Experiment No.01

Aim – To study the Colour Composite Video Signal.

Theory –

VALUES OF LUMINANCE (Y) AND COLOUR DIFFERENCE SIGNALS ON COLOURS

When televising colour scenes even when voltages *R*, *G* and *B* are not equal, the '*Y*' signal still represents monochrome equivalent of the colour because the proportions 0.3, 0.59 and 0.11 taken of *R*, *G* and *B* respectively still represent the contribution which red, green and blue lights make to the luminance. This aspect can be illustrated by considering some specific colours.

Desaturated Purple

Consider a desaturated purple colour, which is a shade of magenta. Since the hue is magenta (purple) it implies that it is a mixture of red and blue. Two word desaturated indicates that some white light is also there. The white light content will develop all the three i.e., R, G and B voltages, the magnitudes of which will depend on the intensity of desaturation of the colour. Thus R and B voltages will dominate and both must be of greater amplitude than G. As an illustration let R = 0.7, G = 0.2 and B = 0.6 volts. The white content is represented by equal quantities of the three primaries and the actual amount must be indicated by the smallest voltage of the three, that is, by the magnitude of G. Thus white is due to 0.2 R, 0.2 G and 0.2 B. The remaining, 0.5 R and 0.4 B together represent the magenta hue.

(i) The luminancesignal

Y = 0.3 R + 0.59 G + 0.11 B. Substituting the values of R, G, and B we get Y = 0.3 (0.7) + 0.59 (0.2) + 0.11(0.6) = 0.394 (volts).

(ii) The colour difference signalsare:

(R – Y) = 0.7 – 0.394 = + 0.306(volts)

(B – Y) = 0.6 – 0.394 = + 0.206(volts)

(iii) Reception at the colour receiver—At the receiver after demodulation, the signals,Y, (B – Y) and (R – Y), become available. Then by a process of matrixing the voltages B and R are obtained as:

R = (R – Y) + Y = 0.306 + 0.394 = 0.7 V

B = (B – Y) + Y = 0.206 + 0.394 = 0.6 V

(iv) (G – Y) matrix—The missing signal (G – Y) that is not transmitted can be recovered by using a suitable matrix based on the explanation givenbelow:

Y = 0.3 R + 0.59G + 0.11B

also (0.3 + 0.59 + 0.11)Y = 0.3R + 0.59G + 0.11B

Rearranging the above expression we get:

0.59(G – Y) = – 0.3 (R – Y) – 0.11 (B – Y)

∴ (G – Y) =– 0.3/ 0.59(R – Y) –0.11/0.59(B – Y) = – 0.51(R – Y) – 0.186 (B – Y)

Substituting the values of (R – Y) and (B – Y)

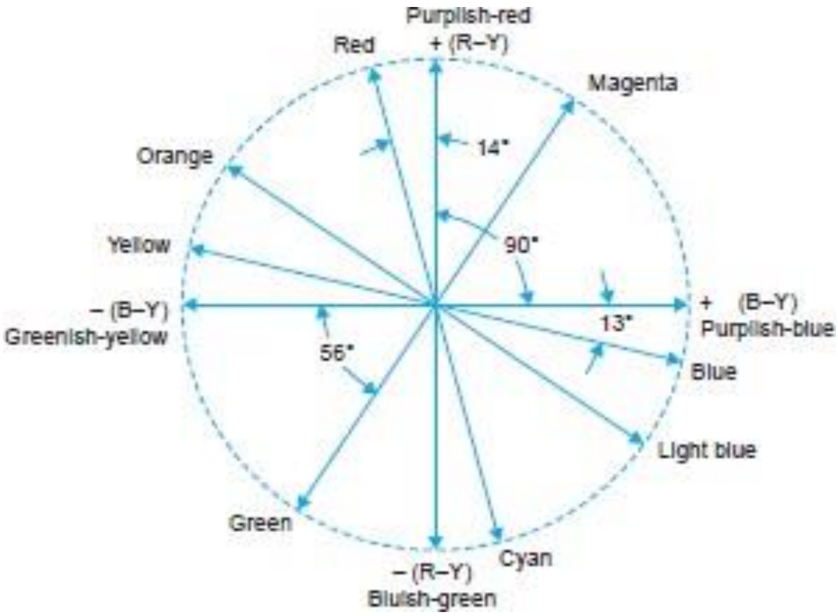
(G – Y) = – (0.51 × 0.306) – 0.186(0.206) = – 0.15606 – 0.038216 = – 0.194

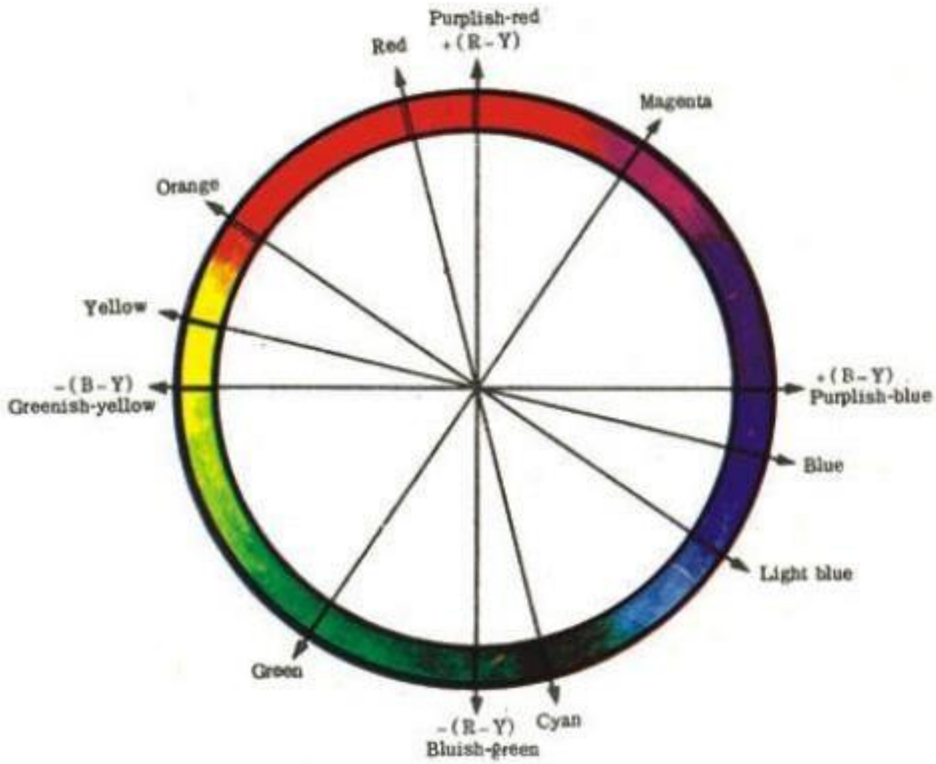
G = (G – Y) + Y = – 0.194 + 0.394 = 0.2, and this checks with the given value.

(v) Reception on a monochrome receiver—Since the value of luminance signal Y = 0.394 V, and the peak white corresponds to 1 volt (100%) the magenta will show up as a fairlydull grey in a black and white picture. This is as would be expected for thiscolour.

POLARITY OF THE COLOUR DIFFERENCE SIGNALS

As has been demonstrated by the above two examples, both (*R* – *Y*) and (*B* – *Y*) can be either positive or negative depending on the hue they represent. The reason is that for any primary, its complement contains the other two primaries. Thus a primary and its complement can be considered as opposite to each other and hence the colour difference signals turn out to be of opposite polarities. This is illustrated by the colour phasor diagram of Fig.below. Observe that a purplish-red hue is represented by + (*R* – *Y*) while its complement, a bluish-green hue corresponds to – (*R* – *Y*). Similarly + (*B* – *Y*) and – (*B* – *Y*) represent purplish-blue and greenishyellow hues respectively. Note that green colour is obtained by a combination of – (*R* – *Y*) and – (*B* – *Y*) while cyan is obtained by a combination of – (*R* – *Y*) and + (*B* – *Y*) signals. Furthermore, any one of the three primaries or their complementaries can be obtained by a combination of two of the above four signals. It may also be noted that the colour difference video signals have no brightness component and represent only the different hues.



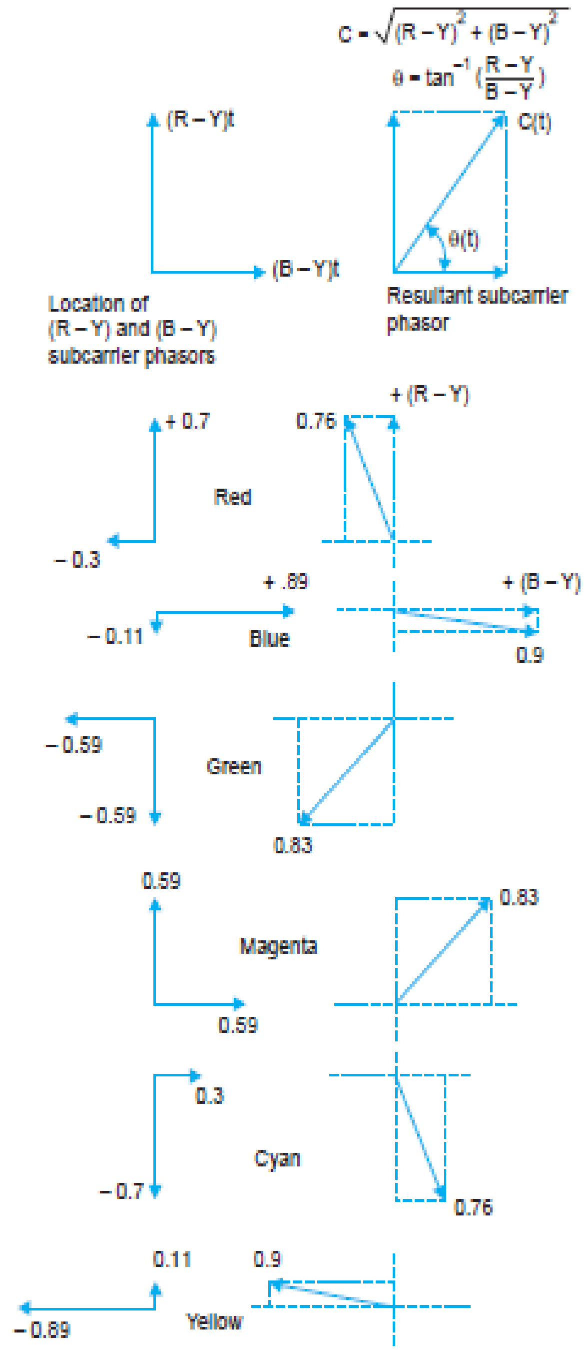


COLOUR SIGNAL TRANSMISSION

Three different systems of colour television (CTV) emerged after prolonged research and Experimentation. These are:
(i) The American NTSC (National Television Systems Committee)system.
(ii) The German PAL (Phase Alteration by Line)systems.
(iii) The French SECAM (Sequential Couleures a memoire)system.

