

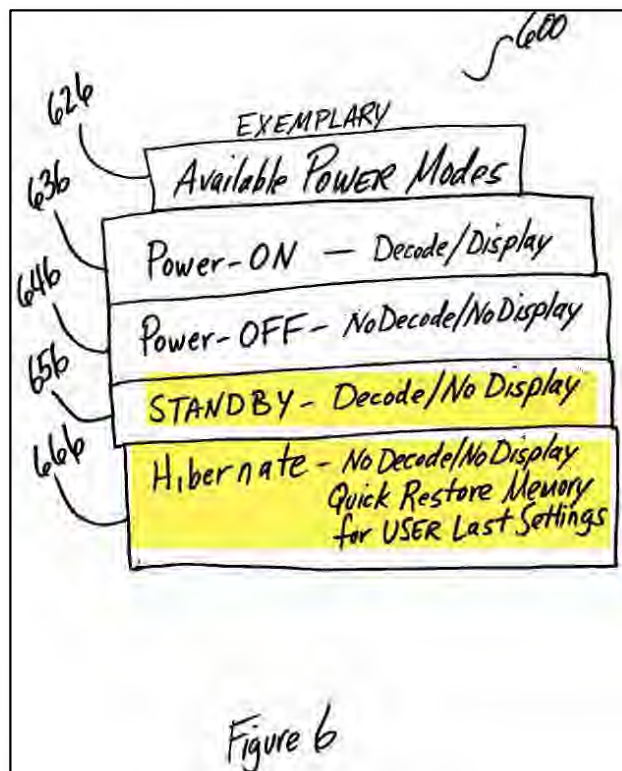
decoding device/entity may be powered on and **the display device/entity may be powered off**”), [0242], [0246], [0247], FIG. 6.

164. Relan further discloses:

The electronic **device may appear to be turned off**, because the display device/entity may not be displaying ... any multimedia-program information. **The display circuitry may be powered off**, wherein the electronic device may be adapted **to reduce power consumption**.

EX1010, [0242].

165. Fig. 6 of Relan confirms that the display is powered off in the “HIBERNATE state/mode” and a “STAND-BY state/mode”:



EX1010 at FIG. 6 (annotated).

166. In addition, as discussed for Limitation 1A, Relan's "power control processor" is connected to a "power supply," "evaluat[es] the power usage," and "ensur[es] that power is not being wasted when the electronic devices are idle or when an end-user is not present." EX1010, [0137], [0222], [0223], [0276], FIG. 5A. Thus, a POSITA would have understood that the "power control processor" controls "entering at least one of a plurality of power-saving modes" (*i.e.*, "*the waiting condition ... is controlled by the first controller...*"). *Id.*

167. Accordingly, Tichelaar's "D μ C 90" ("*first controller*") (alone or combined with Relan) discloses the corresponding structure S1.3. Tichelaar's "*first controller*" is a sub-CPU ("D μ C 90") configured to: (a) when the "*waiting condition*" ("standby mode") "*in which an image is not displayed after stopping a supply of the electric power to the display portion*" is in a "*first waiting condition*" (Tichelaar's "low-power standby"/Relan's "HIBERNATE") or "*second waiting condition*" (Tichelaar's "active standby"/Relan's "STAND-BY"), determine whether to place the "*waiting condition*" into a "*first*" or "*second waiting condition*" (when "screen 85" ("*display*") is off, "D μ C 90" determines whether to place the "audiovisual device" in "active standby" or "low-power standby" or "active standby"); and (b) place the "*waiting condition*" into a "*first*" or "*second waiting condition*" according to the determination (the "D μ C" initiates the determined "low-

power standby” or “active standby”). EX1008, [0045–47]; EX1010, [0137], [0222–23], [0276], FIG. 5A. Any differences between Tichelaar’s disclosure and the structure disclosed in the ’507 Patent are insignificant. Further, Tichelaar discloses performing F1.3 in substantially the same way with substantially the same result.

9. [Limitation 1H] “*the first controller is controlled to be set in operation via supply of the electric power from the electronic power source unit thereto, under the first or second waiting condition*”

168. Tichelaar discloses Limitation 1H.

169. In Tichelaar’s “low-power” or “active” standby modes (“*first or second waiting condition*”), Tichelaar’s “D μ C 90” (“*first controller*”) is responsible for “check[ing]” for valid remote control commands during the “standby” modes (“*set in operation ... under the first or second waiting condition*”). EX1008, [0005], [0036], [0046], [0041], [0042].

170. For this purpose, “SMPS 70 standby supply” supplies power to a separate “standby power supply domain” that is specifically designated for “D μ C 90” (“*supply of the electric power from the electronic power source unit thereto*”). EX1008, [0050], [0059]. Although Tichelaar’s disclosures focus on “low power standby,” a POSITA would have understood Tichelaar to disclose, or at least render obvious, supplying “D μ C 90” with “standby” power in “active standby.” See EX1008, ABSTRACT (**not** limiting “standby” to “low-power” standby), [0047], [0050], [0057], FIG. 4, [0036], [0044], [0046]. “D μ C 90” would still be responsible

for checking for valid remote control signals in that mode. *Id.* Indeed, the primary purpose of “D_μC 90” is to delegate this task from the “main micro-controller 88.” *See* EX1008, ABSTRACT, [0036], [0059].

171. Fig. 4 support this understanding because it shows “infrared remote control receiver front-end 144” providing the remote control signal directly to “D_μC [140].” *See* EX1008 at Fig. 4.

172. Relan also discloses Limitation 1H. In “HIBERNATE state/mode” or “STAND-BY state/mode” (*i.e.*, the “*first or second waiting condition*”), Relan’s “power control processor” (*i.e.*, the “*first controller*”) “is controlled to be set in operation via supply of the electric power from” an “internal power supply apparatus” and “power distributor” (*i.e.*, an “electronic power source unit”), as claimed. EX1010, [0222].

173. In “HIBERNATE state/mode” (*i.e.*, a “*first waiting condition*”), “all of the circuits, except the ‘wakeup-related’ circuits may be switched off...” EX1010, [0109], [0247], [0248]. Such “wakeup-related” circuits include the “power control processor” (*i.e.*, the “*first controller*”), which is tasked with “evaluating the power usage and ensuring that power is not being wasted when the electronic devices are idle...” *See* EX1010, [0137], [0222], [0223], [0276], FIG. 5A.

174. Similarly, “[i]n the STAND-BY state/mode, all functions related to the electronic device may be accessible, except for the display/broadcast functions...”

EX1008, [0246], [0073], [0108], [0242], [0243]. The “power control processor” is not a “display/broadcast function,” and thus, would not be powered off in “STAND-BY state/mode.” *See* EX1010, [0137], [0222], [0223]. To be sure, the power control processor’s task of “evaluating power usage” includes evaluating power consumed during the “STAND-BY state/mode.” *See id.* Thus, the “power control processor” is also powered-on in this mode. *Id.*

10. [Limitation 1I] “*the electric power supplied from the power source unit is controlled, so as to supply the electric power to the remote control signal receiving portion, as well as, not to supply the electric power to the second controller including the decoder, under the first waiting condition, and*”

175. Tichelaar discloses or at least renders obvious Limitation 1I.

176. As discussed for Limitation 1F, “D μ C 90” controls voltage supplied from SMPS 70, including to “resources” (“*the electric power supplied from the power source unit is controlled*”). EX1008 at Claim 1, [0043], [0052], [0058], [0059], [0061], [0063].

177. As discussed for Limitations 1F and 1H, “infrared remote control receiver front-end 42” provides “received remote control signals” to “D μ C 90” in both standby modes. EX1008, [0036]. Accordingly, in both “low-power” and “active standby,” power is supplied from SMPS 70 to the “infrared remote control receiver front-end 144” resource (“*the electric power supplied from the power source*

unit is controlled, so as to supply the electric power to the remote control signal receiving portion ... under the first waiting condition"). EX1008, [0036], [0059].

178. As discussed for Limitations 1F and 1H, in both standby modes, “infrared remote control receiver front-end 144” provides “received remote control signals” to “D μ C 90.” EX1008, [0036]. If power was not supplied to the “infrared remote control receiver front-end 144” in these mode, it would be unable to provide the signals to the controller. *Id.*

179. In addition, during the “low-power standby,” power is **not** supplied to the “main micro-controller 88,” including the decoding functionality (“*not to supply the electric power to the second controller including the decoder, under the first waiting condition*”).

180. In low power standby mode, “only the D μ C 90 and a small part of the DOP 83 is powered by SMPS 70 standby supply ... whereas the rest of the SoC 82 is not powered.” *See* EX1008, [0050], [0036], [0044], [0046]. Thus, the “main micro-controller 88” and “decoder” functionality are in the part of the SoC 82 that is powered off. *See* EX1008, [0005], [0047], [0049].

181. Similarly, Relan discloses Limitation 1I. In Relan’s “HIBERNATE state/mode” (“*first waiting condition*”), power is supplied from the “internal power supply apparatus 516A” and “power distributor 562A” (“*power source unit*”) to the “wakeup-related’ circuits” (“*remote control signal receiving portion*”) and not to

“all” other circuits, including “processor 561” (“*second controller*”) and “decoding-related electronic and electrical circuits” (“*decoder*”). EX1010, [0221–23], [0248].

182. During the “HIBERNATE state/mode,” power is supplied to the ““wakeup-related’ circuits.” See EX1010, [0065]. A POSITA would have found it obvious that such ““wakeup-related’ circuits” could include a remote control receiver. A POSITA would have been familiar with standard television re-mote controllers that conventionally provide a “power” button. See EX1010, [0026], [0049], [0066]. And Relan discloses that in “HIBERNATE state/mode,” “some minimal amount of circuitry of the electronic device may re-main on and operational” and that the electronic device can “emerge from the HI-BERNATE state/mode” by being “switched on or powered on.” See Relan, [0247]. Such circuitry would not require significant power or re-sources, and a user conventionally would have expected to be able to “wakeup” a television from a “HIBERNATE state/mode” by pressing the “power on” button of a remote control. *Id.* The absence of such functionality would have been inconvenient for a user. *Id.* Thus, it would have been obvious to a POSITA that certain circuitry would need to remain operational to receive a “switched on or powered on” command and that that circuitry could include “remote control signal receiving” circuitry to receive the command from a remote control device. *Id.*

183. During the “HIBERNATE state/mode,” power is not supplied to “processor 561,” including the decoder. Relan explicitly discloses, “in HIBERNATE state/mode ... the decoding device/entity may[] be switched off.” EX1010, [0247], [0073], [0074], [0108], [0109], [0235], [0236], [0242], [0246], [0247]. In addition, “processor 561” would also be powered off because it controls decoding and because Relan discloses that only “some minimal amount of circuitry of the electronic device may remain on” during the “HIBERNATE state/mode,” such as “quick restore memory consuming only a small amount of power to maintain the end-user’s last settings and/or preferences.” See EX1010, [0170], [0217], [0218], [0232], [0236], [0247]. A POSITA would have understood that supplying power to “processor 561” is not required to maintain a user’s settings in memory, nor does Relan describe “processor 561” as being used for that purpose. See EX1010, [0170], [0217], [0218], [0232], [0236], [0247]. Thus, it at least would have been obvious to a POSITA that “processor 561” is not powered during the “HIBERNATE state/mode.” *Id.*

11. [Limitation 1J] “*the electric power supplied from the power source unit is controlled so as to supply the electric power to the remote control signal receiving portion and the second controller including the decoder, under the second waiting condition*”

184. Tichelaar discloses, or renders obvious, Limitation 1J.

185. Again, “D μ C 90” controls voltage supplied from SMPS 70 (“*the electric power supplied from the power source unit is controlled*”). See Limitation 1F.

186. In addition, as discussed above, in Tichelaar’s “active standby,” power is supplied from SMPS 70 to the “remote control receiver front-end 144” (“*supply the electric power to the remote control signal receiving portion ... under the second waiting condition*”). EX1008, [0036], [0059].

187. In “active standby”—similar to “low-power standby”—the “the TV should be powered up ... (for example, TV on-key pressed),” if a remote control command is valid. EX1008, ABSTRACT, [0036], [0059]. For this to happen, “infrared remote control receiver front-end 144” must be powered on. *Id.* At the very least this would have been obvious to a POSITA. *Id.* Indeed, a POSITA would have understood that “active standby” includes the functionality of “low-power standby,” including receiving remote control signals, and some “additional tasks.” See EX1008, [0005], [0045], [0047], [0054].

188. Further, a POSITA would have understood Tichelaar to disclose, or render obvious, that in “active standby,” power is supplied to the “main micro-controller 88” and decoder functionality (“*supply the electric power to the remote control signal receiving portion and the second controller including the decoder, under the second waiting condition*”). For example, Tichelaar discloses that, in

“active standby,” the SoC 82 performs “additional tasks,” which would have required the “main micro-controller 88” and “decoding” functionality to be supplied with power. *See* EX1008, [0005], [0045], [0047], [0054]. One such “additional task” is “software downloads,” which requires the main micro-controller 88’s “resources for doing loads and stores of code.” EX1008, [0012], [0047], [0049], [0063]. In contrast, “DμC 90” has only a “minimal set of local re-sources,” inadequate for performing “software downloads.” EX1008, [0035]. Other such “additional task” are “MPEG transport stream (TS) monitoring,” “demultiplexing,” and “descrambling,” which require the decoding functionality, in addition to the “main micro-controller 88,” as discussed in Limitation 1B above. EX1008, [0047]; *see* EX1017, 1:18-19. Thus, power is supplied to these components in “active standby.” *Id.*

189. Similarly, Relan discloses Limitation 1J. In Relan’s “STAND-BY state/mode,” the “internal power supply apparatus 516A” and “power distributor 562A” supply power to” “**all functions** related to the electronic device..., **except** for the display/broadcast functions”¹¹ (“*supply the electric power to the remote control signal receiving portion and the second controller including the decoder*”).

¹¹ The “broadcast” function here refers to audio output from the electronic device.

See EX1010, [0032], [0054].

EX1010, [0246]. During the “STAND-BY state/mode,” power is supplied to the remote control receiver because “all functions” are accessible, “except for the display/broadcast functions,” and as discussed above, a user would have expected to be able to power up a television from a “STAND-BY state/mode” by pressing a button on the remote control. *See* EX1010, [0113] (“The electronic device may ... evaluate the commands, determine appropriate power-saving states/modes to efficiently perform the commands, enable/disable and initiate the determined appropriate power-saving states/modes...”), [0024]. Such powered-on functions include the “processor 561” (“*second controller*”), “decoding-related electronic and electrical circuits” (“*decoder*”), and “wakeup-related’ circuits” (“*remote control signal receiving portion*”).

190. In Relan’s STAND-BY state/mode, “Processor 561” is supplied with power to perform video processing tasks. *Id.* Relan discloses that, in STAND-BY state/mode, an end-user can record a multimedia-program—requiring processing, decoding and saving the program. EX1010, [0258]. “Processor 561” is involved in this process. *See* EX1010, [0170], [0217], [0218], [0232], [0236], [0247]. For example, “processor 561 ... convey[s] the multimedia-program transmission to [an] audio/video decoder.” EX1010, [0111], [0218], [0232], [0243].

