FACTORY CALIBRATION PROCEDURE

CONTENTS:

This is the guide for calibrating new instruments in Product Manufacturing. The procedure consists of 4 sections:

Equipment Required

Factory Test Limits - Factory Test Limits are limits an instrument must meet before leaving Manufacturing. These limits are often more stringent than advertised performance requirements. This is to insure that the instrument will meet advertised requirements after shipment, allows for individual differences in test equipment used, and (or) allows for changes in environmental conditions.

Short Form Procedure - The Short Form Procedure has the same sequence of steps and the same limits on checks or adjustments as the Main Procedure.

Main Procedure - The Main Procedure gives more detailed instructions for the calibration of the instrument. This procedure may require that some checks and adjustments be made so that performance is better than that required by the Factory Test Limits. This insures the Factory Test Limits will be met when side panels are added, permits some normal variation in test equipment and plug-in scopes, etc.

Abbreviations in this procedure will be found listed in TEKTRONIX STANDARD A-100. Definitions of terms used in this procedure may be found in TEKTRONIX STANDARD A-101.

In this procedure, all front panel control labels and Tektronix instrument names are in capital letters (VOLT/DIV, etc). Internal adjustment labels are capitalized only (Gain Adj, etc).

This procedure is company confidential

528

July 1968
For all serial numbers.

CHANGE INFORMATION:

This procedure has been prepared by Product Manufacturing Staff Engineering. For information on changes made to this procedure, to make suggestions for changing this procedure, or to order additional copies: please contact PMSE, 39-307. (NC)

EQUIPMENT REQUIRED:

The following equipment is necessary to complete this procedure:

a. TEKTRONIX Instruments

1 TYPE 547 OSCILLOSCOPE
1 TYPE 1A5 DIFFERENTIAL AMPLIFIER
1 TYPE 520 NTSC OSCILLOSCOPE
1 TYPE 191 CONSTANT AMPLITUDE SIGNAL GENERATOR
1 TYPE 184 TIME MARK GENERATOR
1 TYPE 106 SQUARE-WAVE GENERATOR
1 TYPE TU76 LINE VOLTAGE CONTROL UNIT
1 TYPE P6010 10X PROBE
1 TYPE P6011 1X PROBE

b. Test Fixtures and Accessories

1 DC Voltage Bridge (067-0543-99)
1 Low Frequency Sine-wave Generator (067-0542-99)
1 50Ω to 75Ω Min Loss Attenuator (011-0057-00)
2 75Ω Termination [feed-through type] (011-0055-00)
2 75Ω Termination (011-0023-00)
3 75Ω coaxial cable (012-0074-00)
1 50Ω coaxial cable (012-0057-01)
1 Return Loss Bridge (067-0576-00
1 Special Test Fixture for RGB input & APL checks (PMIE Dwg #2108-B)
1 4X Attenuator, special (PMIE Dwg #2014-B)
1 75Ω Variable attenuator (PMIE Dwg #2018-A)

c. Other Equipment

1 20,000Ω/VDC Multimeter
1 Video Generator capable of producing the following signals:
composite video with burst
composite video without burst
stairstep with burst
$\sin^2$ (T) pulse and bar

Substitute test equipment may be used. The Plant Staff Engineer must approve any substitutions. All equipment listed must perform within its manufacturer's specifications, unless otherwise stated.

QUALIFICATION

Factory Test Limits are qualified by the conditions specified in the main body of the Factory Calibration Procedure. The numbers and letters to the left of the limits correspond to the procedure steps where the check or adjustment is made. Steps without Factory Test Limits (set-ups, presets, etc.) are not listed. Instruments may not meet Factory Test Limits if calibration or checkout methods and test equipment differ substantially from those in this procedure.

2. CALIBRATOR/SWEEP/POWER SUPPLIES

a. Calibrator: 1V ±0.5%
b. Sweep: sweep must free run in all settings of SWEEP sw with no signal applied
c. Power Supplies: displayed video signal remains stable with 99 to 132VAC line variation

3. CRT

a. Trace Align: $\geq 6^\circ$ total range
c. Intensity Limit: No observable blooming with intensity or line voltage variation.

4. HORIZONTAL

a. 1µs/Div Timing: accuracy within 2%
linearity error $\leq 2\%$
b. Sweep Length: 11.6 -12.6div, 2V=2H within ±0.2div
c. Sweep Rep Rates: 2H, burst must be phase locked (no interlacing) 2V= 30Hz rate
d. Mag Registration/2V MAG Timing: some portion of blanking must be visible when switching to mag position; vertical blanking interval width must be 8 - 12div in 2V MAG.
e. Horizontal Position Range: must be able to position start and end of synchronized sweep on screen with any setting of SWEEP switch.

