

## Renesas 8-Mbit Products Overview

This application note describes and compares the 8-Mbit Flash products Renesas offers.

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## 1. Renesas 8-Mbit Products Overview

This document describes 8-Mbit products available from the Renesas Serial Flash Memory family.

The AT25EU0081A is the newest member of the Ultra-Low Energy serial flash memory. It incorporates features geared towards achieving low energy consumption for fundamental flash operations with very fast erase times of 8ms 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 AT25EU0081A supports 1.65V 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 8-Mbit products offered by Renesas.

**Table 1: Renesas 8-Mbit Products Overview**

Family	Part Number	Product Status	Nominal System Voltage	SPI Support
SF	AT25SF081B	Mass Production	2.7 V to 3.6 V	Single/Dual/Quad
FF	AT25FF081A	Mass Production	1.65 V to 3.6 V	Single/Dual/Quad
XE	AT25XE081D	Mass Production	1.65 V to 3.6 V	Single/Dual/Quad
EU	AT25EU0081A	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 8-Mbit products.

**Table 2: Renesas 8-Mbit Products Feature Comparison**

	AT25SF081B	AT25FF081A	AT25XE081D	AT25EU0081A
Total Memory (Bits)	8-Mbit	8-Mbit	8-Mbit	8-Mbit
Total Memory (Bytes)	1-MByte	1-MByte	1-MByte	1-MByte
Total 64KB block #	16	16	16	16
Total 32KB block #	32	32	32	32
Total 4KB sector #	256	256	256	256
Page Size (Bytes)	256	256	256	256
Total Page #	4096	4096	4096	4096
Page Erase Size			256 Bytes	256 Bytes
Block Erase Size	64 kB / 32 kB / 4 kB	64 kB / 32 kB / 4 kB	64 kB / 32 kB / 4 kB	64 kB / 32 kB / 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)	2.5 – 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 <sup>1</sup>	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 8-Mbit products.

Table 3: Renesas 8-Mbit Products Command Set Comparison

	AT25SF081B	AT25FF081A	AT25XE081D	AT25EU0081A
<b>System Commands</b>				
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	n/a
Active Status Interrupt	n/a	n/a	25h	25h
Start Low Battery Detect	n/a	n/a	EFh	n/a
<b>Read Commands</b>				
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	BBh
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
<b>Write Commands</b>				
Write Enable	06h	06h	06h	06h
Volatile SR Write Enable	50h	50h	50h	50h
Write Disable	04h	04h	04h	04h

	AT25SF081B	AT25FF081A	AT25XE081D	AT25EU0081A
<b>Program Commands</b>				
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	n/a	n/a	n/a
<b>Erase Commands</b>				
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
<b>Suspend/Resume Command</b>				
Program/Erase Suspend	75h	75h/B0h	75h/B0h	75h
Program/Erase Resume	7Ah	7Ah/D0h	7Ah/D0h	7Ah
<b>Status Register Commands</b>				
Read Status Register 1	05h	05h	05h	05h
Read Status Register 2	35h	35h	35h	35h
Read Status Register 3	n/a	15h	15h	15h
Write Status Register 1	01h	01h	01h	01h
Write Status Register 2	31h	31h	31h	31h
Write Status Register 3	n/a	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
<b>Device ID Information</b>				
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

	AT25SF081B	AT25FF081A	AT25XE081D	AT25EU0081A
<b>OTP Commands</b>				
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
<b>SRAM Buffer Commands</b>				
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
<b>Lock Commands</b>				
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. AT25XE081D and AT25FF081A have different OTP Security Register programming protocol compared to AT25SF081B and AT25EU0081A
2. AT25FF081A has Read Status Register 1-5 (1-1-0 using Indirect Addressing).
3. AT25FF081A has Write Status Register 1-5 (1-1-1 using Indirect Addressing).
4. AT25XE081D has Read Status Register 1-6 (1-1-0 using Indirect Addressing).
5. AT25XE081D has Write Status Register 1-6 (1-1-1 using Indirect Addressing).

## 4. Device ID Comparison

All Renesas 8-Mbit products have a different device ID to allow identification by the host system.

Table 4: Renesas 8-Mbit Products Device ID Comparison

	AT25SF081B	AT25FF081A	AT25XE081D	AT25EU0081A
<b>Device ID Commands</b>				
Release Power-down / Read ID [ABh]	13h	45h	45h	15h
Manufacturer and Device ID Single I/O [90h]	1Fh, 13h	1Fh, 45h	1Fh, 45h	1Fh, 15h
Manufacturer and Device ID Dual I/O [92h]	1Fh, 13h	n/a	n/a	1Fh, 15h
Manufacturer and Device ID Quad I/O [94h]	1Fh, 13h	1Fh, 45h	1Fh, 45h	1Fh, 15h
Read JEDEC ID [9Fh]	1Fh, 85h, 01h	1Fh, 45h, 08h	1Fh, 45h, 0Ch	1Fh, 15h, 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 AT25FF081A and AT25XE081D do not support opcode 92h.

## 5. Status Register Comparison

Table 5 shows the comparisons in Status Register definitions and access method for all Renesas 8-Mbit products.

