

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MICRON TECHNOLOGY INC.,
Petitioner,

v.

SONRAI MEMORY LIMITED,
Patent Owner

Case IPR2023-00904
Patent 6,920,527

SUPPLEMENTAL DECLARATION OF DAVID KUAN-YU LIU, Ph.D.

TABLE OF CONTENTS

I.	ASSIGNMENT.....	3
II.	TECHNICAL DISCUSSION	4
	A. Claim construction of “portable memory apparatus” (elements 1[p], 15[a]) and “housing” (element 1[a])	5
	B. Tsunoda renders obvious a portable memory apparatus (Ground 1A, elements 1[p], 15[a])	5
	C. Tsunoda renders obvious copying data from the flash memory to the SDRAM (Ground 1A, elements 1[f] and 15[c]) when the MMC is coupled to the host system (Ground 1A, element 1[f])	8
	D. Tomio renders obvious a portable memory apparatus (elements 1[p], 15[a]) having a housing (element 1[a]) under Sonrai’s interpretation in the District Court (Grounds 1B, 2B, 3A, 4A)	11
	E. Tomio (Ground 3A) and Tsunoda-Tomio (Ground 1B) and Tsunoda-Sukegawa-Tomio (Ground 2B) render obvious an internal power source (claims 2, 16-17) that is rechargeable through the connector (claim 4)...16	
	F. Tomio (Ground 3A) and Tsunoda-Tomio (Ground 1B) and Tsunoda-Sukegawa-Tomio (Ground 2B) and Tomio-Sukegawa (Ground 4A) render obvious when the portable memory apparatus is unplugged from the computer system, the internal power source powers the portable memory apparatus and the portable memory apparatus copies data from the volatile memory to the non-volatile memory (claims 3, 16).....	19
	G. Tsunoda-Sukegawa (Ground 2A) renders obvious a portable memory apparatus (elements 1[p], 15[a]) with a volatile memory (elements 1[c] and 15[b])	24
	H. Tomio-Sukegawa renders obvious a portable memory apparatus (elements 1[p], 15[a]) with a volatile memory (elements 1[c] and 15[b])	28
	I. Shigeo is analogous art to the ’527 patent (Grounds 1C, 2C, 3B, 4B)	31
III.	ADDITIONAL REMARKS	33

I, David Kuan-Yu Liu, Ph.D., of Fremont, CA, declare that:

I. ASSIGNMENT

1. I have been retained as a technical expert by counsel on behalf of Micron Technology, Inc. (“Micron” or “Petitioner”). I understand that the Patent Trial and Appeal Board (“PTAB” or “Board”) instituted an *inter partes* review (“IPR”) proceeding of U.S. Patent No. 6,920,527 (“the ’527 patent”) (MTI-1001).

2. I understand that this declaration will be submitted in support of Petitioner’s Reply to Patent Owner’s Response to the Petition for *inter partes* review of the ’527 patent. This declaration supplements, and is intended to be read in conjunction with, my declaration in support of Micron’s Petition (MTI-1003, “my First Declaration”). In my First Declaration, I address many topics, including (but not limited to) my background and qualifications, the level of skill in art, an overview of the ’527 patent, claim construction, certain legal standards explained to me by Micron’s counsel, and a detailed analysis of the prior art against the ’527 patent’s claims. The opinions and explanations expressed in my First Declaration apply equally here.

3. In writing this Supplemental Declaration, I have considered the following: my own knowledge and experience, including my teaching and work experience in the above fields; and my experience of working with others involved in those fields.

4. I have no financial interest in either party or in the outcome of this proceeding. I am being compensated for my work as an expert on an hourly basis, for all tasks involved. My compensation is not dependent on the outcome of these proceedings or on the content of my opinions.

II. TECHNICAL DISCUSSION

5. The analysis and opinions expressed in my First Declaration fully explain why each and every feature of the '527 patent's Challenged Claims is provided in the prior art. I understand that Patent Owner and Dr. Brogioli have considered my opinions and offered their own, some of which are inconsistent with my view. I will address some of those points below. The fact that I have not addressed all of Patent Owner and Dr. Brogioli's opinions should not be interpreted as agreement with them.

6. The Patent Owner's Response (POR) fails to address, much less rebut, positions advanced in my previous testimony. Indeed, in advancing these arguments, Sonrai now relies upon Dr. Brogioli who provides no corroborating evidence or factual analysis in support of his conclusions.

7. As I previously explained with reference to the applied prior art and corroborating references, the Challenged Claims would have been obvious to a POSITA. Below, I provide further testimony in response to Sonrai's arguments.

A. Claim construction of “portable memory apparatus” (elements 1[p], 15[a]) and “housing” (element 1[a])

8. As I explained in my First Declaration, I addressed claims 1-6, 9, 12, and 15-17 as rendered obvious by Tomio under the scope of these claim terms advanced by Patent Owner in its complaint for infringement. MTI-1003, ¶140. Tomio’s 168 pin dual inline module, like Micron’s memory devices that Sonrai identified as allegedly infringing claims of the ’527 patent, can be carried around in the palm of one’s hand. MTI-1016, 6 (showing 168 pin SDRAM DIMM having dimensions 133.35mm x 40mm that can be carried around in the palm of one’s hand). Therefore, Tomio provides the preamble and element 1[a] of claim 1 and element 15[a] of claim 15 in accordance with the scope of the term “portable” and “housing” advanced by Patent Owner in its complaint for infringement. MTI-1003, ¶¶141-142. Though to be clear, I do not agree that Sonrai’s interpretations are correct. As such, my First declaration analyzed the Challenged Claims under both Micron’s and Sonrai’s District Court constructions.