5. VERTICAL

a. Vertical Gain/Cal Frequency:
Gain: 1V=140 ±1 IRE unit
Cal Freq: ≥ 2 cycles in 12 units (2H)
b. VOLTS FULL SCALE 4V Accuracy:
4V=140 IRE units ±2%
c. Variable Range & Lights:
Range: at least X4
green light = cal
red light = uncal
d. Vertical Position Range:
When DC coupled, +1V will position below 90 IRE and -1V position above -30 IRE

6. SYNC

a. Internal Sync Range: 1V composite video provides stable triggering at 1V and 4V settings
b. External Sync Range: ≤ 1.0V to ≥ 5V

7. RESPONSE

a. $\sin^2$ Pulse and Bar Response:
overshoot & ringing: 2 IRE units
preshoot: ≤ 1 IRE unit pulse to bar ratio: 0.99:1 to 1.01:1

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b. Bar and Window Tilt: ≤1%
c. Flat Frequency Response (350kHz -5MHz): flat within ±1% to 3.6MHz, referenced to 50kHz; flat within +1%, -2% to 5MHz, referenced to 50kHz and 3.6MHz.
d. VIDEO OUT: Gain: 140 IRE units = 1V ±15%; Frequency Response (350kHz -5MHz): flat within ±3%; Output DC level (into 75Ω): 2V or less.

e. IRE Response:

Frequency	Amplitude (IRE Units)
50kHz	140 (set)
350kHz	132 - 136
1MHz	98 - 112
2MHz	44 - 59
3.6MHz	8 - 19
4.4MHz	≤11

f. Chroma Response:

Response sw	Frequency	Amplitude (IRE units)
FLAT	3.58MHz	140 (set)
CHROMA	3.58MHz	140 ±1% (adj)
CHROMA	3.1-3.4MHz	98
CHROMA	3.8-4.1MHz	98

g. Diff Gain Expansion: 3 to 5.5 times gain
h. Amplifier Diff Gain: ≤1%
i. Flat Frequency Response (25Hz -350kHz): Vertical Amp: flat within ±1%, referenced to 50kHz; Video Out: flat within ±3%, referenced to 50kHz.

8. DC RESTORER

a. 60Hz Attenuation: ≤20% DC RESTORER ON to OFF
b. Blanking Level Shift with Burst: ≤1 IRE unit
c. Blanking Level Shift with APL Change: ≤ 2 IRE unit

9. RETURN LOSS

a. Video Input Return Loss: ≤40dB (5mV)
b. Ext Sync Input Return Loss: ≤ 46dB (2.5mV)
c. Video Out Return Loss: ≤ 30dB (16mV)

10. STAIRSTEP INPUT

a. Sweep Length: RGB: 27% -33%
YRGB: 20% -25%
b. Deflection Factor: 10V ±15% = 9div displacement.
c. DC Level Range: ≥12V
d. Input Compensation: ≤2% overshoot or tilt

11. VIDEO OUT DIFF GAIN/DIFF PHASE

a. Video Out Diff Gain: ≤2%
Video Out Diff Phase: ≤3°

THE END

Factory TEST LIMITS are limits an instrument must meet before it leaves Manufacturing; therefore, it must be possible to inspect to these limits. Because of normal variations in test equipment and plug-in scopes, addition of side panels, etc, it is necessary to set up some circuits so their performance is better than required by Factory Test Limits. Therefore, the instructions given in the Factory Calibration Procedure may call for checks or adjustments which result in less error than that allowed by the Factory Test Limits.

1. PRELIMINARY

a. Check CRT
b. Preset Controls and Check Fuses:
line fuse: 0.5A Slo blo
F542: 0.75A fast
c. Check Power Supply Resistance:

	Neg meter lead gnd	Pos meter lead gnd
-15V	330Ω	300Ω
+10V	260Ω	310Ω
+100V	4.6KΩ	3kΩ
+300V	45KΩ	2.2KΩ

2. CALIBRATOR/SWEEP POWER SUPPLIES

a. Adjust Calibrator (R575): set to 1V at pin AI
b. Check Sweep: free runs in all settings of SWEEP sw.
c. Check Power Supplies: Video signal remains stable with 99-132VAC line change

Supply	Accuracy	Ripple (hash)
-15	±2%	≤10mV
10	±5%	≤20mV
100	±5%	≤20mV
300	±5%	≤2V
-3850	±5%	

d. Check LINE VOLTS Switch: front panel lights dim but do not go out when LINE VOLTS sw is changed to 198-264V.

3. CRT

a. Adjust TRACE ALIGN: ≥6° total range
b. Adjust ASTIGMATISM:
c. Adjust Intensity Limit (R448): Set for no observable blooming with intensity variation.

