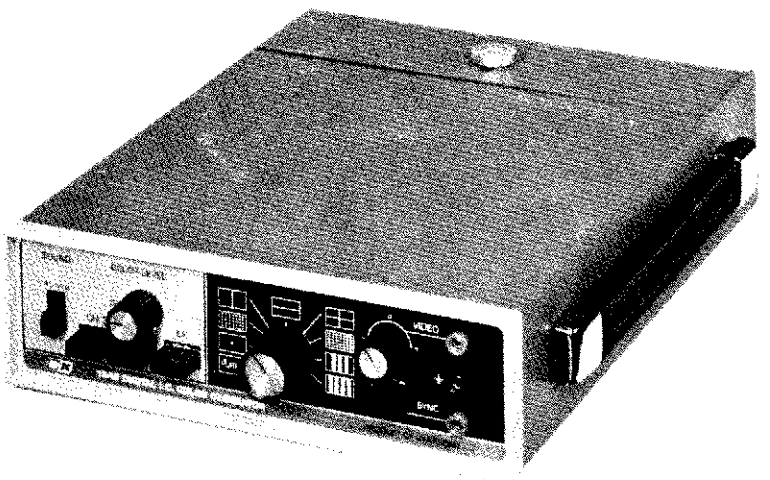
INSTRUCTION MANUAL

B&K Model 1248

DIGITAL IC COLOR GENERATOR



B&K

Product of DYNASCAN CORPORATION
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INTRODUCTION

The Model 1248 Digital IC Color Generator incorporates the latest advances in digital circuit technology. The custom MOS integrated circuit contains all the circuitry necessary for producing broadcast-quality video signals.

Nine patterns are programmed into the 1248 to provide for complete and easy convergence of color receivers. Two crystal-controlled, keyed rainbow color displays are provided to test color circuits, range of hue control and to align color demodulators. A front panel COLOR LEVEL control permits displaying color saturation to any degree up to 150% of sync amplitude.

Multiple dot and crosshatch patterns are provided for adjusting horizontal and vertical linearity, centering, and size on color or black and white TV receivers. Dot size and vertical line width are sharp and bright. Preset to an optimum at the factory, they can be easily readjusted to suit personal preference.

Two crystal-controlled RF channels and a crystal-controlled IF output allow signal injection at the tuner or into the IF section of a receiver.

A 4.5 MHz tuning aid is provided for easy set-up of the receiver fine tuning.

The 1248 also provides a video output signal for injection into a television receiver beyond the video detector and for evaluation of video recorders. Positive-or negative-going sync of at least 1.5V P-P into 75 ohms is provided.

An oscilloscope trigger output is also provided for easy viewing of horizontal or vertical signals.

A zener-regulated power supply provides constant, ripple-free voltage to all internal circuitry even under abnormal line conditions.

SPECIFICATIONS

PATTERNS

Purity	Clear raster
Dots	Single dot at center screen 7 x 11
Lines	Single vertical at center Single horizontal at center
Crosshatch	1 x 1, crosshair 7 x 11
Color Bars	R-Y, B-Y, –(R-Y): 3 bars gated at 90°, 180°, and 270° from burst. Gated Rainbow: 10 bars gated at 30° intervals from burst.

LINE WIDTH

Horizontal	1 horizontal scan line
Vertical	Preset to .25μSEC; internally adjustable from .1 to .8μSEC.

CHROMA

Offset subcarrier system utilizing a frequency of 3.579545 MHz minus 1 horizontal line (15734 Hz) or 3.563811 MHz ± .002%. 10 bars and R-Y, B-Y, –(R-Y) are produced by gating with 188.8 kHz and 63 kHz respectively. The chroma level is front panel adjustable from 0 to 150%.

SIGNAL SYNTHESIS

The 1248 uses a progressive scan system processed by a custom MOS integrated circuit which generates all sync and video information from a 377.6 kHz master crystal oscillator.

SYNC PULSES

	Horizontal	Vertical
Period	63.559μSEC (15734 Hz)	16.652mSEC (60.05 Hz)
Width	5.0847μSEC	190.677μSEC

BLANKING PULSES

	Front Porch	Rear Porch	Total
Horizontal	1.2712μSEC	5.0847μSEC	11.441μSEC
Vertical	223.73μSEC	983.9μSEC	1.398mSEC

RF OUTPUT

Channels	Crystal-controlled on CH. 3 (61.25 MHz) and CH. 4 (67.25 MHz). Selectable by front panel pushbuttons.
Levels	10,000 microvolts minimum into a 300Ω Load.

IF OUTPUT

Frequency	45.75 MHz, switch-selected, crystal-controlled
Level	10,000 microvolts, minimum into 75Ω

VIDEO OUTPUT 0 to ±1.5V P-P, continuously variable into 75Ω

SYNC OUTPUT 5 V horizontal or vertical, switch-selectable

TUNING AID 4.5 MHz unmodulated carrier, ± .2% Fixed injection level of 30% of total modulation.

POWER REQUIREMENTS 100 to 130 Volts AC, 60 Hz

OPERATING RANGE From −25°C to 75°C

MECHANICAL

Size	2.25" x 7" x 9.375"
Weight	3 lbs.
Cable Storage	24.75 cubic inches

OPERATING PROCEDURE

A. CONTROLS AND FUNCTIONS

1. COLOR LEVEL: Rotation of this control adjusts the color sub-carrier amplitude from 0 to 150%; at midpoint (indicator vertical) the level is normal or 100% of sync amplitude. In the extreme counterclockwise position, AC power to the unit is switched off.

