PROPOSAL FOR SOLVING THE CURRENT SHORTCOMMINGS OF THE TMS 9929-A

EUROPEAN CONSUMER DIVISION

L.TIJBEN

MAY 6, 1982 HOLLAND.

SECTION 1

INTRODUCTION

THIS DOCUMENT WAS SET UP IN ORDER TO SHOW WHAT KIND OF SHORTCOMMINGS STILL EXIST ON THE EUROPEAN TMS 9929-A PAL VDP CHIP. THE REPORT IS SUBDIVIDED IN THE FOLLOWING SECTIONS :

1. TREATMENT OF THE GAMMA CORRECTION PROBLEM WICH CAUSES THE PICTURES ON A EUROPEAN TV SET TO APPEAR LESS SATURATED, ESPECIALLY WHEN WE ARE USING RGB DRIVE.

2. DISCUSSION ABOUT THE DIFFERENCE BETWEEN THE TIMING OF THE VIDEO SIGNALS COMMING OUT OF THE CURRENT VDP CHIP AND THE TIMING AS IT SHOULD BE. THIS SECTION IS SUBDIVIDED INTO THE FOLLOWING PARTS:

   a. LINE SYNCHRONISATION TIMING.

   b. FIELD SYNCHRONISATION TIMING.

3. DISCUSSION ABOUT THE BURST AMPLITUDE.

4. DISCUSSION ABOUT THE SYNC AMPLITUDE.

5. CONCLUSIONS AND SUMMARY

SECTION 2

GAMMA CORRECTION

2.1 INTRODUCTION

THE GAMMA CORRECTION IS A PROCESS WICH CORRECTS FOR THE NON LINEARITY OF THE PICTURE TUBE OF THE TV RECEIVER/MONITOR. THIS IS DONE SINCE THERE IS NO LINEARITY BETWEEN THE VOLTAGE APPLIED TO THE PICTURE TUBE AND THE LUMINANCE LEVEL. THE FUNCTION BETWEEN BOTH IS RELATED TO A CONSTANT CALLED GAMMA. FOR THE USA GAMMA HAS A VALUE OF 2.2, IN EUROPE A GAMMA OF 2.8 IS USED. THE PROBLEMS WICH WE HAVE IN EUROPE WITH THE BRIGHTNESS OF SOME COLORS, ESPECIALLY WHEN USING RGB DRIVE ARE DUE TO THE FACT THAT WHEN THE TMS 9929 VDP CHIP WAS DESIGNED, NO CHANGE IN THE GAMMA CORRECTION WAS MADE TO COMPENSATE FOR THE DIFFERENCE BETWEEN EUROPE AND THE USA

2.2 CALCULATION OF THE RIGHT GAMMA VALUES

TABLE 1 SHOWS THE CALCULATIONS WHICH WERE PERFORMED TO SHOW THE DIFFERENCE BETWEEN THE AMERICAN VDP CHIP AND THE TMS 9929 PAL CHIP TAKING INTO ACCOUNT THE DIFFERENCE IN GAMMA CORRECTION.

THE FIRST TABLE CALCULATES FROM THE BLACK/WHITE AMPLITUDE, THE COLOR SIGNAL AMPLITUDE AND THE COLOR PHASE THE RGB VALUES. THESE CALCULATIONS ARE SHOWN IN THE SUBTABLE "TMS 9918 FIGURES".

THE SECOND TABLE TAKES THE RGB VALUES CALCULATED FROM THE FIRST TABLE TO CALCULATE THE COLOR DIFFERENCE SIGNALS V AND U, THE PHASE OF THE COLOR SIGNAL AND THE AMPLITUDE OF THE LUMINANCE SIGNAL FOR THE EUROPEAN PAL SYSTEM. WHEN COMPARING

TMS 9918 FIGURES .

COLOR	Y'	A'	PHASE	I	Q	R'-Y'	B'-Y'	R'	G'	B'	R	G	B
MAGEN	.53	.20	53	.07	.19	.18	.25	.71	.39	.78	.47	.13	.57
GREEN	.47	.24	235	-.09	-.22	-.22	-.27	.25	.64	.20	.05	.37	.03
YEL1	.80	.17	173	.11	-.13	.02	-.33	.82	.86	.47	.65	.71	.19
YEL2	.73	.24	173	.15	-.18	.03	-.43	.76	.80	.25	.55	.62	.05
RED1	.67	.30	114	.30	.05	.31	-.25	.98	.56	.42	.96	.28	.15
RED2	.53	.30	114	.30	.05	.30	-.25	.84	.42	.28	.68	.15	.06
CYAN	.67	.30	295	-.30	-.04	-.31	.26	.36	.78	.93	.11	.57	.85
RED3	.47	.24	114	.23	.04	.24	-.19	.71	.38	.28	.47	.12	.06
BLUE1	.53	.27	354	-.17	.21	-.03	.54	.50	.44	1.06	.22	.16	1.15
BLUE2	.40	.13	354	-.08	.10	-.01	.26	.39	.36	.66	.12	.10	.41
GREEN	.67	.20	235	-.07	-.19	-.19	-.23	.48	.81	.44	.20	.63	.16
GREEN	.53	.27	237	-.11	-.24	-.25	-.29	.28	.72	.24	.06	.48	.04