4. HORIZONTAL

a. Adjust 1μs/DIV Timing: Accuracy within 2%
Linearity error <2%
b. Adjust Sweep Length (R258): 2V=2H=11.6 to 12.6div
c. Check Sweep Rep Rates: 2H must be phase locked
2V=30Hz rate
d. Check Mag Registration/2V Mag Timing: part of blanking must be visible when switching to mag position; vertical blanking interval = 8 -12div.
e. Check Horizontal Position Range: position both ends of trace on graticule area at all sweep settings.

5. VERTICAL

a. Adjust Vertical Gain (R58)/Check Cal Frequency: gain: 1V=140 IRE units
Cal freq: ≥2cycles in 12div
b. Check VOLTS FULL SCALE 4V Accuracy: ±2%
c. Check VARIABLE Range and Lights:
range: at least 4X
lights: green = cal
red = uncal
d. Check Vertical POSITION Range: DC couple the input (jumper TP2 and TP8) apply +1V and position trace below +90 IRE. Apply -1V and position trace to above -30 IRE.

6. SYNC

a. Check Internal Sync Range: 1V composite video provides stable triggering in 1V and 4V volts FULL SCALE settings
b. Check External Sync Range: ≤1.0V to ≥5.0V

7. RESPONSE

a. Adjust Sin^2 Pulse and Bar Response: ringing and overshoot: ≤2 IRE units; preshoot: ≤1 IRE unit; pulse to bar ratio: 0.99:1 to 1.01:1
b. Check Bar and Window Tilt: ≤1%
c. Check FLAT Frequency Response (50kHz -5MHz): flat within ±1% to 3.6MHz, with respect to 50kHz; flat within +1%, -2% to 5MHz, with respect to 50kHz and 3.6MHz.
d. Check VIDEO OUT: gain: 140 IRE units = 1V ±15%; frequency response (50kHz -5MHz): flat within ±3%; Output DC Level: <2V
e. Adjust IRE Response (L42):

Frequency	Amplitude (IRE units)
50kHz	140
350kHz	132 - 136
1MHz	98 - 112
2MHz	44 - 59
3.6MHz	8 - 19
4.4MHz	≤11

f. Adjust CHROMA Response (L45, L47):

RESPONSE sw	Frequency	Amplitude
FLAT	3.58MHz	140 (set)
CHROMA	3.58MHz	140 ±1% (adj)
CHROMA	3.1-3.4MHz	98
CHROMA	3.8-4.1MHz	98

g. Check Diff Gain Expansion: 3.0 to 5.5 times gain.
h. Check Amplifier Diff Gain: ≤1%
i. Check FLAT Frequency Response (25Hz -50kHz): Vert Amp: flat within ±1%, referenced to 50kHz
Video Out: flat within ±3%, referenced to 50kHz

8. DC RESTORER

a. Check 60Hz Attenuation: ≤20%
b. Check Blanking Level Shift with Burst: ≤1 IRE unit
c. Check Blanking Level Shift with APL Change: ≤2 IRE unit

9. RETURN LOSS

a. Adjust Video Input Return Loss: ≤40dB (5mV)
b. Check Ext Sync Input Return Loss: ≤46dB (2.5mV)
c. Check VIDEO OUT return Loss: ≤30dB (16mv)

10. STAIRSTEP INPUT

a. Check Sweep Length: RGB: 27%-33%
YRGB: 20%-25%
b. Check Deflection Factor: 10V ±15% =9div displacement.
c. Check DC Level Range (R304): ≥12V
c. Adjust Input Compensation (C301): adjust for optimum-square corner at pin B

11. VIDEO OUT DIFF GAIN/DIFF PHASE

b. Check VIDEO OUT Diff Gain: ≤2%
c. Check VIDEO OUT Diff Phase: ≤3°

THE END

1. PRELIMINARY

a. Check CRT

Check the CRT for face plate and phosphor defects. (see notes).

If the CRT is replaced, align the face plate so it is flush with the front panel within ±1/32".

Do not reject a CRT without consulting a trained CRT Checker or referring to the Cathode Ray Tube Check Out Procedure.

b. Preset Controls and Check Fuses

Preset rear panel screw driver adjustments and internal adjustments to midr. Preset front panel controls as follows.

POSITION (horizontal)	midr
VOLTS FULL SCALE	1V CAL
VARIABLE	CAL
RESPONSE	FLAT
SWEEP	2H
INTENSITY	ccw
SCALE ILLUM/POWER	OFF
POSITION (vertical)	midr
SYNC	INT
DC RESTORER	OFF
LINE VOLTS sw	99-132

Check fuses for correct value;
line fuse: 0.5A slo-blo
F542: 0.75A fast

c. Check Power Supply Resistance

Check the power supplies for the specified approximate resistance.

