CCITT SGXV
Working Party XV/1
Specialists Group on Coding
for Visual Telephony

Document #217
May 1987

Title: Values of Programmable Items to be Used in Initial Flexible Hardware.

Source: UK, France, Netherlands, FRG, Japan

This document is to be read in conjunction with the latest version of the Flexible Hardware Specification (currently Document #182 and amendments in Document #216 Annex 3).

The following programmable items require preliminary values for incorporation in the Test Pattern Generator and for use in initial compatibility checks:

1. Loop filter signalling
2. Inverse Transformer
3. Scanning classes
4. Quantiser selection table
5. Quantisers
6. Picture Start Code
7. PSPARE
8. QUANT1 and QUANT2 codes
9. GSPARE2
10. Block Address codes
11. TYPE3 codes
12. CLASS codes
13. DMV codes
14. TCOEFF codes

1. LOOP FILTER SIGNALLING

Signalling of filter on or off is by TYPE3 coding.

2. INVERSE TRANSFORMER

The table of coefficients listed in Doc #142 (Issue 2) will be used for the first and second inverse 1-D transforms.

3. SCANNING CLASSES

Although the flexible hardware specification allows for eight possible classes, only the four specified for RM3 will be used for initial compatibility checks. These four sequences are listed on page 22 of Doc #181R. For chrominance blocks only the "ordinary zig-zag" is used.

4. QUANTISER SELECTION TABLE

Initially programmed as follows:

Y/C	INTER/INTRA	SEQUENCY INDEX (0 to 63)	QSEL (0 to 31)
x	INTRA	0	0
x	INTRA	<>0	QZ
x	INTER	x	QZ

NOTES:
1. x = 'Don't care'.
2. QSEL selects one of 32 quantisers.
3. QZ is the quantiser indication signalled by either QUANT1 or QUANT2. (see Figure 4 of Doc #182)
4. QZ is not permitted to be 0.

5. QUANTISERS

The flexible hardware allows up to 32 quantisers selected by QSEL.

Quantiser 0 is used for the dc coefficient in INTRA mode and has stepsize of 4. These coefficients are transmitted as 9 bit fixed length codes. To avoid emulation of PSC and GBSC by these FLCs followed by a VLC with prefix bits of '00000001' the last 8 bits of the FLC must not be all '0's. See Table 1.

All other quantisers are linear, symmetrical about zero and with a threshold of 1.0 times the step-size. Quantiser n (where n is 1 to 31 as determined by QSEL) has step-size of n. See Table 2.

Some quantisers, eg 1 to 3, may not be usable or necessary. They are included for simplicity and completeness.

6. PICTURE START CODE

The invalid Group number used in the PSC is '10101'

7. PSPARE

Value of m is 1, ie PSPARE is 8 bits when present.

8. QUANT1 and QUANT2 CODES

QUANT1 is a fixed length code of 6 bits. When the first bit is '0' then QZ is signalled in each block by QUANT2. When the first bit is '1' then QZ signalled by the following 5 bits is used for all blocks in the GOB. Coding of these 5 bits is as for QUANT2.

QUANT2 is a fixed length code of 5 bits. Code '00000' is not used. Codes '00001' to '11111' are used to signal QZ between 1 and 31.

9. GSPARE

Value of n is 1, ie GSPARE2 is 8 bits when present.

10. BLOCK ADDRESS CODES

As per Table 3. The codes are from Document #215. BA is restricted to the first 132 codes in the table.

11. TYPE3 CODES

TYPE3	Luminance	Chrominance
1	00010	0001
2	11	1
3	0110	001
4	01010	01
5a	00111	
5b	01011	
5c	00110	
5d	0111	
6a	01000	
6b	101	
6c	01001	
6d	100	
7	001010	

12. CLASS codes

Zig-zag	1
Horizontal	01
Vertical	001
Fourth	0001

13. DMV codes

As per Table 7 of Document #192

14. TCOEFF codes

As per Table 3.

