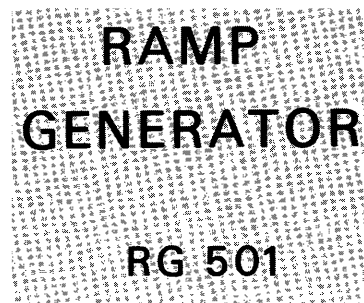


INSTRUCTION MANUAL



Serial Number _____

WARRANTY

All TEKTRONIX instruments are warranted against defective materials and workmanship for one year. Any questions with respect to the warranty should be taken up with your TEKTRONIX Field Engineer or representative.

All requests for repairs and replacement parts should be directed to the TEKTRONIX Field Office or representative in your area. This will assure you the fastest possible service. Please include the instrument Type Number or Part Number and Serial Number with all requests for parts or service.

Specifications and price change privileges reserved.

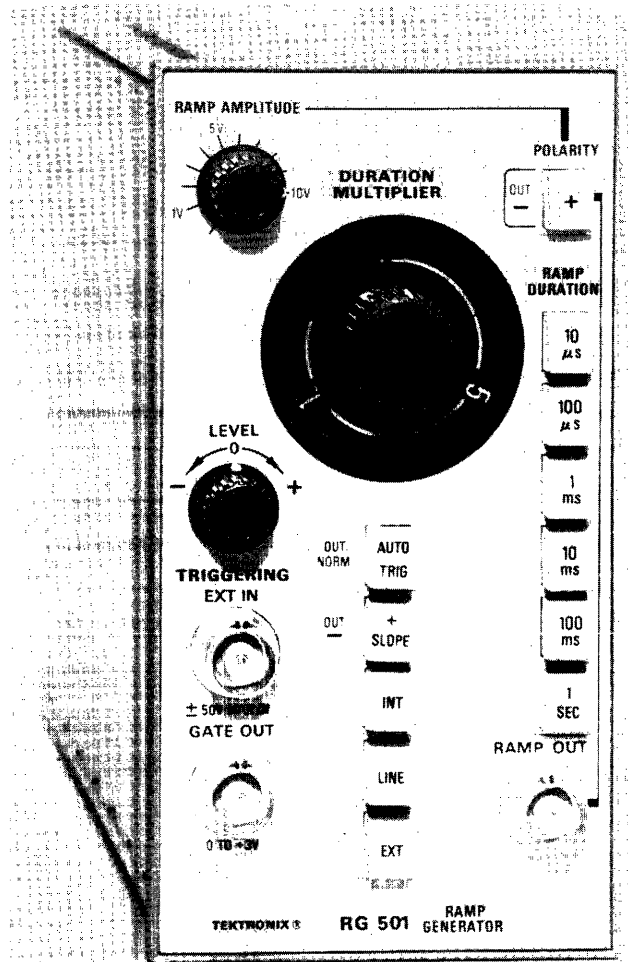
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	Fig. 1 Exploded View



RG 501 Ramp Generator Plug-in Module

SECTION 1 OPERATING INSTRUCTIONS

INSTRUMENT DESCRIPTION

The RG 501 Ramp Generator produces an adjustable 10 V ramp, either positive-going or negative-going, with selectable and variable durations from 10 s to 10 μ s. A TTL-compatible gate signal coincident with the ramp duration is provided at the front panel.

The RG 501 has a full set of oscilloscope-type triggering controls providing normal or automatic triggering, slope and level selection, and triggers from three sources: line, internal, or external via a front panel BNC connector.

The RG 501 operates in a TEKTRONIX TM 500 Series Power Module only. It is a member of the growing family of signal sources in the TM 500 Modular Instrumentation System. It is completely compatible with other members of the system in terms of signal interconnections.

The RG 501 is designed to operate in ambient temperatures between 0°C and +50°C. It can be stored in temperatures ranging from -40°C to +75°C. After storage in these temperatures, allow the RG 501 chassis to return to room ambient before applying power.

PREPARATION FOR USE

Installation and Removal

It is recommended that the Power Module be turned off before inserting or removing the RG 501. Arcing at the connector terminals can reduce contact life. However, no internal damage will result if the ramp generator is inserted into a live Power Module.

Check to see that the white plastic barriers on the interconnecting jack of the selected Power Module compartment match the cut-outs in the RG 501 circuit board edge connector.

Align the RG 501 chassis with the upper and lower guides of the selected compartment. Push the module in and press firmly to seat the circuit board in the interconnecting jack.

To remove the RG 501, pull on the white release latch, located in the lower left corner, until the interconnecting jack disengages and the RG 501 will slide out.

Apply power to the RG 501 by pulling out the power switch knob of the Power Module.

Controls and Connectors

Grasp the tab labeled "Controls, Connectors, and Adjustments" at the rear of the manual and pull it out to

expose the front panel illustration. Even though the RG 501 is fully calibrated and ready to use, the functions and actions of the controls and connectors should be reviewed before attempting any hook-ups. Note that the POLARITY, AUTO TRIG, and SLOPE pushbuttons are push-push actions, while all the rest are self-cancelling actions. Note also that the DURATION MULTIPLIER knob skirt is illuminated from behind. This light is the only visual indication that power is being applied to the RG 501.

Presets

After familiarization with the front panel controls, set them in the following positions to prepare for a basic check-out:

RAMP AMPLITUDE	10 V
DURATION MULTIPLIER	1
POLARITY	In (+)
RAMP DURATION	1 ms
LEVEL	0
AUTO TRIG	In
+ SLOPE	In
INT	Out
LINE	Out
EXT	In

OPERATIONAL CHECK-OUT

If the RG 501 should fail to operate as described in the following check-out steps, consult the adjustment procedure on the foldout page at the rear of the manual. If malfunctions are still present after re-adjustment, consult the System Maintenance section of the Power Module manual for troubleshooting help.

Test Equipment

An oscilloscope system with a dual-channel vertical with Alternate and Added modes and deflection factors from 10 mV to 5 V/div, and a time-base ranging from 1 s to 10 μ s with a 10X magnifier is needed to measure the triggering inputs and the signal outputs of the RG 501.

A time-mark generator with a marker range from 0.1 μ s to 1 s and a trigger range from 1 μ s to 1 s is needed to adequately check the ramp and gate durations.

A sinewave generator with a frequency range to at least 100 kHz and an amplitude variable from 100 mV to at least 2 V peak-to-peak is needed to adequately check the triggering circuits.

See Fig. 1-1 for a typical check-out hook-up.

RAMP OUT

Duration

Using a BNC T-connector and appropriate coaxial cables, connect the time-mark generator and the test scope to the RG 501 as shown in Fig. 1-1. DC-couple the test slope vertical inputs. Set the time-mark generator for 0.1 ms and 10 μ s markers. Set the scope vertical to the Added mode and adjust the deflection factors of each channel to display several divisions of a 10 V ramp with a time-mark comb riding on it. Set the time base for a stable display of one full ramp. Check the display for ten large markers, plus or minus three small markers. Keeping the DURATION MULTIPLIER at 1, check the rest of the RAMP DURATION switch positions in the same fashion, using 10- and 100-marker timing combs.

With any ramp displayed, turn the DURATION MULTIPLIER control throughout its range and observe that the ramp duration can be increased smoothly to at least ten times its initial value. The DURATION MULTIPLIER is not a calibrated control but the 1, 5, and 10 positions on the skirt should be fairly close to that multiple of the selected ramp duration. Using a monitor scope and a timing comb, any ramp duration within the range of the RG 501 can be set with the DURATION MULTIPLIER.

Amplitude

Set the test scope vertical to 2 V/div. Starting with the 10 μ s ramp, set the RAMP AMPLITUDE control fully cw. Observe at least +10 V (5 div) of deflection. Check all the other ramp durations, changing the scope time base as needed. Select —POLARITY from the RG 501 and check for at least –10 V amplitude at all ramp durations.