MODULATION OF COLOUR DIFFERENCE SIGNALS

The problem of transmitting (*B*-*Y*) and (*R*-*Y*) video signals simultaneously with one carrier frequency is solved by creating two carrier frequencies from the same colour subcarrier without any change in its numerical value. Two separate modulators are used, one for the (*B*-*Y*) and the other for the (*R*-*Y*) signal. However, the carrier frequency fed to one madulator is given a relative phase shift of 90° with respect to the other before applying it to the modulator. Thus, the two equal subcarrier frequencies which are obtained from a common generator are said to

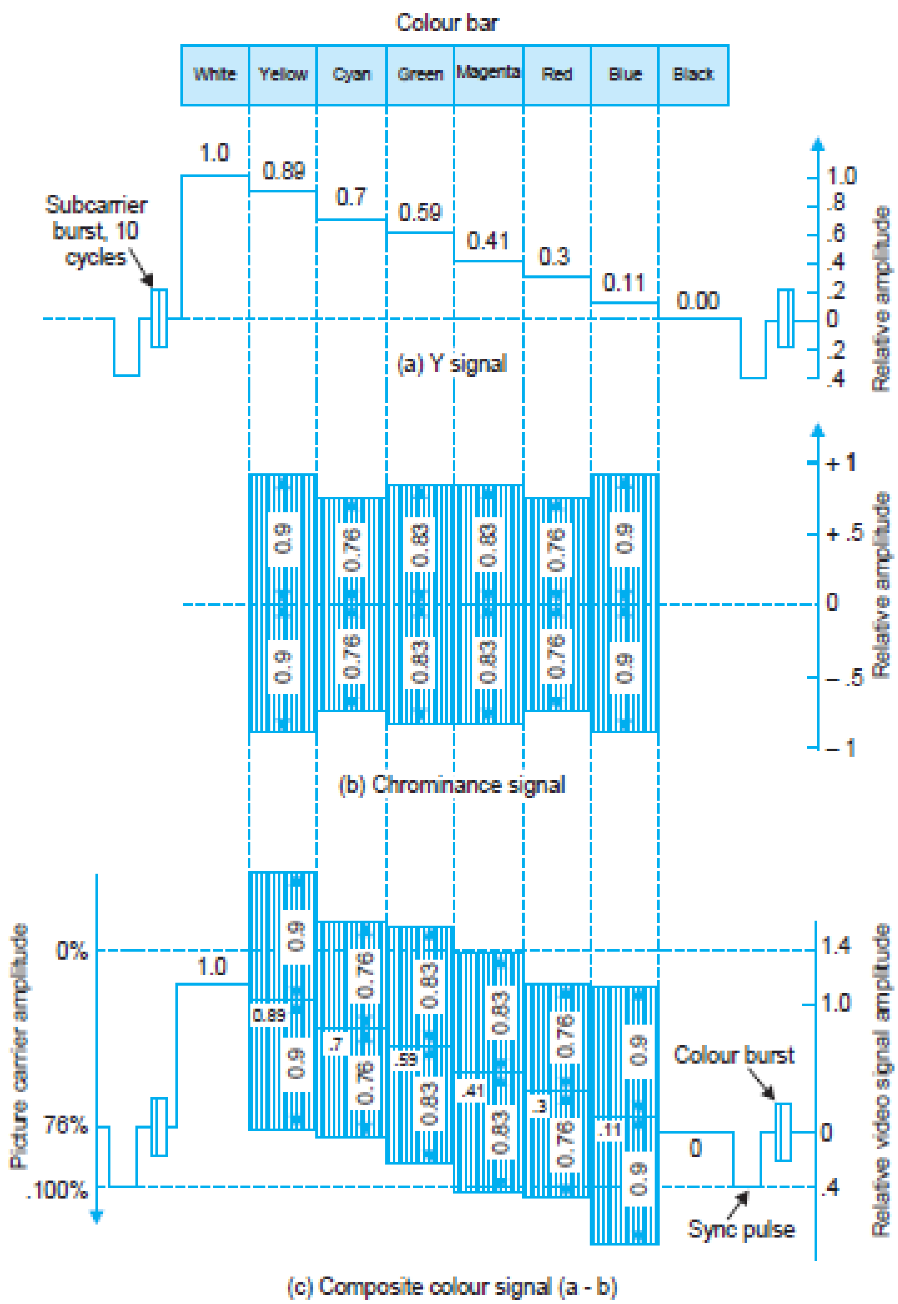


be in quadrature and the method of modulation is known as quadrature modulation. After modulation the two outputs are combined to yield C, the resultant subcarrier phasor. Since the amplitude of C, the chrominance signal, corresponds to the magnitudes of colour difference signals, its instantaneous value represents colour saturation at that instant. Maximum amplitude corresponds to greatest saturation and zero amplitude to no saturation i.e., white. Similarly, the instantaneous value of the C phasor angle (θ) which may vary from 0° to 360° represents hue of the colour at that moment. Thus the chrominance signal contains full information about saturation and hue of various colours. This being a crucial point in colour signal transmission, is illustrated by a few examples. However, it would be necessary to first express (R-Y) and (B-Y) in terms of the three camera output voltages. This is done by substituting

Y = 0.59G + 0.3R + 0.11B in these expressions. Thus (R-Y) becomes R – 0.59G – 0.3R – 0.11B = 0.7R – 0.59G – 0.11B. Similarly, (B-Y) becomes B – 0.59G – 0.3R – 0.11B = 0.89B – 0.59G – 0.3R. Now suppose that only pure red colour is being scanned by the colour camera. This would result in an output from the red camera only, while the green and blue outputs will be zero. Therefore, (R-Y) signal will become simply + 0.7R and (B-Y) signal will be reduced to – 0.3R. The resultant location of the subcarrier phasor after modulation is illustrated in Fig. 26.3. Note that the resultant phasor is counter clockwise to the position of + (R-Y) phasor. Next consider that the colour camera scans a pure blue colour scene. This yields (R-Y) = – 0.11B and (B-Y) = 0.89 B. The resultant phasor for this colour lags + (B-Y) vector by a small angle. Similarly the location and magnitude for any colour can be found out. This is illustrated in Fig. above for the primary and complementary colours. Another point that needs attention is the effect of desaturation on the colour phasors. Since desaturation results in reduction of the amplitudes of both (B-Y) and (R-Y) phasors, the resultant chrominance phasor accordingly changes its magnitude depending on the degree of desaturation. Thus any change in the purity of a colour is indicated by a change in the magnitude of the resultant subcarrier phasor.

WEIGHTING FACTORS

The resultant chrominance signal phasor (C) is added to the luminance signal (Y) before modulating it with the channel carrier for transmission. The amplitude, i.e., level line of Y signal becomes the zero line for this purpose. Such an addition is illustrated in Fig. 26.5 for a theoretical 100 percent saturated, 100 percent amplitude colour bar signal. The peak-to-peak amplitude of green signal (± 0.83) gets added to the corresponding luminance amplitude of 0.59. For the red signal the chrominance amplitude of ± 0.76 adds to its brightness of 0.3. Similarly other colours add to their corresponding luminance values to form the chroma signal. However, observe that it is not practicable to transmit this chroma waveform because the signal peaks would exceed the limits of 100 percent modulation. This means that on modulation with the picture carrier some of the colour signal amplitudes would exceed the limits of maximum sync tips on one side and white level on the other. For example, in the case of magenta signal, the chrominance value of ± 0.83 when added to its luminance amplitude of 0.41 exceeds the limits of 100 percent modulation of both white and black levels. Similarly blue signal amplitude greatly exceeds the black level and willcause a high degree ofovermodulation.



If overmodulation is permitted the reproduced colours will get objectionably distorted. Therefore, to avoid overmodulation on 100 percent saturation colour values, it is necessary to reduce the amplitude of colour difference video signal before modulating them with the colour subcarrier. Accordingly, both (*R*–*Y*) and (*B*–*Y*) components of the colour video signal are scaled down by multiplying them with what are known as 'weighting factors'. Those used are 0.877 for the (*R*–*Y*) component and 0.493 for the (*B*–*Y*) component. The compensated values are obtained by using potentiometers at the outputs of (*R*–*Y*) and (*B*–*Y*) adders (see Fig. 25.9). Note that no reduction is made in the amplitude of *Y* signal. It may also be noted that since the transmitter radiates weighted chrominance signal values, these must be increased to the uncompensated values at the colour TV receiver for proper reproduction of different hues. This is carried out by adjusting gains of the colour difference signal amplifiers. The unweighted and weighted values of colour difference signals are given below in Table below.

Colour	Luminance signal (λ)	$B-Y$ (Unweighted)	$R-Y$ (Unweighted)	$G-Y$ (Unweighted)	C_{sc} (Unweighted)	$B-Y$ (Weighted)	$R-Y$ (Weighted)	C_{sc} (Weighted)
White	1	0	0	0	0	0	0	0
Yellow	0.89	–.89	+.11	+.11	.9	–.4385	+.096	0.44
Cyan	0.7	+.3	–.7	+.3	.76	+.148	–.614	0.63
Green	0.59	–.59	–.59	+.41	.83	–.29	–.517	0.59
Magenta	0.41	+.59	+.59	–.41	.83	+.29	+.517	0.59
Red	0.3	–.3	+.7	–.3	.76	–.148	+.614	0.63
Blue	0.11	+.89	–.11	–.11	.9	+.4388	–.096	0.44
Black	0	0	0	0	0	0	0	0

