Renesas Standard SRAM Product Outline

April 17, 2024

Standard Memory Products Section,
Standard Products Department, Standard Products Division,
Analog & Connectivity Product Group,
Renesas Electronics Corporation

SRAM-2024-E-0417-1

Memory Products Portfolio

■ “One-Renesas” provides optimum memory solutions to various application fields.

Memory Types	Products	Sources
Low Power SRAM	■ (5V, 3V) 256Kb, 1Mb, 4Mb ■ (3V) 2Mb, 8Mb, 16Mb, 32Mb, 64Mb	Renesas
Asynchronous Fast SRAM	■ (5V, 3.3V) 4Mb	Renesas
	■ (5V) 16Kb, 64Kb, 256Kb ■ (5V, 3.3V) 1Mb ■ (3.3V) 4Mb	former IDT
Synchronous SRAM	■ Pipeline Burst / Flow-through : 4Mb, 9Mb ■ Zero Bus Turnaround (ZBT) : 4Mb, 9Mb, 18Mb	former IDT
Specialty Memory	■ Multi-Port (5V, 3.3V, 2.5V) 8Kb ~ 36Mb ■ FIFO (5V, 3.3V, 2.5V) 2Kb ~ 9Mb	former IDT
EEPROM	■ Serial I/F: I2C, SPI (1.8V ~ 5.5V) 2Kb ~ 512Kb	Renesas
SPI NOR Flash	■ Standard Products: (1.8V) 8Mb ~ 128Mb (3V) 256Kb ~ 128Mb (1.8 ~ 3V, Wide Vcc) 256Kb ~ 32Mb	former Dialog
	■ System-Enhancing Products: Fusion / FusionHD 512Kb~32Mb / DataFlash 2Mb~64Mb / Ultra-Low Energy 1Mb~4Mb	former Dialog

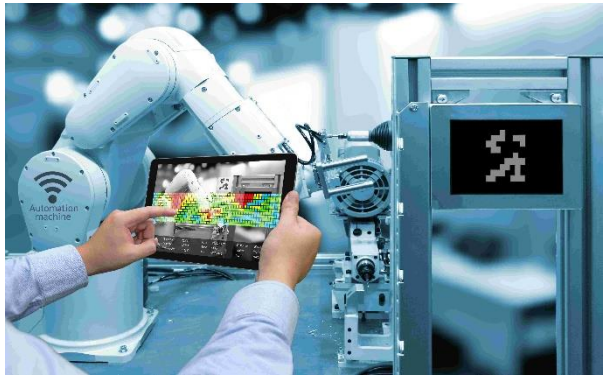
Covered by this Material

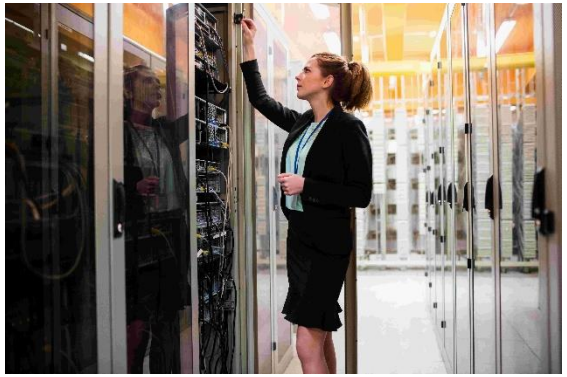
Renesas Standard SRAM

Advantages

➢ Features

- **High Reliability**
  - Excellent soft error immunity without embedded ECC
  - Latch-up free memory cell structure
- **Stable supply and long-term support**
  - Covered by PLP: Product Longevity Program
- **Wide lineup to support all applications**
  - Memory density: Lineup from 256Kb to 64Mb
  - Supply voltage: 3V / 5V (continued support of 5V parts)
  - Package: Varied package lineup





➢ Applications

- **Industrial**
  - Factory automation (PLC, CNC, etc.), servomotor, AC drives (inverter), industrial robot, plant control system, vending machine, ticket gate, automated teller machine, etc.
- **Communication**
  - Router, switch, base station, etc.
- **Social infrastructure**
  - Elevator system, transportation system, railway system, traffic signal system, smart grid devices, etc.
- **Medical / Healthcare**
  - Medical electronic devices
- **Office automation**
  - Multi-function printer, etc.
- **Consumer**
  - Gaming machine, musical instrument, calculator, etc.
- **Car accessories (non-driveline devices)**
  - ETC device, digital tachometer, etc.

Renesas Standard SRAM

Product Roadmap

■ Wide variety of SRAM product lineup 256Kb~64Mb

■ Roadmap

SRAM Type	Density (Voltage)	~2023	2024	2025	2026	2027	2028~
Low Power SRAM	256Kb, 1Mb (5V/3V) 2Mb (3V) 4Mb (5V)	0.15 μm Advanced LPSRAM					
	4Mb (3V) 8Mb, 16Mb (3V) 32Mb, 64Mb (3V)	0.11 μm Advanced LPSRAM					
	16Mb (3V) R1LV1616H series <EOL products>	0.13 μm (ECC-embedded)					
	16Mb (3V) RMLV1616A-U series Alternative to R1LV1616H series	MP: Now	0.11 μm Advanced LPSRAM				
Asynchronous Fast SRAM	4Mb (5V/3V)	0.18 μm CMOS					

As of Apr. 2024

Alternative to R1LV1616H series

RMLV1616A-U series

New Product, MP Now
Contact us for details

■ Drop-in Compatible Speed, Low Power and Packages plus Superior Soft Error Rate !

