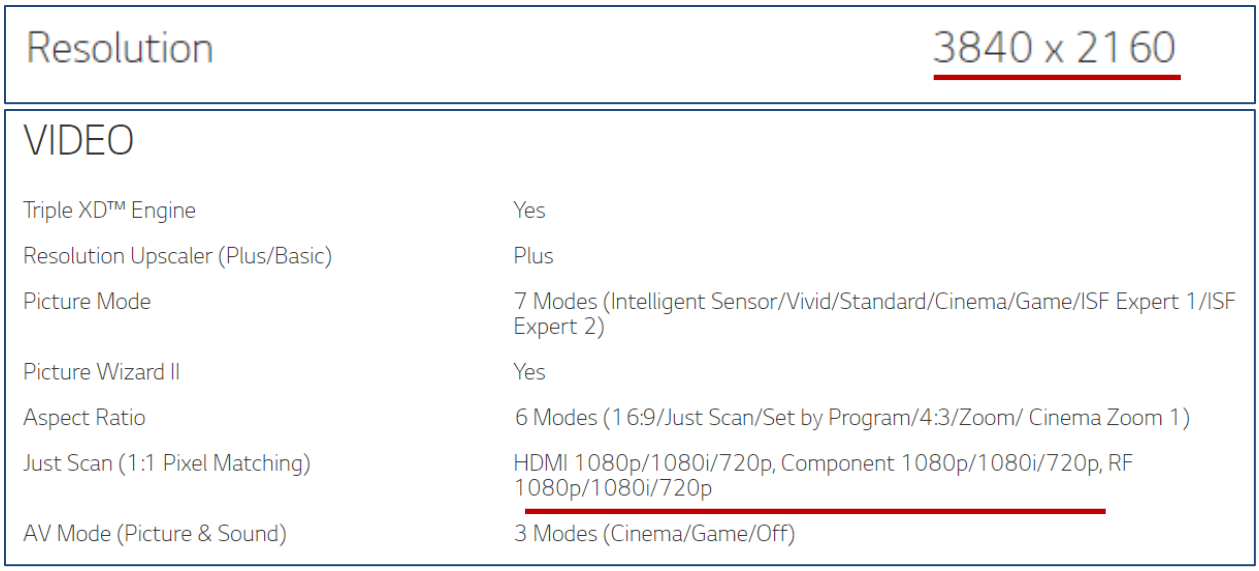
Figure 45

- Since the vast majority of programming is currently produced in 720p and 1080i, if your television is enabled with 1080p or 4K technology, your TV will convert our HD signal so you can continue to enjoy Spectrum TV.

http://www.spectrum.net/support/tv/hdtv-picture-formats/

82. LG Korea TVs generate a modified image frame by at least expanding the first image frame. For example, the LM9600/LM960V has a screen resolution of 3,840 x 2,160 pixels. It has an Upscaler which in real-time expands the received image frames (most often 720p or 1080i) to a modified image frame with the screen's resolution (3,840 x 2,160). As the first image frame and the modified image frame are different sizes, the modified image frame is different from the first image frame, e.g.:

