

Exhibit HH
Claim Chart for U.S. Patent No. 10,680,167 and Western Digital

On information and belief, Western Digital Corporation and Western Digital Technologies, Inc. (collectively, “Western Digital” or “WD”) Accused Products, including their hard disk drives (“HDDs”), infringe U.S. Patent No. 10,680,167.

US 10,680,167	Exemplary Western Digital Infringement
1. A method of manufacturing a magnetic tunnel junction (MTJ) device, comprising:	If the preamble is limiting, each of WD’s hard disk drives (the “WD Accused Products”) includes a tunneling magnetoresistive (Tunneling MR) read head sensor, which is a magnetic tunnel junction (MTJ) device as claimed. WD manufactures “substantially all of the recording heads [] required for our products,”¹ and therefore engages in a method of manufacturing a magnetic tunnel junction (MTJ) device as claimed (hereinafter, “WD Process”). <i>See, e.g.,</i> Terris presentation (Western Digital presentation):²

¹ 2023 10-K, available at <https://investor.wdc.com/static-files/9468af6f-967f-4709-bcaf-c0e9510264dd>, at 8.

² Bruce D Terris, “Magnetic Recording and Magnetic Memory,” presentation at IEEE Magnetism Society Summer School, Virginia Commonwealth University, June 5, 2019, (Copy accessible at <https://egr.vcu.edu/media/engineering/documents/mne/TerrisSummerSchool2019fordistribution.pdf>)

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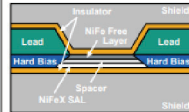
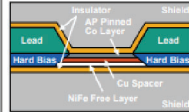
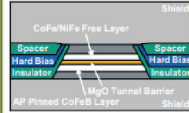
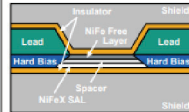
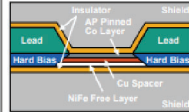
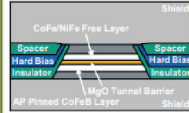
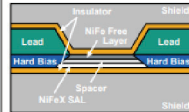
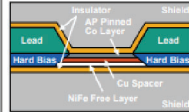
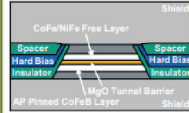
US 10,680,167	Exemplary Western Digital Infringement																																				
	Read Head Sensor Technologies <table><tr><th>Year</th><th>1st Density (Gb/in²)</th><th>Sensor Technology</th><th>Structure</th><th>MR Effect</th><th>Sense Current Geometry</th></tr><tr><td>1979</td><td>0.01 Gb/in²</td><td>Thin-film Inductive</td><td></td><td>N/A</td><td>N/A</td></tr><tr><td>1991</td><td>0.1 Gb/in²</td><td>MR Sensor</td><td></td><td>Anisotropic MR</td><td>CIP</td></tr><tr><td>1997</td><td>2 Gb/in²</td><td>Spin Valve</td><td></td><td>Giant MR</td><td>CIP</td></tr><tr><td>2006</td><td>100 Gb/in²</td><td>Tunnel Valve</td><td></td><td>Tunneling MR</td><td>CPP</td></tr><tr><td>?</td><td>>1Tb/in²</td><td>?</td><td>?</td><td>?</td><td>?</td></tr></table> Western Digital. ©2016 Western Digital Corporation or affiliates. All rights reserved.	Year	1 st Density (Gb/in ²)	Sensor Technology	Structure	MR Effect	Sense Current Geometry	1979	0.01 Gb/in ²	Thin-film Inductive		N/A	N/A	1991	0.1 Gb/in ²	MR Sensor		Anisotropic MR	CIP	1997	2 Gb/in ²	Spin Valve		Giant MR	CIP	2006	100 Gb/in ²	Tunnel Valve		Tunneling MR	CPP	?	>1Tb/in ²	?	?	?	?
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?	>1Tb/in ²	?	?	?	?																																
	A WD patent filed in 2020 and issued in 2022 (U.S. Patent No. 11,283,006, the “’006 Patent”) also describes a “magnetoresistive device [that] includes a read head,” “[t]he read head is a tunneling magnetoresistive reader,” and “an MgO barrier in the sputtered magnetic tunnel junctions.” ’006 Patent, Abstract; 7:56-57. The ’006 Patent lists Zheng Gao as an inventor, who according to LinkedIn is presently Global Director for a “joint Dev and MFG team thin film sensor wafer process” at HGST, a WD company.																																				