Items	R1LV1616H series <EOL products>	RMLV1616A-U series <Alternative products>	☑ Drop-in Compatibility & Remarks
Access time	45ns / 55ns	45ns / 55ns	☑ Supports 45ns
Standby current	0.5µA (typ.) / 8µA (max.)	0.5µA (typ.) / 8µA (max.)	☑ Supports 8µA, max.
Packages	48-ball FBGA (8.0x9.5mm2)	48-ball FBGA (7.5x8.5 mm2)	☑ Identical ball-pitch & pin configs.
	48-pin TSOP (I)	48-pin TSOP (I)	☑ Identical outline & pin configs.
Soft Error Mitigation (countermeasures)	YES (embedded ECC)	YES (Advanced LPSRAM)	☑ Refer to the page for Advanced LPSRAM technology
Soft Error Rate (measured)	< 5.5 FIT/Mb	< 0.04 FIT/Mb	☑ Superior to ECC-embedded SRAMs! Contact us for details

Product Lineup

16Mb Low Power SRAM

Wafer Process	Density	Catalog Part Name	Orderable Part Name	Package (pinout)	Packing Type	Access Time	Standby Current (typ. / max.)	Operating Voltage	Operating Temperature	PLP period
RMLV1616A-U series New Product		RMLV1616AGBG-4U2	RMLV1616AGBG-4U2#AC0	FBGA (48)	Tray	45ns	0.4µA / 8µA	2.7V ~ 3.6V	-40 ~ 85 °C	
			RMLV1616AGBG-4U2#KC0	FBGA (48)	Tape & Reel	45ns	0.4µA / 8µA	2.7V ~ 3.6V	-40 ~ 85 °C	
		RMLV1616AGBG-5U2	RMLV1616AGBG-5U2#AC0	FBGA (48)	Tray	55ns	0.4µA / 8µA	2.7V ~ 3.6V	-40 ~ 85 °C	
			RMLV1616AGBG-5U2#KC0	FBGA (48)	Tape & Reel	55ns	0.4µA / 8µA	2.7V ~ 3.6V	-40 ~ 85 °C	Dec. 2032 (Planned*)
0.11µm Advanced	16Mbit	RMLV1616AGSA-4U2	RMLV1616AGSA-4U2#AA0	TSOP-I (48)	Tray	45ns	0.4µA / 8µA	2.7V ~ 3.6V	-40 ~ 85 °C	
			RMLV1616AGSA-4U2#KA0	TSOP-I (48)	Tape & Reel	45ns	0.4µA / 8µA	2.7V ~ 3.6V	-40 ~ 85 °C	
		RMLV1616AGSA-5U2	RMLV1616AGSA-5U2#AA0	TSOP-I (48)	Tray	55ns	0.4µA / 8µA	2.7V ~ 3.6V	-40 ~ 85 °C	
			RMLV1616AGSA-5U2#KA0	TSOP-I (48)	Tape & Reel	55ns	0.4µA / 8µA	2.7V ~ 3.6V	-40 ~ 85 °C	
RMLV1616A-S series Production Now		RMLV1616AGBG-5S2	RMLV1616AGBG-5S2#AC0	FBGA (48)	Tray	55ns	0.5µA / 16µA	2.7V ~ 3.6V	-40 ~ 85 °C	Dec. 2032
			RMLV1616AGBG-5S2#KC0	FBGA (48)	Tape & Reel	55ns	0.5µA / 16µA	2.7V ~ 3.6V	-40 ~ 85 °C	Dec. 2032
0.11µm Advanced	16Mbit	RMLV1616AGSA-5S2	RMLV1616AGSA-5S2#AA0	TSOP-I (48)	Tray	55ns	0.5µA / 16µA	2.7V ~ 3.6V	-40 ~ 85 °C	Dec. 2032
			RMLV1616AGSA-5S2#KA0	TSOP-I (48)	Tape & Reel	55ns	0.5µA / 16µA	2.7V ~ 3.6V	-40 ~ 85 °C	Dec. 2032
		RMLV1616AGSD-5S2	RMLV1616AGSD-5S2#AA1	µTSOP (52)	Tray	55ns	0.5µA / 16µA	2.7V ~ 3.6V	-40 ~ 85 °C	Dec. 2032
			RMLV1616AGSD-5S2#HA1	µTSOP (52)	Tape & Reel	55ns	0.5µA / 16µA	2.7V ~ 3.6V	-40 ~ 85 °C	Dec. 2032

* Note: To be given the same PLP period as other SRAMs.