B. Tsunoda renders obvious a portable memory apparatus (Ground 1A, elements 1[p], 15[a])

9. As I explained in my first declaration, a POSITA would have found it obvious that Tsunoda’s MMC 1401 shown in Tsunoda’s FIG. 14 is a portable memory apparatus because it can be mounted on a portable information terminal and beneficially allows the contents of the MMC to be transferred easily between

devices or computers. MTI-1003, ¶52. Sonrai does not dispute that the MMC 1401 is a portable memory apparatus. POR, 14; Petition, 8-11.

10. Instead, Sonrai alleges that each of the memory apparatuses of Tsunoda's FIGS. 1, 9, 11, and 12 is not portable because it has a SDRAM interface. POR, 11-13. However, Tsunoda's disclosure of a SDRAM interface is not indicative of whether Tsunoda's memory apparatus is portable. Indeed, Tsunoda explains:

The memory apparatus 101, 901, 1301 and 1401 of the present invention can be applied to any shapes. For example, the apparatus may be a LSI, in which memory chips and a control chip are sealed in one package, or all the functions may be housed on one semiconductor chip. **The components may be housed in a memory card shape such as an MMC.** Further, types of the nonvolatile memory and the volatile memory of the present invention are **not limited to the flash memory 102 or the SDRAM 103.** For example, regarding the nonvolatile memory, similar processing can be carried out in a ferroelectric memory or an MRAM (magnetic memory).

MTI-1004, [0124] ¹.

The present invention is not limited to the foregoing MMC interface 907, but it can be applied to various interfaces. FIGS. 11 and 12 schematically show internal configurations of memory apparatus 1101

¹ Emphasis added unless otherwise noted.

and 1201, in which the present invention is applied to interfaces of **an SD card (small memory card having a width of 24 mm, a length of 32 mm, and a thickness of 2.1 mm**, nine external terminals, and flash memory loaded), and **a memory stick** (registered trade mark of Sony Corporation).

MTI-1004, [0117].

11. Based on my review of Tsunoda's disclosure, Tsunoda uses the term SDRAM interface as an example of an interface that allows communication between a SDRAM inside the portable memory apparatus and a host. MTI-1004, [0096]-[0097]. Tsunoda's use of the term SDRAM interface is not intended to impose any restrictions on the portability of the memory apparatus. The MMC interface shown in Tsunoda's FIGS. 9 and 14 is another example of an interface that allows the transfer of data between the SDRAM inside the portable memory apparatus (MMC) and the host. MTI-1004, [0121]-[0122]. The SD card interface and the memory stick interface shown in Tsunoda's FIGS. 11 and 12, respectively, are other examples of interfaces that allow the transfer of data between the SDRAM inside the portable memory apparatus (SD card or memory stick) and the host. MTI-1004, [0118]-[0119]. As such, Tsunoda renders obvious a portable memory apparatus as claimed.

- C. **Tsunoda renders obvious copying data from the flash memory to the SDRAM (Ground 1A, elements 1[f] and 15[c]) when the MMC is coupled to the host system (Ground 1A, element 1[f])**

12. Sonrai's POR states:

A POSITA would not have understood that this limitation was disclosed or taught by Tsunoda because **Tsunoda teaches copying data from the non-volatile memory to the volatile memory as part of a power up sequence that only applies when there is an SDRAM compatible interface.** ... Tsunoda teaches that the triggering event for when data is copied from the non-volatile memory to the volatile memory is powering up which is detected using voltage detector 4032 in a control unit 4030. ... A POSITA would understand from Tsunoda's third embodiment disclosure that **Tsunoda's third embodiment does not include a Control Unit with a Control Register and a Voltage Detector intended for use with a SDRAM compatible interface.** ... Therefore, **Tsunoda's third embodiment does not support a power up sequence.**

POR, 14-15.

A POSITA would have understood that **an MMC interface alone would not be capable of providing the required SDRAM compatible interface as taught by Tsunoda.**

POR, 16.

13. Sonrai's arguments ignore that, in Tsunoda's other embodiments, the power up sequence is performed by a memory control unit 104 of FIG. 1:

After the power is turned ON, program data on the flash memory

102 is copied to the volatile area 203 of the SDRAM 102, and the host 111 can use the program by accessing the volatile area 203 on the SDRAM 103. ... **After the power is turned ON, user data on the flash memory 102 is copied to the nonvolatile area 204 of the SDRAM 103**, and the host 111 can use the user data by accessing the nonvolatile area 204 on the SDRAM 102.

MTI-1004, [0099].

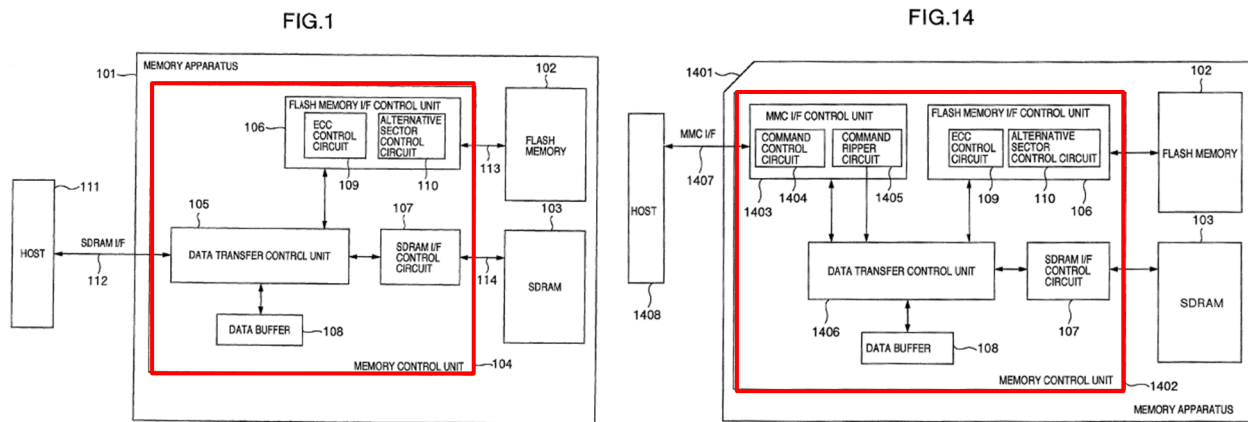
According to the present invention, **functions for executing the foregoing processing steps are provided on the memory control unit 104 shown in FIG. 1.**

