



Kingston Technology

Intel Innovation Day

Nov. 2018

Redkorebrov Anton



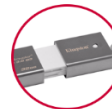
KINGSTON TECHNOLOGY CORPORATION

Divisions of Strength



Kingston Technology

DRAM Solutions



Kingston Digital

NAND Flash Solutions



HyperX

Gaming Solutions



Kingston Solutions Inc.

Embedded Solutions



Advanced Validation Labs

Testing Services



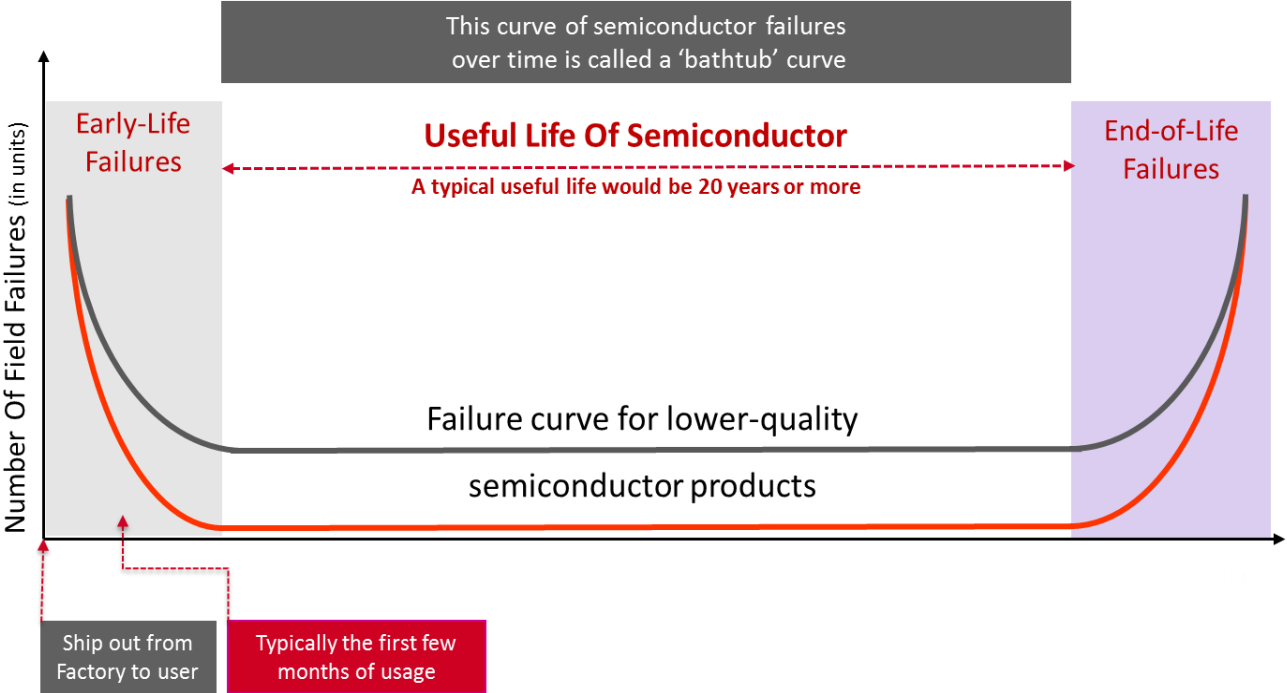
Kingston Technology Services

OEM, ODM & EMS Logistics

The Challenges of Memory Testing and Semiconductor Reliability

Module Capacity	Number of Memory Cells
4GB	34+ Billion Cells
8GB	68+ Billion Cells
16GB	136+ Billion Cells
32GB	272+ Billion Cells
64GB	544+ Billion Cells

Kingston Quality Standard
In production testing
1 bad cell means defective
and cannot leave factory



Kingston Production Testing and Dynamic Server Burn-In

100% Testing

- No spot testing! Kingston memory is 100% tested prior to leaving our factories, as we have always done

Dynamic Server Memory Burn-In

- Shrinking DRAM lithography increases sensitivity to temperature, forcing higher error rates and exposing weak memory cells
- Kingston's advanced burn-in process screens these by simulating 3 months of heavy server use at higher temperatures under full system environment and frequency stress

Proprietary Production Testers

- Kingston's test engineers designed the first automated production testers in the memory industry
- New patented automated testers build upon our test engineering legacy to meet the more stringent demands of evolving memory technology

35 Quality Control Checkpoints

- Kingston uses AQL sampling methods to re-inspect and re-test every lot to ensure our quality standards are being met



Kingston holds **29** patents related to memory testing

Memory Roadmap 1987 – 2018



Technology	Data Rate	Module Classification	Peak Bandwidth
DDR3 (1.5V) DDR3L (1.35V)	800	DDR3-800/PC3-6400	6400 MB/s or 6.4 GB/s
	1066	DDR3-1066/PC3-8500, DDR3L-1066/PC3L-8500	8500 MB/s or 8.5 GB/s
	1333	DDR3-1333/PC3-10600, DDR3L-1333/PC3L-10600	10600 MB/s or 10.6 GB/s
	1600	DDR3-1600/PC3-12800, DDR3L-1600/PC3L-12800	12800 MB/s or 12.8 GB/s
	1866	DDR3-1866/PC3-14900	14900 MB/s or 14.9 GB/s
DDR4 (1.2V)	2133	DDR4-2133 / PC4-2133	17000 MB/s or 17 GB/s
	2400	DDR4-2400 / PC4-2400	19200 MB/s or 19.2 GB/s
	2666	DDR4-2666 / PC4-2666	21300 MB/s or 21.3 GB/s
	2933	DDR4-2933 / PC4-2933	23400 MB/s or 23.4 GB/s
	3200	DDR4-3200 / PC4-3200	25600 MB/s or 25.6 GB/s

