Western Digital Corporation

Patent Portfolio Analysis

September 2019

Introduction

Western Digital Corporation (abbreviated WDC, commonly known as Western Digital and WD) is an American computer hard disk drive manufacturer and data storage company. It designs, manufactures and sells data technology products, including storage devices, data centre systems and cloud storage services. Western Digital has a long history in the electronics industry as an integrated circuit maker and a storage products company. It is also one of the larger computer hard disk drive manufacturers, along with its primary competitor Seagate Technology.[1]

In this report we take a look at Western Digital's patent assets. For the report, we have analyzed a total of 20,025 currently active published patent applications in the Western Digital portfolio. Unless otherwise stated, the report displays numbers for published patent applications that are in force. The analytics are presented in the various charts and tables that follow. These include the following,

- Portfolio Summary
- Published Applications – Growth
- Key Geographies
- Top Forward Citing (FC) Assignees
- Technologies cited by the FC Assignees
- Evolution of the Top Sub-Technologies
- Top CPC codes
- Top technologies covered by the high-quality patents
- Granular Sub-technologies
- Competitor Comparison
- Portfolio Taxonomy

Insights

- There is a steady upward trend in the year-wise number of published applications from 2007 onwards. There's a decline in growth in 2017 that again surges in 2018.
- The home jurisdiction of US is the favored filing destination for Western Digital and accounts for more than half of its published applications. The other significant jurisdictions where Western Digital has sought patent coverage includes China, Japan and the European Patent Office.
- Digital interface arrangements, testing and repairing memories, reading and writing of data to a memory are some of the main technology areas growing in Western Digital's patent portfolio.
- Western Digital's high-quality patents cover technology areas such as EPROM, magnetic record carriers, accessing, addressing or allocating within memory systems.

References

1. Wikipedia

Published Applications – Summary

TOTAL DOCUMENTS COUNT (APPLICATIONS)

20,025

PUBLICATION TYPES

5,136 | 14,887

Applications | Grants

IP TYPES

19,875 | 103 | 2

Invention | Design | Model

PATENT BY STAR RATING

2.57

179
1,758
8,839
7,820
1,429

Peak Year of Activity

2016 (1,997)

No of technologies 248

Top Active Jurisdiction

US (11,956)

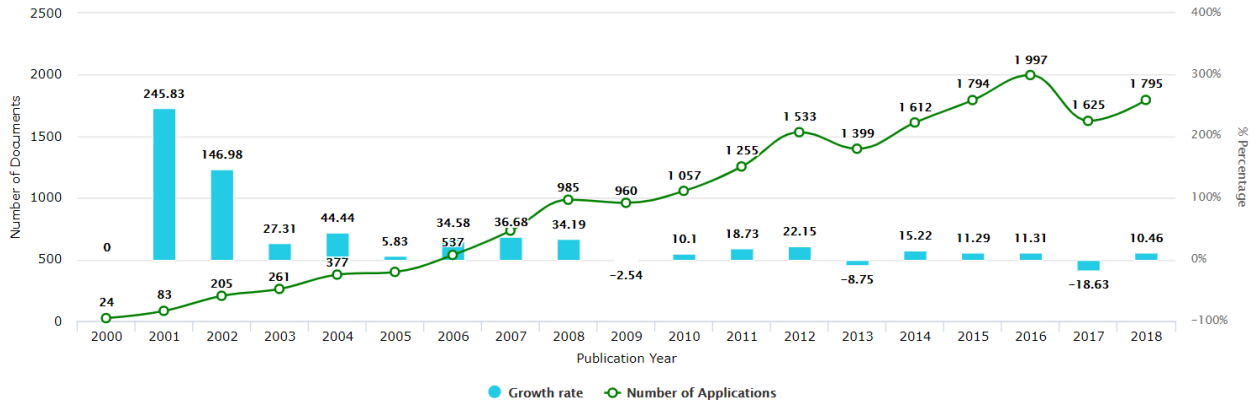
Top Rated

US8719501B2 (5)

