

Renesas 16-Mbit Products Overview

This application note describes and compares the 16-Mbit Flash products Renesas offers.

Contents

1. Renesas 16-Mbit Products Overview.....	1
2. Feature Comparison.....	2
3. Command Set (Opcode) Comparison.....	3
4. Device ID Comparison.....	6
5. Status Register Comparison.....	7
6. SFDP Table Comparison.....	9
7. Packaging Options.....	9
8. XE Family Special Features.....	10
9. Revision History.....	12

1. Renesas 16-Mbit Products Overview

This document describes 16-Mbit products available from the Renesas Serial Flash Memory family.

The AT25EU0161A is the newest member of the Ultra-Low Energy serial flash memory devices. It incorporates features for achieving low energy consumption for fundamental flash operations with very fast erase times of 8 ms typical from page erase to full chip erase while consuming low power for read, program, and erase. Energy consumption is calculated by multiplying power and time.

The AT25EU0161A supports 1.65 V to 3.6 V operations making it ideal for battery operated systems that have finite storage of energy.

Table 1 provides a comparative overview of the 16-Mbit products offered by Renesas.

Table 1: Renesas 16-Mbit Products Overview

Family	Part Number	Product Status	Nominal System Voltage	SPI Support
SF	AT25SF161B	Mass Production	2.7 V to 3.6 V	Single/Dual/Quad
FF	AT25FF161A	Mass Production	1.65 V to 3.6 V	Single/Dual/Quad
XE	AT25XE161D	Mass Production	1.65 V to 3.6 V	Single/Dual/Quad
EU	AT25EU0161A	Mass Production	1.65 V to 3.6 V	Single/Dual/Quad

SF	Standard 3V Flash Family
FF	Wide Vcc Standard Flash Family
XE	Wide Vcc FusionHD Flash Family with Enhanced Features
EU	Wide Vcc Ultr-Low Energy Flash Family

2. Feature Comparison

Table 2 describes major feature differences between the 16-Mbit products.

Table 2: Renesas 16-Mbit Products Feature Comparison

	AT25SF161B	AT25FF161A	AT25XE161D	AT25EU0161A
Total Memory (Bits)	16-Mbit	16-Mbit	16-Mbit	16-Mbit
Total Memory (Bytes)	2-MByte	2-MByte	2-MByte	2-MByte
Total 64KB block #	32	32	32	16
Total 32KB block #	64	64	64	32
Total 4KB sector #	512	512	512	256
Page Size (Bytes)	256	256	256	256
Total Page #	8192	8192	8192	4096
Page Erase Size			256 Bytes	256 Bytes
Block Erase Size	64 kB /32kB/4 kB	64 kB /32kB/4 kB	64 kB /32kB/4 kB	64 kB /32kB/4 kB
OTP Organization	3 x 256 byte	3 x 128 byte	3 x 128 byte	3 x 512 byte
UID Register Size	64-bit	128-byte	128-byte	128-byte
SFDP Table	Y	Y	Y	Y
Single SPI (1-1-1) 03/0B	Y	Y	Y	Y
Dual Read (1-1-2) 3B	Y	Y	Y	Y
Dual I/O (1-2-2) BB	Y			Y
Quad Read (1-1-4) 6B	Y	Y	Y	Y
Quad I/O (1-4-4, 0-4-4) EB [XiP]	Y	Y	Y	Y
Quad I/O (1-4-4, 0-4-4) E7 [XiP]	Y	Y	Y	
QPI (4-4-4) EB/0C				
SRAM buffer commands (RMW)			Y	
Battery Monitor with Active Interrupt			Y	
JEDEC Hardware Reset		Y	Y	
Operating Voltage Range (V)	2.7 – 3.6	1.65 – 3.6	1.65 – 3.6	1.65 – 3.6
Operating Temperature	-40 to +85	-40 to +85	-40 to +85	-40 to +85
Endurance ¹	100K	100K	100K	10K
Data Retention	20 yrs	20 yrs	20 yrs	20 yrs

1. Tested per JEDEC47 Non-Volatile Memory Cycling Endurance Standard.

3. Command Set (Opcode) Comparison

Table 3 shows the comparisons in Command Set or Opcode for all 16-Mbit products.