DDR4

Form Factors

288-pin DIMM
260-pin SODIMM

Performance (in MT/s)

1600 / 1866 / **2133** / **2400** / **2666** / 2933 / 3200

Power

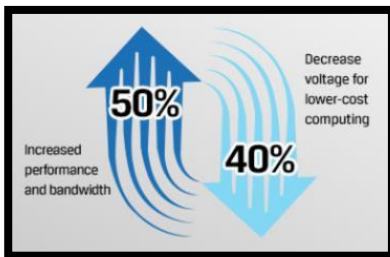
1.2V with improved refreshes, ½K page for x4
12V for NVDIMM (4-pins)

DRAM Densities/DIMM Capacities

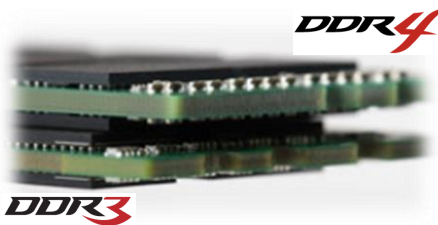
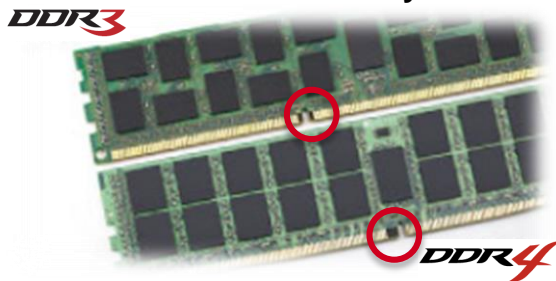
4Gb, 8Gb, 16Gb (x4, x8, x16)
Future DIMM capacities of 128GB, 256GB

New Features

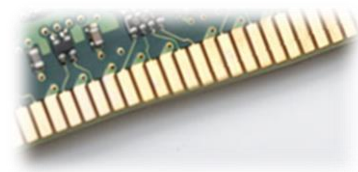
3D chip stacking support (up to 8 stacked dies)
Point-to-Point Memory Channel addressing
More stable than DDR3 with improved error correction code



New Module Key Location



Slightly thicker for improved performance



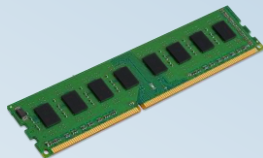
Curved edge for better socket connection



Kingston's Memory Business Lines

Industry Standard

- Order by JEDEC specification
- Ideal for system builders or datacenters
- *Server Premier* product line



System Specific

- Guaranteed compatibility
- Ideal for users who want to upgrade name-brand systems



OEM Services

- Customized, turn-key solutions
- Supply chain management
- Contract manufacturing

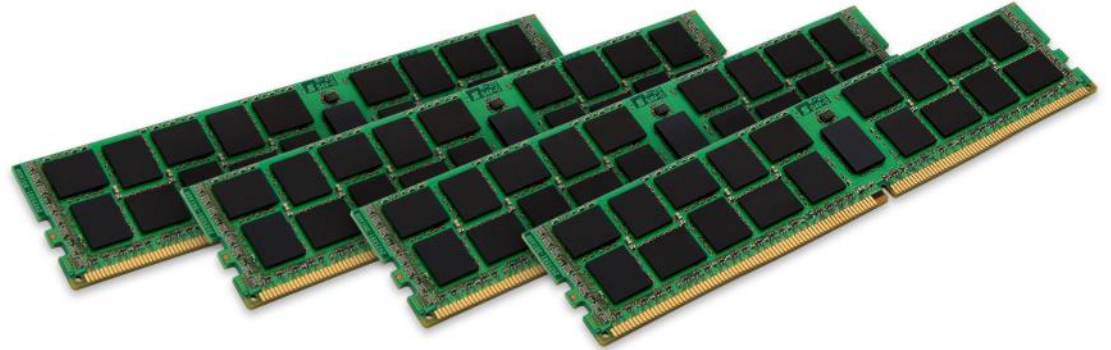


Gaming / Overclocking

- Enthusiast gaming market
- Intel XMP, Plug N Play
- *HyperX* brand



Server Memory



System Specific Memory – *Server*

Guaranteed Compatible

- Testing conducted in the system in which the memory will be installed

Importance of Branded Memory

- Different chips provide varying performance levels
- Chip Compatibility can vary
- Possible constraints in module height or width
- Presence Detect Configuration



