PixSil Technology

Superior Video Solutions in Silicon

PXL-H264-VLC

H.264 Variable Length Coding

General Description

One of the key IP block in PixSil Technology's H.264 solution is VLC(Variable Length Coding). It is a reversible procedure for entropy coding that assigns shorter bit strings to symbols expected to be more frequent and longer bit strings to symbols expected to be less frequent.

The inputs come from the Bit Stream Interface (bsif) block and the input data format is either 2's complement binary number or Exponential Golomb (Exp-Golomb) codes. The hardware logic will decode the incoming data based on four types of decoding schemes (one for 2's complement number and three for Exp-Golomb codes).

This block either passes the input directly to the output or decodes input Exp-Golomb code.

Applications

High Quality Video, Low Bit-Rate, Low Power Applications

Wireless Video

Video Streaming

Video Conferencing

Video Surveillance

Features

Decoding Exp-Golomb-coded syntax elements specified in H.264

Four different modes are supported:
pass-through, ue(v), se(v), and me(v)

N-bit input data (where N >= 8) with standard 8-bit input data bus

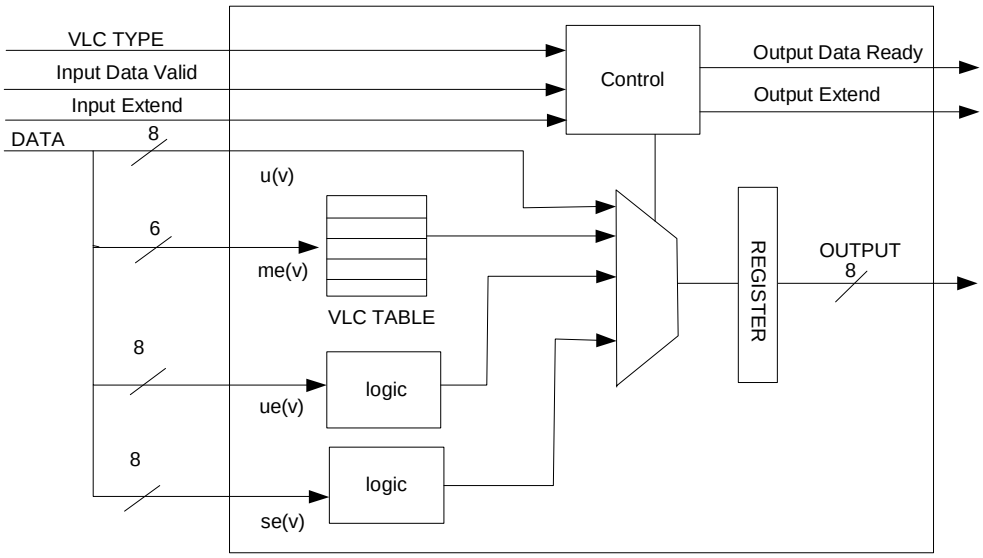
Functional Description

This block decodes the codeword into its symbol value according to tables below. A pipeline register appears on the output of this block. The data type could be one of the following:

1. integer (no decoding required)
2. ue(v) unsigned exp-golumb entropy coding
3. se(v) signed exp-golumb entropy coding
4. me(v) mapped exp-golumb coding

Data type	Code
integer	00
Unsigned	01
Signed	10
mapped	11

Fig.1 VLC Decoder Block Diagram



The data path for all inputs and outputs will be 8 bits. A control input signal called "Input Extend" will continue the data value to the next sequential byte. The Least Significant Byte will be sent first, followed by the next most significant byte, etc. An output signal is called "Output Extend" which will be sent along with the output data value.

For example, a 16-bit ue(v) number will be input as two 8-bit numbers. The first 8-bit input will have "input valid" as 1 and "input extend" as 1 (meaning that there is another byte in the next cycle). The next 8-bit input will have "input valid" as 1 and "input extend" as 0 (meaning that this is the last byte of the input). PPS, SPS information is sent to Output Buffer for subsequent transfer to Main Memory. Header information is sent to control registers. Data is sent to dequant block.

