



SPI NOR FLASH Guide

Standard and System Enhancing Memory



More choices for the system designer

Renesas gives the system designer more choices in data and code storage to meet the power, processing and bandwidth challenges of power-conscious environments.

In addition to our Standard class of Flash that is designed for tasks such as system boot, our System-Enhancing class of memory can reduce MCU overhead and save up to 85% energy.

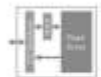
Standard Products

UNIVERSAL COMPATIBILITY

Ideal for simple Bootloader and Execute-in-Place tasks



STANDARD
PIN OUT



STANDARD
ARCHITECTURE



STANDARD
COMMANDS

System-Enhancing Products

IMPROVED SYSTEM PERFORMANCE

Designed to save up to 85% energy and reduce MCU overhead



POWER and
ENERGY SAVINGS



REDUCED
CPU OVERHEAD



SIMPLIFIED
SOFTWARE



HIGH EFFICIENCY
ROBUST DATA
LOGGING



Supports
EXECUTE-IN-PLACE

How to use this Guide

Use the links in the Table of Contents on the next page to navigate to the listings of density, voltage and tips on how to save system energy and improve performance.

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Flash by Task





How the Flash is used in the system will determine which Renesas solution will deliver the best performance and energy efficiency to your design.

While the Standard class is well suited for a bootloader task, Renesas goes further with its System-Enhancing products that reduce host controller overhead and significantly reduce power consumption in power-hungry tasks such as data logging.

| | Task | Requirement |
|---|---------------------------------|---|
|  | Boot and Code Shadow | <ul style="list-style-type: none">• Low power fast Read• Low power Sleep |
|  | Execute-in-Place | <ul style="list-style-type: none">• Continuous Read mode• Low power fast Read• Low power Sleep |
|  | System Settings & configuration | <ul style="list-style-type: none">• Fast update• Fast erase• Low power programming• Low power Sleep |
|  | Data Logging | <ul style="list-style-type: none">• High Endurance• Fast update• Low power programming• Fast save on power failure• User-controlled SRAM buffer |

Memory selection by Task

Renesas offers a broad range of Flash products to fit the Task, ranging from 256 Kb up to 128 Mb available in 1.8 Volt, 3 Volt and our WIDE Vcc choices.

| | | Renesas Flash Families | |
|---|-----------------------------------|---|---|
| | Task | Density | |
|  | Boot and Code Shadow | <ul style="list-style-type: none"> • 32Mbit - 128Mbit • 4Mbit - 128Mbit • 4Mbit - 32Mbit • 1Mbit - 4Mbit | <ul style="list-style-type: none"> • AT25SL • AT25SF • AT25FF • AT25EU Ultra Low Energy |
|  | Execute in Place | <ul style="list-style-type: none"> • 4Mbit - 32Mbit • 4Mbit - 32Mbit • 32Mbit - 128Mbit • 4Mbit - 128Mbit | <ul style="list-style-type: none"> • AT25XE FusionHD • AT25FF • AT25SL • AT25SF |
|  | System Settings and configuration | <ul style="list-style-type: none"> • 1Mbit - 4Mbit • 4Mbit - 32Mbit • 4Mbit - 32Mbit • 256Kbit - 4Mbit | <ul style="list-style-type: none"> • AT25EU Ultra Low Energy • AT25XE FusionHD • AT25FF • AT25DF Fusion |
|  | Data Logging | <ul style="list-style-type: none"> • 2Mbit - 64Mbit • 4Mbit - 32Mbit | <ul style="list-style-type: none"> • AT45DB DataFlash® • AT25XE FusionHD |

Power vs Energy

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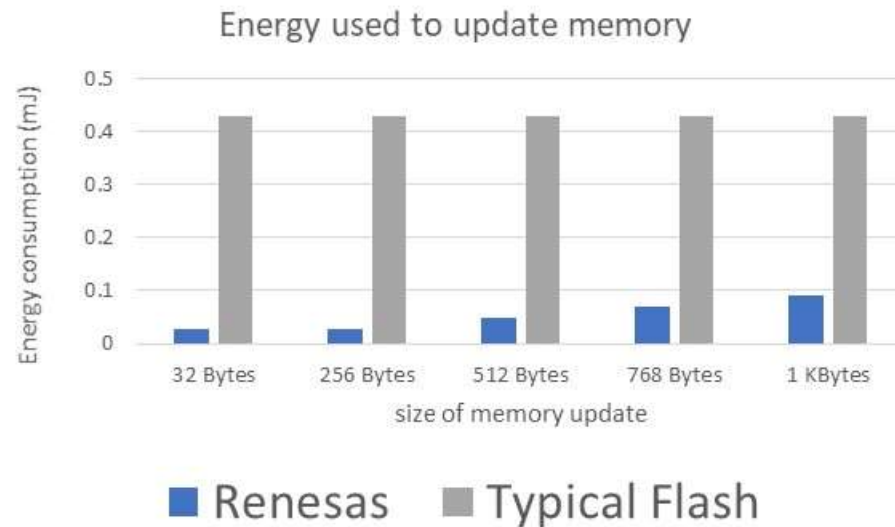


voltage x current x *time*

The pursuit of smaller and more powerful devices challenges system designers to achieve longer battery life without sacrificing performance. Often, low-power Flash devices come at the expense of longer execute times that can consume more energy and shorten battery life.

Renesas System-Enhancing solutions are designed with features that make it easy to achieve significant energy savings to your design through faster execute times and lower power circuits.

Ordinary low power Flash can consume up to 4 times more energy than our System Enhancing Flash depending upon the task.



*Based on AT25EU using Small Page Erase option

ALL PRODUCTS

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DENSITY

| | | | | | | | | |
|--------------------------------|----------------------|----------------------|----------------------|-----------------------|-----------------------|-----------------------|------------------------|------------------------|
| Up to 1 Mb | 2 Mb | 4 Mb | 8 Mb | 16 Mb | 32 Mb | 64 Mb | 128 Mb | 256 Mb |
|--------------------------------|----------------------|----------------------|----------------------|-----------------------|-----------------------|-----------------------|------------------------|------------------------|

OPERATING VOLTAGE

| | | |
|------------------------------|---------------------|-----------------------|
| WIDE VCC | 3 V | 1.8 V |
|------------------------------|---------------------|-----------------------|

SYSTEM-ENHANCING FLASH; Save energy and improve performance

| | |
|----------------------------|---------------------------|
| DataFlash™ | FusionHD™ |
|----------------------------|---------------------------|