Supply	Approx Resistance (neg meter lead gnd)	(pos meter lead gnd)
-15	330Ω	300Ω (X100 scale)
+10	260Ω	310Ω (X100 scale)
+100	4.6kΩ	3kΩ (X1k scale)
+300	45kΩ	2.2kΩ (X1k scale)

2. CALIBRATOR/SWEEP POWER SUPPLIES

a. Adjust Calibrator (R575) 1volt

Apply power to the TYPE 528 via TYPE 76TU LINE VOLTAGE CONTROL UNIT and turn POWER sw on. DC couple the input to the vertical amplifier (jumper between TP2 and TP8). Remove the lead going to pin AG on the Main EC board. Connect the DCVB between gnd and pin AI and turn off the calibrator (VOLTS FULL SCALE in any position except 1V CAL).

Note the DC voltage with the calibrator off (≃ -3mV). Turn the calibrator on and adjust R575 (-15 volt) for exactly 1volt more negative than the previously noted voltage. Remove the DCVB and reconnect the lead to pin AG. Remove the jumper between TP2 and TP8.

b. Check Sweep

Check for a free running sweep in all settings of the SWEEP sw (no signal applied).

c. Check Power Supplies

Connect a composite video signal to A VIDEO INPUT and terminate loop through with 75Ω. Set the SWEEP to 2V. Check that the video signal remains stable with no indication of ripple as the line voltage is varied from 99 to 132VAC.

If the video signal is unstable or has excessive ripple check the power supplies for the following ripple and accuracy with line voltage variations from 99-132VAC.

c. Regulation range applies only if the line voltage crest factor is between 1.414 and 1.3.

Supply	Accuracy	Ripple (high voltage hash)	
-15V	14.7-15.3V	10mV (typically 6mV)	
10V	9.5-10.5V	20mV (" 10mV)	no observable
100V	95-105V	20mV (" 10mV)	120 ∿ ripple
300V	285-315V	2V (" 1.2V)	
-3850V	3658-4042V		

d. Check LINE VOLTS Switch

Change the LINE VOLTS sw to 198-264V. Check that the front panel lights dim but do not go out completely. Return the sw to 99-132V.

3. CRT

a. Adjust TRACE ALIGN *$\geq 6°$ total range*

Change the VOLTS FULL SCALE to A 1V, SWEEP to 2H and center the trace. Rotate the TRACE ALIGN from end to end and check for at least 6° total trace rotation (see notes).

Adjust the TRACE ALIGN so the trace is parallel to the horizontal graticule lines.

b. Adjust ASTIGMATISM

Change the VOLTS FULL SCALE to 1V CAL. Adjust the INTENSITY for normal brightness. Center the display and adjust the FOCUS and ASTIGMATISM for optimum focus of the calibrator waveform.

c. Adjust Intensity Limit (R448)
No observable blooming.

Display the internal calibrator signal at 1μs/div sweep rate. Position the first positive going edge of the calibrator signal to the 1div graticule line. Vary the INTENSITY control from maximum to minimum while adjusting the Intens Limit (R488). Set the Intens Limit to a point just below where the edge of the calibrator waveform shifts 0.1div. Recheck for less than 0.1div shift with the first positive going edge positioned to the 11div graticule line. If necessary readjust R488.

Change the SWEEP to 2H and rough set R58 for 140 IRE Units vertical deflection. Check for no observable blooming while slowly varying the intensity from min to max.

4. HORIZONTAL

a. Adjust 1μs/div Timing (R366)
timing accuracy within 2%
linearity error ≤2%

Connect 1μs time marks from the TYPE 184 to the VIDEO INPUT A. Connect 10μs triggers from the TYPE 184 to the EXT SYNC (some instruments will trigger better on 1μs triggers). Set the VOLTS FULL SCALE to A 1V and SYNC to EXT. Adjust the horizontal POSITION so the trace starts at the first graticule line with the SWEEP at 2H. Change the SWEEP to 1μs and adjust R366 for one time mark per div in the center 10 div.

Instead of using EXT triggers, it is possible to trigger on time markers by varying the amplitude with the VARIABLE control.

Adjust C358 for optimum linearity at the start and end of the sweep. Timing error in any 10div segment must not exceed 2% (excluding first and last div of sweep). Repeat the adjustment of R366 and C358 as necessary.

Display the center of the sweep. With the time marks set on at the 2nd and 12th graticule line, the center time mark must be within 0.1div of the 7th graticule line.

