

HCenc – MPEG2 encoder

Release HCenc028

General information

Ñ **What is HCenc**

HCenc is a simple to use MPEG2 video encoder and is meant for creating MPEG2 video streams with a strong focus on DVD and Blu ray (BD) compliancy.

All MPEG2 SD / HD resolutions are supported, maximum resolution: 1920 x 1152.
Width and height must be divisible by 8.

Ñ **Installation**

Just unzip the archive where you have a few GB free space, the space is needed for the storage of intermediate files.

Ñ **Hardware requirements**

The encoder will run on any Intel and AMD processor using Windows 7/8.

It will probably run under Linux (using Wine) and older Windows versions.

HCenc uses the next CPU extensions if available: MMX/SSE, SSE2, SSE3, SSSE3, at least MMX/SSE must be present, if SSE2, SSE3 or SSSE3 is present HC will also use it, run time will be 5 - 10% faster with SSE2 and 5 – 30% with SSE3 or SSSE3. The encoder will automatically detect the CPU extensions.

Memory requirements: HCenc will run with only 256 MB installed, more is, as always, better.

For HD encodes 2 GB is recommended.

HCenc 028 is a multi-threaded application, it's also possible to run multiple instances of HCenc.

Ñ **Input**

Input can be a DGIndex/DGDecode d2v project or input using Avisynth.

Avisynth 2.6 RC1 or higher is required to run HCenc 0.28.

HCenc 0.28 can handle the next colorspace input formats:

- YV12 (4:2:0)
- YUY2 (4:2:2)
- YV16 (4:2:2)
- YV24 (4:4:4)

Ñ **Versions**

Two versions are available, a GUI version (HCgui) which is easy to use and the actual encoder (HCenc) which is controlled by a series of commands in an ini file, it can also take parameters.

The GUI version will only generate the ini file, it uses HCenc to do the actual encoding.

Ñ **Output**

Output is a regular m2v file which can be used directly in your favorite authoring program.

HCenc 0.28 can generate the next colorspace output formats:

- 4:2:0
- 4:2:2
- 4:4:4

Features

Ñ **1pass/multipass**

HCenc is a 1 or 2 pass encoder which produces a VBR MPEG2 stream.
Bitrate control is controlled by an average bitrate value and a maximum bitrate value.

Ñ **Bitrate control**

Bitrate is controlled by two commands: *BITRATE and *MAXBITRATE.
Buffer underflows will never occur, while encoding the frames, the VBV (Video Buffer Verifier) is constantly checked for buffer underruns, if buffer underruns occur the bit stream will be adapted so the stream will always be DVD-compliant.

Ñ **Encoding quality**

Encoding quality is controlled by the encoding profile: FAST, NORMAL, BEST.
For the *PROFILE command, see the command section.

Ñ **GOP structure**

User controllable, maximum GOP length is 36, maximum consecutive B-pictures is 3.
You can for instance give the command *GOP 15 2 or *GOP 12 1, see the command section.
If the *GOP command is omitted, HCenc will run in AUTOGOP mode, this probably is the best way to run the encoder. In AUTOGOP mode HCenc scans frames to be encoded and measures the activity of the frames. Based on the activity of the frames HC tries to create an optimal GOP structure.
A sequence header is written for each GOP.

Ñ **Scene change detection**

HCenc has a scene change detection algorithm built in, on each scene detection an I-frame is inserted and the GOP will be closed so you can cut the video at each scene change.
If necessary the frames in the two previous GOP's will be redistributed to maintain a nice general GOP structure.

Ñ **Quantization matrices**

You can use any matrix you like, some well known matrices are already built in which can be activated by the *MATRIX command. If you want to use your own matrix (intra and non-intra) just use the command *CUSTOMMATRIX and specify the two matrices, see the command section.
If the *MATRIX command is omitted HCenc will use the standard "adapted" MPEG matrices, see the matrix section for the matrix specification.

Ñ **Progressive/interlaced encoding**

HCenc has an auto-detect mode which will choose the optimal encoding method for each frame (progressive vs interlaced), of course it can be forced to do progressive or interlaced only.

Ñ **Encoding speed**

Encoding speed is highly dependent of:

- Complexity and resolution of the video material
- Speed of your system: CPU, cache size and bus/memory speed
- Availability of CPU extensions

Encoding (interlaced) DV video might take longer to encode.
A fast system will encode a 3 hour movie (DVD backup) in approx. 0.5 hour with *PROFILE BEST.

Command section

HCenc is controlled by a series of commands in the ini file.
It can also use parameters, see the next section.

Commands may be given in any order, they all start with *, commands may be uppercase or lowercase and must start at the first column.

You can simply deactivate a command by putting a space before the command.

NOTE ABOUT INTERLACED ENCODING

There are 3 commands to control interlaced encoding: *PROGRESSIVE, *INTERLACED and *DVSOURCE.
If none of these commands are used it runs in auto detect mode with TFF.

The next commands are available:

***1PASS**

parameter	-	type	-
<i>Status</i>	not required		
<i>Default</i>	-		
<i>Example</i>	*1PASS		

This command activates the 1 pass VBR (Variable Bit Rate) mode. An average bit rate can be set.
A fast sampling pass will be done before the actual encoding pass. The output file size can be off if the encoded clip is short, it will be disabled if the nr. of frames < 1000.