Die-shrink with Achieving Low Power

0.11µm 32Mb/64Mb LPSRAM

Production Now

■ **Not only a generation change but also reduced operating / standby current**

			0.15µm process	0.11µm process	
32Mb FBGA (48) TSOP-I (48) µTSOP (52)	Product family ->		R1LV3216**R** series	RMLV3216**A** series	
	Access time	tAA	55ns	55ns	
	Operating current	Icc1	55mA (Max.)	35mA (Max.)	**Icc1 (Max.) reduction by 36%**
	Standby current	ISB1	4µA (Typ.) @25℃ 80µA (Max.) @85℃	0.6µA (Typ.) @25℃ 24µA (Max.) @85℃	**Isb1 (typ.) reduction by 85%**
	Data retention voltage	VDR	2.0V	1.5V	
64Mb **(MCP:32Mb x2)** FBGA (48) TSOP-I (48) µTSOP (52)	Product family ->		R1WV6416**R** series	RMWV6416**A** series	
	Access time	tAA	55ns	55ns	
	Operating current	Icc1	60mA (Max.)	38mA (Max.)	**Icc1 (Max.) reduction by 36%**
	Standby current	ISB1	8µA (Typ.) @25℃ 160µA (Max.) @85℃	1.2µA (Typ.) @25℃ 46µA (Max.) @85℃	**Isb1 (typ.) reduction by 85%**
	Data retention voltage	VDR	2.0V	1.5V	

Basic Block Diagram

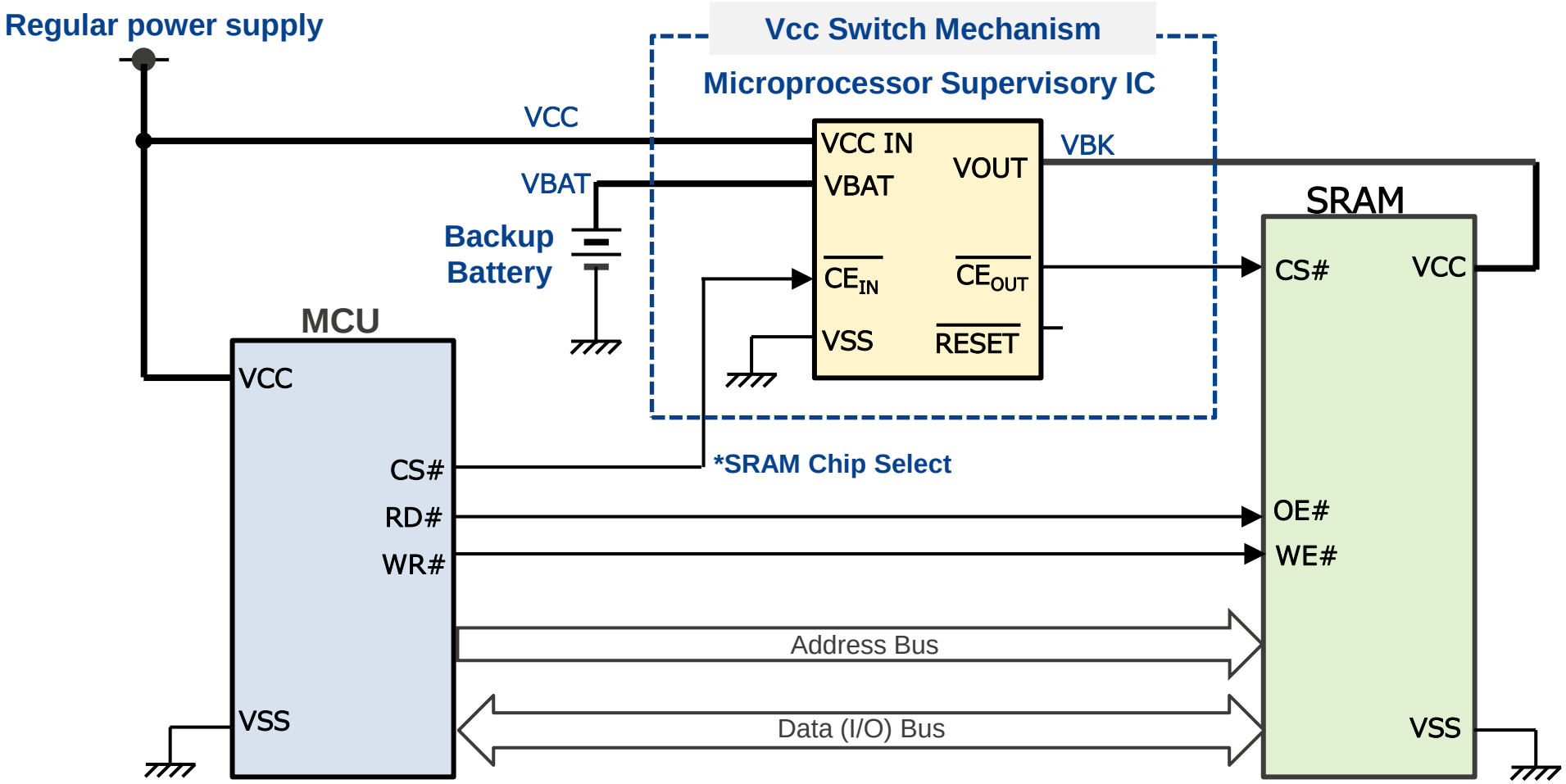
SRAM Battery Backup

Non-volatile RAM by battery backup
- Low Standby Current = Longer battery life
- Low Soft Error Rate = High Reliability on data retention

Visit SRAM FAQs for detailed guidelines

SRAM battery backup circuit (recommended design technique)

Cautions on SRAM battery backup circuits (non-recommended)