Remove the time marks and trigger signal. Change the SYNC to INT.

b. Adjust Sweep Length (R258) 11.6-12.6div

Connect a composite video signal to VIDEO INPUT A and terminate loop through with 75Ω. Change the SWEEP sw back and forth between 2H and 2V. Adjust R258 for the same length in 2V as in 2H. Sweep length must be between 11.6 and 12.6div.

c. Check Sweep Rep Rates
2H: must be phase locked
2V: 30Hz rate

Set the SWEEP to 2H and check that 2 lines are displayed. Set the SWEEP to 1μs/DIV. Check that the burst signal is phase locked (not interlaced). Change the SWEEP to 2V. Check that 2 fields are displayed and the 2V sweep is running at a 30Hz rate (a lower rate will be evident by flicker).

4. (cont'd)

d. Check Mag Registration/2V MAG Timing

part of blanking must be visible when switching to mag position vertical blanking interval = 8-12div

Change the SWEEP to 2H and position the start of the sweep to the 1st graticule line. Change the SWEEP to 1μS/DIV. Some portion of the horizontal blanking pulse must be visible on screen. Change the SWEEP to 2V and position the start of the sweep to the 1st graticule line. Change the SWEEP to 2V MAG. Some portion of the vertical blanking interval must be visible on screen. The width of the vertical blanking must be between 8 and 12div.

e. Check Horizontal Position Range

Check that the horizontal POSITION control has sufficient range to position the start and end of the synchronized sweep on screen at all settings of SWEEP sw.

5. VERTICAL

a. Adjust Vertical Gain (R58)/Check Cal Frequency *1V= 140/IRE Units* *≥2 cycles in 12 Units*

Set the VOLTS FULL SCALE to 1V CAL and SWEEP to 2H. Adjust R58 for 140 Units vertical deflection. Check for no change in vertical gain as the VARIABLE control is wiggled in the detent. Check that there are at least 2 cycles of syncronized calibrator signal in 12 div.

Select value of C472 if triggering of calibration signal is not stable.

5. (cont'd)

b. Check VOLTS FULL SCALE 4V Accuracy ±2%

Set the VOLTS FULL SCALE to A 1V. Connect the TYPE 106 HI AMPLITUDE OUTPUT through the special X4 attenuator (PMIE Dwg #2014-B) to the VIDEO INPUT A. Terminate with 75Ω. Set the TYPE 106 frequency to 1kHz, symmetry for 50% duty cycle and adjust the amplitude for 140IRE Units vertical deflection. Change the VOLTS FULL SCALE to A 4V and switch out the X4 attenuation. Check for 140IRE Units ±2% vertical deflection.

c. Check VARIABLE Range and Lights ≥4X range

Switch in the X4 attenuator. Check that the VARIABLE has sufficient range to increase the vertical deflection to at least 140IRE Units. Check that the CAL (green) light is on when the VARIABLE is in the cal detent and the UNCAL (red) light is on when the VARIABLE is out of the cal detent. Return the VARIABLE to the CAL position.

Remove X4 attenautor and 75Ω terminator.

d. Check Vertical POSITION Range

Change the VOLTS FULL SCALE to A 1V. Connect the output of the RGB-APL checker to A VIDEO INPUT (do not terminate). Connect a 10V square wave from SAC to the test fixture input and set to DC. DC couple the input to the TYPE 528 (jumper between TP2 and TP8).

Set RGB-APL checker to -1V. Rotate the vertical POSITION cw and check that the trace will position above the -30 IRE line. Set switch to +1V and rotate the vertical POSITION ccw and check that the trace will position below the +90 IRE line.

Remove RGB-APL checker and jumper between TP2 and TP8.

6. SYNC

a. Check Internal Sync Range

Connect a 1 volt composite video signal to the A VIDEO INPUT. Terminate loop through with 75Ω. Set the DC RESTORER to ON. Check for a stable clamped display, in all settings of the SWEEP sw, with VOLTS FULL SCALE in A 1V and A 4V.

Through out this procedure use 75Ω coaxial cable to make connection between the video generator and the VIDEO INPUT's. If a 75Ω variable attenuator is used connect the attenuator directly to the INPUT and do not terminate the loop through (the variable attenuator acts as the terminator).

b. Check External Sync Range
≤1.0V to ≥5V

Connect a composite video signal to the A VIDEO INPUT. Connect a composite sync signal through a 75Ω variable attenuator to EXT SYNC jack. Monitor the composite sync signal with the test scope. Change the SYNC sw to EXT.

Check for a stable clamped display, with all settings of the SWEEP sw, while varying the composite sync amplitude from 1.0V to 5V.