MTI-1004, [0104].

FIG. 18 is a flowchart showing a process of area setting data setting processing and **initializing processing when the memory apparatus 101 is started. When the memory apparatus 101 is started**, the memory control unit 104, the SDRAM 103, and the flash memory 102 are initialized (1801). After the end of initialization, the memory control unit 104 issues an area setting data reading command to the flash memory 102 (1802). The flash memory 102 transmits the area setting data to the memory control unit 104 (1804). The memory control unit 104 saves the area setting data in the data buffer 108 (1803). Then, **the memory control unit 104 instructs transfer of the initialization data from the flash memory 102 to the SDRAM 103 based on area setting information, and data is transferred** (1805). Data reading processing will be detailed later. The memory apparatus 101 repeats the data reading processing until all necessary data are read (1806). After the end of the data transfer, the memory apparatus 101 reports the end

of its own initialization to the host 111 (1807). Then, the host 111 and the memory apparatus 101 start normal operations (1808).

MTI-1004, [0131]. All the components of the memory control unit 104 of FIG. 1 (below left) are present in the MMC of FIG. 14 (below right). Therefore, Tsunoda's MMC supports a power up sequence in a similar manner as described with respect to FIG. 1. Indeed, Tsunoda discloses that "the memory apparatus 1401 can issue a command for instructing data transfer between the flash memory [102] and the SDRAM 103... **as in the case of the previous embodiments**, the SDRAM 103 can be accessed from the memory control unit 1402." MTI-1004, [0122].



14. Further, my First Declaration explained that Tsunoda's MMC interface 1407 includes "a power supply terminal (VCC 1) 1004 from the host." MTI-1003, ¶73; Petition, 21; MTI-1004, [0114]. When the MMC interface 1407 couples the MMC 1401 and the host 1408, the host 1408 starts supplying power to the MMC 1401 through the power supply terminal 1004 of the MMC interface

1407. *Id.* Using the power supply voltage on the power supply terminal 1004, Tsunoda's MMC can detect when the MMC is coupled to the host and powered on, and can support a power up sequence. *Id.*; MTI-1004, [0067]-[0068], FIG. 24 (4061-4062), FIG. 25 (4101-4105). As I explained above, Tsunoda further describes that after the power is turned ON, program data and user data on the flash memory 102 is copied to the SDRAM 103. MTI-1004, [0099], [0131], FIG. 18.

15. Based on my knowledge and experience in this field and my review of Tsunoda, it would have been obvious to a POSITA to implement this power up sequence in the MMC 1401, for example, using a memory control unit as described in FIG. 1 or a control unit as described in FIG. 24. MTI-1004, [0067]-[0068], [0099], [0104], [0131]. This power up sequence would include copying data from the flash memory to the SDRAM when the MMC is coupled to the host system as required by the claims. *Id.*

D. Tomio renders obvious a portable memory apparatus (elements 1[p], 15[a]) having a housing (element 1[a]) under Sonrai's interpretation in the District Court (Grounds 1B, 2B, 3A, 4A)

16. With respect to elements 1[p]'s and 15[a]'s recitation of "a portable memory apparatus, Sonrai argues that:

A POSITA would not consider a memory module, such as that disclosed in Tomio, to be a portable memory device in the context of the specification and claims the '527 Patent. Ex. 2012, ¶ 52. The

memory module in Tomio is **not designed to be plugged and unplugged**.

POR, 18, 35.

Accordingly, a POSITA would not understand that Tomio's teachings are directed to a portable memory apparatus. Tomio is instead directed to an **internal memory** that could shorten the startup time for a personal computer. Ex. 1006, [0004]...

POR, 19-21, 36-38, 42-43. With respect to element 1[a]'s recitation of "housing,"

I note that Sonrai does not dispute that Tomio's memory module has a housing.

POR, 38.

17. As I explained in my First Declaration and again above, I addressed elements 1[p], 1[a], and 15[a] as rendered obvious by Tomio under the scope of these claim terms advanced by Patent Owner in its complaint for infringement. MTI-1003, ¶140. Tomio's 168 pin dual inline module, like Micron's memory devices that Sonrai identified as allegedly infringing claims of the '527 patent, can be carried around in the palm of one's hand. MTI-1016, 6 (showing 168 pin SDRAM DIMM having dimensions 133.35mm x 40mm that can be carried around in the palm of one's hand). Therefore, Tomio provides elements 1[p], 1[a] and 15[a] in accordance with the scope of the term "portable" and "housing" advanced by Patent Owner in its complaint for infringement. MTI-1003, ¶¶141-142. Though to be clear, I do not agree that Sonrai's interpretations are correct.