NTSC TO PAL CONVERSION

COLOR	R	G	B	R'	B'	G'	V	U	PHASE	Y
MAGEN	.47	.13	.57	.77	.48	.82	.14	.11	53	.60
GREEN	.05	.37	.03	.34	.70	.27	-.18	-.13	234	.54
YEL1	.65	.71	.19	.86	.88	.55	.02	-.14	173	.98
YEL2	.55	.62	.05	.81	.84	.34	.03	-.21	173	.78
RED1	.96	.28	.15	.98	.63	.51	.23	-.11	116	.72
RED2	.68	.15	.06	.87	.51	.37	.24	-.11	115	.60
CYAN	.11	.57	.85	.45	.82	.94	-.24	.11	294	.72
RED3	.47	.12	.06	.77	.47	.36	.19	-.09	115	.55
BLUE1	.22	.16	1.15	.58	.53	1.05	-.02	.22	355	.60
BLUE2	.12	.10	.41	.47	.44	.72	-.01	.12	355	.48
GREEN	.20	.63	.16	.56	.85	.52	-.14	-.10	234	.73
GREEN	.06	.48	.04	.36	.77	.32	-.20	-.14	234	.60

PAL 9929

COLOR	Y	V	U	R'-Y'	B'-Y'	PHASE	R'	G'	B'	R	G	B
MAGEN	.53	.13	.11	.15	.22	53	.68	.41	.75	.34	.08	.44
GREEN	.47	-.16	-.11	-.18	-.22	235	.29	.60	.25	.03	.24	.02
YEL1	.80	.01	-.13	.01	-.27	173	.74	.79	.37	.44	.52	.06
YEL2	.73	.01	-.18	.01	-.36	173	.74	.79	.37	.44	.52	.06
RED1	.67	.23	-.08	.26	-.17	114	.93	.57	.50	.81	.21	.14
RED2	.53	.23	-.08	.26	-.17	114	.79	.43	.36	.51	.10	.06
CYAN	.67	-.22	.12	-.25	.24	295	.43	.75	.91	.09	.44	.77
RED3	.47	.18	-.07	.20	-.15	114	.67	.40	.32	.33	.07	.04
BLUE1	.53	-.01	.23	.01	.46	354	.52	.45	.99	.16	.11	.97
BLUE2	.40	.02	.25	.03	.51	354	.43	.29	.91	.09	.03	.76
GREEN	.67	-.13	-.08	-.15	-.17	235	.52	.78	.50	.16	.50	.14
GREEN	.53	-.18	-.11	-.20	-.22	237	.33	.68	.31	.04	.33	.04

THE FIRST WITH THE SECOND TABLE IT CAN ALREADY BEEN SEEN THAT FOR THE WEST EUROPEAN MARKET HIGHER LUMINANCE (Y) VALUES ARE REQUIRED DUE TO THE DIFFERENCE IN GAMMA CORRECTION.

THE THIRD TABLE (PAL 9929) FINALLY CALCULATES FROM THE CURRENT VALUES OF THE LUMINANCE (Y), AND COLOR DIFFERENCE SIGNALS (V AND U) THE RGB VALUES WE HAVE. COMPARING THE RGB VALUES FORM THIS TABLE WITH THE RGB VALUES DIRIVED FROM THE FIRST TABLE SHOWS THAT THE TMS 9929 IS GIVING CLEARLY LESS SATURATED COLORS THEN THE AMERICAN VDP CHIP.

2.3 COMMENTS

THE CALCULATIONS MADE ABOVE WHERE BASED ON DESIGN GOALS FOR THE TMS 9918 VDP CHIP. WHEN REDESIGNING THE TMS 9929 THE CALCULATIONS SHOULD BE REPEATED FOR THE MEASURED VALUES ON THE TMS 9918. ALSO BREADBOARD TESTS SHOULD BE CONDUCTED ON EUROPEAN TV SETS, ESPECIALLY THOSE USING RGB DRIVE IN ORDER TO VERIFIE AND OPTIMIZE THE COLORS. NOTE THAT WHEN USING RGB DRIVE, MOST TV SETS WILL NOT REACT ON THE COLOR SATURATION CONTROL AND CONTRAST CONTROL. THEREFORE THE RELATIONSHIP BETWEEN LUMINANCE AND COLOR DIFFERENCE LEVELS IS ESPECIALLY CRITICAL FOR RGB APPLICATIONS.