***ADAPTIVEMATRIX**

parameter	-	type	-
<i>Status</i>	not required		
<i>Default</i>	-		
<i>Example</i>	*ADAPTIVEMATRIX		

This command activates the code in matrix.dll. Using this command you can change matrices at every GOP. **This is meant for very experienced users only !!**
See the adaptive matrices section in this manual how to create the dll.

***AQ**

parameter	strength (0 - 4)	type	integer
<i>Status</i>	not required		
<i>Default</i>	2		
<i>Example</i>	*AQ 3		

This command activates adaptive quantization, flat parts are given a lower quantizer.
Strength 0 means no adaptive quantization, strength 4 generates the lowest quants for flat parts but it may create artifacts around sharp edges.
HCenc 028 will use AQ 2 as default.

***ASPECT**

parameter	1:1, 4:3, 16:9, 2.21:1	type	character string
<i>Status</i>	not required		
<i>Default</i>	16:9		
<i>Example</i>	*ASPECT 4:3 (3:4 is also allowed)		

This command sets the desired aspect ratio.

***AUTOGOP**

parameter	goplength (8 – 18)	type	integer
<i>Status</i>	not required		
<i>Default</i>	15 (12 for 23.976 fps)		
<i>Example</i>	*AUTOGOP 12		

This command sets the maximum GOP length to be used by the autogop algorithm.

Running in AUTOGOP mode means the encoder tries to distribute the I, P and B frames in an optimal manner based on the activity of the frames.

Encoding using AUTOGOP will be DVD-compliant if the next values are used:

- For NTSC source to be pulldowned, use values 12 – 14.
- For PAL source a maximum value of 15 should be used.
- For 29.97 NTSC source the maximum of 18 can be used.

*AVSMEMORY

parameter memory **type** integer
Status not required
Default -
Example *AVSMEMORY 32

This command sets the maximum memory (MB) to be used by Avisynth, maximum value: 1024.
This command is equivalent to the SetMemoryMax() Avisynth command.

*B3

parameter - **type** -
Status not required
Default -
Example *B3

This command allows 3 consecutive B-frames, NOT DVD-COMPLIANT.

*BFF

parameter - **type** -
Status not required
Default NA for progressive, TFF for interlaced, BFF for DV source
Example *BFF

This command specifies bottom field first, only used for interlaced encoding.

*BIAS

parameter bias (range 0 – 100) **type** integer
Status not required
Default 0
Example *BIAS 30

This command tweaks the compression curve, 0 means full VBR (Variable BitRate), 100 tends to CBR (Constant BitRate).

*BITRATE

parameter bitrate **type** integer
Status required
Default -
Example *BITRATE 3250

This command specifies the average bitrate per second in kbits/s. (1 kbit = 1000 bit)

*CHAPTER

parameter nr. of chapters **type** integer
Status not required
Default -
Example *CHAPTER 5
101
1253
2763
5471
8354

This command sets chapter points at the frames given, this means an I-frame is inserted and the GOP is closed.

There's no limit on the number of chapters, you can even set a chapter on every frame.

*CHROMADOWNSAMPLE

parameter method, 0=progressive, 1=interlaced **type** integer
Status not required
Default 0
Example *CHROMADOWNSAMPLE 1

This command switches between progressive or interlaced subsampling.

CHROMADOWNSAMPLE 0 (progressive) is set by default.

Needed for conversion 4:2:2 to 4:2:0.

*CHROMAFORMAT

parameter	420, 422 (4:2:0, 4:2:2,)	type	character string
Status	not required		
Default	420		
Example	*CHROMAFORMAT 422		

This command sets the chroma output format.

For 422 output, input must be YUY2.

For 420 output, input can be YV12 or YUY2.

If needed the input will be down sampled using progressive or interlaced subsampling, this can be set with the *CHROMADOWNSAMPLE command.

*CLOSEDGOPS

parameter	-	type	-
Status	not required		
Default	-		
Example	*CLOSEDGOPS		

This command closes all gops.

CLOSEDGOPS is disabled by default.

*COLOUR

parameter	colorimetry	type	integer
Status	not required		
Default	-		
Example	*COLOUR 5		

This command flags the colorimetry of the stream by outputting the Sequence Display Extension header. For playback this header is ignored (Rec.601 will always be used for SD color conversion, Rec.709 for HD color conversion) but it's useful for MPEG2 compliancy.

Possible settings: 1: BT.709, 4: BT.470-2M, 5: BT.470-2BG, 6: SMPTE170M, 7: SMPTE240M.

By default this header is not written.

*CPU

parameters	AUTO, MMX, SSE2, SSE3, SSSE3	type	character string
Status	not required		
Default	AUTO		
Example	*CPU MMX		

This command can be used to force the cpu to use specific extensions.

*CQ

parameter	quantization	type	real
Status	not required		
Default	-		
Example	*CQ 5.8		

This command orders the encoder to do a 1-pass with a constant quantization factor.