System Specific Memory – *Server SKU*

Adaptec	Cell Computing	CompUSA	IronKey	3Com	Acer	Acros	Agfa	ATI Technologies	ALR	Amstrad	AT&T/NCR
ADA	CEL	CPC	IK	K3C	KAC	KAC	KAG	KAI	KAL	KAM	KAT
Axil Computer	Nortel/Bay Netwrk	NCD	Creative	CMD Technology	Canon	Cisco	Circuit City	Data General	Diamond	Dataprod ucts	KDS Computers
KAX	KBN	KCD	KCL	KCM	KCN	KCS	KCY	KDG	KDM	KDP	KDS
Epson	Everex	Fujitsu	Intergraph	Gateway	Hitachi	Micron	Mitsubishi	Motorola	MIPS	Matrox	Nilox
KEP	KEV	KFJ	KGR	KGW	KHI	KMC	KMI	KMO	KMP	KMX	KNI
NeXT	Olympus	Packard Bell	Tadpole	Psion	RCA	Ricoh	Solbourne	ViewSonic	Siemens Nixdorf	SGI	Samsung
KNX	KOL	KPB	KPO	KPS	KRC	KRI	KSB	KSC	KSE	KSG	KSM
Sharp	AST	Sony	Apple	Brother	Compaq (see HP)	Dell	Tatung	HP/Compaq	Texas Instruments	Tektronix	Lenovo
KSP	KST	KSY	KTA	KTB	KTC	KTD	KTG	KTH	KTI	KTK	KTL
IBM	Lexmark	NEC	Okidata	Panasonic	QMS (see Konica)	Radius	Sun/Oracle	Toshiba	Digital	Zenith	Tandy
KTM	KTM	KTN	KTO	KTP	KTQ	KTR	KTS	KTT	KTV	KTZ	KVT
WinBook	Xerox	Kyocera	MiTAC	SoftLayer	SOTEC	Via	VK Mobile				
KWB	KXR	KYO	MTC	SL	SOT	VIA	VKM				

SERVER PREMIER

Server Premier is our fully controlled data center solution, new for 2017+ server platforms. Ideal for system builders and OEMs alike.

- **Fully BOM controlled (DRAM, Register, PCB)**
- DDR4 2400MT/s and 2666MT/s
- Targeted for Intel “Purley” Xeon-SP and AMD “Naples” EPYC server systems
- PCNs with 90 Day Notice
- No price premium
- Platform validated and ODM qualified