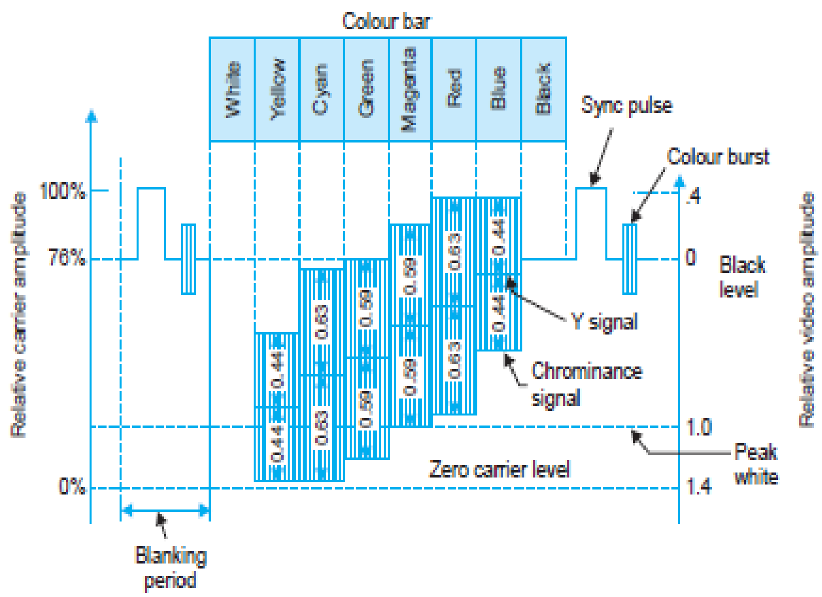
$$C_{sc} = \sqrt{(B-Y)^2 + (R-Y)^2}$$

$(B-Y)$ weighted = 0.493 $(B-Y)$ unweighted

$(R-Y)$ weighted = 0.877 $(R-Y)$ unweighted

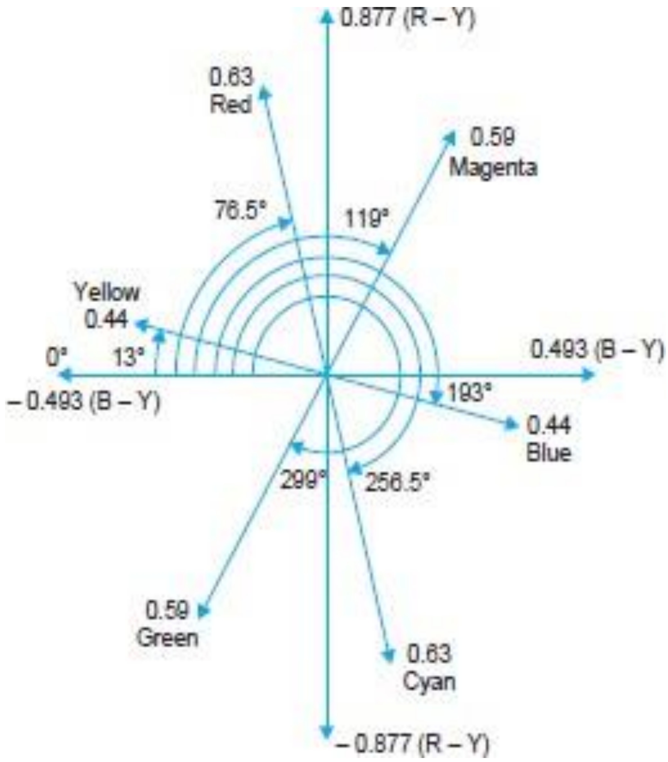
FORMATION OF THE CHROMINANCE SIGNAL

Using the information of Table 26.1, Fig. 26.6 illustrates the formation of the chroma signal for a colour bar pattern after the colour difference signals have been scaled down in accordance with corresponding weighting factors. Note that new amplitudes of the chrominance subcarrier signals are 0.63 for red and cyan, 0.59 for green and magenta and 0.44 for blue and yellow. These amplitudes will still cause overmodulation to about 33%. This is permitted, because in practice, the saturation of hues in natural and staged scenes seldom exceeds 75 percent. Since the amplitude of chroma signal is proportional to the saturation of hue, maximum chroma signal amplitudes are seldom encountered in practice. Therefore, the weighted chroma values result in a complete colour signal that will rarely, if ever, overmodulate the picture carrier of a CTV transmitter. Hence it is not necessary to further decrease the signal amplitudes by employing higher weighting factors.



Chroma Signal Phasor Diagram

The compensation (readjustment) of chroma signal values results in a change of chroma phase angles. In the NTSC system it is a common practice to measure phase angles relative to the– (*B*–*Y*) phasor. This location has been designated 0° or the reference phase position on the phasor diagram (see Fig. 26.7) because this is also the phase of the colour burst that transmitted on the back porch of each horizontal sync pulse. Referring to Fig.below the compensated colour magenta is represented by a phasor at an angle of 119°. In the same manner the diagram indicates phase angles and amplitudes of other coloursignals. Note that primary colours are 120° apart and complementary colours differ in phase by 180° from their corresponding primary colours.



Observations –

Amplitudes of Colour Composite Video Signal		
Sr. No	**Details**	**Voltage levels**
1	White	
2	Yellow	
3	Green	
4	Magenta	
5	Cyan	
6	Blue	
7	Red	
8	Green	
9	Blue	

Experiment No.02

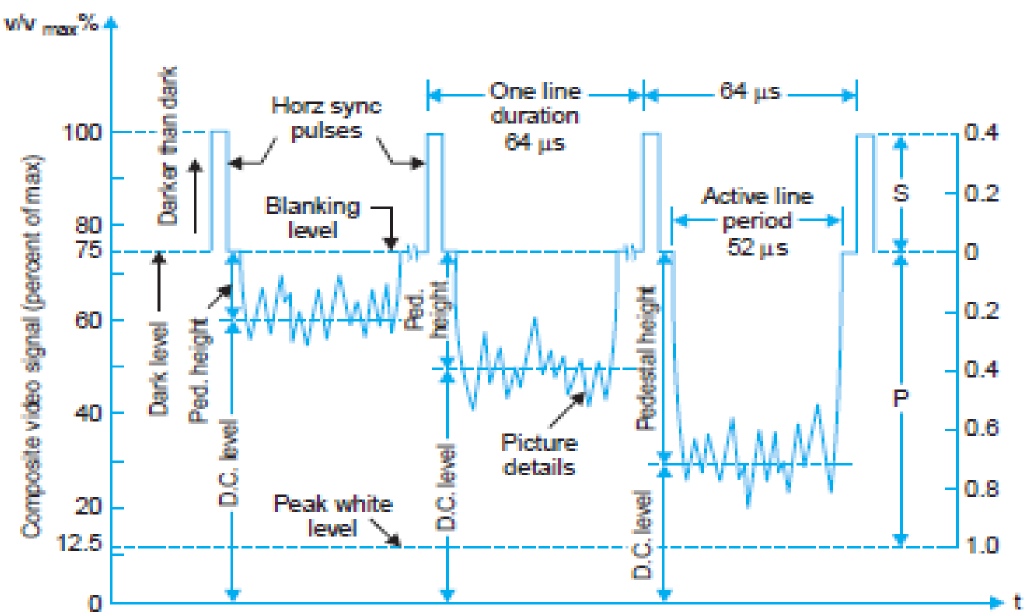
Aim – To study Horizontal and Vertical Sync Details of Composite Video Signal.

Theory - Composite video signal consists of a camera signal corresponding to the desired picture information, blanking pulses to make the retrace invisible, and synchronizing pulses to synchronize the transmitter and receiver scanning. A horizontal synchronizing (sync) pulse is needed at the end of each active line period whereas a vertical sync pulse is required after each field is scanned. The amplitude of both horizontal and vertical sync pulses is kept the same to obtain higher efficiency of picture signal transmission but their duration (width) is chosen to be different for separating them at the receiver. Since sync pulses are needed consecutively and not simultaneously with the picture signal, these are sent on a time division basis and thus form a part of the composite video signal.

Composite video signal details of three different lines each corresponding to a different brightness level of the scene. As illustrated there, the video signal is constrained to vary between certain amplitude limits. The level of the video signal when the picture detail being transmitted corresponds to the maximum whiteness to be handled, is referred to as peak-white level. This is fixed at 10 to 12.5 percent of the maximum value of the signal while the black level corresponds to approximately 72 percent. The sync pulses are added at 75 percent level called the blanking level. The difference between the black level and blanking level is known as the 'Pedestal'. However, in actual practice, these two levels, being very close, tend to merge with each other as shown in the figure. Thus the picture information may vary between 10 percent to about 75 percent of the composite video signal depending on the relative brightness of the picture at any instant. The darker the picture the higher will be the voltage within thoselimits.

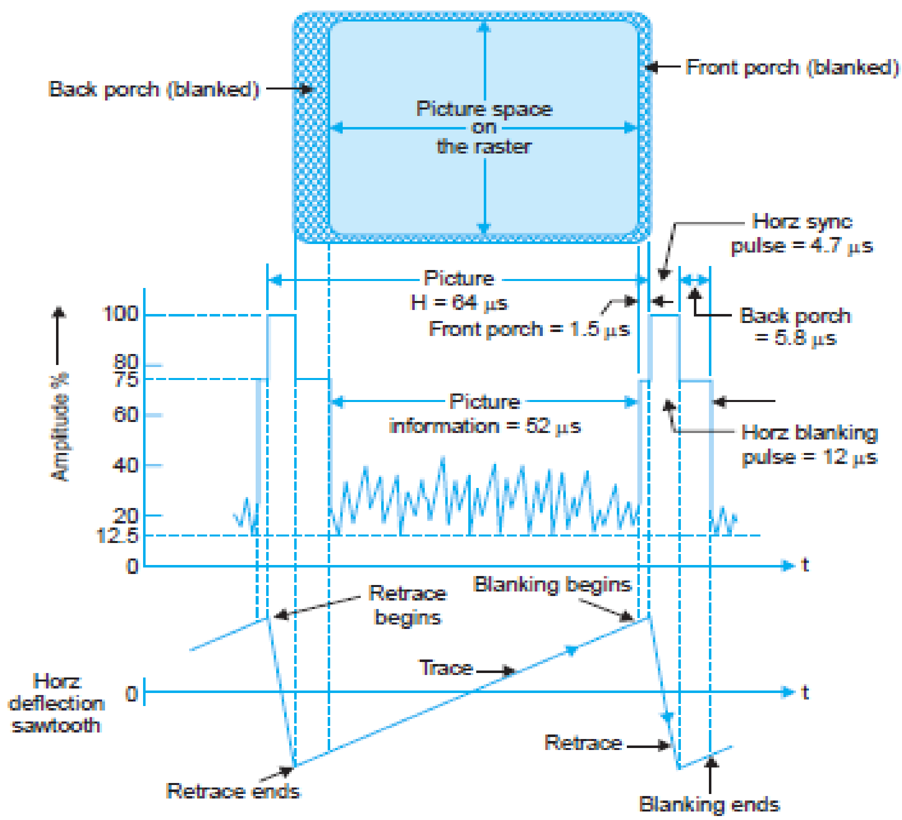
Note that the lowest 10 percent of the voltage range (whiter than white range) is not used to minimize noise effects. This also ensures enough margin for excessive bright spots to be accommodated without causing amplitude distortion at the modulator.

At the receiver the picture tube is biased to ensure that a received video voltage corresponding to about 10 percent modulation yields complete whiteness at that particular point on the screen, and an analogous arrangement is made for the black level. Besides this, the television receivers are provided with 'brightness' and 'contrast' controls to enable the viewer to make final adjustments as he thinksfit.