Set the RAMP AMPLITUDE control fully ccw and set the test scope vertical to 10 mV/div. Observe –50 mV (5 div) or less of deflection for all ramps. Push the POLARITY button and observe +50 mV or less deflection at all ramp durations.

DC Level Between Ramps

Set the test scope vertical to 20 mV/div. Select a ramp and set the RAMP AMPLITUDE for a full-screen display. Position the base line of the ramp at center screen. Ground the vertical input and note that the trace shift does not exceed 1 div. Reverse the polarity of the ramp and test the amount of trace shift in the other direction with respect to ground.

GATE OUT

Amplitude

Connect the RG 501 GATE OUT signal to a test scope vertical set for 1 V/div. Observe a positive-going gate amplitude of +2.4 V to +3.6 V at all ramp durations and both polarities.

Duration

Set the test scope vertical mode to Alternate and display the RG 501 GATE OUT in one channel and the RAMP OUT in the other channel. Externally trigger the test scope time base and the RG 501 from the time-mark generator. Set the RAMP DURATION to 10 μ s and set the time base for several cycles of a triggered display. Keep the external trigger rate close to but slower than the ramp duration. Observe that the gate is at the 3 V level for the duration of the ramp. Check the remaining ramp durations in the same fashion, changing the scope time base and the external trigger rate to maintain a stable display.

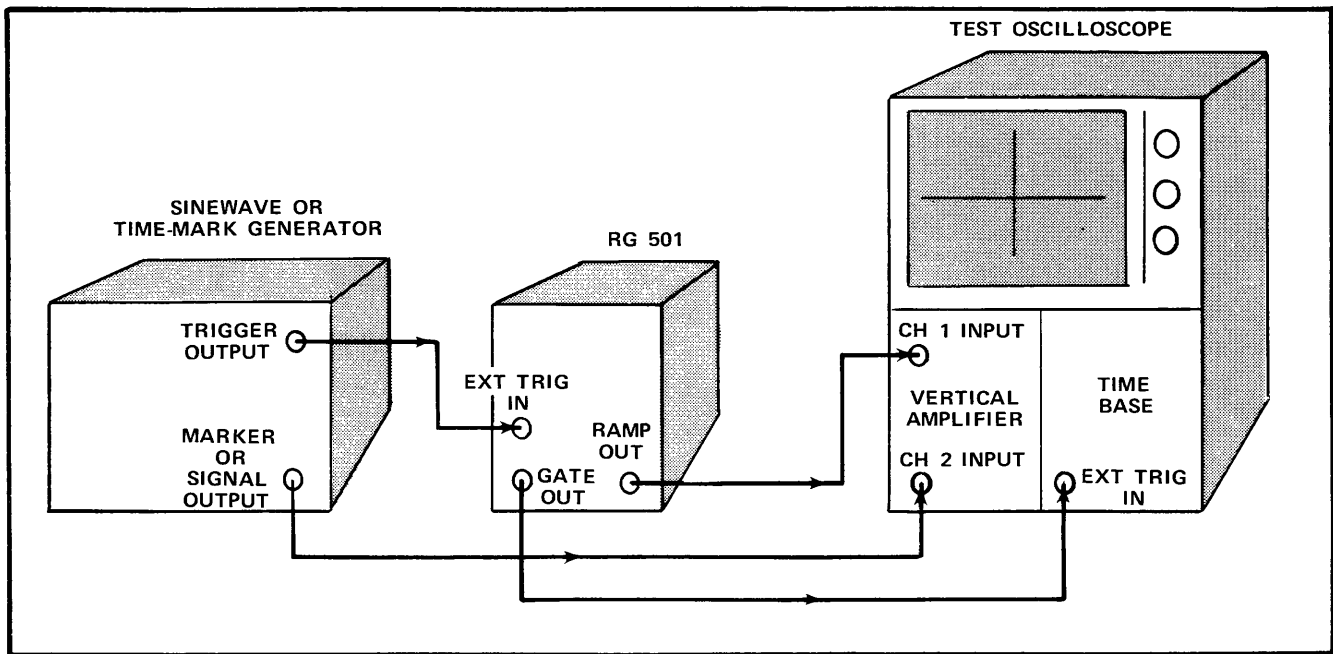


Fig. 1-1. Operational check-out setup.

TRIGGERING

NORM/AUTO TRIG

The Normal Triggered mode (AUTO TRIG button out) provides a repetitive triggered display when the LEVEL control is correctly set in the presence of an adequate triggering signal. Otherwise, the ramp generating circuits remain off and there is no ramp output.

When the Automatic Mode (AUTO TRIG in) is selected, a repetitive triggered ramp is provided when the triggering signal is occurring at a rate of 20 Hz or more and the LEVEL control is properly set. When the trigger rep rate falls below about 20 Hz, or in the absence of an adequate triggering signal, the ramp generator free runs.

Set the RG 501 TRIGGERING to NORM and LEVEL fully cw. Connect the RAMP OUT to the test scope. Select a 1 ms RAMP DURATION. Set the test scope time base to Internal, Auto Triggering, and 2 ms/div. Observe no ramp output for any ramp duration, polarity, amplitude, or trigger source setting. Select AUTO TRIG on the RG 501 and observe a stable ramp display on the test scope.

SLOPE and LEVEL

The SLOPE button determines whether a ramp is initiated on the positive-going or the negative-going portion

of the triggering signal. The LEVEL control determines the voltage level on the triggering waveform at which the ramp is triggered.

Set the RG 501 for about 3 V of a 1 ms positive-going ramp. Set the TRIGGERING controls to NORM, + SLOPE, EXT, and LEVEL to 0. Set the test scope's time-base controls to the same settings. Set the vertical mode to Alternate and set both channels to 0.5 V/div. Establish a zero-volt base line at center screen and DC-couple both inputs. Connect the RG 501 RAMP OUT to one of the channels.

Connect a 1 kHz sinewave to the other channel and adjust the sinewave generator's output for at least 2 V, peak-to-peak. Using BNC T-connectors, connect this same signal to the test scope's External Trigger input and the RG 501's EXT IN.

Adjust the test scope's Level control so that the sinewave display starts a positive-going excursion at the zero-volt reference line. Adjust the RG 501 LEVEL control for a triggered ramp display. Set the time base to 0.5 ms/div.

Using the RG 501 LEVEL control, observe that the ramp start point can be varied over at least a ± 1 V range on the positive slope of the triggering sinewave. Set the RG 501 to - SLOPE and observe that the LEVEL control has the same range on the negative slope of the sinewave.

EXTernal Triggering

External triggering provides a triggered ramp output, time-related to an external signal applied to the EXT IN connector.

Set the RG 501 controls for about 5 V of a positive-going 10 μ s ramp and connect it to one of the test scope's vertical channels. Select NORM, + SLOPE, and EXT. Set the LEVEL control near mid-range.

Using the other channel of the test scope, adjust the output of a sinewave generator for a 100 kHz signal of 200 mV, peak-to-peak, amplitude. Monitor this signal while applying it to the EXT IN connector of the RG 501. Set the test scope vertical mode to Alternate and set the time base to 5 μ s/div. Adjust the LEVEL control of the RG 501 until a ramp appears on the scope display.

Vary the sinewave generator frequency downward to its lowest possible frequency while maintaining at least 200 mV amplitude. Check that the ramp can be triggered throughout this frequency range. At the lower frequencies, change the RG 501 RAMP DURATION and the test scope time base to maintain a useful display. Note that the ramp holdoff time varies directly with the triggering rate.

INTernal Triggering

This mode is operational only when a signal connection has been made to the assigned pin at the rear interface (refer to Fig. 1-5). This mode is especially applicable when the RG 501 is used in a multi-compartment Power Module where intra-compartment connections for a fixed system are possible. Intra-compartment connections with an X-Y Monitor module can convert the X-Y display to a triggered Y-T display. The INT coupling circuit is identical to the EXT circuit. Therefore, the triggering operations are the same.