2. PATTERN SELECTOR: Nine patterns are programmed into the 1248. In sequence:

Purity. Provides sync and reference black for a clear blemish-free raster.

Single Center Dot. Defines center screen and is useful for static convergence.

7 x 11 Dot Pattern. Used in static or dynamic convergence. Dot width is preset to .25 μSEC but may be readjusted internally to suit personal preference.

Single Vertical Line at Center Screen. Used for converging vertical lines.

Single Horizontal Line at Center Screen. Used for converging horizontal lines.

Crosshair. The intersection of the two lines corresponds to center screen and is useful for adjusting position as well as convergence.

7 x 11 Crosshatch. Extremely useful in dynamic convergence, linearity, size and overscan adjustments. The sharp definition of the horizontal and vertical lines helps to insure precise convergence.

R-Y, B-Y, −(R-Y). Derived from the rainbow pattern and gated at 90°, 180°, and 270°, respectively, to rapidly expedite color alignment procedures.

Gated Rainbow. 10 color bars raised on a 50% luminance pedestal and gated at 30° intervals from burst; they are used for testing and aligning color circuitry. The reference black background gives sharp edge definition and aids in recognizing color spill.

3. CARRIER SELECTION: The 1248 offers operation at three crystal-controlled carrier frequencies. Channel 3 (61.25 MHz), Channel 4 (67.25 MHz) or IF (45.75 MHz) can be selected by simply depressing the desired front panel pushbutton.

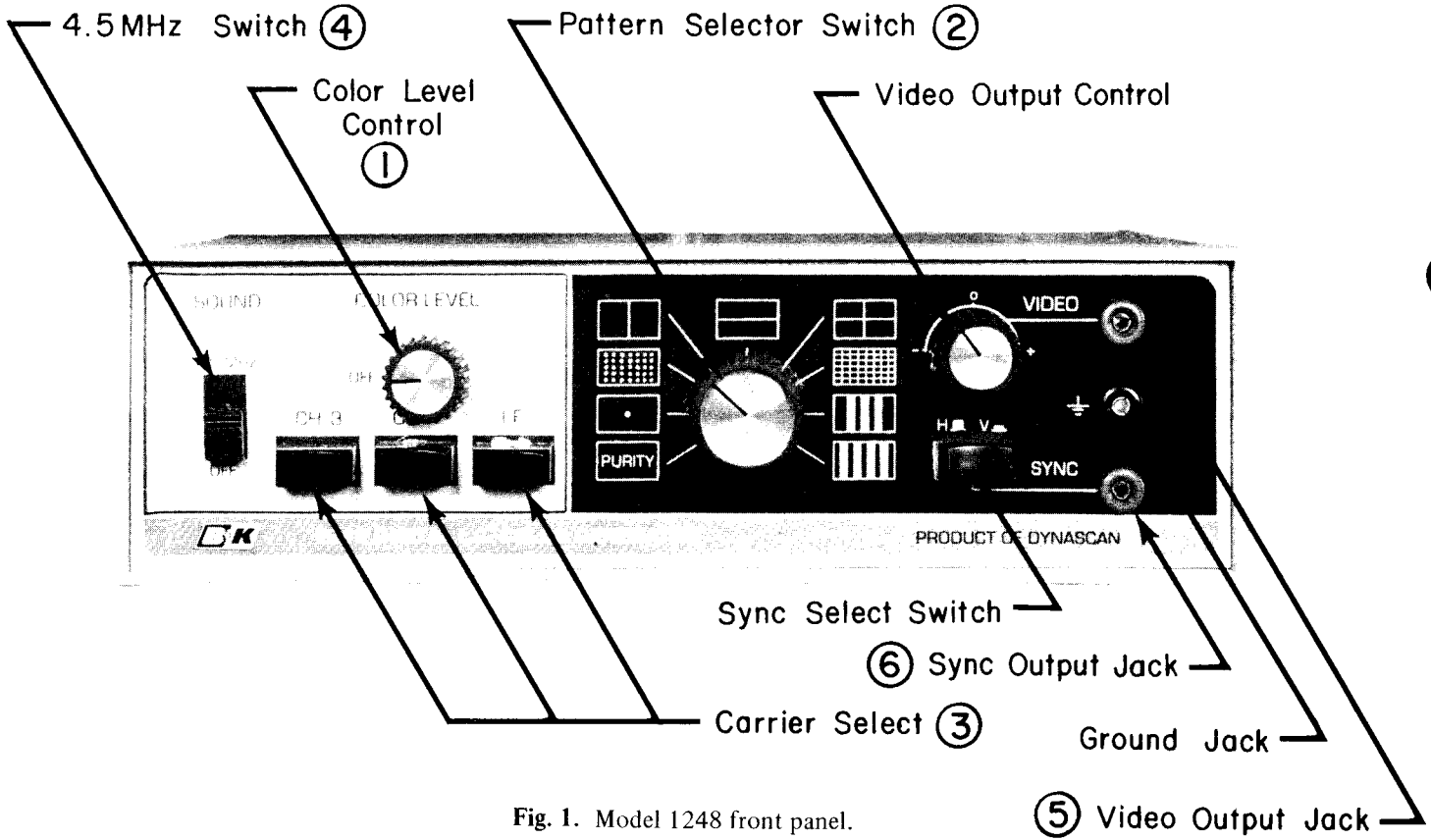
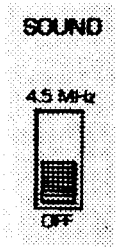
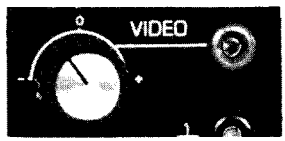


Fig. 1. Model 1248 front panel.