The value for quantization is the non-linear scale value.

No database is created, the output file is created in the first pass.

NOTE: this is not the same as CBR encoding, HCenc doesn't do CBR encoding.

*CQ_BFACTOR

parameter	factor for B-frame quantization	type	real
Status	not required		
Default	1.0		
Example	*CQ_BFACTOR 1.4		

Multiplication factor for the quantization of B-frames using constant quantization.

Range: 0.5 – 4.0.

Example: if *CQ or *CQ_MAXBITRATE is set to 5, using *CQ_BFACTOR 1.4 means B-frames will use $Q = 7$.

*CQ_MAXBITRATE

parameter quantization **type** real
Status not required
Default -
Example *CQ_MAXBITRATE 5.8

This command orders the encoder to do a 1-pass with a constant quantization factor. If the actual bitrate overshoots the maximum bitrate set by the *MAXBITRATE command the quantizer is temporarily raised. Output will be DVD-compliant. The value for quantization is the non-linear scale value. No database is created, the output file is created in the first pass.
NOTE: this is not the same as CBR encoding, HCEnc doesn't do CBR encoding.

*CQ_PFACTOR

parameter factor for P-frame quantization **type** real
Status not required
Default 1.0
Example *CQ_PFACTOR 1.2

Multiplication factor for the quantization of P-frames using constant quantization. Range: 0.5 – 4.0.
Example: if *CQ or *CQ_MAXBITRATE is set to 5, using *CQ_PFACTOR 1.2 means P-frames will use Q = 6.

*CUSTOMMATRIX

parameter - **type** -
Status not required
Default -
Example *CUSTOMMATRIX

```
8 16 19 22 26 27 29 34
16 16 22 24 27 29 34 37
19 22 26 27 29 34 34 38
22 22 26 27 29 34 37 40
22 26 27 29 32 35 40 48
26 27 29 32 35 40 48 58
26 27 29 34 38 46 56 69
27 29 35 38 46 56 69 83

16 17 18 19 20 21 22 23
17 18 19 20 21 22 23 24
18 19 20 21 22 23 24 25
19 20 21 22 23 24 26 27
20 21 22 23 25 26 27 28
21 22 23 24 26 27 28 30
22 23 24 26 27 28 30 31
23 24 25 27 28 30 31 33
```

This command defines custom intra and non-intramatrices to be used and supersedes the default matrix and the *MATRIX command. The matrices must be supplied as given in the example, 8 values per line.

*DBPATH

parameter path **type** character string
Status not required
Default -
Example *DBPATH E:\tmp

This command sets the path for the intermediate database file.

*DC_PREC

parameter dc_precision **type** integer
Status not required
Default 9
Example *DC_PREC 8

This command defines the DC_precision to be used, range 8 - 11.
NOTE: dc_precision 11 is NOT DVD-compliant.

*INTRAVLC

parameter	<i>method</i>	type	integer
<i>Status</i>	not required		
<i>Default</i>	2		
<i>Example</i>	*INTRAVLC 1		

This command sets the method for intra VLC coding, 0 uses table 14, 1 uses table 15, 2 optimizes the VLC coding.

*LASTIFRAME

parameter	-	type	-
<i>Status</i>	not required		
<i>Default</i>	-		
<i>Example</i>	*LASTIFRAME		

The last frame will be encoded as an I-frame.

*LLPATH

parameter	<i>path</i>	type	character string
<i>Status</i>	not required		
<i>Default</i>	-		
<i>Example</i>	*LLPATH E:\tmp		

This command sets the path for the intermediate lossless file.

*LOGFILE

parameter	<i>log file name</i>	type	character string
<i>Status</i>	not required		
<i>Default</i>	-		
<i>Example</i>	*LOGFILE D:\movies\test.log		

This command defines the log filename, if omitted no logfile will be written. If the logfile already exists the logs will be appended.

*LOSSLESS

parameter	-	type	-
<i>Status</i>	not required		
<i>Default</i>	-		
<i>Example</i>	*LOSSLESS		

This command activates the use of a lossless intermediate file for 2 pass encoding.

It can only be used with Avisynth input, can be useful if the avs script is very slow, using lossless means the script has to be processed only once. This command can also be used if there are source mismatch errors which can't be solved with *AVSRELOAD.

WARNING, the lossless file can be huge.

*LUMGAIN

parameter	<i>sensitivity (0 - 4)</i>	type	integer
<i>Status</i>	not required		
<i>Default</i>	0		
<i>Example</i>	*LUMGAIN 2		

This command adapts the quantization matrices on dark scenes so the bitrate will be raised.

- 0 no change
- 1 mild change
- 2 moderate change
- 3 heavy change
- 4 hit dark scenes real hard

CAUTION: although it is DVD compliant, it might not play correct on some HW players.

*MASK_SHIFT

parameter	<i>top bottom shift</i>	type	3*integer
<i>Status</i>	not required		
<i>Default</i>	0 0 0		
<i>Example</i>	*MASK_SHIFT 16 144 64		

This command masks top and bottom lines, the 3th parameter specifies the shift in lines, positive values will shift the video upwards, negative values will shift it down. All values must be even.