LINE Triggering

When the LINE button is pushed, a sample of the power-line frequency is connected to the Trigger Generator circuit. The ramp output occurs at the line rate.

Set the test scope time base to Auto Trig and Line. Connect the RG 501 RAMP OUT to the test scope vertical. Select NORM and LINE on the RG 501. Advance the LEVEL control until a triggered ramp display appears on the scope. Adjust the scope's Level control for a stable display. The ramp period should approximate the reciprocal of the line frequency.

APPLICATIONS

Function Generators

The RG 501 ramp is ideally suited to sweep the VCF or VCO inputs of most function generators. Selectable ramp polarity provides for sweeping frequencies up or down. Variable ramp amplitude and duration provide for controlling the range and rate of the frequency sweep. The RG 501 gate out signal provides for synchronizing the swept oscillator to the sweeper input.

A natural application of the RG 501 would be to pair it with another member of the TM 500 Series, the FG 501 Function Generator. The FG 501 frequency can be swept over a 1000:1 range with the RG 501's 0 to 10 V linear ramp. The output of the FG 501 can then be used to test the response characteristics of frequency sensitive circuits. See Fig. 1-2.

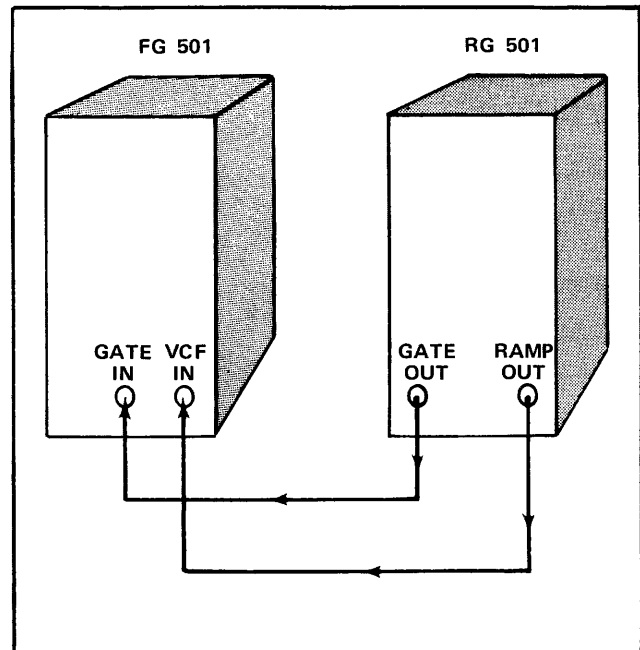


Fig. 1-2. Sweeping and gating a Function Generator synchronously.

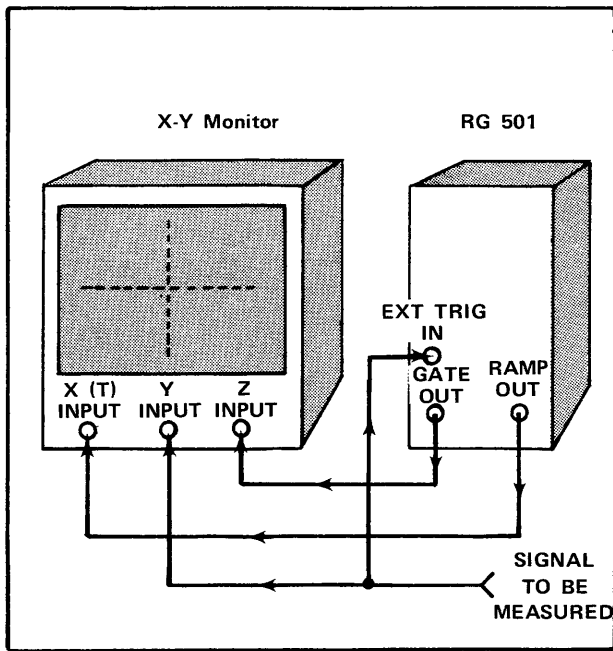


Fig. 1-3. Converting an X-Y display to a Y-T display.

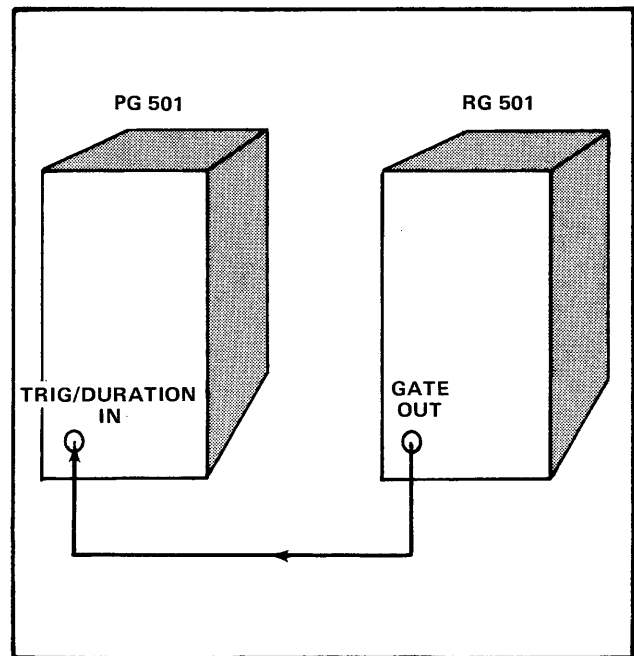


Fig. 1-4. Triggering or gating a Pulse Generator.

X-Y Monitors

The RG 501 can be used as a source for X- and Y-axis signals to convert an X-Y display to a Y-T display. Set the RG 501 to AUTO TRIG and use the RAMP OUT signal to drive the X-axis. A positive-going ramp will sweep most CRT displays from left to right. Vary the RAMP AMPLITUDE for the desired sweep length. The 10-volt range of the RG 501 should give a full-screen scan on just about any X-Y CRT display.

Use the GATE OUT signal, which is coincident with the RAMP OUT, to drive the Z-axis. The gate's +3 V amplitude is sufficient to unblank most CRT's and provide a usable intensity level.

If the event to be displayed in the Y-axis meets the triggering requirements, it can be used to externally trigger the RG 501, producing a stable display when the LEVEL control is correctly set.

Using time marks and a graticule for the CRT display, a calibrated, 3% time base can be generated. See Fig. 1-3.

Pulse Generators

The RG 501 can be used as a source for externally triggering pulse generators, such as the TM 500 Series PG 501 Pulse Generator. For applications where the pulse output period is controlled by the period of the triggering signal, such as the PG 501's External Trigger Mode, the fast-rising GATE OUT signal from the RG 501 can provide periods ranging from about 20 μ s (50 kHz) to about 10 s (0.1 Hz) at voltage levels sufficient to trigger and reset the PG 501.

For applications where the pulse output period and duration are dependent on the period and duration of the triggering signal, such as the PG 501's External Duration Mode, the RG 501 can provide gating periods ranging from about 20 μ s to about 10 s and gate durations from 10 μ s, within 3%, to 1 s, within 3%, and to about 11 s, using the uncalibrated DURATION MULTIPLIER. See Fig. 1-4.

The RG 501 RAMP OUT signal can be used as a calibrated delay trigger source for external trigger circuits having fixed trigger thresholds within the range of the RAMP AMPLITUDE control.

REAR INTERFACE

I/O Assignments

The RAMP OUT and GATE OUT signals are routed to the rear connector in parallel with the front panel outputs. An internal trigger input circuit is also available at the rear connector. This circuit is separate but identical to the EXT input and is selected at the front panel by pushing the INT button. See Fig. 1-5 for the signal assignments and pin numbers at the rear connector. These assignments are in addition to the standard TM 500 Series Power Module/plug-in module interconnections (see the Service section of a Power Module manual).

