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TELEVISION FUNDAMENTALS

VOL 1 OF THE TELEVISION PRINCIPLES MODULE (PRACTICALS)

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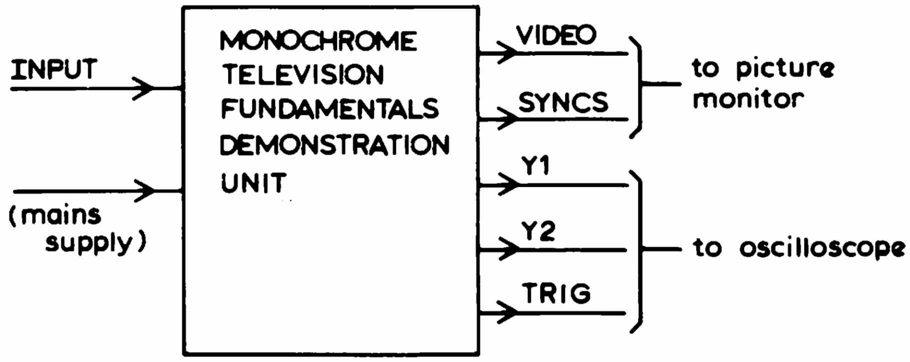
THE MONOCHROME TELEVISION FUNDAMENTALS DEMONSTRATION EQUIPMENT

Introduction
The equipment comprises three items, a picture monitor, a dual-trace oscilloscope and a monochrome fundamentals demonstration unit. The demonstration unit is always used, sometimes with the picture monitor, sometimes with the oscilloscope and sometimes with both the display items. External connections to the demonstration unit are shown in the figure below.



Monochrome Television Fundamentals Demonstration Unit

The unit is made up of a number of panels, eight of which process the video signal in some way. The Split Screen panel selects either vertical or horizontal division of the screen display on the picture monitor. One part of the display is of one video signal and the other part of the display is of a different signal. This allows 'before' and 'after' picture monitoring of the signal processing.

The inputs to the oscilloscope are normally, but not always, tied to the split screen display and thus allow 'before' and 'after' monitoring of the video waveform.

Terminations are needed on the oscilloscope and picture monitor. The monitor should be selected to external syncs.

A standard video signal input is always needed and may be selected from a number of sources. Generally a line-repetitive sawtooth waveform and a monochrome test card are provided.

DEMONSTRATION 1.1: SCANNING

The object is to demonstrate how the lines of a raster are laid down for both Sequential and Interlace scanning.

The demonstration uses the picture monitor, the oscilloscope is not used.

Operation
A video input with line and field syncs is required.

SELECTOR panel	Press the SCAN button.
S. SCREEN panel	Put the selector switch to divide the frame ( ) and turn the top knob fully clockwise.
SCANNING panel	1. To display a sequential scan:- a) Press the SEQ button b) Press the RUN button. (This is non-locking). 2. To display an interlaced scan:- a) Press the INT button b) Press the RUN button.

Now return to the theory text (Section 1.6).

NOTES

DEMONSTRATION 2.1: BLANKING PERIOD MEASUREMENT

Apply a monochrome test card to the equipment.

Line Blanking Measurement

SELECTOR panel	Press the GAMMA button
INPUT panel	Press the L button, this selects pulses at line frequency to externally trigger the oscilloscope. Select a suitable timebase speed on the oscilloscope.

Measure and note the duration of the line-blanking period.

Field Blanking Measurement

INPUT panel	Press the F button, this provides a field trigger pulse to the oscilloscope. Select a suitable timebase display on the oscilloscope.

Measure and note the duration of the field blanking period.

Now return to the theory text (Section 2.2)

NOTES

SYNCHRONISATION

DEMONSTRATION 2.2: LINE SYNC AND SIMPLE FIELD SYNC DETECTION

The purpose of this demonstration is to show how the field synchronising waveform is built-up and also to show the effects of differentiating and integrating the waveform in its various stages of development.

The picture monitor is not used in this demonstration.

General
The SYNCHRONISING panel produces two outputs for display by the Y1 and Y2 channels of the oscilloscope. The displays show the television waveform around the field synchronising time. If the oscilloscope is used in the alternate mode, one displays field 1 and the other displays field 2.