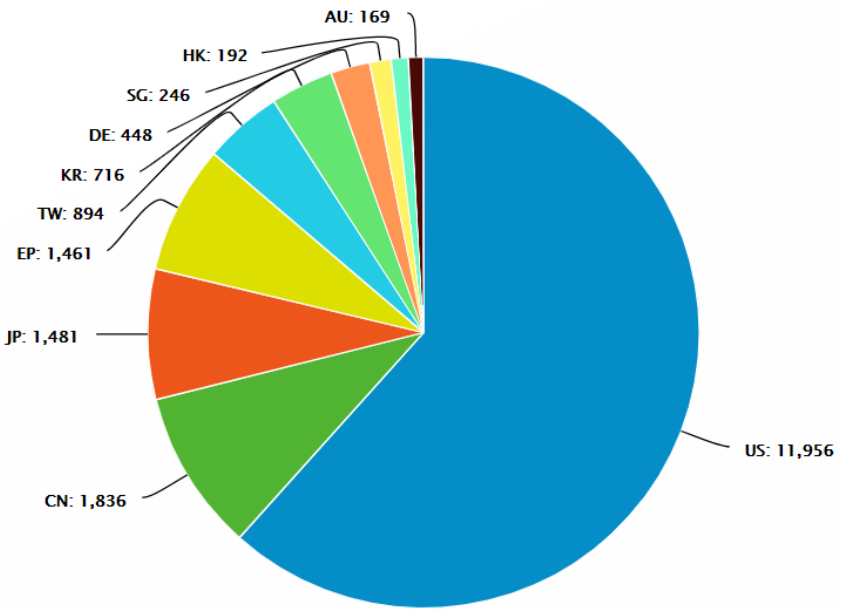
Top Cited

US6456528B1 (873)