System Considerations

All signal source plug-in modules of the TM 500 Series have a key-slot cut between pins 23 and 24 of the edge connector. Once a Power Module compartment has been wired with specialized interconnections for RG 501 or other signal source plug-ins, a barrier should be installed in that compartment to match the key-slot. For extra barriers, order TEKTRONIX part number 214-1543-00.

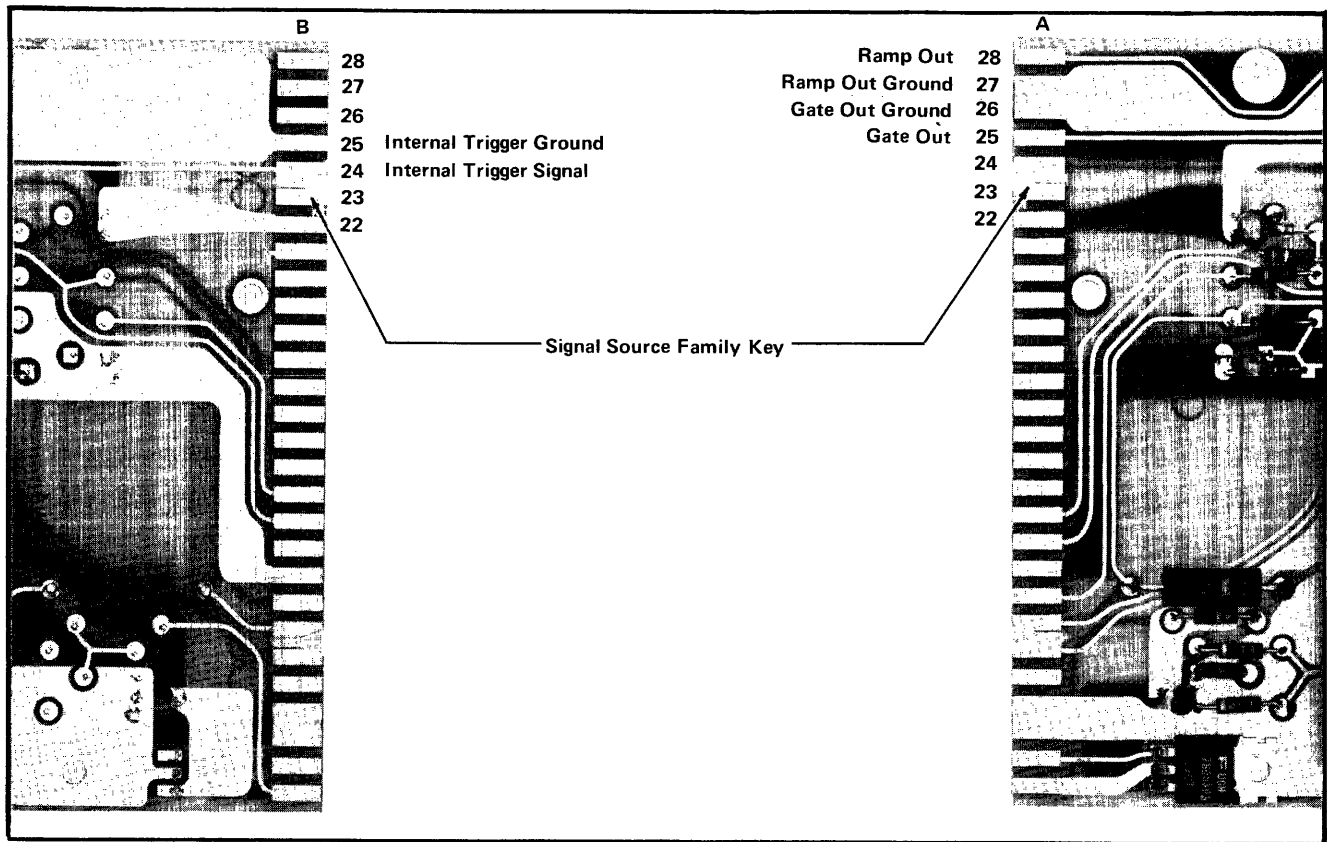


Fig. 1-5. I/O assignments at rear connector.

SPECIFICATIONS

Ramp

Duration. Range, 1 s to 10 μ s; Multiplier, X1 to at least X10; Accuracy, within 3% with MULTIPLIER set to 1 (MULTIPLIER not calibrated).

Linearity. Within 2% of a straight-line plot.

Amplitude. Range, variable from 50 mV or less to at least 10 V, either polarity; DC Level Between Ramps, 0 V, within 20 mV; Driving Capability, 3 k Ω minimum,, 300 pF maximum.

Gate

Duration. Coincident with ramp.

Amplitude. TTL-compatible, 0 V, within 100 mV, to +3 V, within 0.6 V; Risetime, 100 ns or less; Falltime, 100 ns or less.

Source Impedance. 160 Ω , within 5%.

Triggering

Level. Range, at least ± 1 V.

Auto. Sweep circuit free-runs in absence of an adequate internal or external signal or in the presence of a signal running at 20 Hz or less.

External. Sensitivity, at least 200 mV peak-to-peak; Response, DC to at least 100 kHz; Input Impedance, 10 k Ω to 20 k Ω , diode-protected; Max Input Voltage, 50 V (DC + peak AC).

Internal. Same as External except that the trigger input is via the rear interface.

Line. Triggers at the line frequency.

Other

Temperature. Operating, 0°C to +50°C; Nonoperating, -40°C to +75°C.

Altitude. Operating, To 15,000 feet; Nonoperating, To 50,000 feet.

SECTION 2 SERVICE INFORMATION

DIAGRAMS, PARTS LISTS, AND ILLUSTRATIONS

Symbols and Reference Designators

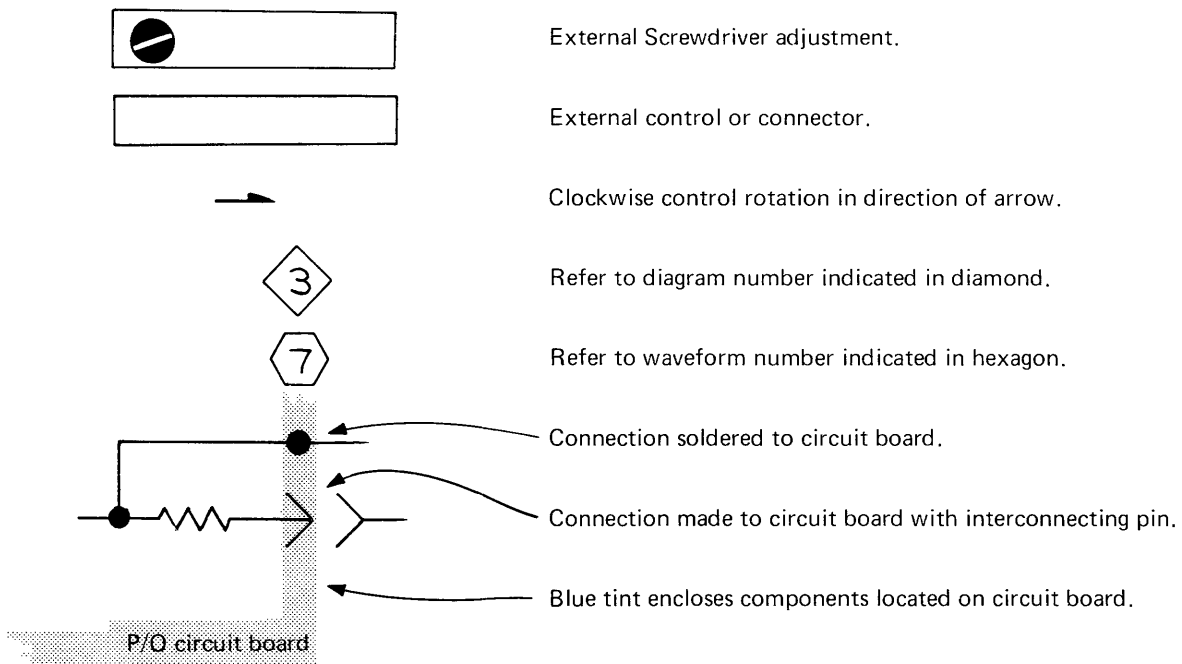
Electrical components shown on the diagrams are in the following units unless noted otherwise:

- Capacitors = Values one or greater are in picofarads (pF).
Values less than one are in microfarads (μ F).
- Resistors = Ohms (Ω)

Symbols used on the diagrams are based on ANSI Y32.2 – 1970.

