

JPEG IP core (KJN series)

The KJN series of still-image compression/decompression IP cores complies with the JPEG Baseline/Extended process Standard

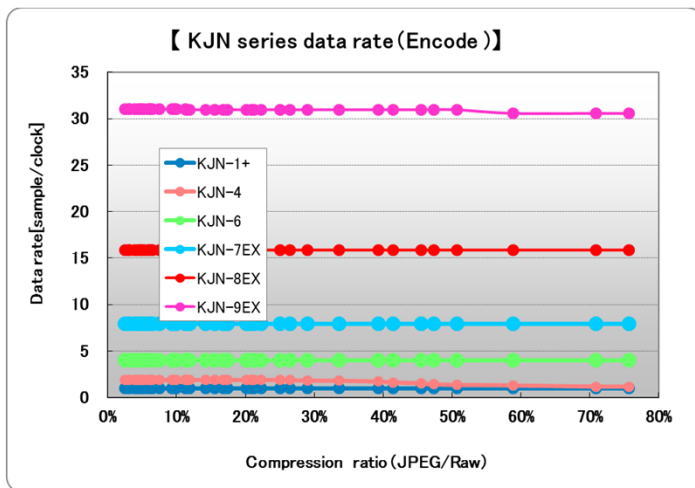
Overview

- Complies with JPEG Baseline / Extended / Lossless (ISO/IEC 10918-1, ITU-T T.81 Annex H)
- Obtains high-speed, small-scale and power-efficient processing by Shikino's original algorithms
- The arithmetic accuracy satisfies the compliance testing requirement of JPEG Part2 (ISO/IEC 10918-2, ITU-T T.83)
- Operation parameters such as processing mode, image size, DRI value etc. are set in internal registers via external CPU
- Markers Automatically generated on Encode, and automatically analyzed on Decode.
Supported markers: SOI, SOF₀ (Baseline), SOF₁ (Extended), SOF₃ (Lossless), SOS, DQT, DHT, DRI, RST_m, EOI
- A flexible lineup meeting a wide range of demands on Processing speed (Data rate) and Image bit depth

Performance

◆ The KJN series is up to 32X faster data rate against other common JPEG IP cores

Encode data rate



Decode data rate

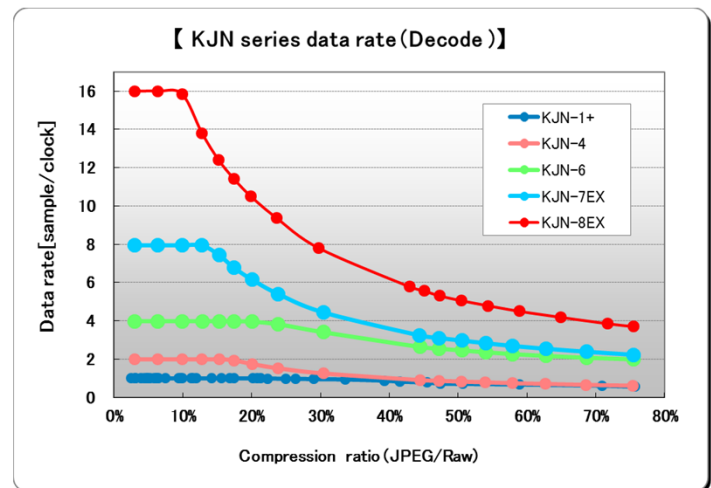
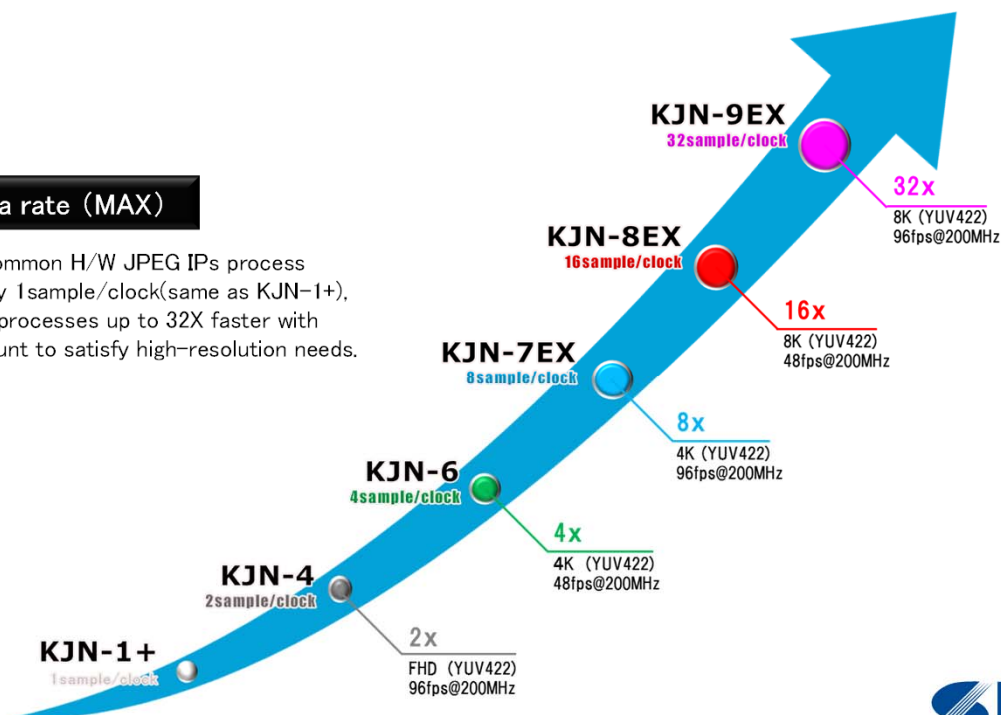