There are five switches on the panel. The bottom switch (SYNCS) is common to both displays and is used to show the build-up of the waveform around field sync time. Two of the other switches (one above the other) are associated with one field (the Y1 display) and the other two with the other field (the Y2 display). These switches select the Y1 (or Y2) trace to display an unaltered, or differentiated, or integrated version of the sync waveform, together with the network time constant.

Object
To observe the effect of differentiating line syncs and integrating a simple field sync pulse.

Operation

SELECTOR panel	Press the DIFF/INT button
INPUT panel	Press the F button
SYNCHRONISING panel	SYNC switch to 1. Two top Switches to 0 (central) Both CR switches to 1
OSCILLOSCOPE	Timebase set to 0.1ms/div EXT trigger selected Both Y inputs to DC coupled.

Both oscilloscope traces display the simple field sync pulse and line syncs.

Line Synchronisation
Select Y2 to DIFF on the Synchronising panel.

The Y2 display should now consist of positive and negative spikes. What is their relationship to the television waveform? How are they used?

Speed up the oscilloscope timebase to see more clearly the shape of the pulses.

Field Sync Detection
Switch to INT, change the time constant to 25μs and observe the effect on the displays.

Adjust the position of the displays and observe any differences between them. If they are not the same, explain why.

Now return to the theory text (Section 2.3.4)

DEMONSTRATION 2.3: COMPLETE FIELD SYNC CONSTRUCTION AND DETECTION

Operation

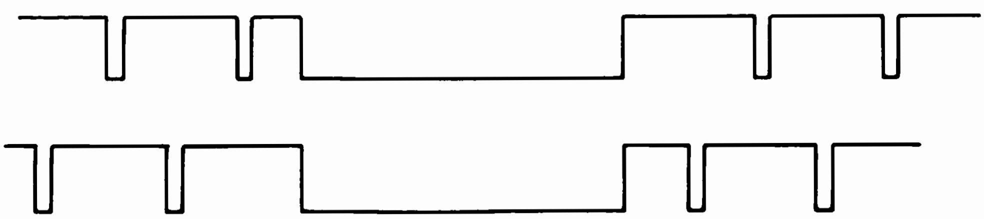
SELECTOR panel — Press the DIFF/INT button.

INPUT panel — Press the F button

Oscilloscope
- a) Select EXT trigger
- b) Select 50μs/div timebase
- c) ALTernate trace switching

SYNCHRONISING panel
- a) Put the two top switches to the central (0) position.
- b) Put both of the time constant control switches to 1.
- c) Put the SYNC switch to 1.

The oscilloscope displays show the television waveform centred on the frame synchronising time of the two fields. The displays should be as shown below.



Observation

Note the effect of selecting different positions of the sync switch.

Adjust the gains of the two Y channels to give identical displays. (Overlay the two traces to obtain this).

Select INTegrate on both channels, using a 25μs time constant.

Starting with position 1 on the sync switch go through the possible field sync waveforms. Observe the differences between the two integrated waveforms, particularly around the leading and trailing edges of the integrated field sync pulse.

Now return to the theory text (Section 2.3.5.).

DEMONSTRATION 3.1: GAMMA

The object is to observe the effect on a linear sawtooth waveform of circuits that have a non-linear transfer characteristic similar to those of a picture tube and a gamma correction circuit.

Both the picture monitor and the oscilloscope are used.

Only channel 1 on the oscilloscope has a display.

Operation
Apply a linear sawtooth video signal to the equipment.

SELECTOR panel	Press the GAMMA button
S. SCREEN panel	Put the selector switch to divide the frame (I) and set the top control knob so the division occurs about half way down the screen. This means that now only half the frame is affected by the Gamma panel. The other being the original signal.
GAMMA panel	Centre the Law control. Observe the signal on the oscilloscope and monitor and note the effect of varying the LIFT and GAIN controls. Adjust the LAW, LIFT and GAIN controls so that a single linear sawtooth is displayed on the oscilloscope. The two halves of the picture monitor should be the same and the dividing point should be barely discernible.

Adjustment of the LAW control on the GAMMA panel shows how the transfer characteristic can be changed.

The response shape of a gamma correction circuit and a tube characteristic can be compared to a linear response.