Logic symbology is based on MIL-STD-806B in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The following special symbols are used on the diagrams:



ELECTRICAL PARTS LIST

Replacement parts should be ordered from the Tektronix Field Office or Representative in your area. Changes to Tektronix products give you the benefit of improved circuits and components. Please include the instrument type number and serial number with each order for parts or service.

ABBREVIATIONS AND REFERENCE DESIGNATORS

A	Assembly, separable or repairable	FL	Filter	PTM	paper or plastic, tubular molded
AT	Attenuator, fixed or variable	H	Heat dissipating device (heat sink, etc.)	R	Resistor, fixed or variable
B	Motor	HR	Heater	RT	Thermistor
BT	Battery	J	Connector, stationary portion	S	Switch
C	Capacitor, fixed or variable	K	Relay	T	Transformer
Cer	Ceramic	L	Inductor, fixed or variable	TP	Test point
CR	Diode, signal or rectifier	LR	Inductor/resistor combination	U	Assembly, inseparable or non-repairable
CRT	cathode-ray tube	M	Meter	V	Electron tube
DL	Delay line	Q	Transistor or silicon-controlled rectifier	Var	Variable
DS	Indicating device (lamp)	P	Connector, movable portion	VR	Voltage regulator (zener diode, etc.)
Elect.	Electrolytic	PMC	Paper, metal cased	WW	wire-wound
EMC	electrolytic, metal cased	PT	paper, tubular	Y	Crystal
EMT	electrolytic, metal tubular				
F	Fuse				

Ckt. No.	Grid Loc	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
ASSEMBLY					
A1		670-2213-00			MAIN Circuit Board Assembly
CAPACITORS					
C5	J4	281-0523-00			100 pF, Cer, 350 V, 20%
C8	B4	281-0523-00			100 pF, Cer, 350 V, 20%
C10	B5	283-0187-00	B010100	B029999	0.047 μF, Cer, 400 V, 10%
C10	B5	283-0341-00	B030000		0.047 μF, Cer, 100 V, 10%
C15	D3	281-0523-00			100 pF, Cer, 350 V, 20%
C35	G3	290-0247-00			5.6 μF, Elect., 6 V, 10%
C37	K5	290-0244-00			0.47 μF, Elect., 35 V, 5%
C38	K5	281-0525-00			470 pF, Cer, 500 V, 20%
C40	G3	281-0504-00			100 pF, Cer, 500 V, 10%
C42	H3	283-0177-00			1 μF, Cer, 25 V, +80%-20%
C50	F3	283-0003-00			0.01 μF, Cer, 150 V, +80%-20%
C53	H3	281-0518-00			47 pF, Cer, 500 V, 20%
C54	H2	281-0523-00			100 pF, Cer, 350 V, 20%
C55	H3	281-0184-00			2-18 pF, Plastic, 500 V
C56	K3	283-0633-00			77 pF, Mica, 100 V, 1%
C57	K2	295-0161-00			0.001 μF
C58	K3				0.01 μF
C59	K3				0.1 μF, Matched set
C60	K4				1 μF
C61	K5				10 μF

¹Individual timing capacitors in this assembly must be ordered by the 9-digit part number, letter suffix and tolerance printed on the timing capacitor to be replaced.

Example:

285-XXXX-XX F-

The letter suffix and the tolerance should be the same for all the timing capacitors in the assembly.

ELECTRICAL PARTS LIST (cont)