Up to 1 Mb

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| Density | Product # | Read Speed (MHz) | Oper Voltage | Interface | Low power Sleep | Read current (mA) | | | Bootloader | XiP | Sys Settings | Data Logging |
|---------|-------------|------------------|-----------------|-----------------|-----------------|-------------------|---------------------|-----------------------------|------------|-----|--------------|--------------|
| 1 Mb | AT25EU0011A | 85 | 1.65 V to 3.6 V | SPI, Dual, Quad | 100 nA | 1.2 | Lowest energy Flash | For battery-powered designs | ● | ● | ● | |
| 1 Mb | AT25DF011 | 104 | 1.65 V to 3.6 V | SPI, Dual | 200 nA | 4.5 | | For battery-powered designs | ● | | ● | ● |
| 1 Mb | AT25XE011 | 104 | 1.65 V to 3.6 V | SPI, Dual | 200 nA | 3.5 | | For battery-powered designs | ● | | ● | ● |
| 1 Mb | AT25DN011 | 104 | 2.3 V to 3.6 V | SPI, Dual | 350 nA | 6 | | | ● | | ● | ● |
| 512 Kb | AT25DF512C | 104 | 1.65 V to 3.6 V | SPI, Dual | 200 nA | 4.5 | | For battery-powered designs | ● | | ● | ● |
| 512 Kb | AT25XE512C | 104 | 1.65 V to 3.6 V | SPI, Dual | 200 nA | 4.5 | | For battery-powered designs | ● | | ● | ● |
| 512 Kb | AT25DN512C | 104 | 2.3 V to 3.6 V | SPI, Dual | 350 nA | 6 | | | ● | | ● | ● |
| 256 Kb | AT25DF256 | 104 | 1.65 V to 3.6 V | SPI, Dual | 200 nA | 4.5 | | For battery-powered designs | ● | | ● | ● |
| 256 Kb | AT25DN256 | 104 | 2.3 V to 3.6 V | SPI, Dual | 350 nA | 6 | | | ● | | ● | ● |

2 Mb

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| Energy Saving System Enhancing Class | Product # | Read Speed (MHz) | Oper Voltage | Interface | Low power Sleep | Read current (mA) | | | Bootloader | XIP | Sys Settings | Data Logging |
|--------------------------------------|-------------|------------------|-----------------|-----------------|-----------------|-------------------|--|-------------------------------|------------|-----|--------------|--------------|
| ★ | AT25EU0021A | 85 | 1.65 V to 3.6 V | SPI, Dual, Quad | 100 nA | 1.2 | lowest energy Flash | For battery-powered designs | ● | ● | ● | |
| ★ | AT45DB021E | 85 | 1.65 V to 3.6 V | SPI | 200 nA | 4.5 | Robust, highest efficiency | User-controlled SRAM included | | | ● | ● |
| ★ | AT25DF021A | 104 | 1.65 V to 3.6 V | SPI, Dual | 200 nA | 4.5 | | | ● | | ● | ● |
| ★ | AT25XE021A | 70 | 1.65 V to 3.6 V | SPI, Dual | 200 nA | 3.5 | | | ● | | ● | ● |
| ★ | AT25XV021A | 70 | 1.65 V to 4.4 V | SPI, Dual | 200 nA | 4.5 | | | ● | | ● | ● |
| ★ | AT25PE20 | 85 | 1.65 V to 3.6 V | SPI | 200 nA | 4.5 | Robust, highest efficiency with STANDARD pin-out | User-controlled SRAM included | | | ● | ● |

4 Mb

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| Energy Saving System Enhancing Class | Product # | Read Speed (MHz) | Oper Voltage | Interface | Low power Sleep | Read current (mA) | | | Bootloader | XiP | Sys Settings | Data Logging |
|--------------------------------------|-------------|------------------|-----------------|-----------------|-----------------|-------------------|--|-------------------------------|------------|-----|--------------|--------------|
| ★ | AT25DF041B | 85 | 1.65V to 3.6V | SPI, Dual | 200 nA | 4.5 | | | ● | | ● | ● |
| ★ | AT25EU0041A | 108 | 1.65 V to 3.6 V | SPI, Dual, Quad | 100 nA | 1.2 | lowest energy Flash | For battery-powered designs | ● | ● | ● | |
| ★ | AT25XE041B | 85 | 1.65 V to 3.6V | SPI, Dual | 200 nA | 3.5 | | | ● | | ● | ● |
| ★ | AT25XE041D | 133 | 1.65V to 3.6V | SPI, Dual, Quad | 7 nA | 5.6 | Uses up to 70% less power | reduce MCU overhead | ● | ● | ● | ● |
| ★ | AT25XV041B | 85 | 1.65V to 4.4V | SPI, Dual | 200 nA | 3.5 | | | ● | | ● | ● |
| ★ | AT45DB041E | 104 | 1.65V to 3.6V | SPI | 400 nA | 6 | Robust, highest efficiency | User-controlled SRAM included | | | ● | ● |
| | AT25FF041A | 133 | 1.65 V to 3.6V | SPI, Dual, Quad | 7 nA | 8.5 | Lowest power Sleep | | ● | ● | ● | |
| | AT25SF041B | 108 | 2.5V to 3.6V | SPI, Dual, Quad | 1.2 uA | 3.3 | | | ● | ● | | |
| ★ | AT25PE40 | 104 | 1.65V to 3.6V | SPI | 400 nA | 6 | Robust, highest efficiency with STANDARD pin-out | User-controlled SRAM included | | | ● | ● |

8 Mb

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| Energy Saving System Enhancing Class | Product # | Read Speed (MHz) | Oper Voltage | Interface | Low power Sleep | Read current (mA) | | | Bootloader | XiP | Sys Settings | Data Logging |
|--------------------------------------|-------------|------------------|------------------|-----------------|-----------------|-------------------|--|-------------------------------|------------|-----|--------------|--------------|
| ★ | AT25XE081D | 133 | 1.65 V to 3.6 V | SPI, Dual, Quad | 7 nA | 5.6 | Uses up to 70% less power | reduce MCU overhead | ● | ● | ● | ● |
| ★ | AT25EU0081A | 108 | 1.65 V to 3.6 V | SPI, Dual, Quad | 100 nA | 5.6 | Uses up to 70% less power | reduce MCU overhead | ● | ● | ● | ● |
| ★ | AT45DB081E | 133 | 1.7 V to 3.6 V | SPI | 400 nA | 6 | Robust, highest efficiency | User-controlled SRAM included | | | ● | ● |
| | AT25DL081 | 85 | 1.65 V to 1.95 V | SPI, Dual | 8 uA | 10 | | | ● | | | |
| | AT25FF081A | 133 | 1.65 V to 3.6 V | SPI, Dual, Quad | 7 nA | 8.5 | Lowest power Sleep | | ● | ● | ● | |
| | AT25SF081B | 108 | 2.5 V to 3.6 V | SPI, Dual, Quad | 1.2 uA | 3.3 | | | ● | ● | | |
| | AT25DF081A | 100 | 2.7 V to 3.6 V | SPI, Dual | 5 uA | 12 | | | ● | | | |
| ★ | AT25PE80 | 133 | 1.7 V to 3.6 V | SPI | 400 nA | 6 | Robust, highest efficiency with STANDARD pin-out | User-controlled SRAM included | | | ● | ● |

16 Mb

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▶ All products by density

| Energy Saving System Enhancing Class | Product # | Read Speed (MHz) | Oper Voltage | Interface | Low power Sleep | Read current (mA) | | | Bootloader | XiP | Sys Settings | Data Logging |
|--------------------------------------|-------------|------------------|------------------|-----------------|-----------------|-------------------|--|-------------------------------|------------|-----|--------------|--------------|
| ★ | AT25XE161D | 133 | 1.65 V to 3.6V | SPI, Dual, Quad | 7 nA | 5.5 | Uses up to 70% less power | reduce MCU overhead | ● | ● | ● | ● |
| ★ | AT25EU0161A | 108 | 1.65 V to 3.6V | SPI, Dual, Quad | 100 nA | 5.5 | Uses up to 70% less power | reduce MCU overhead | ● | ● | ● | ● |
| ★ | AT45DB161E | 104 | 2.3V to 3.6V | SPI | 400 nA | 6 | Robust, highest efficiency | User-controlled SRAM included | | | ● | ● |
| ★ | AT45DQ161 | 100 | 2.3V to 3.6V | SPI, Dual, Quad | 400 nA | 6 | Robust, highest efficiency | User-controlled SRAM included | | | ● | ● |
| | AT25DL161 | 85 | 1.65 V to 1.95 V | SPI, Dual | 8 uA | 10 | | | ● | | | |
| | AT25FF161A | 133 | 1.65V to 3.6V | SPI, Dual, Quad | 7 nA | 8.5 | Lowest power Sleep | | ● | ● | ● | |
| | AT25SF161B | 108 | 2.7 V to 3.6V | SPI, Dual, Quad | 1.2 uA | 3.3 | | | ● | ● | | |
| ★ | AT25PE16 | 104 | 2.3V to 3.6V | SPI | 400 nA | 6 | Robust, highest efficiency with STANDARD pin-out | User-controlled SRAM included | | | ● | ● |