Technology Challenges: Soft Errors

1. A phenomenon observed as a memory failure by occasional bit(s) upset.
   Also referred as “Single Event Upset (SEU).”

2. Not a permanent hard failure and can be corrected by rewriting from the system (MCU) side.

Fig.1: Alpha-particle induced soft error

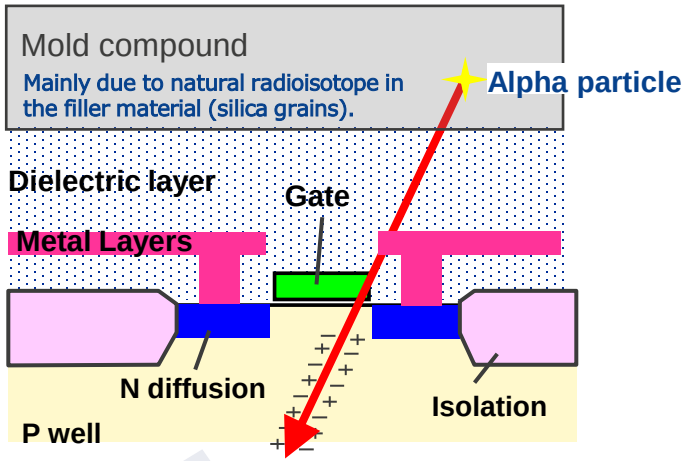
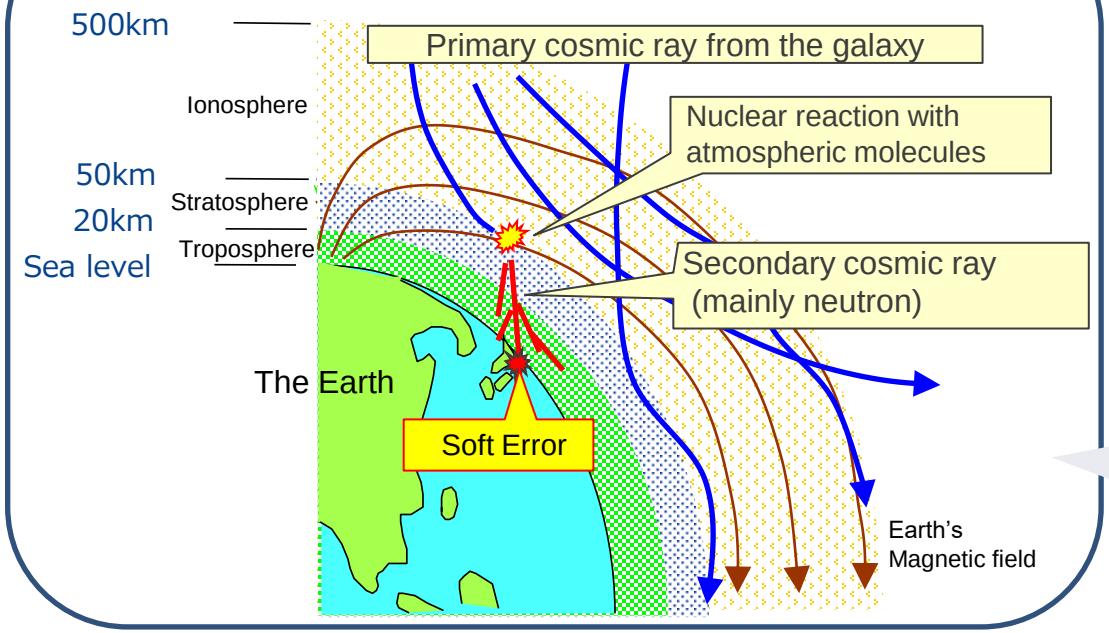


Fig.2: Cosmic ray (neutron) induced soft error



3. Until the early '90s, the main cause was α (alpha) rays generated from radioisotopes contained in trace amounts in semiconductor packaging materials. (Fig.1)

4. Since the '90s, when the feature size of wafer process has been downsized to 0.1µm (100nm) or less, "Terrestrial Cosmic Rays" are being recognized as a dominant cause of soft errors. (Fig.2)

Product Differentiation

■ Renesas supports soft error free products for entire lineup of 256Kbit to 64Mbit

Soft Error Countermeasures ?

YES | NO

✓In Production

Supplier	Process	256Kb	1Mb	2Mb	4Mb	8Mb	16Mb	32Mb	64Mb	Remarks
RENESAS LP-SRAM	0.15µm Advanced	✓	✓	✓	✓ (5V)	Changes to 0.11µm Advanced				Market Introduction in 2004 (first with 16Mb)
	0.11µm Advanced				✓ (3V)	✓	✓	✓	✓	Market Introduction in 2013 (first with 4Mb)
Competitor A LP-SRAM	90nm CMOS, Non-ECC	EOL	✓	✓	✓	✓	✓	✓	✓	90nm CMOS (Note)
	65nm CMOS, ECC embedded				✓	✓	✓	✓	✓	65nm CMOS (Note)
Competitor B LP-SRAM	CMOS, Non-ECC	✓	✓	✓	✓	✓	✓			No 32Mb+ product (Note)
	CMOS, ECC embedded				✓	✓				No 16Mb+ product (Note)

ECC: Error Correction Code, or Error Checking and Correction

Note : Renesas recognition based on public information and sales information. It is not the official announcement of each competitor company.