Figure 46



Resolution	3840 x 2160

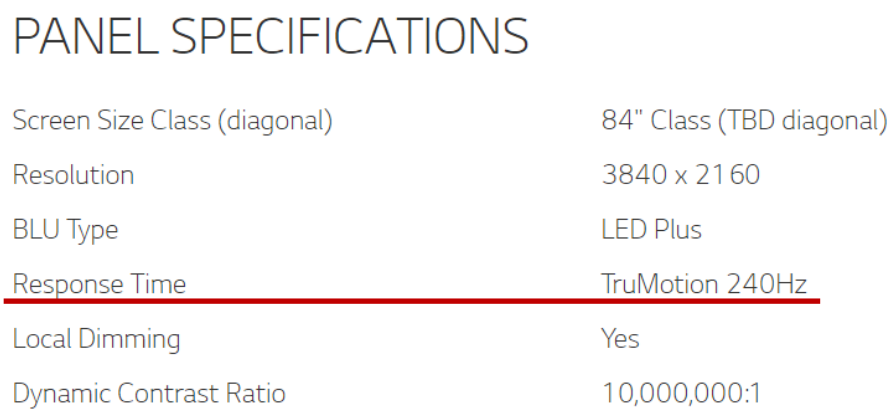
VIDEO

Triple XD™ Engine	Yes
Resolution Upscaler (Plus/Basic)	Plus
Picture Mode	7 Modes (Intelligent Sensor/Vivid/Standard/Cinema/Game/ISF Expert 1/ISF Expert 2)
Picture Wizard II	Yes
Aspect Ratio	6 Modes (16:9/Just Scan/Set by Program/4:3/Zoom/ Cinema Zoom 1)
Just Scan (1:1 Pixel Matching)	HDMI 1080p/1080i/720p, Component 1080p/1080i/720p, RF 1080p/1080i/720p
AV Mode (Picture & Sound)	3 Modes (Cinema/Game/Off)

http://www.lg.com/us/tvs/lg-84LM9600-led-tv

83. LG Korea TVs generate a first altered image frame that includes first and second non-overlapping portions. For example, the LM9600/LM960V features LG Korea's TruMotion 240Hz with Clear Plus technology, e.g.:

Figure 47



PANEL SPECIFICATIONS

Screen Size Class (diagonal)	84" Class (TBD diagonal)
Resolution	3840 x 2160
BLU Type	LED Plus
Response Time	TruMotion 240Hz
Local Dimming	Yes
Dynamic Contrast Ratio	10,000,000:1

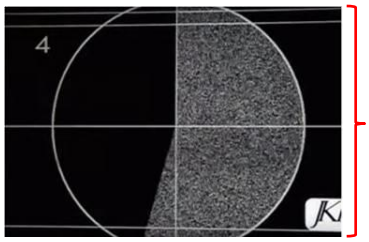
http://www.lg.com/us/tvs/lg-84LM9600-led-tv

84. The following are screenshots from a recording of an LG47LM960V TV showing

how backlight scanning generate a first (and second) altered image frame that includes first and second non-overlapping portions, e.g.:

Figure 48.

Still from high-speed video recordings of LG 47LM960V with "Trumotion" turned **off**. This illustrates how the modified image is generated with Trumotion Clear Plus turned

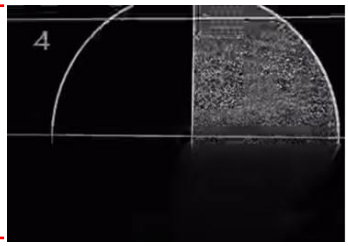


Modified image frame

(Source: https://www.youtube.com/watch?v=p8BE8NmjJok)

Still from high speed video recording of LG 47LM960V with "Trumotion Clear Plus" turned **on**

a first altered image frame that includes first and second non-overlapping portions,



first non-overlapping portion comprises a first portion of the modified image frame

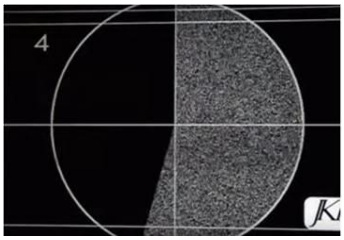
a second non-overlapping portion wherein the second non-overlapping portion is not include in the modified image frame or in the first image frame

(Source:https://www.youtube.com/watch?v=Jo4b2jEePg0)

85. LG televisions generate a second altered image frame that includes third and fourth non-overlapping portions wherein the third non-overlapping portion comprises a second portion of the modified image frame, the second portion of the modified image frame being different from the first portion of the modified image frame, wherein the first image frame does not include the fourth non-overlapping portion, wherein the modified image frame does not include the fourth non-overlapping portion, *e.g.*:

Figure 49.

Still from high-speed video recording of LG 47LM960V with "Trumotion" turned **off**. This illustrates how the modified image is generated with Trumotion Clear Plus turned on.

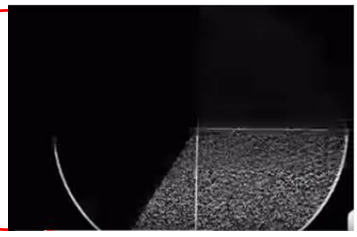


Modified image frame

(Source: https://www.youtube.com/watch?v=p8BE8NmjJok)

Stills from high-speed video recording of LG 47LM960V with "Trumotion Clear Plus" turned **on**

a second altered image frame that includes third and fourth non-overlapping portions,



a fourth non-overlapping portion, wherein the fourth non-overlapping portion is not included in the modified image frame or in the first image

a third non-overlapping portion comprises a second portion of the modified image frame, the second portion of the modified image frame being different from the first portion of the modified image frame

(Source: https://www.youtube.com/watch?v=Jo4b2jEePg0)

86. By making, using, selling, offering for sale, and importing LG Korea TVs and other similar products, LG Korea is infringing the claims of the ’874 Patent, including but not limited to claim 1. LG Korea has committed these acts of infringement without license or authorization.