Table 1. Inputs/Outputs Description

Signal Names	**Input (I) / Output (O)**	**Descriptions**
Rst	I	Block reset
Clk	I	Clock (targeted to 60MHz)
bsif_intra4x4	I	1=Intra4x4; 0=Inter prediction mode
bsif_vlcdata_valid	I	Inputs valid
bsif_data_extend	I	Extend the data input > 8 bit
bsif_data_type[1:0]	I	Input data type; 00=integer, 01=ue, 10=se, 11=me
bsif_data[7:0]	I	Input Data
exvlc_data_valid_s	O	Outputs valid
exvlc_data_extend_s	O	Extend the data output > 8 bit
exvlc_value_s[7:0]	O	Syntax Element Value
exvlc_sign_s	O	Sign Bit for the LAST byte output which is crucial for ue(v) and se(v) mappings
exvlc_se_s	O	It is used to discard the LSB in the FIRST byte of se(v) mapping

Fig. 2 IO Timings for Single Byte and Multi Bytes Transfers

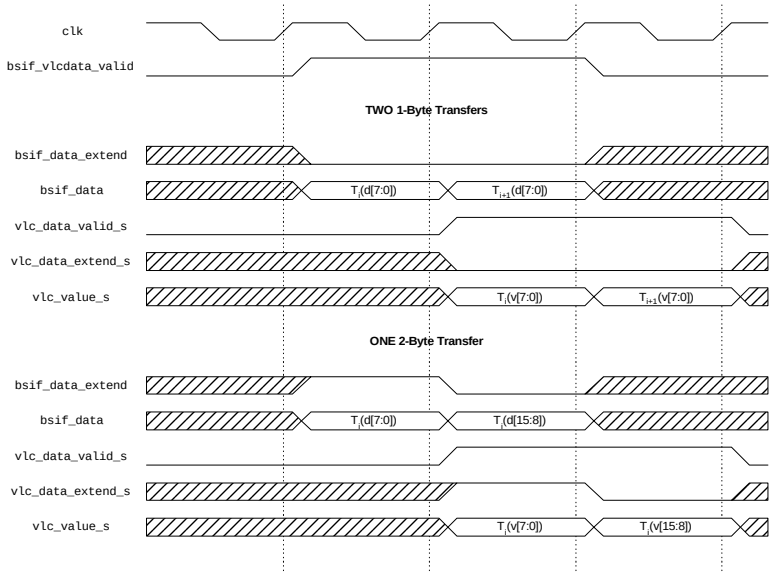


Table 2. Code number and Exp-Golomb codewords in explicit form and used as ue(v)

Code_num	Code word
0	1
1	0 1 0
2	0 1 1
3	0 0 1 0 0
4	0 0 1 0 1
5	0 0 1 1 0
6	0 0 1 1 1
7	0 0 0 1 0 0 0
8	0 0 0 1 0 0 1
9	0 0 0 1 0 1 0

Table 3. Assignment of symbol values and code_nums for signed Exp-Golomb entropy coding se(v)

Code number	Symbol value
0	0
1	1
2	-1
3	2
4	-2
5	3
6	-3
7	4
8	-4
9	5
10	-5
k	$(-1)^{k+1}$ Ceil(k÷2)

Table 4. Assignment of codeword number and parameter values for mapped Exp-Golomb-coded symbols

Code number	coded_block_pattern assignment to macroblock prediction types	
	Intra, SIntra (Intra4x4 == 1)	Pred, SPred (Intra4x4 == 0)
0	47	0
1	31	16
2	15	1
3	0	2
4	23	4
5	27	8
6	29	32
7	30	3
8	7	5
9	11	10
10	13	12
11	14	15
12	39	47
13	43	7
14	45	11
15	46	13
16	16	14
17	3	6
18	5	9
19	10	31
20	12	35
21	19	37
22	21	42
23	26	44
24	28	33
25	35	34
26	37	36
27	42	40
28	44	39
29	1	43
30	2	45
31	4	46
32	8	17
33	17	18
34	18	20
35	20	24
36	24	19
37	6	21
38	9	26
39	22	28
40	25	23
41	32	27
42	33	29
43	34	30
44	36	22
45	40	25
46	38	38
47	41	41

For more information, please contact us at:

PixSil Technology Corporation
4533 MacArthur Blvd., Newport Beach, CA 92660
Email: info@pixsiltech.com Internet: www.pixsiltech.com