4. TUNING AID: The 4.5 MHz switch energizes an oscillator which inserts a 4.5 MHz subcarrier into the composite video and blanks the bars in the two color positions to provide an ungated rainbow. A 936 kHz "herringbone" pattern (4.5 MHz – 3.56 MHz) will appear on the screen to aid in accurately fine-tuning the receiver.



5. VIDEO OUTPUT: The 1248 provides a video output for signal substitution directly into the video circuits of a television receiver and for testing video recorders. Clockwise rotation of the video output control will produce a composite video signal with positive-going sync. Counterclockwise rotation produces negative-going sync. A minimum of 1.5V of signal is produced into 75Ω.



6. SYNC OUTPUT: The 1248 also provides a sync output jack for use in synchronizing an oscilloscope for viewing the composite video waveform. When the pushbutton is "out", horizontal sync pulses are present at the output jack. Pushing the button "in" provides vertical sync pulses.

B. OPERATION

NOTE

Read this entire section carefully to avoid unnecessary confusion and to obtain maximum performance from the 1248.

1. Disconnect all antenna lines from the receiver VHF antenna terminals; attach the 1248 RF cable to these terminals.
2. Tune both the receiver and generator to either channel 3 or 4.
3. Turn the instrument on by rotating the COLOR LEVEL control clockwise.
4. Rotate the pattern selector to GATED RAINBOW and set the COLOR LEVEL control to its midpoint position (indicator vertical); advance the receiver color level control approximately 1/4 from minimum. Adjust the contrast and brightness to provide a comfortable viewing intensity.
5. Slide the 4.5 MHz switch to the ON position. All bars will disappear.
6. Rotate the receiver fine tuning until an ungated rainbow with a light herringbone pattern appears: this is due to a beat between the sound and color subcarriers. Adjust the fine tuning once again for color with minimum herringbone. At this point, the receiver IF sound trap has attenuated the 4.5 MHz, and the receiver is properly tuned. Switch off the 4.5 MHz.

NOTE

With certain receivers, it may be impossible to either locate or tune out the herringbone. This may be due to a poorly aligned sound trap. An alternate method of fine tuning is presented if this occurs.

ALTERNATE METHOD OF FINE TUNING:

1. Set the pattern selector to CROSSHATCH, switch off the 4.5 MHz and fine tune the receiver until a reasonably good display is obtained.
2. Reduce the contrast and brightness controls until both the horizontal and vertical lines are barely visible; one may be brighter than the other, but both should be *visible.*
3. Carefully readjust the fine tuning for brightest vertical lines, then reset the contrast and brightness for a comfortable viewing intensity.

NOTE

The 1248 possesses a high percentage of RF modulation. To obtain the sharpest test pattern and avoid "blooming" of the TV screen display, never operate the receiver with excessive contrast and brightness during convergence or color adjustments.

4. Rotate the pattern selector to GATED RAINBOW and set the COLOR LEVEL control to its midpoint position.
5. Advance the receiver color level control until color appears. When color does not appear at all or only with the control near maximum, carefully readjust the fine tuning. It should only require a slight amount of rotation; *excessive* rotation indicates tuner or IF misalignment. If this last step fails to produce color, it is likely that a malfunction exists somewhere in the receiver and must be corrected before proceeding. When the receiver is properly tuned, it is then ready for convergence and color adjustments.

C. VIDEO OUTPUT

Signal substitution can be carried out beyond the video detector using the video output signal provided by the 1248. Both positive and negative polarity signals are controlled by the VIDEO control. Clockwise rotation provides a signal with positive-going sync and CCW rotation provides negative-going sync. The peak-to-peak amplitude varies with control rotation.

Connect a test lead from the GND (black) jack on the 1248 to the receiver chassis. Connect another lead from the Video (red) jack on the 1248 to the receiver test location. (A pair of pin plugs are provided for test lead hook-up.) Set the VIDEO control to the proper polarity and amplitude.

Adjust the following receiver controls for a clear display: color, tint, brightness, and contrast.

A minimum of 1.5V P-P signal into 75Ω is available from the 1248. A 20μF DC blocking capacitor is built into the video output circuit of the 1248. The video output should not be connected to a location where more than ±200V is present.

D. OSCILLOSCOPE TRIGGERING

When it is desirable to view the video signals from the receiver on an oscilloscope the sync signals for triggering the scope are available from the 1248. This feature minimizes the readjustments required when viewing the video signal at the horizontal or vertical rate.

Connect a lead from the black GND jack on the 1248 to the receiver chassis. Connect another lead from the red SYNC jack on the 1248 to the oscilloscope EXT TRIGGER input. Set the trigger or sync control on the scope for external trigger and the polarity + (positive).

The trigger signal applied to the scope is determined by the SYNC selector switch. With the button "out", horizontal sync pulses are applied; when "in", vertical sync pulses are applied.

Once the oscilloscope controls are set, no further adjustments are necessary when viewing horizontal or vertical signals.

CONVERGENCE

A detailed convergence procedure will not be presented here, as there are many excellent and thorough manuals available on this subject; however, the principle pattern uses are presented to help speed convergence.

A. PURITY

The first position of the 1248 selector provides sync and a reference baseline free of video information. This is advantageous when adjusting purity. Older methods required turning to an unused channel or disabling the tuner; "snow" produced by this method can be annoying and cause inaccuracy in set-up. Using this position, the operator can be assured that the adjusted purity condition will be maintained when the convergence procedure is initiated.

B. STATIC CONVERGENCE

Static, or DC, convergence is always performed *before* and *after* purity adjustments. The 1248 pattern switch is programmed to provide the necessary dot patterns in the positions following purity. The single center dot pattern is most convenient because it automatically pinpoints screen center and is quickly located when working from behind the receiver, viewing the screen at an angle.