The blanking pulses - The composite video signal contains blanking pulses to make the retrace lines invisible by raising the signal amplitude slightly above the black level (75 percent) during the time the scanning circuits produce retraces. As illustrated in Fig. 3.2, the composite video signal contains horizontal and vertical blanking pulses to blank the corresponding retrace intervals. The repetition rate of horizontal blanking pulses is therefore equal to the line scanning frequency of 15625 Hz. Similarly the frequency of the vertical blanking pulses is equal to the field-scanning frequency of 50 Hz. It may be noted that though the level of the blanking pulses is distinctly above the picture signal information, these are not used as sync pulses. The reason is that any occasional signal corresponding to any extreme black portion in the picture may rise above the blanking level and might conceivably interfere with the synchronization of the scanning generators. Therefore, the sync pulses, specially designed for triggering the sweep oscillators are placed in the upper 25 per cent (75 per cent to 100 per cent of the carrier amplitude) of the video signal, and are transmitted along with the picture signal. 25 per cent by the sync pulses. Thus, as shown in Fig. 3.1, the final radiated signal has a picture to sync signal ratio (P/S) equal to 10/4. This ratio has been found most satisfactorybecause if the picture signal amplitude is increased at the expense of sync pulses, then when the signal to noise ratio of the received signal falls, a point is reached when the sync pulse amplitude becomes insufficient to keep the picture locked even though the picture voltage is still of adequate amplitude to yield an acceptable picture. On the other hand if sync pulse height is increased at the expense of the picture detail, then under similar conditions the raster remains locked but the picture content is of too low an amplitude to set up a worthwhile picture. A ratio of P/S = 10/4, or thereabout, results in a situation such that when the signal to noise ratio reaches a certain low level, the sync amplitude becomes insufficient, *i.e.*, the sync fails at the same time as the picture ceases to be of entertainment value. This represents the most efficient use of the televisionsystem.

HORIZONTAL SYNC DETAILS



The horizontal blanking period and sync pulse details are illustrated in Fig. 3.3. The interval between horizontal scanning lines is indicated by *H*. As explained earlier, out of a total line period of 64 µs, the line blanking period is 12 µs. During this interval a line synchronizing pulse is inserted. The pulses corresponding to the differentiated leading edges of the sync pulses are actually used to synchronize the horizontal scanning oscillator. This is the reason why in Fig. above and other figures to follow, all time intervals are shown between sync pulse leading edges. The line blanking period is divided into three sections. These are the 'front porch', the line sync' pulse and the 'back porch'. The time intervals allowed to each part are summarized below and their location and effect on the raster is illustrated in Fig. above.

Details of Horizontal Scanning

Period	*Time (µs)*
Total line (*H*)	64
Horz blanking	12 ± .3
Horz sync pulse	4.7 ± 0.2
Front porch	1.5 ± .3
Back porch	5.8 ± .3
Visible line time	52

Front porch - This is a brief cushioning period of 1.5 µs inserted between the end of the picture detail for that line and the leading edge of the line sync pulse. This interval allows the receiver video circuit tosettle down from whatever picture voltage level exists at the end of the picture line to the blanking level before the sync pulse occurs. Thus sync circuits at the receiver are isolated from the influence of end of the line picture details. The most stringent demand is made on the video circuits when peak white detail occurs at the end of a line. Despite the existence of the front porch when the line ends in an extreme white detail, and the signal amplitude touches almost zero level, the video voltage level fails to decay to the blanking level before the leading-edge of the line sync pulse occurs. This results in late triggering of the time base circuit thus upsetting the 'horz' line sync circuit. As a result the spot (beam) is late in arriving at the left of the screen and picture information on the next line is displaced to the left. This effect is known as 'pulling-on-whites'.

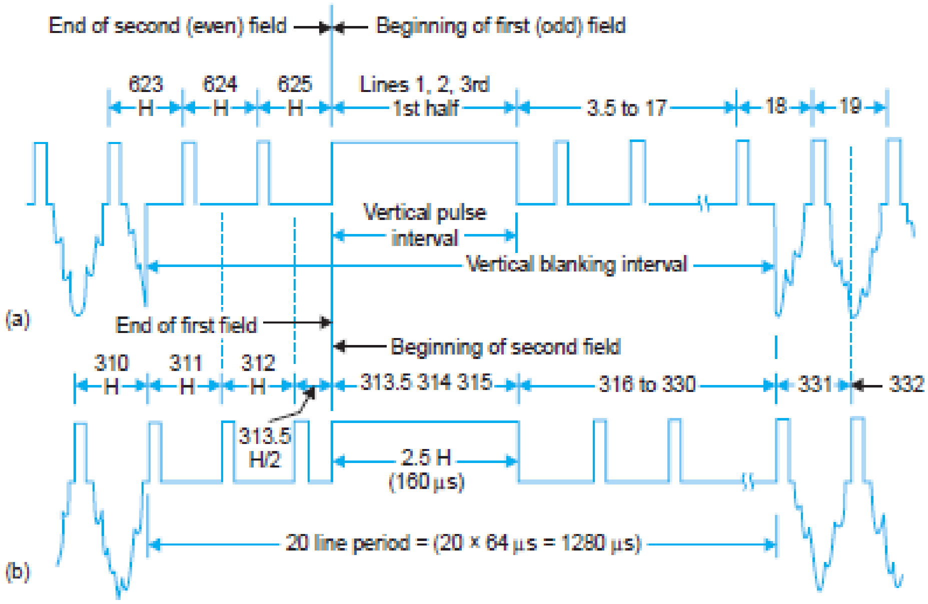
Line sync pulse - After the front proch of blanking, horizontal retrace is produced when the sync pulse starts. The flyback is definitely blanked out because the sync level is blacker than black. Line sync pulses are separated at the receiver and utilized to keep the receiver line time base in precise synchronism with the distant transmitter. The nominal time duration for the line sync pulses is 4.7 µs. During this period the beam on the raster almost completes its back stroke (retrace) and arrives at the extreme left end of the raster.

Back porch - This period of 5.8 µs at the blanking level allows plenty of time for line flyback to be completed. It also permits time for the horizontal time-base circuit to reverse direction of current for the initiation of the scanning of next line. Infact, the relative timings are so set that small black bars (see Fig. above) are formed at both the ends of the raster in the horizontal plane. These blanked bars at the sides have no effect on the picture details reproduced during the active line period.

The back porch* also provides the necessary amplitude equal to the blanking level (reference level) and enables to preserve the dc content of the picture information at the transmitter. At the receiver this level which is independent of the picture details is utilized in the AGC (automatic gain control) circuits to develop true AGC voltage proportional to the signal strength picked up at the antenna.

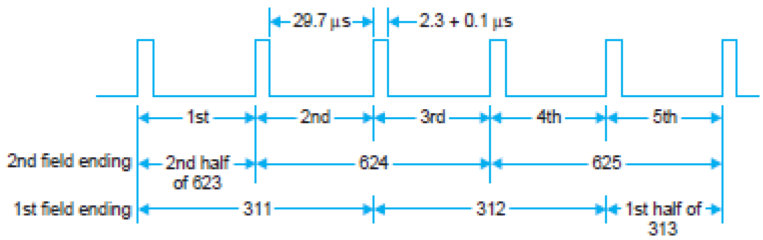
VERTICAL SYNC DETAILS

The vertical sync pulse train added after each field is somewhat complex in nature. The reason for this stems from the fact that it has to meet several exacting requirements. Therefore, in order to fully appreciate the various constituents of the pulse train, the vertical sync details are explored step by step while explaining the need for its various components. The basic vertical sync added at the end of both even add odd fields is shown in Fig. below. Its width has to be kept much larger than the horizontal sync pulse, in order to derive a suitable field sync pulse at the receiver to trigger the field sweep oscillator. The standards specify that the vertical sync period should be 2.5 to 3 times the horizontal line period. If the width is less than this, it becomes difficult to distinguish between horizontal and vertical pulses at the receiver.

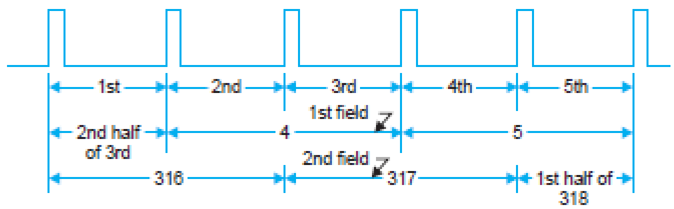


If the width is greater than this, the transmitter must operate at peak power for an unnecessarily long interval of time. In the 625 line system 2.5 line period (2.5 × 64 = 160 □s) has been allotted for the vertical sync pulses. Thus a vertical sync pulse commences at the end of 1st half of 313th line (end of first field) and terminates at the end of 315th line. Similarly after an exact interval of 20 ms (one field period) the next sync pulse occupies line numbers— 1st, 2nd and 1st half of third, just after the second field is over. Note that the beginning of these pulses has been aligned in the figure to signify that these must occur after the end of vertical stroke of the beam in each field, *i.e.*, after each 1/50th of a second. This alignment of vertical sync pulses, one at the end of a half-line period and the other after a full line period (see Fig.above), results in a relative misalignment of the horizontal sync pulses and they do not appear one above the other but occur at half-line intervals with respect to each other. However, a detailed examination of the pulse trains in the two fields would show that horizontal sync pulses continue to occur exactly at 64 ms intervals (except during the vertical sync pulse periods) throughout the scanning period from frame to frame and the apparent shift of 32 ms is only due to the alignment of vertical sync instances in thefigure.

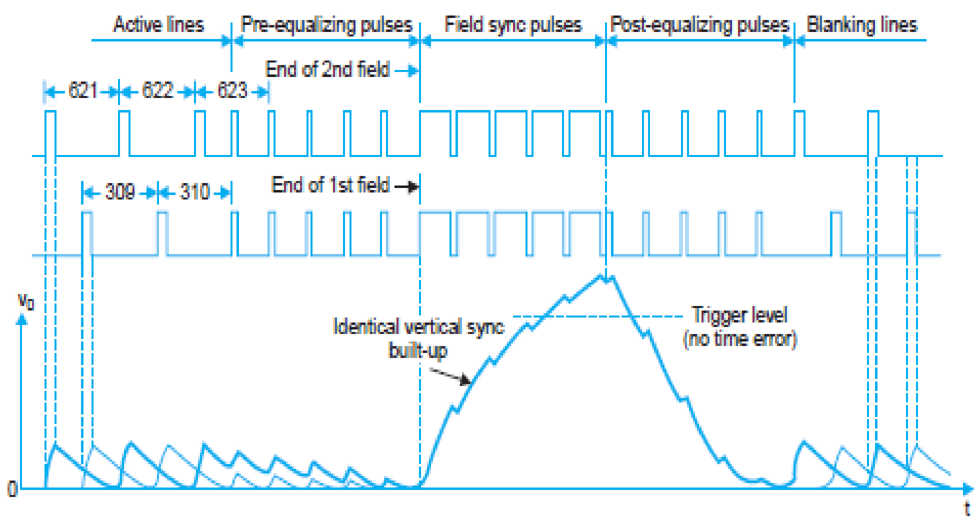
The polarity of the pulses as obtained at the outputs of their respective fields may not be suitable for direct application in the controlled synchronizing oscillator and might need inversion depending on the type of oscillator used. This aspect will be fully developed in the chapter devoted to vertical and horizontal oscillators.