Table 5: Renesas 8-Mbit Products Status Register Comparison

	AT25SF081B	AT25FF081A	AT25XE081D	AT25EU0081A
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/65h	15h/65h	15h
Read Status Register 4		65h (addr 04h)	65h (addr 04h)	n/a
Read Status Register 5		65h (addr 05h)	65h (addr 05h)	n/a
Read Status Register 6			65h (addr 06h)	n/a
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/71h	11h/71h	11h
Write Status Register 4		71h (addr 04h)	71h (addr 04h)	n/a
Write Status Register 5		71h (addr 05h)	71h (addr 05h)	n/a
Write Status Register 6			71h (addr 06h)	n/a

For AT25SF081B each opcode (01h, 31h) follows with one byte of data. Second byte is ignored. To write Status Register 1 and 2, host sends 01h with one byte, then 31h with another byte.

For AT25FF081A and AT25XE081D, each opcode (01h, 31h, 11h) will follow with one byte of data. To write Status Registers 1 & 2, host should send 01h with one byte then 31h with another byte. For compatibility with legacy devices command (01h) can also be used with 2 bytes of data. In such case, second byte will be written to Status Register 2. 11h will be used for Status Register 3. Status Register 4, 5, 6 will use indirect addressing. For read operation, opcode will be 65h and address will match the status register # (ex: address 04h for status register 4). For write operation, opcode will be 71h and address will match status register #.

Table 6: Renesas 8-Mbit Products Status Register Bit-Level Comparison

		AT25SF081B	AT25FF081A	AT25XE081D	AT25EU0081A
<b>Status Register 1</b>	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
<b>Status Register 2</b>	0	SRP1	SRP1	SRP1	SRP1
	1	QE	QE	QE	QE
	2	P_SUS	Reserved	Reserved	Reserved
	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	SUS
<b>Status Register 3</b>	0		Reserved	Reserved	Reserved
	1		Reserved	Reserved	Reserved
	2		WPS	WPS	Reserved
	3		Reserved	Reserved	Reserved
	4		Reserved	Reserved	Reserved
	5		DRV0	DRV0	DRV0
	6		DRV1	DRV1	DRV1
	7		Hold/RST	Hold/RST	Reserved
<b>Status Register 4</b>	0		BWS0	BWS0	
	1		BWS1	BWS1	
	2		BWS2	BWS2	
	3		XiP	XiP	
	4		EE	EE	
	5		PE	PE	
	6		SPM	SPM	
	7		PDM	PDM	
<b>Status Register 5</b>	0		DWA	DWA	
	1		STPE	STPE	
	2		PS	PS	
	3		ES	ES	
	4		DC0	DC0	
	5		DC1	DC1	
	6		DC2	DC2	
	7		SRLOCK	SRLOCK	



		AT25SF081B	AT25FF081A	AT25XE081D	AT25EU0081A
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 8-Mbit products, contain an SFDP (Serial Flash Discoverable Parameters) table. Each product family has different SFDP table definitions. Contact Renesas for detail SFDP table documents for specific product.

Table 7: Renesas 8-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)	
<b>Wide Vcc FusionHD Flash Family with Enhanced Features</b>						
AT25XE081D			x			SFDP-T010
<b>3.0V Standard Flash</b>						
AT25SF081B					x	SFDP-T021
<b>Wide Vcc Standard Flash</b>						
AT25FF081A			x			SFDP-T015
AT25EU0081A					x	SFDP-T026

## 7. Packaging Options

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

Table 8: Renesas 8-Mbit Packaging Options

	AT25SF081B	AT25FF081A	AT25XE081D	AT25EU0081A
<b>SOIC Package</b>				
8-pin SOIC (0.150" narrow body)	x	x	x	x
8-pin SOIC (0.208" wide body)	x	x	x	x
<b>UDFN Package</b>				
8-pad 5 x 6 mm UDFN				
8-pad 2 x 3 mm UDFN	x	x	x	x
<b>TSSOP Package</b>				
8-pad 4 x 4 mm TSSOP				
<b>WLCSP Package</b>				
8-ball (3 x 2 x 3) WLCSP		x	x	

## 8. XE Family Special Features

AT25XE081D contains special function blocks for special applications. For example, EEPROM emulation can be done using 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.