QUANTISER FOR INTRA-MODE DC COMPONENT

INTRA DC level into quantiser	FLC		Reconstruction level into inverse transform
0 - 5	000000001	(1)	4
6 - 9	000000010	(2)	8
10 - 13	000000011	(3)	12
.	.		.
.	.		.
1018 - 1021	011111111	(255)	1020
1022 - 1025	111111111	(511)	1024
1026 - 1029	100000001	(257)	1028
.	.		.
.	.		.
2034 - 2037	111111101	(509)	2036
2038 - 2047	111111110	(510)	2040

Notes.

1. FLC 'n' is used to encode the 4 values 4n-2, 4n-1, 4n, 4n+1.
   except FLC 1 is also used for input values 0 and 1.
   FLC 256 is not used, FLC 511 substitutes.
   FLC 510 is also used for input values 2042 - 2047
   though these should not theoretically occur.
   FLC 511 is used for input values 1022 - 1025.

2. The decoded value corresponding to FLC 'n' is 4n
   except FLC 511 gives 1024

Table 1

QUANTISERS FOR AC AND INTER MODE DC COMPONENTS

Level into Quantiser	Quantiser Index No. V_I	Reconstruction Level into Inverse Transform
-(QSEL-1) - (QSEL-1)	V_0	0
(QSEL) - (2*QSEL-1)	V_1	1.5*QSEL
(2*QSEL) - (3*QSEL-1)	V_2	2.5*QSEL
(3*QSEL) - (4*QSEL-1)	V_3	3.5*QSEL
.	.	.
.	.	.
(m*QSEL) - ((m+1)*QSEL-1)	Vm	(m+0.5)*QSEL
.	.	.
.	.	.
(101*QSEL) - (102*QSEL-1)	V_{101}	101.5*QSEL

Notes:

1. QSEL selects the quantiser characteristic. QSEL can take integer values between 1 and 31, both inclusive.
2. Where QSEL is an odd number, perform truncation of (I+0.5)*QSEL
3. For m<>0, entries for V_{-m} are obtained by negating the numbers in the first and third columns.
4. Input range is -2048 to 2047. For QSEL less than 20 the input may exceed the highest available level. In such cases V_{101} or V_{-101} is used as appropriate.
5. Quantiser index numbers corresponding to output levels outside the range -2048 to 2047 are not valid.

Table 2

Code	Length	TCOEFF (a)	TCOEFF (b)	BA
1	1	V0	V1	0
001	3	EOB	not used	1
010	3	V1	V-1	2
011	3	V-1	V2	3
00010	5	V2	V-2	4
00011	5	V-2	V3	5
000010	6	V3	V-3	6
000011	6	V-3	V4	7
0000010	7	V4	V-4	8
0000011	7	V-4	V5	9
00000010	8	V5	V-5	10
00000011	8	V-5	V6	11
0000000100000001	16	V6	V-6	12
0000000100000010	16	V-6	V7	13
0000000100000011	16	V7	V-7	14
0000000100000101	16	V-7	V8	15
0000000100000110	16	V8	V-8	16
0000000100000111	16	V-8	V9	17
0000000100001001	16	V9	V-9	18
0000000100001010	16	V-9	V10	19
0000000100001011	16	V10	V-10	20
....		..	..	..
....		..	..	..
0000000110011110	16	V65	V-65	130
0000000110011111	16	V-65	V66	131
0000000110100001	16	V66	V-66	
0000000110100010	16	V-66	V67	
....		..	..	
....		..	..	
0000000011111101	16	V-100	V101	
0000000011111110	16	V101	V-101	
0000000011111111	16	V-101	V0	

Notes.

1. TCOEFF. Column (a) is used for the quantiser index of all coefficients except for the one immediately preceding the EOB.

Column (b) is used for the quantiser index of the coefficient immediately preceding the EOB.

2. BA is the block address.

3. To find the last 8 bits of the 16 bit codeword in row 'n' where n ranges from 12 (TCOEFF(a)=V6 or BA=12) to 203 (TCOEFF(a)=V-101):

```
Subtract 11 from n to give p
Divide p by 3 to give integer quotient q and remainder r
Multiply q by 4
If r=0 then subtract 1
   r=1      add 1
   r=2      add 2
Convert result to 8 bits
```

Table 3