191. In addition, Relan explicitly discloses that power is supplied to the “decoder” in STAND-BY state/mode:

[I]n the STAND-BY state/mode, the display device/entity may be powered off and **the decoding device/entity may remain powered on. ...**

[T]he decoding circuitry may be powered on, wherein the electronic device may be receiving, decoding, and storing multimedia-program information for later playback.

EX1010, [0242], [0243], [0246], [0108], [0235]

192. Relan also discloses an example of the decoding functionality in STAND-BY state/mode:

[T]he electronic device may HIBERNATE, (*i.e.*, enter the HIBER-NATE state/mode), after receiving and storing/saving a plurality of end-user commands, for example, record, playback, etc. The electronic device may remain in the HIBERNATE state/mode until entering the STAND-BY state/mode, for example. Upon entering the STAND-BY state/mode, the electronic device may initiate recording of a first selected multimedia-program. The electronic device may remain in the STAND-BY state/mode until completion of recording the first selected multimedia-program, wherein the electronic device may once again re-enter the HIBERNATE state/mode until another selected program-related event is imminent.

EX1010, [0111].

193. Thus, “multimedia-program recording may be commenced ... while the electronic device is in the STAND-BY state/mode,” without powering the display. EX1010, [0111], [0246].

194. Finally, a POSITA would have understood Relan to disclose that, in the “STAND-BY state/mode,” power is supplied to “wakeup-related’ circuits,” including the remote control receiver. Relan discloses that “**all functions**,” “except for the display/broadcast functions,” are accessible. EX1010, [0246]. In addition, Relan discloses evaluating remote control commands while in various power saving modes. *See* EX1010, [0113] (“**evaluate the commands [to] ... disable ... power-saving states/modes...**”), [0024].

C. Claim 2

195. Claim 2 is similar to Claim 1. For example, Claim 2 differs in that it is directed to a “*display apparatus*”, recites “*control circuit[s]*” rather than “*controller[s]*,” and “*control[ling] parts of the display portion*” rather than “*processing of a received digital broadcasting signal via a decoder*.”

196. These differences are immaterial with respect to the prior art, which discloses them, or at the very least renders them obvious. For example, Tichelaar’s “micro-controllers” are included on an “integrated circuit (IC)” and are themselves circuits (“*control circuit[s]*”). EX1008, [0001], [0019], [0020], [0022]; *see also*,

EX1001, 6:6-8. Similarly, Relan’s “processors” are circuits and are integrated into circuits. *See* EX1010, [0073–74].

197. In addition, the OS-based controllers were disclosed by the prior art, and known to POSITAs, “*to control parts of the display portion.*” *See, e.g.,* EX1008, [0004]; EX1016; EX1011, [0005], [0010], [0011], [0013], [0032] (“under a control of CPU”), [0041–42]. For example, the “WindowsCE” controller, disclosed by Steinfatt, which is referenced by Tichelaar, controlled a display. *Id.*

198. Thus, for the same reasons discussed for Claim 1, Tichelaar, in view of the knowledge of a POSITA and/or Relan, discloses or at least renders obvious every element of the Claim 2.¹²

1. [Preamble] “*A display apparatus, comprising*”

199. *See* Preamble 1, *supra*.

2. [Limitation 2A] “*a receiving portion, which is configured to receive a digital broadcasting signal*”

200. *See* Preamble 1, *supra*.

¹² To the extent Patent Owner argues there is a substantial difference between the “decoder” in Claims 1 and 2, a POSITA would have understood that decoder functionality conventionally could be handled by a controller and/or dedicated circuitry. *See, e.g.,* EX1015, 3:60-21; EX1022, 2:24-26.

3. **[Limitation 2B]** *“a decoder, which is configured to decode the digital broadcasting signal received by the receiving portion”*

201. See Limitation 1B, *supra*, regarding the decoder.

4. **[Limitation 2C]** *“a display portion, which is configured to display an image using a signal decoded within the decoder”*

202. See Limitation 1C, *supra*.

5. **[Limitation 2D]** *“an electric power source unit which is configured to supply predetermined electric power”*

203. See Limitation 1D, *supra*.

6. **[Limitation 2E]** *“a remote control signal receiving portion, which is configured to receive a remote control signal for operating the display portion”*

204. See Limitation 1E, *supra*.

7. **[Limitation 2F]** *“a main control circuit, which is configured to be started up by a predetermined OS to control parts of the display portion”*

205. See Limitation 1B, *supra*.

8. **[Limitation 2G]** *“a sub-control circuit, being smaller in consumption of electric power than the main control circuit, which is configured to control the electric power supplied from the electric power source unit, responsive to the remote control signal received by the remote control signal receiving portion”*

206. See Limitation 1F, *supra*.

9. [Limitation 2H] *“wherein a waiting condition of the display apparatus in which an image is not displayed after stopping a supply of the electric power to the display portion, is controlled by the sub-control circuit, so as to be placeable into either of a first waiting condition or a second waiting condition”*

207. See Limitation 1G, *supra*.

10. [Limitation 2I] *“the sub-control circuit is controlled to be set in operation via supply of the electric power from the electronic power source unit thereto, under the first or second waiting condition”*

208. See Limitation 1H, *supra*.

11. [Limitation 2J] *“the electric power supplied from the power source unit is controlled, so as to supply the electric power to the remote control signal receiving portion, as well as, not to supply the electric power to the decoder and the main control circuit, under the first waiting condition”*

209. See Limitation 1I, *supra*.

12. [Limitation 2K] *“the electric power supplied from the power source unit is controlled so as to supply the electric power to the remote control signal receiving portion, the decoder and the main control circuit, under the second waiting condition”*

210. See Limitation 1J, *supra*.

- D. Claim 8 “*The display apparatus, as described in the [sic] claim 2, comprising: a timer, which is configured to detect a present time, wherein under the first waiting condition, the apparatus is shifted from the first waiting condition into the second waiting condition, when the present time detected by the timer lies within a predetermined time range, and under the second waiting condition, the apparatus is shifted from the second waiting condition into the first waiting condition, when the present time does not lie within a predetermined time range*”**

211. Tichelaar, in view of Relan and the knowledge of a POSITA renders obvious, claim 8.

212. Relan expressly that the television apparatus includes a “real-time clock” to “determine a current correct local time/date” (“*a timer, which is configured to detect a present time*”). EX1010, [0120–21]. Relan further discloses, “**the real-time clock may also support and be associated with the power-saving states/modes** active in the electronic device.” *Id.* Tichelaar also discloses that the “audio/visual device” includes both a “timer” and a “real-time clock.” EX1008, *e.g.*, [0005], [0008–12].

213. Relan discloses that the system can “autonomously/unilaterally” enter STAND-BY and HIBERNATE either based on a detected period of inactivity and/or at specified dates/times according to a preset schedule. *Id.*, [0140–49], [0202], [0251–70], [280–85], Figs. 6–10.

214. In one example, the user may schedule a time for the system to record a program when the user will not be home. *See* EX1010, [0251–70]. When the “the

real-time clock” (“*timer*”) determines that the scheduled recording time has arrived (“*when the present time detected by the timer lies within a predetermined time range*”), the device transitions from HIBERNATE to STAND-BY so that the program can be recorded (“*wherein under the first waiting condition, the apparatus is shifted from the first waiting condition into the second waiting condition*”). EX1010, [0263-64]. When the program concludes (“*when the present time does not lie within a predetermined time range*”), the system then shifts the system back into the HIBERNATE (“*the apparatus is shifted from the second waiting condition into the first waiting condition*”). *Id.*

E. Claim 9 “*The display apparatus, as described in the [sic] claim 8, wherein the predetermined time range can be changed in accordance with a user’s instruction.*”

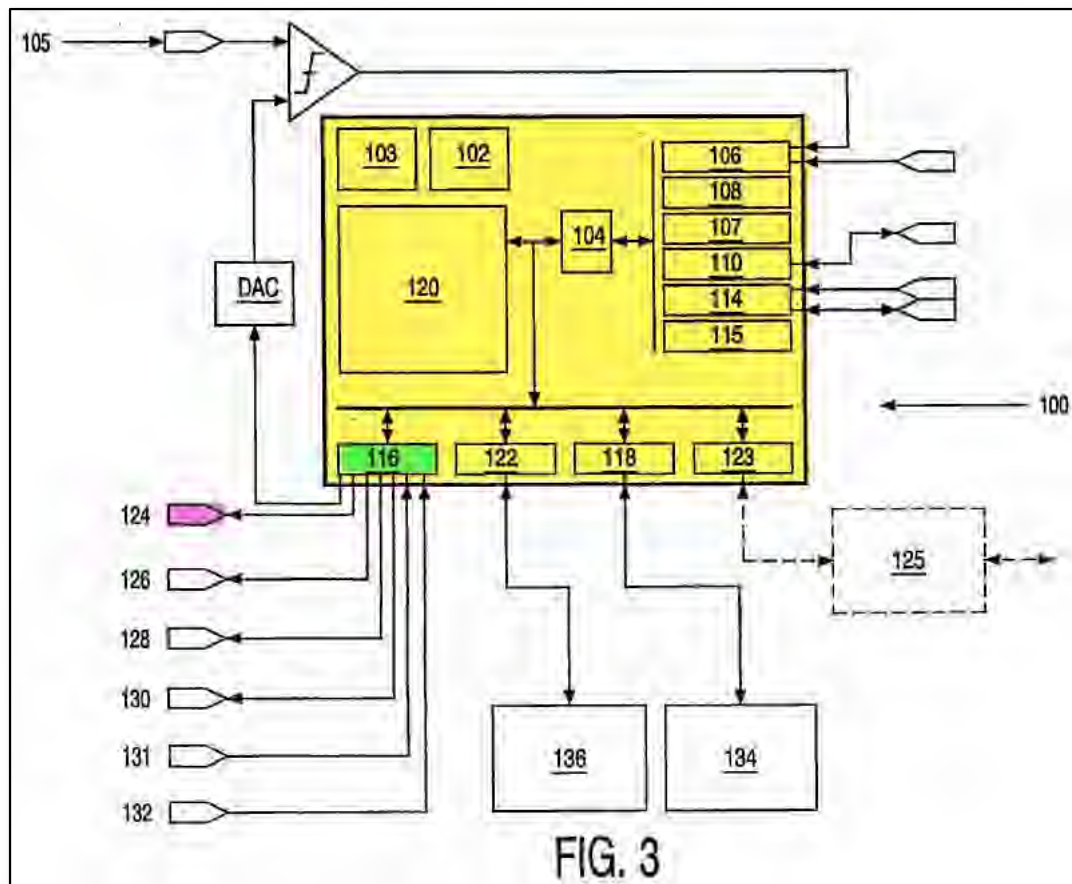
215. As discussed above, Tichelaar in view of Relan and the knowledge of a POSITA renders obvious claim 8.

216. With respect to claim 9, Relan further expressly discloses that the parameters for the system to autonomously transition between HIBERNATE and STAND-BY are determined according to a user’s interaction (*e.g.*, scheduling the device to record a program at a specific date/time) with the system (“*wherein the predetermined time range can be changed in accordance with a user’s instruction*”). EX1010, [0140-49], [0202], [0251–70], [280–85], Figs. 6–10.

- F. Claim 10** *“The display apparatus, as described in the [sic] claim 2, comprising: a light emitting element which changes an emitting condition thereof depending on whether the display apparatus is in the first waiting condition or the second waiting condition, and wherein the light emitting element makes the display portion distinguishable whether the display apparatus is in the first waiting condition or the second waiting condition.”*

217. Tichelaar, in view of the knowledge of a POSITA, discloses, or renders obvious, Claim 10.

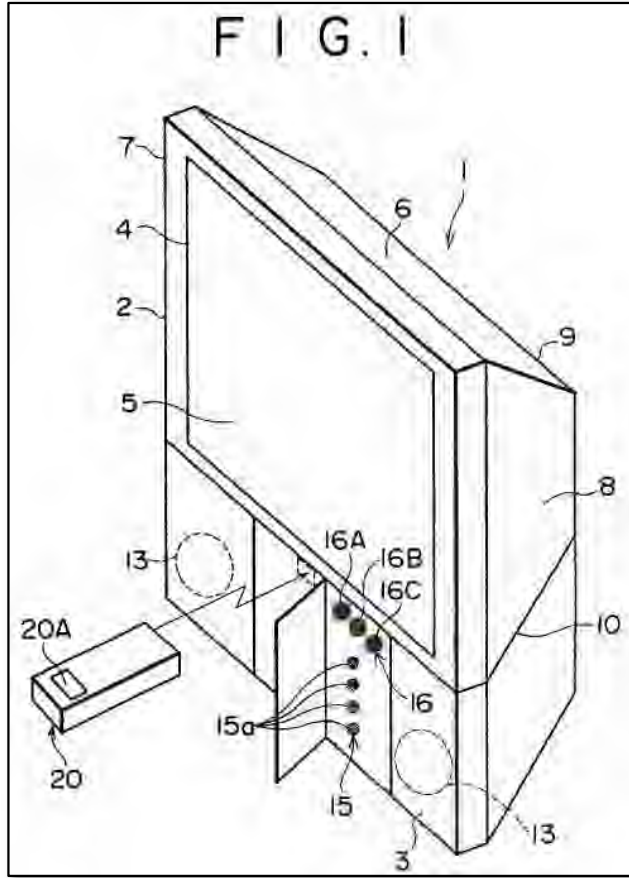
218. Figure 3 of Tichelaar (annotated below) discloses that “D μ C 90” (highlighted in yellow) includes “PORTS 116” (highlighted in green) which interfaces with ports 124, 126, 128, 130, 131, and 132:



EX1008, [0057], [0058], FIG. 3 (annotated).

219. Tichelaar further discloses, “[a] first output 124 port is used to control a **standby LED**” (highlighted pink) (“*a light emitting element*”). *Id.* A POSITA would have found it obvious that “D μ C 90” could control the “standby LED” to change its condition in the “low-power standby” and “active standby” (“*changes an emitting condition thereof depending on whether the display apparatus is in the first waiting condition or the second waiting condition, and wherein the light emitting element makes the display portion distinguishable whether the display apparatus is in the first waiting condition or the second waiting condition*”). For example, in the case of a single color LED, in “low-power standby,” the LED could be off and in “active standby” it could be illuminated.

220. In addition, it would have been obvious to locate the “standby LED” in manner that “*make the display portion distinguishable.*” Placing LEDs in a television display apparatus (which is how the ’507 Patent describes the LED placement (*see* EX1001, 10:59-11:9)) to indicate its power status, including the state of a “standby” mode, had long been known in the art. EX1018, [0028], [0059], FIG. 1. For example, a POSITA would have been aware of Hamakada *et al.*, assigned to Sony Corporation, which discloses a television with three LEDs, including a “power LED 16A,” a “standby LED 16B,” and a “BS [(‘broadcast signal’)] power LED 16C”, as shown in annotated Fig. 1 below:



Id.