SECTION 3

VDP CHIP SYNCHRONISATION TIMING

3.1 LINE SYNCHRONISATION TIMING

FIGURE 1 ON THE FOLLOWING PAGE SHOWS THE LINE SYNCHRONISATION TIMING FOR THE TMS 9929 VDP CHIP. WHEN WE ARE COMPARING THIS TIMING TO THE TIMING AS REQUIRED BY THE PAL STANDARD WICH IS GIVEN IN FIGURE 2, WE CAN CONCLUDE THAT THE THE TOTAL TIME FOR THE SYNCHRONISATION INTERVAL IS 10.8 INSTEAD OF THE 12 MICRO SECONDS IN EUROPE. THIS DIFFERENCE IN TIMING IS CAUSING ALREADY PROBLEMS WITH TV SETS IN EUROPE. AN EXAMPLE WHAT CAN HAPPEN IS GIVEN IN FIGURE 3. FIGURE 3 SHOWS THE TIMING FOR THE THOMSON TV SET ON WICH THE EUROPEAN PAL HOME COMPUTER EASILY LOOSES COLOR. AS CAN BEEN SEEN FROM FIGURE 3, THE THOMSON TV SET HAS A BURST GATE WICH HAS A WIDE EQUAL TO THE BACK PORCH OF THE PAL SYSTEM. DUE TO THE TOO SHORT LINE SYNCHRONISATION TIMING OF THE TMS 9929, ALREADY SOME PICTURE INFORMATION IS WITHIN THE BURST GATE. THIS CAUSES THE TV TOO LOOSE CORRECT PAL SYNCHRONISATION AND THUS LOOSE COLOR.

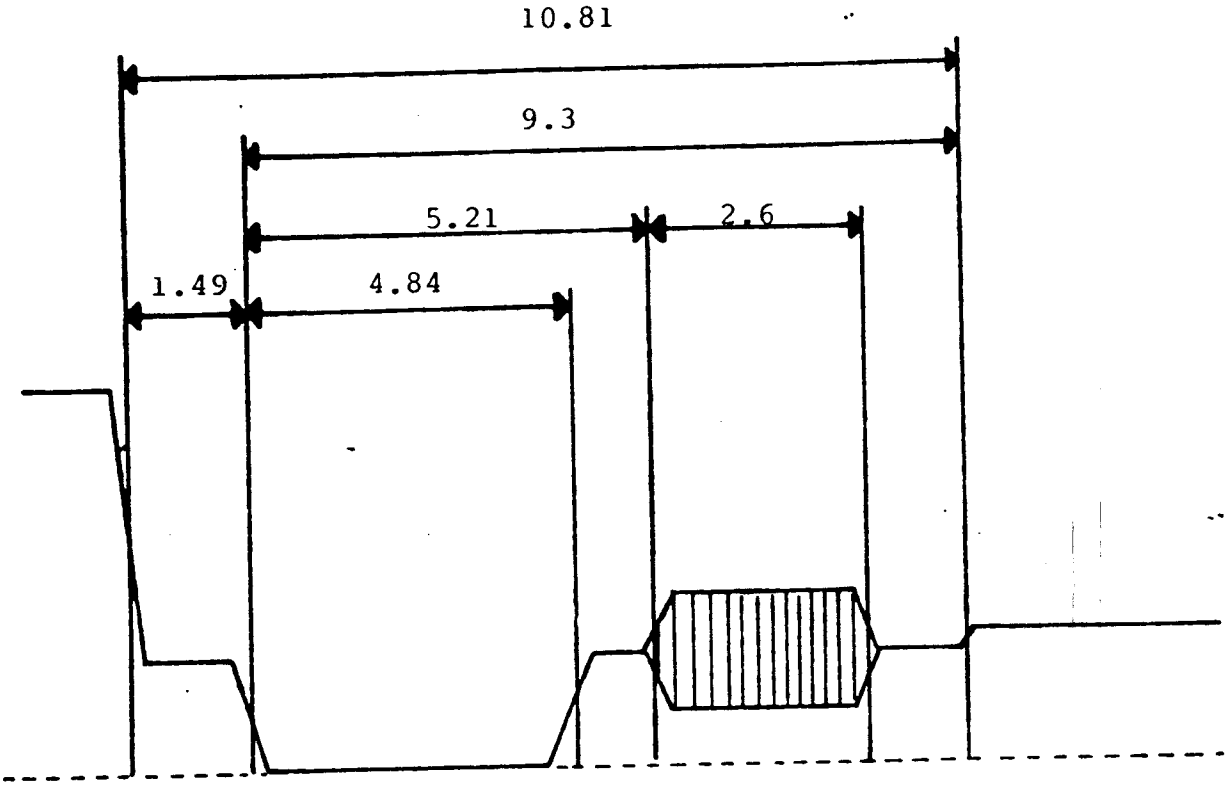
FIGURES 4 AND 5 ARE SHOWING THE TIMING OF THE CURRENT TMS 9929 VDP CHIP AND THE NEW TIMING PROPOSED IN TERMS OF DOT COUNTS. THE NEW PROPOSED TIMING ALSO SOLVES ANOTHER PROBLEM WE HAVE IN EUROPE. THIS PROBLEM CONSISTS OF THE PICTURE BEING SHIFTED TO THE LEFT ON THE SCREEN AND IS ALSO CAUSED BY THE SAME TIMING ERROR WICH IS CAUSING THE THOMSON TV TO LOOSE COLOR.