7. RESPONSE

a. Adjust Sin ^{2} Pulse and Bar Response
ringing and overshoot: <2IRE Units
preshoot: <1IRE Unit
pulse to bar ratio: 0.99:1 to 1.01:1

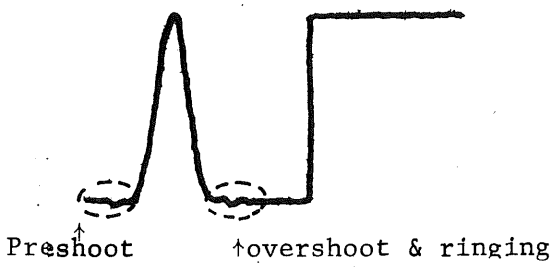
Connect a sin ^{2} pulse (125ns HAD) and bar signal to the VIDEO INPUT A. Terminate loop through with 75Ω. Connect the VIDEO OUTPUT through a 75Ω cable and a 75Ω feed through terminator to the test scope vertical input.

7a. (cont'd)

Set the VOLTS FULL SCALE to A 1V. Adjust the $\sin^2$ pulse and bar for 100IRE Units bar amplitude. Adjust C4 for unity pulse to bar ratio as viewed on the test scope. Change the VOLTS FULL SCALE to A 4V and adjust C2 for unity pulse to bar ratio as viewed on the test scope.

Return the VOLTS FULL SCALE to A 1V. Adjust R168, C168, L150 and L170 for unity pulse to bar ratio (as viewed on 528) with least amount of overshoot and ringing. (Adjust equally between L150 and L170).

After final adjustments the $\sin^2$ pulse response must be within the following limit (for 100IRE Units bar amplitude): pulse amplitude: 99-101IRE Units
preshoot: less than 1IRE Unit
overshoot and ringing: less than 2IRE Units



b. Check Bar and Window Tilt $\leq 1\%$

Check the bar for no more than 1IRE Units tilt (exclude overshoot or rounding on front corner of bar). Change the SWEEP to 2V and check the window for no more than 1IRE Unit tilt. NOTE: The DC RESTORER must be off for this check.

Remove the $\sin^2$ pulse and bar signal from the A VIDEO INPUT.

c. Check FLAT Frequency Response (350kHz-5MHz)
within ±1% to 3.6MHz with respect to 50kHz, flat within ±1%, -2% to 5MHz with respect to 50kHz and 3.6MHz

Connect the TYPE 191 OUTPUT through a 50Ω cable and a 50Ω to 75Ω min loss attenuator to the A VIDEO INPUT, terminate loop through with 75Ω. Set the SYNC sw to EXT. Set the

7c. (cont'd)

TYPE 191 frequency to 50kHz and adjust the amplitude for 140IRE Units vertical deflection. Vary the frequency from 350kHz to 3.6MHz, amplitude must not vary more than ±1%. Note the amplitude at 3.6MHz and vary the frequency from 3.6MHz to 5MHz. The amplitude must not vary more than +1%, -2% with respect to the amplitude at 50kHz and 3.6MHz. If C168, R168, L150 and L170 are readjusted to bring the frequency response within limits recheck the transient response with the $\sin^2$ pulse and bar signal.

d. Check VIDEO OUT
gain: 140IRE Units = 1V ±15%
frequency response (350kHz-5MHz):
flat within ±3%
output DC Level: <2V

Check that the amplitude of the VIDEO OUT signal (test scope) display is between 0.85V and 1.15V.

Vary the TYPE 191 frequency from 350kHz to 5MHz. Check that the VIDEO OUT amplitude remains flat within ±3%.

Change the VOLTS FULL SCALE to B 1V (no signal in). Check that the VIDEO OUT DC level is less than 2V.

e. Adjust IRE Response (L42)
follows IRE 1958 std 23S-1

Change the VOLTS FULL SCALE to A 1V. Set the TYPE 191 frequency to 3.6MHz and adjust the amplitude for 140 IRE Units vertical deflection. Change the RESPONSE sw to IRE and adjust L42 for vertical deflection between 7.5 and 20IRE Units (nominally 10 IRE Units). Check that the vertical deflection is within the specified limits at the following frequencies: (If necessary readjust L42)

7e. (cont'd)

Frequency	Amplitude (IRE Units)
50kHz	140
350kHz	132-136
1MHz	98-112
2MHz	44-59
3.6MHz	8 -19
4.43MHz	≤11

f. Adjust Chroma Response

Connect a composite video signal, with burst, to the B VIDEO INPUT. Set the VOLTS FULL SCALE to B 1V, RESPONSE sw to FLAT, SYNC to INT and SWEEP to 1μs/DIV. Adjust the VARIABLE for 50 IRE units of burst amplitude.

Change the RESPONSE sw to CHROMA, adjust L47 for maximum burst amplitude and L45 for the same amplitude as in FLAT. Compromise with the adjustment of L45 and L47 to keep the burst packet as symmetrical as possible.

