

Exhibit FF
Claim Chart for U.S. Patent No. 9,608,198 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. 9,608,198.

US 9,608,198	Exemplary Western Digital Infringement
1. A tunnel barrier layer disposed between a first ferromagnetic material layer and a second ferromagnetic material layer that are disposed over a substrate,	If the preamble is limiting, each of WD’s hard disk drives (the “WD Accused Products”) includes a tunnel barrier layer disposed between a first ferromagnetic material layer and a second ferromagnetic material layer that are disposed over a substrate. 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 disposed between ferromagnetic layers including two Co₆₀Fe₂₀B₂₀ (“CoFeB”) layers.¹ The CoFeB layers are ferromagnetic material layers and include a first ferromagnetic material layer and a second ferromagnetic material layer that are disposed over a substrate (“Thermally oxide Si wafe[r]”). 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.² The same presentation cites Dr. Yuasa’s 2004 publication in a slide titled “TMR Barrier from Year 2004.”³

¹ https://nccavs-usergroups.avs.org/wp-content/uploads/PAG2013/2013_4gao.pdf at 12.

² <https://www.guru3d.com/story/western-digital-moves-away-from-the-hgst-branding>.

³ See *supra*, footnote 3 at 10.

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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 wafe Stack configuration Anneal: 360 °C, 2 h, 1 The MgO layer in the Thin Film Read Magnetic Sensor is a tunnel barrier layer. <i>See e.g.</i> Terris presentation (Western Digital presentation):⁴

⁴ Bruce D Terris, “Magnetic Recording and Magnetic Memory,” presentation at IEEE Magnetics 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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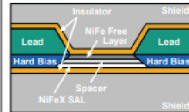
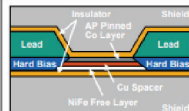
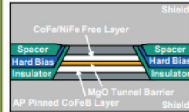
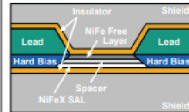
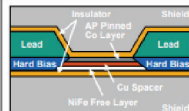
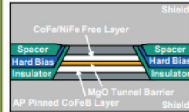
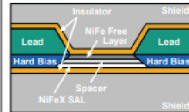
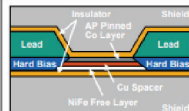
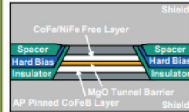
US 9,608,198	Exemplary Western Digital Infringement																																				
	Read Head Sensor Technologies <table><tr><th>Year</th><th>1st Density (Gb/in²)</th><th>Sensor Technology</th><th>Structure</th><th>MR Effect</th><th>Sense Current Geometry</th></tr><tr><td>1979</td><td>0.01 Gb/in²</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>	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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	As another example, a WD patent (U.S. Patent No. 8,914,970, the “’970 Patent”) titled “method for making a tunneling magnetoresistive (TMR) sensor” claims the following: “1. A method for making a tunneling magnetoresistive sensor comprising: providing a substrate; depositing a first ferromagnetic layer on the substrate, a MgO spacer layer on the first ferromagnetic layer, a second ferromagnetic layer on the MgO spacer layer.” ’970 Patent, claim 1. The ’970 Patent further describes that “[t]he AP1 and AP2 layers, as well as the free ferromagnetic layer 110, are typically formed of <i>crystalline CoFeB</i>.” Id., 4:27-29.
wherein the tunnel barrier layer comprises a poly-crystalline magnesium oxide layer in which a (001) crystal plane is preferentially oriented,	On information and belief, the tunnel barrier in the WD Accused Products comprises a poly-crystalline magnesium oxide layer 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”) illustrates a barrier layer 420 in FIG. 4B that is described as including “MgO with (001) crystalline texture.” ’006 Patent, 10:7-13.
wherein the first ferromagnetic material layer is composed of an	On information and belief, the first ferromagnetic material layer in the WD Accused Products is composed of an Fe—Co alloy of BCC which alloy comprises Fe, Co, and B.

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Fe—Co alloy of BCC which alloy comprises Fe, Co, and B,	For example, a WD patent (U.S. Patent No. 8,914,970, the “’970 Patent”) titled “method for making a tunneling magnetoresistive (TMR) sensor” describes that “[t]he AP1 and AP2 layers, as well as the free ferromagnetic layer 110, are typically formed of <i>crystalline CoFeB</i>.” ’970 Patent, 4:27-29. Another WD patent (U.S. Patent No. 8,427,791, the “’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, an annealing step is necessary in order to produce <i>crystallized bcc CoFeB</i> (100)/MgO(100)/<i>crystallized bcc CoFeB</i> (100).” ’791 Patent, 1:39-44. As another example, 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 the amorphous CoFeB pinned layer 716, it spontaneously grows with a very strong 100 crystallographic orientation. During anneal, <i>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 first ferromagnetic material layer is located between the tunnel barrier layer and the substrate.	The first ferromagnetic material layer in WD Accused Products is located between the tunnel barrier layer and the substrate. For example, the 2013 presentation illustrates a Co₆₀Fe₂₀B₂₀ (“CoFeB”) layer located between the MgO tunnel barrier layer and the substrate (“Thermally oxide Si wafe[r]”).⁵

⁵ https://nccavs-usergroups.avs.org/wp-content/uploads/PAG2013/2013_4gao.pdf at 12.

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