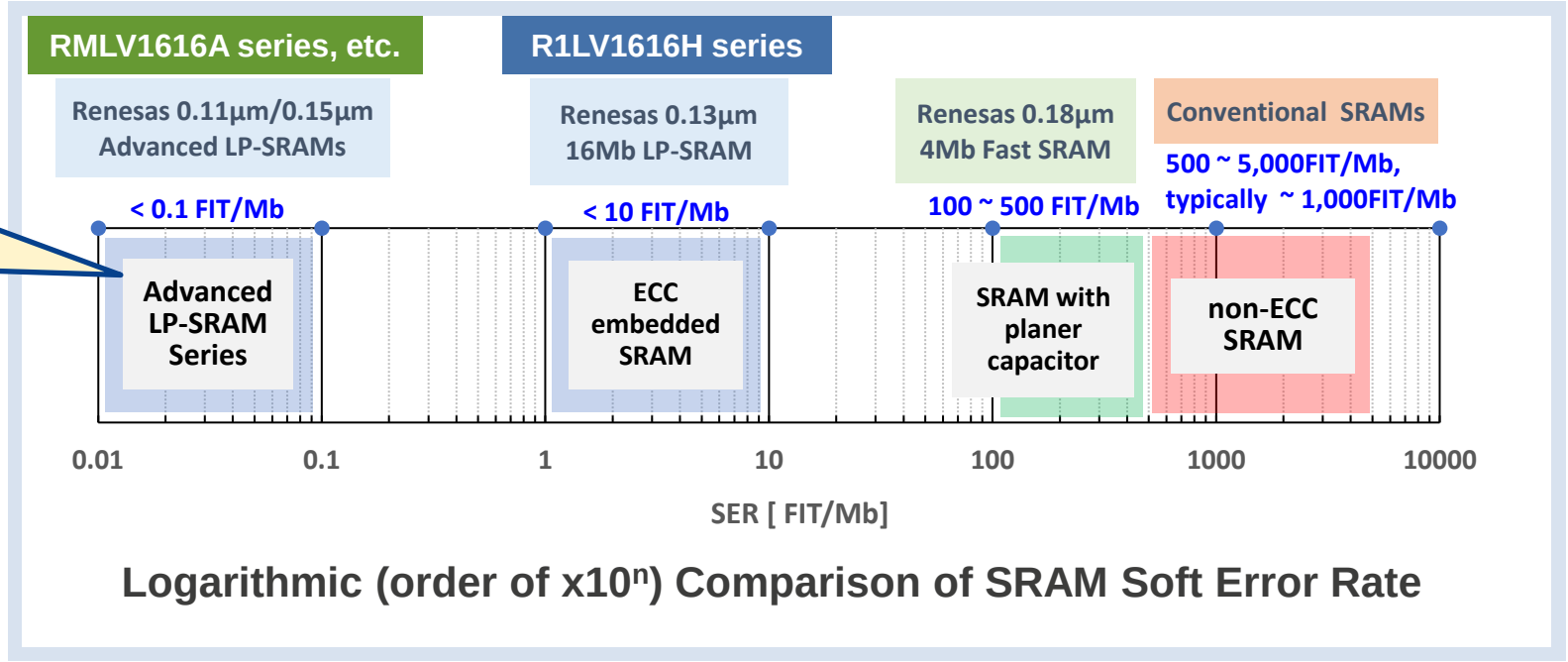
Technology Comparison

Soft-error Countermeasures

Product Family	ECC installed?	Soft Error Mitigation?	By what?	Soft error rate (Measured)	Differentiator
Advanced LPSRAM series (0.11µm / 0.15µm)	NO	YES	Increasing Critical Charge (Qcrit) by the proprietary technology	< 0.04 FIT/Mb [0.11µm] < 0.06 FIT/Mb [0.15µm]	Outstanding soft error rate over ECC-based products
(EOL) R1LV1616H series (0.13µm CMOS 16Mb)	YES	YES	Embedded ECC	< 5.5 FIT/Mb	Single FIT/Mb: excellent soft error rate in practical use

Note: Critical charge (Qcrit) is the minimum electric charge to cause a bit flip.

Advanced LPSRAM is Superior to ECC-based SRAM



Logarithmic (order of x10^n) Comparison of SRAM Soft Error Rate

Process & Device technology

Advanced Low Power SRAM

- Exclusive technology achieves both high-performance and high-reliability without any technical trade-off
- Excellent soft error immunity without embedded ECC
- Latch-up free memory cell structure