87. LG Korea has injured VEI and is liable to VEI for direct infringement of the claims of the ’874 Patent pursuant to 35 U.S.C. § 271(a), (b), and (c).

88. As a result of Defendant’s infringement of the ’874 Patent, VEI has suffered harm and seeks monetary damages in an amount adequate to compensate for infringement, but in no event less than a reasonable royalty for the use made of the invention by LG Korea, together with interest and costs as fixed by the Court.

COUNT V

INFRINGEMENT OF U.S. PATENT NO. 7,030,902

(AGAINST LG KOREA ONLY)

89. Plaintiff incorporates by reference each of the allegations in the foregoing paragraphs, and further alleges as follows:

90. On April 18, 2006, the United States Patent and Trademark Office issued the '902 Patent. In one claimed embodiment, a method for creating an appearance of continuous movement with a plurality of picture frames using two or more pictures, said method comprises a) selecting at least two image pictures which are visually similar, a first image picture and a second image picture; b) selecting a bridging picture which is dissimilar to said image picture; c) arranging said pictures in a sequential order to create a first series of pictures, said sequential order being one or more first image pictures, one or more second image pictures, and one or more bridging pictures; d) placing said first series of pictures on a plurality of picture frames wherein each picture of said first series is placed on a single frame; and e) repeating the first series of pictures a plurality of times to create a continuous plurality of picture frames having said first series thereon, such that when said plurality of picture frames are viewed an appearance of continuous movement is perceived by a viewer. A true and correct copy of the '902 Patent is attached as Exhibit E.

91. LG Korea has been and is now directly infringing one or more claims of the '902 Patent, in this judicial District and elsewhere in the United States.

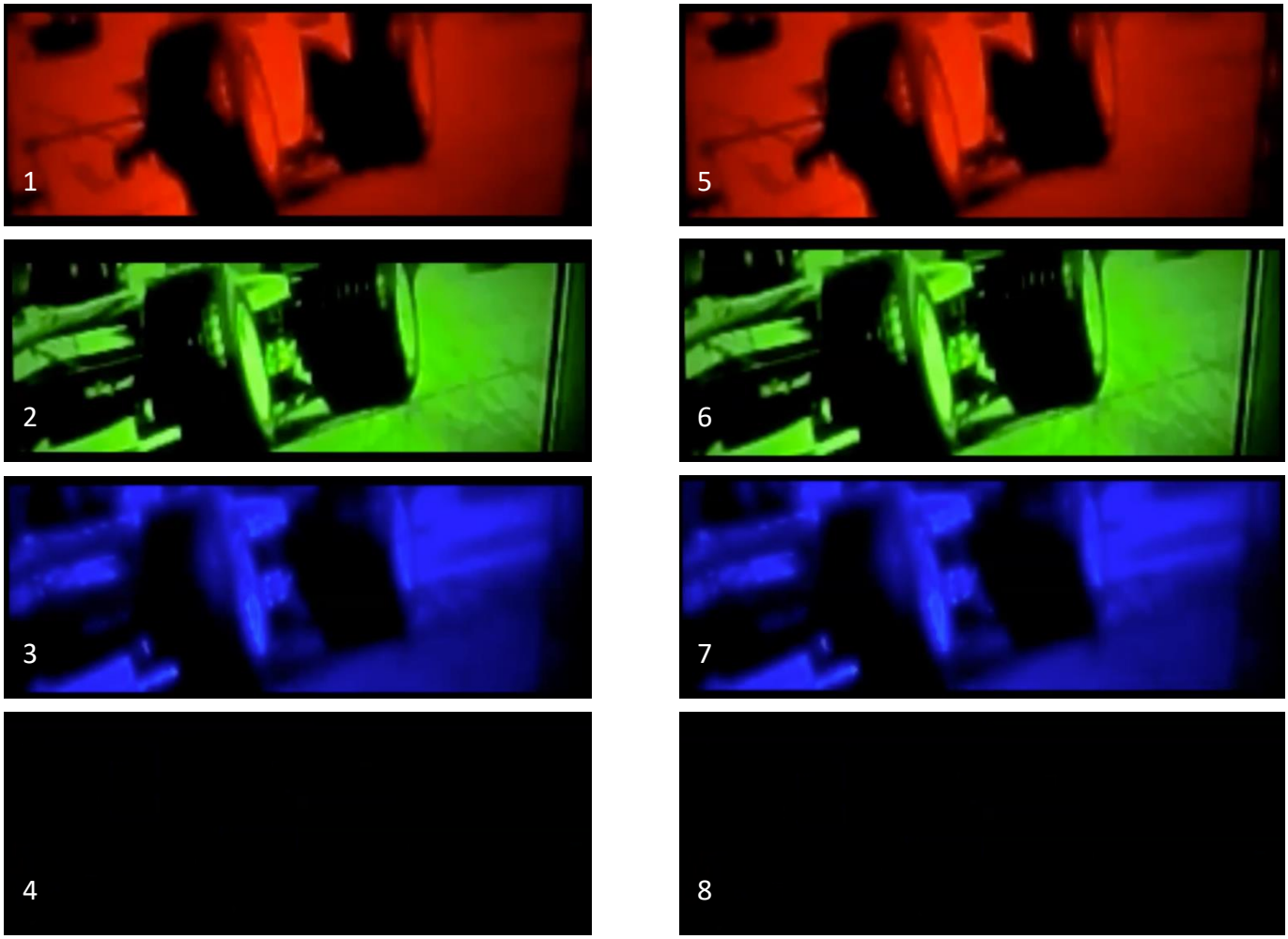
92. For example, LG Korea directly infringes the ’902 Patent, including but not limited to claim 1, by making, using, selling, offering for sale and importing LG Korea laser projectors. The LG Hecto is representative of the products accused, which encompass other LG Korea products having similar features.