Image data rate (MAX)

* Although common H/W JPEG IPs process images at only 1sample/clock (same as KJN-1+), our JPEG IP processes up to 32X faster with small gate count to satisfy high-resolution needs.



Advantage of KJN series

Comparison against common JPEG IP

	Data rate (Samples/clock)	Image Bit Depth	Lossless	Supported Formats	Codec gate count	ASIC /FPGA	Frame Rate (fps) (8K:YUV422@200MHz)	Gate count estimation at 96fps (8K:YUV422@200MHz)
Shikino IP (KJN series)	Up to 32	8-16bit	Yes	JPEG (Baseline, Extended, Lossless) JPEG XR	Least 80KG	Yes	96	Around 400KGates
Common JPEG IP	1	8bit	No	JPEG (Baseline)	Around 100KG	Yes	3	Around 3200KGates (1Sample/clock IP x 32)

* Above numbers might vary depending on environments and/or image.

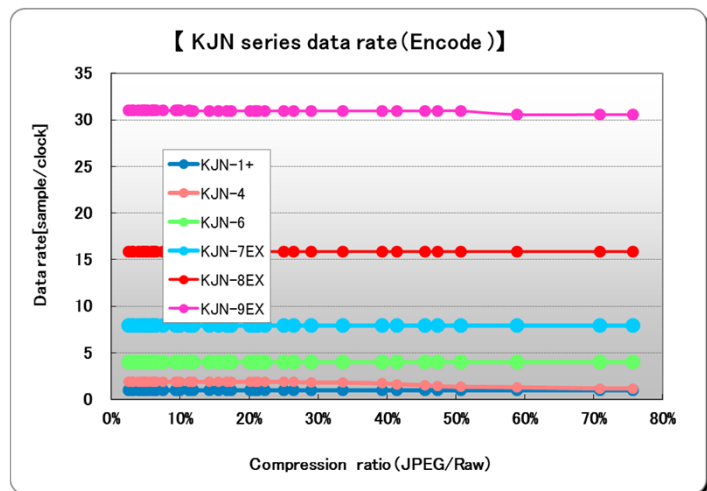
◆ Overwhelming superiority in Data rate and Gate count

KJN series attains up to 32X higher data rate against other common JPEG IP and only 1/32 frequency is needed to achieve the same target frame rate. On the other hand, it is also possible to meet the target frame rate with a lower gate count.

