

# INSTRUCTION MANUAL

MODIFICATION INSERT

Serial Number \_\_\_\_\_

7904  
MOD 721K

This insert is provided as a supplement to the instruction manual furnished with this modified instrument. The information given in this insert supersedes that given in the manual.

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This manual supplement describes the special features of MOD 721K as installed in the 7904 Oscilloscope. The instrument has been modified to provide single-shot readout and pulsed graticule illumination. Separate front-panel controls allow either or both features to be used. Rear-panel connectors allow either of the above features to be triggered remotely by a switch closure to ground or by a negative-going pulse (which is available from one of the additional rear-panel connectors).

## CHARACTERISTICS

<u>Characteristic</u>	<u>Information</u>
Graticule Illumination	
Pulsed Mode	
Pulse Timing	Internally adjustable from less than 50 ms to greater than 500 ms. Normally set to 500 ms, $\pm 10\%$ .
PULSED GRAT LIGHTS	
Connector	
Input Resistance	4.8 k $\Omega$ , $\pm 10\%$ 0 V to 5 V. Diode coupled to a capacitive load.
Signal Requirements	Negative-going transition from +5 V to 0 V, $\pm 0.5$ V with a minimum rate of change of $-1$ V/microsecond. For switch closure operation, resistance limits are 10 k $\Omega$ (minimum) to 0 ohm and 0 ohm to 400 ohm (maximum) with the transition taking place in 1 microsecond or less.
Maximum Input	+25 V peak or -5 V peak without instrument damage. Input clamped via 100 ohm to ground for negative input levels.
Recovery Time After	20 ms or 5 time-constants of 4.8 k $\Omega$ and the external cable capacitance (figure 0.5 ms per meter of external cable) whichever is longer.
Readout Mode Switch	The Readout Mode switch S2110 located on the Readout board has been removed. Circuit is permanently wired in the 'Gate

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## CHARACTERISTICS (cont)

<u>Characteristic</u>	<u>Information</u>
Readout Mode Switch (cont)	Trig'd" mode. A readout mode switch has been added to the Remote Control board and functions as an end-of-sweep (remote-internal) readout switch when the readout switch is in the SINGLE position.
Remote Operation	Refer to the above information on PULSED GRAT LIGHTS connector.
Parallel Operation of Several 7904 MOD 721K Instruments	For several SINGLE READOUT and PULSED GRAT ILLUM inputs operating in parallel from a single ground-closure circuit, minimum "open circuit" resistance is multiplied by, and maximum "closed circuit" resistance is divided by the number of inputs paralleled.
END SWP TRIG Connector	
Signal Output	The end-of-sweep signal is an AC-coupled signal derived from the output waveform selected (internal switch) to appear at the front-panel +GATE connector. Normally loaded with a resistance pull-up to +5 V, the signal is clamped at +5 V and appears as a negative-going trigger coincident with the end of the selected sweep. Output amplitude is adequate to trigger either the Pulsed Graticule Illumination or the Single Readout circuit, or both in parallel, on a single-sweep basis. Maximum usable sweep repetition rate as limited by this and other circuits when the Single Readout feature is used, is approximately 10 per second.
Signal Loading	The end-of-sweep signal is isolated from the front-panel +GATE connector, and loading of this signal has negligible effect on the front-panel signal output. Excessive loading of the front-panel + GATE connector, however, may inhibit the rear panel END SWP TRIG signal.

FRONT AND REAR-PANEL  
CONTROLS AND CONNECTORS

The front and rear-panel controls and connectors with their appropriate markings for this modified product differ from that of the standard instrument. The correct controls and connectors with their functions and markings are as follows:

Cathode Ray Tube (CRT)

ASTIG	No change.
A INTENSITY	No change.
FOCUS	Provides adjustment for optimum display definition when the Readout NORM-SINGLE switch is set to NORM.
B INTENSITY	No change.
BEAM FINDER (PULL LOCK)	No change.
READOUT	Name changed to (Readout) OFF-MAX INTEN and physically relocated to Readout control group. The control governs readout intensity only when the NORM-SINGLE switch is set to NORM.
CONTROL ILLUM	Location changed below original position.
TRACE ROTATION	No change.
GRAT ILLUM	Controls graticule illumination continuously in all positions of the control except PULSED.  In the PULSED position of the control the graticule lights are pulsed on by either pushing the PULSED front-panel pushbutton or by supplying a trigger signal to the rear-panel PULSED GRAT LIGHTS connector. The time that the graticule lights remain on is determined by an internal adjustment (R2033).
PULSED (Grat. Illum)	Pushbutton for manually pulsing the graticule lights.
PRESET	Controls the brightness of the graticule lights when the GRAT ILLUM control is set to PULSED.