221. Thus, Tichelaar, in view of the knowledge of a POSITA, renders Claim 10 obvious.

G. Claim 13 “*The display apparatus, as described in the [sic] claim 2, wherein when a power button of the display apparatus is turned ON under the first waiting condition or the second waiting condition, the sub-control circuit controls the electronic power source unit, so as to supply the electric power to the receiving portion and the display portion, so as to operate the display apparatus in a normal manner*”

222. Tichelaar discloses Claim 13.

223. Tichelaar discloses that in the “standby” modes (*“first waiting condition or the second waiting condition”*), “D μ C 90” (*“sub-control circuit”*) “validates autonomously a remote control command ...” and the “TV system is powered up only when a command is valid, *e.g.* remote control channel, standby or **power on key pressed, keypad on key pressed** etc” (*“when a power button of the display apparatus is turned ON ... supply the electric power to the receiving portion and the display portion, so as to operate the display apparatus in a normal manner”*). EX1008, [0062].

224. As discussed for Limitations 1A and 1F, Tichelaar discloses “D μ C 90” causes the television to “return from standby mode” by controlling the supply of electric power from SMPS 70 (*“the sub-control circuit controls the electronic power source unit”*), including via EHT generator 142. EX1008, [0017–19], [0023], [0024], [0027], [0035], [0036], [0038], [0042–44], [0052], [0057–61], Claim 1.

225. Relan also discloses Claim 13. Relan discloses a “POWER-ON mode” where “all circuits of the electronic devices may be one of switched-on and active.” EX1010, [0075]. The electronic device may enter the “POWER-ON mode,” “[u]pon determining that a valid end-user is present,” which determination may be made based on “pressing a sequence of one of buttons and keys on at least one of the remote control device [and] the electronic device...” EX1010, [0022], [0025], [0063], [0065], [0076]. In particular, Relan discloses, “the POWER-ON state/mode

may occur when a switch is employed to turn on the electronic device, enabling power flow and power consumption within the electronic device” (*i.e.*, “when a power button of the display apparatus is turned ON ... supply the electric power to the receiving portion and the display portion”). EX1010, [0240].

226. “Upon entering the POWER-ON state/mode, a display device/entity of the electronic device may be switched on and the electronic device may initiate playback of recorded multimedia-programs or perform another program-related event” (*i.e.*, “so as to operate the display apparatus in a normal manner”). EX1010, [0112], [0239]. Relan further discloses that the electronic device may transition to the “POWER-ON mode/state” from another power saving mode (*e.g.*, the “HIBERNATE state/mode”) (“*under the first waiting condition or the second waiting condition*”). EX1010, [0109].

227. Finally, as discussed for Limitations 1A and 1F, Relan discloses that the “power control processor” is connected to a “power supply” and “adapted to regulate the power usage ... when the electronic devices are idle or when an end-user is not present...” (*i.e.*, “the sub-control circuit controls the electronic power source unit”). EX1010, [0137], [0222], [0223], [0276], FIG. 5A

H. It would have been Obvious to Modify Tichelaar in view of a POSITA’s Knowledge (Ground 1)

228. In the event that the Patent Owner argues that Tichelaar does not expressly disclose one or more limitations of Limitations 1B/2F, 1G/2H or 1J/2K,

those limitations would have been obvious in view of a POSITA's knowledge, and accomplished with a reasonable expectation of success.

1. Obviousness Rationales

a. Limitations 1B/2F

229. Tichelaar would have suggested to, and motivated, a POSITA to use an OS-based main micro-controller 88 (“a *second controller configured to be started up by a predetermined OS to control a processing of a received digital broadcasting signal via a decoder*”/“a *main control circuit, which is configured to be started up by a predetermined OS to control parts of the display portion*”).

230. As discussed above, Tichelaar discloses a “main micro-controller 88” that can load and store “code and data” and specifically references “software downloads.” *See* EX1008, [0012], [0047]. These disclosures would have suggested to, and motivated, a POSITA to use an OS-based “main micro-controller” to perform such tasks. *See* EX1020, 1:17-46. In addition, a POSITA would have also looked at Tichelaar discussions of Steinfatt, which would have provided additional suggestions and motivations. *See* EX1008, [0004]; EX1016, 354. Steinfatt discloses that OS-based controllers are “for use in **high-end TV sets**” and “allows TVs to implement ... **Internet TV**.” *Id.* A POSITA would have been motivated to use an OS-based “main micro-controller” in Tichelaar’s system to address the high-end TV market and provide such desired functionality (*e.g.*, Internet TV). *Id.*

231. In addition, a POSITA would have been well-aware of other prior art that disclosed motivations to use OS-based “main micro-controllers.” *See* EX1001, 1:51-65; EX1011, [0005]; EX1006, [0004], [0005]; EX1023, 2:46-56, 3:18-39.

232. In particular, Kim’616 discloses that “[d]uring [a] booting process, RAM 130 loads the operating system and the application programs...” EX1011, [0031]. “CPU 110 then loads an application program stored in HDD 150 into RAM 130,” “performs the application program,” and “processes an input of the user to view the television broadcast output through the television card.” *See* EX1011, [0042].

233. Although Kim’616 discloses allowing the television to display an “initial screen” while the OS is booting (*see* EX1011, [0016]), once the OS is booted, the main controller resumes control of the television system under operation of the OS, including controlling reception and processing of digital broadcasts. *See* EX1011, [0032–33], [0040–42].

234. For example, Kim’616¹³, originally assigned to Samsung Electronics, discloses that televisions conventionally were “based on [an] operating system” and included OS-based controllers to control processing of a digital broadcast and

¹³ As discussed in Section VIII.A, Kim’616 is analogous art in the same field of endeavor.

display thereof. EX1011, [0005], [0009], [0011], [0013], [0032–33], [0040–42]. Kim’616 also discusses the prior art reference Vaughan, assigned to Hewlett Packard, that discloses “computer/television (PC/TV) convergence systems.” EX1020, 1:17-46. According to Vaughan, OS-based systems provided several benefits over traditional televisions, such as the ability to display “TV programs and computer applications,” “utilize[e] the communications bandwidth, mass storage and graphics application of the computer to deliver, store and display applications within a television viewing environment,” and “download information.” *Id.* A POSITA would have been aware of such benefits of using a conventional OS-based processor, including to control a television, video processing, and a display.

b. Limitations 1G/2H

235. Tichelaar also would have suggested to, and motivated, a POSITA to place its “standby mode” into either “low-power standby” or “active standby” (“*waiting condition ... placeable into either of a first waiting condition or a second waiting condition*”) (Limitations 1G/2H).

236. Tichelaar itself would have suggested to, and motivated, a POSITA to modify its “audiovisual device”: (1) to place its “standby” mode (“*waiting condition*”) into either a “low-power standby mode” or “active standby mode” (“*either of a first waiting condition or a second waiting condition*”) in which power is not supplied to “screen 85” (“*in which an image is not displayed after stopping a*

supply of the electric power to the display portion”) (Limitations 1G/2H), and (2) in active standby mode, to control SMPS 70 to supply power to the “infrared remote control receiver front-end,” “main TV micro-controller,” and “decoder” functionality (“*the power source unit is controlled so as to supply the electric power to the remote control signal receiving portion and the second controller including the decoder, under the second waiting condition*”) (Limitations 1J/2K).

237. As discussed above, although Tichelaar “focus[es]” on “low-power standby,” it also “supports” “active standby.” *See* §VII.B.8, *supra*. Indeed, Tichelaar explicitly discloses that TVs “in general [have] four **power modes** of operation: Off, **Low-power standby** (or standby passive), **Active standby**, Running (System operational).” *See* EX1008, [0045]. Moreover, Tichelaar discloses that “active standby” provides desirable “different possibilities,” including: (1) “small signal functions,” (2) “activat[ing] ... FM radio,” (3) “rout[ing] SCART signals,” (4) “fetch[ing] VBI data,” (5) “MPEG transport stream (TS) monitoring for specific data or programs,” and (6) “software downloads.” EX1008, [0047]. These disclosures would have provided ample suggestion and motivation to implement both standby modes. *Id.* Tichelaar also would have at least suggested to a POSITA to control “active standby” with “D μ C 90” in the same manner as it controls “low-power standby.” The difference for “active standby” is that there would be fewer inactive modules and resources with power switched off than in “low-power standby.” *Id.*

238. Tichelaar would have further suggested to, and motivated, a POSITA not to supply power to CRT display “screen 85” in either “standby” mode (low/active) (“*a waiting condition of the display apparatus in which an image is not displayed after stopping a supply of the electric power to the display portion*”) (Limitations 1G/2H). For example, Tichelaar discloses: (1) the need to conserve “standby” power, (2) a standby power “code of conduct” that requires less power than the power consumed by a CRT display (*i.e.*, less than 10 W), (3) “active standby” functionality that does not require a display (*e.g.*, monitoring an MPEG transport stream), and (4) the ability to stop the supply of power to “screen 85.” *See* EX1008, [0004], [0050], FIG. 4.

239. These disclosures would have provided a POSITA with ample suggestion and motivation to not supply power to “screen 85” in low and active “standby” modes. *Id.*

240. In addition, a POSITA would have been aware of other prior art that would have provided other and similar suggestions and motivations to not supply power to a display during “standby,” such as reducing user “inconven[ience]” and “quickly power[ing] up when the television is turned back on.” EX1009, 4:51-5:3, EX1011, [0005]; EX1012, [0008]; EX1006, [0004], [0005]; EX1001, 1:51-65.

241. Such prior art discloses providing power to certain circuitry before providing power to a display, “so that television’s logic circuits 180 and the

television's main microprocessor [] can quickly power up when the television is turned back on.” *Id.* For example, it was generally known that loading a television OS could cause a user to “wait for a long time (about 10 to about 30 seconds) without being able to view the television broadcast.” EX1011, [0005]; *see also* EX1012, [0008]; EX1006, [0004], [0005]; EX1001, 1:51-65. Thus, a POSITA would have had motivation to begin loading the OS preemptively in certain “standby” modes, before powering the display.

c. Limitations 1J/2K

242. Tichelaar would have further suggested to, and motivated, a POSITA to provide power to the “infrared remote control receiver front-end,” the “main micro-controller 88,” and “decoder” functionality, in its “active standby” (*e.g.*, “*the electric power supplied from the power source unit is controlled so as to supply the electric power to the remote control signal receiving portion and the second controller including the decoder, under the second waiting condition*”) (Limitations 1J/2K). *See* §VII.B.11 *supra*.

243. For example, the “main micro-controller 88” and “decoder” would have been required to support “active standby” desirable “different possibilities,” including “MPEG transport stream (TS) monitoring for specific data or programs,” “demultiplexing,” “descrambling,” and “software downloads,” “small signal

functions,” “activat[ing] ... FM radio,” “rout[ing] SCART signals,” and “fetch[ing] VBI data,” as discussed above.

244. And as discussed for Limitations 1F, 1H, and 1I, a POSITA would have understood power is supplied to the “infrared remote control receiver front-end 144” in “active standby” to provide “signals” to “DμC 90” for validation. *See* EX1008, ABSTRACT (not limiting “standby” to “low-power” standby), [0036], [0059].

245. Known prior art would have also suggested to, and motivated, a POSITA to supply power to Tichelaar’s “infrared remote control receiver front-end,” the “main micro-controller 88,” and the “decoder” functionality, in “active standby.” For example, Kim’977, discloses that a “minimum amount of power, enough to turn on power to the display device upon receiving a power on command from a remote control device” is supplied in stand-by mode, including in “active” standby mode. EX1007, 5:31-47. Kim’977 also discloses that “in the active stand-by mode, it is preferable to supply power to the micro computer and to the signal processor but not to the display module... The reason is that the display module requires high power consumption, the user may choose to use other features, such as recording, without using the display.” EX1007, 1:59-67, 5:48-54. Such recording would require providing power at least to: (1) the “main micro-controller 88” for processing the received signal, (2) a transport stream “decoder” for decoding the transport stream

(in the case of a digital broadcast), and (3) a video “decoder” for decoding the video.

Id.

2. Reasonable Expectation of Success

a. Limitations 1B/2F

246. It would have been a matter of routine skill and design choice to us an OS-based “main micro-controller,” and a POSITA would have had a reasonable expectation of success in doing so. A POSITA reading the disclosures of Tichelaar—with knowledge of prior art OS-based systems, such as the admitted prior art in the ’507 Patent, Kim’616, and Steinfatt (which is discussed by Tichelaar)—would have understood that televisions’ “main micro-controllers” could be, and in these cases were, “*started up by a predetermined OS.*”

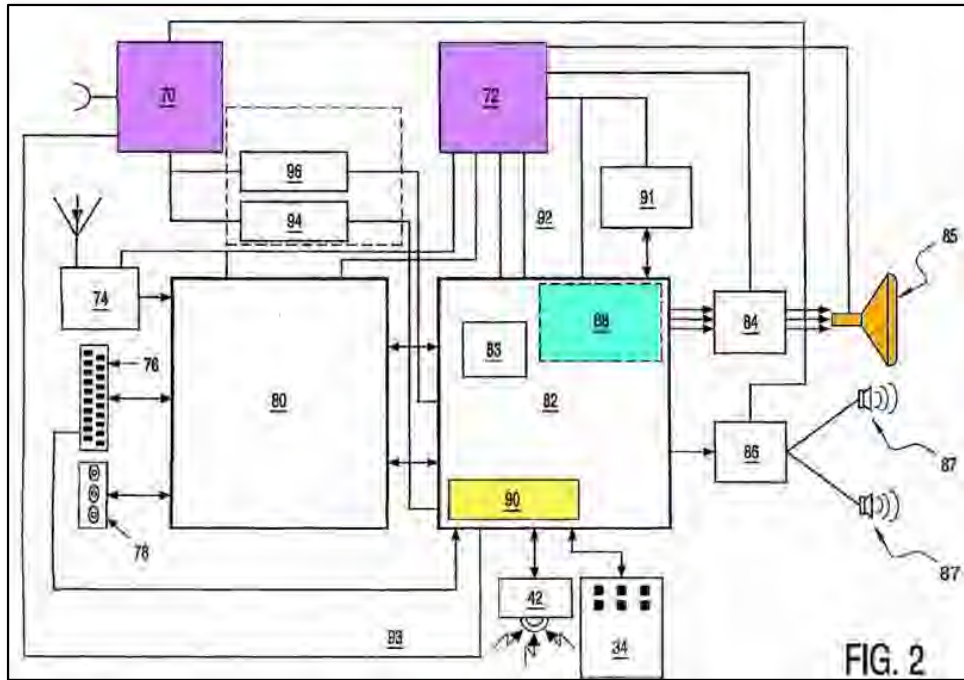
247. A POSITA also would have understood that Tichelaar’s “main micro-controller 88,” including its OS functionality, would continue to operate in the same manner as such prior art “main micro-controllers.” Although Tichelaar discloses delegating certain “low-power tasks” from the “main micro-controller 88” to “D μ C 90,” Tichelaar does not disclose modifying the functionality of the “main micro-controller 88,” while it is in normal-power operation. EX1008, [0035].