Table 3: Renesas 16-Mbit Products Command Set Comparison

	AT25SF161B	AT25FF161A	AT25XE161D	AT25EU0161A
System Commands				
Enable Reset	66h	66h	66h	66h
Reset Device	99h	99h	99h	99h
Deep Power-down	B9h	B9h	B9h	B9h
Release/Resume from Deep Power-down	ABh	ABh	ABh	Abh
Ultra Deep Power-down	n/a	79h/B9h	79h/B9h	n/a
Terminate / Abort operation	n/a	F0h	F0h	F0h
Active Status Interrupt	n/a	n/a	25h	25h
Start Low Battery Detect	n/a	n/a	EFh	n/a
Read Commands				
Normal Read Data	03h	03h	03h	03h
Fast Read	0Bh	0Bh	0Bh	0Bh
Dual Output Fast Read	3Bh	3Bh	3Bh	3Bh
Dual I/O Fast Read	BBh	n/a	n/a	BBh
Dual I/O Fast Read (Continuous Mode)	BBh	n/a	n/a	n/a
Quad Output Fast Read	6Bh	6Bh	6Bh	6Bh
Quad I/O Fast Read	EBh	EBh	EBh	EBh
Quad I/O Fast Read (Continuous Mode)	EBh	EBh	EBh	EBh
Word Read Quad I/O	E7h	E7h	E7h	n/a
Word Read Quad I/O (Continuous Mode)	E7h	E7h	E7h	n/a
Set Burst with Wrap	77h	77h	77h	77h
Write Commands				
Write Enable	06h	06h	06h	06h
Volatile SR Write Enable	50h	50h	50h	50h
Write Disable	04h	04h	04h	04h

	AT25SF161B	AT25FF161A	AT25XE161D	AT25EU0161A
Program Commands				
Page Program	02h	02h	02h	02h
Sequential Program Mode	n/a	ADh/AFh	ADh/AFh	n/a
Dual Page Program	n/a	A2h	A2h	A2h
Quad Page Program (1-1-4)	32h	32h	32h	32h
Quad Page Program (1-4-4)	n/a	32h	32h	n/a
Erase Commands				
Page Erase (256B)	n/a	n/a	81h/DBh	81h/DBh
Sector Erase (4KB)	20h	20h	20h	20h
Block Erase (32KB)	52h	52h	52h	52h
Block Erase (64KB)	D8h	D8h	D8h	D8h
Chip Erase	C7h/60h	C7h/60h	C7h/60h	C7h/60h
Suspend/Resume Command				
Program/Erase Suspend	75h	75h/B0h	75h/B0h	75h
Program/Erase Resume	7Ah	7Ah/D0h	7Ah/D0h	7Ah
Status Register Commands				
Read Status Register 1	05h	05h	05h	05h
Read Status Register 2	35h	35h	35h	35h
Read Status Register 3	15h	15h	15h	15h
Write Status Register 1	01h	01h	01h	01h
Write Status Register 2	31h	31h	31h	31h
Write Status Register 3	11h	11h	11h	11h
Read Status Register 1-5/6 (1-1-0 using Indirect Addressing)	n/a	65h	65h	n/a
Write Status Register 1-5/6 (1-1-1 using Indirect Addressing)	n/a	71h	71h	n/a
Status Register Lock	n/a	6Fh	6Fh	n/a
Device ID Information				
Manuf/Device ID	90h	90h	90h	90h
Manuf/Device ID Dual I/O	92h	n/a	n/a	92h
Manuf/Device ID Quad I/O	94h	94h	94h	94h
Read JEDEC ID	9Fh	9Fh	9Fh	9Fh
Read Serial Flash Discoverable Parameter	5Ah	5Ah	5Ah	5Ah
Resume from DPD and read ID	ABh	ABh	ABh	ABh