**NORM - SINGLE** In the NORM position the readout time-shares with the signal display. The SINGLE position inhibits the time-sharing operation and the readout is separately triggered and is displayed for a complete readout display.

**OFF - MAX INTEN** Formerly called READOUT.

**TRIG** Pushbutton for manually triggering the readout display.

**INTEN** Controls the readout intensity when the NORM - SINGLE switch is set to SINGLE.

Mode Selectors

**VERTICAL MODE** No change.

**A TRIGGER SOURCE** No change.

**HORIZONTAL MODE** No change.

**B TRIGGER SOURCE** No change.

**VERT TRACE SEPARATION (B)** No change.

Calibrator

**CALIBRATOR** No change.

**RATE** No change.

Outputs

**+SAWTOOTH** No change.

**+GATE** No change.

**CAL** No change.

Outputs (cont)

40 mA Current Loop      No change.

Ground (Not Labeled)      No change.

SIG OUT      No change.

Rear Panel

Line Selector (Not Labeled)      No change.

PROBE POWER      No change.

Z-AXIS INPUTS      No change.

J1075      No change.

END SWP TRIG      Output connector providing a negative-going pulse at the end of the sweep, that may be used to trigger either or both the single readout and pulsed graticule light circuitry.

SINGLE READOUT      Input connector for applying trigger signal to single readout circuitry, has been relocated from J90 to a separate rear panel BNC connector.

PULSED GRAT LIGHTS      Input connector for applying trigger signal to pulsed graticule light circuitry.

Cord Wrap (Not Labeled)      No change.

CALIBRATION

The following changes and additions to the calibration procedure in the Type 7904 Instruction Manual are necessary to permit making a complete calibration on the Type 7904, MOD 721K Oscilloscope.

Place the READOUT NORM/SINGLE switch to the NORM position. Perform the calibration procedure as directed in the Instruction Manual. Be certain that the NORM/SINGLE switch remains in the NORM position throughout the standard calibration procedure.

After completion of the calibration procedure in the Instruction Manual, perform the following steps:

31. Check SINGLE READOUT and PULSED GRAT ILLUM operation.

- a. Install a horizontal plug-in unit (Type 7B92 recommended) into the A HORIZONTAL TIME BASE compartment. Place HORIZONTAL MODE selector to A.
- b. Set the Time Base Unit (Type 7B92) SOURCE selector to EXT and the MODE to NORM.
- c. Connect the single end of a T-connector to the rear panel End Sweep Trig connector. Connect a 50-ohm coaxial cable from one leg of the T-connector to the rear-panel Single Readout connector. Connect a 50-ohm coaxial cable from the remaining leg of the T-connector to the rear-panel Pulsed Grat Lights connector.
- d. Connect a 50-ohm coaxial cable from a Time Mark Generator (Type 2901 or Type 184 recommended) to the Type 7B92 Plug-In Unit EXT TRIG IN connector. Set the Time Mark Generator for 50 microseconds.
- e. Set the Type 7B92 Time/Div switch to 100  $\mu$ s/div.
- f. Set the READOUT NORM/SINGLE switch to SINGLE, the GRAT ILLUM control to the PULSED position and the internal Readout Mode Switch to (INT). Set R2033 (pulsed Time) and front-panel GRAT ILLUM preset clockwise.
- g. Adjust READOUT INTENSITY screwdriver adjustment for optimum readout display. Check that the adjustment of READOUT INTENSITY control does not affect the intensity of sweep display.
- h. Set the Type 7B92 MODE to SINGLE SWP, and SOURCE to LINE. Set the TIME/DIV switch to .2 seconds.
- i. Press the RESET button on the Type 7B92. Check for a horizontal sweep followed by an illumination of the graticule and a readout display. Set R2033 for a flash duration of 0.5 sec (can be measured at P2014, Pin-1).
- j. Change the TIME/DIV switch to 0.2 ms. Repeat part i.
- k. Change the TIME/DIV switch to 0.5 ns. Repeat part i.
- l. Press the READOUT TRIG button. Check for readout on CRT.
- m. Press the PULSED GRAT ILLUM button. Check for illumination of graticule for approximately 0.5 sec.
- n. Change the internal Readout Mode switch to (REMOTE) then repeat steps h through m.
- o. Set flash duration (R2033) to optimize the range of the front-panel GRAT ILLUM preset for the type of film and camera lens used.
- p. This completes the Calibration Procedure.

