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Paper 25
Date: July 10, 2024

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

LG ELECTRONICS, INC.,
Petitioner,

v.

CONSTELLATION DESIGNS, LLC,
Patent Owner.

IPR2023-00319
Patent 10,693,700 B1

Before BRENT M. DOUGAL, MICHAEL T. CYGAN, and SCOTT RAEVSKY *Administrative Patent Judges.*

DOUGAL, *Administrative Patent Judge.*

JUDGMENT
Final Written Decision
Determining No Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

A. Background and Summary

Petitioner, LG Electronics Inc., filed a Petition to institute an *inter partes* review challenging the patentability of claims 5, 15, and 25[1] (the "challenged claims") of U.S. Patent 10,693,700 B1 (Ex. 1001, "the '700 patent"). Paper 3 ("Petition" or "Pet."). Patent Owner, Constellation Designs, LLC, filed a Preliminary Response. Paper 7. Applying the standard set forth in 35 U.S.C. § 314(a), we instituted *inter partes* review. Paper 10.

Patent Owner filed a Response (Paper 12, "PO Resp."), Petitioner filed a Reply (Paper 13, "Reply"), Patent Owner filed a Sur-reply (Paper 14, "PO Sur-reply"), and Petitioner filed a Sur-sur-reply (Paper 20, "Pet. Sur-reply")[2]. An oral hearing was held on April 17, 2024, and a copy of the transcript is in the record. Paper 24 ("Tr.").

We have jurisdiction under 35 U.S.C. § 6. This Decision is a Final Written Decision under 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73 as to the patentability of the claims on which we instituted trial. Having reviewed the arguments of the parties and the supporting evidence, we determine that Petitioner has not shown by a preponderance of the evidence that the challenged claims are unpatentable.

B. Related Matters

The parties identify the following related district court litigation: *Constellation Designs, LLC v. LG Electronics Inc. et al.*, No. 2:21-cv-00448 (E.D. Tex.). Pet. 81; Paper 5, 1. Patent Owner also identifies the following

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[1] Claims 2, 3, 12, 13, 22, and 23, though challenged by Petitioner, were disclaimed by Patent Owner after trial was instituted. Ex. 2024.
[2] The Petitioner Sur-reply was authorized in view of our authorization for Patent Owner to file declarant testimony with the Patent Owner Sur-reply.

related *inter partes* reviews: IPR2022-01482, IPR2022-01549, IPR2023-00228, IPR2023-00229, and IPR2023-00320. Paper 5, 1–2.