The example will mask 16 top lines and 144 bottom lines, the video is shifted upwards 64 lines.

The shift is done first, after that the top and bottom masking.

*MATRIX

parameter matrix **type** character string
Status not required
Default MPEG matrix
Example *MATRIX HClow

This command defines the intra and non-intra matrix to use.
See the matrix section for available built-in matrices and the default matrix specification.

*MAXBITRATE

parameter bitrate **type** integer
Status required
Default -
Example *MAXBITRATE 9000

This command specifies the maximum bitrate in kbits per second. (1 kbit = 1000 bit)

*MINBRFAC

parameter value **type** real
Status not required
Default 1.00
Example *MINBRFAC 1.2

This command manipulates the lower limit for creating the compression curve for 2 pass encoding. Range for MINBRFAC: 0.5 – 2.0.
WARNING: small values may cause blocking.

*NOSEQ_ENDCODE

parameter - **type** -
Status not required
Default -
Example *NOSEQ_ENDCODE

This command disables output of the sequence endcode (00 00 01 B7) at the end of the stream.

*NOSCD

parameter - **type** -
Status not required
Default -
Example *NOSCD

This command disables the scene change detection.
Scene change detection is enabled by default, at each scene change an I-frame is inserted and the GOP is closed.

*NOSMP

parameter - **type** -
Status not required
Default -
Example *NOSMP

HC will detect the nr. of processors on your system and will use multi-thread encoding if the nr. of processors > 1.

This command disables multi-thread encoding.

*NOVBV

parameter - **type** -
Status not required
Default -
Example *NOVBV

This command disables the VBV (Video Buffer Verifier) checking.

VBV checking is enabled by default. This command should not be used for DVD creation.

*OUTFILE

parameter output file name **type** character string
Status required
Default -
Example *OUTFILE D:\movies\test.m2v

This command defines the output filename, required.

*PANSCAN

parameter	hordisp, vertdisp, nr. of frames	type	3*integer
Status	not required		
Default	-		
Example	*PANSCAN 540 576 3 900 1440 0 1200 -1440 0 1600 0 0		

This command defines the 4:3 panscan window. The active window is defined by hordisp (horizontal size) and vertdisp (vertical size). Additional frames can be input to define the horizontal and vertical shift, the shift is defined in pixel/16 values.

The example sets the normal 4:3 panscan (540*576 PAL), 3 frames with shifts are given.

The clip starts with zero shifts, from frame 900 the scan window is shifted 90 pixels to the right, from frame 1200 the scan window is set to 90 pixels to the left. From frame 1600 the display is centered. To use panscan, colorimetry (*COLOUR) must also be active, if colorimetry is not given, colour 5 (BT.470-2BG) is assumed.

Panscan will only work with 720/704 x 576/480 resolutions.

*PREVIEW

parameter	-	type	-
Status	not required		
Default	-		
Example	*PREVIEW		

This command turns on the preview window in the encoder.

*PRIORITY

parameter	IDLE, LOW, NORMAL, HIGH	type	character string
Status	not required		
Default	IDLE		
Example	*PRIORITY LOW		

This command sets the process priority.

*PROFILE

parameter	FAST, NORMAL, BEST	type	character string
Status	not required		
Default	NORMAL		
Example	*PROFILE BEST		

This command defines the encoding quality. As usual the best encoding will take the most time.

*PROGRESSIVE

parameter	-	type	-
Status	not required		
Default	-		
Example	*PROGRESSIVE		

Use this command if you're sure your source is progressive, all frames will be encoded progressive. If this command is used also the zigzag scanmethod is set.

This command will not set the progressive_sequence flag in the sequence extension header.

*PROG_SEQ

parameter	-	type	-
Status	not required		
Default	-		
Example	*PROG_SEQ		

This command sets the progressive_sequence flag in the sequence extension header, this means the encoded stream contains only progressive frames. The *PROGRESSIVE command needs to be set also.

*PULLDOWN

parameter - **type** -
Status not required
Default -
Example *PULLDOWN

This command sets pulldown flags for 23.976 29.97 pulldown.
Interlaced will be turned off, if your source is interlaced, please de-interlace it first.
If the source isn't 23.976 fps this setting will be ignored.

*SCDFILE

parameter - **type** -
Status not required
Default -
Example *SILENT

This command writes the frames with a scene change in file <output>.scd.

*SHUTDOWN

parameter - **type** integer
Status not required
Default -
Example *SHUTDOWN

This command will shutdown the system in 300 seconds after finishing encoding.

*SILENT

parameter - **type** -
Status not required
Default -
Example *SILENT

This command disables the encoder GUI, background encode. It might have a marginal speed increase.

*SMP

parameter - **type** -
Status not required
Default -
Example *SMP

HC will detect the nr. of processors on your system and will use multi-thread encoding if the nr. of processors > 1.

This command forces multi-thread encoding, even on single processor PC's.

*TFF

parameter - **type** -
Status not required
Default NA for progressive, TFF for interlaced, BFF for DV source
Example *TFF

This command specifies top field first, only used for interlaced encoding.