(a) Pre-sync equalizing pulses (five)



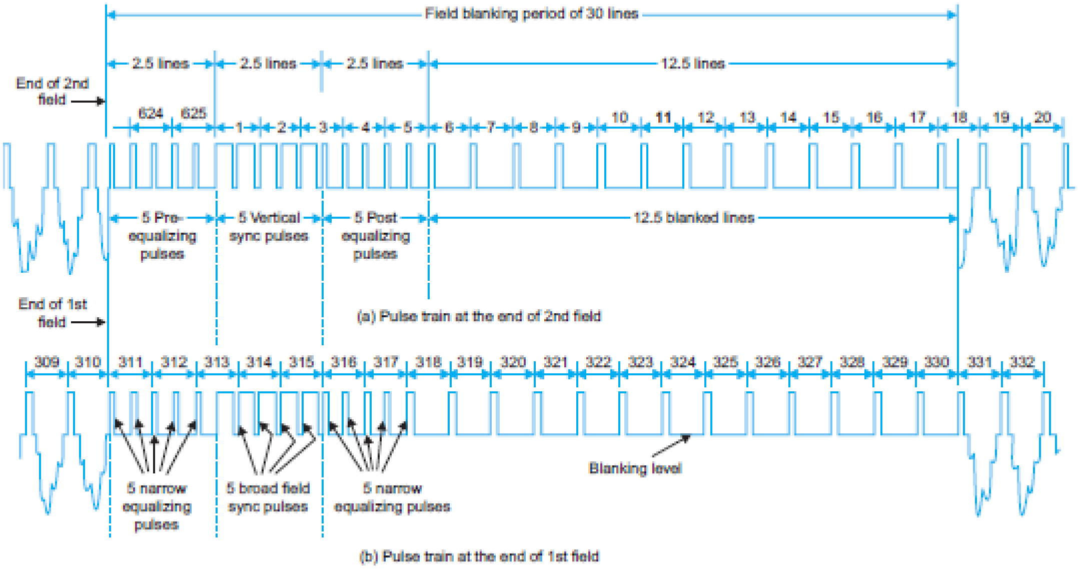
(b) Post-sync equalizing pulses (five)



SCANNING SEQUENCE DETAILS

First Field (odd field)
Line numbers : one to 1st-half of 313th line (312.5 lines)
1, 2 and 3rd 1st-half, lines 2.5 lines—Vertical sync pulses
3rd 2nd-half, 4, and 5 2.5 lines—Post-vertical sync equalizing pulses.
6 to 17, and 18th 1st-half 12.5 lines—Blanking retrace pulses
18th 2nd-half to 310 292.5 lines—Picture details
311, 312, and 313th 1st-half 2.5 lines—Pre-vertical sync equalizing pulses for the 2nd field.
Total number of lines = 312.5
Second field (even field)
Line numbers : 313th 2nd-half to 625 (312.5 lines)
313th 2nd-half, 314, 315 2.5 lines—Vertical sync pulses
316, 317, 318th 1st-half 2.5 lines—Post-vertical sync equalizing pulses
318th 2nd-half-to 330 12.5 lines—Blanking retrace pulses
331 to 1st-half of 623rd 292.5 line—Picture details
623 2nd-half, 624 and 625 2.5 lines—Pre-vertical sync equalizing pulses

for the 1st field
Total number of lines = 312.5
Total Number of Lines per Frame = 625



Observations –

Sr. No.	Details	Actual	Observed
	Amplitudes of Composite Video Signal		
1	White Level	10%	
2	Black Level	75%	
3	Synchronization Pulse	25%	
4	Total Amplitude of Video Signal		
	Horizontal Scanning Details		
1	Total Horizontal Line Period	64 µs	
2	Trace Time	52 µs	
3	Retrace Time	12 µs	
4	Front Porch	1.5 µs	
5	Sync. Pulse	4.7 µs	
6	Back Porch	5.8 µs	
	Vertical Scanning Details		
1	Total Vertical field Time	20 ms	
2	Trace Time	18720 µs	
3	Retrace Time	1280 µs	
4	Vertical Sync. Pulse	2.5H=160 µs	
5	Pre-equalizing Pulse	160 µs	
6	Post- equalizing Pulse	160 µs	

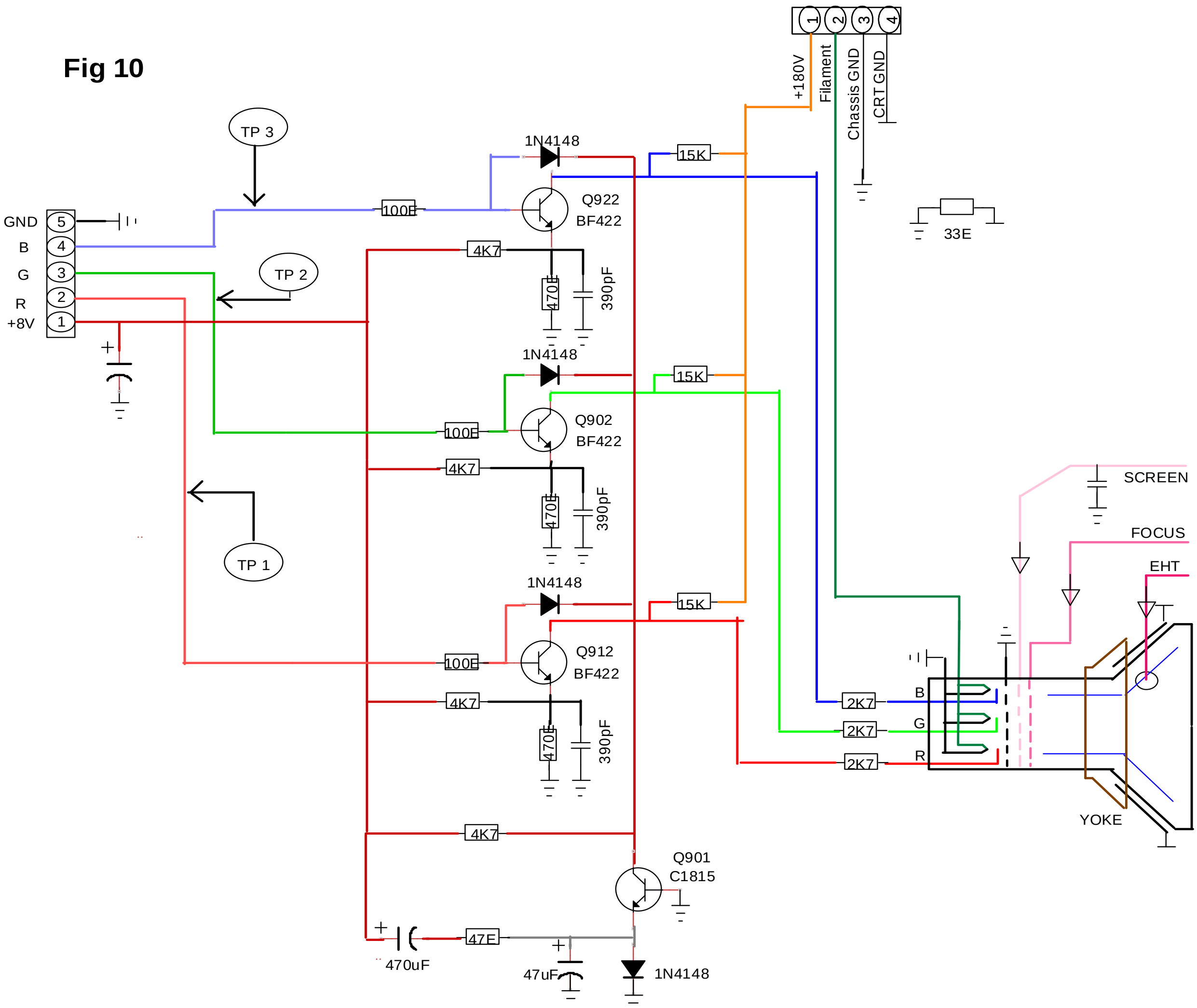
Experiment No 03

Aim: -
To study R, G & B video amplifier section on crt board.

Apparatus required: -
CTV trainer, CRO, DMM & Pattern Generator.

Diagram & theory:-
Please refer to CRT section on page 16 for related theory. Related diagram is shown below.

Fig 10



Procedure: -
Set Pattern Generator (PG) to colour bar pattern. Connect it to TV trainer via RF in (Tuner). Tune CTV to channel outputted by PG. Observe clear colour bar on

screen.
Set brightness, contrast &colour parameters at mid-level, max level & min level one by one by remote or panel switches. Fill up Table no 1 by measuring signals at TP1 (Red signal drive at R video amp transitor), TP2 (G drive) & TP3 (B drive). Measure DC voltage by DMM & signal on CRO.

TABLE 1

TEST POINT	BRI, CON & COL MID		BRI, CON & COL MAX		BRI, CON & COL MIN	
	DC VOLT	WAVEFORM	DC VOLT	WAVEFORM	DC VOLT	WAVEFORM
TP1						
TP2						
TP3						

Conclusion:-

As bri, con & col parameters increased, R, G, B drive voltage also increases, so also amplitude of waveform increases. This results in larger amplification by R, G & B amplifiers. Picture on screen becomes bright & strong. Vice a versa when bri, con & col parameters decreased.

Experiment No.04

Aim:-

Study of fault finding in RGB Section.

Apparatus required: -

CTV trainer, CRO, DMM & Pattern Generator.

Fault 1: Absence of red color on the screen with OK Picture.

Fault Insertion: Make switch F1 off.

Symptoms: Good picture on the screen with absence of red colour.

Fault Section: RGB Section

Procedure:

- Check voltage across TP1.
- If voltage is not available then there may be track open between supply provided for red cathode gun.
- If supply available then there may be fault in cathode gun or no proper projection of electrons.
- Switch on Switch F1.

Result: Now you should get picture in normal colors.

Fault 2: Absence of green color on the screen with OK Picture.

Fault Insertion: Make switch F2 off.

Symptoms: Good picture on the screen with absence of green color.

Fault Section: RGB Section

Procedure:

- Check voltage across TP2.
- If voltage is not available then there may be track open between supply provided for green cathode gun.
- If supply available then there may be fault in cathode gun or no proper projection of electrons.
- Switch on Switch F2.

Result: Now you should get picture in normal colors.

Fault 3: Absence of blue color on the screen with OK Picture.
Fault Insertion: Make switch F3 off.
Symptoms: Good picture on the screen with absence of blue color.
Fault Section: RGB Section
Procedure:

- Check voltage across TP3.
- If voltage is not available then there may be track open between supply provided for blue cathode gun.
- If supply available then there may be fault in cathode gun or no proper projection of electrons.
- Switch on Switch F3.

Result: Now you should get picture in normal colors.

Experiment No 05

Aim: -

To study primary & secondary colours.

Apparatus required: -

CTV trainer, CRO, DMM & Pattern Generator.

Diagram & theory:-

Refer to diagram of experiment no1. Pure white or gray scale picture is a result of equal amplification by R, G & B video amplifiers.

If we disable any one amplifier, we get secondary colour picture on screen. i.e. absence of R produces cyan colour, absence of G produces magenta colour& absence of B produces yellow colour.