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## PARTS LIST

The following changes should be made to the appropriate parts list.  
When ordering replacement parts specify instrument type and MOD number.  
Include circuit number, part number and description of the desired item.

## Electrical

## Semiconductor Device, Diodes

CR1542	Add	152-0141-02	1N4152
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## Inductor

L1541	Add	276-0552-00	4-turns
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## Resistors

R1540	Add	315-0512-00	5.1 k	$\frac{1}{4}$ W	5%
**R1541	Change	311-0237-00	10 k, Var		
R1542	Add	311-1319-00	10 k, Var		
R1544	Change	315-0113-00	11 k	$\frac{1}{4}$ W	5%
R1545	Change	315-0203-00	20 k	$\frac{1}{4}$ W	5%
R1547	Add	308-0218-00	150 $\Omega$	3W, WW	5%
*R2124	Change	037-0050-00	5 k, Var		
R2125	Add	311-1339-01	5 k, Var		

\*Part of S2124

\*\*Part of S1541

## Switches

S122	Change	031-0135-00
***S1541	Add	311-0237-00
S1542	Add	260-0735-00
S2014	Add	260-0735-00
*S2124	Add	037-0050-00
S2125	Add	260-0715-00

\*Part of R2124

\*\*\*Part of R1541



## Electrical (cont)

Remote Control Circuit Board Assembly  
037-6167-00 Complete Board

## Capacitors

C2004	281-0546-00	330 pF	Cer	500 V
C2015	283-0065-02	.001 $\mu$ F	Cer	100 V
C2018	283-0051-00	.0033 $\mu$ F	Cer	100 V
C2025	283-0065-02	.001 $\mu$ F	Cer	100 V
C2028	283-0051-00	.0033 $\mu$ F	Cer	100 V
C2019	283-0003-02	.01 $\mu$ F	Cer	500 V
C2033	290-0535-00	33 $\mu$ F	Fixed	10 V
C2051	283-0003-02	.01 $\mu$ F	Cer	500 V
C2052	283-0003-02	.01 $\mu$ F	Cer	500 V
C2053	283-0003-02	.01 $\mu$ F	Cer	500 V

## Semiconductor Device, Diodes

CR2012	152-0141-02	Silicon	1N4152
CR2014	152-0141-02	Silicon	1N4152
CR2020	152-0141-02	Silicon	1N4152
CR2023	152-0141-02	Silicon	1N4152
CR2102	152-0141-02	Silicon	1N4152
CR2113	152-0141-02	Silicon	1N4152
CR2119	152-0141-02	Silicon	1N4152

## Inductor

L2007	120-0285-00	Toroid 4-turn
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## Transistors

Q2004	151-0221-00	Silicon	2N4258
Q2006	151-0223-00	Silicon	2N4275
Q2035	151-0188-00	Silicon	2N3906
Q2037	151-0190-00	Silicon	2N3904

## Resistors

R2003	315-0301-00	300	1/4 W	5%
R2004	315-0102-00	1 k	1/4 W	5%
R2005	315-0473-00	47 k	1/4 W	5%
R2006	315-0512-00	5.1 k	1/4 W	5%
R2007	315-0301-00	300	1/4 W	5%
R2039	311-1260-00	250	Var	

Electrical (cont)

Resistors (cont)

R2008	315-0102-00	1 k	1/4 W	5%
R2011	315-0101-00	100	1/4 W	5%
R2013	315-0301-00	300	1/4 W	5%
R2014	315-0101-00	100	1/4 W	5%
R2015	315-0475-00	4.7 M	1/4 W	5%
R2018	315-0682-00	6.8 k	1/4 W	5%
R2019	315-0472-00	4.7 k	1/4 W	5%
R2021	315-0101-00	100	1/4 W	5%
R2022	315-0472-00	4.7 k	1/4 W	5%
R2025	315-0475-00	4.7 M	1/4 W	5%
R2028	315-0682-00	6.8 k	1/4 W	5%
R2029	315-0472-00	4.7 k	1/4 W	5%
R2031	315-0102-00	1 k	1/4 W	5%
R2032	315-0472-00	4.7 k	1/4 W	5%
R2033	311-1246-00	50 k	1/2 W	
R2035	315-0202-00	2 k	1/4 W	5%
R2036	315-0272-00	2.7 k	1/4 W	5%
R2037	315-0153-00	15 k	1/4 W	5%
R2038	315-0102-00	1 k	1/4 W	5%
R2041	321-0266-00	5.76 k	1/8 W	1%
R2051	307-0113-00	5.1	1/4 W	5%
R2052	307-0113-00	5.1	1/4 W	5%
R2053	307-0113-00	5.1	1/4 W	5%
R2112	315-0472-00	4.7 k	1/4 W	5%