Ckt No.	Grid Loc	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
CAPACITORS (cont)					
C88	J1	290-0512-00			22 μ F, Elect., 15 V, 20%
C98	J3	283-0111-00			0.1 μ F, Cer, 50 V,
C100	B3	290-0512-00			22 μ F, Elect., 15 V, 20%
C102	D3	290-0527-00			15 μ F, Elect., 20 V, 20%
C110	B5	290-0527-00			15 μ F, Elect., 20 V, 20%
C120	B2	290-0512-00			22 μ F, Elect., 15 V, 20%
C122	E2	290-0527-00			15 μ F, Elect., 20 V, 20%
DIODES					
CR5	J5	152-0141-02			Silicon, replaceable by 1N4152
CR6	J5	152-0141-02			Silicon, replaceable by 1N4152
CR8	B4	152-0141-02			Silicon, replaceable by 1N4152
CR9	B4	152-0141-02			Silicon, replaceable by 1N4152
CR21	F2	152-0141-02			Silicon, replaceable by 1N4152
CR44	F2	152-0141-02			Silicon, replaceable by 1N4152
CR71	H2	152-0141-02			Silicon, replaceable by 1N4152
CR72	I2	152-0141-02			Silicon, replaceable by 1N4152
CR80	I2	152-0141-02			Silicon, replaceable by 1N4152
CR89	K2	152-0141-02			Silicon, replaceable by 1N4152
VR100	B3	152-0243-00			Zener, replaceable by 1N965B, 0.4 W, 15 V, 5%
VR120	B2	152-0212-00			Zener, selected from 1N936, 0.5 W, 9 V, 5%
BULB					
DS56	Chassis	150-0107-00			Incandescent, 0.04A
CONNECTORS					
J40	Chassis	131-0955-00			Receptacle, electrical, BNC, female
J45	Chassis	131-0955-00			Receptacle, electrical, BNC, female
J90	Chassis	131-0955-00			Receptacle, electrical, BNC, female
INDUCTOR					
L85	L2	120-0407-00			Toroid, 5 turns, single
TRANSISTORS					
Q15	E3	151-0219-00			Silicon, PNP, replaceable by 2N4250
Q44	G2	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q46	G2	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q70A,B	H2	151-0232-00			Silicon, NPN, replaceable by NS7348 or selected from 2N2919, dual
Q78	H2	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q82	I2	151-0103-00			Silicon, replaceable by 2N2219
Q90	I2	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q92	J2	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q100	D3	151-0302-00			Silicon, NPN, replaceable by 2N2222A
Q120	D2	151-0301-00			Silicon, PNP, replaceable by 2N2907
RESISTORS					
R5	J5	315-0103-00			10 k Ω , 1/4 W, 5%
R8	B4	315-0103-00			10 k Ω , 1/4 W, 5%
R10	B5	315-0104-00			100 k Ω , 1/4 W, 5%
R12	B5	315-0473-00			47 k Ω , 1/4 W, 5%
R13	B5	315-0432-00			4.3 k Ω , 1/4 W, 5%
R15	D4	315-0103-00			10 k Ω , 1/4 W, 5%
R18	E2	315-0152-00			1.5 k Ω , 1/4 W, 5%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Grid Loc	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)					
R19	E2	315-0201-00			200 Ω , 1/4 W, 5%
R21	E3	315-0103-00			10 k Ω , 1/4 W, 5%
R23		315-0473-00	XB040000		47 k Ω , 1/4 W, 5%
R25	F4	315-0392-00			3.9 k Ω , 1/4 W, 5%
R27	Chassis	311-1368-00			5 k Ω , Var
R30	F3	315-0682-00			6.8 k Ω , 1/4 W, 5%
R32	E3	315-0682-00			6.8 k Ω , 1/4 W, 5%
R33	E3	315-0682-00			6.8 k Ω , 1/4 W, 5%
R35	G3	315-0223-00			22 k Ω , 1/4 W, 5%
R37	J4	315-0303-00			30 k Ω , 1/4 W, 5%
R39	K4	315-0104-00			100 k Ω , 1/4 W, 5%
R40	H2	315-0682-00			6.8 k Ω , 1/4 W, 5%
R41	K4	315-0105-00			1 M Ω , 1/4 W, 5%
R42	H3	315-0621-00			620 Ω , 1/4 W, 5%
R44	F2	315-0512-00			5.1 k Ω , 1/4 W, 5%
R46	F2	315-0471-00			470 Ω , 1/4 W, 5%
R47	F1	315-0161-00			160 Ω , 1/4 W, 5%
R50	F5	311-1370-00			2 k Ω , Var
R51	F3	321-0262-00			5.23 k Ω , 1/8 W, 1%
R52	G4	321-0282-00			8.45 k Ω , 1/8 W, 1%
R53	G3	315-0682-00			6.8 k Ω , 1/4 W, 5%
R54	H2	315-0101-00			100 Ω , 1/4 W, 5%
R55	I3	321-0406-02			165 k Ω , 1/8 W, 1/2%
R56	Chassis	311-1365-00	B010100	B010244	50 k Ω , Var
R56	Chassis	311-1470-00	B010245		50 k Ω , Var
R57	B5	303-0511-00			510 Ω , 1 W, 5%
R59	J3	321-0253-00			4.22 k Ω , 1/8 W, 1%
R63	I3	311-1226-00			2.5 k Ω , Var
R65	I4	321-0126-00			200 Ω , 1/8 W, 1%
R66	I3	315-0153-00			15 k Ω , 1/4 W, 5%
R67	H2	321-0193-00			1 k Ω , 1/8 W, 1%
R69	H1	321-0356-00			49.9 k Ω , 1/8 W, 1%
R70	G1	311-1363-00			50 k Ω , Var
R72	I3	315-0752-00			7.5 k Ω , 1/4 W, 5%
R74	H1	321-0251-00			4.02 k Ω , 1/8 W, 1%
R75	I1	321-0193-00			1 k Ω , 1/8 W, 1%
R76	I1	315-0153-00			15 k Ω , 1/4 W, 5%
R78	I1	315-0302-00			3 k Ω , 1/4 W, 5%
R79	I1	315-0123-00			12 k Ω , 1/4 W, 5%
R81	I2	315-0222-00			2.2 k Ω , 1/4 W, 5%
R83	I2	315-0101-00			100 Ω , 1/4 W, 5%
R84	K1	307-0103-00			2.7 Ω , 1/4 W, 5%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Grid Loc	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)					
R85	Chassis	311-1369-00			1 k Ω , Var
R86	K2	321-0260-00			4.99 k Ω , 1/8 W, 1%
R88	J1	315-0100-00			10 Ω , 1/4 W, 5%
R89	J1	315-0202-00			2 k Ω , 1/4 W, 5%
R90	J2	311-1363-00			50 k Ω , Var
R92	K2	321-0452-00			499 k Ω , 1/8 W, 1%
R94	K2	321-0261-00			5.11 k Ω , 1/8 W, 1%
R95	J3	315-0103-00			10 k Ω , 1/4 W, 5%
R97	J2	315-0202-00			2 k Ω , 1/4 W, 5%
R98	J3	303-0221-00			220 Ω , 1 W, 5%
R100	B3	315-0302-00			3 k Ω , 1/4 W, 5%
R102	D3	307-0105-00			3.9 Ω , 1/4 W, 5%
R120	B2	315-0242-00			2.4 k Ω , 1/4 W, 5%
R122	D2	307-0105-00			3.9 Ω , 1/4 W, 5%
R124	D2	321-0268-00			6.04 k Ω , 1/8 W, 1%
R126	B2	321-0285-00			9.09 k Ω , 1/8 W, 1%
SWITCHES					
S10A	C6	260-1437-00			Push, TRIGGERING
S10B	C5				
S10C	C5				
S10D	C4				
S10E	C4				
S50A	L2	260-1438-00			Push, RAMP DURATION
S50B	L3				
S50C	L3				
S50D	L4				
S50E	L4				
L50F	L5				
S90	L1	260-1208-00			Push-push, POLARITY
INTEGRATED CIRCUITS					
U30	H3	155-0056-00			Monolithic, sweep control
U50	F2	155-0042-03			Monolithic, Miller integrator and delay pickoff
U100	C3	156-0067-00			Operational amplifier, replaceable by UA741C
U110	B6	156-0277-00			Voltage regulator, replaceable by UA7805
U120	C2	156-0067-00			Operational amplifier, replaceable by UA741C

INTERNAL ADJUSTMENT PROCEDURE

Services Available

Tektronix, Inc. provides complete instrument repair and adjustment at local Field Service Centers and at the Factory Service Center. Contact your local TEKTRONIX Field Office or representative for further information.

Test Equipment

For measurement of the power supply voltages, a 20,000 ohms/volt VOM will give satisfactory measurements.

For making duration and offset adjustments, a wideband oscilloscope system with a dual-channel vertical having an added display mode, and a time-mark generator with at least 0.1 μ s marker range will give satisfactory measurements.

Preparation

The RG 501 can be operated either fully installed in a TM500-series Power Module, or connected to the Power Module via a flexible plug-in extender (TEKTRONIX Part No. 067-0645-01). If the RG 501 is to be adjusted inside, the Power Module cabinet must be removed. All the RG 501 adjustments are located on the right side (facing the instrument) of the circuit board.

Although instrument performance is valid over the range 0°C to +50°C, make adjustments at an ambient temperature between +20°C and +30°C.

Power Supplies

Before making any adjustments, check the DC power supplies at the points labeled in the Adjustment Location illustration. Check for +15 V, -15 V, and +5 V, all within 5%, with a multimeter.

10 μ s Timing

This adjustment can be made at any time without affecting other adjustments.

Set the RG 501 for a 10 μ s RAMP DURATION (DURATION MULTIPLIER at 1), and select 1 μ s and 0.1 μ s markers from the time-mark generator. With the oscilloscope set to the Added mode, monitor the timing comb riding on the RG 501 ramp signal. Adjust C55, 10 μ s Timing, for 10 major markers, plus or minus 3 markers.

X11 Ramp Cal

This adjustment can be made at anytime for any RAMP DURATION setting without affecting other adjustments.

Set the RG 501 DURATION MULTIPLIER fully ccw and select any RAMP DURATION. From a time-mark generator, select a timing comb of 10 markers for one RG 501 ramp duration. With the oscilloscope set to the Added mode, monitor the markers riding on the RG 501 ramp.

Adjust R63, X11 Ramp Cal, for at least eleven markers on the ramp. This adjustment can be made for any RAMP DURATION selection.

X1 Ramp Length

This adjustment affects the X11 Ramp Cal and the 10 μ s Timing adjustments. Be sure to make these adjustments if the X10 Ramp Length is changed.

Set the RG 501 DURATION MULTIPLIER to 1 and select any RAMP DURATION. From a time-mark generator, select a timing comb of 10 major and 100 minor markers for one RG 501 ramp duration. With the oscilloscope set to the Added mode, monitor the timing comb riding on the RG 501 ramp.