18. Tomio's disclosure that "a module formed using a semiconductor memory 8 of the present invention may be used instead of a conventional floppy disk or CDROM" indeed suggests that its memory module can be portable. MTI-1006, [0037]; *see* Petition, 53-54. Based on my knowledge and experience in this field, a POSITA would have recognized that conventional floppy disks and CDROMs are portable data storage devices as they are designed to be repeatedly inserted into and removed from a computer system. Indeed, the '527 patent describes floppy disks and CDs as portable storage mediums. MTI-1001, 1:15-16. Tomio's disclosure that its memory module can be used *instead of* a floppy disk or CDROM indicates that its memory module can be designed to replace a floppy disk or CDROM, which would include implementing the memory module to include the feature of these devices of being designed to be repeatedly inserted and removed from a computer system. *Id.* A POSITA would have understood that the drives that read these devices would also need to be replaced with a connector designed for repeatedly plugging and unplugging Tomio's memory module from the computer system.

19. Sonrai argues that:

A POSITA would not look to Tomio for a portable memory apparatus because of the problems that would be encountered plugging and unplugging a portable memory apparatus with this many connections. ... A POSITA would have known that unplugging Tomio's memory

apparatus would likely corrupt the volatile memory.... A POSITA would have known that unplugging memory without previous notification to the host device would create significant problems and could be catastrophic. ... There would be a loss of data integrity and possible damage to the host or the portable memory apparatus. ... A POSITA would have recognized that the data corruption could result in an unacceptable data loss to the user...

As Dr. Brogioli explains, “[t]he problems inherent in unplugging a memory apparatus with numerous connectors such as Tomio’s memory apparatus (or one of Tsunoda’s SDRAM interface embodiments) including, e.g., floating electrical signal values, necessary modification of logic and command structure, etc., would have meant that combining Tomio’s and Tsunoda’s teachings would have required more than combining known prior art elements according to known methods and would not have yielded predictable results.” Ex. 2012, ¶68.

POR, 21-22, 38, 40, 43-44, 46.

As Dr. Brogioli explains, “if the memory device in Tsunoda were removed from the host by the user, without a priori knowledge by the host, it would create multiple unacceptable and potentially catastrophic problems. To begin, allowing a device to be removed from the host at a point in time that is random from the host’s perspective, precludes the host from being able to perform an orderly set of commands to ensure data and control integrity of the device. Commands and signals cannot be sent back and forth in an orderly manner to ensure proper command signaling protocol and data integrity, but abruptly removing the device presents an issues whereby the electrical signals at the device interface

can be in seemingly random states upon removal. This would have undesirable and potentially electrically damaging effects on the system.” Ex. 2012, ¶66. Furthermore, data integrity of file content in the non-volatile memory cannot be ensured because the device may be in a state of processing a transaction when power is removed. *Id.*

POR, 33. Based on my knowledge and experience in this field, these problems do not distinguish whether a memory device is or is not portable. These problems can occur not only “in unplugging a memory apparatus with numerous connectors such as Tomio’s memory apparatus,” as Dr. Brogioli contends (POR, 22; EX2012, ¶68), but can also occur in unplugging a portable memory apparatus with 7 contact terminals such as Tsunoda’s MMC or with 4 contact terminals such as Tsunoda-Sukegawa’s USB drive. MTI-1032, 1 (“If you remove the [flash drive or memory card] device without first stopping it the information on it can be corrupted.”); MTI-1033, 1 (“To avoid losing data, it’s important to remove external hardware like hard drives and USB drives safely.”); MTI-1042, 2 (“USB flash drives and external hard drives connected via USB need power use a small amount of power and if they are suddenly disconnected can actually physically damage the device. Again there goes all your data.”).

20. Based on my review of the ’527 patent and Tomio, Tomio is from the same field of endeavor as the ’527 patent. The ’527 patent explicitly states that it “relates generally to computer storage mediums.” MTI-1001, 1:7-9. Tomio’s

memory module falls into the general descriptive category of “computer storage mediums.” A POSITA considering technical problems involving computer storage mediums would have considered art like Tomio.

E. Tomio (Ground 3A) and Tsunoda-Tomio (Ground 1B) and Tsunoda-Sukegawa-Tomio (Ground 2B) render obvious an internal power source (claims 2, 16-17) that is rechargeable through the connector (claim 4)

21. For Ground 3A, Sonrai does not dispute that Tomio’s memory module includes a rechargeable battery. *See* POR, 35-41. For Grounds 1B and 2B, however, Sonrai argues that:

Tsunoda teaches issuing a busy signal that prevents the host from stopping supply of power to the memory apparatus until the busy signal is released by the memory apparatus. *Id.* [0085]-[0087]. Because Tsunoda already discloses a method to ensure data transfer is completed before power is shut off, adding an internal power source to ensure that the memory apparatus can transfer the data from the volatile memory to the non-volatile memory would unnecessarily add components and complexity to the memory apparatus. Ex. 2012, ¶45. Accordingly, a POSITA would not be motivated to add an internal power source to Tsunoda’s memory apparatus. *Id.*

POR, 23-24. As I explained in my First Declaration:

Tsunoda does not account for the situation where power is abruptly turned off (by unplugging or power outage) before the transfer starts or before the transfer completes. In this situation, data that is not copied from the volatile memory to the nonvolatile memory will be lost. MTI-

1004, [0075] (“Since the SDRAM 4010 is a volatile memory, data written in the SDRRAM 4010 is lost when the power supply to the memory apparatus 4000 is stopped.”); MTI-1006, [0002] (DRAMs currently used in a wide variety of applications can be accessed at high speed, but are volatile memories that lose stored information when the power is turned off.”), [0032], [0039], [0027]; MTI-1007, [0009]-[0012] (“data stored in the volatile RAM is also lost when the remaining battery power is low and the battery dies.”), [0061].