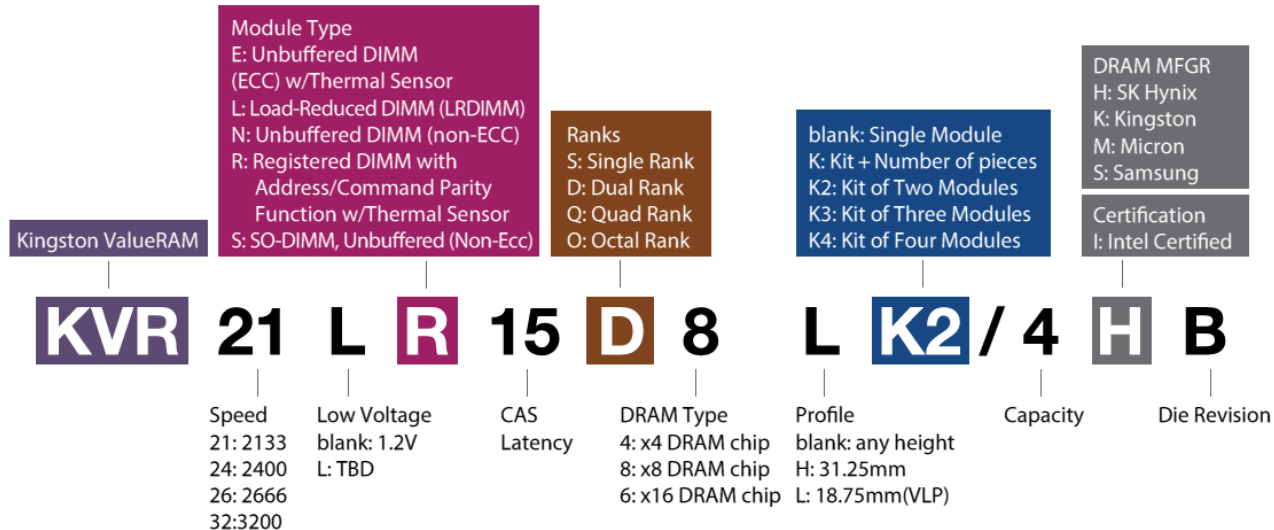
Quanta Computer



ValueRAM Product Decoder

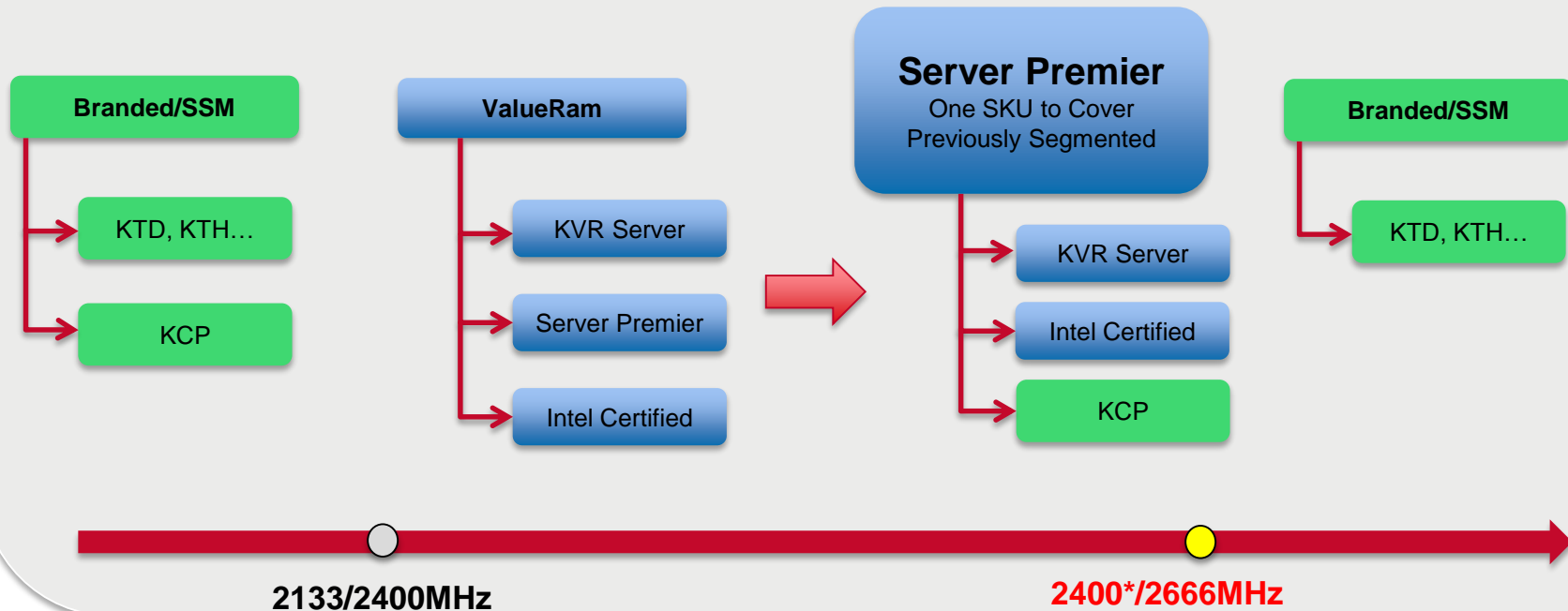
Kingston industry standard memory is built to the specifications outlined by J.E.D.E.C., the **Joint Electron Device Engineering Council**, on which Kingston holds a seat. Intel, AMD, and other computing chipset architects adhere to these standards for industry agreement and cross-platform compatibility. J.E.D.E.C. provides the specifications for Pin Count, Form Factor, Speed, Power, and Memory Technology Types.

DDR4 (PC4-2133, PC4-2400, PC4-2666, PC4-3200)



Память для серверов KSM (Kingston Server Memory)

- “Перезапуск” Server Premier и реорганизация серверного сегмента памяти

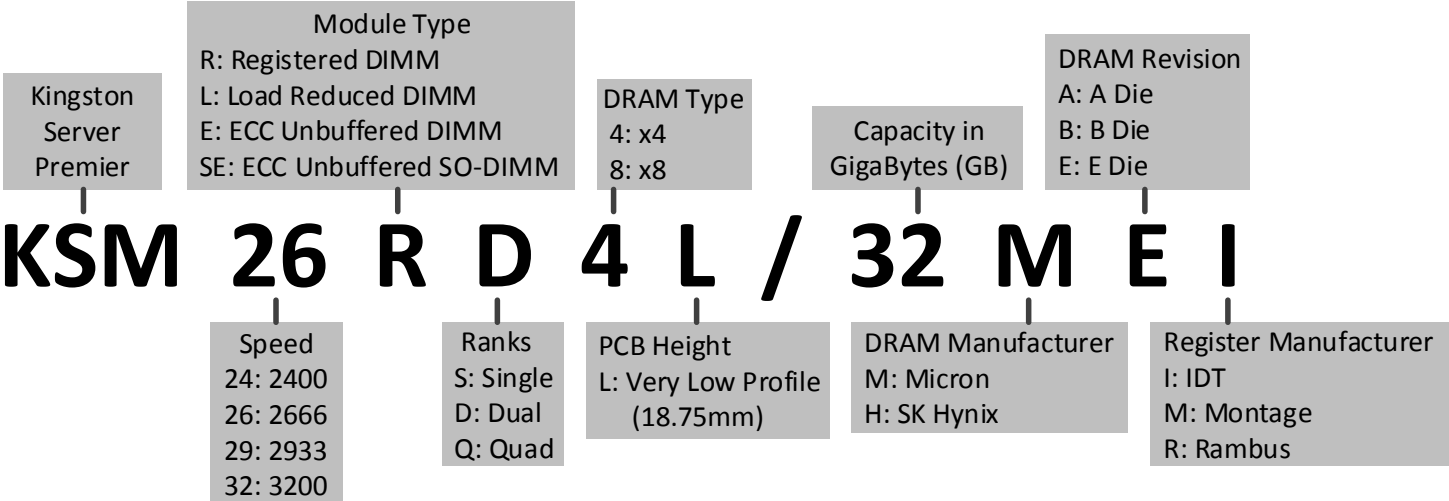


*2400 SKUs will be targeted at Purley Platforms

Server Premier Memory Decoder

Kingston industry standard memory is built to the specifications outlined by J.E.D.E.C., the Joint Electron Device Engineering Council, on which Kingston holds a seat. Intel, AMD, and other computing chipset architects adhere to these standards for industry agreement and cross-platform compatibility. J.E.D.E.C. provides the specifications for Pin Count, Form Factor, Speed, Power, and Memory Technology Types.

SERVER PREMIER



Qualification Programs

In addition to the strategic partnerships Kingston has with ODMs for submitting memory for qualification, we also work with independent memory test lab AVL for specific platform, motherboard, or system qualification. Test certificates are available on our website.