	AT25SF161B	AT25FF161A	AT25XE161D	AT25EU0161A
OTP Commands				
Erase Security Registers	44h	n/a	n/a	44h
Program Security Registers	42h	9Bh	9Bh	42h
Read Security Registers	48h	4Bh	4Bh	48h
Read Unique ID number	4Bh	4Bh	4Bh	4Bh
SRAM Buffer Commands				
Buffer Read	n/a	n/a	D4h	n/a
Buffer Write	n/a	n/a	84h	n/a
Buffer to Main Memory Page Program w/o Erase	n/a	n/a	88h	n/a
Read-Modify-Write	n/a	n/a	0Ah	n/a
Lock Commands				
Individual Block Lock	n/a	36h	36h	n/a
Individual Block UnLock	n/a	39h	39h	n/a
Read Block Lock	n/a	3Ch/3Dh	3Ch/3Dh	n/a
Global Block Lock	n/a	7Eh	7Eh	n/a
Global Block UnLock	n/a	98h	98h	n/a

Notes:

1. AT25XE161D and AT25FF161A have different OTP Security Register programming protocol compared to AT25SF161B.
2. AT25FF161A has Read Status Register 1-5 (1-1-0 using Indirect Addressing).
3. AT25FF161A has Write Status Register 1-5 (1-1-1 using Indirect Addressing).
4. AT25XE161D has Read Status Register 1-6 (1-1-0 using Indirect Addressing).
5. AT25XE161D has Write Status Register 1-6 (1-1-1 using Indirect Addressing).

4. Device ID Comparison

All Renesas 16-Mbit products have a different device ID to allow identification by the host system.

Table 4: Renesas 16-Mbit Products Device ID Comparison

	AT25SF161B	AT25FF161A	AT25XE161D	AT25EU0161A
Device ID Commands				
Release Power-down / Read ID [ABh]	14h	46h	46h	16h
Manufacturer and Device ID Single I/O [90h]	1Fh, 14h	1Fh, 46h	1Fh, 46h	1Fh, 16h
Manufacturer and Device ID Dual I/O [92h]	1Fh, 14h	n/a	n/a	1Fh, 16h
Manufacturer and Device ID Quad I/O [94h]	1Fh, 14h	1Fh, 46h	1Fh, 46h	1Fh, 16h
Read JEDEC ID [9Fh]	1Fh, 86h, 01h	1Fh, 46h, 08h	1Fh, 46h, 0Ch	1Fh, 16h, 01h
Read SFDP [5Ah]	Yes	Yes	Yes	Yes

Notes:

1. The SFDP header can be read using 5Ah command with one dummy byte after power-on.
2. The AT25FF161A and AT25XE161D do not support opcode 92h.

5. Status Register Comparison

Table 5 shows the comparisons in Status Register definitions and access method for all Renesas 16-Mbit products.

Table 5: Renesas 16-Mbit Products Status Register Comparison

	AT25SF161B	AT25FF161A	AT25XE161D	AT25EU0161A
Read Status Register 1	05h	05h/65h	05h/65h	05h
Read Status Register 2	35h	35h/65h	35h/65h	35h
Read Status Register 3	15h	15h/65h	15h/65h	15h
Read Status Register 4		65h (addr 04h)	65h (addr 04h)	
Read Status Register 5		65h (addr 05h)	65h (addr 05h)	
Read Status Register 6			65h (addr 06h)	
Write Status Register 1	01h	01h/71h	01h/71h	01h
Write Status Register 2	31h	31h/71h	31h/71h	31h
Write Status Register 3	11h	11h/71h	11h/71h	11h
Write Status Register 4		71h (addr 04h)	71h (addr 04h)	
Write Status Register 5		71h (addr 05h)	71h (addr 05h)	
Write Status Register 6			71h (addr 06h)	

For the AT25SF161B, each write register opcode (01h, 31h, 11h) is followed with one byte of data only. Additional bytes are ignored. To write any Status Register, use its dedicated opcode with one byte of data.