MTI-1003, ¶129; Petition, 45-46. Tsunoda’s method therefore would not ensure that data transfer from the volatile memory to the nonvolatile memory is completed, or even started, before the power is abruptly turned off. Based on my knowledge and experience in this field, a POSITA would have been motivated to include an internal power source in the portable memory apparatus (e.g., Tsunoda’s MMC or Tsunoda-Sukegawa’s USB drive) that continues to supply sufficient power to the portable memory apparatus to allow the portable memory apparatus to transfer data from the volatile memory to the nonvolatile memory after unplugging without previous notification to the host. Adding an internal power source to implement this beneficial feature in the portable memory apparatus would not “unnecessarily” add components and complexity.

22. Sonrai further argues that:

Tsunoda’s third embodiment teaching of a portable memory apparatus as a MultiMediaCard (Ex. 1004, Fig. 14) is incompatible with

Tomio's rechargeable battery because of the physical size limitations of a MultiMediaCard form factor. Ex. 2012, ¶48. ... A MultiMediaCard has specific size limitations set by the standard, including a height of 1.4mm. Ex. 1008, 2:16-20, 4:35-36, Fig. 6B (showing the form factor of a MultiMediaCard). Ex. 2012, ¶48. A POSITA would have known that an internal power source would not have fit onto Tsunoda's MMC embodiment. *Id.*, ¶48. A POSITA would also have recognized that "the MMC interface includes a very limited pin count and a low power electrical interface that would not—without significant, costly, and impractical re-engineering and modifications—have the ability to recharge a battery, such as the rechargeable battery in Tomio." Ex. 2012, ¶49.

POR, 24-25.

Moreover, Sukegawa's teaching of a USB memory device without volatile memory would have, in fact, taught away from modifying Tsunoda with Tomio's teaching of a battery. Ex. 2012, ¶64. Sukegawa's recognition of "an urgent need for an improved USB flash drive that is reduced in size, [and] is less expensive, ..." would have taught away from additional expense and complexity. Ex. 1005, 2:27-28; Ex. 2012, ¶64. *See also* Ex. 1005, 4:39-40 ("In this way, the number of parts within the USB flash drive is reduced and the physical size of the drive can be drastically reduced ..."). A rechargeable battery would have added size and expense to a portable memory apparatus.

POR, 32. I disagree, and based on my knowledge and experience in this field, a POSITA would have been capable of employing ordinary creativity to carry out

implementations of Tsunoda's MMC and Tsunoda-Sukegawa's USB drive in a manner necessary to achieve the advantages taught by Tomio. For example, a POSITA would have been capable of implementing each of Tsunoda's MMC and Tsunoda-Sukegawa's USB drive to include a rechargeable battery by varying the size and shape of the housing and varying the power supplied through the electrical interface to accommodate the rechargeable battery. As another example, a POSITA would have been capable of implementing each of Tsunoda's MMC and Tsunoda-Sukegawa's USB drive to include a rechargeable battery that is custom built for Tsunoda's MMC or Tsunoda-Sukegawa's USB drive form factor. MTI-1034, 10 ("very small batteries... can be custom built for devices"). As yet another example, a POSITA would have been capable of implementing each of Tsunoda's MMC or Tsunoda-Sukegawa's USB drive to include an internal capacitor to act as a battery or charge reservoir for supplying current at a given voltage for a certain limited period of time, dictated by the size of the capacitor.

F. Tomio (Ground 3A) and Tsunoda-Tomio (Ground 1B) and Tsunoda-Sukegawa-Tomio (Ground 2B) and Tomio-Sukegawa (Ground 4A) render obvious when the portable memory apparatus is unplugged from the computer system, the internal power source powers the portable memory apparatus and the portable memory apparatus copies data from the volatile memory to the non-volatile memory (claims 3, 16)

23. Sonrai argues that:

Neither Tsunoda or Tomio disclose unplugging a portable memory apparatus.

POR, 22.

First, there is no disclosure in Tsunoda, Tomio, or Sukegawa related to a memory device being unplugged.

POR, 33.

Tomio does not disclose or suggest unplugging a portable memory apparatus.

POR, 40.

Tomio does not disclose, teach or suggest unplugging a portable memory apparatus.

POR, 46. Even if there were no explicit disclosure in Tsunoda, Tomio, or Sukegawa of the precise claim language that “the portable memory apparatus is unplugged from the computer system,” a POSITA would have recognized that Tomio suggests unplugging a portable memory apparatus from the computer system. As I explained in my First Declaration at ¶136, Tomio discloses that:

The rechargeable battery 61 continues to output direct current power supply potentials VDD and VDDQ for a predetermined period of time **even when supply of the direct current power supply potential VDD from the direct current power supply 60 has been stopped.**

MTI-1006, [0039].

When the external power supply switch 15 is turned off in ③ (time t3), the signal $\phi 1$ reaches the "L" level and the supply of the alternating current power supply voltage VAC for the direct current power supply 6 is stopped. Because the direct current power supply 6 includes

rechargeable batteries as described above, it continues to output power supply voltages VCC, VDD, and VDDQ **even when the supply of the alternating current power supply voltage VAC is stopped.**

MTI-1006, [0027]; Petition, 51. Based on my knowledge and experience in this field, a POSITA would have found it obvious that “supply of the direct current power supply potential VDD from the direct current power supply 60 has been stopped” when the module 51 is unplugged from the personal computer or when the personal computer powers off. MTI-1003, ¶¶136, 129-130; MTI-1006, [0038]-[0039], [0022], [0027]-[0028], [0032]; Petition, 51, 45-46. A POSITA would have found it obvious to supply power from a battery when the external power supply is abruptly stopped by unplugging the memory device from the host. MTI-1003, ¶¶129-130. This modification would have beneficially provided a memory apparatus that retains data even when the external power supply is abruptly stopped. MTI-1003, ¶131.

