

Some useful component video relationships. Robert L. Bleidt 4-5-88

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New SMPTE 170 scaling for NTSC modulation 12-31-91

Gamma-corrected Primary Signals:

A				
Y	0.299	0.587000000	0.114000000	R
BY =	-0.299000000	-0.587000000	0.886000000	G
RY	0.701000000	-0.587000000	-0.114000000	B
B				
R	1.000000000	0.000000000	1.000000000	Y
G =	1.000000000	-0.194207836	-0.509369676	BY
B	1.000000000	1.000000000	0.000000000	RY

These are fundamental relations for the FCC Color Primaries

The range may be thought of for RGB as [0,0,0] = Black; [1,1,1] = White

SMPTE Component Analog Video Standard:

D				
CAV =				[Y,R,Y,BY]'
Y	1.000000000	0.000000000	0.000000000	Y
Pb=	0.000000000	0.564334086	0.000000000	BY
Pr	0.000000000	0.000000000	0.713266762	RY

Here Pb and Pr have the same p-p amplitude as Y for the complete gamut of RGB values.

In RGB each component is 700mV for white, 0V for black

F				
CAV =				[R,G,B]'
Y	0.299000000	0.587000000	0.114000000	R
Pb=	-0.168735892	-0.331264108	0.500000000	G
Pr	0.500000000	-0.418687589	-0.081312411	B

G				
RGB =				[Y,Pr,Pb]'
R	1.000000000	0.000000000	1.402000000	Y
G=	1.000000000	-0.344136286	-0.714136286	Pb
B	1.000000000	1.772000000	0.000000000	Pr

kr = 0.877283220
kb = 0.492111041

NTSC Modulation:

E					S
NTSC =				[Y,BY,RY]'	+
Y1	0.925000000	0.000000000	0.000000000	Y	0.075000000
by=	0.000000000	0.455202713	0.000000000	BY	0.000000000
ry	0.000000000	0.000000000	0.811486978	RY	0.000000000

by, ry are actual subcarrier modulation components (same as rotated I & Q)
BY,RY are the transcoded gamma corrected primaries from the section above. The RGB components are assumed [0,0,0] = black; [1,1,1] = white. The NTSC output is shown as 1.0 = 100 IRE.

Encoded NTSC = $Y1 + \text{Subc0} * by + \text{Subc90} * ry$

NTSC Modulation:

NTSC =	H			[Y,BY,Ry]'	+	S
Y1	0.925000000	0.000000000	0.000000000	Y		0.075000000
i=	0.000000000	-0.247921166	0.680570245	BY		0.000000000
q	0.000000000	0.381765118	0.441967485	RY		0.000000000

i,q are actual subcarrier modulation components

I			
I	-0.268022883	0.735751616	BY
Q	0.412719046	0.477802686	RY

I,Q scaled, no setup, RY,BY transcoded primaries

J			
BY	-1.106740125	1.704230342	I
RY	0.955986104	0.620824635	Q

I,Q scaled, no setup, RY,BY transcoded primaries

PAL Modulation:

PAL =	C			[Y,Ry,By]'
Y	1.000000000	0.000000000	0.000000000	Y
U	0.000000000	0.493000000	0.000000000	BY
V	0.000000000	0.000000000	0.877000000	RY

Finding the RGB components of NTSC burst:

First make composite matrix X by multiplying ExB

X			=	E			B		
0.276575000	0.542975000	0.105450000		0.925000000	0.000000000	0.000000000	0.299000000	0.587000000	0.114000000
-0.136105611	-0.267203993	0.403309604		0.000000000	0.455202713	0.000000000	-0.299000000	-0.587000000	0.886000000
0.568852372	-0.476342856	-0.092509516		0.000000000	0.000000000	0.811486978	0.701000000	-0.587000000	-0.114000000

Now Invert X:

X-1		
1.081081081	0.000000000	1.232305664
1.081081081	-0.426640332	-0.627699137
1.081081081	2.196823462	0.000000000

Now Multiply X-1 by Y,Ry,By values of burst:

X-1				Burst
0.000000000	1.081081081	0.000000000	1.232305664	0.000000000
-0.085328066	1.081081081	-0.426640332	-0.627699137	0.200000000
0.439364692	1.081081081	2.196823462	0.000000000	0.000000000

As above, for cases where burst is generated with no setup attenuation:

Make Y as Rescaled E x B

Y			modified E			B		
0.276575000	0.542975000	0.105450000	0.925000000	0.000000000	0.000000000	0.299000000	0.587000000	0.114000000
-0.147141201	-0.288869181	0.436010382	0.000000000	0.492111041	0.000000000	-0.299000000	-0.587000000	0.886000000
0.614975537	-0.514965250	-0.100010287	0.000000000	0.000000000	0.877283220	0.701000000	-0.587000000	-0.114000000

Invert:

Y-1		
1.081081081	0.000000000	1.139882739
1.081081081	-0.394642307	-0.580621702
1.081081081	2.032061702	0.000000000

Now Multiply X-1 by Y,Ry,By values of burst:

		Y-1		Burst
0.000000000	1.081081081	0.000000000	1.139882739	0.000000000
0.078928461	1.081081081	-0.394642307	-0.580621702	-0.200000000
-0.406412340	1.081081081	2.032061702	0.000000000	0.000000000

Finding the RGB components of I and Q flags:

First make composite matrix Z by multiplying HxB:

Z			=	H			B		
0.276575000	0.542975000	0.105450000	0.925000000	0.000000000	0.000000000	0.299000000	0.587000000	0.114000000	
0.551208171	-0.253965009	-0.297243161	0.000000000	-0.247921166	0.680570245	-0.299000000	-0.587000000	0.886000000	
0.195671437	-0.483531038	0.287859601	0.000000000	0.381765118	0.441967485	0.701000000	-0.587000000	-0.114000000	

Invert:

Z-1		
1.081081081	1.033498491	0.671161768
1.081081081	-0.294067813	-0.699680142
1.081081081	-1.196475810	1.842411181

Now Multiply X-1 by Y,Ry,By values of burst:

-0.206699698	1.081081081	1.033498491	0.671161768	0.000000000 Y1
0.058813563	1.081081081	-0.294067813	-0.699680142	-0.200000000 i
0.239295162	1.081081081	-1.196475810	1.842411181	0.000000000 q
0.134232354	1.081081081	1.033498491	0.671161768	0.000000000 Y1
-0.139936028	1.081081081	-0.294067813	-0.699680142	0.000000000 i
0.368482236	1.081081081	-1.196475810	1.842411181	0.200000000 q