*TIMECODE

parameters hour minute second frame **type** (4X) integer
Status not required
Default 0 0 0 0
Example *TIMECODE 1 2 3 4

This command sets the timecode.

*WAIT

parameter second **type** integer
Status not required
Default 5
Example *WAIT 0

This command sets the waiting time before HC exits after an encoding session, range 0 – 99.
If you have a lot of short encodes it's best set to *WAIT 0.

***ZONE**

<i>parameter</i>	nr. of zones	<i>type</i>	integer
<i>Status</i>	not required		
<i>Default</i>	-		
<i>Example</i>	*ZONE 3		
	1200 1.3		
	1500 1.		
	2700 0.5		

This command raises or lowers the bitrate for parts of the video.

The example will raise the bitrate starting at frame 1200, reset to normal at frame 1500 and lowers the bitrate starting at frame 2700.

The number of zones is limited to 6400.

Using parameters

The next commands with parameters can be passed:

command	parameter	info
-i	<i>inputfile</i>	full path
-o	<i>outputfile</i>	full path
-b	<i>bitrate</i>	kbit/s
-maxbitrate	<i>max.bitrate</i>	kbit/s
-minbrfac	factor	scale factor for minimum bitrate setting
-filesize	<i>filesize</i>	file size in kbyte
-frames	<i>startframe endframe</i>	frame range
-frames	<i>all</i>	encode all frames
-gop	<i>goplength B-frames</i>	GOP length and nr. of B-frames
-b3		allow 3 consecutive B-frames
-log	<i>logfile</i>	full path
-chapter	<i>chapterfile</i>	full path
-ini	<i>inifile</i>	full path
-profile	<i>fast, normal, best</i>	encoding quality
-aspectratio	<i>1:1, 4:3, 16:9, 2:21</i>	3:4, 9:16, 2.21:1 or 1:2.21 can also be used
-scene		enable scene change detection
-noscene		disable scene change detection
-interlaced		interlaced encoding, TFF flag set, alternate scan
-progressive		progressive encoding, zigzag scan
-dvsources		interlaced encoding, BFF flag set, alternate scan
-matrix	<i>mpeg, qlb ...</i>	use a built-in matrix, see the matrices section for the available matrices, default: mpeg matrix
-tff		set Top Field First
-bff		set Bottom Field First
-dc_prec	<i>8, 9, 10, 11</i>	dc precision, 11 is NOT DVD-compliant
-bias	<i>biasvalue</i>	0 – 100
-aq	<i>AQstrength</i>	Adaptive Quantization (default: strength=2)
-intravlc	<i>0, 1, 2</i>	0=table14, 1=table15, 2=auto (optimized)
-cq	<i>CQvalue</i>	constant quantizer, one pass
-cq_maxbitrate	<i>CQvalue</i>	constant quantizer respecting max bitrate and VBV, one pass
-cq_bfactor	<i>CQB-factor</i>	CQ factor for b-frames
-cq_pfactor	<i>CQP-factor</i>	CQ factor for p-frames
-pulldown		activate pulldown (only 23.796 --> 29.97)
-closedgops		close all GOPs
-priority	<i>idle, low, normal, high</i>	set priority
-smp		use multi threading
-nosmp		disable multi threading
-silent		background encoding, no HCenc gui
-wait	<i>seconds</i>	nr. of seconds before gui closes
-shutdown		shut down when encoding is finished
-noini		don't process the default HC.ini file
-1pass		do a 1 pass VBR encode
-2pass		always do a 2 pass encode, skip all CQ commands
-lossless		use a lossless file for 2 pass Avisynth encodes
-deadzone	<i>intravalue intervalvalue</i>	use deadzone quantization (zero values for disable)
-avsmemory	<i>memory</i>	sets the memory (MB) to be used by Avisynth

For a detailed description, see the command section.

If -noini isn't used, HCenc will always look if there's a HC.ini file in the same directory as the exe file and will also read values from it. Parameters passed have a higher priority than the values supplied in the ini file. For batch processing you can do something like this:

```
HCenc_028 -i d:\movies\test1.avs -o d:\movies\test1.m2v -b 4000 -maxbitrate 9000 -ini d:\movies\hc.ini  
HCenc_028 -i d:\movies\test2.d2v -o d:\movies\test2.m2v -b 3500 -maxbitrate 8000 -ini d:\movies\hc.ini
```

Input file, output file, bitrate and maxbitrate are set as parameter, rest of the commands are read from HC.ini.

Reading all from (different) ini files:

```
HCenc_028 -ini d:\movies\hc1.ini  
HCenc_028 -ini d:\movies\hc2.ini
```

Matrices

The next built-in matrix will be used as default, the MPEG adapted matrix.
The intra matrix is the standard MPEG matrix and will not be written in the MPEG2 stream.