24. Along with its complaint that Tsunoda, Tomio, or Sukegawa lacks disclosure of unplugging a memory apparatus, Sonrai argues that a POSITA would “not be motivated to copy data from the volatile to the non-volatile memory when Tomio’s memory apparatus (or one of Tsunoda’s SDRAM interface embodiments) was unplugged from the computer” because:

A POSITA would not look to Tomio for a portable memory apparatus because of the problems that would be encountered plugging and

unplugging a portable memory apparatus with this many connections. ... A POSITA would have known that unplugging Tomio's memory apparatus would likely corrupt the volatile memory.... A POSITA would have known that unplugging memory without previous notification to the host device would create significant problems and could be catastrophic. ... There would be a loss of data integrity and possible damage to the host or the portable memory apparatus. ... A POSITA would have recognized that the data corruption could result in an unacceptable data loss to the user...

As Dr. Brogioli explains, "[t]he problems inherent in unplugging a memory apparatus with numerous connectors such as Tomio's memory apparatus (or one of Tsunoda's SDRAM interface embodiments) including, e.g., floating electrical signal values, necessary modification of logic and command structure, etc., would have meant that combining Tomio's and Tsunoda's teachings would have required more than combining known prior art elements according to known methods and would not have yielded predictable results." Ex. 2012, ¶68.

POR, 21-22, 38, 40, 43-44, 46.

As Dr. Brogioli explains, "if the memory device in Tsunoda were removed from the host by the user, without a priori knowledge by the host, it would create multiple unacceptable and potentially catastrophic problems. To begin, allowing a device to be removed from the host at a point in time that is random from the host's perspective, precludes the host from being able to perform an orderly set of commands to ensure data and control integrity of the device. Commands and signals cannot be sent back and forth in an orderly manner to ensure proper command

signaling protocol and data integrity, but abruptly removing the device presents an issues whereby the electrical signals at the device interface can be in seemingly random states upon removal. This would have undesirable and potentially electrically damaging effects on the system.” Ex. 2012, ¶66. Furthermore, data integrity of file content in the non-volatile memory cannot be ensured because the device may be in a state of processing a transaction when power is removed. *Id.*

POR, 33. As I explained above, these problems can occur not only “in unplugging a memory apparatus with numerous connectors such as Tomio’s memory apparatus,” but can also occur in unplugging a portable memory apparatus with 7 contact terminals such as Tsunoda’s MMC or with 4 contact terminals such as Tsunoda-Sukegawa’s USB drive. MTI-1032, 1 (“If you remove the [flash drive or memory card] device without first stopping it the information on it can be corrupted.”); MTI-1033, 1 (“To avoid losing data, it’s important to remove external hardware like hard drives and USB drives safely.”). A POSITA facing these alleged problems would have in fact been motivated to include an internal power source in the portable memory apparatus (e.g., Tsunoda’s MMC and Tsunoda-Sukegawa’s USB drive) that continues to supply sufficient power to the portable memory apparatus to allow the portable memory apparatus to complete processing, to retain its data, and to safely turn off after unplugging without previous notification to the host. MTI-1003, ¶¶129-131; Petition, 45-46.

G. Tsunoda-Sukegawa (Ground 2A) renders obvious a portable memory apparatus (elements 1[p], 15[a]) with a volatile memory (elements 1[c] and 15[b])

25. Sonrai argues that “Sukegawa does not disclose, teach or suggest the use of volatile memory in a portable memory apparatus” and that “Tsunoda does not disclose, teach or suggest a memory apparatus with a USB interface.” POR, 27-29. However, the analysis in my First Declaration is based on the combination of Tsunoda and Sukegawa. MTI-1003, ¶¶95-109. As I explained in my First Declaration, Tsunoda discloses a MMC 1401 having a SDRAM where “connection with the host 1408 is not made through the SDRAM interface 112, but only through the MMC interface 1407.” MTI-1003, ¶74; Petition, 22; MTI-1004, [0121]. I further explained that, in the Tsunoda-Sukegawa Combination, the host accesses the data in the SDRAM through the USB interface in a similar manner as the MMC interface. MTI-1003, ¶109; Petition, 38.

26. Sonrai argues that:

Tsunoda’s discussion of other interfaces, such as a DDRSRAM (double data rate SDRAM) interface, suggest a higher speed interface, not a slower interface. *See* Ex. 1004 [0094]. Tsunoda explicitly discloses using an SD card interface with the SDRAM interface or a memory stick interface with the SDRAM interface, but notably does not disclose using a USB interface in any capacity. *Id.*, [0117]-[0119]; Ex. 2012, ¶59.

In fact, none of the prior art identified by Petitioner discloses a

volatile memory apparatus with a USB interface, let alone a portable memory apparatus with high-speed memory like synchronous DRAM. A POSITA would have known that a USB interface is not an SDRAM interface. A POSITA would have known that a USB interface is not an MMC interface. A POSITA would have further understood that a USB interface is not an SDRAM-compatible interface. Ex. 2012, ¶¶60-63.