Observe the effect of adjusting the LAW control on the picture monitor. Repeat using test card as the video signal. Observe particularly the effect on the grey-scale. Note that the test card is gamma-corrected at source, so the LAW control enables the signal to be under or over corrected.

Now return to the theory text (Section 3.1.4).

A.C. COUPLING, D.C. RESTORER AND CLAMPING DEMONSTRATIONS

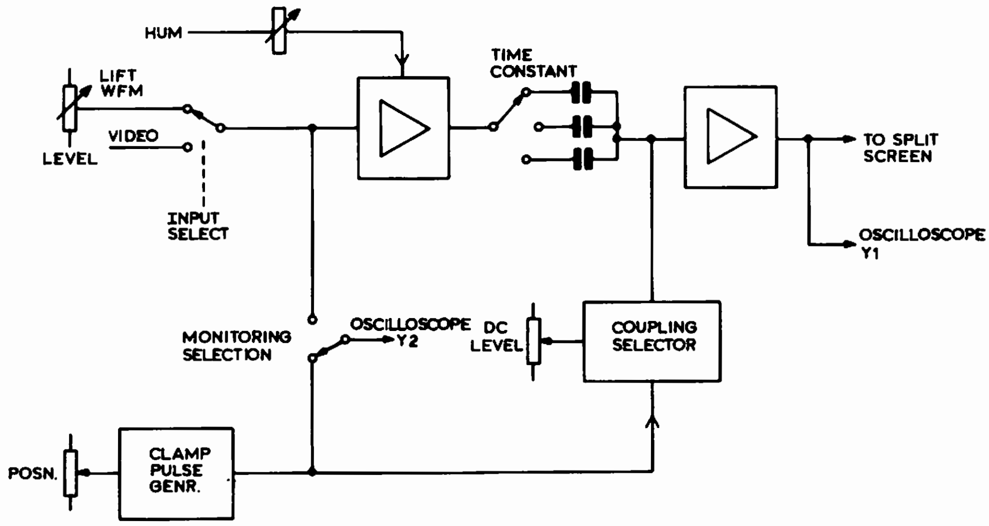
Introduction

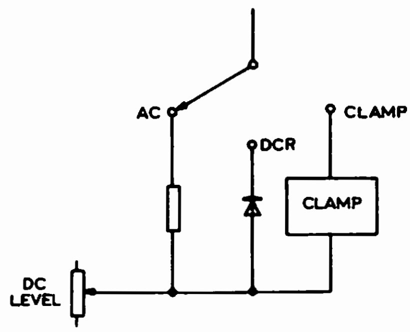
The purpose of these demonstrations is to display the problem of a.c. coupling and also to show various effects of D.C. Restorer and Clamp circuits.

The CLAMP panel does the signal processing. The signal used for processing can be either the external input or an internally generated signal.

The internal signal has a uniform picture level the amplitude of which can be varied from black level to white level by means of the LEVEL control.

A simplified diagram of the clamping demonstration is shown below.





DEMONSTRATION 3.2: A.C. COUPLING

Operation

SELECTOR panel	Press the CLAMP button
SPLIT SCREEN	Select a horizontal split and adjust the split-screen position for a 50-50 split.
INPUT panel	Press the L button, this selects a line trigger pulse.
Oscilloscope	Y1 input to D.C. coupled Y2 input to GND EXT trigger selected Timebase adjusted to display two or three lines of video.
CLAMP panel	VIDEO/LIFT switch to lift. HUM control fully counter-clockwise. TIME CONST switch to long. MODE switch to A.C. LEVEL control to mid-position

Adjust the LIFT control to match the two halves of the display on the picture monitor. Set the monitor brightness so that the dark grey bar of the test signal is just visible.

Adjust the oscilloscope position controls of both the Y1 and Y2 amplifiers to set the display mid-screen and the Y2 trace (used as a reference) to coincide with black level of the Y1 trace.

Turn the LEVEL control fully anticlockwise, this reduces the picture amplitude. Observe any motion of the signal on the oscilloscope, and the picture monitor, and account for its direction.

Now turn the LEVEL control clockwise, this increases the picture level. Again note and account for any movement of the signal as displayed.

What would be the effect on a displayed picture if a.c. coupling was used throughout the complete source-to-viewer chain?

Now return to the theory text (Section 3.3).