If we disable any two amplifiers we get remaining primary colouron screen. i.e. absence of R &G produces only blue colour, absence of B &G produces only red colour& absence of R &B produces only green colour.

Procedure: -

Set Pattern Generator (PG) to colour bar pattern. Connect it to TV trainer via RF in (Tuner). Tune CTV to channel outputted by PG. Observe clear colour bar pattern on screen.

Set brightness, contrast &colour parameters at mid-level.

Create fault no 1, by keeping switch F1 down. Observe signals at TP1 to TP3.

Similarly create fault no 2 & fault no 3 & fill up table 2. One should get 0V at TP1 when fault no 1 is created.

TABLE 2

TEST POINT	F1		F2		F3	
	DC VOLT	WAVEFORM	DC VOLT	WAVEFORM	DC VOLT	WAVEFORM
TP1						
TP2						
TP3						

Now create two faults at a time & observe respective colour on screen. Fill up the table no 3 given below.

TABLE 3

TEST POINT	F1 & F2		F2& F3		F3 & F1	
	DC VOLT	WAVEFORM	DC VOLT	WAVEFORM	DC VOLT	WAVEFORM
TP1						
TP2						
TP3						

Conclusion:-

Principle of primary & secondary colours& their effect on additive mixing can be understood by toggling switches F1 to F3 with their different combinations. If one keeps all three switches down at a time, he/she should get no raster or light on screen.

Experiment No 06

Aim:-

To understand working of Automatic Brightness Limiter (ABL)& Voltage settings of screen (G2) & focus (G3) controls.

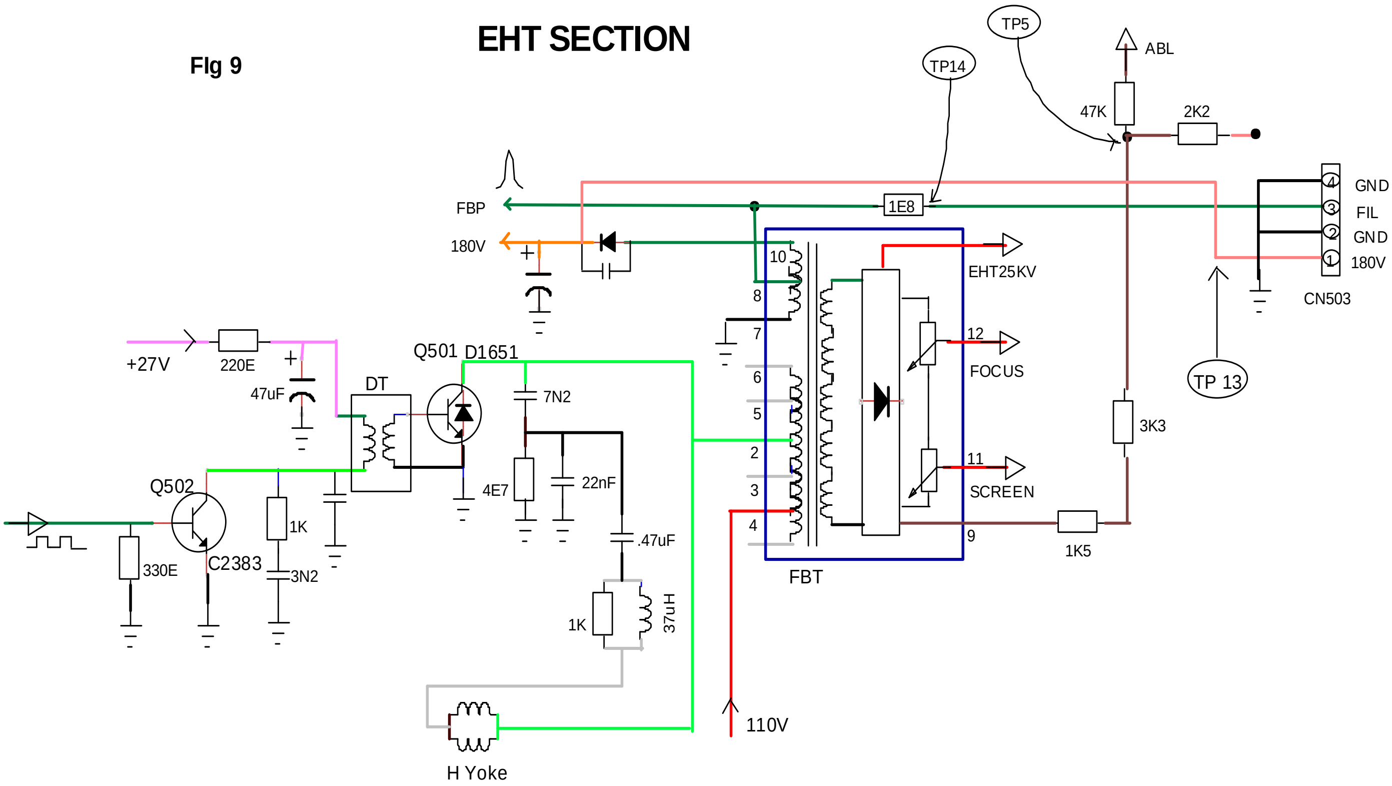
Apparatus required: -

CTV trainer, DMM & Pattern Generator.

Diagram & theory:-

FIg 9

EHT SECTION



If for any reason any adverse condition develops, like excess EHT voltage due to excess +B Voltage or excess H frequency or wrong settings of G1 &G2 , set may starts to emit more light along with X-Rays. This situation is harmful to viewer. To prevent more emition of light one counter measure is ABL circuit.
So if for any reason beam current increases, it causes more light on screen which then trigger less or –Ve voltage at ABL point. This ABL is feedback to pin 27 of main IC. Voltage on this pin controls output voltages of R, G & Bpins 50, 51& 52. Less ABLvoltage makes fewer signals& less voltage at output pins there by reducing beam current.
If situation goes out of control then ABL voltage becomes –Ve& IC cutoffs R, G & B bias. Simultaneously X-protection circuit derived from FBP triggers & it stops H drive pulses. So, EHT also stops.
How ABL works can be understood by creating fault no 5.

Procedure: -

Set Pattern Generator (PG) to colour bar pattern. Connect it to TV trainer via RF in (Tuner). Tune CTV to channel outputted by PG. Observe clear colour bar pattern on screen.
Set brightness, contrast &colour parameters at mid-level.
1) Check voltages at test points TP1 to TP3 & TP5. Create fault no 5 by switch F5.

Observe reduction of light on screen & again measure voltage at above test points & compare them. Fill the table no 6.

2) Under strict observation of instructor, mark position of focus & screen controls with marker. Then first vary focus control towards high & low position, observe its effect on picture sharpness. After this vary screen pot for high & low voltage, observe its effect on picture brightness. G2 (screen) voltage can be measured on CRT base PCB. G3 (focus) cannot be measured without high voltage probe. So don't measure it. Also G3 pin is always hidden under cover.

TABLE 6

Test Point	Measurment Before Fault DC VOLT	Measurment After Fault DC VOLT
TP1		
TP2		
TP3		
TP4	×	×

Conclusion:-

In every properly designed set, there are measures to protect viewer from accidental exposure to excess light & X-ray radiation.

Experiment no 07

Aim:-

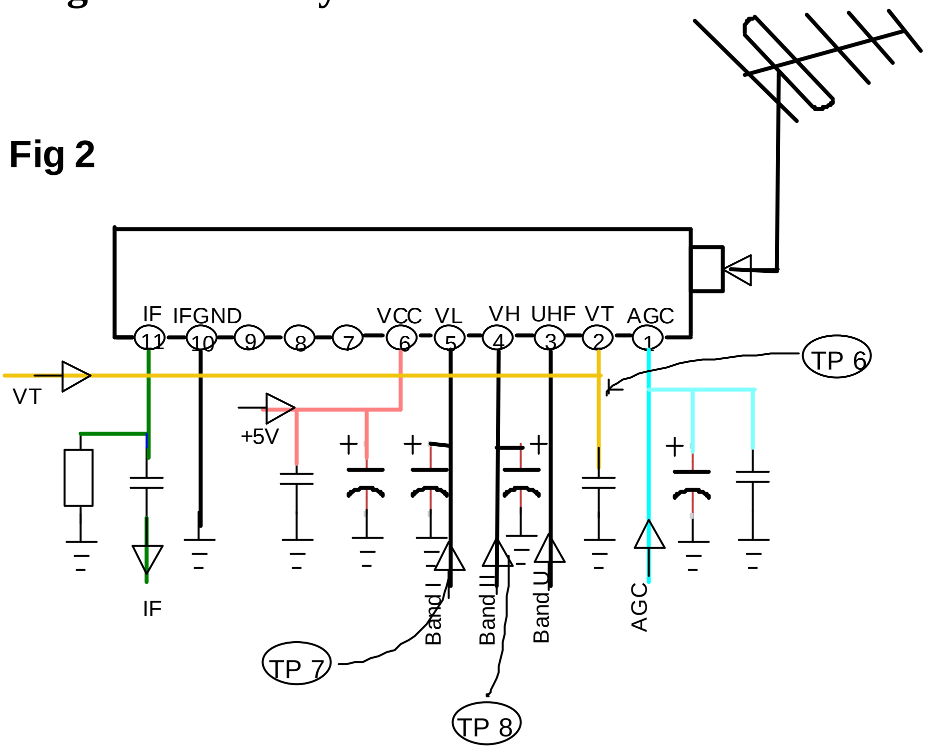
To study working of tuner.

Apparatus required: -

CTV trainer, DMM & Pattern Generator.

Diagram & theory:-

Fig 2



Please read theory given under Tuner Section page no 5. Like in superhet radio receivers, CTV tuner contains RF tuned circuit & local oscillator. Simultaneous variation of their frequencies is achieved by varicdiodes. Capacitance offered by them is controlled by tuning voltage available at tuner.

Procedure: -

Auto tune set for various numbers of channels or at least tune two channels one from VL & one from VH on different program numbers say Pr 1 &Pr 2. While auto tuning, measure VT at TP 6 for variation of 0V to 30V for each band.

Under guidance of instructor, tuner AGC voltage can be checked directly on chassis under signal & no signal condition.

Create faults F6 to F8 one by one & fill table 7. Observe their effect on tuned picture.

TABLE 7 FOR PR NO 1 Chanel tuned on VL band.

TEST POINT	NORMAL CONDITION	WITH FAULT F6	WITH FAULT F7	WITH FAULT F8
TP 6 (VT)				
TP 7 (VL)				
TP 8 (VH)	×	×	×	×

TABLE 8 FOR PR NO 2 Chanel tuned on VH band.

TEST POINT	NORMAL CONDITION	WITH FAULT F6	WITH FAULT F7	WITH FAULT F8
TP 6 (VT)				
TP 7 (VL)	×	×	×	×
TP 8 (VH)				

Conclusion:-

Without band switching & tuning voltage, tuning operation is not possible.