Figure 50

http://www.lg.com/ae/projectors/lg-HECTO

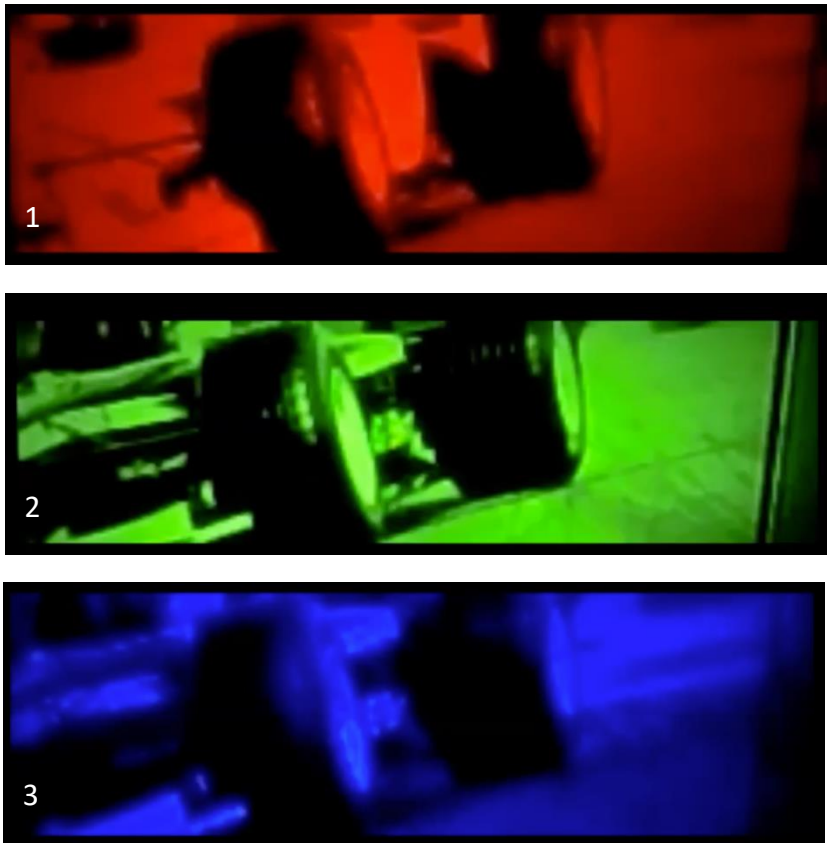
93. The evidence used in this section are screenshots from a video of a LG laser projector (e.g. LG Hecto) being filmed in ultra slow-motion to show each individual frame being displayed. Below are the first 8 frames displayed in said video, e.g.:

Figure 51



94. LG Korea laser projectors select at least two image pictures which are visually similar. For example, the LG Hecto selects three image pictures (shown below as 1, 2 and 3) which are visually similar. In this case, similar red, green and blue image pictures, e.g.:

Figure 52

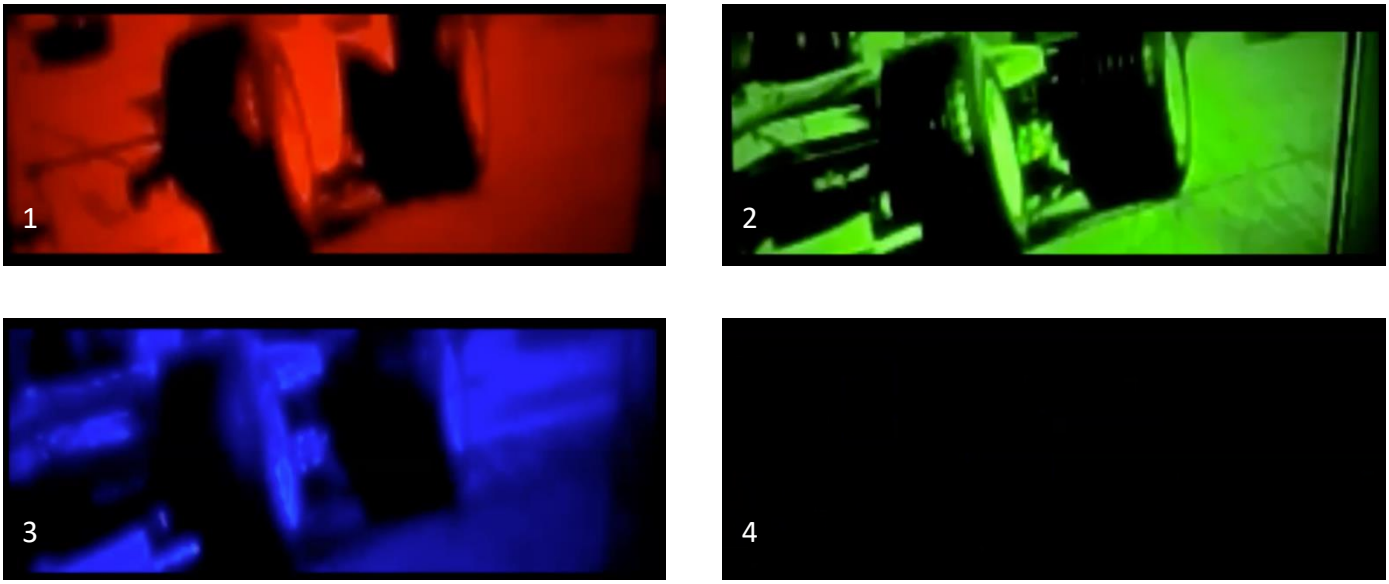


95. LG Korea laser projectors select a bridging picture which is dissimilar to said image pictures. For example, the LG Hecto selects an all-black bridging picture (shown below as 4), which is dissimilar to said image pictures, e.g.:

Figure 53

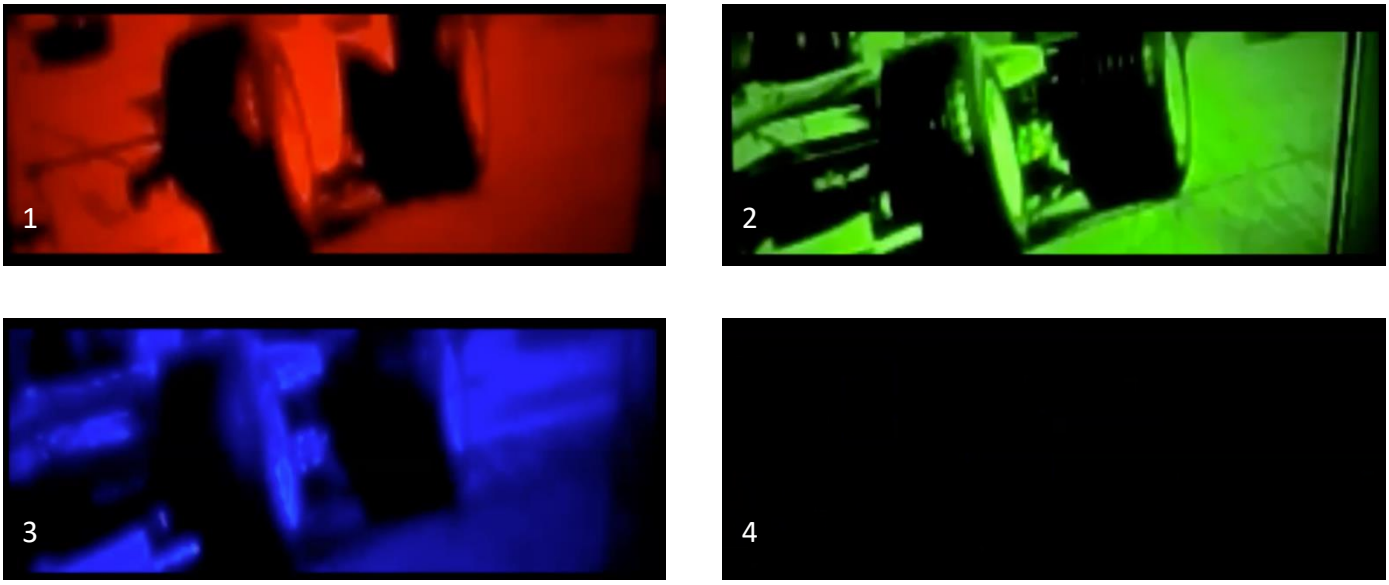
96. LG Korea laser projectors arrange said pictures in a sequential order to create a first series of pictures. For example, the LG Hecto arranges (and displays) said pictures in sequential order to create a first series of pictures. Shown below, the order the pictures are arranged (and displayed) is 1, 2, 3, 4, e.g.:

Figure 54



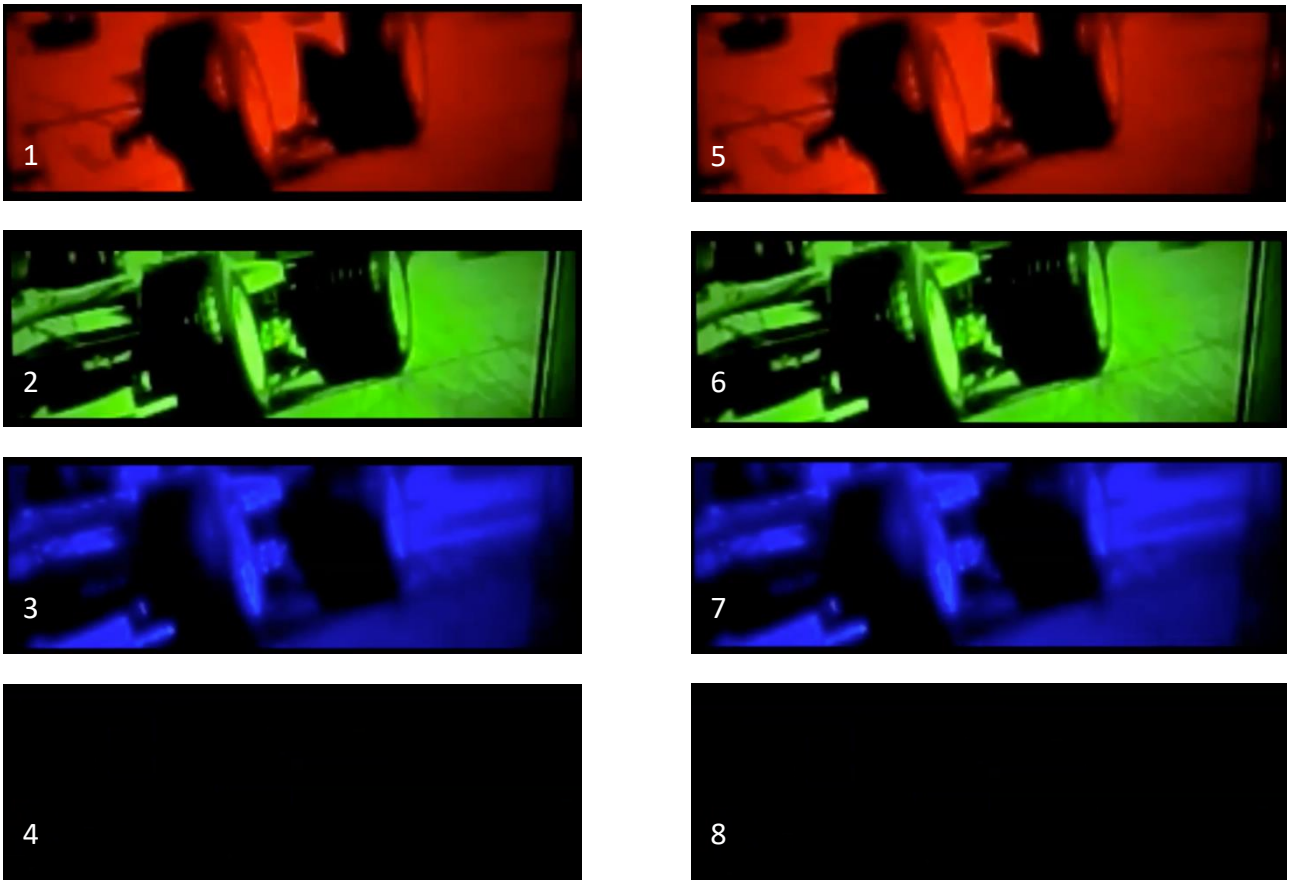
97. LG Korea laser projectors place said first series of pictures on a plurality of picture frames wherein each picture of said first series is placed on a single frame. For example, the LG Hecto places the first series of pictures on a plurality of picture frames, each of the pictures having their own frame. As shown below, each of the image pictures and the bridging picture are displayed on their own frame, e.g.:

Figure 55



98. As shown below, the first series of pictures, frames 1-4, are repeated in frames 5-8, e.g.:

Figure 56



99. By making, using, selling, offering for sale, and importing LG Korea laser projectors, LG Korea is infringing the claims of the '902 Patent, including but not limited to claim 1. LG Korea has committed these acts of infringement without license or authorization.

100. LG Korea has injured VEI and is liable to VEI for direct infringement of the claims of the '902 Patent pursuant to 35 U.S.C. § 271(a), (b), and (c).

101. As a result of LG Korea's infringement of the '902 Patent, VEI has suffered harm and seeks monetary damages in an amount adequate to compensate for infringement, but in no event less than a reasonable royalty for the use made of the invention by LG Korea, together with interest and costs as fixed by the Court.

PRAYER FOR RELIEF

Plaintiff respectfully requests the following relief from this Court:

A. That LG USA and LG Korea have each directly infringed the ’408 and ’922 Patents;

B. That LG Korea has directly infringed the ’444, ’874 and ’902 Patents;

C. That LG USA and LG Korea be ordered to pay damages to VEI, together with costs, expenses, pre-judgment interest and post-judgment interest as allowed by law;

D. A declaration that this case is exceptional under 35 U.S.C. § 285, and an award of VEI’s reasonable attorneys’ fees;

E. That the Court enter judgment against LG USA and LG Korea, and in favor of VEI in all respects;

F. For any such other and further relief as the Court deems just and equitable.

JURY TRIAL DEMANDED

Pursuant to Rule 38 of the Federal Rules of Civil Procedure, VEI requests a trial by jury of any issues so triable by right.

Dated: September 26, 2018

Respectfully submitted,

STAMOULIS & WEINBLATT LLC

/s/ Stamatios Stamoulis

Stamatios Stamoulis #4606
stamoulis@swdelaw.com
Richard C. Weinblatt #5080
weinblatt@swdelaw.com
Two Fox Point Centre
6 Denny Road, Suite 307
Wilmington, DE 19809
Telephone: (302) 999-1540

LAW OFFICES OF N.D. GALLI LLC

/s/ Nicole D. Galli
Nicole D. Galli (*pro hac vice forthcoming)*
ndgalli@ndgallilaw.com
Charles P. Goodwin (*pro hac vice forthcoming*)
cgoodwin@ndgallilaw.com
2 Penn Center Plaza, Suite 910
1500 JFK Blvd.
Philadelphia, PA 19102
Telephone: (215) 525-9580

Attorneys for Plaintiff
Visual Effect Innovations, LLC