C. DYNAMIC CONVERGENCE

Crosshatch is the recommended pattern for performing dynamic convergence, although some technicians use dots throughout the entire procedure; this is a matter of personal performance. However, misconvergence is most easily seen with horizontal and vertical lines.

The single horizontal line and the single vertical line patterns are useful when converging red and green lines at these locations. Elimination of all other lines removes any confusion as to the correct points to converge.

NOTE

Defocusing, blooming and "kinks" at crosshatch intersections indicate that brightness and contrast are excessive. It is important never to perform convergence in this condition, or accuracy will greatly suffer.

COLOR ADJUSTMENTS

Service notes should always be consulted when testing and aligning color circuitry. Following the recommended procedure will assure best performance. The following sections provide a general technique if manufacturer's data is not available.

A. HUE SETTING AND RANGE

Step 1. Rotate the 1248 pattern selector to GATED RAINBOW and set the COLOR LEVEL control to its mid-point position.

Step 2. Adjust the receiver's saturation, brightness and contrast controls to produce a pleasing color pattern. Ten individual color bars should be visible on the face of the screen (see Fig. 2 and 4).

NOTE

Some receivers may only display eight or nine bars; this is due to excessive overscan and/or blanking.

Step 3. Turn the 1248 selector to R-Y, B-Y, –(R-Y). Three color bars, representing the third, sixth and ninth bar out of the gated rainbow should now be visible.

Step 4. Adjust the receiver's HUE control to display a red, blue, and bluish green bar in this order from left to right (see Fig. 3). If this arrangement cannot be obtained with any setting of the HUE control, then internal adjustment of hue range coil or control is necessary.

It can be assumed that the color circuits in the receiver are operating properly if these steps produce the correct results.

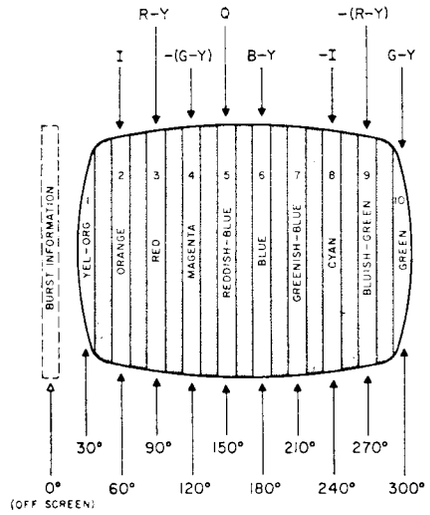


Fig. 2. Gated rainbow.

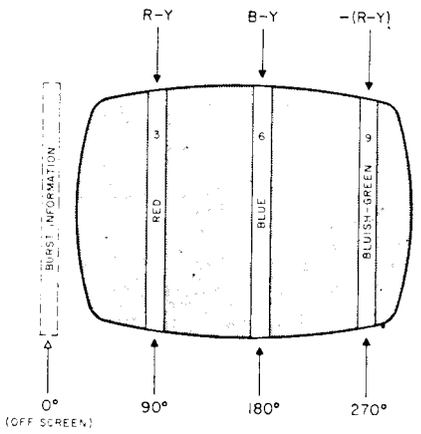


Fig. 3. R-Y, B-Y, –(R-Y).

B. DEMODULATOR ALIGNMENT CHECK

A rapid check of demodulator alignment can be performed without the use of a vectorscope right in the customer's home. This technique is simple and utilizes the color CRT itself as the analysis instrument.

Step 1. Rotate the 1248 selector to R-Y, B-Y, –(R-Y) and set the COLOR LEVEL control to its mid-point position.

Step 2. Turn the receiver's contrast control to minimum and adjust the brightness for the brightest display possible without blooming; the receiver color control should be set to a very low level-just enough to produce color.

Step 3. Disable the red and green guns of the CRT. Adjust the HUE control so that color and shading in the area to the left and right of the first bar (left hand side of screen) matches the center section of that bar.

Step 4. Disable the blue and green guns and leave only the red gun active. If the color demodulators are properly aligned, the bar in the center of the screen will match the color and shading of the area to either side of it. A large amount of error usually indicates the need for demodulator alignment.

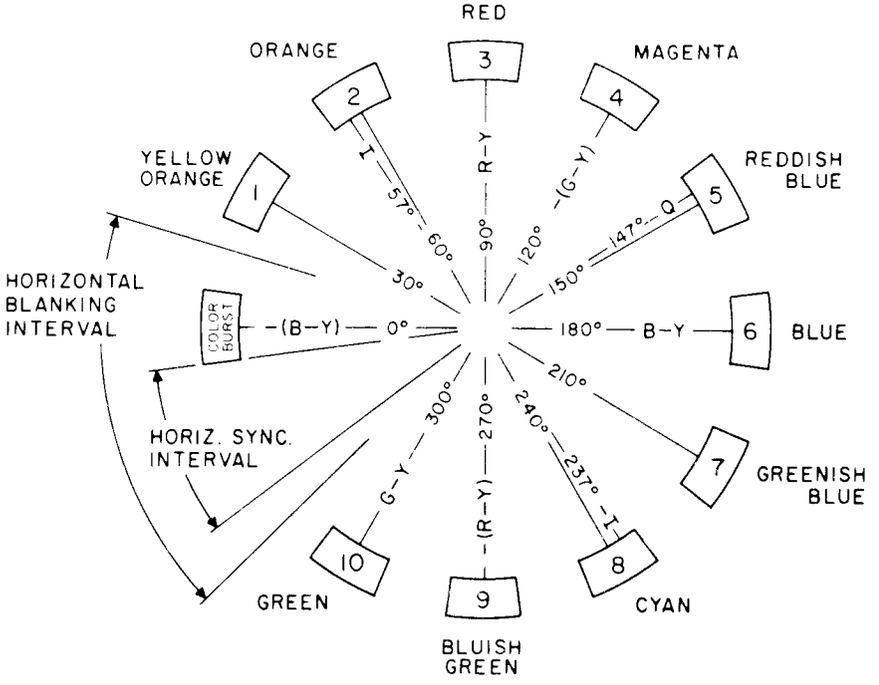


Fig. 4. Gated rainbow phase relation.