For the AT25FF161A and AT25XE161D, each opcode (01h, 31h, 11h) is followed with one byte of data. To write Status Registers 1 and 2, the host must send 01h with one byte, then 31h with another byte. For compatibility with legacy devices, command 01h can also be used with two bytes of data. In this case, the second byte is written to Status Register 2. Opcode 11h is used for Status Register 3. Status Register 4, 5, and 6 use indirect addressing. For a read operation, the opcode is 65h, and the address matches the status register # (for example: address 04h for status register 4). For a write operation, the opcode is 71h, and the address matches the status register #.

Table 6: Renesas 16-Mbit Products Status Register Bit-Level Comparison

		AT25SF161B	AT25FF161A	AT25XE161D	AT25EU0161A
Status Register 1	0	RDY/BSY	RDY/BSY	RDY/BSY	RDY/BSY
	1	WEL	WEL	WEL	WEL
	2	BP0	BP0	BP0	BP0
	3	BP1	BP1	BP1	BP1
	4	BP2	BP2	BP2	BP2
	5	TB	TB	TB	BP3
	6	SEC	BPSIZE	BPSIZE	BP4
	7	SRP0	SRP0	SRP0	SRP0

		AT25SF161B	AT25FF161A	AT25XE161D	AT25EU0161A
Status Register 2	0	SRP1	SRP1	SRP1	SRP1
	1	QE	QE	QE	QE
	2	P_SUS	Reserved	Reserved	SUS2
	3	LB1	Lock1	Lock1	LB1
	4	LB2	Lock2	Lock2	LB2
	5	LB3	Lock3	Lock3	LB3
	6	CMP	CMP	CMP	CMP
	7	E_SUS	SUS	SUS	SUS1
Status Register 3	0	Reserved	Reserved	Reserved	Reserved
	1	Reserved	Reserved	Reserved	Reserved
	2	Reserved	WPS	WPS	Reserved
	3	Reserved	Reserved	Reserved	Reserved
	4	Reserved	Reserved	Reserved	Reserved
	5	DRV0	DRV0	DRV0	Reserved
	6	DRV1	DRV1	DRV1	Reserved
	7	Reserved	Hold/RST	Hold/RST	Hold/RST
Status Register 4	0		BWS0	BWS0	
	1		BWS1	BWS1	
	2		BWS2	BWS2	
	3		XiP	XiP	
	4		EE	EE	
	5		PE	PE	
	6		SPM	SPM	
	7		PDM	PDM	
Status Register 5	0		DWA	DWA	
	1		STPE	STPE	
	2		PS	PS	
	3		ES	ES	
	4		DC0	DC0	
	5		DC1	DC1	
	6		DC2	DC2	
	7		SRLOCK	SRLOCK	
Status Register 6	0			LBD	
	1			LBLD0	
	2			LBLD1	
	3			LBVL0	
	4			LBVL1	
	5			LBVL2	
	6			LBS0	
	7			LBS1	

6. SFDP Table Comparison

All Renesas 16-Mbit products, contain an SFDP (Serial Flash Discoverable Parameters) table. Each product family has different SFDP table definitions. Contact Renesas for detailed SFDP table documents for a specific product.

Table 7: Renesas 16-Mbit SFDP Documentation Availability

Adesto Part Number	JESD216					SFDP Table Document Number
	(v1.0)	A(v1.5)	B(v1.6)	C(v1.7)	D(v1.8)	
Wide Vcc FusionHD Flash Family with Enhanced Features						
AT25XE161D			x			SFDP-T011
3.0V Standard Flash						
AT25SF161B					x	SFDP-T019
Wide Vcc Standard Flash						
AT25FF161A			x			SFDP-T016
AT25EU0161A					x	SFDP-T029

7. Packaging Options

Table 8 provides the current packaging options available for all 16-Mbit products. Contact Renesas for questions regarding packaging options. Most 16-Mbit products are also available in KGD form.