248. For example, a POSITA would have understood, at least based the disclosure of an OS-based main micro-controller in Tichelaar’s background section, that Tichelaar intended for its “D μ C 90” to work with an OS-based “main micro-

controller.” *Id.* Indeed, a conventional OS-based “main micro-controller” would have been able to perform all of Tichelaar’s “main micro-controller 88” functions. *Id.* And nothing in Tichelaar is inconsistent with using an OS-based main micro-controller. *Id.* For example, Tichelaar’s disclosure of delegating low-power standby tasks to “D μ C 90” would not have interfered with the tasks performed by an OS-based main micro-controller. *Id.*

b. Limitations 1G/2H and 1J/2K

249. A POSITA would have had a reasonable expectation of success that Tichelaar’s “D μ C 90” could control power from SMPS 70 and/or EHT generator 72 to various television components and resources to implement an active, non-display “standby” mode. *Id.* As discussed for Limitation 1F, Tichelaar discloses that “D μ C 90” controls power to the “audiovisual device” through SMPS 70 and/or EHT generator 72. Tichelaar also discloses the ability to selectively choose to supply (and not to supply) power to certain circuitry from SMPS 70 and/or EHT generator 72, including to sections of the SoC, “RGB amplifier 84” and “screen 85” (*i.e.*, the “display”), as shown in annotated Fig. 2 and as discussed previously (*see* Limitations 1F and 1G):



EX1008 at FIG. 2, [0059], [0063].

250. Alternatively, it would have been in the common understanding of a POSITA to use “D μ C 90” to control switches or power regulators to control power to various components. *Id.*

251. Accordingly, to the extent not already disclosed by Tichelaar, a POSITA would have had a reasonable expectation of success that Tichelaar's "audiovisual device" could implement an "active standby" by using "DμC 90" to control the supply of power to the "main micro-controller 88," "decoder," and "infrared remote control receiver front-end" in "active standby," while at the same time conserving energy by not supplying power to "screen 85." *Id.*

I. It would have been Obvious to Modify Tichelaar in view of a POSITA's Knowledge and Relan (Ground 2)

252. In the event that the Patent Owner argues that Tichelaar does not expressly disclose one or more limitations of Limitations 1G/2H or 1J/2K, those limitations also would have been obvious in view of a POSITA's knowledge, as discussed above, in further view of Relan, and accomplished with a reasonable expectation of success.

1. Relan is Analogous Art in the Same Field of Endeavor

253. Relan is within the same field of endeavor as Tichelaar, and the '507 Patent, at least because it relates to implementing television power conservation modes, including standby/hibernates modes, by controlling power to various television components, including a display. EX1010, [0014], [0015], [0021], [0041], [0071], [0073], [0074], [0105], [0108], [0109], [0111], [0149], [0235], [0236], [0242], [0243], [0246], [0247], [0248], [0263].

254. Relan is also reasonably pertinent to one of the problems purportedly addressed by the '507 Patent: "suppress[ing] power consumption" in standby modes. *See* EX1001, 3:46-55, 7:54-8:30.

2. Obviousness Rationales

a. Limitations 1G/2H and 1J/2K

255. **First**, Relan would have provided suggestions and motivations to a POSITA to modify Tichelaar to provide an "active standby" in which: (1) power is

not supplied to “screen 85” (Limitations 1G/2H), and (2) power is supplied to the “infrared remote control receiver front-end,” the “main micro-controller 88,” and the “decoder” functionality (Limitations 1J/2K). In particular, Relan would have provided a strong suggestion and motivation to conserve power in “active standby” while providing enhanced non-display functionality. Relan discloses that a user may desire to record broadcast programs when the user is not present to watch them. *See* EX1010, [0103–05], [0258]. Relan also discloses that “the display/broadcast functions ... consume more power than other electronic device functions.” EX1010, [0014], [0015], [0246], [0275]. Thus, as discussed for Limitations 1G/2H above, Relan discloses enabling certain functionality to process and record video (*e.g.*, the main processor, decoder, and remote control receiver) while disabling the unnecessary and power-rich display functionality. *Id.*

256. In addition, a POSITA would have recognized that such non-display video recording would have allowed for a better user experience. A POSITA would have recognized that such recording (without the program being displayed) would have allowed users to do other activities while the video is being broadcast and watch the video at a more convenient time.

257. A POSITA would have been well aware of these benefits, which consumers would have expected to see in 2006, because this functionality had been in wide-scale use since at least the 1980s (if not earlier) in the form of various

recording devices such as VCR, DVD, and the later DVR/PVR devices, such as the branded TiVo device, for video-on-demand and streaming video content. *Id.*

258. **Second**, modifying Tichelaar’s “active standby” with Relan’s explicit disclosures of supplying power to the processors and decoder, while not supplying power to a display, would have been the application of a known technique (*i.e.*, implementing non-display functionality in “standby mode”) to a known device (*i.e.*, Tichelaar’s “audiovisual device,” including its SoC, micro-controllers, power supply, and display) ready for improvement (*i.e.*, an enhanced active, non-display standby mode) to yield predictable results (*i.e.*, an “audiovisual device” capable of providing non-display video recording).

259. **Third**, a POSITA would have recognized this as using a known technique (*i.e.*, providing Relan’s enhanced non-display standby functionality) to improve a similar device (*i.e.*, Tichelaar’s “audiovisual device”) in the same way (*i.e.*, modifying Tichelaar to provide enhanced non-display standby functionality, such as video broadcast recording during standby). A POSITA would have known that implementing such non-display standby functionality in Tichelaar’s “audiovisual device” could be achieved by using Tichelaar’s “D μ C 90” to control, *e.g.*, SMPS 70 to supply power to the SoC and its non-display related resources, as discussed below.

b. Claims 8 and 9

260. As discussed above, it would have been obvious to a POSITA to modify Tichelaar’s “active standby” to further include the advantages (*e.g.*, lower-power recording) of Relan’s STAND-BY mode. Thus, it would have further been obvious to modify Tichelaar’s system to incorporate Relan’s ability to autonomously shift the device from “low-power standby” (“*first waiting condition*”) mode to “active standby” (“*second waiting condition*”) when the time for a user-scheduled recording arrived and then back to “low-power standby.” *Id.* A POSITA would have recognized that this would have enabled Tichelaar to maximize the power-saving benefits of the “low-power standby” by only leaving this mode for the time required to complete the scheduled recording. *Id.*

3. Reasonable Expectation of Success

261. A POSITA would have recognized that modifying Tichelaar would have been accomplished with a reasonable expectation of success. As discussed, Relan’s enhanced, non-display “standby” functionality primarily concerns the ability to record broadcast video without powering a display. A POSITA would have understood that this functionality is similarly relevant to Tichelaar’s “audiovisual device.” *See* EX1008, [0016]. Tichelaar’s “audiovisual device” included functionality that would have allowed it to easily access and record digitally broadcast video programs, while in “active standby.” For example, Tichelaar

discloses the capability of the “audiovisual device,” in “active standby,” to monitor an MPEG transport stream of a digital broadcast “for specific ... programs.” EX1008, [0047]. Tichelaar further discloses that its “audiovisual device” includes a “time-shift recorder.” *Id.* In addition, Tichelaar discloses several memories that would have been capable of recording broadcast video. For example, Tichelaar discloses that the “main” micro-controller has access to “high performance” resources “for doing ... stores of ... data,” including “cache, scratch-pad memory 21, [and] external memory 29” and to “flash memory 91” and “non-volatile memory 163.” EX1008, [0012], [0050], [0060]. For this reason, a POSITA would have recognized that Tichelaar’s “audiovisual device” was ready for the improvement of implementing Relan’s enhanced functionality “standby” mode, *e.g.*, to record such video while a user was not present.

262. In addition, both Tichelaar and Relan use well-known architectural elements, such as one micro-controller/processor to control a television, a second micro-controller/processor to control power and standby modes, a power supply, a decoder, a display, a remote control, and a remote control receiver, all performing their well-known and intended functions. For example, Tichelaar and Relan both disclose using a “second” micro-controller/processor, during standby, to receive and process a remote control signals and to control power to other components of the

television, including a main micro-controller/processor, decoder, and display. *See* Section (Limitations 1A and 1H) *supra*.

263. Providing enhanced, non-display functionality would have been a natural extension of Tichelaar's system. A POSITA would have recognized that Tichelaar already included all the necessary hardware, code, processing circuitry, memory, and interfaces to record broadcast video (*e.g.*, the SoC 82, its "main micro-controller 88," the "decoder," "tuner 74", "MPIF 80," various memories, and signals). *See, e.g.*, EX1008, [0035]. In addition, a POSITA would have further understood, that Tichelaar's "D μ C 90" could selectively control the supply of power to non-display functionality of the "audiovisual device" in active standby mode, as discussed above. EX1008 at FIG. 2, [0059], [0063]. Alternatively, it would have been in the common understanding of a POSITA to use "D μ C 90" to control switches or power regulators to control power to various components. *Id.* Thus, a POSITA would have had a reasonable expectation of success in the modification.

VIII. GROUND 3-4: TICHELAAR, IN VIEW OF RELAN, KIM'616, AND THE KNOWLEDGE OF A POSITA, RENDERS THE CHALLENGED CLAIMS OBVIOUS

264. The combination of Tichelaar, the knowledge of a POSITA, and Kim'616 (Ground 3), and the combination of Tichelaar, the knowledge of a POSITA, Relan, and Kim'616 (Ground 4) merely combine the combinations discussed in Grounds 1 and 2 with the OS functionality disclosed in Kim'616, for Limitations

1B/2F. Kim'616 discloses a OS-based main controller that is "*configured to be started up by a predetermined OS to control a processing of a received digital broadcasting signal via a decoder*" or "*to control parts of the display,*" as claimed. The proposed combination incorporates into Tichelaar the functionality expressly disclosed in Kim'616.

265. Kim'616 discloses a television that includes a controller ("CPU") that installs the OS to control processing of a digital broadcast and display thereof. EX1011, [0005] ("the user cannot manipulate the television until the loading of the operating system is completed"), [0010] ("under a control of CPU 10"), [0011], [0013] ("the television based on the operating system can be viewed only after a completion of the system booting process"), [0032] ("under a control of CPU"), [0041–42]. Kim'616 discloses that "[d]uring [a] booting process, RAM 130 loads the operating system and the application programs, which are stored in HDD 150, by a control of the CPU." EX1011, [0031]. "CPU [] then loads an application program stored in HDD [] into RAM" and "performs the application program" "**to view the television broadcast** output through the television card." See EX1011, [0032], [0040–42].

266. Kim'616 discloses a problem that, when using conventional controllers, an image "cannot be viewed by a viewer until a booting process is completed." EX1011, [0005]. For this reason, Kim'616 discloses allowing the television to

display an “initial screen” while the OS is booting. *See* EX1011, [0016].

Nevertheless, once the OS is loaded, the controller executing the OS resumes control of the television system. *See* EX1011, [0032], [0040–42].

A. Kim’616 is Analogous Art in the Same Field of Endeavor

267. Kim’616 is within the same field of endeavor as the ’507 Patent, at least because it relates to a television capable of receiving “television broadcast[s].” EX1011, [00015]. In addition, Kim’616 discloses the “need for a television based on an operating system in which the viewer can view a television broadcast directly after the television is turned on.” EX1011, Abstract, [0014]. Kim’616 therefore is also reasonably pertinent to one of the problems purportedly addressed by the ’507 Patent: “shortening the waiting time after starting up.” EX1001, 3:46-55.

B. Obviousness Rationales for Limitations 1B/2F

268. **First**, for all of the reasons cited in Ground 1 above, a POSITA would have sought to use an OS-based main processor, such as disclosed by Kim 616, in Tichelaar’s “audiovisual device.” *See* section VII.B.3, VII.H.1.a; *see also* EX1020, 1:17-46.

269. Additional suggestions and motivations to use an OS-based “main micro-controller” are provided by prior art reference Vaughan, discussed by Kim’616, which discloses several benefits of such controllers. EX1020, 1:17-46. According to Vaughan, such systems, provided several benefits over traditional

televisions, such as the ability to display “TV programs and computer applications,” “utilize[e] the communications bandwidth, mass storage and graphics application of the computer to deliver, store and display applications within a television viewing environment,” and “download information.” EX1020, 1:17-46

270. **Second**, to the extent not already disclosed by Tichelaar, using an OS-based main micro-controller, as disclosed in Kim’616, would have been the simple substitution of one known element for another to obtain predictable results. CITE. Each reference uses a main micro-controller/processor/CPU to control a digital television to process and display video received from a digital broadcast. In addition, Tichelaar already discloses mass storage (*e.g.*, “external memory 29,” “flash memory 91” and “non-volatile memory 163”), “graphics,” and “software download” functionality to implement an OS-based system, as well as the necessary hardware, memory, circuitry, and interfaces. *See, e.g.*, EX1008, [0012], [0035], [0049], [0050], [0060]. In addition, nothing in Tichelaar or Relan conflicts with substituting an OS-based main micro-controller, such as that disclosed by Kim’616, for the main micro-controller 88 disclosed by Tichelaar. Such substitution would have been well within the capabilities of a POSITA.

C. Reasonable expectation of success

271. For the same reasons as discussed above, a POSITA would have had a reasonable expectation of success in the substitution.

IX. GROUND 5: KITAMURA, IN VIEW OF KIM’616 AND THE KNOWLEDGE OF A POSITA, RENDERS OBVIOUS CLAIMS 1, 2, AND 13

272. Kitamura, in view of Kim’616 and the knowledge of a POSITA, discloses and renders obvious every element of the Challenged Claims. Kitamura, originally filed by Sharp Corporation, discloses a sub CPU that controls power to a main CPU, and other television components, in multiple standby modes.

273. Kitamura discloses a “television receiver having a **plurality of standby power modes.**” EX1012, Title, [0003]. Kitamura acknowledges that several standby modes had already become conventional in the prior art. *Id.*, [0005–06]. Kitamura, however, discloses the problem that loading software “takes time” and can cause user “inconvenien[ce]”:

When a channel to be displayed ... requires a descrambling process by a CableCARD module, a startup from the above-mentioned full standby or the partial standby **requires restarting in view of software.** Accordingly, it **takes time till displaying a program guide and programs after startup** for both the full standby and the partial standby, **thus making the user to feel inconvenient** even though standby power can be reduced.

EX1012, [0008].