C. COLOR SYNC LOCKING

The COLOR LEVEL control on the 1248 varies the amplitude of the color subcarrier from 0 to 150%. Utilization of this control can help determine if the set will adequately lock on a color signal.

Step 1. Rotate the 1248 selector to GATED RAINBOW and adjust the COLOR LEVEL control to its mid-point position; this represents normal color subcarrier amplitude.

Step 2. Adjust the receiver color control to produce a recognizable color pattern.

Step 3. Slowly rotate the 1248 COLOR LEVEL control counterclockwise until the colors become pale and finally disappear; the rate of fading will depend entirely upon the model under test. Most receivers will maintain color sync throughout the entire range of the level control; however, some sets may lose it just before the color disappears, evidenced by their diagonal running. Both of these conditions indicate normal operation of the sync circuits. If a slight reduction of the chroma amplitude from normal causes the color to fall out of lock, synchronization of the receiver may be inadequate.

In the full clockwise position of the COLOR LEVEL control, the amplitude of the sub-carrier is 150% of sync amplitude. This additional range is helpful in diagnosing receiver conditions, such as RF/IF misalignment or chroma circuit malfunction.

D. COLOR FIT

The 1248 produces color bars that are raised on a luminance pedestal so that spaces between the colors are reference black. When displaying 10 and 3 bar patterns, color should only be seen in the luminance area; a defective delay line in the video amplifier or incorrect alignment of the chroma bandpass amplifier will cause the colors to overlap or spill into the black region.

E. COLOR KILLER

Color killer threshold can be set while displaying CROSSHATCH; adjust the color killer control of the receiver until the vertical lines start to tear with color. Back this control off until the tear is removed, then give a slight additional turn to provide a safety margin.

DEFLECTION SYSTEM TESTS

A rapid check of receiver scanning can help disclose any abnormal or border-line situations which might exist in the electrical or mechanical components of the deflection system. When evaluating any results from these tests, always use the manufacturer's recommendations as a criterion.

A. OVERSCAN

1. Rotate the 1248 pattern selector to CROSSHATCH.
2. Adjust receiver contrast and brightness to display sharp, thin lines against a black background.
3. Count the number of vertical and horizontal lines. A typical receiver will display 10 vertical and 7 horizontal lines. An additional vertical line, however, may just be visible at the screen's edge; this one is outside the normal picture area and should be ignored when performing adjustments.

NOTE

Certain receivers have an inherent tendency towards a greater amount of overscan and/or blanking. This phenomenon may result in a 9 x 7 crosshatch instead of a 10 x 7. The same effect will produce an 8 x 9 color bar pattern instead of 10.

B. LINEARITY, SIZE AND CENTERING

The repetitive spacing of the CROSSHATCH pattern provides a stable source with which to perform these tests and adjustments. Abnormal conditions such as pincushion distortion, deflection non-linearity and excessive 60 Hz hum become immediately obvious.

Vertical size and linearity should be adjusted so that all horizontal lines are evenly spaced. Inability to do so usually indicates a vertical deflection problem.

Pincushion distortion is common to a great number of large screen receivers; the outermost vertical and horizontal crosshatch lines are most useful in determining the correct amount of compensation.

A horizontal bar rolling vertically through the crosshatch pattern indicates that 60 Hz hum is entering the receiver circuitry. Excessive amounts of it cause a very noticeable and annoying pattern displacement.

The CROSSHAIR pattern provides 1 vertical and 1 horizontal line that intersect at exact screen center; any visual deviation from it may indicate a need for position adjustments.

THEORY OF OPERATION

The heart of the model 1248 Digital IC Color Bar Generator is the custom MOS digital integrated circuit. This 16-pin package contains all the digital countdown circuitry, gating logic, and D/A converters necessary to produce a composite video signal with a minimum of external components. See Fig. 5.

Pins 12 and 13 of the IC are the input pins to the on-chip oscillator circuit. A 377.6 kHz crystal is connected to these terminals to establish the master oscillator at this frequency. C3, C4, and R4 are added to stabilize the oscillator frequency. Pins 3, 4, 5, and 6 are internally connected to a decoder ROM (Read Only Memory) which selects the proper video pattern (crosshatch, dots, etc.) from the BCD information provided to these pins by the PATTERN SELECTOR switch.

Vertical line width is determined by an RC timing network which is connected to pins 7 and 8. Varying the resistance of R3 increases or decreases the width of vertical lines and dots. The vertical lines present at .25μSEC and may be adjusted from .1 to .8μSEC to suit personal preference.

The composite video output appears at pin 9 and the color bar gating signal appears at pin 10. Sync signals appear at pin 1 with horizontal or vertical being selected by a high or low at pin 16.

Transistor Q2 adds the color bar gating signal to the sync signal and also provides a luminous step for the color bars. Q2 also provides positive and negative video signals which are buffered by Q3 and are available at the video output on the front panel.