32 Mb

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▶ All products by density

| Energy Saving System Enhancing Class | Product # | Read Speed (MHz) | Oper Voltage | Interface | Low power Sleep | Read current (mA) | | | Bootloader | XiP | Sys Settings | Data Logging |
|--------------------------------------|------------|------------------|-----------------|-------------------------|-----------------|-------------------|----------------------------|-------------------------------|------------|-----|--------------|--------------|
| ★ | AT25XE321D | 133 | 1.65 V to 3.6 V | SPI, Dual, Quad | 7 nA | 5.5 | Uses up to 70% less power | reduce MCU overhead | ● | ● | ● | ● |
| ★ | AT45DB321E | 104 | 2.3 V to 3.6 V | SPI | 400 nA | 6 | Robust, highest efficiency | User-controlled SRAM included | | | ● | ● |
| ★ | AT45DQ321 | 104 | 2.3 V to 3.6 V | SPI, Dual, Quad | 400 nA | 6 | Robust, highest efficiency | User-controlled SRAM included | | | ● | ● |
| | AT25FF321A | 133 | 1.65 V to 3.6 V | SPI, Dual, Quad | 7 nA | 8.5 | Lowest power Sleep | | ● | ● | ● | |
| | AT25QL321 | 104 | 1.7 V to 2 V | SPI, Dual, Quad-default | 2 uA | 5 | | | ● | ● | | |
| | AT25SF321B | 108 | 2.7 V to 3.6 V | SPI, Dual, Quad | 1.2 uA | 3.3 | | | ● | ● | | |
| | AT25SL321 | 104 | 1.7 V to 2 V | SPI, Dual, Quad | 2 uA | 5 | | | ● | ● | | |
| | AT25DF321A | 100 | 2.7 V to 3.6 V | SPI, Dual | 5 uA | 12 | | | ● | | | |

64 Mb

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| Energy Saving System Enhancing Class | Product # | Read Speed (MHz) | Oper Voltage | Interface | Low power Sleep | Read current (mA) | | | Bootloader | XiP | Sys Settings | Data Logging |
|--------------------------------------|------------|------------------|----------------|-------------------------|-----------------|-------------------|----------------------------|-------------------------------|------------|-----|--------------|--------------|
| ★ | AT45DB641E | 85 | 1.7 V to 3.6 V | SPI | 400 nA | 7 | Robust, highest efficiency | User-controlled SRAM included | | | ● | ● |
| | AT25QF641B | 104 | 2.7 V to 3.6 V | SPI, Dual, Quad-default | 1.2 uA | 3.3 | | | ● | ● | | |
| | AT25QL641 | 133 | 1.7 V to 2 V | SPI, Dual, Quad-default | 2 uA | 5 | | | ● | ● | | |
| | AT25SF641B | 104 | 2.7 V to 3.6 V | SPI, Dual, Quad | 1.2 uA | 3.3 | | | ● | ● | | |
| | AT25SL641 | 133 | 1.7 V to 2 V | SPI, Dual, Quad | 2 uA | 5 | | | ● | ● | | |
| | AT25DF641A | 100 | 2.7 V to 3.6 V | SPI, Dual | 5 uA | 25 | | | ● | | | |

128 Mb

| Product # | Read Speed (MHz) | Oper Voltage | Interface | Low power Sleep | Read current (mA) | Bootloader | XiP | Sys Settings | Data Logging |
|------------|------------------|----------------|-------------------------|-----------------|-------------------|------------|-----|--------------|--------------|
| AT25QF128A | 133 | 2.7 V to 3.6 V | SPI, Dual, Quad-default | 2 uA | 12 | ● | ● | | |
| AT25QL128A | 133 | 1.7 V to 2 V | SPI, Dual, Quad-default | 2 uA | 7 | ● | ● | | |
| AT25SF128A | 133 | 2.7 V to 3.6 V | SPI, Dual, Quad | 2 uA | 12 | ● | ● | | |
| AT25SL128A | 133 | 1.7 V to 2 V | SPI, Dual, Quad | 2 uA | 7 | ● | ● | | |

For 1.8 Volt applications

★ Wide voltage solutions also available ([go to WIDE VCC](#))

| Wide Voltage Available | Density | Product # | Read Speed (MHz) | Oper Voltage | Interface | Low power Sleep | Read current (mA) | Bootloader | XIP | Sys Settings | Data |
|------------------------|---------|------------|------------------|------------------|-------------------------|-----------------|-------------------|------------|-----|--------------|------|
| | 128 Mb | AT25QL128A | 133 | 1.7 V to 2 V | SPI, Dual, Quad-default | 2 uA | 7 | ● | ● | | |
| | 128 Mb | AT25SL128A | 133 | 1.7 V to 2 V | SPI, Dual, Quad | 2 uA | 7 | ● | ● | | |
| | 64 Mb | AT25QL641 | 133 | 1.7 V to 2 V | SPI, Dual, Quad-default | 2 uA | 5 | ● | ● | | |
| | 64 Mb | AT25SL641 | 133 | 1.7 V to 2 V | SPI, Dual, Quad | 2 uA | 5 | ● | ● | | |
| ★ | 32 Mb | AT25QL321 | 104 | 1.7 V to 2 V | SPI, Dual, Quad-default | 2 uA | 5 | ● | ● | | |
| ★ | 32 Mb | AT25SL321 | 104 | 1.7 V to 2 V | SPI, Dual, Quad | 2 uA | 5 | ● | ● | | |
| ★ | 16 Mb | AT25DL161 | 85 | 1.65 V to 1.95 V | SPI, Dual | 8 uA | 10 | ● | | | |
| ★ | 8 Mb | AT25DL081 | 85 | 1.65 V to 1.95 V | SPI, Dual | 8 uA | 10 | ● | | | |