Experiment 08

Aim:

To study waveforms and important voltage level in a Understanding DTH System

Theory:

This section of the manual gives the brief description of the waveforms and voltages observed at the output of different sections of DTH receiver. Study of these signals helps the student to understand the different types of analog/digital input/output signals as well as in troubleshooting of various sections of DTH receiver.

Condition: Before performing this experiment, please insure that the Dish should be properly installed and the RG-6 cable form LNB to DTH receiver should be carried out to connect it to Scientech 2664.

Apparatus required:

a) Audio/Videocable

b) TV withRemote

c) DTH System withRemote

d) Power supply for Understanding DTHSystem

e) Oscilloscope

f) Multimeter

Procedure:

1. Connect the Power supply to DTH Systemtrainer.
2. Connect the mains cord to Powersupply.
3. Before connecting DTH System trainer to television receiver make sure that the power supply to the DTH System trainer and the Television receiver is switched off.
4. Connect RG-6 cable coming from LNB to Line in socket of RFtuner.
5. Check that all the switch faults should be in updirection.
6. Check that Volume L & Volume R pot positions are in middleposition.
7. Switch on the power switch of Power supply, the power LED will glow on mimic.
8. The Lock indicator LED will glow and seven segment LED display will show a channel number by default, which was selected lasttime.
9. Speaker L & R will give the sound of selectedprogram.
10. Connect the Audio/Video Cable’s one pin to Audio L socket (Red) of Trainer and other end to TV’s audiosocket.
11. Connect the Audio/Video Cable’s one pin to Video socket of Trainer and other end to TV’s Videosocket.

12. Switch On the TV and put it in AVmode.
13. You will observe pictures and sound of the selectedprogram.
14. Connection of Audio L (Red) can be replaced with Audio R(White).

Study the important voltage levels of SMPS Power Supply Section:

15. Check the voltage at TP 25V. It will be in the range of 19 to 25V approx. This Voltage is generated by the secondary winding of 25V and converted from AC to DC by the rectifier diode and then smoothened by filter capacitors. This supply is then fed to satellite tuner section and also used to generate +12V supply required for Video Amplifier section, and Audio output section of DTH Receiver.
16. Check the voltage at TP 18V. It will be in the range of 15 to 18V approx. This Voltage is generated by the secondary winding of 18V and converted from AC to DC by the rectifier diode and then smoothened by filter capacitors. This supply is then fed to LNB of Dishantenna.
17. Check the voltage at TP 5V. It will be in the range of 5V approx. This Voltage is generated by the secondary winding of 5V and converted from AC to DC by the rectifier diode and then smoothened by filter capacitors. This supply is then fed to satellite tuner, Front Panel Control Section and RF Modulator of DTH Receiver.
18. Check the voltage at TP Vint. It will be in the range of 6 to 7V approx. This Voltage is generated by the secondary winding of 6V and converted from AC to DC by the rectifier diode and then smoothened by filter capacitors. This supply is then used to generate the lower supply like 1.8V & 3.3V required for Memory section, Digital to Analog converter, Microcontroller MPEG Decoder and Channel Decoder section of DTHReceiver.

Observation Table:

Sr.No.		Actual Voltage	Observed Voltage
1	Video Amplifier section	19 to 25V	
2	Video Amplifier section	15 to 18V	
3	Front Panel Control Section	5V	
4	Channel Decoder section	1.8 to 3.3V	

Conclusion:

In this experiment we observed waveforms and voltage level in DTH system.

Experiment 09

Aim:

Creation of Simulated Faults on DTH

Fault 1: Disable

Fault 2: Put the switch fault 2 in down position.

Symptoms: Remote Control will not work.

Procedure: Check the batteries of Remote control and check the voltage of each using multimeter it should be 1.5V dc. (Working condition of Remote Control can also be checked on mobile camera, it will show you red light blinking whenever you press any key of RemoteControl.)

If remote Control is OK, Now Check the IR signals at TP 'IR'.

Reason: IR signals generated from IR transmitter are disconnected from processor unit; the result is that no function can be control form Remote Control.

Troubleshooting: Check the position of switch Fault 2 and Put it in up direction.

Fault 3: Put the switch fault 3 in down position.

Symptoms: No picture on TV screen, Audio is OK.

Procedure: Check the Video signal at TP of Video Encoder output. If video signal is obtained then check the cable connection between Composite Video out and Video Socket for AV mode, if connectivity is present, then check TV is selected in AV mode.

Reason: Video signal from Video encoder is disconnected from Video RCA socket.

Troubleshooting: Check the position of switch Fault 3 and Put it in up direction.

Fault 4: Put the switch fault 4 in down position.

Symptoms: No output in Speaker L (of Trainer and TV)

Procedure: Connect Video out of Trainer to Video In of TV. Now connect Audio L of Trainer to Audio In of TV and keep the Volume L pot to maximum position and Volume R pot to minimum position. Now check audio signal at the output TP of Stereo Audio DAC, if Signals are there, check the signal at the TP of AudioAmplifier
L. You will find that Audio L is neither coming in Speaker nor in TV. Check the connectivity of Audio cable.

Troubleshooting: Check the position of switch Fault 4 and Put it in up direction.

Fault 5: Put the switch fault 5 in down position.

Symptoms: No output in Speaker R (of Trainer and TV)

Procedure: Connect Video out of Trainer to Video In of TV. Now connect Audio R of Trainer to Audio In of TV and keep the Volume R pot to maximum position and Volume L pot to minimum position. Now check audio signal at the output TP of Stereo Audio DAC, if Signals are there, check the signal at the TP of AudioAmplifier

R. You will find that Audio R is neither coming in Speaker nor in TV. Check the connectivity of Audio cable.

Troubleshooting: Check the position of switch Fault 5 and Put it in up direction.

Fault 6: Put the switch fault 6 in down position.

Symptoms: No output in Speaker L (of Trainer only)

Procedure: Connect Video out of Trainer to Video In of TV. Now connect Audio L of Trainer to Audio In of TV and keep the Volume L pot to maximum position and Volume R pot to minimum position. Now check audio signal at the output TP of Stereo Audio DAC, if Signals are there, check the signal at the TP of AudioAmplifier L. You will find that Audio L is coming in TV but not in Speaker L of trainer.**Troubleshooting:** Check the position of switch Fault 6 and Put it in up direction.**Fault 7:** Put the switch fault 7 in down position.

Symptoms: No output in Speaker R (of Trainer only)

Procedure: Connect Video out of Trainer to Video In of TV. Now connect Audio R of Trainer to Audio In of TV and keep the Volume R pot to maximum position and Volume L pot to minimum position. Now check audio signal at the output TP of Stereo Audio DAC, if Signals are there, check the signal at the TP of AudioAmplifier R. You will find that Audio R is coming in TV but not in Speaker R of trainer.**Troubleshooting:** Check the position of switch Fault 7 and Put it in up direction.**Initial Setting before study of Switch fault 8:**

Connect the RF out of RF Converter section to the RF Input of TV (Tuner/ Antenna Socket). Put the TV in 'TV' mode and search by Auto / Manual mode. At particular channel DTH will tune and you will get clear picture and sound (comparatively lower than AV mode).

Fault 8: Put the switch fault 8 in down position.

Procedure: Clear picture and sound will be disturbed. Snow in picture will be observed and sound will become noisy.

Troubleshooting: Check the position of switch Fault 7 and Put it in up direction.

Conclusion:

In this experiment we studied various faults related to Set Top Box and the way to troubleshoot them.

Experiment 10

Aim – To study the CCTV System.

Review of Closed-Circuit Television (CCTV) Techniques

1 INTRODUCTION

Closed circuit television (CCTV) refers to the use of video cameras to transmit signals to a specific place with a set of monitors, as shown in Figure 1. Nowadays CCTV plays a significant role in protecting the public and implementing security. It is increasingly used by many countries for critical applications, such as bank monitoring, retail control and crime detection, where manual monitoring can be difficult, problematic or unfeasible [1][2][3]. For instance, the number of CCTV cameras in the United Kingdom is estimated in the range from three to six million, dispersed across motorways, trunk roads, car parks, shops, hospitals, airports, train stations, streets etc

As world population increases, traffic control is becoming a critical application for CCTV. CCTV provides a way to monitor multiple cameras internally and analyse generated images to extract useful information [5] about traffic parameters, such as speed, traffic composition, vehicle shapes, vehicle types, vehicle identification numbers and occurrences of traffic violations or road accidents. This offers a great help for transportation authorities, allowing them to make decisions accordingly and distribute traffic information to drivers [6], resulting in improved traffic flow, prompt accident detection, shorter journey time, less fuel consumption, reduced emissions and more satisfied travelers [7][8].

This paper presents a review on vehicles traffic management by the CCTV technology. It highlights existing architectural and deployment models, as well as the various approaches utilised to analyse generated traffic data. However, due to the great variety in CCTV deployment models and analysis approaches, this literature review by no means intends to be a comprehensive study. Instead, the objective is to shed some light on these models and approaches to promote future research in thisarea.

In the context of vehicles traffic management, there are two different perspectives to be considered: the driver's perspective and the traffic authority's perspective. As far as drivers are concerned, the quickest and shortest path is usually preferred. This paper focuses on the perspective of the traffic authority, which is more interested in road safety and eliminating congestion. Additionally, although traffic control applies equally to vehicles and pedestrians, this paper considers pedestrians traffic control as out-of-scope, due to time constraints.

The rest of this paper is structured as follows: Section 2 illustrates the structural and architectural elements of CCTV systems for traffic control applications. Deployments models and issues are discussed in Section 3. Data analysis steps and reaction approaches are presented in Section 4 and Section 5, respectively. Section 6 touches on some considerations and legal issues associated with CCTV. Finally, Section 7 provides a brief summary and possible future research directions.

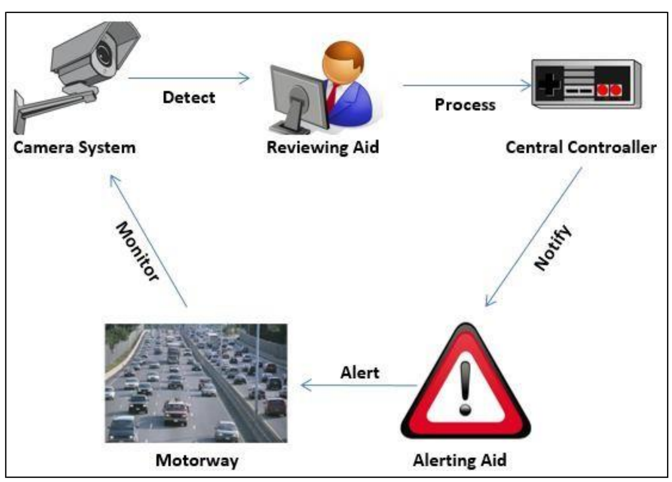
2 SYSTEMARCHITECTURE

A CCTV system is a closed video system where the signal is transmitted to a limited set of monitors, restricting the view to a certain set of people with specific purposes. This is in contrast to broadcast TVs, where the signal is openly transmitted to unclosed recipients.