*MATRIX MPEG

8	16	19	22	26	27	29	34	16	17	18	19	20	21	22	23
16	16	22	24	27	29	34	37	17	18	19	20	21	22	23	24
19	22	26	27	29	34	34	38	18	19	20	21	22	23	24	25
22	22	26	27	29	34	37	40	19	20	21	22	23	24	26	27
22	26	27	29	32	35	40	48	20	21	22	23	25	26	27	28
26	27	29	32	35	40	48	58	21	22	23	24	26	27	28	30
26	27	29	34	38	46	56	69	22	23	24	26	27	28	30	31
27	29	35	38	46	56	69	83	23	24	25	27	28	30	31	33

The next built-in matrix can be used with the *MATRIX command, the MPEG standard matrix.
Both the intra and inter matrix will not be written in the MPEG2 stream.

*MATRIX MPEGSTD

8	16	19	22	26	27	29	34	16	16	16	16	16	16	16	16
16	16	22	24	27	29	34	37	16	16	16	16	16	16	16	16
19	22	26	27	29	34	34	38	16	16	16	16	16	16	16	16
22	22	26	27	29	34	37	40	16	16	16	16	16	16	16	16
22	26	27	29	32	35	40	48	16	16	16	16	16	16	16	16
26	27	29	32	35	40	48	58	16	16	16	16	16	16	16	16
26	27	29	34	38	46	56	69	16	16	16	16	16	16	16	16
27	29	35	38	46	56	69	83	16	16	16	16	16	16	16	16

The next built-in matrices can be used with the *MATRIX command:
(some of these matrices are copyrighted by their respective owners)

*MATRIX QLB

8	16	19	22	26	27	29	34	16	17	18	19	20	21	22	23
16	16	22	24	27	29	34	37	17	18	19	20	21	22	23	25
19	22	26	27	29	34	37	39	18	19	20	21	22	23	24	26
22	22	26	27	29	34	38	42	19	20	21	22	23	24	26	28
22	26	27	29	32	36	40	50	20	21	22	23	25	26	28	29
26	27	29	32	36	40	50	61	21	22	23	24	26	28	29	31
26	27	29	35	40	50	59	75	22	23	24	26	28	29	31	34
27	29	35	40	50	59	75	89	23	24	25	28	29	31	34	38

*MATRIX NOTCH

8	9	12	22	26	27	29	34	16	18	20	22	24	26	28	30
9	10	14	26	27	29	34	37	18	20	22	24	26	28	30	32
12	14	18	27	29	34	37	38	20	22	24	26	28	30	32	34
22	26	27	31	36	37	38	40	22	24	26	30	32	32	34	36
26	27	29	36	39	38	40	48	24	26	28	32	34	34	36	38
27	29	34	37	38	40	48	58	26	28	30	32	34	36	38	40
29	34	37	38	40	48	58	69	28	30	32	34	36	38	42	42
34	37	38	40	48	58	69	79	30	32	34	36	38	40	42	44

*MATRIX BACH1

8	16	19	22	26	27	29	34	16	18	20	22	24	26	28	30
16	16	22	24	27	29	34	37	18	20	22	24	26	28	30	32
19	22	26	27	29	34	34	38	20	22	24	26	28	30	32	34
22	22	26	27	29	34	37	40	22	24	26	30	32	32	34	36
22	26	27	29	32	35	40	48	24	26	28	32	34	34	36	38
26	27	29	32	35	40	48	58	26	28	30	32	34	36	38	40
26	27	29	34	38	46	56	69	28	30	32	34	36	38	42	42
27	29	35	38	46	56	69	83	30	32	34	36	38	40	42	44

*MATRIX HC

8 9 13 20 23 27 29 34
9 11 16 23 26 29 34 39
12 16 21 25 28 33 39 45
15 20 25 28 33 38 44 52
19 24 28 33 38 43 51 60
23 27 32 38 42 49 58 68
27 31 37 42 48 57 67 77
30 36 41 47 55 65 76 87

16 16 18 20 22 24 27 30
16 17 19 22 24 27 30 34
18 19 22 24 27 30 34 39
20 22 24 27 30 34 39 45
22 24 27 30 34 39 45 52
24 27 30 34 39 45 52 60
27 30 34 39 45 52 60 69
30 34 39 45 52 60 69 79

*MATRIX HCLOW

8 16 17 18 20 22 26 32
16 16 17 20 22 26 30 36
17 17 18 22 26 30 36 40
18 20 22 26 30 36 40 48
20 22 26 30 36 40 48 56
22 26 30 36 40 48 56 72
26 30 36 40 48 56 72 96
32 36 40 48 56 72 96 108

16 16 17 18 19 20 22 24
16 16 17 19 20 22 24 26
17 17 17 20 22 24 26 30
18 19 20 22 24 26 30 36
19 20 22 24 26 30 36 40
20 22 24 26 30 36 40 48
22 24 26 30 36 40 48 56
24 26 30 36 40 48 56 64

*MATRIX JAWOR1CD

8 16 20 23 27 30 32 34
16 16 23 24 29 31 34 38
20 23 27 28 30 35 38 40
23 24 28 29 35 39 40 44
27 29 30 35 39 42 45 50
30 31 35 39 42 46 54 59
32 34 38 40 45 54 62 72
34 38 40 44 50 59 72 84

17 19 21 23 25 27 29 31
19 21 23 25 27 28 29 33
21 23 25 27 29 30 32 37
23 25 27 30 31 34 40 45
25 27 29 31 38 46 54 60
27 28 30 34 46 58 72 74
29 29 32 40 54 72 90 100
31 33 37 45 60 74 100 124