Encode data rate

Our fastest IP core
32X faster than common JPEG IP

Common JPEG IP (same as KJN-1+) →



◆ Support high bit depth/Lossless

The KJN series supports not only standard 8bit JPEG (Baseline), but also 12bit JPEG (Extended) to satisfy high bit depth needs such as HDR(WDR). This function provides the same compression efficiency with JPEG and outstanding images with less image quality deterioration during image compression/decompression of 10-14bit camera sensor data.

Furthermore, this series also provides Lossless formats for applications where any deterioration of image quality is unacceptable. Lossless format : ISO/IEC 10918-1, ITU-T T.81 Annex H and JPEG XR.

Our original high speed algorithm used by the high bit depth/lossless IP cores enables a reduction of the clock frequency and/or gate count.

◆ A thorough support system

We offer customization of the Interface, additional functions and/or the IP core itself, to satisfy specific user demands.

- Processing capacity.
- Fully reversible lossless compression method.
- Code stream format.
- Rate control & image area segmentation functions.
- IP core peripheral circuit design.
- Integration with customer IP core.

High bit depth/Lossless image IP core

An IP core supporting high bit depth and lossless function to obtain ultra-high definition images against traditional 8bit RGB. We are ready to provide an IP core supporting more than 12 bits depth, Lossless/Lossy image, which minimizes image quality deterioration and enables advanced image correction/edit.

◆ High bit depth

In addition to the existing 8bit depth in JPEG, the high bit depths (10bit/12bit) attains high image quality. It is even possible to select bit depths for each frame. This product is most suitable for the medical/broadcasting/aerospace/industrial camera fields requiring color reproducibility and exactness.

◆ Lossless/Lossy

Besides the existing lossy JPEG format, the KJN series supports lossless compression for color reproducibility. This technology is very useful in highly advanced medical equipment, image processing inspection devices and aviation/aerospace equipment that previously have required customers to use uncompressed and large-capacity RAW images to prevent image quality deterioration.

◆ High speed

The Lossy processing function provides users with the 32X, 32Sample/clock processing speed (data rate). This is optimal for consumer devices requiring high-speed consecutive shooting (e.g. DSC, DSLR, Smartphones, Tablets, 8K displays and so forth).

High bit depth/Lossless IP core list

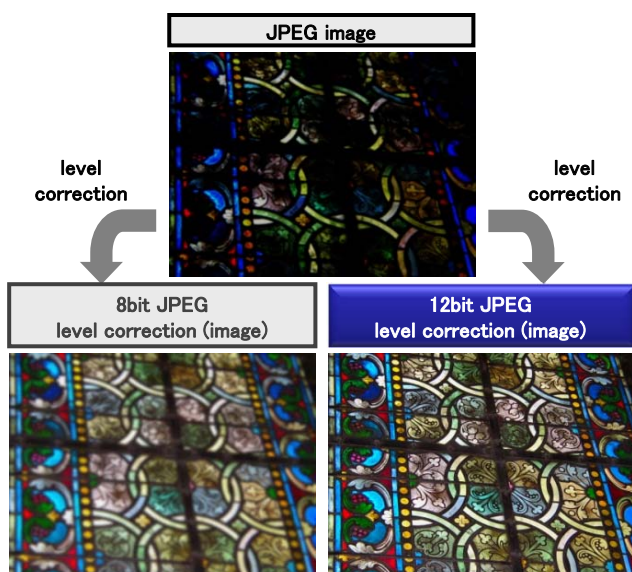
	Image Bit Depth (bits)	Mode	Data Rate (Samples/clock)	Supported Formats
KJN-1LSC	8,12,14,16	Lossless	1	JPEG (Lossless)
KJN-7EX_LSC (Lossless)	8,10,12,14,16	Lossless	8 (Decode:4)	JPEG (Lossless)
KJN-7EX	8,10*,12	Lossy	8	JPEG (Baseline, Extended)
KJN-7EX_LSC	8,10*,12	Lossless/Lossy	8 (Lossless Decode:4)	JPEG (Baseline, Extended, Lossless)
KJN-8EX	8,10*,12	Lossy	16	JPEG (Baseline, Extended)
KJN-9EX_ENC	8,10*,12	Lossy	32	JPEG (Baseline, Extended)
KJN-X1+	1,5,8,10,12*,14*,16	Lossless/Lossy	3	JPEG XR