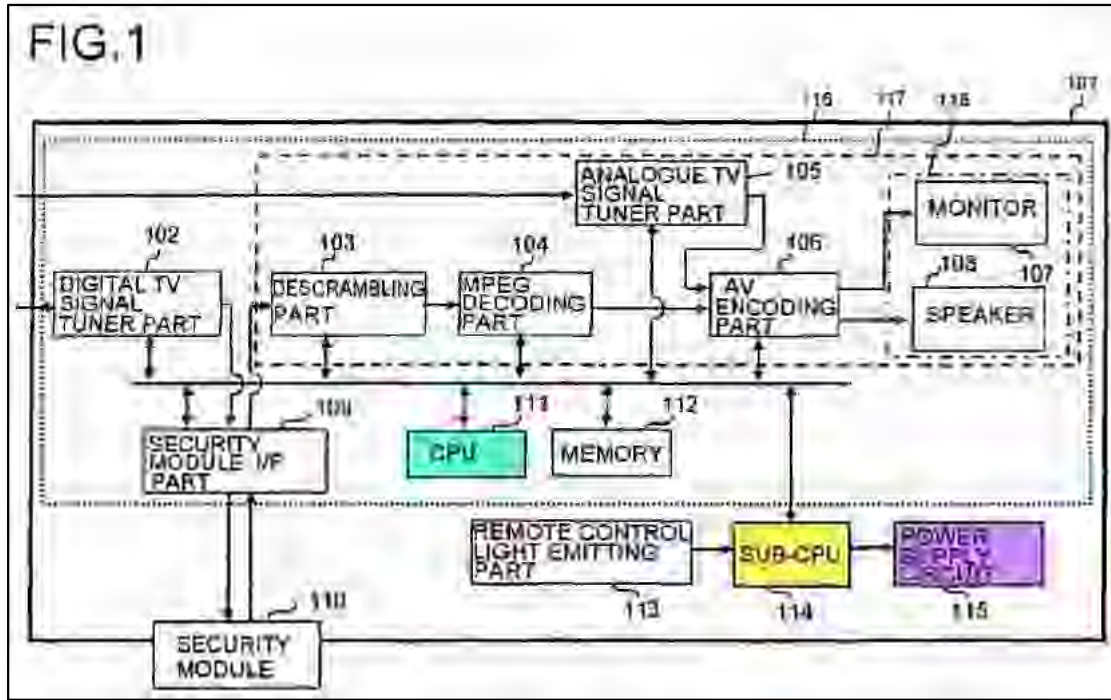
274. To address this problem, Kitamura discloses, and claims, a television with three standby modes:

A television ... comprises at least a standby power mode for supplying power only to hardware, such as a remote control receiver (**full standby**), a standby power mode for supplying power also to a security module other than the hardware supplied with power in the full standby (**partial standby**), and a standby power mode for stopping supply of power only to a monitor at minimum (**false standby**) ...

EX1012, Abstract, [0009]; claim 1.

275. Kitamura discloses that such “standby” modes strike a “good balance” between conserving “standby power” and “ease of use” (*i.e.*, “prevent[ing] the presentation of images and electronic program guides to a user at startup from being too late”). EX1012, [0012], [0033], [0037–38].

276. To control the standby modes, Kitamura discloses a “sub-CPU 114” that “analyzes[] remote control signals for controlling a power supply circuit 115.” EX1012, [0029]. “Power supply circuit 115” supplies power to components of the television, including a main “CPU 111 [that] controls entirely using the programs and data stored in a memory 112” and a decoder. EX1012, [0029], [0031], [0028] (main CPU), [0025] (decoding part), [0040], FIG. 1. The “sub-CPU” (highlighted yellow), main “CPU 111” (highlighted blue), and “power supply circuit 115” (highlighted purple) are shown in Figure 1 below:



EX1012 at FIG. 1.

277. As discussed further below, Kitamura discloses all of the limitations of the Challenged Claims.

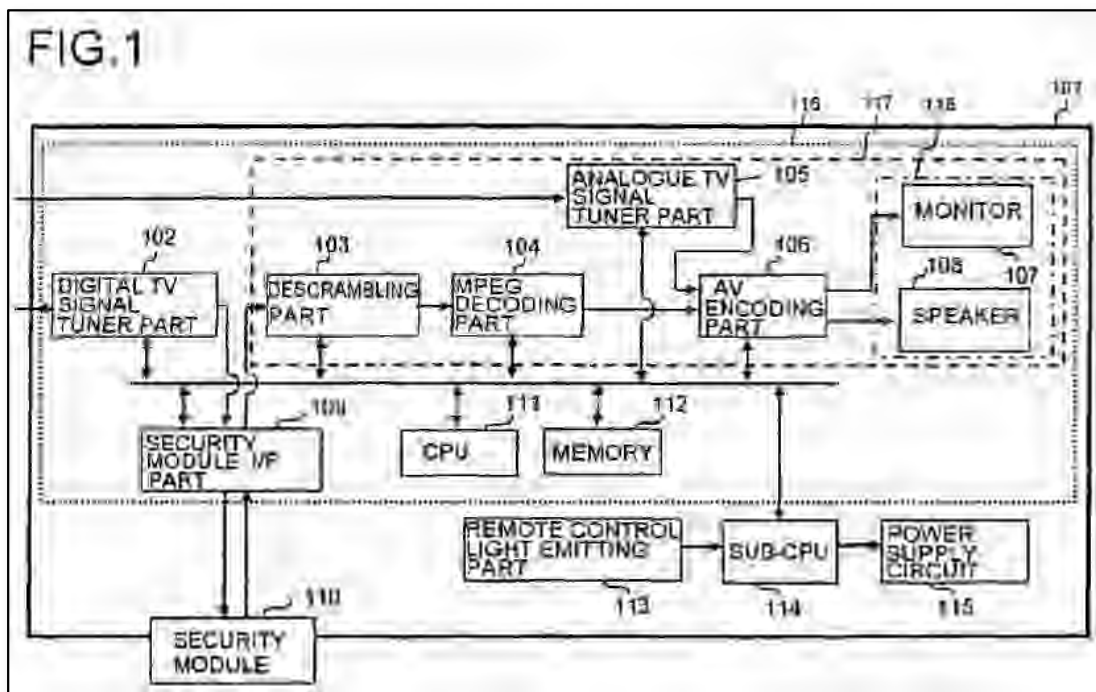
278. To the extent, however, that Patent Owner argues Kitamura does not explicitly disclose a controller that is “configured to be started up by a predetermined OS to control a processing of a received digital broadcasting signal via a decoder” or “to control parts of the display” (Limitations 1B/2F), Kim’616 explicitly discloses them, as discussed above for Grounds 1, 3 and 4. *See e.g.*, EX1011, Abstract, [0005], [0009], [0011], [0013], [0016], [0032], [0040–42].

279. Kim'616's disclosures are consistent with the admitted prior art in the background section of the '507 Patent and the knowledge of a POSITA at the time of the alleged invention. *Id.*; see Sections V, VII.A, VII.H, VIII.A–C, *supra*.

A. Claim 1

1. PREAMBLE

280. To the extent the preamble is limiting, Kitamura discloses it. Kitamura discloses “a television receiver [101]” (“*broadcast program receiving apparatus*”), as shown in annotated Fig. 1:



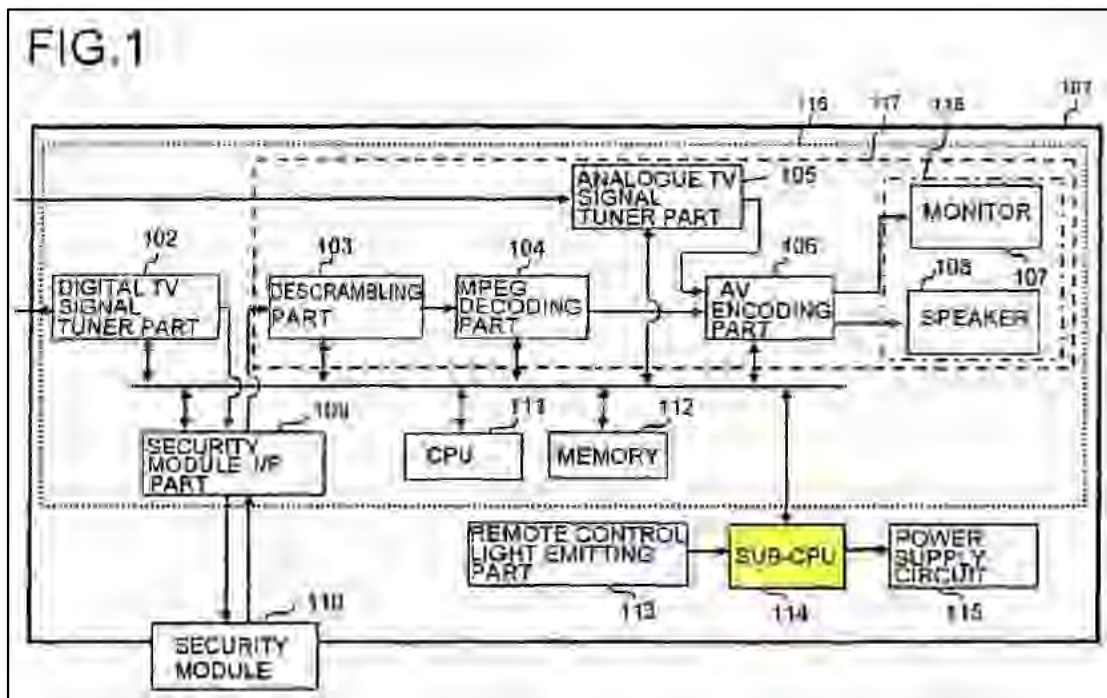
EX1012, Abstract, [0009], [0018–20], FIG. 1 (annotated).

281. The “television receiver” includes a “digital TV signal tuner part 102” (“*receiving portion*”) that receives “digital broadcast” signals, including “MPEG (Moving Picture Experts Group) transport stream[s],” and a “monitor 107” (“*display*”).

portion”) that displays received broadcast programs (“*display a program broadcast via a digital broadcasting signal*”). EX1012, [0027], FIG. 1, [0006], [0008], [0022], [0035], [0038] (“the programs ... can be immediately displayed), [0039].

2. Limitation 1A

282. Kitamura discloses Limitation 1A. Kitamura discloses a “sub-CPU” (“*first controller*”) (highlighted yellow), as shown in Fig. 1:



EX1012, [0029], FIG. 1 (annotated).

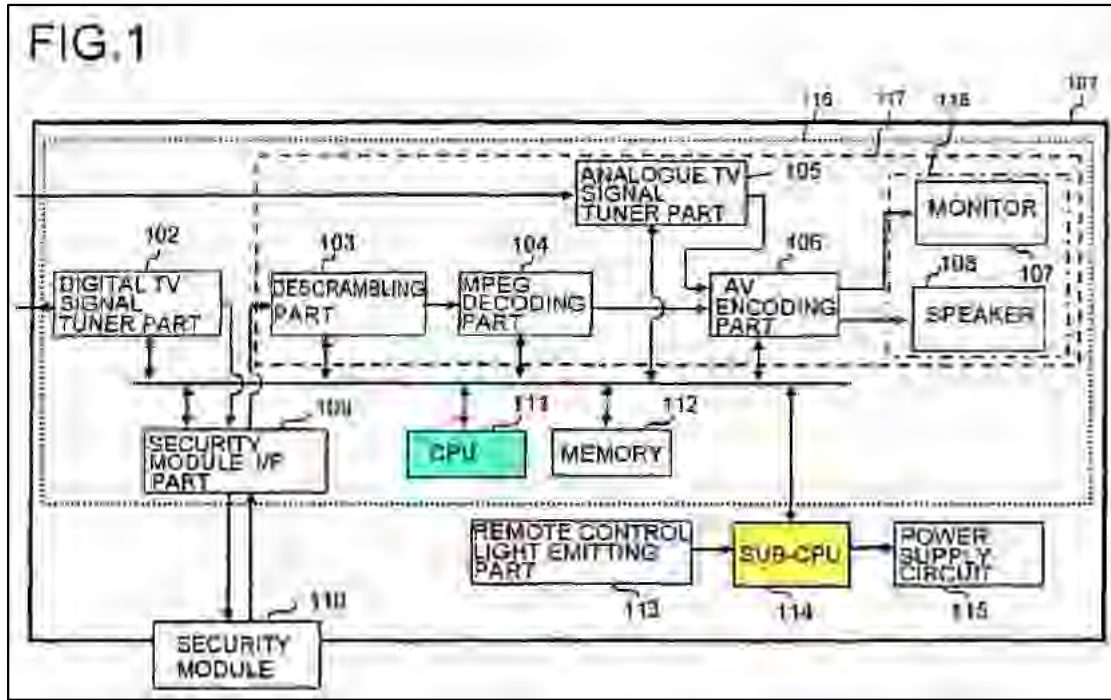
283. To the extent “*first controller*” is governed by §112, ¶6, Kitamura discloses the recited first function (F1.1) and corresponding structure (S1.1) identified in §IV.

284. With respect to function F1.1, “sub-CPU 114” is responsible for “controlling a power supply circuit 115,” which in turn “supplies power/stops supply of power so that [the television] may have [] three **standby power modes...**” (“*control a waiting condition*”). EX1012, [0030].

285. As to structure S1.1, Kitamura’s “*first controller*” is a sub-CPU (“sub-CPU 114”) configured to set the “*broadcast program receiving apparatus*” (“television receiver 101”) into the “*first waiting condition*” (“full standby”) and “*second waiting condition*” (“false standby”). EX1012, [0030–31]. Any differences between Kitamura’s disclosure and the structure disclosed in the ’507 Patent are insignificant. Further, Kitamura discloses performing F1.1 in substantially the same way with substantially the same result.

3. Limitation 1B

286. Kitamura discloses, or renders obvious, Limitation 1B. Kitamura discloses a main “CPU 111” (“*second controller*”) (highlighted blue), as shown in Fig. 1:



EX1012, [0028], FIG. 1 (annotated).

287. To the extent “second controller” is governed by §112, ¶6, Kitamura discloses the recited function and corresponding structure identified in §IV.

288. With respect to the corresponding structure, Kitamura’s “second controller” is a processor (“CPU 111”) configured to control: (1) a video “decoder” (CPU 111 controls, *inter alia*, “descrambling part 103” and “MPEG decoding part 104”) to decode a video signal and (2) providing the decoded signal to the display portion (CPU 111 controls the television “entirely,” including causing the decoded video to be displayed by monitor 107). EX1012, [0030–31]. Any differences between Kitamura’s disclosure and the structure disclosed in the ’507 Patent are

insignificant. Further, Kitamura discloses performing the recited function in substantially the same way with substantially the same result. *Id.*

289. Kitamura further discloses that CPU 111” (“*second controller*”) further performs the recited function (“*control a processing of a received digital broadcasting signal via a decoder*”). EX1012, [0025], [0028], [0040]. “CPU 111” controls the television “entirely,” including controlling a processing of the digitally broadcast MPEG transport stream signal that is decoded by “descrambling part 103” and “MPEG decoding part 104” (“*control a processing of a received digital broadcasting signal*”). *Id.*

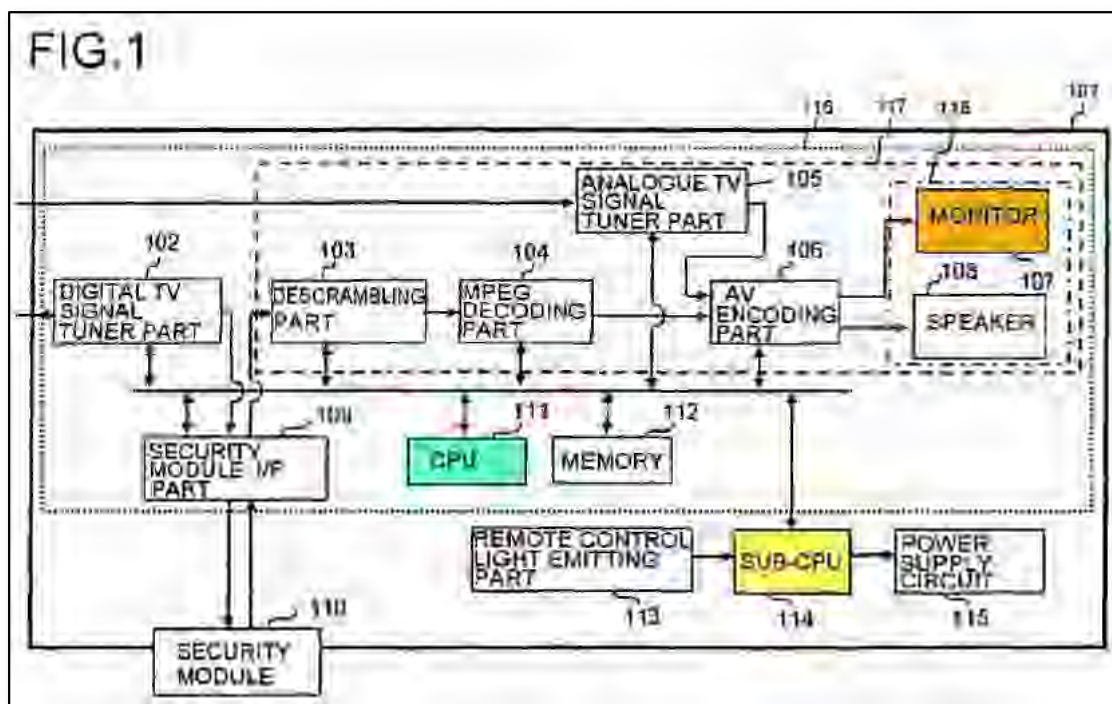
290. In addition to the recited function discussed above, Kitamura’s “CPU 111” also discloses remainder of Limitation B. At “startup,” the television must “restart[] ... software” and that “CPU 111 controls entirely using the programs and data stored in a memory 112” (“*a second controller configured to be started up by a predetermined OS*”). See EX1012, [0008], [0028]. A POSITA would have understood this to disclose, or at least render obvious, an OS-based main CPU. A POSITA would have been motivated to use an OS-based CPU at least for the reasons discussed in Ground 1, and would have had a reasonable expectation of success in making the modification—to the extent not already disclosed by Kitamura. See §§VII.H.1.a, VII.H.2, VIII.B–C, *supra*.