Transistor Q4 is a modified Crystal-Colpitts oscillator with R22 (COLOR LEVEL) as the load resistor; the output is thus variable in amplitude from 0 to 150% of sync level. Q5 is operated as a switch which grounds the color signal between bars. The gating signal comes from pin 10 of IC1 and is buffered by Q1 which drives the base of Q5.

Transistor Q6 and surrounding components comprise a temperature-compensated 4.5 MHz oscillator which generates the sound subcarrier used as a tuning aid. Capacitor C22 injects a level of 30% total modulation excursion into the modulator. A front panel slide switch controls power to this circuit and also blanks the bar patterns to provide an ungated rainbow.

The assembled composite video from Q2 is sent to the VHF OSCILLATOR/MODULATOR where it is impressed upon the desired RF frequency and routed through the output cable. Q7 and surrounding components form a crystal-controlled VHF oscillator that generates the carrier frequency. Front panel push-buttons control the DC bias to six RF switching diodes thereby energizing the desired crystal and selecting the proper resonating capacitor for the tank circuit. Modulator transistor Q8 is a low-capacity device connected as a diode; this scheme provides temperature compensation and a high modulation percentage. Shielded coaxial cable is provided for convenient connection to the receiver terminals.

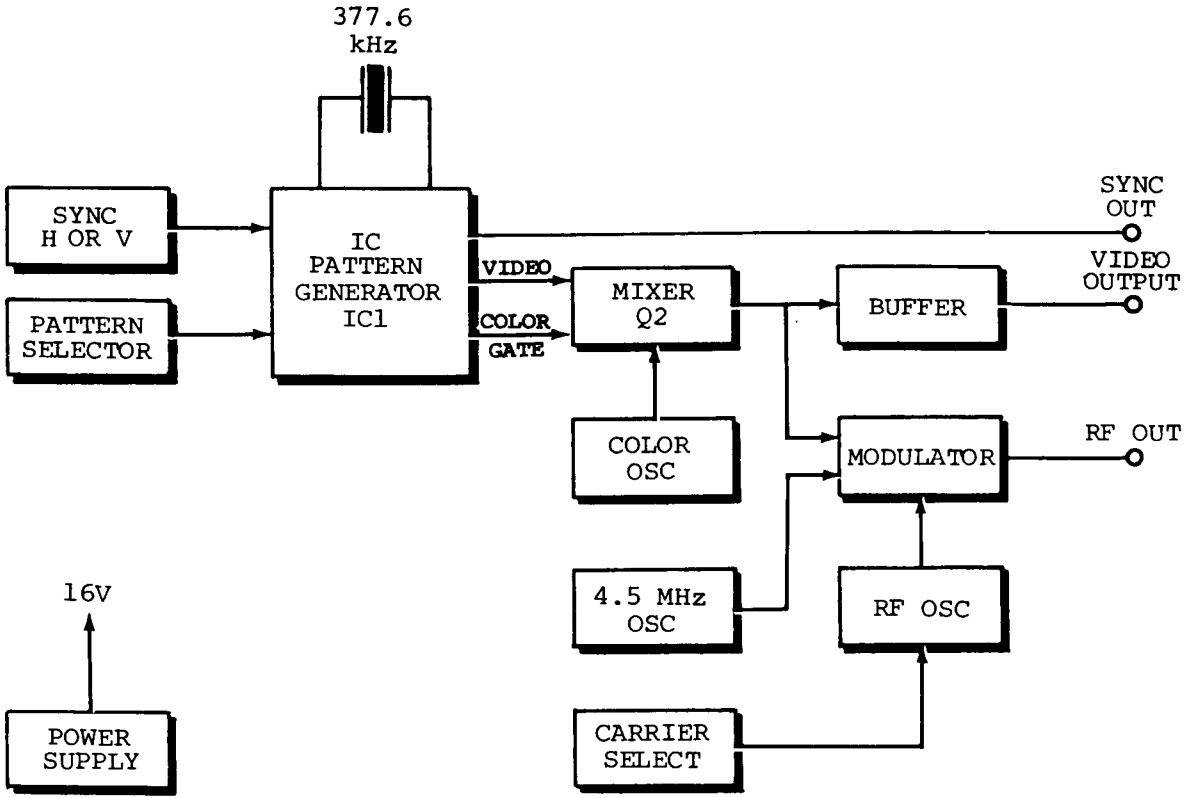


Fig. 5. Block diagram.

CALIBRATION AND MAINTENANCE

The 1248 is aligned and calibrated at the factory for optimum performance. As a result, access to the instrument's interior is only necessary for dot size readjustment–all other trimming controls should not be touched. If misalignment occurs either through damage or accidental movement, recalibration is possible by following the procedures in succeeding sections.

A. DOT SIZE

Trimmer control R3 DOT SIZE (See Fig. 6) varies the width of pulses used to construct dots and vertical lines. It is preset to .25μSEC, which has been found to produce a sharp, bright dot on the majority of receivers. If readjustment is preferred, simply display a dot pattern and rotate this control until the desired size is obtained. Since vertical lines are also affected, it is wise to inspect the crosshatch pattern; a compromise between optimum dot size and vertical line width may be necessary.

B. RF OSCILLATOR/MODULATOR

Because the RF carrier of the 1248 is crystal-controlled, it is not necessary to retune L2 when changing channels; it has purposely been damped so that Q7 will oscillate with either of the crystals. If operation on one channel should cease, rotate L2's slug to see if it can be restored before suspecting component failure.

It is necessary to view the detector output of a working receiver with an oscilloscope when calibrating the MOD trimmer, R15.