*MATRIX HVSGOOD

8 16 16 16 17 18 21 24
16 16 16 16 17 19 22 25
16 16 17 18 20 22 25 29
16 16 18 21 24 27 31 36
17 17 20 24 30 35 41 47
18 19 22 27 35 44 54 65
21 22 25 31 41 54 70 88
24 25 29 26 47 65 88 115

20 20 20 20 21 23 26 30
20 20 20 20 22 24 27 32
20 20 21 22 24 27 31 36
20 20 22 26 30 34 38 44
21 22 24 30 37 44 51 59
23 24 27 34 44 56 68 81
26 27 31 38 51 68 88 109
30 32 36 44 59 81 109 144

*MATRIX HVSBETTER

8 16 16 16 17 18 21 24
16 16 16 16 17 19 22 25
16 16 17 18 20 22 25 29
16 16 18 21 24 27 31 36
17 17 20 24 30 35 41 47
18 19 22 27 35 44 54 65
21 22 25 31 41 54 70 88
24 25 29 36 47 65 88 115

19 19 19 19 20 22 25 29
19 19 19 19 20 23 26 30
19 19 20 21 23 26 29 34
19 19 21 25 28 32 37 42
20 20 23 28 35 42 48 56
22 23 26 32 42 53 64 77
25 25 29 37 48 64 83 104
29 30 34 42 56 77 104 137

*MATRIX HVSBEST

8 16 16 16 17 18 21 24
16 16 16 16 17 19 22 25
16 16 17 18 20 22 25 29
16 16 18 21 24 27 31 36
17 17 20 24 30 35 41 47
18 19 22 27 35 44 54 65
21 22 25 31 41 54 70 88
24 25 29 36 47 65 88 115

18 18 18 18 19 21 23 27
18 18 18 18 19 21 24 29
18 18 19 20 22 24 28 32
18 18 20 24 27 30 35 40
19 19 22 27 33 39 46 53
21 21 24 30 39 50 61 73
23 24 28 35 46 61 79 98
27 29 32 40 53 73 98 129

***MATRIX AVAMAT6**

8 16 19 22 26 27 29 34
16 16 22 24 27 29 35 35
19 22 26 27 29 34 35 38
22 22 26 27 29 34 35 40
22 26 27 29 32 35 40 48
26 27 29 32 35 40 48 50
26 27 29 35 40 48 50 60
27 29 35 40 48 50 60 62

16 20 24 28 32 36 40 44
20 24 28 32 36 40 44 48
24 28 32 36 40 44 48 52
28 32 36 40 44 48 52 56
32 36 40 44 48 52 56 58
36 40 44 48 52 56 58 60
40 44 48 52 56 58 60 62
44 48 52 56 58 60 62 62

***MATRIX AVAMAT7**

8 16 19 22 26 28 32 38
16 16 22 24 28 32 38 44
19 22 26 28 32 38 44 48
22 22 26 32 38 44 48 54
22 26 32 38 44 48 54 64
26 32 38 44 48 54 64 74
32 38 44 48 54 64 74 84
38 44 48 54 64 74 84 94

16 20 24 28 36 42 46 52
20 24 28 36 42 46 52 58
24 28 36 42 46 52 58 62
28 36 42 46 52 58 62 68
36 42 46 52 58 62 68 78
42 46 52 58 62 68 78 88
46 52 58 62 68 78 88 99
52 58 62 68 78 88 99 99

***MATRIX FOX1**

8 8 9 11 13 13 14 17
8 8 11 12 13 14 17 18
9 11 13 13 14 17 17 19
11 11 13 13 13 17 18 20
11 13 13 13 16 17 20 24
13 13 13 16 17 20 24 29
13 12 13 17 19 23 28 34
12 13 17 19 23 28 34 41

8 8 8 9 9 9 9 10
8 8 9 9 9 9 10 10
8 9 9 9 9 10 10 10
9 9 9 9 10 10 10 10
9 9 9 10 10 10 10 11
9 9 10 10 10 10 11 11
9 10 10 10 10 11 11 11
10 10 10 10 11 11 11 11

*** MATRIX FOX2**

8 8 9 11 13 13 14 17
8 8 11 12 13 14 17 18
9 11 13 13 14 17 17 16
11 11 13 13 13 17 18 20
11 13 13 13 16 17 20 24
13 13 13 16 17 20 24 29
13 12 13 17 19 23 28 34
12 13 17 19 23 28 34 41

8 8 9 10 11 12 12 12
8 9 10 11 12 12 12 13
9 10 11 12 12 12 13 14
10 11 12 12 12 13 14 15
11 12 12 12 13 14 15 16
12 12 12 13 14 15 16 16
12 12 13 14 15 16 16 16
12 13 14 15 16 16 16 16

*** MATRIX FOX3**

8 8 9 11 13 13 14 17
8 8 11 12 13 14 17 18
9 11 13 13 14 17 17 16
11 11 13 13 13 17 18 20
11 13 13 13 16 17 20 24
13 13 13 16 17 20 24 29
13 12 13 17 19 23 28 34
12 13 17 19 23 28 34 41