Published Applications – Growth



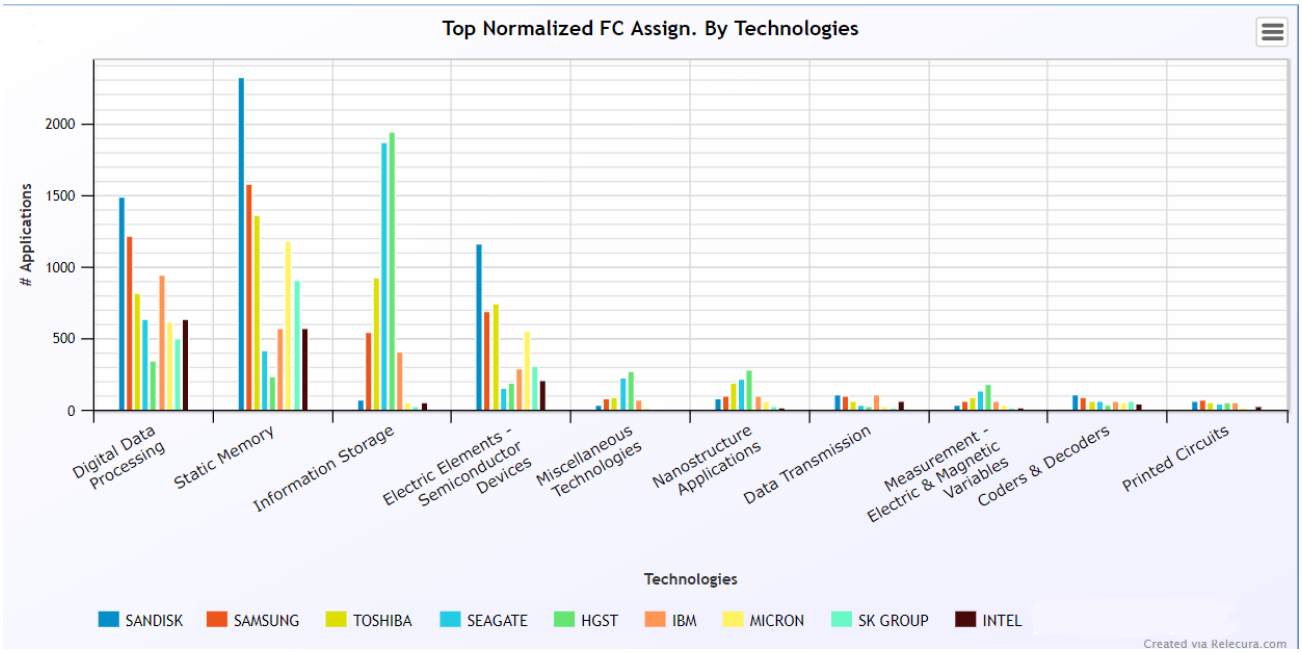
Key Geographies



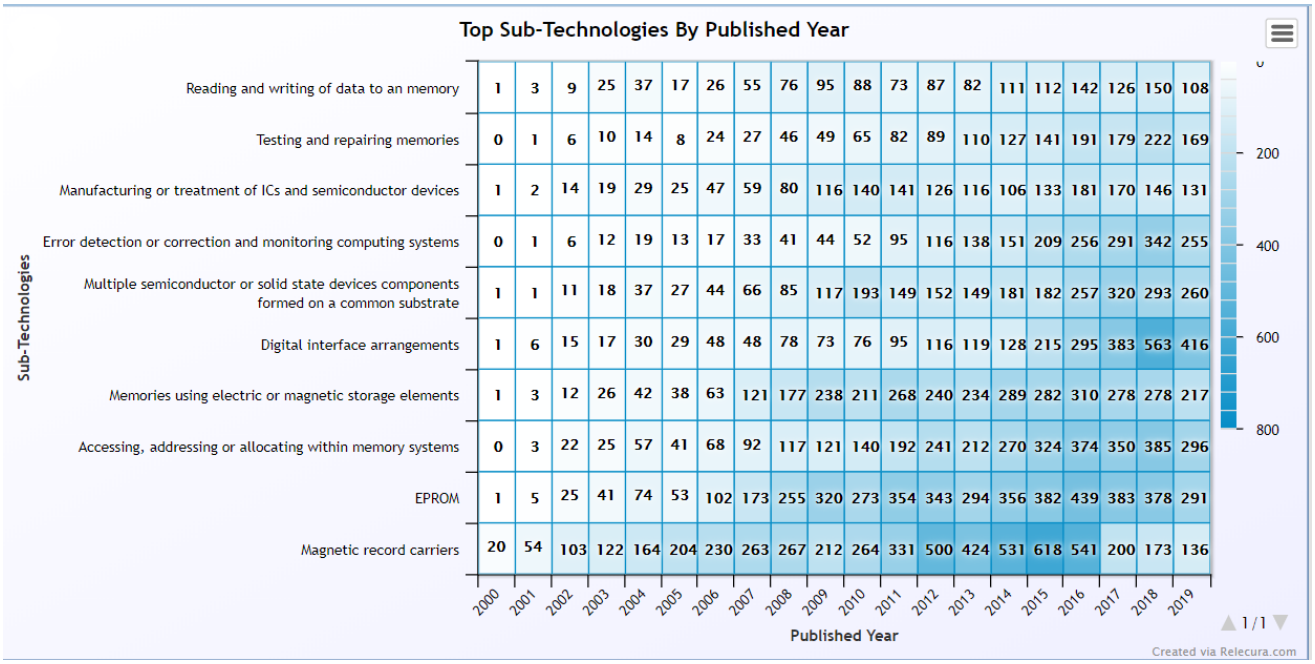
Top Forward Citing (FC) Assignees

FC Assignees	# Applications
SANDISK	3,936
SAMSUNG	3,228
TOSHIBA	3,020
SEAGATE	2,635
HGST	2,380
MICRON	1,770
IBM	1,730
SK GROUP	1,305
INTEL	1,120

Technologies cited by FC Assignees



Evolution of Sub-technologies



Published Applications - Top CPC Codes

CPC Code	Description	# Applications
G06F 12/0246	Accessing, addressing or allocating within memory systems or architectures, in block erasable memory, e.g. flash memory	1724
G11C 16/0483	Erasable programmable read-only memories, comprising cells having several storage transistors connected in series	1689
G11C 11/5628	Programming or writing circuits; Data input circuits	1422
G11C 16/10	Programming or data input circuits	1265
G06F 3/0679	Non-volatile semiconductor memory device, e.g. flash memory, one time programmable memory [OTP]	1137
G11C 11/5642	Sensing or reading circuits; Data output circuits	968
G11C 16/26	Sensing or reading circuits; Data output circuits	936
G11C 16/3418	Disturbance prevention or evaluation; Refreshing of disturbed memory data	839
G06F 3/0659	Command handling arrangements, e.g. command buffers, queues, command scheduling	754
B82Y 10/00	Nanotechnology for information processing, storage or transmission, e.g. quantum computing or single electron logic	729
H01L 27/11582	Multistep manufacturing processes therefor > with charge-trapping gate insulators, e.g. MNOS or NROM, the channels comprising vertical portions, e.g. U-shaped channels	723
G06F 3/0688	Non-volatile semiconductor memory arrays	668
G11B 5/1278	Structure or manufacture of heads, e.g. inductive, specially adapted for magnetisations perpendicular to the surface of the record carrier	616
G11C 16/3427	Circuits or methods to prevent or reduce disturbance of the state of a memory cell when neighbouring cells are read or written	586
G11B 5/3163	Fabrication methods or processes specially adapted for a particular head structure, e.g. using base layers for electroplating, using functional layers for masking, using energy or particle beams for shaping the structure or modifying the properties of the basic layers	582
G11C 16/3459	Circuits or methods to verify correct programming of nonvolatile memory cells	556
G11B 5/3116	Shaping of layers, poles or gaps for improving the form of the electrical signal transduced, e.g. for shielding, contour effect, equalizing, side flux fringing, cross talk reduction between heads or between heads and information tracks	549
G11B 2005/0021	Thermally assisted recording using an auxiliary energy source for heating the recording layer locally to assist the magnetization reversal	544
G06F 3/061	Dedicated interfaces to storage systems, specifically adapted to achieve a particular effect, Improving I/O performance	513
G11C 2213/71	Resistive array aspects, Three dimensional array	513