3.2 FIELD SYNCHRONISATION TIMING

THE FIELD SYNCHRONISATION PERIOD FOR THE CURRENT TMS 9929 IS

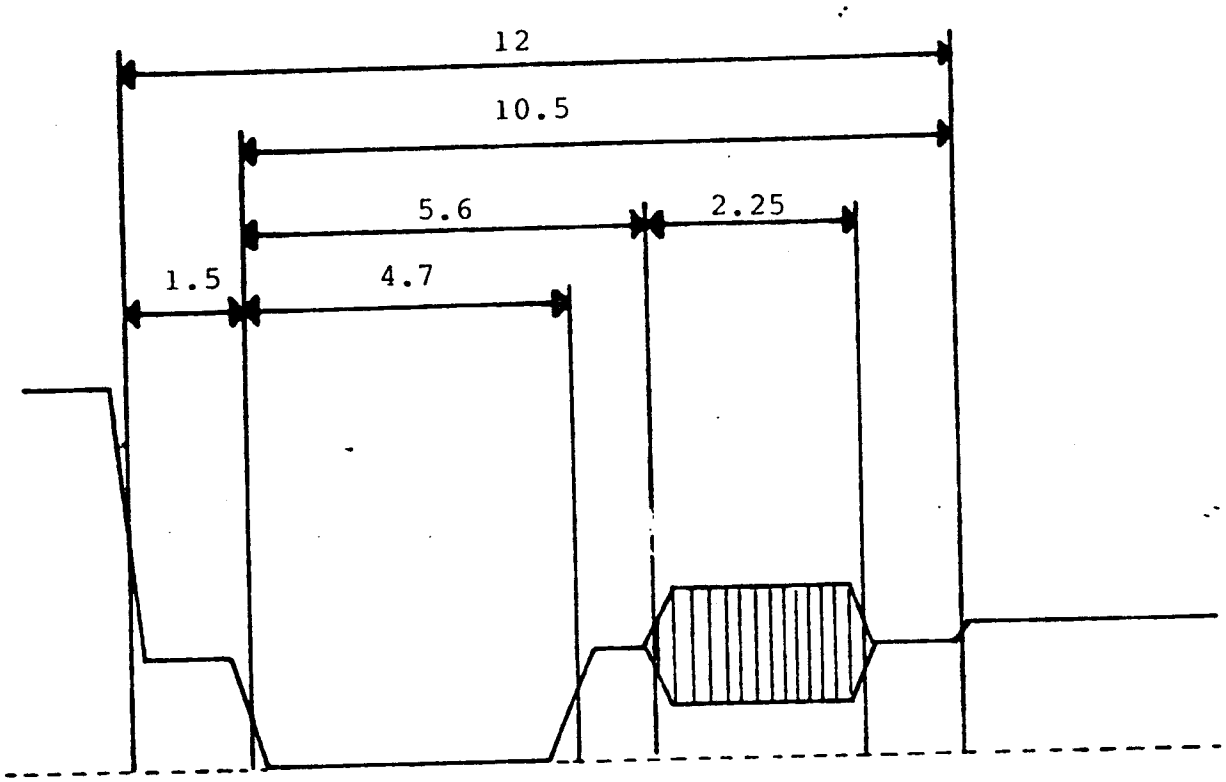
TIMING DIAGRAM

TMS 9929 A VDP



TIMING DIAGRAM

EUROPEAN PAL SYSTEM



VERSUS

TMS 9929 A TIMING;