291. To the extent, however, that Patent Owner argues that Kitamura does not explicitly disclose, or render obvious, an OS-based main CPU, as claimed, Kim’616 discloses it, as discussed in Grounds 3 and 4 above. *See* §§VII.H.1.a, VII.H.2, VIII.B–C, *supra*.

4. Limitation 1C

292. Kitamura discloses Limitation 1C.

293. Kitamura discloses “monitor 107” (“*display portion*”) (highlighted orange), as shown in Figure 1:



EX1012, [0027], FIG. 1 (annotated).

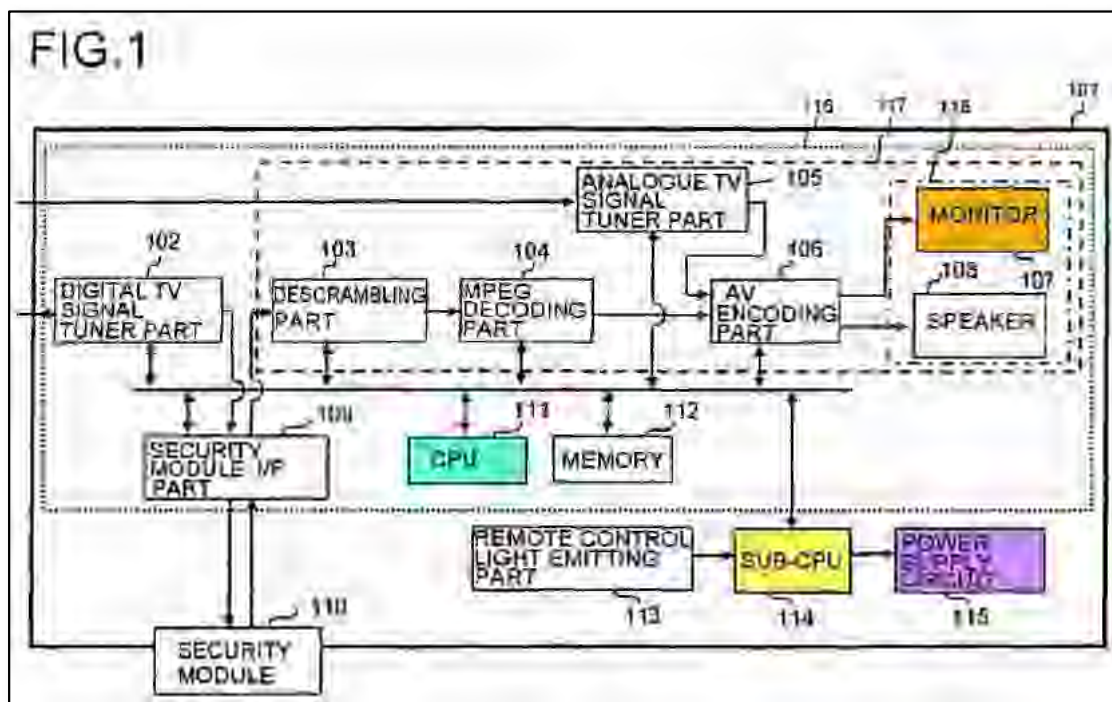
294. Kitamura discloses that “monitor 107” displays images sent from “MPEG decoding part 104” via “AV encoding part 106.” *See id.* As discussed above

(see Limitation 1B), “CPU 111” controls this process (“*display an image using a signal processed by the second controller*”). See EX1012, [0028].

5. Limitation 1D

295. Kitamura discloses Limitation 1D.

296. Kitamura discloses “power supply circuit 115” (“*an electric power source unit*”) (highlighted purple), as shown in Fig. 1:



EX1012, [0030], FIG. 1 (annotated).

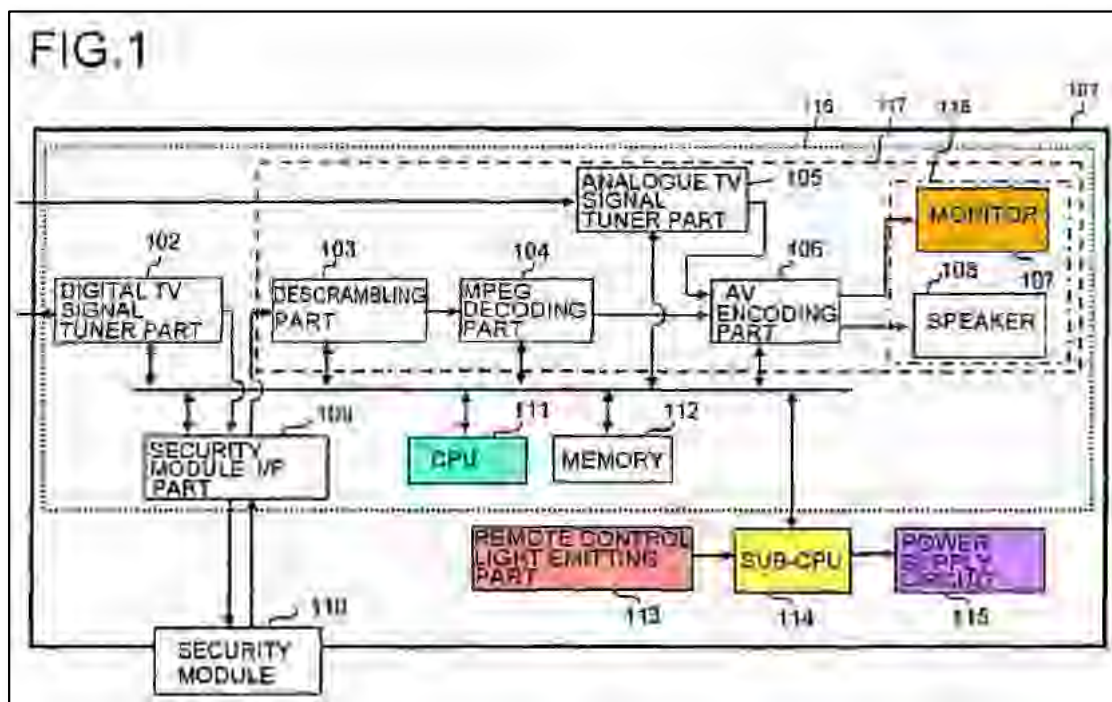
297. “[P]ower supply circuit 115” selectively “supplies power/stops supply of power” to portions of the television (“*to supply predetermined electric power*”). EX1012, [0030–31]. For example, it can selectively start/stop the supply power to

the hardware “enclosed with dotted lines 116,” “enclosed with dashed lines 117,” and/or “enclosed with chain lines 118.” *Id.*

6. Limitation 1E

298. Kitamura discloses Limitation 1E.

299. Kitamura discloses “remote control light receiving part 113” (“*remote control signal receiving portion*”) (highlighted red), as shown in annotated Fig. 1:



EX1012, [0029], FIG. 1 (annotated).

300. The “remote control light receiving part 113 receives remote control signals” providing “remote control operations and the like from a user” for the television (“*configured to receive a receive a remote control signal for operating the*

display portion”). EX1012, [0029], [0005]. A POSITA would have understood such operation to include operating “monitor 107.” *Id.*

7. Limitation 1F

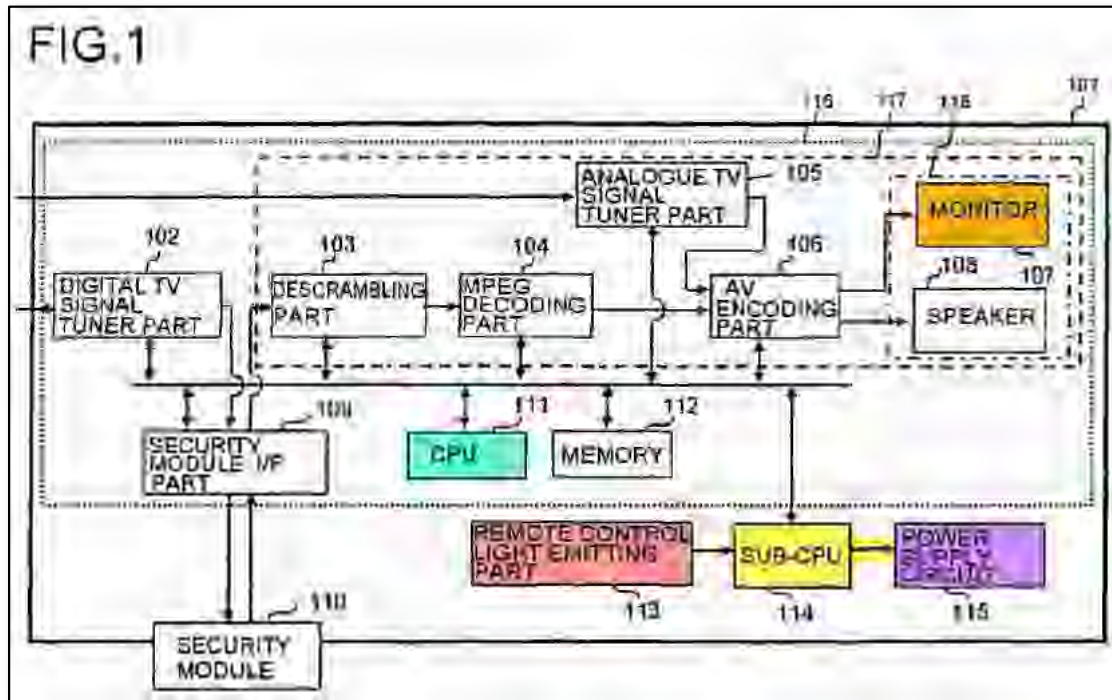
301. Kitamura discloses, or renders obvious, Limitation 1F.

302. A POSITA would have understood that sub-CPU 114 consumes less power than CPU 111 as it is tasked with performing fewer functions than the “main” CPU and is provided with fewer resources (*“first controller being smaller in consumption of electric power than the second controller”*). *See, e.g.,* EX1021, ABSTRACT (“a sub-CPU having power consumption lower than that of the main CPU”).

303. Indeed, while Kitamura’s sub-CPU 114 is tasked with “analyz[ing] the remote control signals” and “controlling a power supply circuit 115,” its main CPU 111 is tasked with generally controlling the “entire[]” television. *See* EX1012, [0028–29]. In addition, Kitamura discloses that when main CPU 111 is powered on (*e.g.,* in “false standby”) the “standby power” becomes “large.” EX1012, [0013]. On the other hand, when “supply[ing] power only to the minimum required hardware, such as a remote control reception part and [sub-CPU 114]” (*e.g.,* in “full standby”), the “power would be smallest.” EX1012, [0030], [0034].

304. To the extent §112, ¶6 applies, Kitamura discloses the recited second function (F1.2) and corresponding structure (S1.2) identified in §VI.

305. With respect to function F1.2, Kitamura discloses that “Sub-CPU 114” (highlighted yellow) “control[s] power supply circuit 115” (highlighted purple) to supply the television with power (“*configured to control the electric power supplied from the electric power source unit*”), as shown in Figure 1:



EX1012, [0029–30], FIG. 1 (annotated).

306. In particular, Kitamura discloses that “remote control light receiving part 113 receives remote control signals, and a sub-CPU 114 analyzes the remote control signals for controlling a power supply circuit 115” (“*responsive to the remote control signal received by the remote control signal receiving portion*”). *Id.*

307. As to structure S1.2, Kitamura’s “*first controller*” is a sub-CPU (“sub-CPU 114”) configured to (a) receive a signal from the “*remote control signal*

receiving portion” corresponding to a “*remote control signal*” (sub-CPU 114 “receives remote control signals” and “analyzes the remote control signals for controlling a power supply circuit 115”) and (b) responsively transmits a control signal to the “*electric power source unit*” (“Power Supply Circuit 115”) to “*control the electric power supplied from the electric power source unit*” (“Sub-CPU 114” “control[s] power supply circuit 115”). EX1012, [0029–30]. A POSITA would have understood that the arrow from Sub-CPU 114 to Power Supply Circuit 115 indicates a control signal, or at least it would have been obvious to use one based on this disclosure. EX1012, [0029–30], FIG. 1. Any differences between Kitamura’s disclosure and the structure disclosed in the ’507 Patent are insignificant. Further, Kitamura discloses performing F1.2 in substantially the same way with substantially the same result. Id.