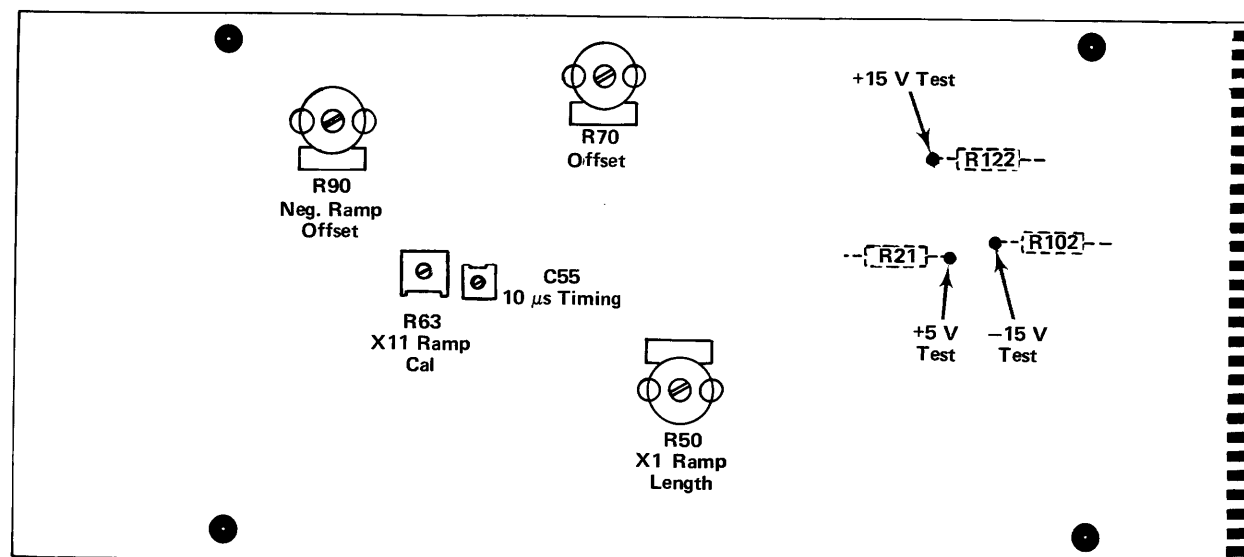
Adjust R50, X1 Ramp Length, for 10 major markers, plus or minus 3 minor markers. This adjustment can be made for any RAMP DURATION selection.

Ramp Start Offsets

These adjustments can be made at any time, with any setting, without affecting other adjustments.

Establish a zero-volts (ground) reference point on the oscilloscope display. DC-couple a positive-going ramp from the RG 501 to the vertical. (Do not overdrive the vertical.)

Adjust R70, offset, until the ramp start potential matches the ground reference level. Change the RG 501 POLARITY to minus and adjust R90, Negative Ramp Offset, until the ramp start potential matches the ground reference level.



RAMP
Varies the rate of the 50 mV greater end.

DURATION
Varies the DURATION (calibration) to about end. Co in betw

L1
Varies the on the which window

EX
BNC c an in trigger

GATE
BNC c front-pa Gate coincide signal.

W
Pull-to

ANAL ADJUSTMENT PROCEDURE

X11 Ramp Cal

This adjustment can be made at anytime for any RAMP DURATION setting without affecting other adjustments.

Set the RG 501 DURATION MULTIPLIER fully ccw and select any RAMP DURATION. From a time-mark generator, select a timing comb of 10 markers for one RG 501 ramp duration. With the oscilloscope set to the Added mode, monitor the markers riding on the RG 501 ramp.

Adjust R63, X11 Ramp Cal, for at least eleven markers on the ramp. This adjustment can be made for any RAMP DURATION selection.

X1 Ramp Length

This adjustment affects the X11 Ramp Cal and the 10 μ s Timing adjustments. Be sure to make these adjustments if the X10 Ramp Length is changed.

Set the RG 501 DURATION MULTIPLIER to 1 and select any RAMP DURATION. From a time-mark generator, select a timing comb of 10 major and 100 minor markers for one RG 501 ramp duration. With the oscilloscope set to the Added mode, monitor the timing comb riding on the RG 501 ramp.

Adjust R50, X1 Ramp Length, for 10 major markers, plus or minus 3 minor markers. This adjustment can be made for any RAMP DURATION selection.

Ramp Start Offsets

These adjustments can be made at any time, with any setting, without affecting other adjustments.

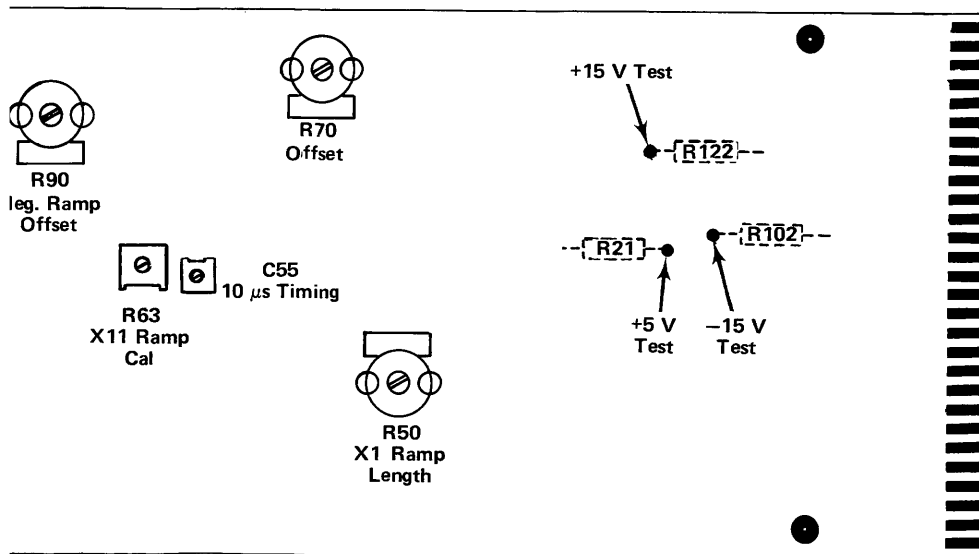
Establish a zero-volts (ground) reference point on the oscilloscope display. DC-couple a positive-going ramp from the RG 501 to the vertical. (Do not overdrive the vertical.)

Adjust R70, offset, until the ramp start potential matches the ground reference level. Change the RG 501 POLARITY to minus and adjust R90, Negative Ramp Offset, until the ramp start potential matches the ground reference level.

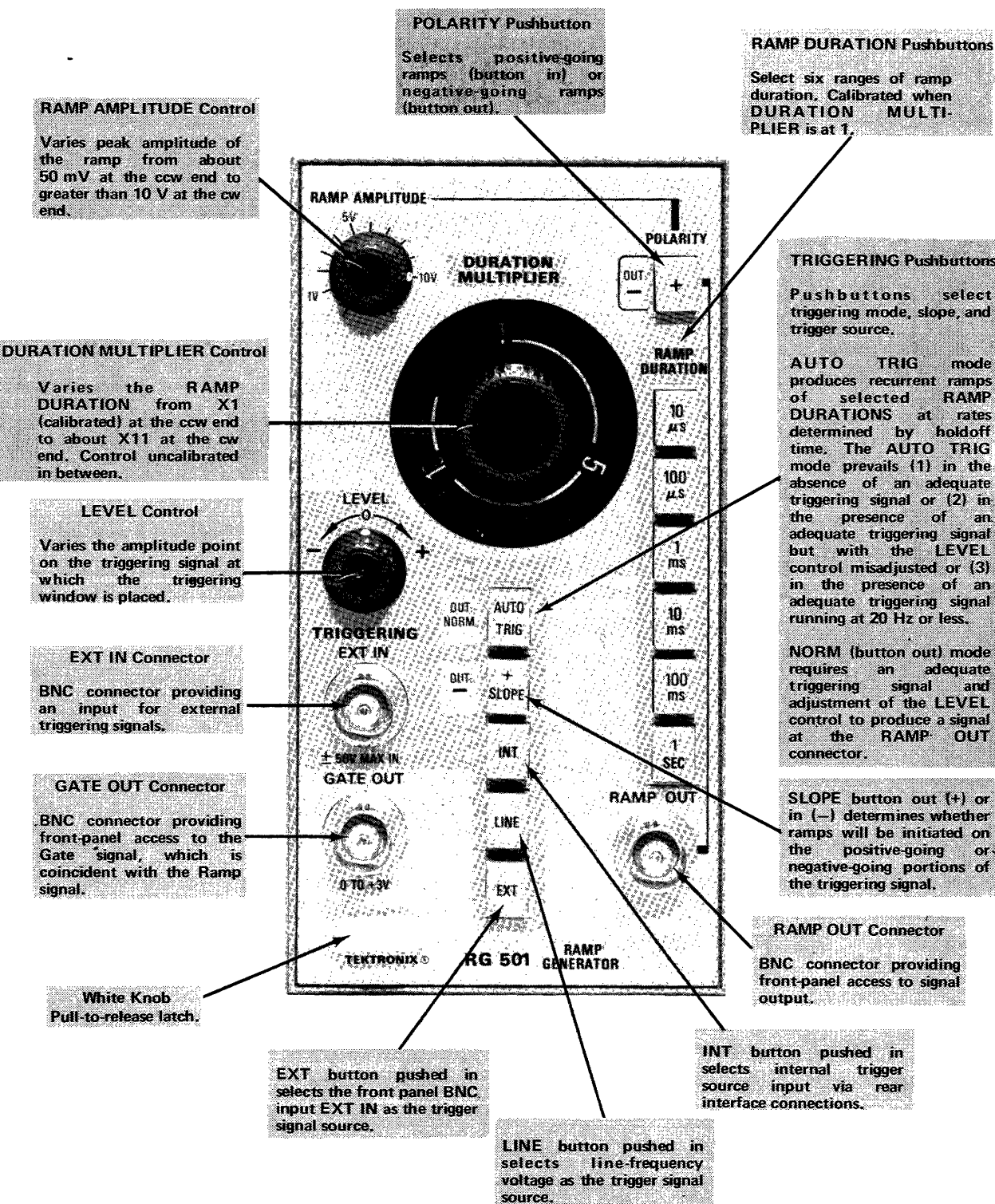
Adjustments, check the DC power supply in the Adjustment Location for -15 V, and +5 V, all within