DEMONSTRATION 3.3: D.C. RESTORATION

Operation

SELECTOR panel	Press the CLAMP button
INPUT panel	Press the L button
SPLIT SCREEN	As Demonstration 3.2
Oscilloscope	Y1 input to D.C. coupled Y2 input to GND EXT trigger selected Timebase to 20μs/div or 50μs/div
CLAMP panel	VIDEO/LIFT switch to Lift HUM control fully counter-clockwise TIME CONST switch to Long MODE switch to DCR long LEVEL control to mid-scale LIFT control to match two halves of monitor display.

Adjust the oscilloscope position controls of both the Y1 and Y2 amplifiers to set the display mid-screen and the Y2 trace to coincide with black level (or sync tips) of the Y1 trace.

Turn the LEVEL control fully counter-clockwise. Observe any motion of the trace.

Turn the LEVEL control fully clockwise and again observe any motion of the trace.

Does this overcome the problems of displaying an a.c. coupled signal on a picture monitor?

Use the MODE switch and the TIME CONST switch to select the shortest time constant. Inspect the displayed signal and account for its shape.

Hum added to the signal

INPUT panel	Press the F button
OSCILLOSCOPE	Y2 input to D.C. coupled Timebase to 5ms/div
CLAMP panel	Set the controls as for the start of the previous demonstration. Put Pulse/Video switch to Video. Turn the Hum control clockwise to add 50Hz hum to the signal.

The two traces now display the signal before and after the D.C. restorer. Try changing the time constant to find the position which combines maximum hum rejection with minimum sag over a one-line period.

Now return to the theory text (Section 3.3.4).

DEMONSTRATION 3.4: CLAMPING

Operation

SELECTOR panel	Press the CLAMP button
SPLIT SCREEN	As demonstration 3.2
INPUT panel	Press the L button
Oscilloscope	Y1 input to D.C. coupled Y2 input to D.C. coupled EXT trigger selected Timebase to 20μs/div
CLAMP panel	VIDEO/LIFT switch to Lift TIME CONST switch to Short MODE switch to CLAMP LEVEL control to mid-scale HUM control fully counter-clockwise POSITION control fully counter-clockwise LIFT control to match the two halves of the monitor display PULSE/VIDEO switch to VIDEO

i) The two traces show the signal before and after the clamp. Alter the A.P.L. of the signal by means of the LEVEL control and confirm that the black level of the clamped signal does not vary.

ii) Put the VIDEO/LIFT switch to VIDEO and connect a test card signal to the input. Select F on the input panel and adjust the oscilloscope for a field-rate display (e.g. 5ms/div).

iii) Add hum to the signal and observe the ability of the clamp to reject it.

Is this true for all time constant settings? If not, why not?

iv) Turn the HUM control to minimum and put the PULSE/VIDEO switch to PULSE. The Y2 trace now displays the clamp pulses.

Reposition the monitor split-screen transition to near the bottom of the display.

Select a short time constant.

Use the POSITION control to change the timing of the clamp pulses. Explain the effects which occur. Turn the control fully clockwise.

Why is the effect different for the different castellations?

Increase the time constant. Explain the effect on the display.

v) Reset the clamp pulses to their correct position.

Select a short time constant and return the split-screen transition to mid-screen. Match the two halves of the display, using the LIFT control if necessary.

Select WHI (white noise spectrum) on the noise panel. Increase the noise level until noise is clearly visible on both halves of the split-screen display.

Why is the display different on the upper half of the screen?

Soften the action of the clamp.

Why does this change the effect?

Note: For optimum observation of the effects of noise, ensure that the split-screen displays are matched by using the LIFT control when changing the time constant. Turn the NOISE off when matching, then reselect WHI when the matching has been completed. Do not re-adjust the noise level.

Summary of Points Covered in this Demonstration:

i) The black level clamp eliminates errors due to mean level variations.

ii) Provided that the time constant is reasonably short, the clamp will reject large amounts of hum superimposed on a waveform.

iii) Clamp streaking results if the pulse overlaps into active picture time.

iv) Random streaking occurs if the clamp time constant is too short and the signal is a noisy one.

If time permits, repeat some of the clamp demonstrations using an off-air video signal (not Test card). Observe particularly the effect of:

a.c. coupling,
incorrect clamp pulse timing,
time constant too short.

Now return to Section 4 of the theory text.

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