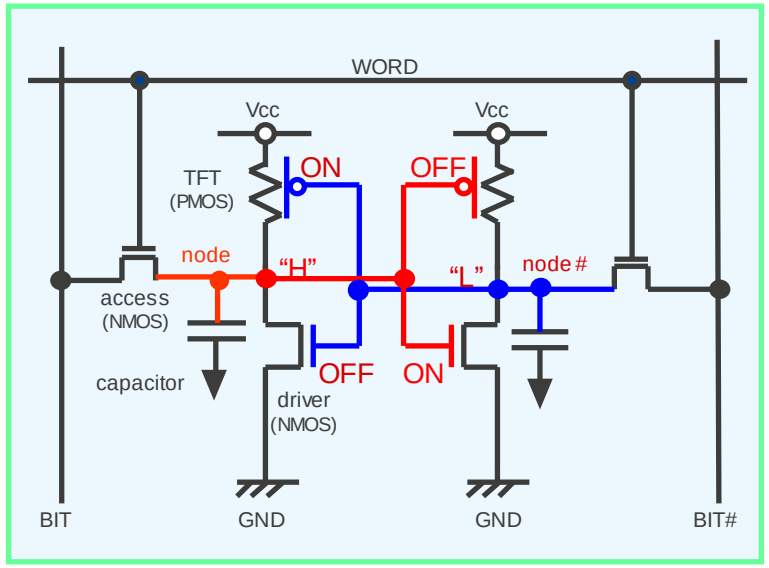


Fig.1: Memory cell circuit

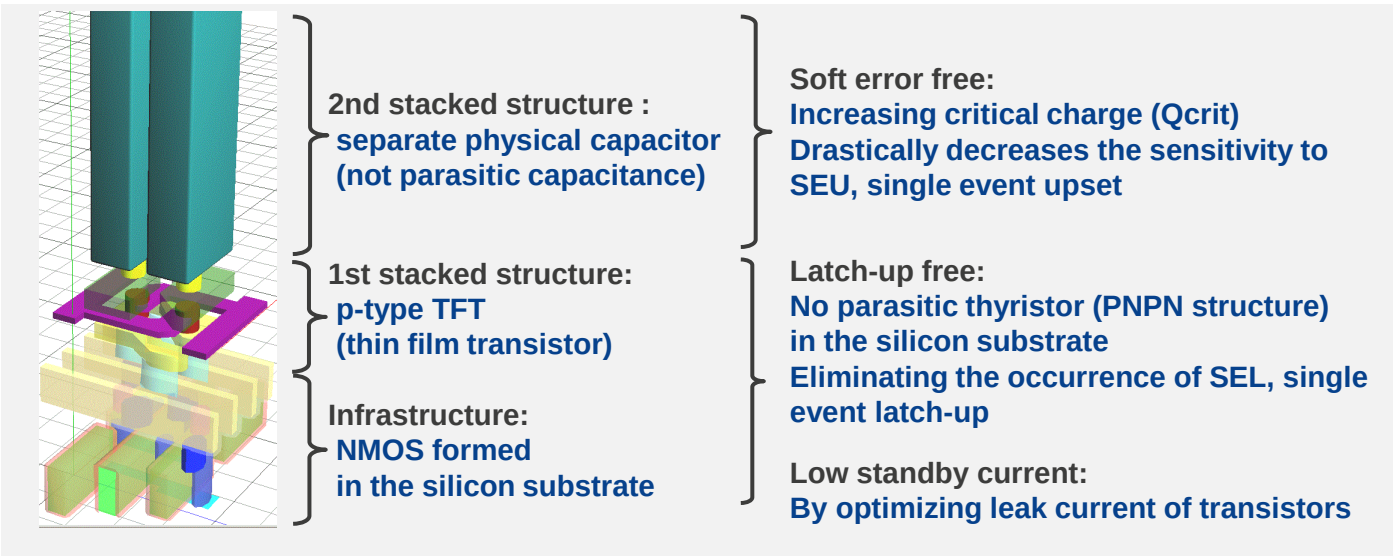
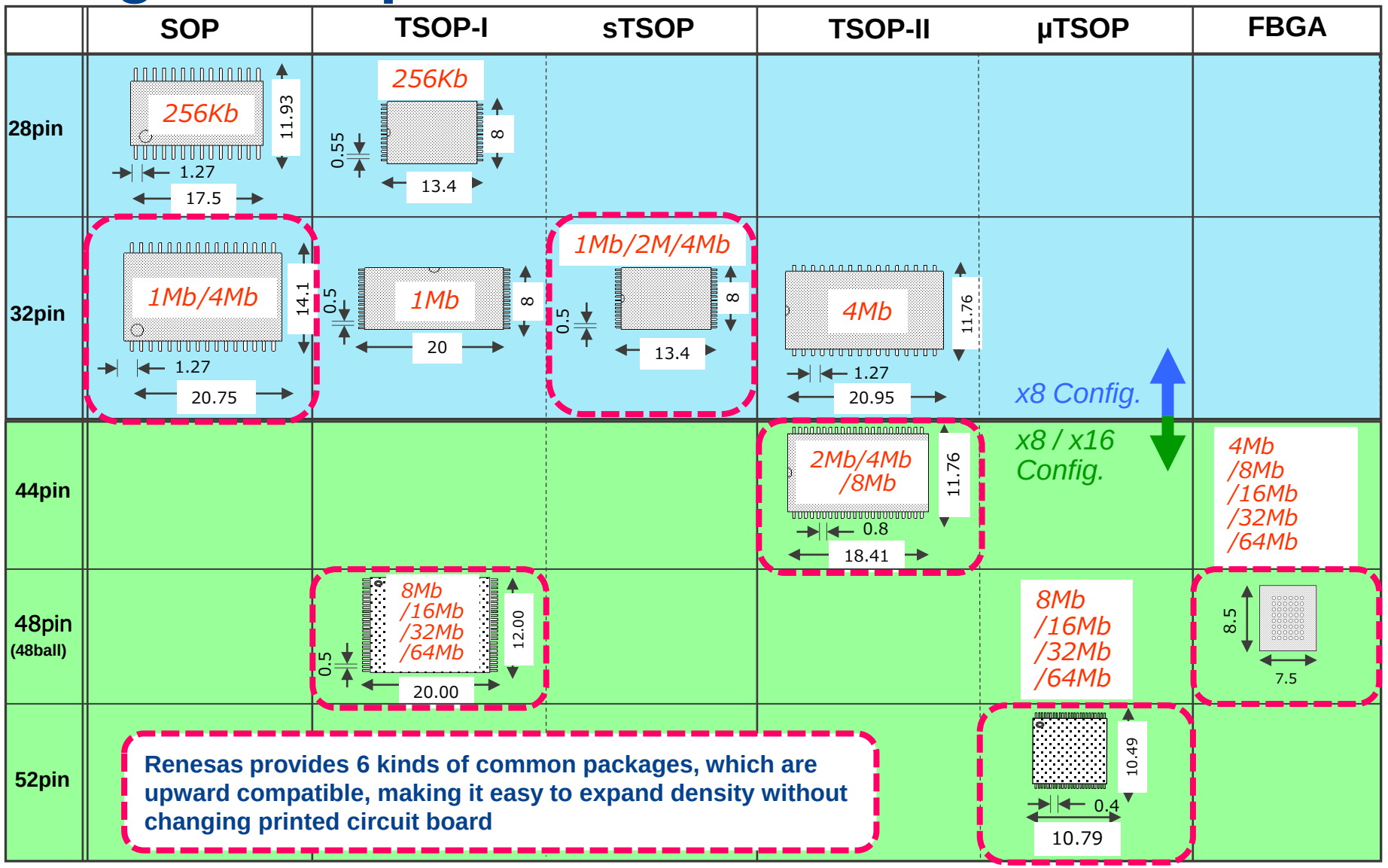