<http://www.kingston.com/us/memory/server>



Manufacturer Certified

Memory tested and qualified to meet exact manufacturer specifications.

Select Manufacturer

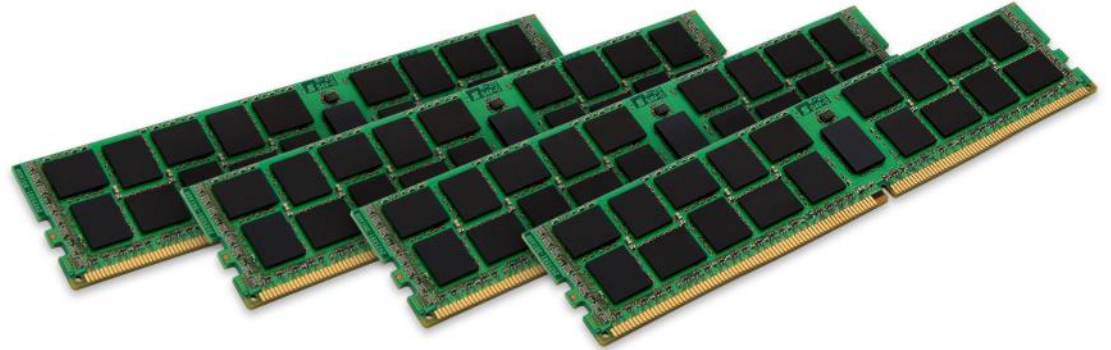
- AIC
- ASRock
- Asus
- Gigabyte
- Intel
- Supermicro
- Tyan



Supermicro Compatible

Part Number	Description	SM Boards Supported	Test Report
KVR21R15S4/8HA	8GB DDR4-2133 Registered DIMM CL15 1Rx4 1.2V Hynix A	X10DRI-LN4+, X10DRI-T4+, X10DRC-T4+, X10DRC-LN4+, X10DRU-i+	Download
		X10DRI, X10DAI, X10DAC, X10DRI-T, X10DRH-CT, X10DRT-P, X10DRT-PT, X10DRT-PIBQ, X10DRT-PIBF, X10DRFR, X10DRFR-T, X10DRW-I, X10DRW-IT, X10DDW-I, X10DDW-IN, X10DRG-H, X10DRG-HT	Download
		X10DRL-I, X10DRL-L, X10DRFF, X10DRFF-C	Download

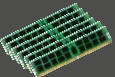
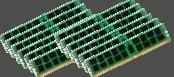
Memory Configurations for Intel



Next Generation Intel® Xeon® SP (Codename Skylake)

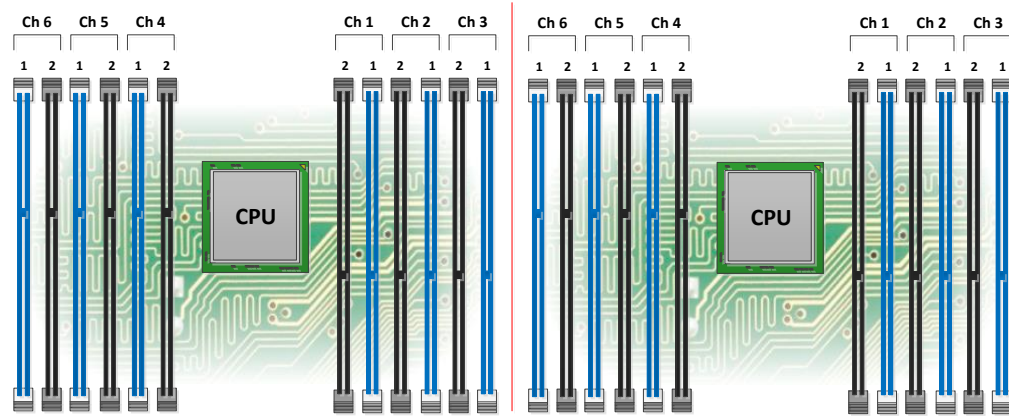


(6 Channel, 12 sockets per CPU, 2 DPC)

Module Type (No Mixing in a Server)	1 DIMMs per Channel 1 DPC 	2 DIMMs per Channel 2 DPC 
Registered DIMM (RDIMM, 3DS)	<h1>2666</h1>	
Load Reduced DIMM (LRDIMM, 3DS)		