Table 8: Renesas 16-Mbit Packaging Options

	AT25SF161B	AT25FF161A	AT25XE161D	AT25EU0161A
SOIC Package				
8-pin SOIC (0.150" narrow body)	x	x	x	x
8-pin SOIC (0.208" wide body)	x	x	x	x
UDFN Package				
8-pad 5 x 6 mm UDFN				
8-pad 2 x 3 mm UDFN	x	x	x	x
TSSOP Package				
8-pad 4 x 4 mm TSSOP				
WLCSP Package				
8-ball (3 x 2 x 3) WLCSP		x	x	x (4x2)

8. XE Family Special Features

The AT25XE161D contains special function blocks for special applications. For example, EEPROM emulation can be done using the RMW command (0Ah). Data logging and temporary data storage can be supported using Buffer operation commands such as Buffer Read, Buffer Write, and Buffer to Main Memory Program w/o Erase. Battery health monitoring can be done using the Low Battery Detect circuit and Active Interrupt feature.

Renesas provides separate Technical Notes and Application Notes to cover these features in more detail.

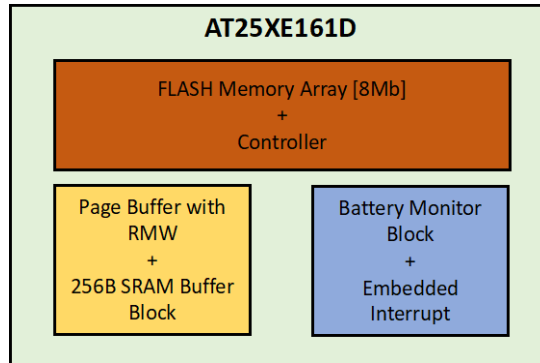


Figure 1: AT25XE161D Block Diagram

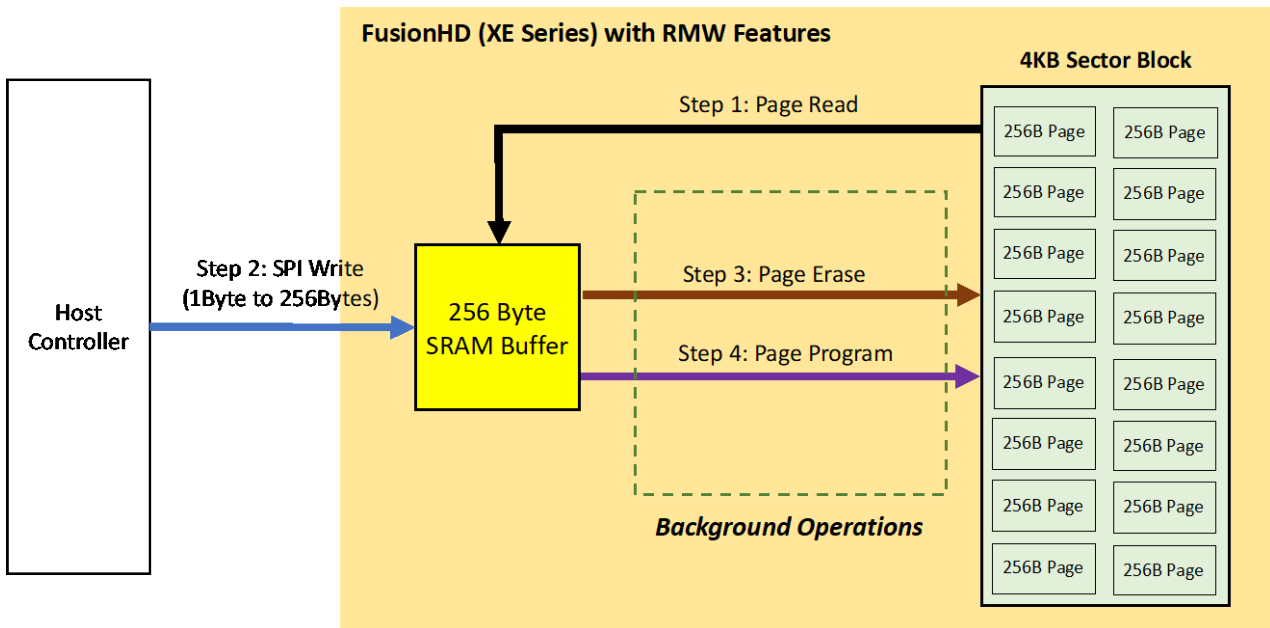


Figure 2: AT25XE161D 256Byte SRAM Page Buffer Block with RMW Feature

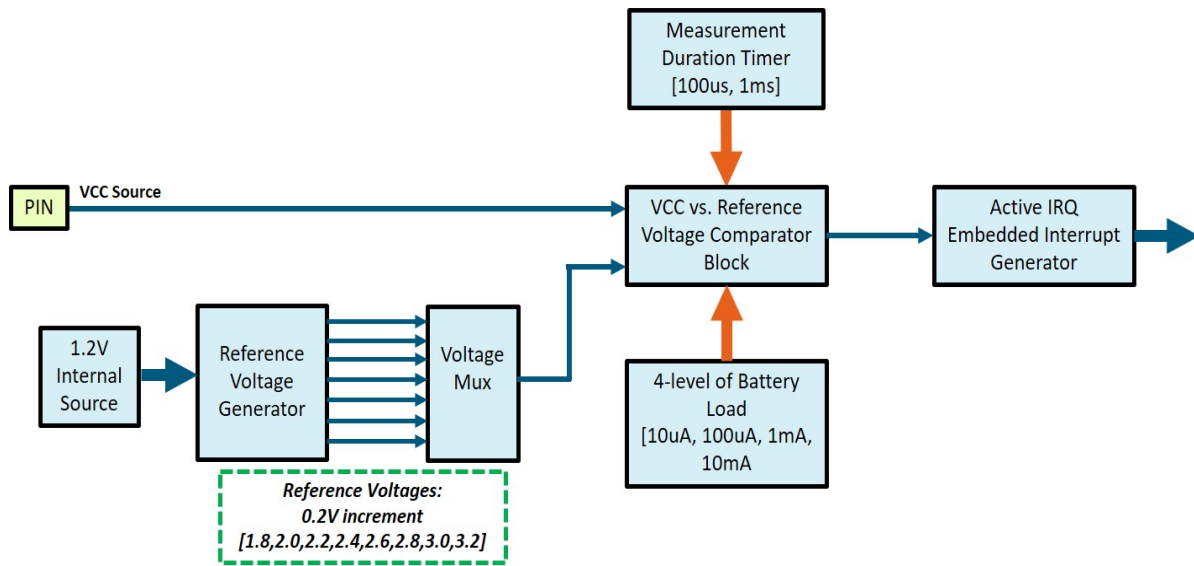


Figure 3: AT25XE161D Battery Monitor Block

9. Revision History

Revision	Date	Description
A1	05/2020	Initial release.
A2	05/2024	Removed the AT25SF161 product. Added AT25EU0161A. Made changes to Table 5. Made changes to first paragraph after Table 5. Corrected one value in Table 4 Applied new corporate template to document.

IMPORTANT NOTICE AND DISCLAIMER

RENESAS ELECTRONICS CORPORATION AND ITS SUBSIDIARIES (“RENESAS”) PROVIDES TECHNICAL SPECIFICATIONS AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for developers skilled in the art designing with Renesas products. You are solely responsible for (1) selecting the appropriate products for your application, (2) designing, validating, and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. Renesas grants you permission to use these resources only for development of an application that uses Renesas products. Other reproduction or use of these resources is strictly prohibited. No license is granted to any other Renesas intellectual property or to any third party intellectual property.

Renesas disclaims responsibility for, and you will fully indemnify Renesas and its representatives against, any claims, damages, costs, losses, or liabilities arising out of your use of these resources. Renesas' products are provided only subject to Renesas' Terms and Conditions of Sale or other applicable terms agreed to in writing. No use of any Renesas resources expands or otherwise alters any applicable warranties or warranty disclaimers for these products.

(Rev.1.0 Mar 2020)

Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

www.renesas.com/contact/

Contact Information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit:

Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.