High Quality* Patents - Top Sub-technologies Covered

*(*High Quality ~ Relecura Star Rating 3 or more on a scale of 5)*

Sub-technologies	Relecura Star Rating				
	3	3.5	4	4.5	5
EPROM	637	214	138	66	0
Magnetic record carriers	327	307	307	8	0
Accessing, addressing or allocating within memory systems	472	180	159	72	2
Memories using electric or magnetic storage elements	543	146	110	48	0
Digital interface arrangements	366	118	88	46	0
Multiple semiconductor or solid-state devices components formed on a common substrate	352	106	102	32	0
Error detection or correction and monitoring computing systems	301	109	89	39	0
Manufacturing or treatment of ICs and semiconductor devices	219	77	67	14	0
Testing and repairing memories	215	59	57	27	0
Interconnection, Information transfer between, memories, i/o devices or CPUs	173	75	66	37	0
Multistep manufacturing process for rectifiers, oscillators, capacitors and resistors	197	67	67	13	0
Reading and writing of data to an memory	195	59	35	23	0
Digital stores using electric or magnetic storage elements	168	57	37	16	0
Memories using miscellaneous storage elements	157	39	35	18	0
Solid state devices for rectifying, amplifying, oscillating or switching without a potential-jump barrier	100	27	27	17	0
Details of semiconductor memories	99	29	27	14	0
Signal processing and circuits for record carriers	49	49	59	3	0
Head arrangements for any type of moving record carrier	58	46	43	0	0
Program control unit	76	28	32	8	0
Details of semiconductor devices	88	29	20	2	0