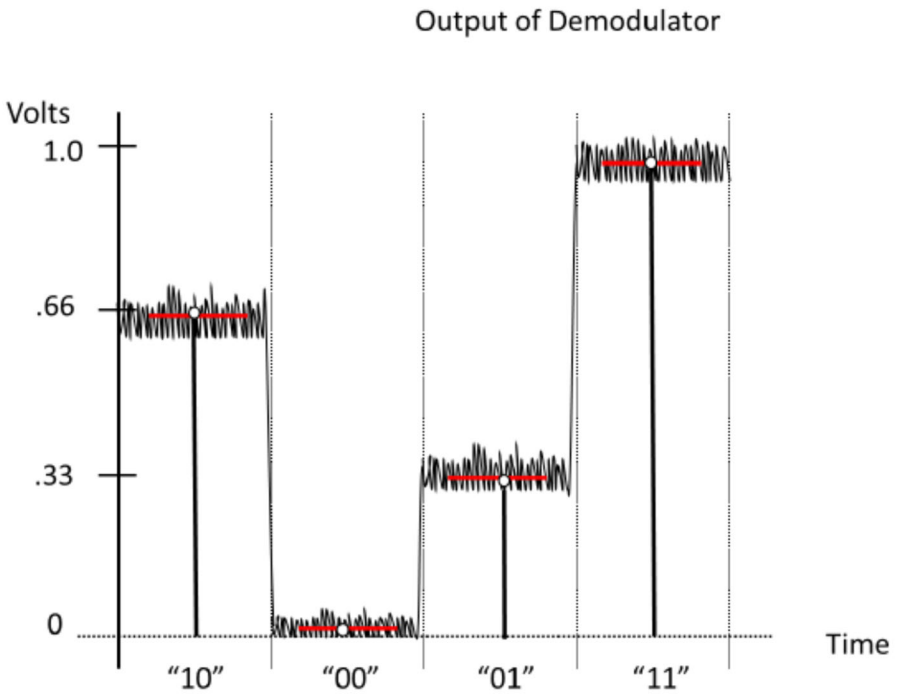
C. The '700 Patent

The '700 patent is directed to digital communication or transmission systems with "unequally spaced constellations." Ex. 1001, 1:38–44. As background to the technology, "[a] digital communication system is used to transmit digital bits (sequences of 0s and 1s) from one device (a transmitter) to another (a receiver)." Ex. 2001 ¶ 12. Each digital communication system has a measurable "capacity," which is the maximum amount of information that the system can reliably send over the channel. *Id.* ¶ 15. The transmitter maps each new bit sequence to constellation points. *Id.* ¶¶ 15, 18. "[A] 'constellation' point is a carrier signal value (such as amplitude and/or phase) that can be used to represent a longer sequence of bits." *Id.* ¶ 12. The receiver in turn attempts to detect symbols that were received, from the transmitter, by mapping a received signal to a constellation. Ex. 1001, 1:44–46. The minimum distance (d_{min}) between constellation points at high signal-to-noise ratios (SNRs) correlates to the capacity of the constellation, and accordingly, many communication systems aim to maximize this value in order to maximize capacity of the system. Ex. 2001 ¶¶ 46–54. This is to decrease the risk that the noise in the signal makes the signal unreadable, i.e., decreases the risk that the system is unable to determine which signal value was intended between two adjacent signal values.

As a simple illustration, Patent Owner's declarant, Dr. Giuseppe Caire, provides the following example of a one-dimensional constellation, with bit values (constellation label) and signal amplitude values (constellation location):

Constellation Label	Constellation Location
"00"	0
"01"	.33
"10"	.66
"11"	1.0

Ex. 2001 ¶ 30. An output based on this constellation, and including an illustration of signal noise, is reproduced below.



Id. ¶ 33. The above figure, provided by Dr. Caire, is a graph of the signal amplitude, in volts, over time. As can be seen above, "a time-dependent continuous waveform is shown in black including noise, the average of the time-dependent continuous waveform is shown in red, the output of the demodulator is shown as discrete time values in black, and the figure is again annotated with the corresponding bit sequence." *Id.* Thus, it can be seen how each bit value (constellation label) corresponds to the signal amplitude value (constellation location) in wave form. The receiver, with

information about the constellation, is thus able to determine the bit values communicated from the transmitter.

As mentioned, the '700 patent is directed to digital communication systems with "unequally spaced constellations." Ex. 1001, 1:38–44. Rather than focusing on maintaining a minimum distance (d_{min}) between the signal values of the constellation, the '700 patent attempts to provide "direct optimization of the constellation points of a communication system utilizing a capacity approaching channel code, [that] can yield different constellations depending on the SNR for which they are optimized" *Id.* at 5:11–16. The '700 patent explains that "capacity optimized constellation at low SNRs are geometrically shaped constellations that can achieve significantly higher performance gains (measured as reduction in minimum required SNR) than constellations that maximize d_{min}." *Id.* at 8:24–29. The '700 patent provides that "a constellation at one code rate can achieve gains that cannot be achieved at another code rate." *Id* at 5:20–21. Dr. Caire provides one example of "a constellation optimized for a code rate of 1/2 provides gains when with a code rate of 1/2, but may not provide the same gains at other code rates, such as 2/3 code rate." Ex. 2001 ¶ 60. Thus, "[i]nstead, when using a code rate of 2/3, a different constellation may be used – a constellation optimized for use at 2/3 code rate." *Id.*

"Capacity measures that can be used in the selection of the location of constellation points include . . . parallel decode (PD) capacity and joint capacity." Ex. 1001, 5:6–8. The "PD capacity of a channel can be viewed in terms of the mutual information between the output bits of the encoder (such as an LDPC encoder) at the transmitter and the likelihoods computed by the demapper at the receiver," and it is "influenced by both the placement of

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