8. Limitation 1G

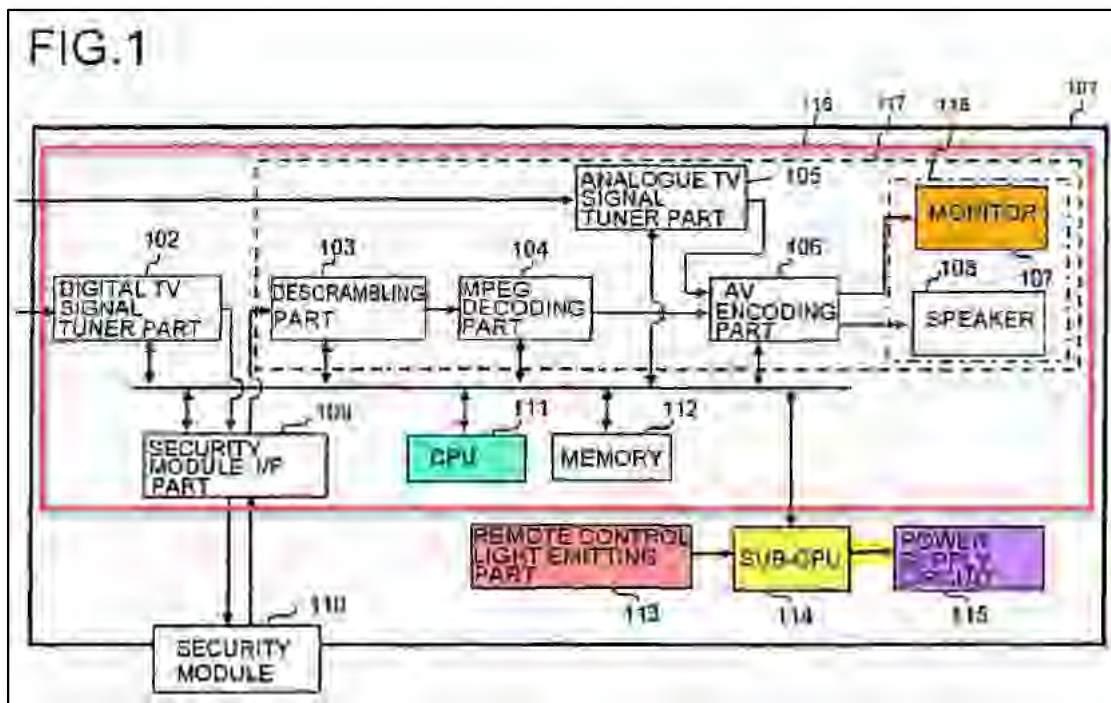
308. Kitamura discloses Limitation 1G.

309. To the extent §112, ¶6 applies, Kitamura discloses the recited third function (F1.3) and corresponding structure (S1.3) identified in §IV. EX1012, [0030–31].

310. With respect to function F1.3, Kitamura discloses that “sub-CPU 114” controls “power supply circuit 115” to supply, and stop the supply of, power so that the television may have “three standby power modes” (“*the waiting condition ... is*

controlled by the first controller, so as to be placeable into either of a first waiting condition or a second waiting condition”). See EX1012, [0030]. These include the “full standby” (“first waiting condition”) and “false standby” (“second waiting condition”). EX1012, [0030–31].

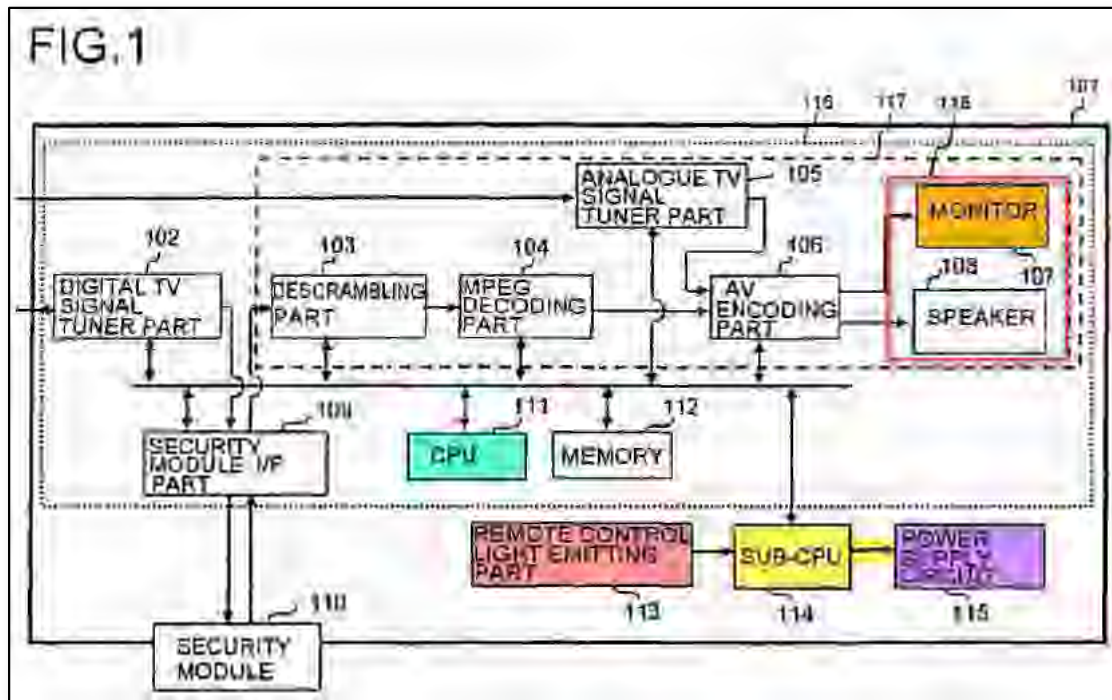
311. Kitamura further discloses that in both “full standby” and “false standby,” no power is provided to “monitor 107” (“the waiting condition in which an image is not displayed after stopping a supply of the electric power to the display portion”). *Id.* In particular, Kitamura discloses that, in “full standby,” power is “stopped” to “hardware enclosed with dotted lines 116,” as shown in Fig. 1:



EX1012, [0030], FIG. 1 (annotated).

312. As shown above, “monitor 107” is “enclosed with dotted lines 116.”

Id. Similarly, Kitamura discloses that, in “false standby,” power is “stopped” to “hardware enclosed with chain lines 118”:



EX1012, [0031], FIG. 1 (annotated).¹⁴

313. As to structure S1.3, Kitamura’s “first controller” is a sub-CPU (“sub-CPU 114”) configured to: (a) when the “waiting condition” (“standby mode”) “in which an image is not displayed after stopping a supply of the electric power to the display portion” is in a “first waiting condition” (“full standby”) or “second waiting

¹⁴ Power is also not supplied to monitor 107 in “partial standby.” See EX1012, [0031], FIG. 1.

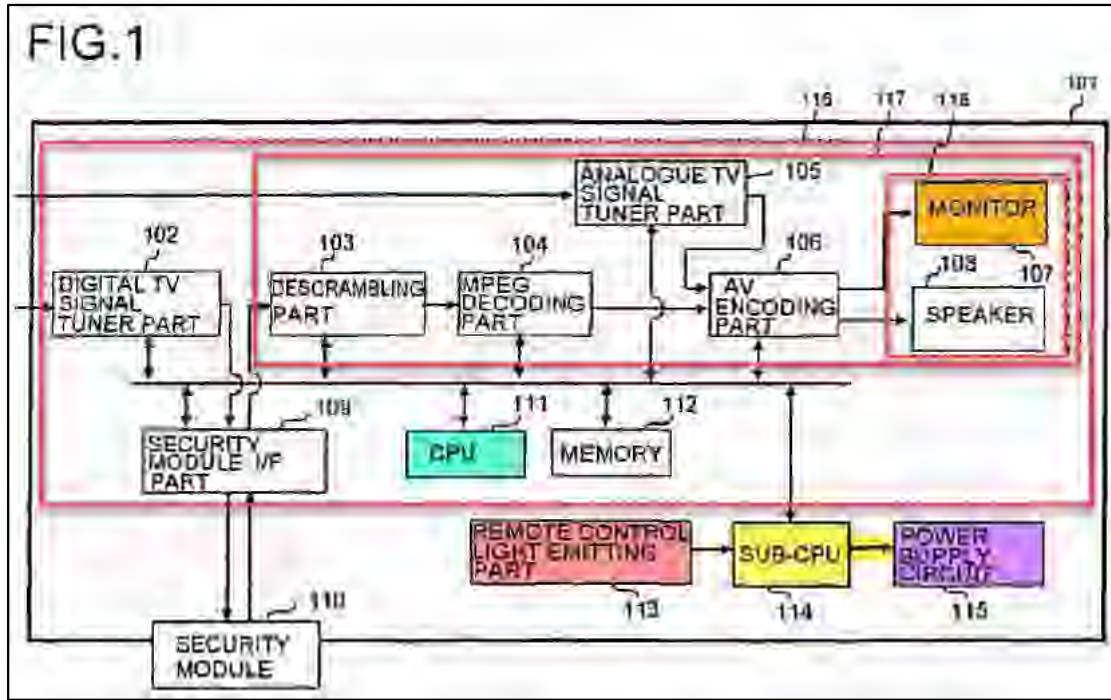
condition” (“false standby”), determine whether to place the “waiting condition” into a “first” or “second waiting condition” (when “monitor 118” is off, the “sub-CPU 114” determines whether to place the “television 101” into “false” or “full standby”); and (b) place the “waiting condition” into a “first” or “second waiting condition” according to the determination (“sub-CPU 114” initiates the determined “standby”). Any differences between Kitamura’s disclosure and the structure disclosed in the ’507 Patent are insignificant. Further, Kitamura discloses performing F1.3 in substantially the same way with substantially the same result. *Id.*

9. Limitation 1H

314. Kitamura discloses Limitation 1H.

315. Kitamura discloses that “power supply circuit 115” supplies power to “sub-CPU 114” in each of the “three standby modes,” including “full standby” and “false standby” (“*the first controller is controlled to be set in operation via supply of the electric power from the electronic power source unit thereto, under the first or second waiting condition*”). EX1012, [0030–31].

316. In particular, Kitamura discloses that “power supply circuit 115” (“*electronic power source unit*”) is controlled to selectively stop the supply power to the hardware enclosed in 116, 117, and 118, for each standby mode, respectively, as shown in Fig. 1:



EX1012, [0029–31], FIG. 1 (annotated).

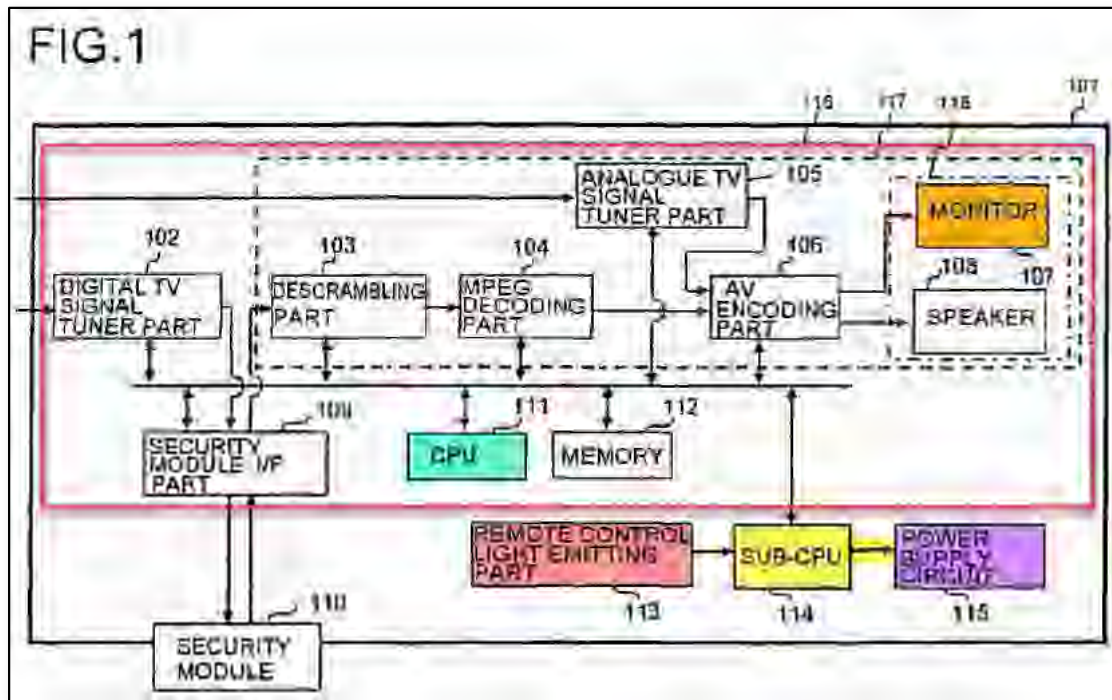
317. As shown above, “sub-CPU 114” (highlighted yellow) is not enclosed in any of lines 116, 117, or 118. *Id.* Thus, power is supplied to sub-CPU 114 in each standby mode. *Id.*

10. Limitation 1I

318. Kitamura discloses Limitation 1I.

319. Kitamura discloses that in “full standby,” “sub-CPU 114” (“*first controller*”) controls “power supply circuit 115” (“*power source unit*”) to supply power to “the minimum required hardware, such as a remote control reception part and the like (to stop power supply to hardware enclosed with dotted lines 116)” (“*the electric power supplied from the power source unit is controlled, so as to supply the*

electric power to the remote control signal receiving portion, as well as, not to supply the electric power to the second controller including the decoder, under the first waiting condition”), as shown in Fig. 1:



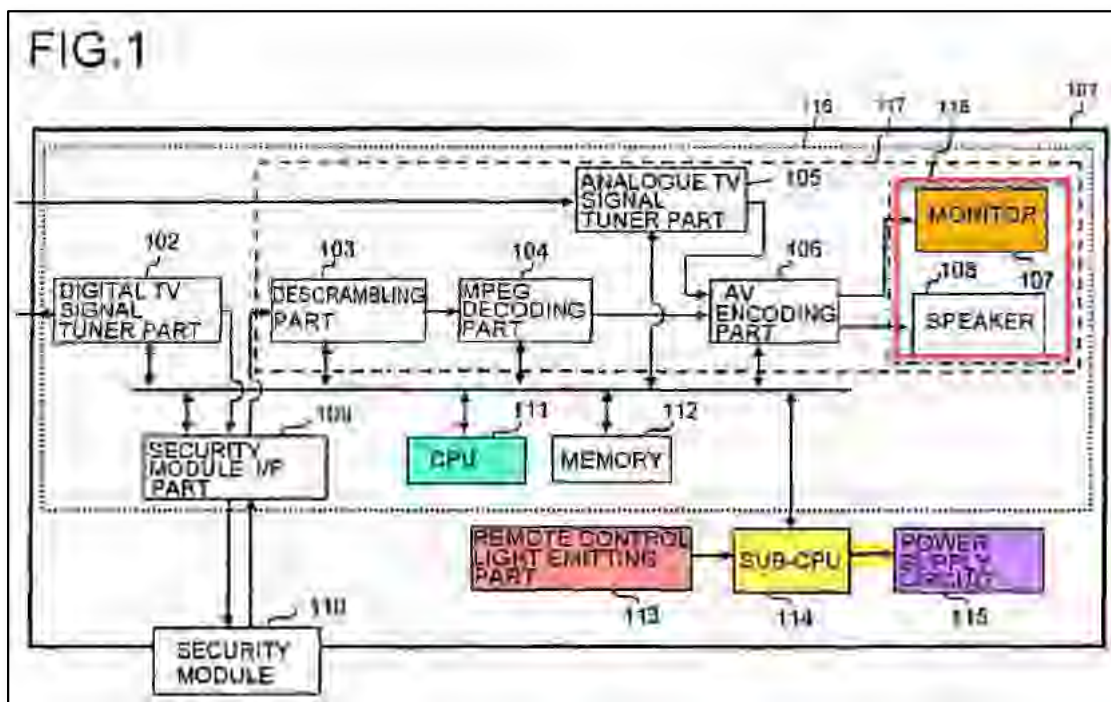
EX1012, [0029–30], FIG. 1 (annotated).