Change the VOLTS FULL SCALE to A 1V. Set the TYPE 191 frequency to 3.58MHz (see notes) and adjust the amplitude for 140 IRE units. Check for the same 3.58 MHz amplitude in FLAT and CHROMA, if necessary readjust L45.

The correct dial setting for 3.58MHz can be found by zero beating the TYPE 191 frequency against a known 3.579545MHz subcarrier; e.g., 067-0546-00 subcarrier output.

Decrease the TYPE 191 frequency until the amplitude reduces to 98 IRE units (-3dB). The frequency, as read on the TYPE 191 dial, must be between 3.1 and 3.4MHz.

Increase the TYPE 191 frequency (from 3.58MHz) until the amplitude is reduced to 98 IRE units. The frequency must be between 3.8 and 4.1MHz.

g. Check Diff Gain Expansion *3 to 5.5 times gain increase*

Set the TYPE 191 frequency to 3.58MHz and adjust the amplitude for 20 IRE units. Change the RESPONSE sw to DIFF GAIN and check that the vertical deflection increases to between 60 and 110 IRE units.

Remove the TYPE 191 signal.

h. Check Amplifier Diff Gain ≤1%

Connect a 1V stairstep signal to A VIDEO INPUT. Change the VOLTS FULL SCALE to A 1V and RESPONSE to DIFF GAIN. Check for no more than 1% differential gain.

i. Check FLAT Frequency Response (25Hz-350kHz)
Vert Amp: flat within ±1%, referenced to 50kHz
Video Out: flat within ±3%, referenced to 50kHz

Connect the output of the Low Frequency Sine-wave Generator (LFSG) (067-0542-99) through a 50Ω to 75Ω min loss attenuator to the A VIDEO INPUT, terminate the loop through with 75Ω. Set the RESPONSE sw to FLAT. Set the LFSG frequency to 50kHz and adjust the amplitude for 140 IRE Units vertical deflection. Vary the frequency from 350kHz to 25Hz and check for no more than ±1% variation in amplitude. Check for no more than ±3% variation in amplitude at the VIDEO OUTPUT.

8. DC RESTORER

a. Check 60Hz attenuation ≤20%

Connect a composite video signal to EXT SYNC and set the SYNC sw to EXT. Set the SWEEP to 2V and DC RESTORER to OFF. Connect the output of the Low Frequency Sine-wave Generator to A VIDEO INPUT. Set the frequency to 60Hz and adjust the amplitude for 50 IRE units. Change the DC RESTORER to ON. The amplitude of the 60Hz signal must not attenuate by more than 20% (10 IRE units).

Remove the sine-wave generator and the video signal.

b. Check Blanking Level Shift with Burst ≤1 IRE Unit

Connect a video signal, with burst, to A VIDEO INPUT and adjust the amplitude for 140 IRE Units. Change the RESPONSE sw from FLAT to IRE. The back porch level must not shift by more than 1 IRE Unit.

If the shift exceeds 1 IRE unit, recheck with a composite video signal with burst that can be turned on and off.

c. Check Shift with APL Change ≤2 IRE Units

Connect the output of the RGB-APL checker to A VIDEO INPUT (do not terminate). Connect a composite video signal to the EXT SYNC INPUT. Set the SYNC sw to EXT, VOLTS FULL SCALE to a 1V and DC RESTORER to ON. DC couple the input to the TYPE 528 (jumper between TP2 and TP8). Connect a 10V square wave to the test fixture input.

Check for no more than 2 IRE units trace shift while changing the test fixture polarity sw from - to + (10% - 90% APL).

Remove the test fixture and the jumper between TP2 and TP8.

The APL adjustment on the test fixture should be set so there is 60 IRE units shift (DC restorer off) when the polarity sw is changed from + to - (10% - 90% APL).

9. RETURN LOSS

a. Adjust Video Input Return Loss ≤40db

Connect the Return Loss Bridge (067-0576-00) to the TYPE 1A5 inputs. Set the 1A5 DISPLAY to A-B, A INPUT to AC, B INPUT to GND and VOLTS/CM to .2. Connect the TYPE 191 OUTPUT to the input of the Return Loss Bridge. Set the 191 frequency to 5MHz and adjust the amplitude for 1volt. Change the B INPUT to AC, VOLTS/CM to 1mV and note the common mode signal amplitude (should be less than 1mV).

Remove the 75Ω termination from one of the cables on the Return Loss Bridge, connect the cable to the A VIDEO INPUT and connect the terminator to the other connector on the loop through. Adjust the A loop through coil, by squeezing the windings together or pulling apart, for less than 5mV (minus the common mode signal noted previously) residual signal amplitude as viewed on the test scope. Check with all settings of the VOLTS FULL SCALE sw.