*1 Our original specification, as an extension to the standard

High bit depth advantage example

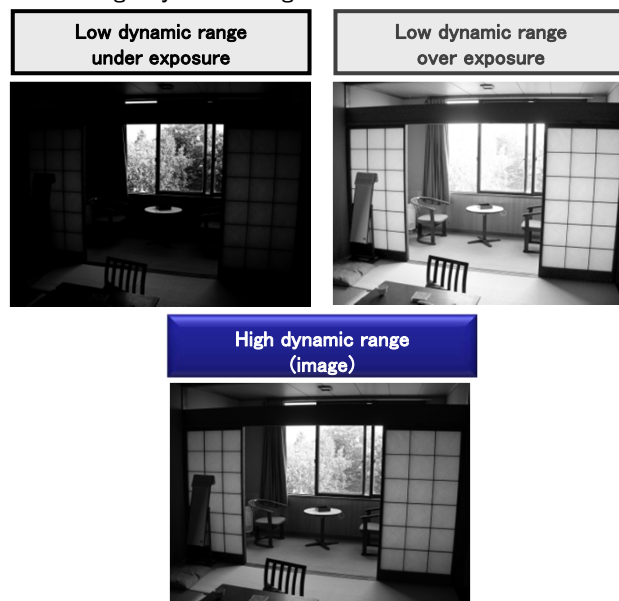
◆ Image data manipulation

Reduce image quality deterioration by high-level image edit.



◆ HDR(WDR)

Obtain high dynamic range.



Introduction of new product IP core (1/2)

We introduce new products added.

Lossless JPEG IP core

◆ Lossless / High bit depth

KJN-7EX_LSC's supported formats is Lossy/Lossless

KJN-7EX_LSC(Lossless) supports Lossless only, and reduced the area ratio by 52%.

KJN-7EX_LSC(Lossless) corresponds to multi bit depth of 8bit /10bit /12bit /14bit /16bit, realizing high image quality.

It is even possible to select bit depths for each frame. This product is most suitable for the medical/broadcasting/aerospace/industrial camera fields requiring color reproducibility and exactness.

	Image Bit Depth (bits)	Mode	Data Rate (Samples/clock)	Supported Formats
KJN-7EX_LSC (Lossless)	8,10,12,14,16	Lossless	8 (Lossless Decode:4)	JPEG (Lossless)

JPEG IP core supporting IEEE 1180-1990

◆ Improve calculation accuracy

The conventional KJN series supported only to the calculation precision of ITU-T83.

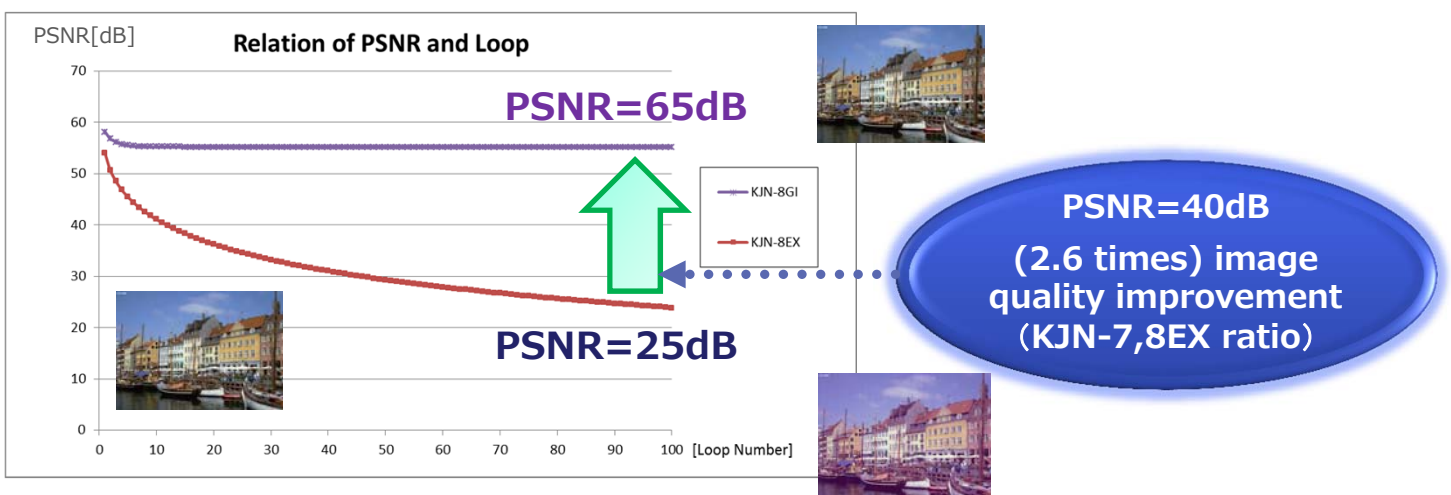
KJN-7GI, KJN-8GI conforming to IEEE 1180-1990 will be added to the line-up.