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	Zheng Gao · 2nd Director at HGST, a Western Digital company San Jose, California, United States · Contact info Experience  HGST, a Western Digital brand 15 yrs 2 mos Global Director Jan 2016 - Present · 8 yrs 2 mos San Jose, CA Joint Dev and MFG Team Thin Film Sensor Wafer Process As another example, a WD patent (U.S. Patent No. 8,914,970, the “’970 Patent”) explains in its “[b]ackground of the Invention” that “[o]ne type of conventional current-perpendicular-to-the-plane (CPP) magnetoresistive sensor used as the read head in magnetic recording disk drives is a <i>magnetic tunnel junction</i> sensor, also called a tunneling MR or TMR sensor,” and claims a “method for making a tunneling magnetoresistive sensor.” ‘970 Patent, Title; claim 1; 1:13-17.
forming a first CoFeB layer that is amorphous;	On information and belief, the WD Process includes forming a first CoFeB layer that is amorphous. The WD Accused Products comprise a first CoFeB layer that is amorphous. For example, a 2013 presentation by a member of HGST’s Read Head Development team describes a “Thin Film Read Magnetic Sensor” with the following structure comprising a MgO layer between ferromagnetic layers including two Co₆₀Fe₂₀B₂₀ (namely, “CoFeB”) layers.³ The lower CoFeB layer is a first CoFeB layer. HGST was acquired as a subsidiary of WD in 2012, and since 2018 WD has transitioned away from hard disk drive products using the HGST brand into the WD branding.⁴ The

³ https://nccavs-usergroups.avs.org/wp-content/uploads/PAG2013/2013_4gao.pdf at 12.

⁴ <https://www.guru3d.com/story/western-digital-moves-away-from-the-hgst-branding>.

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US 10,680,167	Exemplary Western Digital Infringement
	same presentation cites Dr. Yuasa's 2004 publication in a slide titled "TMR Barrier from Year 2004."⁵ Stack configuration Anneal: 360 °C, 2 h, 1 WD's patents have described forming a CoFeB layer that is amorphous, before using an anneal to crystallize the CoFeB layer. For example, a WD patent (U.S. Patent No. 8,427,791, the "'791 Patent") describes that "[g]enerally, <i>these adjacent layers are amorphous magnetic layers, such as CoFeB</i> and the like. In order to obtain a high MR ratio in amorphous CoFeB/crystalline MgO/amorphous CoFeB MTJs, an annealing step is necessary in order to produce crystallized bcc CoFeB (100)/MgO(100)/crystallized bcc CoFeB (100)." '791 Patent, 1:39-44. In another WD patent (U.S. Patent No. 7,751,156, the "'156 Patent), it is described that "when MgO barrier layer 717 is deposited on <i>the amorphous CoFeB pinned layer</i> 716, it spontaneously grows

⁵ See *supra*, footnote 3 at 10.

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US 10,680,167	Exemplary Western Digital Infringement
	with a very strong 100 crystallographic orientation. During anneal, the CoFeB immediately contacting the MgO barrier layer 717 crystallizes thus forming the desired CoFeX/MgO/CoFeX structure, and gives rise to very large TMR coefficients.” ‘156 Patent, 7:34-40.
forming a magnesium oxide (MgO) layer over the first CoFeB layer;	The WD Process includes forming a magnesium oxide (MgO) layer over the first CoFeB layer. The WD Products comprise a magnesium oxide (MgO) layer over the first CoFeB layer. For example, the 2013 presentation by HGST describes a “Thin Film Read Magnetic Sensor” with the following structure comprising a MgO layer over a CoFeB layer.⁶ Stack configuration Anneal: 360 °C, 2 h, 1 WD’s patents have described forming a magnesium oxide (MgO) layer over the first CoFeB layer. For example, WD’s ‘156 Patent describes that “when <i>MgO barrier layer 717 is deposited on the amorphous CoFeB pinned layer 716.</i>” ‘156 Patent, 7:34-40.

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	<i>See also</i> WD's '970 Patent, which claims in claim 1: "1. A method for making a tunneling magnetoresistive sensor comprising: providing a substrate; <i>depositing</i> a first ferromagnetic layer on the substrate, <i>a MgO spacer layer on the first ferromagnetic layer</i>, a second ferromagnetic layer on the MgO spacer layer."
forming a second CoFeB layer that is amorphous over the MgO layer; and	On information and belief, the WD Process includes forming a second CoFeB layer that is amorphous over the MgO layer. The WD Accused Products comprise a second CoFeB layer that is amorphous over the MgO layer. For example, the 2013 presentation by HGST describes a "Thin Film Read Magnetic Sensor" with the following structure comprising an upper CoFeB layer (i.e. second CoFeB layer) over the MgO layer.⁷

⁷ *See supra*, footnote 3.