Fig.2: 3D image of the memory cell

Renesas LPSRAM

Package Lineup



Product Lineup

Low Power SRAMs (256Kb ~ 4Mb)

Product Series	Density	Org.	Operating Voltage	Access Time	Standby Current (typ.)	Operating Temperature	Chip Select Option	Package				Mass Production	PLP
								TSOP	SOP	FBGA	µTSOP		
R1LP5256E	256 Kb	x8	4.5 ~ 5.5V	55	0.6 µA	-40°C ~ 85°C	1: CS#	✓	✓			Now	Dec. 2032
R1LP0108E	1 Mb	x8	4.5 ~ 5.5V	55	0.6 µA	-40°C ~ 85°C	2: CS1#, CS2	✓	✓			Now	Dec. 2032 *Mar. 2031
R1LP0408D	4Mb	x8	4.5 ~ 5.5V	55	0.8 µA	-40°C ~ 85°C	1: CS#	✓	✓			Now	Dec. 2032 *Mar. 2031
R1LV5256E	256 Kb	x8	2.7 ~ 3.6V	55	0.6 µA	-40°C ~ 85°C	1: CS#	✓	✓			Now	Dec. 2032
R1LV0108E	1 Mb	x8	2.7 ~ 3.6V	55	0.6 µA	-40°C ~ 85°C	2: CS1#, CS2	✓	✓			Now	Dec. 2032 *Mar. 2031
R1LV0208BSA	2 Mb	x8	2.7 ~ 3.6V	55	1 µA	-40°C ~ 85°C	2: CS1#, CS2	✓				Now	Dec. 2032
R1LV0216BSB	2 Mb	x16	2.7 ~ 3.6V	55	1 µA	-40°C ~ 85°C	1: CS#	✓				Now	Dec. 2032
RMLV0408E	4 Mb	x8	2.7 ~ 3.6V	45	0.3 µA	-40°C ~ 85°C	1: CS#	✓	✓			Now	Dec. 2032 *Mar. 2031
RMLV0414E	4 Mb	x16	2.7 ~ 3.6V	45	0.3 µA	-40°C ~ 85°C	1: CS#	✓				Now	Dec. 2032
RMLV0416E	4 Mb	x16	2.7 ~ 3.6V	45	0.3 µA	-40°C ~ 85°C	2: CS1#, CS2	✓		✓		Now	Dec. 2032

*** For TSOP-I (32) and TSOP-II (32) packages**

(Note) Check the Renesas website for respective orderable part names.

Low Power SRAMs | Renesas

Product Lineup

Low Power SRAMs (8Mb ~ 64Mb)

Product Series	Density	Org.	Operating Voltage	Access Time	Standby Current (typ.)	Operating Temperature	Chip Select Option	Package				Mass Production	PLP
								TSOP	SOP	FBGA	µTSOP		
RMLV0808BGSB	8 Mb	x8	2.4 ~ 3.6V	45ns	0.45 µA	-40°C ~ 85°C	2: CS1#, CS2	✓				Now	Dec. 2032
RMLV0816BGBG	8 Mb	x16	2.4 ~ 3.6V	45ns	0.45 µA	-40°C ~ 85°C	2: CS1#, CS2			✓		Now	Dec. 2032
RMLV0816BGSA	8 Mb	x16	2.4 ~ 3.6V	45ns	0.45 µA	-40°C ~ 85°C	2: CS1#, CS2	✓				Now	Dec. 2032
RMLV0816BGSB	8 Mb	x16	2.4 ~ 3.6V	45ns	0.45 µA	-40°C ~ 85°C	1: CS#	✓				Now	Dec. 2032
RMLV0816BGSD	8 Mb	x16	2.4 ~ 3.6V	45ns	0.45 µA	-40°C ~ 85°C	2: CS1#, CS2				✓	Now	Dec. 2032
RMLV1616A-S	16 Mb	x16	2.7 ~ 3.6V	55ns	0.5 µA	-40°C ~ 85°C	2: CS1#, CS2	✓		✓	✓	Now	Dec. 2032
RMLV1616A-U	16 Mb	x16	2.7 ~ 3.6V	45ns, 55ns	0.4 µA	-40°C ~ 85°C	2: CS1#, CS2	✓		✓		Now	Dec. 2032 (Planned*)
RMLV3216A	32 Mb	x16	2.7 ~ 3.6V	55ns	0.6 µA	-40°C ~ 85°C	2: CS1#, CS2	✓		✓	✓	Now	Dec. 2032
RMWV3216A	32 Mb	x16	2.7 ~ 3.6V	55ns	1 µA	-40°C ~ 85°C	2: CS1#, CS2			✓		Now	Dec. 2032
RMWV6416A	64 Mb	x16	2.7 ~ 3.6V	55ns	1.2 µA	-40°C ~ 85°C	2: CS1#, CS2	✓		✓	✓	Now	Dec. 2032

*** To be given the same PLP period as other SRAMs.**

(Note) Check the Renesas website for respective orderable part names.