A POSITA would not have combined the teachings of Tsunoda and Sukegawa. Ex. 2012, ¶59. A POSITA would not have been motivated to use a USB interface with Tsunoda's memory apparatus. *Id.*, ¶¶59-62. In view of the differences between an MMC interface and a USB interface, a POSITA would not have considered using a USB interface with Tsunoda's memory apparatus as simply the predictable result of combining known prior art elements according to known methods. *Id.* The Petition does not discuss how this would have been done, and Tsunoda's omission of any disclosure or suggestion of a USB interface is telling. Modifying Tsunoda's memory apparatus with a USB interface would not have been within the level of a POSITA without undue experimentation. *Id.*, ¶62.

A POSITA would also have known that Tsunoda's teachings of additional components were incompatible with Sukegawa's teachings of a minimally sized flash drive that should be small enough to fit in a USB connector shield. *Id.*, ¶37.

POR, 29-30. Based on my knowledge and experience in this field, Sonrai's alleged design challenges and tradeoffs premised on differences between interfaces do not undermine a POSITA's motivation to combine Tsunoda and Sukegawa.

Sukegawa's USB interface is a suitable option for connecting Tsunoda's MMC to a host.

27. Indeed, Sukegawa's teachings alone are sufficient to establish the suitability of a USB interface in the context of Tsunoda. Sukegawa explicitly states that the USB 2.0 standard provides "bandwidth for multimedia and storage applications" and "has a raw data rate at 480 Mbps." MTI-1005, 1:25-35. By comparison, the MMC interface at the time provided a maximum data rate up to 52 Mbps, which is much slower than the USB 2.0 interface. MTI-1030, 6; MTI-1031, 10. Further, a USB interface for connecting MMC cards to a host came into existence almost immediately after the USB and MMC standards were available in the marketplace, attesting to their complementary and compatible nature and the obviousness of modifying Tsunoda's MMC card to include a USB interface. For example, U.S. Patent No. 6,438,638 to Jones describes a MMC card reader that connects to a host through a USB interface. MTI-1040, 8:24-61, FIG. 6. The POSITA would have resolved Sonrai's concern regarding compatibility of Sukegawa's USB interface with Tsunoda's SDRAM using a POSITA's general knowledge and creativity. For example, a POSITA would have found obvious an implementation that would include a USB 2.0 interface control unit that, like Tsunoda's MMC interface control unit in the MMC, allows communication of data between the SDRAM and host through the USB 2.0 interface. *See, e.g.,* MTI-

1005, 5:38-65 (“...For example, the protocol engine 250 facilitates with any serial to parallel conversion...”); MTI-1040, 8:24-61 (“Converter chip 40 generates the appropriate USB-interface signals to transfer the data [from the MMC] to host PC 20”).

28. Sonrai additionally argues that:

A POSITA would also have known that Tsunoda’s teachings of additional components were incompatible with Sukegawa’s teachings of a minimally sized flash drive that should be small enough to fit in a USB connector shield. *Id.*, ¶37.

POR, 28, 30. Sonrai’s argument that the size, shape, and components of Sukegawa’s USB drive would be incompatible with Tsunoda’s components does not preclude a motivation to combine Tsunoda and Sukegawa, as I did not propose a physical combination without modifications. As I stated in my First Declaration:

Based on my knowledge and experience in this field and my review of Tsunoda and Sukegawa, a POSITA would have found it obvious to implement, in Tsunoda-Sukegawa’s USB flash drive, the memory control unit (memory controller [chip]), the SDRAM (volatile memory), and the flash memory (non-volatile memory) as one, two, or three modules that are mounted within the housing formed by the USB connector shield case 120, overmold boot, and end cap 110 to provide a very small, inexpensive, portable and removable storage media. MTI-1005, 4:44-66, 5:20-24, 5:29-37, 7:6-18, 7:26-37, 8:6-9:31, FIGS. 5A-5H. Based on my knowledge and experience in this field, a **POSITA**

would have been capable of employing ordinary creativity to carry out an implementation of the USB flash drive with the memory control unit (memory controller [chip]), the SDRAM (volatile memory), and the flash memory (non-volatile memory) mounted within the housing in a manner necessary to achieve the advantages taught by Sukegawa by, for example, varying the size and shape of the housing to accommodate the electronic components, as corroborated by other publications illustrating USB flash drives in varying shapes and sizes. *Id.*; *see, e.g.*, MTI-1013; MTI-1017; MTI-1018; MTI-1019; MTI-1020.

MTI-1003, ¶106; Petition, 35.

H. Tomio-Sukegawa renders obvious a portable memory apparatus (elements 1[p], 15[a]) with a volatile memory (elements 1[c] and 15[b])

29. Sonrai argues that “Tomio is directed to a non-portable memory” and “Sukegawa does not disclose, teach or suggest the use of volatile memory in a portable memory apparatus.” POR, 42-44. However, the analysis in my First Declaration is based on the combination of Tomio and Sukegawa providing a memory apparatus with a volatile memory and a USB interface. MTI-1003, ¶¶173-190; Petition, 68-82.

30. Sonrai further argues that:

Sukegawa teaches minimizing the size of a USB drive with NAND flash memory. Ex. 1005, 2:27-30 (“an improved USB flash drive that is reduced in size [and] is less expensive ...”). Sukegawa teaches a

USB flash drive where “the number of parts within the USB flash drive is reduced and the physical size of the drive can be drastically reduced such that all or a majority of the apparatus’ circuitry is incorporated within the USB connector shield case.” *Id.*, 4:39-43. Sukegawa teaches that the flash drive should be small enough to be “mounted within the USB connector shield case.” *Id.*, 4:35-36.