Switch

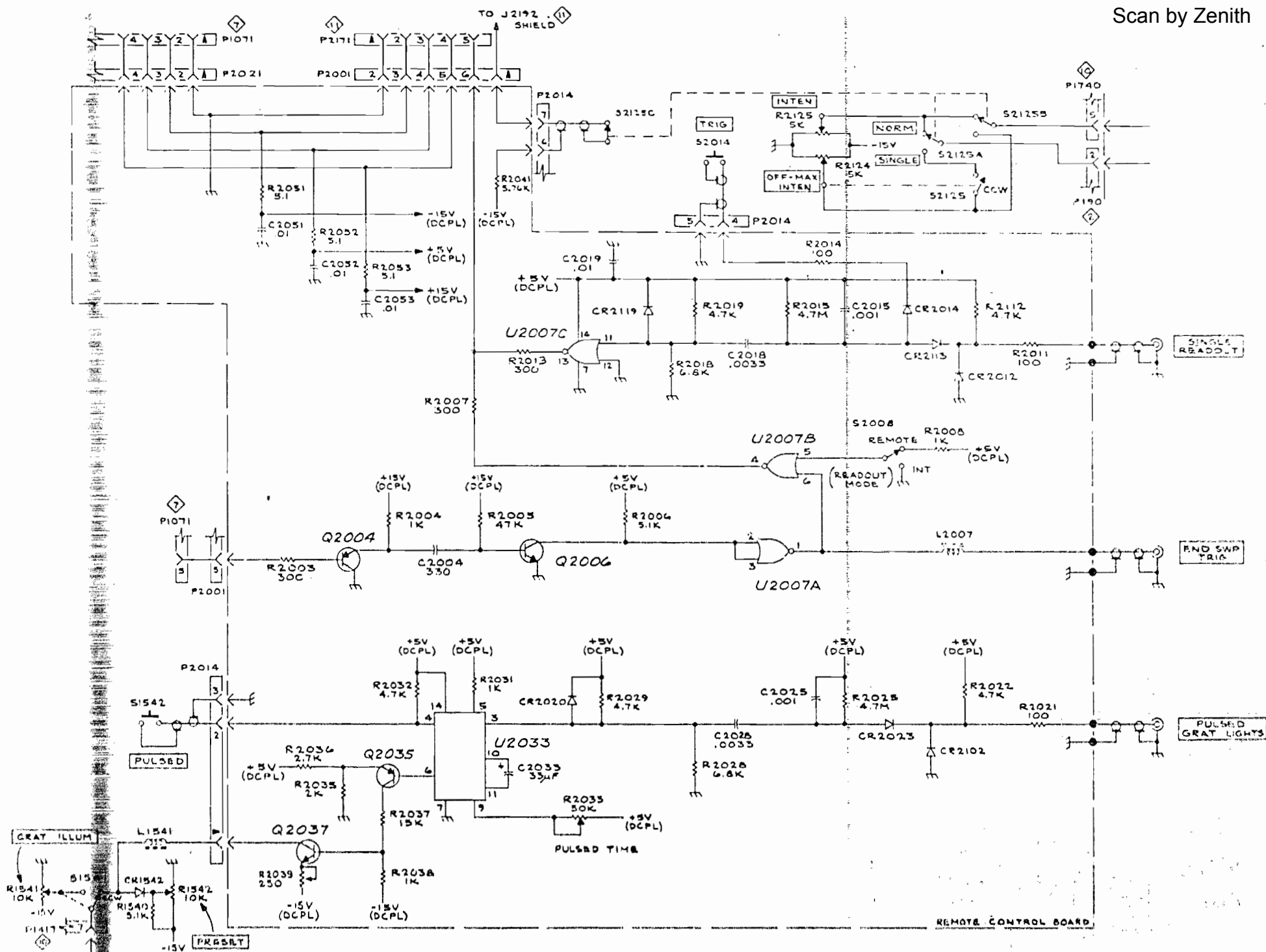
S2008 260-0723-00 Slide, DPDT

Integrated Circuits

U2007 156-0043-00 SN7402N  
U2033 156-0072-00 SN74121N

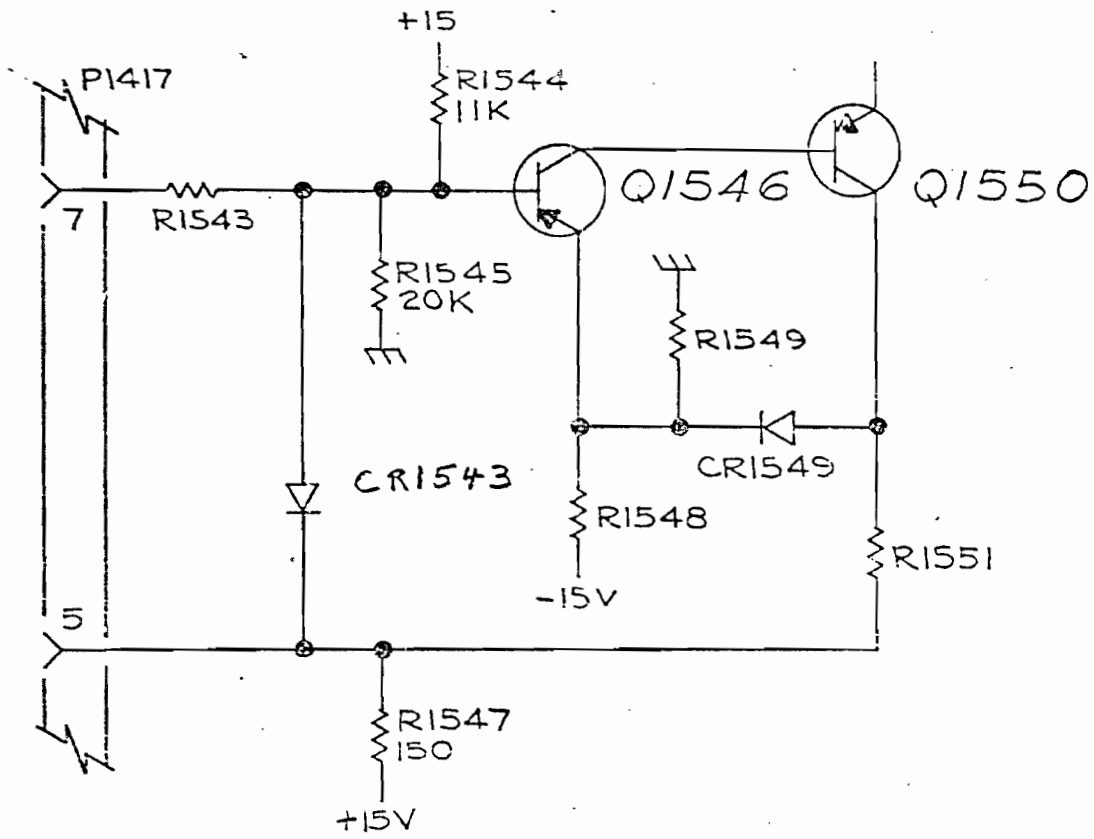
## Mechanical

Terminal, pin, 0.365-inch long	Add	18	131-0608-00
Socket, IC	Add	2	136-0269-00
Socket, pin connector	Add	12	136-0252-04
Cable Harness, Remote Control Board	Add	1	179-0850-00
Chassis, Cal Sig Output board	Change	1	030-0709-03
Subpanel, rear	Change	1	030-0659-04
Frame, front	Change	1	030-0016-05
Panel, rear, film #6514	Change	1	034-0487-00
Panel, front, film #6513	Change	1	034-0486-00
Cover, BNC	Add	3	200-0678-00
Strap, retaining, BNC cover	Add	3	346-0045-00
Holder, terminal, 5-slot, black	Add	1	352-0162-00
Holder, terminal, 5-slot, brown	Add	2	352-0162-01
Holder, terminal, 6-slot, black	Add	1	352-0163-00
Bushing, panel, gray	Add	2	358-0301-00
Bushing, panel, 1/4-32 x 0.275-inch long	Add	2	348-0377-00
Knob, charcoal, 1/4-inch shaft	Add	2	366-1024-00



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1 UNIT R REMOTE CONTROL



PART. L.V. REGULATOR 10

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