1. Set-up the receiver and generator to display CROSSHATCH.
2. Adjust the oscilloscope to view two vertical fields of the recovered waveform.
3. Rotate R15 until the sync amplitude (upper half) of the composite signal equals the video amplitude (lower half).

C. COLOR OSCILLATOR

A frequency counter with input impedance of greater than 100kΩ is needed to perform the following adjustments:

1. Rotate the 1248 selector to GATED RAINBOW and turn the unit on.
2. Attach the frequency counter across the COLOR LEVEL control and rotate the COLOR LEVEL control fully clockwise.
3. Adjust "COLOR TRIM" capacitor (C11) with a non-metallic tool until a reading of 3.563811 MHz in obtained.

D. 4.5 MHz OSCILLATOR

1. Attach the frequency counter to the emitter of Q6 (see Fig. 6).
2. Slide the actuator of the 4.5 MHz front panel switch to ON and adjust L1, 4.5 ADJ, for a reading of 4.500 MHz. Calibration is now complete.

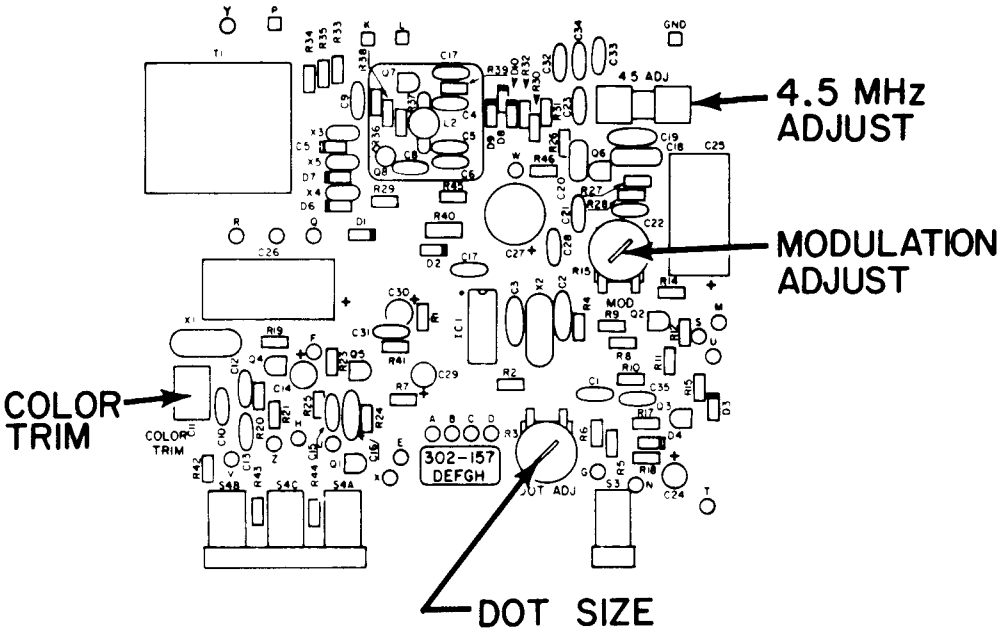
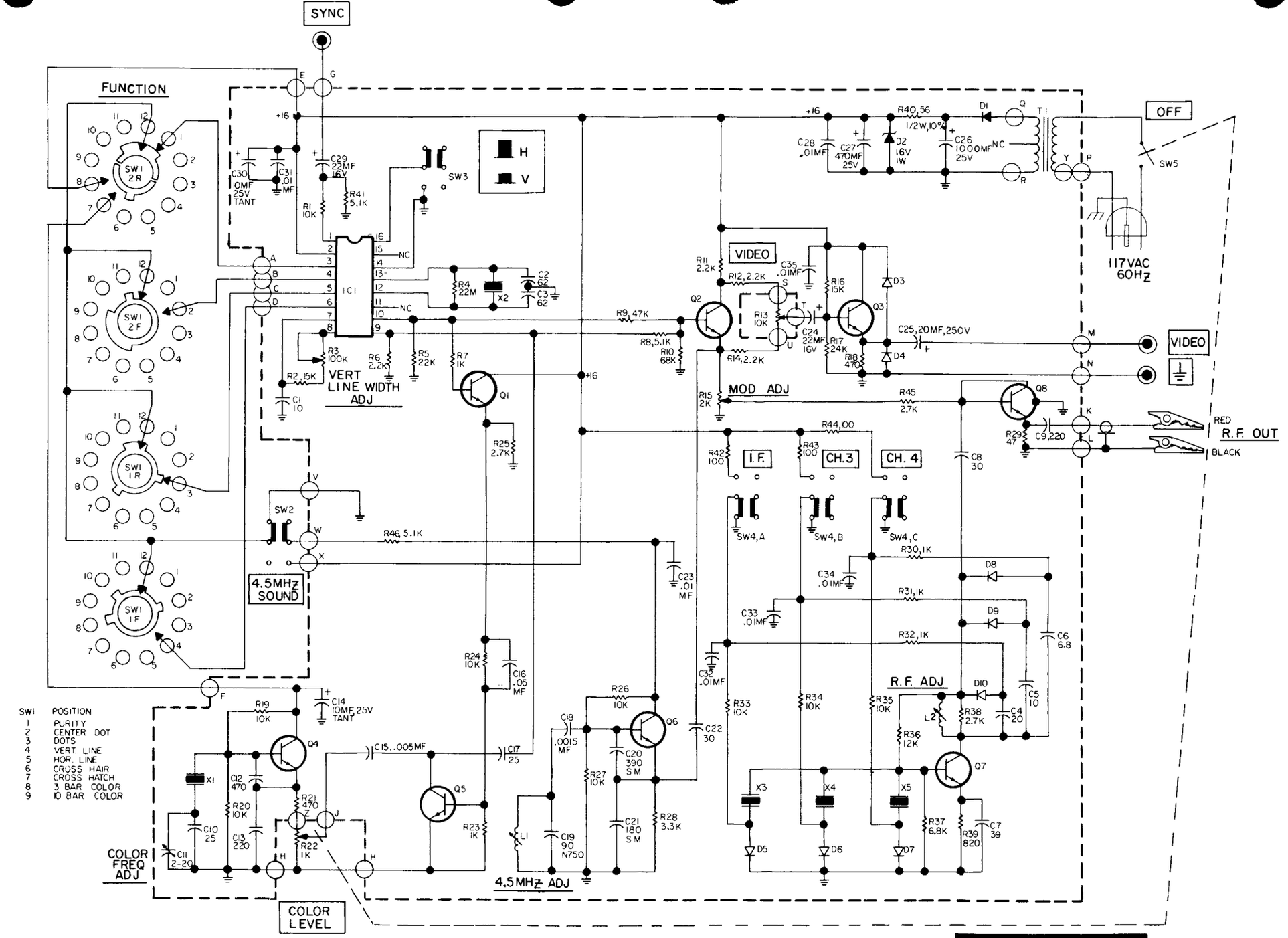