Furthermore, as Dr. Brogioli explains, “the shortened data transfer time Tomio teaches for volatile versus non-volatile memory would be nullified by a USB interface.” *Id.*, ¶75. Even with the “high data transmission speed (12 mb/sec)” identified by Petitioner, Paper 2, Pet. at 70, the USB transmission rate would be slower than the flash memory access rate. *Id.* A POSITA would not be motivated to add the complexity of a DRAM, including DRAM controller functionality, to a USB flash drive. Ex. 2021, ¶75-77.

A POSITA would not have found it obvious to use Tomio’s combination memory with a USB connector in a portable memory apparatus. *Id.*, ¶76. None of the prior art identified by Petitioner discloses DRAM with a USB connector and implementing it would not have been the predictable result of combining known prior art elements according to known methods for the reasons discussed above. Resolving the data corruption and loss issues would not have been within the level of skill of a POSITA, even with undue experimentation.

POR, 44-45. Based on my knowledge and experience in this field, Sonrai’s alleged design challenges and tradeoffs premised on size, number of components, and transfer speeds do not undermine a POSITA’s motivation to combine Tomio

and Sukegawa. And for similar reasons as discussed above in Sections II.D and II.F, the alleged “data corruption and loss issues” would not have undermined the motivation to combine Tomio and Sukegawa. POR, 45.

31. Sonrai’s argument that the size, shape, and components of Sukegawa’s USB drive would be incompatible with Tomio’s components does not preclude a motivation to combine Tomio and Sukegawa, as I did not propose a physical combination without modifications. As I stated in my First Declaration:

Based on my knowledge and experience in this field and my review of Tomio and Sukegawa, a POSITA would have found it obvious to implement, in Tomio-Sukegawa’s USB flash drive, the memory control unit (memory controller [chip]), the SDRAM (volatile memory), and the flash memory (non-volatile memory) as one, two, or three modules that are mounted within the housing formed by the USB connector shield case 120, overmold boot, and end cap 110 to provide a very small, inexpensive, portable and removable storage media. *Id.* Based on my knowledge and experience in this field, **a POSITA would have been capable of employing ordinary creativity to carry out an implementation of the USB flash drive** with the memory control unit (memory controller [chip]), the SDRAM (volatile memory), and the flash memory (non-volatile memory) mounted within the housing **in a manner necessary to achieve the advantages taught by Sukegawa by, for example, varying the size and shape of the housing to accommodate the electronic components**, as corroborated by other publications illustrating USB flash drives in varying shapes and sizes.

Id.; *see, e.g.*, MTI-1013; MTI-1017; MTI-1018; MTI-1019; MTI-1020.

MTI-1003, ¶187; Petition, 76.

32. Sukegawa's USB interface is a suitable option for connecting Tomio's memory apparatus to a host. Sukegawa's teachings alone are sufficient to establish the suitability of a USB interface in the context of Tomio. Sukegawa makes clear that the USB 2.0 standard provides "bandwidth for multimedia and storage applications" and "has a raw data rate at 480 Mbps... 40 times faster than its predecessor interface, USB 1.1., which tops at 12 Mbps." MTI-1005, 1:25-35. Contrary to Dr. Brogioli's contentions (POR, 45; EX2012, ¶75), this 480 Mbps USB 2.0 transmission rate is faster than the flash memory access rate, which for examples of flash memory around the time of the '527 patent, and even now, is at most 62 Mbps. MTI-1035, 5; MTI-1036, 1; MTI-1037, 3.

I. Shigeo is analogous art to the '527 patent (Grounds 1C, 2C, 3B, 4B)

33. Other than the arguments I already addressed above, Sonrai's only additional argument is that:

Shigeo discloses an information processing device, such as a mobile information terminal, that is driven by a battery or dry cell (e.g., flashlight battery). Ex. 1007, [0001]. Shigeo's information processing device is not a memory apparatus, let alone a portable memory apparatus with a connector. *See Id.*, Fig. 10, [0078] ("Fig. 10 is a diagram showing the exterior of a mobile information device that is a

computer operating on battery power. In this figure, 701 is the main case that houses the CPU 104, ROM 106, RAM 107, nonvolatile RAM 103, display driver 108, and input device 110, etc.”). ... Shigeo’s information processing device includes a CPU and a power supply detecting device that periodically checks the power supply voltage and, depending on the power supply voltage detected, can interrupt the CPU or set a CPU-readable register value. Ex. 1007, [0059]. Thus, as Dr. Brogioli determined “[a] POSITA would have recognized that **Shigeo’s teachings regarding an information processing device are neither analogous to or applicable to a portable memory apparatus.**” Ex. 2012, ¶57.

POR, 25-27, 34, 41-42, 46-48. I disagree that Shigeo is not analogous art. Shigeo is at least reasonably pertinent to the particular problem with which the invention is involved, i.e., the invention of claims 13 and 20 of the ’527 patent. The ’527 patent “relates generally to computer storage mediums.” MTI-1001, 1:7-9.

Similarly, Shigeo discloses that it “also relates to an information storage method and a storage medium.” MTI-1007, [0001]. Indeed, Shigeo addresses the same problems as claims 13 and 20, that if the external power supply is abruptly stopped and the battery is not sufficiently charged and does not have enough power to power the RAM and the flash memory for the writing of data to the flash memory, the data stored in the RAM would be lost. Petition, 87; MTI-1003, ¶¶219-221. A POSITA considering technical problems involving minimization of data loss in low battery conditions would have considered art like Shigeo.

III. ADDITIONAL REMARKS

I currently hold the opinions set expressed in this declaration. But my analysis may continue, and I may acquire additional information and/or attain supplemental insights that may result in added observations.

I hereby declare that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I further declare that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of the Title 18 of the United States Code.

Dated: June 12, 2024

By: 

David Kuan-Yu Liu, Ph.D.