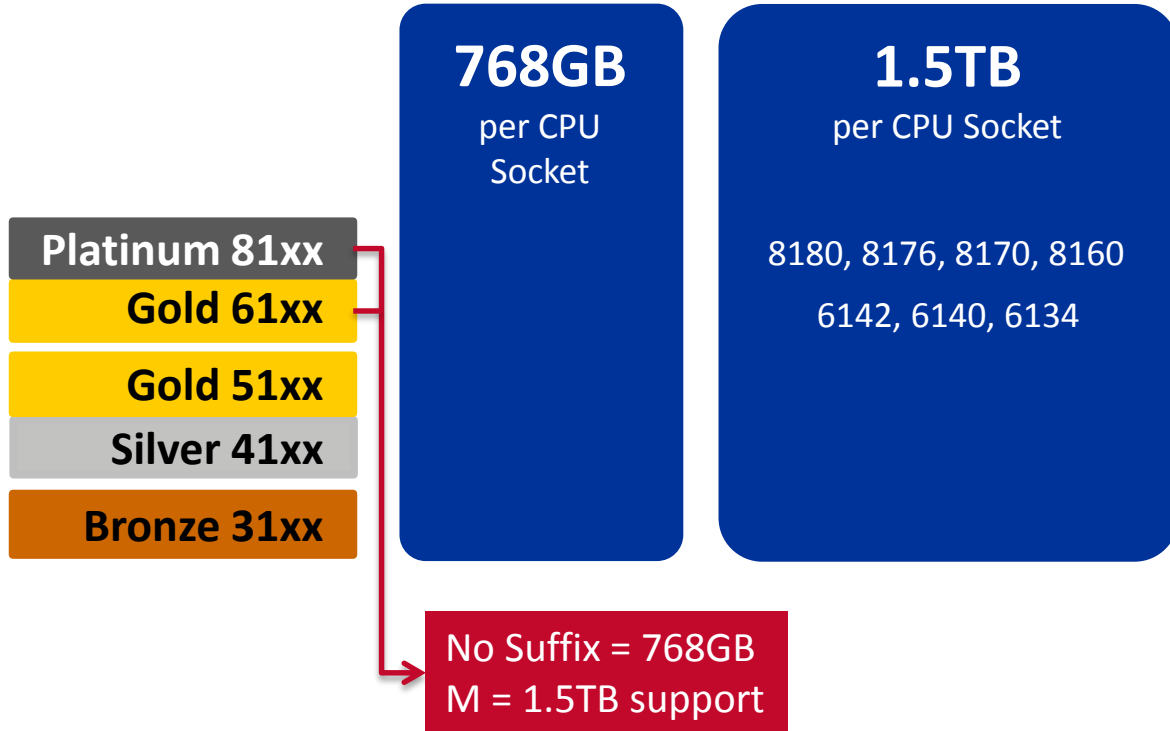
New Intel Xeon SP Processors

Platinum 81xx	<h1>2666</h1>
Gold 61xx	
Gold 51xx*	<h1>2400</h1>
Silver 41xx	<h1>2133</h1>
Bronze 31xx	



Next Generation Intel® Xeon® SP (Codename Skylake)

Base vs Large Memory Options





Kingston Technology

Client Memory Roadmap

Nov. 2018

Slides marked **CONFIDENTIAL** require local NDA for viewing and distribution



System Specific Memory

Guaranteed Compatible (*Kingston “KCP” Product Line*)

- Testing conducted on the system in which the memory will be installed
- 100% factory tested
- Lifetime warranty

Importance of Branded Memory

- Different chips provide varying performance levels
- Chip Compatibility can vary on name brand systems
- Possible constraints in module height or width

acer



DELL™



lenovo

Industry Standard Memory – *ValueRAM*

JEDEC Standard (Kingston ValueRAM “KVR” Product Line)

Built to Industry Standard Specifications

- DDR3, DDR3L, and DDR4 standard speeds, voltages, and PCB designs
- 100% factory testing
- Lifetime warranty

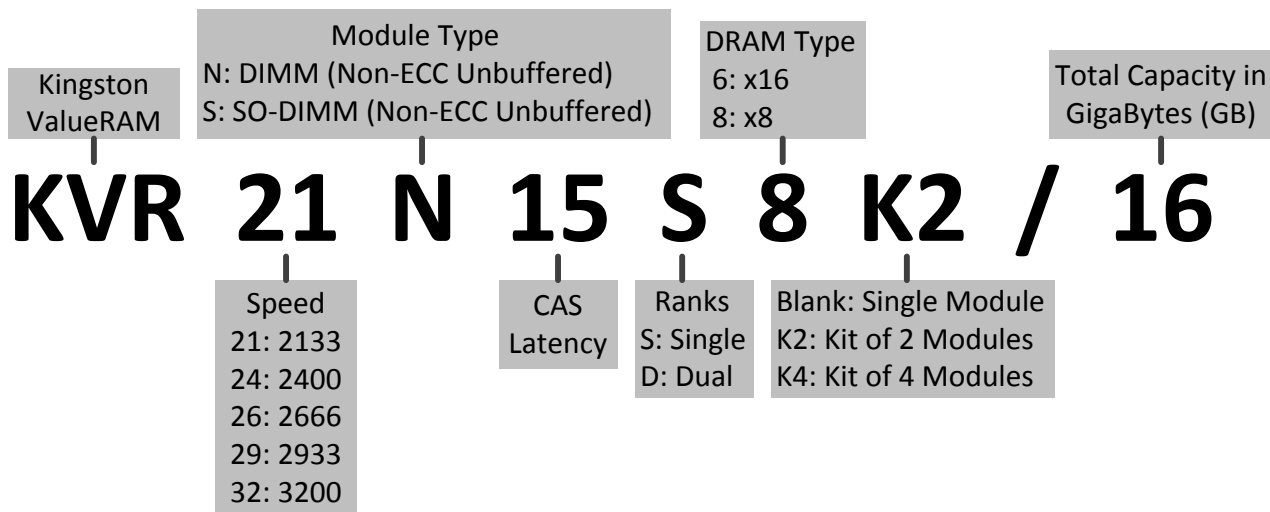
Guaranteed Compatible

- Platform validated on Intel and AMD systems
- Featured on motherboard vendor qualified memory lists



Industry Standard Memory Decoder

Kingston industry standard memory is built to the specifications outlined by J.E.D.E.C., the **Joint Electron Device Engineering Council**, on which Kingston holds a seat. Intel, AMD, and other computing chipset architects adhere to these standards for industry agreement and cross-platform compatibility. J.E.D.E.C. provides the specifications for Pin Count, Form Factor, Speed, Power, and Memory Technology Types.