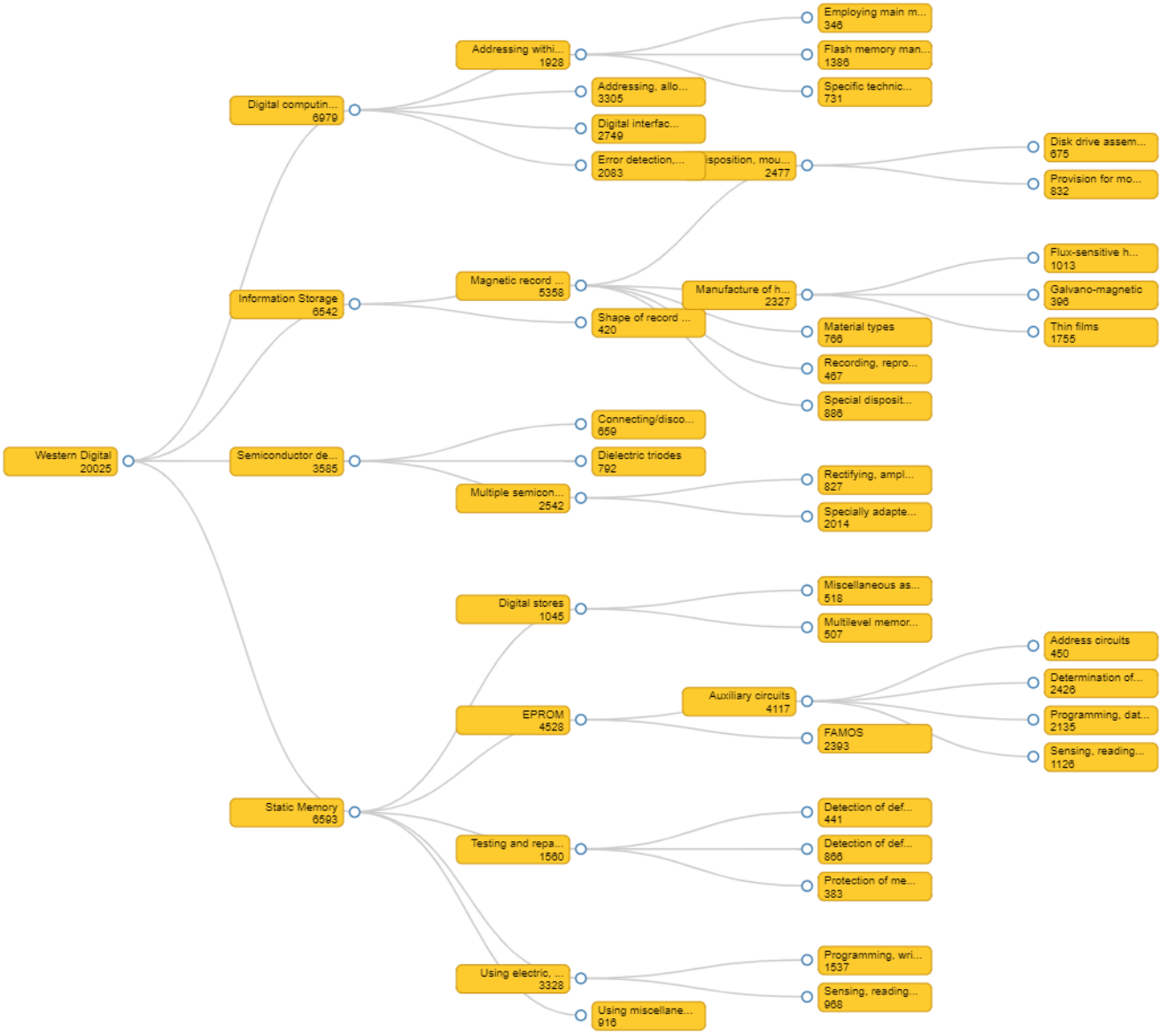
Granular Sub-technologies

Competitor Comparison – Break-up by Technology Categories

(# Applications given for color-coded categories)

Technology Categories				Western Digital	Seagate	NetApp	Kingston	Toshiba	Samsung
Digital computing systems	Addressing within memory	Employing main memory		346	31	18	0	167	279
		Flash memory management		1386	177	30	7	773	916
		Specific technical effect		731	150	85	5	587	858
	Addressing, allocation			3305	678	937	30	3537	5144
	Digital interface arrangements			2749	719	1354	60	6060	32265
	Error detection, correction			2083	543	1326	19	2216	3674
Information Storage	Magnetic record carriers	Disposition, mounting of heads	Disk drive assemblies	675	558	0	0	176	50
			Provision for moving the head	832	534	0	0	395	131
		Manufacture of heads	Flux-sensitive heads	1013	626	0	0	414	79
			Galvano-magnetic	396	183	0	0	206	44
			Thin films	1755	1414	0	0	477	58
		Material types		766	477	0	0	331	95
		Recording, reproducing or erasing		467	469	2	0	293	40
		Special dispositions, recording techniques		886	1046	0	0	374	87
	Shape of record carrier			420	181	1	0	195	211
Semiconductor devices	Connecting/disconnecting semiconductor bodies			659	48	0	26	6052	11287
	Dielectric triodes			792	62	0	0	996	1438
	Multiple semiconductor on a common substrate	Rectifying, amplifying or switching without surface barrier		827	47	0	0	885	1383
		Specially adapted for rectifying, oscillating, amplifying or switching		2014	66	0	2	7491	19878
Static Memory	Digital stores	Miscellaneous aspects		518	20	0	0	399	475
		Multilevel memory programming aspects		507	3	0	0	331	285
	EPROM	Auxiliary circuits	Address circuits	450	14	0	3	922	1050
			Determination of programming status	2426	93	1	4	1470	2194
			Programming, data input circuits	2135	70	0	8	1843	2752
			Sensing, reading circuits	1126	73	0	3	1274	1519
		FAMOS		2393	66	0	4	2899	3151
	Testing and repairing memories	Detection of defective auxiliary circuits		441	40	2	4	227	747
		Detection of defective memory elements		866	86	6	15	950	1892
		Protection of memory contents		383	88	5	0	297	415
	Using electric, magnetic elements	Programming, writing circuits		1537	37	0	3	863	991
		Sensing, reading circuits		968	54	0	0	580	661
	Using miscellaneous storage elements			916	133	1	1	1186	1902

Portfolio Taxonomy



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