For 3 Volt applications

★ Wide voltage solutions also available ([go to WIDE VCC](#))

| Wide Voltage Available | Density | Product # | Read Speed (MHz) | Oper Voltage | Interface | Low power Sleep | Read current (mA) | | Bootloader | XIP | Sys Settings | Data Logging |
|------------------------|---------|------------|------------------|----------------|-------------------------|-----------------|-------------------|--|-------------------------------|-----|--------------|--------------|
| | 128 Mb | AT25QF128A | 133 | 2.7 V to 3.6 V | SPI, Dual, Quad-default | 2 uA | 12 | | ● | ● | | |
| | 128 Mb | AT25SF128A | 133 | 2.7 V to 3.6 V | SPI, Dual, Quad | 2 uA | 12 | | ● | ● | | |
| | 64 Mb | AT25QF641B | 104 | 2.7 V to 3.6 V | SPI, Dual, Quad-default | 1.2 uA | 3.3 | | ● | ● | | |
| | 64 Mb | AT25SF641B | 104 | 2.7 V to 3.6 V | SPI, Dual, Quad | 1.2 uA | 3.3 | | ● | ● | | |
| | 64 Mb | AT25DF641A | 100 | 2.7 V to 3.6 V | SPI, Dual | 5 uA | 25 | | ● | | | |
| ★ | 32 Mb | AT45DB321E | 104 | 2.3 V to 3.6 V | SPI | 400 nA | 6 | Robust, highest efficiency | User-controlled SRAM included | | ● | ● |
| ★ | 32 Mb | AT45DQ321 | 104 | 2.3 V to 3.6 V | SPI, Dual, Quad | 400 nA | 6 | Robust, highest efficiency | User-controlled SRAM included | | ● | ● |
| ★ | 32 Mb | AT25SF321B | 108 | 2.7 V to 3.6 V | SPI, Dual, Quad | 1.2 uA | 3.3 | | ● | ● | | |
| | 32 Mb | AT25DF321A | 100 | 2.7 V to 3.6 V | SPI, Dual | 5 uA | 12 | | ● | | | |
| ★ | 16 Mb | AT45DB161E | 104 | 2.3 V to 3.6 V | SPI | 400 nA | 6 | Robust, highest efficiency | User-controlled SRAM included | | ● | ● |
| ★ | 16 Mb | AT45DQ161 | 100 | 2.3 V to 3.6 V | SPI, Dual, Quad | 400 nA | 6 | Robust, highest efficiency | User-controlled SRAM included | | ● | ● |
| ★ | 16 Mb | AT25PE16 | 104 | 2.3 V to 3.6 V | SPI | 400 nA | 6 | Robust, highest efficiency with STANDARD pin-out | User-controlled SRAM included | | ● | ● |
| ★ | 16 Mb | AT25SF161B | 108 | 2.7 V to 3.6 V | SPI, Dual, Quad | 1.2 uA | 3.3 | | ● | ● | | |
| ★ | 8 Mb | AT25SF081B | 108 | 2.5 V to 3.6 V | SPI, Dual, Quad | 1.2 uA | 3.3 | | ● | ● | | |
| ★ | 4 Mb | AT25SF041B | 108 | 2.5 V to 3.6 V | SPI, Dual, Quad | 1.2 uA | 3.3 | | ● | ● | | |
| ★ | 1 Mb | AT25DN011 | 108 | 2.3 V to 3.6 V | SPI, Dual | 350 nA | 6 | | ● | | ● | ● |
| ★ | 512 Kb | AT25DN512C | 108 | 2.3 V to 3.6 V | SPI, Dual | 350 nA | 6 | | ● | | ● | ● |
| ★ | 256 Kb | AT25DN256 | 108 | 2.3 V to 3.6 V | SPI, Dual | 350 nA | 6 | | ● | | ● | ● |

Widest voltage range

| System Enhancing | Density | Product # | Read Speed (MHz) | Interface | Low power Sleep | Read current (mA) | | | Bootloader | XIP | Sys Settings | Data |
|------------------|---------|-------------|------------------|-----------------|-----------------|-------------------|----------------------------|-------------------------------|------------|-----|--------------|------|
| ★ | 64 Mb | AT45DB641E | 85 | SPI | 400 nA | 7 | Robust, highest efficiency | User-controlled SRAM included | | | ● | ● |
| ★ | 32 Mb | AT25XE321D | 133 | SPI, Dual, Quad | 7 nA | 5.5 | Uses up to 70% less power | reduce MCU overhead | ● | ● | ● | ● |
| | 32 Mb | AT25FF321A | 133 | SPI, Dual, Quad | 7 nA | 8.5 | Lowest power Sleep | | ● | ● | ● | |
| ★ | 16 Mb | AT25XE161D | 133 | SPI, Dual, Quad | 7 nA | 5.5 | Uses up to 70% less power | reduce MCU overhead | ● | ● | ● | ● |
| | 16 Mb | AT25FF161A | 133 | SPI, Dual, Quad | 7 nA | 8.5 | Lowest power Sleep | | ● | ● | ● | |
| ★ | 8 Mb | AT25XE081D | 133 | SPI, Dual, Quad | 7 nA | 5.6 | Uses up to 70% less power | reduce MCU overhead | ● | ● | ● | ● |
| ★ | 8 Mb | AT45DB081E | 133 | SPI | 400 nA | 6 | Robust, highest efficiency | User-controlled SRAM included | | | ● | ● |
| ★ | 8 Mb | AT25EU0081A | 108 | SPI, Dual, Quad | 100 nA | 1.2 | lowest energy Flash | power-conscious designs | ● | ● | ● | |
| | 8 Mb | AT25FF081A | 133 | SPI, Dual, Quad | 7 nA | 8.5 | Lowest power Sleep | | ● | ● | ● | |
| ★ | 4 Mb | AT25EU0041A | 108 | SPI, Dual, Quad | 100 nA | 1.2 | lowest energy Flash | power-conscious designs | ● | ● | ● | |
| ★ | 4 Mb | AT25DF041B | 85 | SPI, Dual | 200 nA | 4.5 | | | | | ● | ● |
| ★ | 4 Mb | AT25XE041B | 85 | SPI, Dual | 200 nA | 3.5 | | | ● | | ● | ● |
| ★ | 4 Mb | AT25XE041D | 133 | SPI, Dual, Quad | 7 nA | 5.6 | Uses up to 70% less power | reduce MCU overhead | ● | ● | ● | ● |
| ★ | 4 Mb | AT25XV041B | 85 | SPI, Dual | 200 nA | 3.5 | | | ● | | ● | ● |
| ★ | 4 Mb | AT45DB041E | 104 | SPI | 400 nA | 6 | Robust, highest efficiency | User-controlled SRAM included | | | ● | ● |
| ★ | 4 Mb | AT25PE40 | 104 | SPI | 400 nA | 6 | Robust, highest efficiency | User-controlled SRAM included | | | ● | ● |
| | 4 Mb | AT25FF041A | 133 | SPI, Dual, Quad | 7 nA | 8.5 | Lowest power Sleep | | ● | ● | ● | |
| ★ | 2 Mb | AT25EU0021A | 85 | SPI, Dual, Quad | 100 nA | 1.2 | lowest energy Flash | power-conscious designs | ● | ● | ● | |
| ★ | 2 Mb | AT45DB021E | 85 | SPI | 200 nA | 4.5 | Robust, highest efficiency | User-controlled SRAM included | | | ● | ● |
| ★ | 2 Mb | AT25PE20 | 85 | SPI | 200 nA | 4.5 | Robust, highest efficiency | User-controlled SRAM included | | | ● | ● |
| ★ | 2 Mb | AT25DF021A | 104 | SPI, Dual | 200 nA | 4.5 | | | | | ● | ● |
| ★ | 2 Mb | AT25XE021A | 70 | SPI, Dual | 200 nA | 3.5 | | | ● | | ● | ● |
| ★ | 2 Mb | AT25XV021A | 70 | SPI, Dual | 200 nA | 4.5 | | | ● | | ● | ● |
| ★ | 1 Mb | AT25EU0011A | 85 | SPI, Dual, Quad | 100 nA | 1.2 | lowest energy Flash | power-conscious designs | ● | ● | ● | |
| ★ | 1 Mb | AT25DF011 | 104 | SPI, Dual | 200 nA | 4.5 | | | | | ● | ● |
| ★ | 1 Mb | AT25XE011 | 104 | SPI, Dual | 200 nA | 3.5 | | | ● | | ● | ● |
| ★ | 512 Kb | AT25DF512C | 104 | SPI, Dual | 200 nA | 4.5 | | | | | ● | ● |
| ★ | 512 Kb | AT25XE512C | 104 | SPI, Dual | 200 nA | 4.5 | | | ● | | ● | ● |
| ★ | 256 Kb | AT25DF256 | 104 | SPI, Dual | 200 nA | 4.5 | | | | | ● | ● |

System-Enhancing FusionHD and DataFlash™

Renesas Standard Flash is ideal for Bootloader and XiP tasks, but Renesas goes further and incorporates a suite of easy-to-use features in its FusionHD and DataFlash brands that can save significant system energy and overhead. All products are Wide Voltage, operating at a minimum of 1.65 Volts and up to 4.4 Volts.