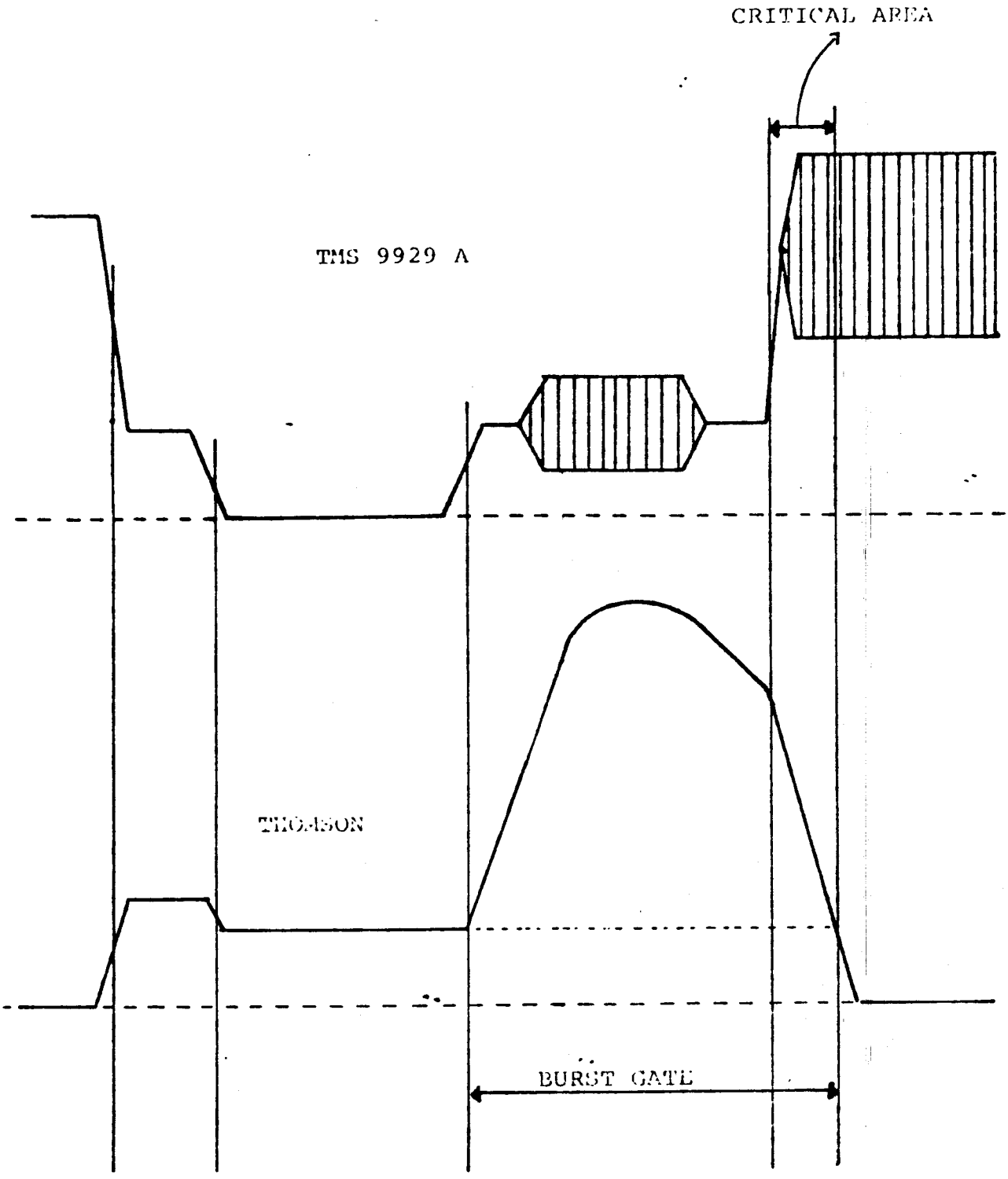
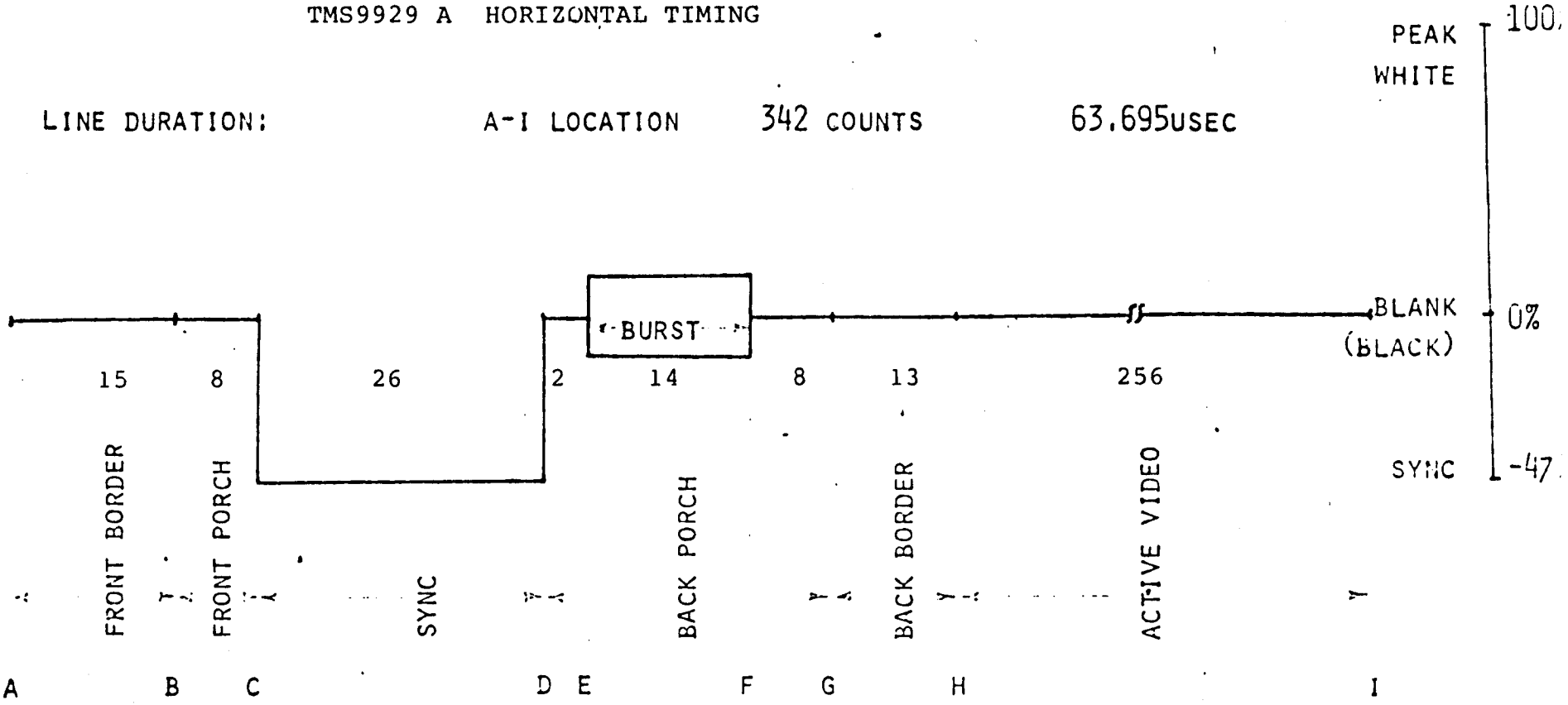


FIGURE 4.