Repeat the adjustment on the B VIDEO INPUT coil.

b. Check Ext Sync Return Loss ≤46dB

Connect the cable and the termination to the EXT SYNC inputs. Check for no more than 2.5mV return loss signal amplitude.

c. Check VIDEO OUT Return Loss ≤30dB

Connect one of the cables from the Return Loss Bridge (minus the 75Ω terminator) to the VIDEO OUT. Change the 1A5 VOLTS/CM to 5mV and check for less than 16mV residual signal amplitude

Remove the Return Loss Bridge from the 528 and 1A5. Remove the TYPE 191 signal.

10. STAIRSTEP INPUT

a. Check Sweep Length

RGB 27% -33%
YRGB 20% -25% } *of normal sweep length*

Connect the 9 pin plug from the RGB-APL checker to J370 on the rear panel. Connect a composite video signal to the A VIDEO INPUT. Set the VOLTS FULL SCALE to A 1V, and SWEEP to 2H. Adjust the horizontal position so the sweep starts at the left edge of the graticule.

Note the 2H sweep length. Change the Relay sw on the test fixture to on. Check that the YRGB sweep length, in 2V and 2H, is between 20% and 25% of the normal sweep length.

Solder the shorting strap: between TP263 and TP264, and between TP293 and TP294. Check that the RGB sweep length, in 2V and 2H, is between 27% and 33% of the normal sweep length.

b. Check Deflection Factor

0.945 to 1.28V/DIV

Connect a 10V square-wave from the SAC to the 10V input on the test fixture. Set the polarity sw to + and adjust R304 to position the start of the first sweep to the left edge of the graticule. The distance between the start of the first sweep and the start of the second sweep must be 7.8 to 10.6div.

c. Check DC Level Range (R304)

$\geq$12V

Set the polarity sw to - (minus). Check that R304 has sufficient range to position the start of the first sweep at least 2div to the right of the left edge of the graticule. Change the polarity sw to + and check that R304 can again position the start of the first sweep at least 2div to the right of the left edge of the graticule. Leave R304 at this setting.

d. Adjust Input Compensation (C301)

adjust for optimum square corner

Connect a compensated X10 probe from the test scope to square pin B on the MAIN EC board. Adjust C301 for optimum square corner. Overshoot or rolloff must not exceed 2%.

Remove the test fixture.

11. VIDEO OUT DIFF GAIN/DIFF PHASE

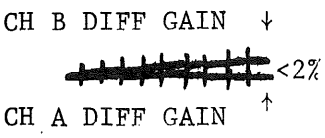
a. Setup

Connect a stairstep signal, with burst, to A VIDEO INPUT and loop through to CH A INPUT on the TYPE 520. Terminate the 520 CH A INPUT with 75Ω. Adjust the stairstep signal for 140IRE Units as displayed on the TYPE 528. Connect the TYPE 528 VIDEO OUT through a 75Ω cable and a 75Ω variable attenuator to the 520 CH B INPUT, do not terminate with 75Ω. Set the TYPE 520 front panel controls as follows:

CH A	Pushed in
CH B	" "
FULL FIELD	" "
CH B	" "
AØ/BØ ALT	" "
DIFF GAIN	" "
Ø REF sw	BURST
GAIN (CH A & CH B)	MAX GAIN
Variable	CAL
LUMINANCE GAIN	CAL

b. Check VIDEO OUT Diff Gain <2%

Adjust the TYPE 520 VERT POSITION to display the diff gain signal. Adjust the 75Ω variable attenuator (in series with CH B signal path) so the last step of the CH B differential gain display overlays the last step of the CH A differential gain display.



The difference between the CH A and CH B differential gain must be less than 2% (10IRE Units).

c. Check VIDEO OUT Differential Phase <3°

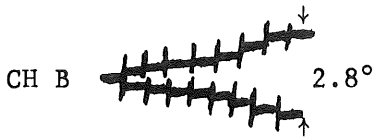
Use same setup as in step a. Depress the DIFF PHASE button and set the CALIBRATED PHASE dial to 0. Adjust the CHANNEL A PHASE control so the two lines (CH A diff phase display) just touch at the point of minimum separation. Adjust the CALIBRATE PHASE so the two lines just touch at the point of maximum separation. Note the CALIBRATED PHASE dial reading and return to 0.

11c. (cont'd)

Adjust the CHANNEL B PHASE control so the two lines (CH B diff phase display) just touch at the point of minimum separation. Adjust the CALIBRATED PHASE so the two lines just touch at the point of maximum separation. Note the dial reading. The difference between the two noted dial readings must be less than 3°.

THE END

EXAMPLE:



DIFF PHASE = 2.8°--1.3° =1.5°