Use FusionHD to realize 5x faster execution for less than 70% energy and take advantage of user-controlled SRAM buffers in every DataFlash to create the most efficient and robust Data Logging application in your design.

Click on the Benefits below to learn about the features that can improve system level performance.

click below to learn more

| Brand | Density | Product # | Read Speed (MHz) | Interface | Low power Sleep | Reduce MCU Overhead by 75% | Power Fail fast save | Save up to 70% energy on memory update | Eliminate polling Auto-alert MCU | Bootloader | XiP | Sys Settings | Data Logging |
|------------|---------|------------|------------------|-----------------|-----------------|----------------------------|----------------------|--|----------------------------------|------------|-----|--------------|--------------|
| DataFlash™ | 64 Mb | AT45DB641E | 85 | SPI | 400 nA | ● | ● | ● | ● | | | ● | ● |
| FusionHD™ | 32 Mb | AT25XE321D | 133 | SPI, Dual, Quad | 7 nA | ● | ● | ● | ● | ● | ● | ● | ● |
| DataFlash™ | 32 Mb | AT45DB321E | 104 | SPI | 400 nA | ● | ● | ● | ● | | | ● | ● |
| DataFlash™ | 32 Mb | AT45DQ321 | 104 | SPI, Dual, Quad | 400 nA | ● | ● | ● | ● | | | ● | ● |
| FusionHD™ | 16 Mb | AT25XE161D | 133 | SPI, Dual, Quad | 7 nA | ● | ● | ● | ● | ● | ● | ● | ● |
| DataFlash™ | 16 Mb | AT45DB161E | 104 | SPI | 400 nA | ● | ● | ● | ● | | | ● | ● |
| DataFlash™ | 16 Mb | AT45DQ161 | 100 | SPI, Dual, Quad | 400 nA | ● | ● | ● | ● | | | ● | ● |
| FusionHD™ | 8 Mb | AT25XE081D | 133 | SPI, Dual, Quad | 7 nA | ● | ● | ● | ● | ● | ● | ● | ● |
| DataFlash™ | 8 Mb | AT45DB081E | 133 | SPI | 400 nA | ● | ● | ● | ● | | | ● | ● |
| FusionHD™ | 4 Mb | AT25XE041D | 133 | SPI, Dual, Quad | 7 nA | ● | ● | ● | ● | ● | ● | ● | ● |
| DataFlash™ | 4 Mb | AT45DB041E | 104 | SPI | 400 nA | ● | ● | ● | ● | | | ● | ● |
| DataFlash™ | 2 Mb | AT45DB021E | 85 | SPI | 200 nA | ● | ● | ● | ● | | | ● | ● |

Significant energy savings on memory updates

Feature: Small Page Erase

Same architecture as standard Flash but with additional 256-byte erase block for superior small update performance

Benefit

Save energy; 70% less energy versus typical Flash

Faster updates

75% less overhead required vs typical Flash

Reduce Flash wear

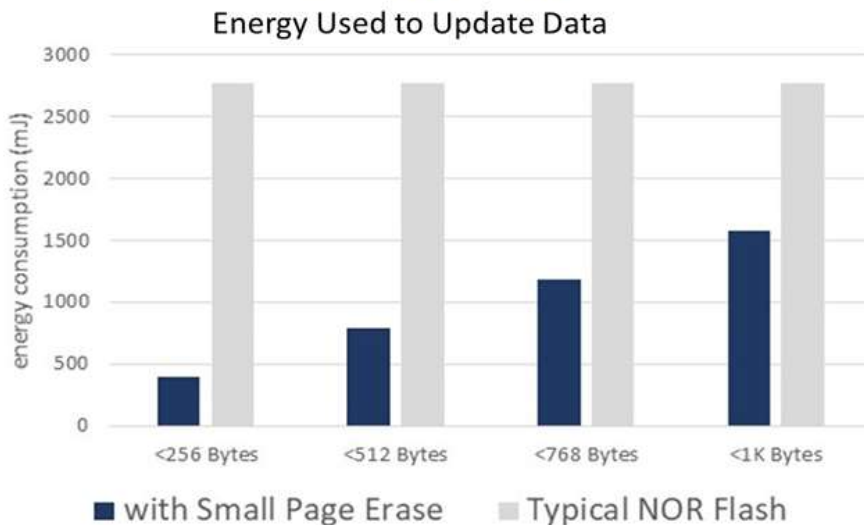
Ideal for

Small updates < 1 KBytes

Data Logging task

Update system settings task

Realize 40% to 80% energy savings with Renesas Flash



Feature **Small Page Erase**

Available on

AT45 DataFlash

AT25XE FusionHD

AT25EU Ultra Low Energy

AT25PE

[See all products with feature](#)

Tip

Add the Active Interrupt feature

Eliminates polling

Save on MCU overhead

Go To

[Video](#)

[App Note](#)

Reduce MCU overhead and enable multi-tasking

Feature: Active Interrupt

Auto-alerts the host controller upon task completion

Benefit

- Eliminate MCU polling
- Reduced system power and MCU overhead
- No waiting for maximum completion times when updating memory
- Execute other operations versus continually monitoring the Flash

Ideal for

Data Logging task

Update system settings task



Feature

Active Interrupt

Available on

AT25XE FusionHD

AT25EU Ultra Low Energy

[See all products with feature](#)

Tip

Use with Small Page Erase feature to save more MCU overhead

Go To

[Video](#)

[App Note](#)

Controllable SRAM buffer

Feature: Flexible R/W buffer

Same architecture as standard Flash
With added independent control of the SRAM buffer

Read, hold and modify data directly in the buffer
Fast transfer into main memory with a single command

Hold data in the buffer while in Deep Power Down mode

Benefit

Save system energy; hold and modify frequently changing values without programming to main memory

Reduce Flash wear in update-intensive applications

Use as scratchpad function

Hold critical values for fast save on system power fail

Ideal for

- Data Logging task
- Update system settings task

Feature **Flexible R/W buffer**

Available on
AT45 DataFlash
AT25XE FusionHD
At25PE

[See all products with feature](#)