TMS9929 A HORIZONTAL TIMING

LINE DURATION: A-I LOCATION 342 COUNTS 63.695USEC

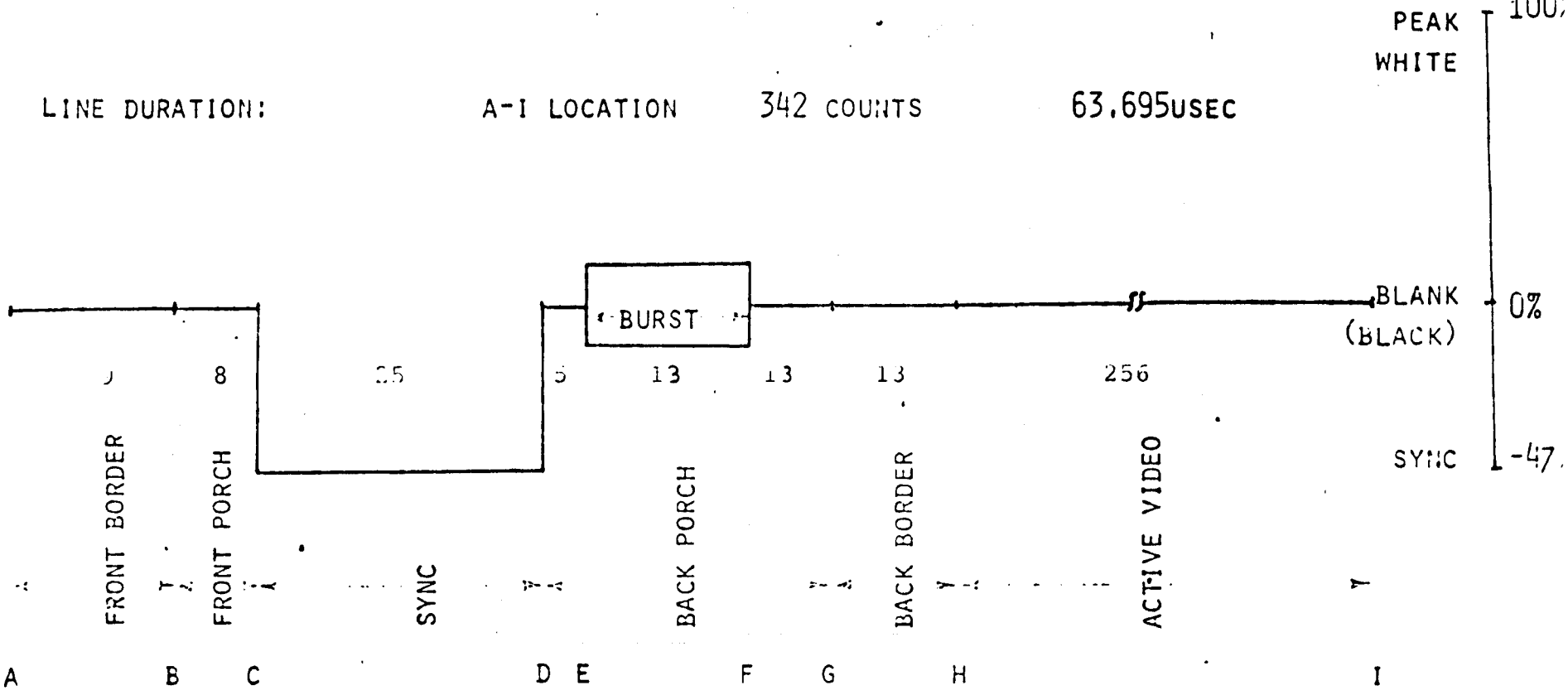


NAME	LOCATION	COUNTS	TIME(uSEC)
FRONT PORCH	B-C	8	1.49
SYNC	C-D	26	4.84
BACK PORCH	D-G	24	4.47
BURST	E-F	14	2.6
BLANKING	B-G	58	10.8
FRONT BORDER	A-B	15	2.8
BACK BORDER	G-H	13	2.42
ACTIVE VIDEO	H-I	256	47.67

FIGURE 5.

PROPOSED NEW TMS 9929 A TIMING

LINE DURATION: A-I LOCATION 342 COUNTS 63.695USEC



NAME	LOCATION	COUNTS	TIME (uSEC)
FRONT PORCH	B-C	8	1.49
SYNC	C-D	25	4.66
BACK PORCH	D-G	31	5.77
BURST	E-F	13	2.42
BLANKING	B-G	64	11.92
FRONT BORDER	A-B	9	1.68
BACK BORDER	G-H	13	2.42
ACTIVE VIDEO	H-I	256	47.67

SHOWN IN FIGURE 6. THIS FIELD SYNCHRONISATION TIMING IS CONFORM THE AMERICAN STANDARD AND CONSISTS OF A FRONT BLANKING PERIOD OF 3 LINES, A VERTICAL SYNC PULSE OF 3 LINES DURATION AND A BACK BLANKING PERIOD OF 13 LINES. THIS BRINGS THE TOTAL FIELD SYNCHRONISATION PERIOD TO 19 LINES. HOWEVER THE EUROPEAN PAL SPEC CALLS FOR A TOTAL FIELD SYNCHRONISATION PERIOD OF 25 LINES SUBDEVIDED AS FOLLOW :