	Image Bit Depth (bits)	Mode	Data Rate (Samples/clock)	Supported Formats
KJN-7GI	8	Lossy	8	JPEG (Baseline)
KJN-8GI	8	Lossy	16	JPEG (Baseline)

An example of the comparison result of the PSNR values of ITU-T 83 and IEEE 1180-1990 is shown below.

Perform a test that compression/decompression 100 times and compare the PSNR values of each.

In the test result, IEEE 1180-1990 improves image quality by 2.6 times for ITU - T 83.



Introduction of new product IP core (2/2)

KJN-F Series which implements high performance in FPGA device

JPEG IP core for FPGA device

Comparison with conventional KJN Series products

Low Gate size significantly

High Frequency significantly

Comparison with our products
Great Improvement

Gate Size About 30%
Frequency About twice

Gate Size About 12%
Frequency About twice

	Codec			Encoder		
	KJN Series KJN-1+	KJN-F Series KJN-F1	(Reference) Company A	KJN Series KJN-1ENC	KJN-F Series KJN-F1ENC	(Reference) Company B
Intel Cyclone-V						
I/Os	192	80	—	148	56	73
Gate Size [ALMs]	4670	3200	4094	1930	1700	2430
Frequency [MHz]	63	132	130	83	182	166
Processing capacity [MPixel/sec]	31	66	65	41	91	83
RAMs [M10K]	12	9	9	4	9	3
DSPs	1	26	18	1	15	1

Vary depending on synthesis conditions.

Specifications

KJN-F series	Data Rate Samples ^{*1} /clock k	Interface(bit)			Quantization Table	Huffman Table	Profile
		CPU I/F	Image I/F	Code I/F			
KJN-F1	1	8	8	8	4 (RAM)	DC2(Fix) AC2(Fix) *2	Baseline
KJN-F1ENC	1	8	8	8	4 (RAM)	DC2(Fix) AC2(Fix) *2	
KJN-F4	2	32	32	32	4 (RAM)	DC2(Fix) AC2(Fix) *2	
KJN-F4ENC	2	32	32	32	4 (RAM)	DC2(Fix) AC2(Fix) *2	
KJN-F4DEC	2	32	32	32	4 (RAM)	DC 2 (RAM) AC 2 (RAM) *3	
KJN-F4DEC_LI	2	32	32	32	4 (RAM)	DC2(Fix) AC2(Fix) *2	

- *1 1 Component (e.g. :1Sample=8bit at Baseline)
- *2 Huffman table fixed recommendation standard table.
- *3 Use downloaded Huffman table.

JPEG XR IP core

The KJN-X1+ is a still-image compression/decompression IP core, complies with the JPEG XR Standard.

Overview

◆ High Compression Efficiency

One of the advantages of JPEG XR format is the very high compression efficiency. The images below show the image quality for JPEG and JPEG XR respectively, when the compression ratio is below 1%. In spite of the poor quality JPEG image, the JPEG XR image remains useful as a normal photo. PSNR of the JPEG XR image is still around 40dB at this high compression ratio.