320. As shown above, “**remote control light receiving part 113**” (highlighted red) is not enclosed by dotted lines 116, and thus **is supplied with power**. *Id.* On the other hand, **CPU 111** (highlighted blue), “**descrambling part 103,**” and “**MPEG decoding part 104**” are enclosed by dotted lines 116, and thus **are not supplied with power**. *Id.*

11. Limitation 1J

321. Kitamura discloses Limitation 1J.

322. Kitamura discloses that in “false standby,” “sub-CPU 114” (“*first controller*”) controls “power supply circuit 115” (“*power source unit*”) to “stop power supply only to a monitor and a speaker (to stop power supply to hardware enclosed with chain lines 118)” (“*the electric power supplied from the power source unit is controlled so as to supply the electric power to the remote control signal receiving portion and the second controller including the decoder, under the second waiting condition*”), as shown in Fig. 1:



EX1012, [0029–31], FIG. 1 (annotated).

323. As shown above, “remote control light receiving part 113” (highlighted red), CPU 111 (highlighted blue), “descrambling part 103,” and “MPEG decoding

part 104” are not enclosed by chain lines 118, and thus **are supplied with power**.

Id.

B. Claim 2

324. As with Grounds 1 and 2, the differences between Claims 1 and 2 are also immaterial with respect to Kitamura and Kim’616. *See* §VII.C, *supra*. Kitamura’s CPU’s are circuits. The ’507 patent itself calls a sub-CPU a circuit. *See* EX1001, 6:6-8. In addition, Kim’616’s OS-based controller controls both processing of video and parts of a display. *See, e.g.*, EX1011, [0005], [0010–11], [0013], [0032], [0041–42]. Thus, for the same reasons discussed for Claim 1, Kitamura, in view of the knowledge of a POSITA and/or Kim’616, discloses or at least renders obvious every element of the Claim 2.¹⁵

C. Claim 13

325. Kitamura in view of the knowledge of a POSITA discloses, or renders obvious, Claim 13.

326. Kitamura discloses a state of “[television] receiver 101” where the “power supply [is fully] on.” *See, e.g.*, EX1012, [0032]. In this “power supply on”

¹⁵ The same mapping of related support from Claim 1 to Claim 2 used in Grounds 1–2 applies here as well (*e.g.*, Limitation 2A corresponds to 1 Preamble, 2F corresponds to 1B, 2K corresponds to 1J, etc.).

state, “[broadcast] images and sounds can be immediately presented to the user.”

See, e.g., EX1012, [0022], [0034], [0038].

327. A POSITA would have understood that in such a state “power supply circuit 115” would supply power to the entire television, including “tuner 102” and “monitor 107,” to receive and display such images (“*the sub-control circuit controls the electronic power source unit, so as to supply the electric power to the receiving portion and the display portion, so as to operate the display apparatus in a normal manner*”). *See, e.g.*, EX1012, [0027].

328. In addition, the “power supply on” state can be achieved from “full standby” and the “false standby” (“*under the first waiting condition or the second waiting condition*”). *See, e.g.*, EX1012, [0034], [0038]. Finally, Kitamura discloses the “sub-CPU 114 analyzes the remote control signals for controlling a power supply circuit 115” (“*when a power button of the display apparatus is turned ON ... the sub-control circuit controls the electronic power source unit*”). *See, e.g.*, EX1012, [0029–30]. A POSITA would have understood that television remote controllers conventionally included a “power button.” *Id.*

D. It would have been Obvious to a POSITA to Modify Kitamura with Kim’616 OS-Based CPU

329. To the extent patent owner argues that Kitamura does not disclose Limitations 1B/2F, it would have been obvious to a POSITA use an OS-based CPU,

such as disclosed by Kim'616, for Kitamura's CPU 111, for the reasons discussed in Limitation 1B above and for those discussed for Grounds 3-4.

X. GROUND 6: KITAMURA, IN VIEW OF KIM'616, TICHELAAR AND THE KNOWLEDGE OF A POSITA, RENDERS OBVIOUS CLAIM 10

330. This ground combines Tichelaar's "standby LED" with Ground 5. *See* §VII.F, *supra*. As discussed for Ground 1, Tichelaar's "D_μC 90," which similar to Kitamura's "sub-CPU 114," controls the power supply to place a television into one or more "standby" modes. *See* §VII.B.2, *supra*. Thus, Kitamura and Tichelaar are analogous art and directed to the same field of endeavor.

331. A POSITA would have found it obvious to combine Tichelaar's "standby LED" functionality, as discussed in Ground 1, with Kitamura. Modifying Kitamura would have been the application of a known technique (*i.e.*, implementing an "standby LED" indicator in a television) to a known device (*i.e.*, Kitamura's television receiver 101, including its sub-CPU and related interface) ready for improvement (*i.e.*, a television indicating whether standby mode is active or not) to yield predictable results (*i.e.*, television with a standby LED indicator) ("*a light emitting element which changes an emitting condition thereof depending on whether the display apparatus is in the first waiting condition or the second waiting condition, and wherein the light emitting element makes the display portion distinguishable whether the display apparatus is in the first waiting condition or the*

second waiting condition”). In that regard, a port of sub-CPU 114 could be dedicated to controls one or more “standby LED[s].” *See* EX1018, [0059].

XI. SECONDARY CONSIDERATIONS

332. Having considered the impact of secondary considerations, I am unaware of any substantial secondary considerations that would have led a POSITA to find the claims not to be obvious or to be less obvious.

XII. CONCLUSION

333. I reserve the right to supplement my opinions in the future to respond to any arguments that the Patent Owner raises and to take into account new information as it becomes available to me.

Andrew Wolfe Ph.D.

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Email: awolfe@awolfe.org

Education:

Ph.D. in Computer Engineering, Carnegie Mellon University, 1992
Visiting Graduate Student, Center for Reliable Computing, Stanford University, 1988-1989
M.S. in Electrical and Computer Engineering, Carnegie Mellon University, 1987
B.S.E.E. in Electrical Engineering and Computer Science, The Johns Hopkins University, 1985

Recent Employment:

Lecturer, [September 2013-present]

Santa Clara University

Teaching graduate and undergraduate courses on embedded computing, mechatronics, real-time systems, computer architecture, and community service.

Consultant, [October 2002-present]

Wolfe Consulting

Consultant on processor technology, computer systems, consumer electronics, software, design tools, and intellectual property issues. Testifying and consulting expert for IP and other technology-related litigation matters.

Sample clients include:

AMD	Nvidia	Samsung
IBM	Motorola/Lenovo	HTC
AT&T	Verizon Mobile	Huawei
Apple	T-Mobile	Western Digital
Nintendo	Google	Sonos
Sony	Netflix	Roku
Synaptics	Activision	Sawstop
Tivo	LG	TCL
Medigus	William Hill	ZTE
Egnyte	Acer	Waymo

Chief Technical Officer, [1999-2002]; Sr. VP of Business Development, [2001-2002]; VP, Systems Integration, S3 Fellow, [1998 – 1999]; Director of Technology, S3 Fellow, [1997 - 1998]
SONIC|blue, Inc., Santa Clara, CA (formerly S3 Inc.)

Strategic Business Development:

Developed and implemented strategy to reposition S3 from PC graphics into the leading networked consumer electronics company.

- Acquired Diamond Multimedia and coordinated integration of communications, Rio digital music, and workstation graphics divisions into S3.
- Identified and negotiated acquisitions to grow digital media businesses including Empeg, ReplayTV, and Sensory Science.
- Identified and negotiated strategic investments including Comsilica, Intellon, KBGear Interactive, Entridia, DataPlay and others.

- Developed strategy for integrated graphics/core-logic products and established a joint venture with Via Technologies to design and market these products.
- Negotiated divestiture of graphics chip business to Via and the workstation graphics division to ATI.

Product Planning and Development:

- Drove roadmap development within SONICblue product divisions.
- Managed Business Development for all product lines.
- Led New Product Development and Corporate Vision processes.
- Acting co-General Manager of Rio digital music business in 2nd half of 2001. Responsible for all areas of product development, business development, and cost management.
- Managed development of the Savage/MX and Savage/IX mobile 3D graphics accelerators and Savage/NB system logic products.

Public Relations, Public Policy and Investor Relations:

- Present company products and strategy at industry events such as CES, Comdex, and Microprocessor Forum.
- Discuss new products and initiatives with the press.
- Promote issues of interest to SONICblue to industry groups and in Washington.
- Brief analysts, and investors on company progress. Participate in quarterly conference calls.

IP Management and Licensing:

- Negotiated and managed partnership agreements including a critical cross-licensing agreement with Intel.
- Renegotiated technology-licensing agreements with IBM for workstation graphics products.
- Evaluated outside technology opportunities, managed video research and development, and managed corporate IP strategy with legal staff including patent filings, cross licensing, and litigation.

Consulting Professor, [1999-2002]
Stanford University, Stanford, CA

Teaching computer architecture and microprocessor design.

Assistant Professor [1991 - 1997]
Princeton University, Princeton, NJ

Teaching and research in the Electrical Engineering department. Research in embedded computing systems, multimedia, video signal processors, compiler optimization, and high performance computer architecture. Principal investigator or project manager for ~\$6M in funded research.

Visiting Assistant Professor, [1992]
Carnegie Mellon University, Pittsburgh, PA

Research and preparation of teaching materials on advanced microprocessor designs including new superscalar and superpipelined processor architectures.

Founder and Vice President and Consultant, [1989 - 1995]
The Graphics Technology Company, Inc., Austin, TX

Founded company to develop touch-sensitive components and systems for the first generation of PDA devices and interactive public systems. Obtained financing from Gunze Corp., Osaka, Japan. Company is now part of 3M.

Senior Electrical Engineer, [1989]
ESL - TRW, Advanced Technology Division, Sunnyvale, CA

Designed the architecture for an Intel i860-based multiple-processor digital signal processing system for advanced military applications. Designed several FPGA interface chips for VME-bus systems.

Design Consultant, [1986 -1987]

Carroll Touch Division, AMP Inc., Round Rock, TX

Developed several new technologies for touch-screen systems. Designed the first ASIC produced for AMP, a mixed-signal interface chip for controlling touch-screen sensors. Developed the system electronics, system firmware, and customer utility software for numerous products including those based on the new ASIC.

Senior Design Engineer, [1983 -1985]

Touch Technology Inc., Annapolis, MD

Advisory Boards:

Director, Turtle Beach Corporation (NASDAQ:HEAR) (formerly Parametric Sound Corporation), KBGear Interactive, Inc., Comsilica, Inc., Rioport.com, various S3 subsidiaries.

Technical Advisory Boards, Ageia, Inc., Intellon, Inc., Comsilica, Inc., Entridia, Inc., Siroyan, Ltd., BOPS, Inc, Quester Venture Funds

Carnegie Mellon University Silicon Valley Advisory Board; Johns Hopkins University Tech Transfer Advisory Board

Awards:

IEEE Fellow - for contributions in hardware code compression of embedded software, power consumption analysis, and optimization, 2022

IEEE Computer Society Distinguished Contributor - 2021

Micro Test-of-Time Award (in recognition of one of the ten most influential papers of the first 25 years of the symposium), 2014

Business 2.0 “20 Young Executives You Need to Know”, 2002

Walter C. Johnson Prize for Teaching Excellence, 1997.

Princeton University Engineering Council Excellence in Teaching Award, Spring 1996

AT&T/Lucent Foundation Research Award, 1996.

Walter C. Johnson Prize for Teaching Excellence, 1995

IEEE Certificate of Appreciation, 1995, 2001.

AT&T Foundation Research Award, 1993.

Semiconductor Research Corporation Fellow, 1986 - 1991.

Burroughs Corporation Fellowship in Engineering, 1985 - 1986.

Professional Activities:

Program Chair: Micro-24, 1991, Hot Chips 13, 2001.

General Chair: Micro-26, 1993, Micro-33, 2000.

Associate Editor: IEEE Computer Architecture Letters; ACM Transactions in Embedded Computing Systems

Speaker at CES, WinHec, Comdex, Intel Dev. Forum, Digital Media Summit, Microprocessor Forum, etc.

Keynote speaker at Micro-34, ICME 2002

IEEE B. Ramakrishna Rau Award committee – 2012-2016

IEEE Computer Society Awards Committee – 2015

CES Awards Judge – 2016

Entrepreneurship Mentor – Draper University

Over 50 refereed publications.**Publications since January 2006:**

Wolfe, A., “Retrospective on Code Compression and a Fresh Approach to Embedded Systems”, IEEE MICRO, July/Aug. 2016, Invited paper.

Patents:

- U.S. Pat. 5,041,701 – *Edge Linearization Device for a Contact Input System*, Aug. 20, 1991.
- U.S. Pat. 5,438,168 – *Touch Panel*, Aug. 1, 1995.
- U.S. Pat. 5,736,688 – *Curvilinear Linearization Device for Touch Systems*, Apr. 7, 1998.
- U.S. Pat. 6,037,930 – *Multimodal touch sensitive peripheral device*, March 14, 2000.
- U.S. Pat. 6,408,421 – *High-speed asynchronous decoder circuit for variable-length coded data*, June 18, 2002.
- U.S. Pat. 6,865,668 – *Variable-length, high-speed, asynchronous decoder circuit*, March 8, 2005
- U.S. Pat. 7,079,133 – *Superscalar 3D Graphics Engine*, July 18, 2006
- EP 1 661 131 B1 – *PORTABLE ENTERTAINMENT APPARATUS*, Jan. 21, 2009
- U.S. Pat. 7,555,006 – *Method and system for adaptive transcoding and transrating in a video network*, June 30, 2009
- U.S. Pat. 7,996,595 – *Interrupt Arbitration for Multiprocessors*, Aug. 9, 2011
- EP 2 241 979 B1 – *Interrupt Arbitration for Multiprocessors*, Oct. 10, 2011
- U.S. Pat. 8,131,970 – *Compiler Based Cache Allocation*, March 6, 2012
- U.S. Pat. 8,180,963 – *Hierarchical read-combining local memories*, May 15, 2012
- U.S. Pat. 8,193,941 – *Snoring Treatment*, June 5, 2012
- U.S. Pat. 8,203,541 – *OLED display and sensor*, June 19, 2012
- U.S. Pat. 8,243,045 – *Touch-sensitive display device and method*, August 14, 2012
- U.S. Pat. 8,244,982 – *Allocating processor cores with cache memory associativity*, August 14, 2012
- U.S. Pat. 8,260,996 – *Interrupt Optimization for Multiprocessors*, Sept. 4, 2012
- 101185761 (KR) – *Noise Cancellation for Phone Conversation*, Sept. 19, 2012
- 101200740 (KR) – *OLED display and sensor*, November 7, 2012
- 101200741 (KR) – *Touch-sensitive display device and method*, November 7, 2012
- U.S. Pat. 8,321,614 – *Dynamic scheduling interrupt controller for multiprocessors*, Nov. 27, 2012
- U.S. Pat. 8,352,679 – *Selectively securing data and/or erasing secure data caches responsive to security compromising conditions*, Jan. 8, 2013
- U.S. Pat. 8,355,541 – *Texture Sensing*, Jan. 15, 2013
- U.S. Pat. 8,370,307 – *Cloud Data Backup Storage Manager*, Feb. 5, 2013
- U.S. Pat. 8,398,451 – *Tactile Input Interaction*, March. 19, 2013
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