1. VERTICAL FRONT BLANKING	2.5 H
2. VERTICAL SYNC PULSE	2.5 H
3. VERTICAL BACK BLANKING	20 H
TOTAL FIELD SYNCHRONISATION PERIOD	25 H

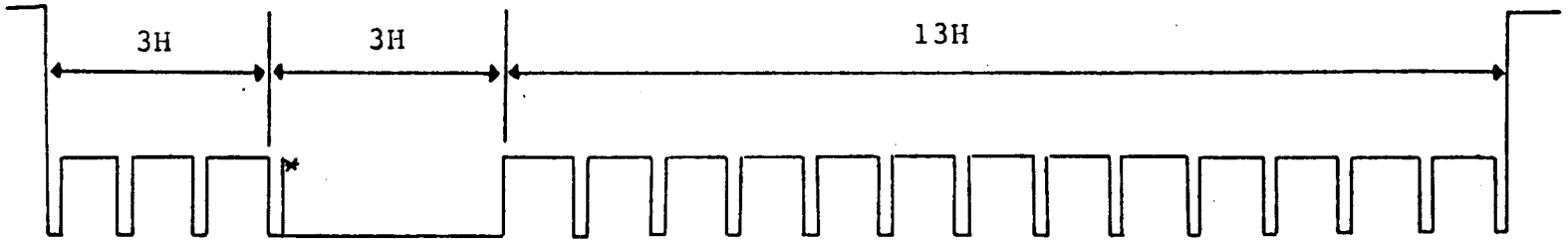
SINCE THE VERTICAL TIMING IN THE VDP CHIP IS DONE BY COUNTING LINE PERIODS, THE NEW PROPOSED VERTICAL TIMING USES 3 LINES FOR THE VERTICAL FRONT BLANKING PERIOD AND THE VERTICAL SYNC PULSE. THIS NEW TIMING IS GIVEN IN FIGURE 7. THE NEW TIMING HAS AS A CONSEQUENCE THAT THE TOP AND BOTTEM BORDERS HAVE TO BE CHANGED. THE TOP BORDER CURRENTLY CONSISTS OF 52 LINES AND THE BOTTEM BORDER HAS 50 LINES.(SEE TMS 9929 SPECIFICATION). IT IS ADVISED TO BRING THE TOP BORDER BACK TO 49 LINES AND THE BOTTEM BORDER TO 47 LINES GIVING THE FOLLOWING VERTICAL LINE ASSIGNMENT :

LOCATION	NAME	NUMBER OF LINES
LINE 001-049	TOP BORDER	49
LINE 050-241	ACTIVE AREA	192
LINE 242-288	BOTTEM BORDER	47
LINE 289-291	VERTICAL FRONT BLANKING	3
LINE 292-294	VERTICAL SYNC PULSE	3
LINE 295-313	VERTICAL BACK BLANKING	19
	TOTAL NUMBER OF LINES	313

ALSO CONCERNING THE VERTICAL TIMING IT IS PROPOSED TO REPLACE THE SMALL VERTICAL 465 NSEC PULSE INSIDE THE VERTICAL SYNC PULSE (SEE FIGURE 6) BY AN PULSE OF THE SAME WIDTH AS THE SYNC PULSE AND POSITIONED SO THAT THE NEGATIVE GOING EDGE WILL BE IN THE SAME LOCATION AS THE NEGATIVE GOING EDGE OF A SYNC PULSE .(SEE FIGURE 7). NOTE THAT ONE PULSE WITHIN THE VERTICAL SYNC PULSE IS NECESSARY FOR A PROPER OPERATION OF THE PAL SWITCH IN THE PAL ENCODER.

FIGURE 6.

FIELD SYNCHRONISATION TIMING
FOR THE TMS 9929.
(NON INTERLACED OPERATION)

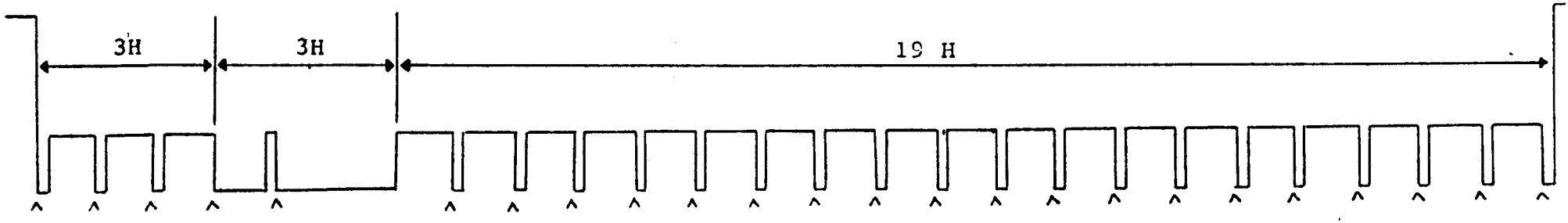


* 465 nsec PULSE.

VERTICAL FRONT BLANKING	3H
VERTICAL SYNC	3H
VERTICAL BACK BLANKING	13H
TOTAL VERTICAL FIELD SYNC PERIOD	19H

FIGURE 7.