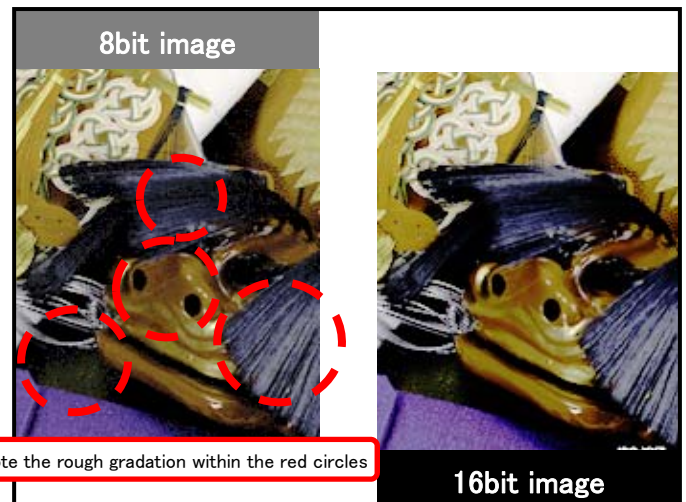
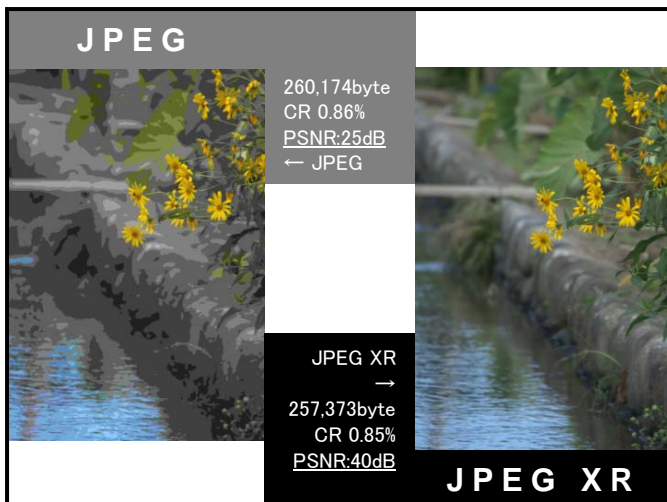
◆ High bit depth/Lossless

High-end users who modify their photos using photo retouch software prefer raw format for taking DSC pictures. The raw format is the best for storing image base data, when anticipating certain image corrections. This is due to the format being able to record all the data from the image sensor. However, these users also wish to have an alternative format, to reduce the currently gigantic raw file size.

JPEG XR supports Lossless format. This means JPEG XR is able to store the same data as the raw format with much smaller file size. This new format makes it possible to reduce the file size to around 30-40% of the original natural pictures. (Compression Ratio depends on the picture) Our JPEG XR IP core supports up to 16 bits depth in both Lossless and Lossy modes, enabling the use of well compressed, but still unreduced quality image sensor data..

◇ Compression ratio & PSNR (Original image : 30,357,644byte)

◇ Luminance correction with high bit depth image



Specification list

	Gate Count *2			Interface			Color Format
	LOGIC*1	Internal SRAM	Line Memory	CPU Interface	Image Interface	Code Interface	YONLY/ YUV420 / YUV422 / YUV444 / CMYKDIRECT / RGB / CMYK
KJN-X1+	990KG	W=1920 194Kbit	W=1920 224Kbit	8/16/32 bit	64bit	64bit	Support *3

*1:Estimated gate count at 90nm@200MHz/NON SCAN/NON CTS. Depends on synthesis options.

*2:Size for 8bit image data bit depth. Differs by bit depth settings.

*3:Formats YONLY,YUV,YUVK are specified in JPEG XR Part2[3rd edition].

Depending on settings, RGB/CMYK will be internally converted and processed in YUV/YUVK format.