16 16 16 16 16 16 16 16
16 16 16 16 16 16 16 16
16 16 16 16 16 16 16 16
16 16 16 16 16 16 16 16
16 16 16 16 16 16 16 16
16 16 16 16 16 16 16 16
16 16 16 16 16 16 16 16
16 16 16 16 16 16 16 16

*** MATRIX MANONO1**

8 8 8 9 11 13 14 17
8 8 9 11 13 13 14 17
8 8 11 12 13 14 17 94
9 11 13 13 14 17 17 94
11 11 13 13 14 17 94 94
13 13 14 16 17 20 94 94
13 13 14 17 94 94 94 94
13 14 17 94 94 94 94 94

12 12 13 14 15 16 22 26
12 13 14 15 16 22 26 32
13 14 15 16 22 26 32 41
14 15 16 22 26 32 41 53
15 16 22 26 32 41 53 94
16 22 26 32 41 53 70 94
22 26 32 41 53 70 94 94
26 32 41 53 94 94 94 94

*** MATRIX MANONO2**

8 12 13 14 15 16 19 22
12 13 14 15 16 19 22 26
13 14 15 16 19 22 26 32
14 15 16 19 22 26 32 41
15 16 19 22 26 32 41 53
16 19 22 26 32 41 53 70
19 22 26 32 41 53 70 94
22 26 32 41 53 70 94 127

12 12 13 14 15 16 19 22
12 13 14 15 16 19 22 26
13 14 15 16 19 22 26 32
14 15 16 19 22 26 32 41
15 16 19 22 26 32 41 53
16 19 22 26 32 41 53 70
19 22 26 32 41 53 70 94
22 26 32 41 53 70 94 127

*** MATRIX MANONO3**

8 10 10 12 13 15 16 20
10 10 12 15 17 19 20 20
10 12 15 17 19 20 20 23
12 15 17 19 20 20 25 25
13 17 19 20 23 25 25 27
15 19 20 23 25 27 27 30
16 20 20 25 25 27 30 35
20 20 23 25 27 30 35 45

12 14 17 18 19 20 24 28
14 16 17 18 19 23 27 32
17 17 18 19 20 27 30 37
18 18 19 20 27 30 35 37
19 19 20 27 30 35 37 40
20 23 27 30 35 37 40 44
24 27 30 35 37 40 40 44
28 32 37 37 40 44 44 48

Adaptive matrices

With HC028 you can change the matrices per GOP.
You have to write your own code to do so and create a DLL which should be named matrix.dll, this DLL should be in the same directory as the HCEnc executable.

The next (Fortran 90) example shows how to create the routine and how it should be called.

```
subroutine EXTMATRIX(motion,luminance,intra,inter)
! input      - motion      integer*4          value 0 - 32 (0=low, 32=high)
! input      - luminance   integer*4          averaged GOP luminance per pixel (0 - 255)
! input/output - intra     integer*2 array    intra matrix (64 values, row order)
! input/output - inter     integer*2 array    inter matrix (64 values, row order)

!DEC$ ATTRIBUTES DLLEXPORT:: EXTMATRIX      ! export routine

integer*4 motion,luminance
integer*2 intra(64),inter(64)

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
! Example code for adaptive matrix DLL creation.
!
! DLL: matrix.dll, should be in the same directory
! as the HCEnc executable.
!
! This Fortran example adapts the intra and inter
! matrices dependent of source motion and luminance.
! If the *ADAPTIVEMATRIX command is present,
! this routine is called at every GOP during the
! first pass so the matrices can change at every GOP.
!
! Of course you can create any matrix you want, to be
! sure matrix values are valid, HCEnc will limit all
! values between 8 and 255 and set intra(1) to 8,
! just like the last 3 lines of code in this example.
!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

! motion stuff
  if (motion <= 5) then
    a=1.-(5.-motion)/50.
  else
    a=1.+(motion-5.)/270.
  endif
! interpolate factor a to minimum = 0.9 for low motion
! interpolate factor a to maximum = 1.1 for high motion

! luminance stuff
  b=1.
  if (luminance < 48) b=0.90
  if (luminance < 32) b=0.70
! lower values for medium dark scenes
! lower values for dark scenes

! adapt matrix
  intra=NINT(a*b*intra)
  inter=NINT(a*b*inter)
! set to nearest integer for whole intra matrix
! set to nearest integer for whole inter matrix

! scale values into "safe values"
  intra=MAX(intra,8); intra=MIN(intra,255)
  inter=MAX(inter,8); inter=MIN(inter,255)
  intra(1)=8
! scale intra values, 8 <= intra <= 255
! scale inter values, 8 <= inter <= 255
! first intra value should always be 8

end
```

Note 1: Entering the routine the matrices intra and inter will have the values as given in the inputfile.

Note 2: This example code is just what it says, it's only an example how to create the routine, there's no guarantee this code will improve your encode.

Note 3: Using Fortran it's not necessary to declare local variables, variables are declared implicit: all variables are real*4 except variables which start with i - n, these are integer*4.