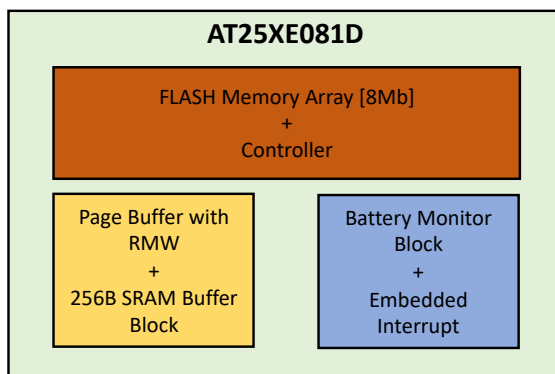


Figure 1: AT25XE081D Block Diagram

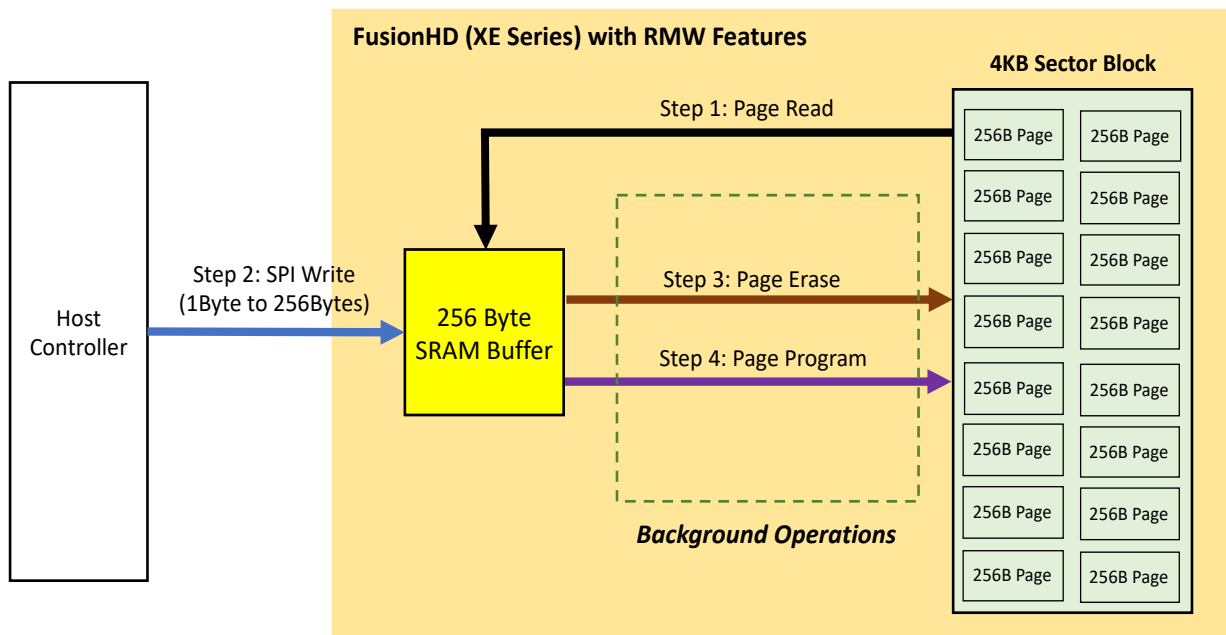


Figure 2: AT25XE081D 256Byte SRAM Page Buffer Block with RMW Feature

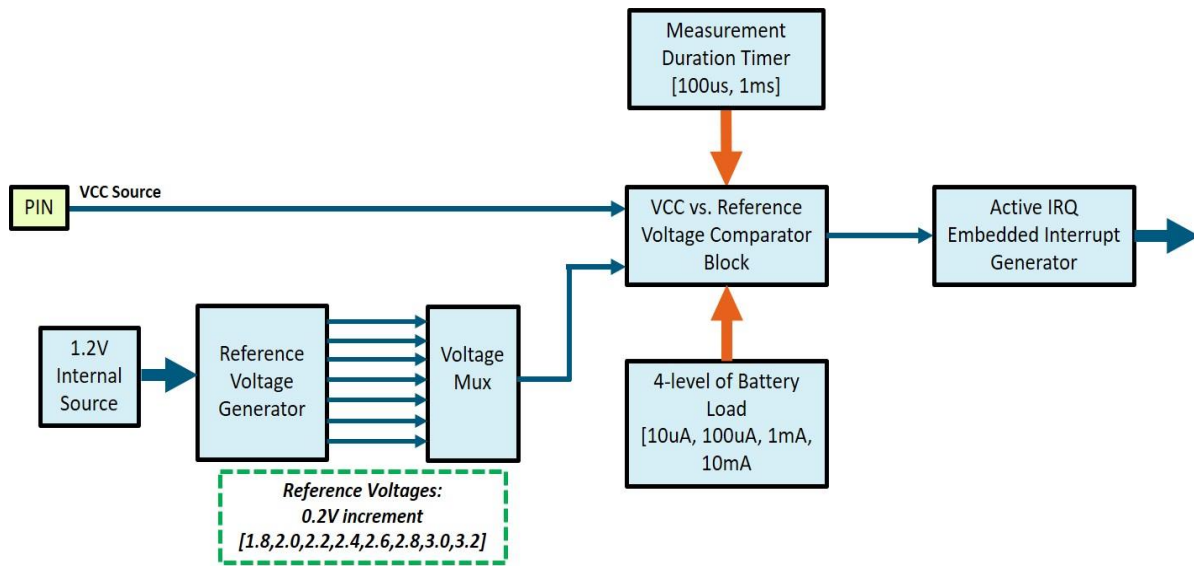


Figure 3: AT25XE081D Battery Monitor Block

## 9. Revision History

Revision	Date	Description
A1	05/2020	Initial release.
A2	10/2020	Removed the status register 3 functions for AT25SF081B in table 3, table 5 and table 6 since status register 3 is not supported
A3	9/2023	Applied new corporate template to document and added AT25EU0081A