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	Top electrode $\text{Co}_{60}\text{Fe}_{20}\text{B}_{20}$ (3 nm) Co ferrite (x nm) MgO (1.2 nm) $\text{Co}_{60}\text{Fe}_{20}\text{B}_{20}$ (3 nm) Ru (0.9 nm) $\text{Co}_{70}\text{Fe}_{30}$ (2.5 nm) IrMn (7 nm) Ru (5 nm) Bottom electrode Thermally oxide Si wafer Stack configuration Anneal: 360 °C, 2 h, 1 WD's patents have described forming a CoFeB layer that is amorphous, before using an anneal to crystallize the CoFeB layer. For example, a WD patent (U.S. Patent No. 8,427,791, the "'791 Patent") describes that "[g]enerally, <i>these adjacent layers are amorphous magnetic layers, such as CoFeB</i> and the like. In order to obtain a high MR ratio in amorphous CoFeB/crystalline MgO/amorphous CoFeB MTJs, an annealing step is necessary in order to produce crystallized bcc CoFeB (100)/MgO(100)/crystallized bcc CoFeB (100)." '791 Patent, 1:39-44. In another WD patent (U.S. Patent No. 7,751,156, the "'156 Patent), it is described that "when MgO barrier layer 717 is deposited on <i>the amorphous CoFeB pinned layer</i> 716, it spontaneously grows with a very strong 100 crystallographic orientation. During anneal, the CoFeB immediately contacting the MgO barrier layer 717 crystallizes thus forming the desired CoFeX/MgO/CoFeX structure, and gives rise to very large TMR coefficients." '156 Patent, 7:34-40.

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US 10,680,167	Exemplary Western Digital Infringement
annealing the first and second CoFeB layers and the MgO layer,	On information and belief, the WD Process includes annealing the first and second CoFeB layers and the MgO layer. For example, the 2013 presentation by HGST indicates that the two Co₆₀Fe₂₀B₂₀ layers (namely, the first and second ferromagnetic material layers) and the MgO layer have undergone anneal.⁸ Stack configuration Anneal: 360 °C, 2 h, 1 WD's patents also describe annealing the first and second CoFeB layers and the MgO layer. For example, WD's '791 Patent describes that "[g]enerally, these adjacent layers are amorphous magnetic layers, such as CoFeB and the like. In order to obtain a high MR ratio in amorphous CoFeB/crystalline MgO/amorphous CoFeB MTJs, <i>an annealing step</i> is necessary in order to produce crystallized bcc CoFeB (100)/MgO(100)/crystallized bcc CoFeB (100)." '791 Patent, 1:39-44. As another example, WD's '156 Patent describes that "when MgO barrier layer 717 is deposited on the amorphous CoFeB pinned layer 716, it spontaneously grows with a very strong 100

⁸ See *supra*, footnote 3 at 12.

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	crystallographic orientation. <i>During anneal</i>, the CoFeB immediately contacting the MgO barrier layer 717 crystallizes thus forming the desired CoFeX/MgO/CoFeX structure, and gives rise to very large TMR coefficients.” ‘156 Patent, 7:34-40.
wherein the first and second CoFeB layers are crystallized by the annealing, and	On information and belief, in the WD Process, the first and second CoFeB layers are crystallized by the annealing. For example, WD’s ‘791 Patent describes that “[g]enerally, these adjacent layers are amorphous magnetic layers, such as CoFeB and the like. In order to obtain a high MR ratio in amorphous CoFeB/crystalline MgO/amorphous CoFeB MTJs, <i>an annealing step is necessary in order to produce crystallized bcc CoFeB (100)/MgO(100)/crystallized bcc CoFeB (100).</i>” ‘791 Patent, 1:39-44. As another example, WD’s ‘156 Patent describes that “when MgO barrier layer 717 is deposited on the amorphous CoFeB pinned layer 716, it spontaneously grows with a very strong 100 crystallographic orientation. <i>During anneal, the CoFeB immediately contacting the MgO barrier layer 717 crystallizes</i> thus forming the desired CoFeX/MgO/CoFeX structure, and gives rise to very large TMR coefficients.” ‘156 Patent, 7:34-40.
wherein the MgO layer is poly-crystalline in which a (001) crystal plane is preferentially oriented.	On information and belief, in the WD Process, the MgO layer is poly-crystalline in which a (001) crystal plane is preferentially oriented. For example, a WD patent filed in 2020 and issued in 2022 (U.S. Patent No. 11,283,006, the “’006 Patent”) describes a barrier layer 420 in FIG. 4B as “MgO with (001) crystalline texture.” ’006 Patent, 10:7-13. Furthermore, WD’s ‘791 Patent describes “an annealing step is necessary in order to produce crystallized bcc CoFeB (100)/<i>MgO(100)</i>/crystallized bcc CoFeB (100).” ‘791 Patent, 1:39-44.