PROPOSED NEW FIELD SYNCHRONISATION TIMING
FOR THE TMS 9929
(NON INTERLACED OPERATION)



VERTICAL FRONT BLANKING	3H
VERTICAL SYNC PULSE	3H
VERTICAL BACK BLANKING	19H
TOTAL VERTICAL FIELD SYNC PERIOD	25H

SECTION 4

BURST AND COLOR SIGNAL

THE RELATIONSHIP BETWEEN THE BURST AND COLOR SIGNALS ON ONE SIDE AND THE RELATIONSHIP BETWEEN THE AMPLITUDE OF THE BURST AND THE AMPLITUDE OF THE SYNC PULSE CAN BE IMPORTANT FOR PROPER COLOR DISPLAY, ESPECIALLY WHEN USING RGB ENCODING SINCE THESE PARAMETERS DETERMINE RELATIVE LUMINANCE AND COLOR SATURATION. THE FOLLOWING PARAGRAPHS ARE TREATING THIS SUBJECT.

$$B = \sqrt{B_1^2 + B_2^2}$$

4.1 BURST AMPLITUDE

THE BURST AMPLITUDE IS RELATED TO THE AMPLITUDE OF THE SYNC PULSE. IN THE NTSC SYTEM AS WELL AS IN THE PAL SYTEM BOTH HAVE THE SAME AMLITUDE. ON THE TMS 9929 THE BURST IS PRESENT ON BOTH COLOR DIFFERENCE SIGNALS. AFTER COLOR MODULATION THE AMPLITUDE OF THE BURST IS CALCULATED AS :

IN WICH B1 THE AMPLITUDE OF THE BURST ON THE R-Y SIGNAL AND B2 THE AMPLITUDE OF THE B-Y SIGNAL. DOING THIS CALCULATION FOR THE CURRENT VALUES OF THE TMS 9929 YIELDS A BURST AMPLITUDE OF .375 OF THE BLACK WHITE SWING. FOR THE PAL SYTEM THE CORRECT VALUE SHOULD BE .43 WICH GIVES A RELATIVE AMPLITUDE FOR B1 AND B2 AS :

$$B1 = B2 = .30$$

4.2 COLOR SIGNAL AMPLITUDE

THE AMPLITUDES OF THE COLOR DIFFERENCE SIGNALS NEED TO BE

CALCULATED WITH RESPECT TO THE BLACK WITHE SWING OF THE LUMINANCE SIGNAL AND SHOULD HAVE THE VALUES AS ALREADY INDICATED IN TABLE 1.

SECTION 5

SYNC AMPLITUDE

IN A TV SET THE CONTRAST IS DETERMINED BY THE CONTRAST CONTROL AND ALSO BY THE AUTOMATIC GAIN CONTROL. MOST TV SETS ARE MEASURING THE SYNC AMPLITUDE TO SET THE AUTOMATIC GAIN CONTROL AND THEREFORE THE RIGHT RELATIONSHIP BETWEEN LUMINANCE SIGNAL AND SYNC PULSE HAVE TO BE MAINTAINED. FOR THE PAL SYSTEM THE SYNC AMPLITUDE IS .43 TIMES THE BLACK WHITE SWING OF THE LUMINANCE SIGNAL. ON THE CURRENT VDP CHIP THIS VALUE IS .46 .

SECTION 6

CONCLUSIONS AND SUMMARY

A SHORT SUMMARY OFF ALL PROPOSED CHANGES IS GIVEN BELOW

1. LEVELS FOR THE LUMINANCE AND COLOR DIFFERENCE SIGNALS NEED TO BE CHANGED TO COMPLIE WITH THE EUROPEAN GAMMA CORRECTION.

2. LINE SYNCHRONISATION TIMING NEEDS TO BE ADJUSTED TO BE CONFORM THE EUROPEAN PAL SPECIFICATION IN ORDER TO PREVENT TIMING ERRORS IN SOME BRANDS OF TV SETS.

3. FIELD SYNCHRONISATION TIMING NEEDS TO BE ADJUSTED TO PREVENT POSSIBLE TIMING ERRORS ON EUROPEAN TV SETS.

4. BURST AMPLITUDE NEEDS TO BE CORRECTED

5. SYNCHRONISATION SIGNAL LEVEL NEEDS A SMALL ADJUSTMENT TO COMPLIE WITH THE EUROPEAN SPECIFICATIONS.

SINCE THE ABOVE LIST IS QUITE EXTENSIVE , THE COSTS OF A REDESIGN WILL BE QUITE HIGH. THEREFORE IT IS SUGGESTED TO INCORPORATE IN THE REDESIGN ALSO A 40 CHARACTER COLOR MODE FOR THE FOLLOWING REASONS :

1. FOR COLOR THE 40 CHARACTER MODE IS BECOMMING A KIND OF STANDARD SINCE COMPETITION IS CHANGING TO IT.

2. THE 40 CHARACTER COLOR MODE IS BECOMMING MORE AND MORE IMPORTANT IN DATA COMMUNICATIONS.

3. VIEWDATA AND ANTIOPE WILL BE POSSIBLE WITHOUT THE NEED FOR A SPECIAL PERIPHERAL.