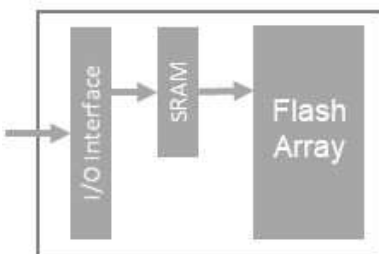


Go To

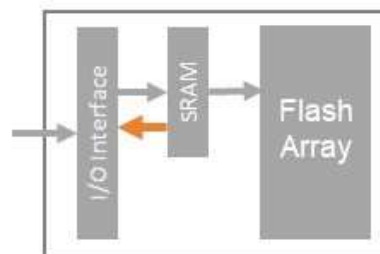
[Video](#)

[App Note](#)

Ordinary Flash



Renesas Flash



3 additional operations not available from ordinary Flash

Buffer Read

Data can be read out of buffer rather than Flash Array

Buffer Write

Additional data can be written to SRAM

Buffer Transfer to Memory Array

SRAM data written to Flash Array

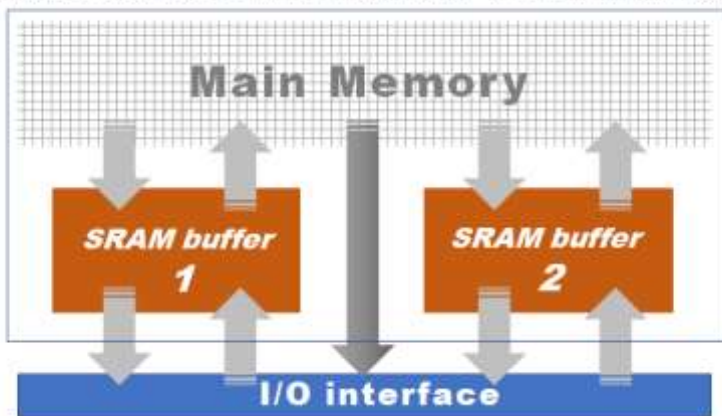
Highest efficiency for demanding Data Logging tasks

Feature: Dual SRAM buffers

Same architecture as standard Flash but with 2 built-in SRAM buffers

Fully independent- *programmable, readable controllable*

Controllable dual buffers for maximum Read / Write flexibility



Benefit

- Achieve maximum Read / Write flexibility
Read Buffer 1 while loading Buffer 2
- Fast Save
Preserve critical data during system power fail events
Smaller power budget for 'last save'
- Continuous Read
- Reduce Flash wear
- Robust for industrial environments

Ideal for

Data Logging task

Update system settings task

Feature

Dual SRAM buffers

Available on

AT45 DataFlash

AT25PE

[See all products with feature](#)

Tip

Add the Small Page Erase for



Go To

[Video](#)

[App Note](#)

Single command reduces MCU overhead for memory updates

Feature: Read-Modify-Write

Use 90% fewer instructions than typical Flash in updates

Easily modify a single data byte or a block of sequential data bytes

Only 1 MCU command required

EEPROM emulation

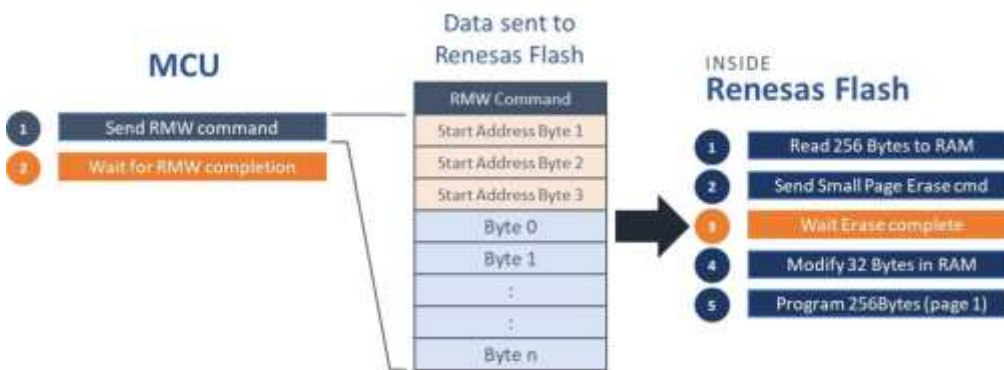
Benefit

- Significant system energy savings
75% faster and lower energy consumption versus ordinary Flash for small data updates
- Avoid big block reprogramming as required by ordinary Flash
- 90% reduction of MCU instructions when making small updates
- Simplify software
- Preserve data integrity

Ideal for

Data Logging task

Update system settings task



Feature

Read-Modify-Write

Available on

AT45 DataFlash

[See all products with feature](#)

Tip

Lower MCU even further with the Active Interrupt feature

Go To

[Video](#)

[App Note](#)

Lowest Sleep power

Feature: Ultra-deep Sleep power

Power down is critical in bootloader and XiP tasks that infrequently access the Flash

Save system energy with Renesas products that drop power consumption to as low as 7 nA

Benefit

- Longer system battery life
- No power switching required

Ideal for

Bootloader tasks especially in battery-operated equipment

Execute-in-Place tasks

Infrequent updates such as system settings

Feature

Ultra-deep Sleep power

Available on

AT25XE FusionHD

AT25FF

AT25EU Ultra-low Energy

[See all products with feature](#)

Tip

Best solutions for battery-powered designs:

AT25XE FusionHD

AT25EU Ultra-low Energy

Go To

[Video](#)

[App Note](#)

All products with features that improve system performance

| Density | Product # | Operating Voltage | 256 Byte Small page Erase | Active Interrupt | Flexible R/W buffer | Dual SRAM buffers | Read-Modify-Write | Ultra-deep Sleep power |
|---------|-------------|-------------------|---------------------------|------------------|---------------------|-------------------|-------------------|--------------------------|
| 256 Kb | AT25DF256 | Widest Vcc | ● | | ● | | | 200 nA |
| 256 Kb | AT25DN256 | 2.3 V to 3.6 V | ● | | | | | 350 nA |
| 512 Kb | AT25DF512C | Widest Vcc | ● | | ● | | | 200 nA |
| 512 Kb | AT25XE512C | Widest Vcc | ● | | ● | | | 200 nA |
| 512 Kb | AT25DN512C | 2.3 V to 3.6 V | ● | | | | | 350 nA |
| 1 Mb | AT25EU0011A | Widest Vcc | ● | ● | ● | | | 100 nA |
| 1 Mb | AT25DF011 | Widest Vcc | ● | | ● | | | 200 nA |
| 1 Mb | AT25XE011 | Widest Vcc | ● | | ● | | | 200 nA |
| 1 Mb | AT25DN011 | 2.3 V to 3.6 V | ● | | | | | 350 nA |
| 2 Mb | AT45DB021E | Widest Vcc | ● | | ● | | ● | 200 nA |
| 2 Mb | AT25PE20 | Widest Vcc | ● | | ● | | ● | 200 nA STANDARD pin-out |
| 2 Mb | AT25DF021A | Widest Vcc | ● | | ● | | | 200 nA |
| 2 Mb | AT25EU0021A | Widest Vcc | ● | ● | ● | | | 100 nA |
| 2 Mb | AT25XE021A | Widest Vcc | ● | | ● | | | 200 nA |
| 2 Mb | AT25XV021A | Widest Vcc | ● | | ● | | | 200 nA |
| 4 Mb | AT25EU0041A | Widest Vcc | ● | ● | ● | | | 100 nA |
| 4 Mb | AT25DF041B | Widest Vcc | ● | | ● | | | 200 nA |
| 4 Mb | AT25XE041B | Widest Vcc | ● | | ● | | | 200 nA |
| 4 Mb | AT25XE041D | Widest Vcc | ● | ● | ● | | ● | 7 nA LOWEST POWER |
| 4 Mb | AT25XV041B | Widest Vcc | ● | ● | ● | | | 200 nA |
| 4 Mb | AT45DB041E | Widest Vcc | ● | | | ● | ● | 400 nA |
| 4 Mb | AT25PE40 | Widest Vcc | ● | | | ● | ● | 400 nA STANDARD pin-out |
| 8 Mb | AT25XE081D | Widest Vcc | ● | ● | ● | | ● | 7 nA LOWEST POWER |
| 8 Mb | AT45DB081E | Widest Vcc | ● | | | ● | ● | 400 nA |
| 8 Mb | AT25EU0081A | Widest Vcc | ● | ● | ● | | | 100 nA ● |
| 16 Mb | AT25XE161D | Widest Vcc | ● | ● | ● | | ● | 7 nA LOWEST POWER |
| 16 Mb | AT45DB161E | 3 V | ● | | | ● | ● | 400 nA |
| 16 Mb | AT25PE16 | 3 V | ● | | | ● | ● | 400 nA STANDARD pin-out |
| 16 Mb | AT45DQ161 | 3 V | ● | | | ● | ● | 400 nA |
| 32 Mb | AT25XE321D | Widest Vcc | ● | ● | ● | | ● | 7 nA LOWEST POWER |
| 32 Mb | AT45DB321E | 3 V | ● | | | ● | ● | 400 nA |
| 32 Mb | AT45DQ321 | 3 V | ● | | | ● | ● | 400 nA |
| 64 Mb | AT45DB641E | Widest Vcc | ● | | | ● | ● | 400 nA |
| 4 Mb | AT25FF041A | Widest Vcc | | | | | | 7 nA LOWEST POWER |
| 8 Mb | AT25FF081A | Widest Vcc | | | | | | 7 nA LOWEST POWER |
| 16 Mb | AT25FF161A | Widest Vcc | | | | | | 7 nA LOWEST POWER |
| 32 Mb | AT25FF321A | Widest Vcc | | | | | | 7 nA LOWEST POWER |