Fig. 6. Location of internal adjustments.



SWI	POSITION
1	PURITY
2	CENTER DOT
3	DOTS
4	VERT. LINE
5	HOR. LINE
6	CROSS HAIR
7	CROSS HATCH
8	3 BAR COLOR
9	10 BAR COLOR

LAST NO.'S USED
R46
C35
D10
Q8

UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTANCE IN OHMS 1/4W, 5%
2. ALL CAPACITORS IN P.F.
3. SW1 SHOWN IN FULL CCW POSITION (PURITY)
SW2, SW4, SW5 SHOWN IN OFF POSITION (SW3 SHOWN IN HOR. POSITION, OUT)
4. TITLES IN RECTANGLES INDICATE FRONT PANEL NOMENCLATURE
5. ABBREVIATIONS:
K=1,000 TANT = TANTALUM ⏚ = CASE GROUND
M=1,000,000 ⏚ = FOIL GROUND

B&K
MODEL 1248
DIGITAL I.C. COLOR GENERATOR
488-142-9-001

B & K MODEL 1248 PARTS LIST

488-142-9-002

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART NO.

SWITCHES

S1	9-Position Rotary, Function	083-167-9-001
S2	DPDT Slide, "4.5MHz"	084-017-9-001
S3	Pushbutton, "SYNC"	088-024-9-001
S4	3-Station, Pushbutton	088-025-9-001

MISCELLANEOUS

	Cable, RF	539-029-0-000
	Case, Leather, Carrying	271-026-9-001
	Foot, Rubber	381-004-9-001
	Instruction Manual	480-158-9-001
	Jack, Tip, Black	773-055-9-001
	Jack, Tip, Red	773-056-9-001
	Knob, Control	751-069-9-001
	Knob, Rotary Switch	751-114-9-001
	Knob, Pushbutton	384-013-9-001

NOTE: Standard value resistors and capacitors are not listed. Values may be obtained from schematic diagram. Minimum charge $5.00 per invoice. Orders will be shipped C.O.D. unless previous open account arrangements have been made or remittance accompanies order. Advance remittance must cover postage or express charges. Specify serial number when ordering replacement parts.

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART NO.

RESISTORS & POTENTIOMETERS

R3	100k, ±30%, 1/8W, Trimpot	008-216-9-001
R13	10k, ±30%, 1/4W, Carbon Pot, VIDEO	008-215-9-001
R15	2k, ±30%, 1/8W, Trimpot	008-217-9-001
R22/S5	1k, ±30%, 1/4W, Carbon Pot/Switch, COLOR LEVEL	008-214-9-001

CAPACITORS

C11	2-20pf, Trimmer	028-001-9-001
C14, C30	10 MF, 25V Tantalum	027-006-9-002
C18	.0015 MF, ±5%, Mylar	025-035-9-001
C19	90 PF, N750, ±5%, Ceramic Disc	020-079-9-001
C20	390 PF, ±5%, Silver Mica	023-004-9-001
C21	180 PF, ±5%, Silver Mica	023-025-9-001
C24, C29	22 MF, 16V, Electrolytic	022-085-9-001
C25	20 MF, 250V, Electrolytic	021-034-9-001
C26	1000 MF, 25V, Electrolytic	022-107-9-001
C27	470 MF, 25V, Electrolytic	022-095-9-001

COILS & TRANSFORMERS

L1	4.5 MHz Coil	044-023-9-001
L2	RF Oscillator Coil	044-017-9-001
T1	Power Transformer	065-107-9-001

CRYSTALS

X1	3.563795 MHz	131-003-9-001
X2	377.6 kHz	131-018-9-001
X3	45.75 MHz	132-002-9-009
X4	61.25 MHz	132-004-9-002
X5	67.25 MHz	132-004-9-004

DIODES, TRANSISTORS & IC'S

D1,D3,D4	1A Silicon Diode	151-018-9-001
D2	16V, ±5%, 1W, Zener Diode	152-009-9-001
D5-D10	1N4148 Silicon Diode	151-038-9-001
Q1-Q6	MPS A20, NPN, Silicon Transistor	176-023-9-001
Q7	SE1010, NPN, Silicon Transistor	176-005-9-001
Q8	40897, NPN, Silicon Transistor	176-040-9-001
IC1	MM5322, Custom MOS Integrated Circuit	307-057-9-001