JPEG IP core specification list

Specification list

KJN series	Data Rate Samples ^{*1} /clock	Gate Count		Interface(bit)			Quantization Table	Huffman Table	Profile
		LOGIC*4	Internal SRAM	CPU I/F	Image I/F	Code I/F			
KJN-1+ *9	1	75KG	11Kbit	8	8	8	4(RAM)	DC2(RAM) AC2(RAM)	Baseline
KJN-1ENC *9	1	40KG	4Kbit	8	8	8	2(RAM)	DC2(Fix) AC2(Fix) *2	
KJN-4	2	120KG	9Kbit	8	16	16	4(RAM)	DC2(RAM) AC2(RAM)	
KJN-4ENC	2	75KG	5Kbit	8	16	16	4(RAM)	DC2(Fix) AC2(Fix) *2	
KJN-6	4	185KG	7Kbit	32	32/64	32/64	4(RAM)	DC2(RAM) AC2(RAM)*3	
KJN-6ENC	4	90KG	7Kbit	32	32/64	32/64	4(RAM)	DC2(Fix) AC2(Fix) *2	
KJN-7	8	300KG	7Kbit	32	64	64	4(RAM)	DC2(RAM) AC2(RAM)*3	
KJN-7ENC	8	130KG	7Kbit	32	64	64	4(RAM)	DC2(Fix) AC2(Fix) *2	
KJN-7EX	8	480KG	9Kbit	32	96	64/96/128	4(RAM)	DC4(RAM) AC4(RAM)*5	Baseline Extended
KJN-7EX_LSC*8	8	680KG	9Kbit	32	96	64/96/128	4(RAM)	DC4(RAM) AC4(RAM)*6	Baseline Extended Lossless
KJN-8EX (8bit)	16	390KG	9Kbit	32	128	128	4 (RAM)	DC2(RAM) AC2(RAM)*3	Baseline
KJN-8EX (12bit) *7	16	610KG	12Kbit	32	192	256	4 (RAM)	DC4(RAM) AC4(RAM)*5	Baseline Extended
KJN-8EX_ENC (8bit)	16	200KG	9Kbit	32	128	128	4 (RAM)	DC2(Fix) AC2(Fix) *2	Baseline
KJN-8EX_ENC (12bit) *7	16	330KG	12Kbit	32	192	128/256	4 (RAM)	DC2(Fix) AC2(Fix) *5	Baseline Extended
KJN-8EX_DEC (8bit)	16	255KG	9Kbit	32	128	128	4 (RAM)	DC2(RAM) AC2(RAM)*3	Baseline
KJN-8EX_DEC (12bit) *7	16	390KG	12Kbit	32	192	256	4 (RAM)	DC4(RAM) AC4(RAM)*5	Baseline Extended
KJN-8GI*10	16	415KG	11Kbit	32	128	128	4 (RAM)	DC 2 (RAM) AC 2 (RAM) *3	Baseline
KJN-9EX_ENC (8bit)	32	365KG	9Kbit	32	256	256	4(RAM)	DC2(Fix) AC2(Fix) *2	Baseline
KJN-9EX_ENC (12bit) *7	32	585KG	12Kbit	32	384	512	4(RAM)	DC2(Fix) AC2(Fix) *5	Baseline Extended
KJN-1LSC	1	51KG	-	8	8/12/ 14/16	32	-	DC 4(RAM)	Lossless
KJN-7EX_LSC*8 (Lossless)	8	324KG	-	32	128	64/96/128	-	DC 4(RAM)	

*1 1 Component (e.g. :1Sample=8bit at Baseline)

*2 Huffman table is based on recommended standard table.

*3 Huffman table is based on recommended standard table for compression processing,

and optional Huffman table can be used for expansion processing.

*4 Estimated gate size at 90nm@150MHz /NON SCAN /NON CTS.
Vary depending on synthesis conditions.

*5 Fixed table is used on Encode.(DC:2,AC:2)

12bit JPEG: SHIKINO original table

8bit JPEG: Standard table

Download from compressed data on Decode.(DC:4,AC:4)

*6 Use Four DC tables for Lossless. Lossy tables are the same as "*5"

possible to switch the circuit of 8/12bit parameter settings.

*7 KJN-7EX_LSC (Lossy mode), not support 411 colorformat

*8 KJN-1+,KJN-1ENC not support CMYK format

*9 Arithmetic accuracy complies with IEEE 1180-1990

*10



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