Recommendations based on Task

| Renesas Family | Bootloader | XiP | System Settings | Data Logging | Data Logging Lite | |
|----------------|------------|-----|-----------------|--------------|-------------------|--|
| AT25DFxxx | ● | | ● | ● | ● | |
| AT25DLxxx | ● | | | | | |
| AT25EUxxx | ● | ● | ● | | ● | <i>lowest energy Flash</i> |
| AT25FFxxx | ● | ● | ● | | | <i>Standard Flash with lowest power Sleep</i> |
| AT25QFxxx | ● | ● | | | | |
| AT25QLxxx | ● | ● | | | | |
| AT25SFxxx | ● | ● | | | | |
| AT25SLxxx | ● | ● | | | | |
| AT25EXxxx | ● | ● | ● | ● | ● | <i>5x faster / save 70% energy</i> |
| AT45xxx | | | ● | ● | ● | <i>Robust, most efficient data logging</i> |
| AT25PExxx | | | ● | ● | ● | <i>Robust, most efficient data logging includes STANDARD pin-out</i> |

High Temperature and Die products

Renesas Standard and System-Enhancing products are available in the wafer formfactor.

Incorporate energy saving features directly into IoT SIP solutions, motor drives, actuators, and sensors for all applications including those designed for harsh environments.

Look for the 'DWF' (**D**ie in **W**afer **F**orm) package suffix in the ordering table on every datasheet.

100% functional testing, inducing:

DC Characteristics per product datasheet

High temperature preconditioning

Program and Read of rigorous data patterns

Operating Range

-40 °C to +85 °C

Up to +125 °C for select products

High temperature products

Renesas System-Enhancing products are designed, built and 100% tested to provide reliable long-life performance in high temperature industrial applications.

| Density | Product # | Operating Temp up to | Formfactor Package | Formfactor Wafer |
|---------|------------|-------------------------|-----------------------|---------------------|
| 128 Mb | AT25SF128A | 105 °C | ● | |
| 128 Mb | AT25QF128A | 105 °C | ● | |
| 32 Mb | AT45DQ321 | 105 °C | ● | ● |
| 16 Mb | AT25FF161A | 105 °C | ● | |
| 16 Mb | AT25DL161 | 105 °C | ● | |
| 4 Mb | AT45DB041E | 125 °C | ● | ● |
| 4 Mb | AT25XE041B | 125 °C | ● | ● |
| 4 Mb | AT25DF041B | 125 °C | ● | ● |
| 2 Mb | AT25DF021A | 125 °C | ● | ● |
| 1 Mb | AT25DF011 | 125 °C | ● | ● |

Product Spotlight- AT25EU Ultra-low Energy Flash memory

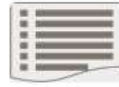


- Energy and power savings of more than 70% versus typical Flash
- 60x faster low-power erase
- Ideal for bootloader and system settings update tasks

Universal Compatibility



Standard Pin Out



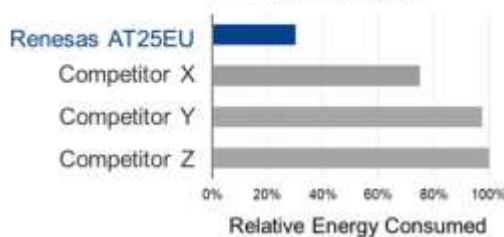
Standard Commands



Standard Features

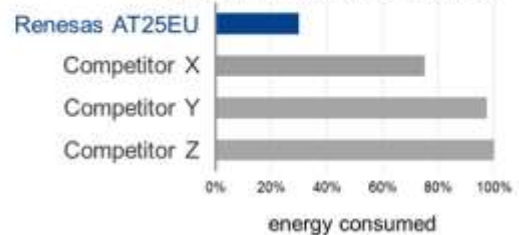
Up to **70%**
LESS ENERGY

READ operation



Up to **75%**
LESS ENERGY

Programming (256 Bytes)



>60x / **<1%**
FASTER / ENERGY

Full Chip Erase



| Part Number | Size | Wide Operating Voltage | Ideal for |
|-------------|--------|------------------------|---------------------------------------|
| AT25EU0011A | 1 Mbit | 1.65 V to 3.6 V | Bootloader, XiP and Data Logging-Lite |
| AT25EU0021A | 2 Mbit | 1.65 V to 3.6 V | |
| AT25EU0041A | 4 Mbit | 1.65 V to 3.6 V | |
| AT25EU0081A | 8 Mbit | 1.65 V to 3.6 V | |