Overclocking Memory – *HyperX*

Overclock

Memory tuned beyond JEDEC specifications using voltage, speed, and latency to achieve higher performance.

PnP (Plug N Play) – FURY, Impact

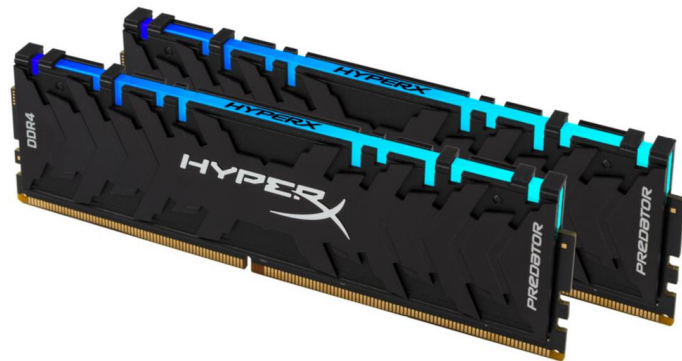
- Automatic overclock from factory preset values that use standard JEDEC voltage, but at higher speed and lower latency
- Ideal for name-brand systems that don't allow memory specs to be adjusted, or XMP profiles to be enabled (Apple, HP, Dell, Lenovo, Acer, etc)

Intel XMP (Extreme Memory Profiles) – Predator

- Engineer tuned overclock profiles programmed onto the module that can be enabled using BIOS or software
- Higher voltages, speeds, and lower latencies than PnP
- JEDEC default specs from factory with two profiles available, one extreme, one slightly less extreme
- XMP Ready and XMP Certified
 - “Ready” if it features the preset profiles
 - “Certified” if it has been submitted and verified by Intel, then posted to their website

Overclocking Memory – *HyperX*

- 2933MHz, 3200MHz, 3600MHz, 4000MHz
- 8GB single modules, Dual and Quad Channel kits
- Optimized for both AMD and Intel's latest chipsets
- Patent pending HyperX Infrared Sync technology
- Factory preset RGB wave lighting effect
- Lighting customizable with motherboard RGB control software
- HyperX NGenuity software control available in 2019
- 16GB modules and kits targeted for CES 2019 debut

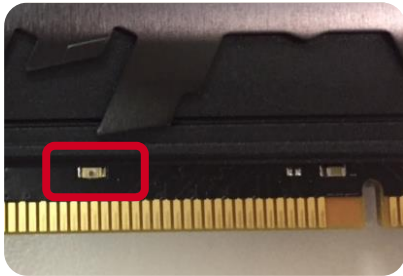


PREDATOR DDR4 RGB INFRARED SYNC

IR Signal Receiver



IR Signal Sender



IR Sensor Working Distance



→ LEDs are Synchronized (Dual Channel)



→ LEDs are NOT Synchronized (too far apart)