CCTV systems vary greatly in size, starting from small systems installed in houses for private purposes and ending with extra-large systems spanning multiple continents [1]. A typical CCTV system, shown in Figure 2, is composed of the following:

- Camera System: all CCTV systems contain a group of cameras to monitor specific areas and capture images from them. Cameras used can be analogue or digital. However, analogue cameras suffer from low resolution, storage limitations and difficulty in searching through captured images. There are two types of CCTV cameras, based on the recording method: non-automatic recording and automatic recording; the difference is that in the non-automatic recording cameras, there are no smart detectors to identify whether there is something worth recording or not, which requires a trained observer to monitor the videos. On the other hand, the automatic recording CCTV cameras include detectors to sense abnormal activities and consequently record them [9]. This has the great advantage of saving power as well asstorage.

- Reviewing Aid: captured images can be viewed in real-time or recorded for later review [10]. This includes devices such as VHS video tapes, CDs, DVDs, tapes or a computer-based medium connected to a viewing monitor. Observers, on-site or off-site, can review captured images directly on screens or through telephone lines, the Internet or any other network[11].



- Central Controller: this part is responsible for pre-processing, processing and post-processing of captured images. These functions can be carried out manually or automatically with the use of computer hardware and software tools, as will be described in the followingsection.
- Accessories: some modern CCTV systems come with accessories, such as extra lighting

for recording in dark or difficult areas, and video-motion automatic detectors, which can be programmed to detect motion in a specific direction or objects of a specific size or speed[12].

3 DEPLOYMENTMODELS

For a CCTV system to estimate the traffic load dynamically and control it in real-time, it is essential to choose a suitable deployment model, which determines the number of cameras and their placement over road junctions. Three deployment models have been addressed in [13]:

- Full installation: the CCTV cameras are installed at every junction. Although this model is the most expensive model, it proves to be the most effectiveone.
- Partial installation: only some junctions have cameras installed, based on certain criteria. For example, junctions known for their high frequency of accidents can have cameras. Other junctions will have no cameras and hence no trafficinformation.
- Optimum installation: only some junctions have cameras installed based on calculating the optimum number of cameras that best controls the entire network traffic. Although other junctions have no cameras, they can get traffic information from the junctions that have them. This deployment model is cost-effective even though it has partial installation. It has almost the same efficiency as that of the fullinstallation.

However, for the best performance, full installation is preferable. To overcome the difficulty associated with constructing a new CCTV system by installing a large number of CCTV cameras to cover all road junctions, it is recommended to combine between the new CCTV system and an existing one. One of the studies that followed this approach is presented in [9]. It took place in the City of Leeds in the United Kingdom. It added new cameras to an existing CCTV system, which was already running by the city council. Based on this study, choosing an existing system has some disadvantages, because the system was not especially designed for the end objective. As a result, some existing cameras needed to be replaced and others had to be redirected to avoid obstructions.

Another issue that faces reusing existing CCTV systems is the possibility that the actual coverage provided by existing cameras does not equal the desired coverage. This means that some cameras will not be useful for the new system due to their locations. Therefore, their captured images should be excluded [13].

In general, making a decision whether and where to deploy a CCTV system is critical. All role players, including the police, emergency services and the local community should make an input in this decision, taking several factors into consideration. The main factors that should be considered when deploying a CCTV project include:

- Location of the project: whether it is situated in an urban area, large city or small town. Additionally, the fields of sight and availability of structures and places to installcameras.
- Available equipment and technology: There are numerous CCTV equipment in the market. Therefore, careful consideration should be taken when selecting them based on the context. For instance, whether the system needs to function in poor light will influence choice of equipment and technology.
- Characteristics of the traffic: By studying reoccurring traffic patterns and trends, it is possible to learn how they are formed and why. Some CCTV cameras can be more effective for certain traffic types. Additionally, certain traffic patterns might require special cameras or controlling mechanisms[14].

- Geography of the area: the physical characteristics and layout of streets. Some obstructions that can affect CCTV cameras deployment decisionsinclude:

– Physical obstruction of buildings: This problem is clearer when roads arecurved.

– Vegetation obstruction: such as that by long trees, so their removals might benecessary.

– Street accessories: for example, lamps and traffic lights and road signs. These are not a problem from a distance, but they are whenzooming.

– Street alignment: The higher area of the street cannot be monitored if cameras are not highenough.

– Large vehicles: may cause a temporary visionobstruction.

– Constructional area: usually have large winches and derricks that obscure vision[13].

4 DATA ANALYSISAPPROACHES

Initially, CCTV systems were managed manually, having people working as observers to analyse captured data and react accordingly. This process was error-prone and expensive in terms of time and cost. The use of digital cameras in CCTV systems has widened the utilisation of computer systems in analyzing captured data and processing it. Two main approaches can be identified for computer analysis of CCTV in traffic control applications: sound-based systems and image-based systems.

Sound-based CCTVSystems

A Sound-based CCTV system contains one or more cameras with a directional microphone, a central controller and a video recorder. The sound is recorded constantly accompanied by the video on a memory unit. When the system hears an unusual sound, for instance a "crash-like" sound then, automatically, the pre- and post-accident recorded scenes are sent from the memory to the controller. The controller analyses the situation and identifies possible causes. This system was developed by Mitsubishi Electric Company in 1995, it was called the Traffic Accident Auto Memory System (TAAMS) or the Auto Incident Recording System (AIRS). Its first use was in Japan and then it was widely adopted in the USA [5] However, it seems like the amount of work available in this approach is still lacking when compared to image-based CCTVsystems.

Image-based CCTVSystems

Figure 3. Software tool ANPR for automatic extraction of vehicle information

Image-based CCTV systems have the ability to recognize unusual and abnormal events on roads by analyzing digital images and extracting traffic parameters such as speed and traffic composition. Special software tools are usually used to help in recognizing vehicle shapes, vehicle types, vehicle identification numbers and occurrence of traffic violations or road accidents. Figure 3 shows the Automatic Number Plate Recognition (ANPR) system as an example of suchtools.

There are four steps that are usually carried out by an image-based traffic control CCTV system to automatically analyse capturedimages:

- Pre-processing: in this step, irrelevant details and noises, such as shadows, light effects, rain and camera-moving effects, are reduced form captured images. This step is not mandatory, but is offered by some modern CCTV systems to provide results that are moreaccurate.
- Processing: the raw or pre-processed captured images are processed by searching for specific patterns, extracting relevant features and highlighting them. In [15], a framework for processing captured CCTV images from traffic control scenes was developed. It operates by detecting vehicles, based on either a motion mask or an image texture. The detector uses background estimation to model the static part of the scene after removing unnecessary details such as shadows
- Post-processing: having CCTV cameras continuously recording certain scenes will make reviewing them a difficult and time consuming task, because of their large amount. Therefore, some software tools have been suggested, such as BriefCam [4], which can automatically summarise the recorded scenes. The basic idea behind the software is that most CCTV cameras are stationary and so they record static backgrounds. As a result, when a moving object enters the scene, it can be detected and sections of the video including it are identified. Then, all events occurring in a given time period are superimposed in a short video that shows all of the actions at once. An operator or a reviewer needs only to view the summary video. If any unusual thing is spotted, he can click on it to jump straight to the relevant point in the originalvideo.

5 REACTIONAPPROACHES

After processing captured data and detecting an incident, two different approaches are available in the literature to implement the systemreaction:

- Manual reaction: where the workflow of the CCTV system does not include a specific component that directly communicates with road users or traffic authorities to notify them of hazards or traffic conditions. Rather, skilled observers frequently analyse captured scenes and make decisions accordingly. If actions were required, such as alerting road users, this would be carried outmanually.
- Automatic reaction: some new CCTV computer analysis techniques include intelligent modules to react or make a decision in case of hazards. The CCTV system, beside its monitoring and detection tasks, also preforms the observer’s job of notifying road users. This means that the CCTV system in this case has access to smart road signs or traffic lights, allowing it to alert the drivers directly to overcome any sort of problems that may obstruct traffic flow. Furthermore, traffic lights can be managed by the CCTV system, by inputting the traffic load in a junction. Based on that, the system regulates the timing of traffic signals in real-time, taking in to account the variation in traffic demand[13].

Although the automated reaction approach might offer better traffic control, the process is very complicated and can be problematic; this is why it is always recommended to follow the system reactions closely and get them approved for safety. As argued by [16], it is better to have two cooperative monitoring procedures: the first is a spot-detection system generating vehicle count rate, speed, road occupancy and headway measures. The second is an extended-range road surveillance process to make decisions about suitable reactions and long term plans. An example of such a system is ARTEMIS, which stands for the Automatic Road Traffic Event Monitoring Information System. The mechanism of such system is that the extended-range camera will notice the vehicles starting to queue and the spot-detection system will confirm this by detecting the

movement of traffic flow. If it is slower than the pre-defined speed threshold, then the system will send automatic alerts [11].

6 CONSIDRATIONS AND LEGALISSUES

CCTV leads to better traffic control. On the other hand, it is equally important to consider the disadvantages or possible threats that suggest that CCTV should not be used for traffic control. Indeed, there are distinct problems and issues associated with traffic control by CCTV:

CCTV systems are extremely costly to install and operate and may in fact not be the best form of traffic control in every case [8]. Therefore, the decision to install a CCTV traffic control system should be put in context. Sometimes, a transportation authority gets caught up in the rush to follow a popular trend or have unrealistic expectations about the system and push for something that is, in fact, neither necessary nor fits a particular traffic problem. Additionally, there are some indications that traffic in areas monitored by CCTV cameras are simply transferred to other areas with no CCTV cameras, as people would rather take unmonitoredrouts.

A big issue associated with CCTV systems is that they are offensive to privacy. Therefore, many countries have introduced a code of conduct for CCTV systems to insure that the systems are operated in a highly professional and private manner. The document sets guidelines for practice and procedures that should be followed, including: camera positions, sound facilities, video storage, video tapes as evidence, control rooms, etc. [11][17].

As stated in [18], a list of legal requirements must be met by a CCTV system. This includes:

- “CCTV should only be used in public places, i.e. in areas where persons do not have a reasonable expectation ofprivacy.
- Approval must be obtained from the owners of buildings and structures to which cameras will beattached.
- Personnel operating the system should be carefully screened and selected to ensure professionalism and trustworthiness since recorded material is sensitive andconfidential.
- The recorded material must be treated as highly-confidential and be erased after a specified period of no longer than 30 days, unless needed for evidence. Material can, under no circumstances, be used for any purpose other than crime detection and evidence. Video tapes must be kept locked and there must be registers to control the storage ofmaterial.
- There should be sanctions attached to the transgression ofguidelines.
- No promises or guarantees should be made to the public or any other role player about thesystem.”

Observations.

Name of Manufacturer	Cost for Eight Camera system 1TB HD	Technology aspects	Human resource required for Installation