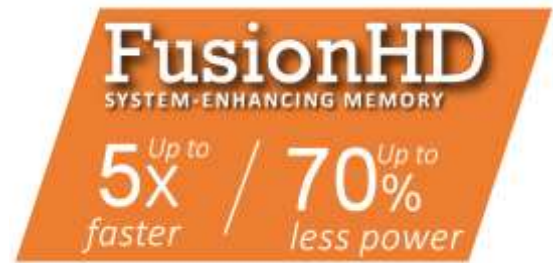
Product Spotlight

Ideal for all tasks spanning Bootloader to Datalogging

Save up to 70% energy with FusionHD Memory

Combines system-enhancing features with low power

Faster updates and lower energy consumption than typical Flash



Features

4 Mb to 32 Mb

Continuous read, wrap and burst modes for XiP

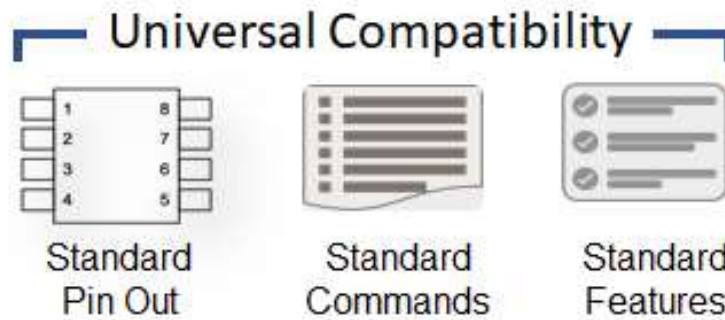
7 nA Sleep power for bootloader tasks

Preserve data during system power fail with the controllable R/W SRAM buffer

Active Interrupt to reduce MCU overhead and eliminate polling

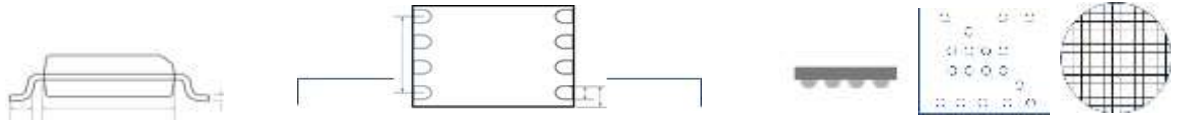
256-byte page erase for efficient Data Logging

Ideal for small updates; Read Modify Write feature reduces MCU overhead by 90%



| Part Number | Density | Wide Voltage | Low Sleep power | Speed | Supports XiP |
|-------------|---------|-----------------|-----------------|---------|--------------|
| AT25XE321D | 32 Mbit | 1.65 V to 3.6 V | 7 nA | 133 MHz | ● |
| AT25XE161D | 16 Mbit | 1.65 V to 3.6 V | 7 nA | 133 MHz | ● |
| AT26XE081D | 8 Mbit | 1.65 V to 3.6 V | 7 nA | 133 MHz | ● |
| AT25XE041D | 4 Mbit | 1.65 V to 3.6 V | 7 nA | 133 MHz | ● |

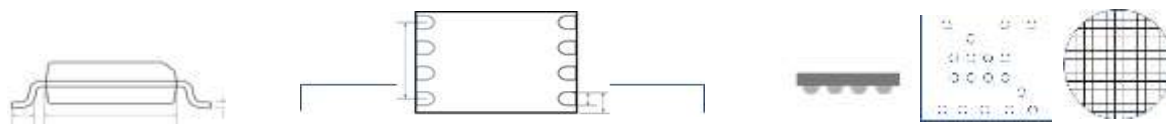
Packages



| Product Part Number | N-SOIC 3.81 mm | W-SOIC 5.18 mm | DFN 2 x 3 mm | DFN 3 x 4 mm | DFN 5 x 6 mm | DFN 6 x 8 mm | BGA | WLCSP | Wafer |
|---------------------|-------------------|-------------------|--------------------|--------------------|--------------------|--------------------|-----|-------|-------|
| AT25DF011 | ● | | ● | | | | | ● | |
| AT25DF021A | ● | | ● | | ● | | | ● | |
| AT25DF041B | ● | | ● | | ● | | | ● | |
| AT25DF081A | ● | | | | ● | | | | |
| AT25DF256 | ● | | ● | | | | | | |
| AT25DF321A | | ● | | | ● | | | | |
| AT25DF512C | ● | | ● | | | | | | |
| AT25DF641A | | ● | | | ● | | | | |
| AT25DL081 | ● | | | | ● | | | | |
| AT25DL161 | ● | | | | ● | | | | |
| AT25DN011 | ● | | ● | | | | | | |
| AT25DN256 | ● | | ● | | | | | | |
| AT25DN512C | ● | | ● | | | | | | |
| AT25EU0011A | ● | | ● | | | | | | |
| AT25EU0021A | ● | | ● | | | | | | |
| AT25EU0041A | ● | | ● | | | | | | |
| AT25EU0081A | ● | ● | ● | | | | | | |
| AT25FF041A | ● | ● | ● | | | | | ● | |
| AT25FF081A | ● | ● | ● | | | | | ● | |
| AT25FF161A | ● | ● | ● | | | | | ● | |
| AT25FF321A | ● | ● | | ● | ● | | | ● | |
| AT25PE16 | ● | ● | | | ● | | | | |
| AT25PE20 | ● | ● | | | ● | | | | |
| AT25PE40 | ● | ● | | | ● | | | | |
| AT25PE80 | ● | ● | | | ● | | | | |
| AT25QF128A | | ● | | | ● | | | | |
| AT25QF641B | | ● | | | ● | | | | |
| AT25QL128A | | | | | ● | | ● | ● | |
| AT25QL321 | | | | ● | ● | | ● | ● | |
| AT25QL641 | | | | | ● | | ● | | |
| AT25SF041B | ● | ● | ● | | ● | | | | |
| AT25SF081B | ● | ● | ● | | | | | | |

Continued →

Packages (cont'd)



| Product Part Number | N-SOIC 3.81 mm | W-SOIC 5.18 mm | DFN 2 x 3 mm | DFN 3 x 4 mm | DFN 5 x 6 mm | DFN 6 x 8 mm | BGA | WLCSP | Wafer |
|---------------------|-------------------|-------------------|--------------------|--------------------|--------------------|--------------------|-----|-------|-------|
| AT25SF128A | | ● | | | ● | | | | |
| AT25SF161B | ● | ● | | | ● | | | ● | |
| AT25SF321B | ● | ● | | | ● | | | | |
| AT25SF641B | | ● | | | ● | | | | |
| AT25SL128A | | | | | ● | | ● | ● | |
| AT25SL321 | ● | | | ● | ● | | | ● | |
| AT25SL641 | | | | | ● | | ● | | |
| AT25XE011 | ● | | ● | | | | | ● | |
| AT25XE021A | ● | | ● | | ● | | | ● | |
| AT25XE041B | ● | | ● | | ● | | | ● | |
| AT25XE041D | ● | ● | ● | | | | | ● | |
| AT25XE081D | ● | ● | ● | | | | | ● | |
| AT25XE161D | ● | ● | ● | | | | | ● | |
| AT25XE321D | ● | ● | | | ● | | | ● | |
| AT25XE512C | ● | | ● | | | | | | |
| AT25XV021A | ● | | ● | | ● | | | ● | |
| AT25XV041B | ● | | ● | | ● | | | ● | |
| AT45DB021E | ● | ● | | | ● | | | ● | |
| AT45DB041E | ● | ● | | | ● | | ● | | |
| AT45DB081E | ● | ● | | | ● | | ● | ● | |
| AT45DB161E | ● | ● | | | ● | | | ● | |
| AT45DB321E | | ● | | | ● | | | | |
| AT45DB641E | | ● | | | ● | ● | | | |
| AT45DQ161 | ● | ● | | | ● | ● | | | |
| AT45DQ321 | | ● | | | ● | ● | | | |

Revision History

| Date | Revision | Description |
|------------|----------|-----------------------------|
| 03/15/2022 | A | Initial release |
| 09/14/2022 | B | Add new product AT25EU0041A |
| 06/16/2023 | C | Add AT25EU0081A |