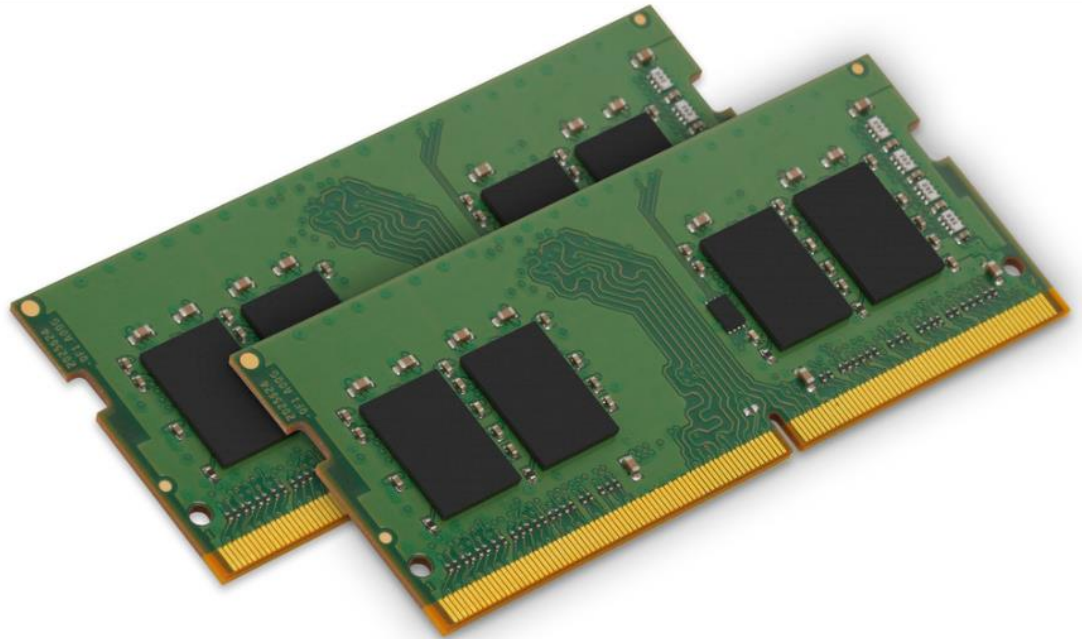
2018 HYPERX DRAM FAMILY LINE UP



Speed	<u>FURY DDR3</u>		<u>Savage DDR3</u>	<u>Impact DDR3</u>	<u>FURY DDR4</u>	<u>Predator DDR4</u>	<u>Predator DDR4 RGB</u>	<u>Impact DDR4</u>
4133MHz						CL19		
4000MHz						CL19	CL19	
3600MHz						CL17	CL17	
3466MHz					CL19			
3333MHz						CL16		
3200MHz					CL18	CL16	CL16	CL20
3000MHz						CL15		
2933MHz					CL17		CL15	CL17
2666MHz					CL15 - CL16	CL13		CL15
2400MHz					CL15	CL12		CL14
2133MHz			CL11	CL11	CL14 - Phase Out			CL13 - Phase Out
1866MHz	CL10	CL11	CL9	CL11				
1600MHz	CL10	CL10	CL9	CL9				
1333MHz	CL9							
Features	<u>FURY DDR3</u>		<u>Savage DDR3</u>	<u>Impact DDR3</u>	<u>FURY DDR4</u>	<u>Predator DDR4</u>	<u>Predator DDR4 RGB</u>	<u>Impact DDR4</u>
XMP	No	No	Yes	No	Yes	Yes	Yes	Yes
PnP	Yes	Yes	No	Yes	Yes	No	No	Yes
CAS Latencies	CL9 - CL10	CL10 - CL11	CL9 - CL11	CL9 - CL11	CL15 - CL19	CL12 - CL19	CL15 - CL19	CL14 - CL20
Voltages	1.5V	1.35V	1.5V & 1.6V	1.35V or 1.5V	1.2V	1.35V	1.35V	1.2V
Module Capacities	4GB - 8GB	4GB - 8GB	4GB - 8GB	4GB - 8GB	4GB - 16GB	4GB - 16GB	8GB	4GB - 16GB
Kit Capacities	8GB - 16GB	8GB - 16GB	8GB - 32GB	8GB - 16GB	8GB - 64GB	8GB - 128GB	16GB - 32GB	8GB - 64GB
Single Modules	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dual Channel Kits	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quad Channel Kits	No	No	Yes	No	Yes	Yes	Yes	Yes
PCB Color	Black	Black	Black	Black	Black	Black	Black	Black
Heat Spreader Colors	Blue, Black, Red, White	Black	Red	Black	Black, Red, White	Black	Black	Black
Height	32.8mm	32.8mm	33.3mm	30mm	34.04mm	42.2mm	42.2mm	30mm



Client Memory Platform Update



Intel Client Platform Validation

DDR4-2666 UDIMM	Coffee Lake-S 300 Series	Skylake-X X299
KVR26N19D8/16	X	X
KVR26N19S8/8	X	X
KVR26N19S6/4	X	

DDR4-2666 SODIMM	Coffee Lake-H 300 Series
KVR26S19D8/16	X
KVR26S19S8/8	X
KVR26S19S6/4	X

DDR4-2400 UDIMM	Kaby Lake-S 200 Series
KVR24N17D8/16	X
KVR24N17S8/8	X
KVR24N17S6/4	X

DDR4-2400 SODIMM	Kaby Lake-H 200 Series
KVR24S17D8/16	X
KVR24S17S8/8	X
KVR24S17S6/4	X

<https://www.intel.com/content/www/us/en/platform-memory/platform-memory.html>

2018 DRAM Opportunities with Intel Desktop Systems



X

Processors

X299

- Skylake-X (8th Gen Core)
- Quad Channel (8 sockets)
- Kabylake-X (8th Gen Core)
- Dual Channel (4 sockets)

DDR4
2666



KVR26N19S8/8
KVR26N19D8/16
KCP426NS8/8
KCP426ND8/16



FURY 2666 – 3466 K2 / K4
Predator 2666 – 3600 K2 / K4
(K2 for KBL-X, K4 for SKL-X)

S

Processors

300
Series

- Coffee Lake-S (8th Gen Core)
- Dual Channel (4 sockets)

DDR4
2666

KVR26N19S8/8
KVR26N19D8/16
KCP426NS8/8
KCP426ND8/16

FURY 2666 – 3466 K2
Predator 2666 – 3600 K2

S

Processors

200
Series

- Kabylake-S (7th Gen Core)
- Dual Channel (4 sockets)
- Pentium J 4000 / 5000
- Celeron J 3000 / 4000

DDR4
2400

KVR24N17S4/4
KVR24N17S8/8
KVR24N17D8/16
KCP424NS6/4
KCP424NS8/8
KCP424ND8/16

FURY 2400 – 3466 K2
Predator 2400 – 3333 K2

N

Processors

SOC

- Apollo Lake (System on Chip)
- Gemini Lake (System on Chip)

DDR3L
LPDDR3
DDR4
LPDDR4

Platform Specific
Discrete DRAM
SODIMM
UDIMM

תודה
 Dankie Gracias
 Спасибо شكراً
 Merci Takk
 Köszönjük Terima kasih
 Grazie Dziękujemy Děkojame
 Ďakujeme Vielen Dank Paldies
 Kiitos Täname teid 谢谢
Thank You Tak
 感謝您 Obrigado Teşekkür Ederiz
 Σας Ευχαριστούμ 감사합니다
 ขอบคุณ
 Bedankt Děkujeme vám
 ありがとうございます
 Tack