Low Power SRAMs | Renesas

Product Lineup

Asynchronous Fast SRAMs (4Mb)

Product Series	Density	Org.	Operating Voltage	Access Time	Standby Current (max.) Std. / L-ver. / S-ver.	Operating Temperature	Chip Select Option	Package		Mass Production	PLP (for TSOP)
								TSOP	SOJ		
R1RP0408D-I	4Mb	x8	4.5 ~ 5.5V	12ns	5mA / - / -	-40°C ~ 85°C	1: CS#		✓	Now	-
R1RP0408D-R	4Mb	x8	4.5 ~ 5.5V	12ns	5mA / 1.0mA / -	0°C ~ 70°C	1: CS#		✓	Now	-
R1RP0416D-I	4Mb	x16	4.5 ~ 5.5V	10ns, 12ns	5mA / - / -	-40°C ~ 85°C	1: CS#	✓	✓	Now	Dec. 2032
R1RP0416D-R	4Mb	x16	4.5 ~ 5.5V	10ns, 12ns	5mA / 1.0mA / 0.5mA	0°C ~ 70°C	1: CS#	✓	✓	Now	Dec. 2032
R1RW0408D-I	4Mb	X8	3.0 ~ 3.6V	12ns	5mA / - / -	-40°C ~ 85°C	1: CS#		✓	Now	-
R1RW0408D-R	4Mb	x8	3.0 ~ 3.6V	12ns	5mA / 0.8mA / -	0°C ~ 70°C	1: CS#		✓	Now	-
R1RW0416D-I	4Mb	x16	3.0 ~ 3.6V	10ns, 12ns	5mA / - / -	-40°C ~ 85°C	1: CS#	✓	✓	Now	Dec. 2032
R1RW0416D-R	4Mb	x16	3.0 ~ 3.6V	10ns, 12ns	5mA / 0.8mA / 0.5mA	0°C ~ 70°C	1: CS#	✓	✓	Now	Dec. 2032

(Note) Check the Renesas website for respective orderable part names.

Asynchronous SRAMs | Renesas

Low Power SRAM : Part name decoder

R1 L V 5256 E SA - 5 S I #B1

R1 L P 04 08 D SP - 5 S I #B1

RM L V 04 16 E G SB - 4 S 2 #A A 1

RENESAS Memory

Chip configuration

L	LPSRAM, Single chip
W	LPSRAM, Two chips

Operating Voltage

V	3V
P	5V

Memory Density

5256	256Kb (x8)
01	1Mb
02	2Mb
04	4Mb
08	8Mb
16	16Mb
32	32Mb
64	64Mb

Bus Width

08	x8
16	x16

Chip Generation

Industrial Grade

Package Type

SA	TSOP-I (256Kb/8Mb/16Mb/32Mb/64Mb) sTSOP (1Mb/2Mb/4Mb)
SB	TSOP-II
SD	µTSOP
SF	TSOP-I (1Mb)
SP	SOP (256Kb, 4Mb)
SN	SOP (1Mb)
BG	FBGA

Access time

5	55 ns
4	45 ns

Stand-by current / Data retention current

S	Low power version
U	Ultra Low power version

Operating Temperature

R	0 ~ 70°C
I	-40 ~ 85°C
2	-40 ~ 85°C

Packing

A	Tray
C	Magazine
H	Tape & Reel (TSOP-II, µTSOP, SOP)
K	Tape & Reel (FBGA, TSOP-I, sTSOP)

Environment

A	Pb free (pure-Tin plating)
C	Pb free (non-pure-Tin plating)

Assembly Site Rev. , etc.

0	Rev. Code
1	Rev. Code

Packing, Environmental

	Packing	Environmental
#B0 / #B1	Tray or Magazine	Pb free
#S0 / #S1	Tape & Reel	Pb free

Asynchronous Fast 4Mb SRAM : Part name decoder

R1 R W 04 16 D SB - 2 P I #D1

RENESAS Memory

Fast SRAM

Operation Voltage

W	3.3V
P	5V

Memory density

04	4Mb

Bus Width

08	x8
16	x16

Chip generation

Package type

GE	SOJ
SB	TSOP-II

Access time

2	12 ns
0	10 ns

Stand by current / Data retention current

P	Standard
L	Low power version
S	Super Low power version

Operating Temperature

R	0 ~ 70°C
I	-40 ~ 85°C

Packing, Environmental

	Packing	Environmental
#B0 / #B1	Magazine (SOJ)	Pb free
#D0 / #D1	Tray (TSOP)	Pb free
#S0 / #S1	Tape & Reel	Pb free

Renesas.com