made at any time without

a 10 μ s RAMP DURATION setting at 1), and select 1 μ s and time-mark generator. With the oscilloscope set to the Added mode, monitor the timing comb riding on the RG 501 ramp. Adjust C55, 10 μ s timing, plus or minus 3 markers.



FRONT PANEL CONTROLS AND CONNECTORS



ADJUSTMENTS

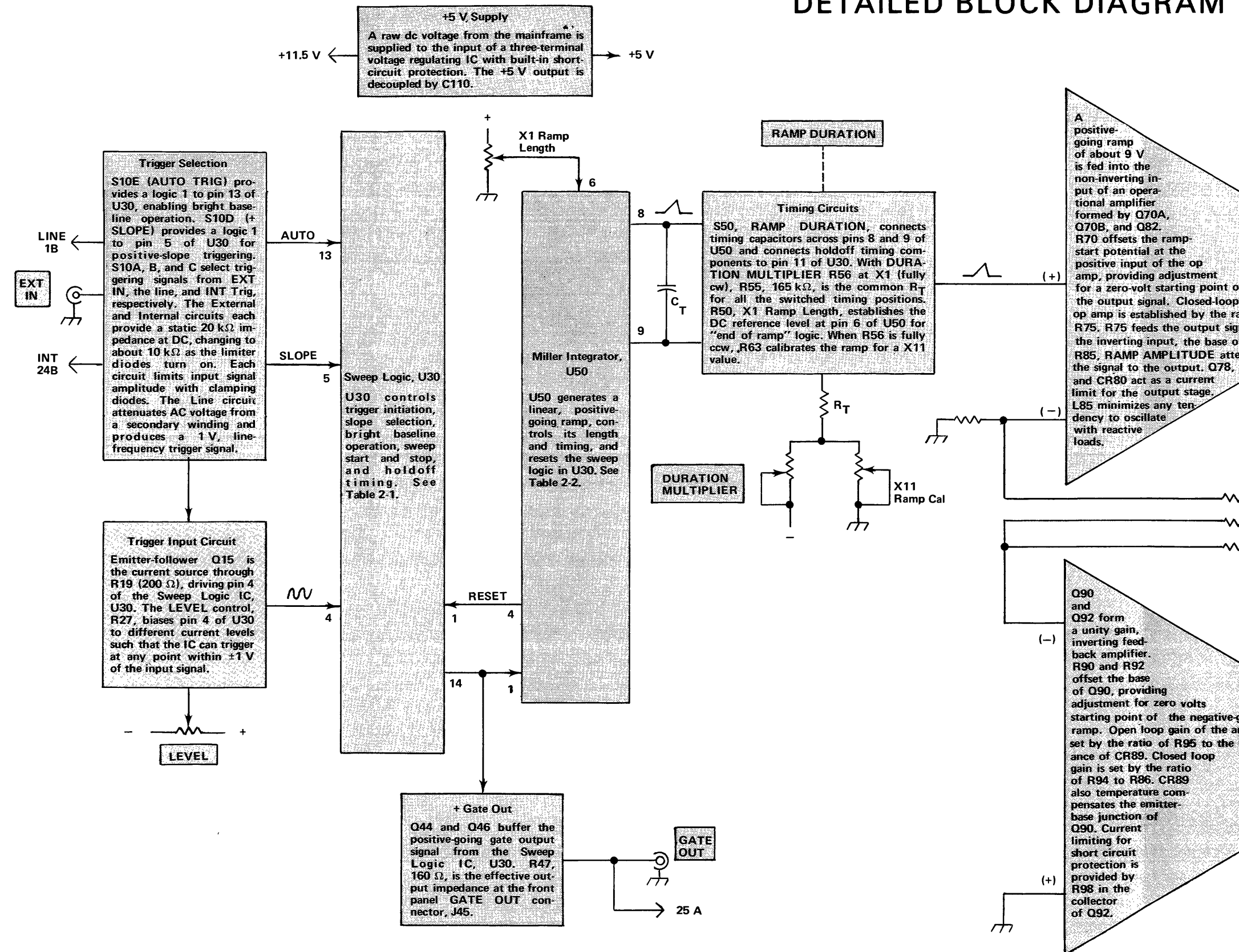
TABLE 2-1
Sweep Logic U30

Pin	Function
1, Reset	Current (logic 1, high state) for at least 20 ns ends ramp, regardless how far the ramp has run up. No current (logic 0, low state) allows U30 to operate.
3, Ground	Circuit ground.
4, Trigger Input	Analog input, low impedance. Accepts analog current trigger signal. Trigger threshold: Zero current, $\pm 100 \mu\text{A}$.
5, Slope Select	Logic 1 permits trigger to be initiated on the positive slope of the trigger signal. Logic 0 permits trigger to be initiated on the negative slope of the trigger signal.
6, Not Used	Held at logic 1.
8, GND, Uubstrate	Reference ground.
11, Holdoff Timing	Connects timing components which set trigger lockout period after end of ramp. Holdoff capacitor discharges when ramp starts and holdoff timing starts at end of ramp as holdoff cap charges. When upper threshold is reached, a new ramp can be started.
12, Bright Baseline Timing/Off	Used in Auto Triggered Mode to connect timing components which set bright baseline off period after trigger recognition. If triggering signal is absent or occurring at a rate less than 20 hertz, capacitor charges toward +3.5-volt threshold. Above this level, U30 is conditioned to provide a free running sweep at a rate determined by the sweep timing and holdoff RC. As soon as a trigger arrives at pin 4 of U30, pin 12 is driven to ground and C35 is discharged.
13, Bright Baseline Control	Current into pin (logical 1) for ≥ 20 ns keeps pin 12 at ground, holding Bright Baseline off. Baseline remains off for one timing period after current level is removed. No input (logical 0) allows Bright Baseline to function (see pin 12).
14, + Gate Out	Provides a +5 V (logic 1) source through R40 during ramp runup, driving current into pin 1 of the Miller Integrator. Logic 0 ends ramp.
16, Power Supply	Provides V_{CC} of +5 V.

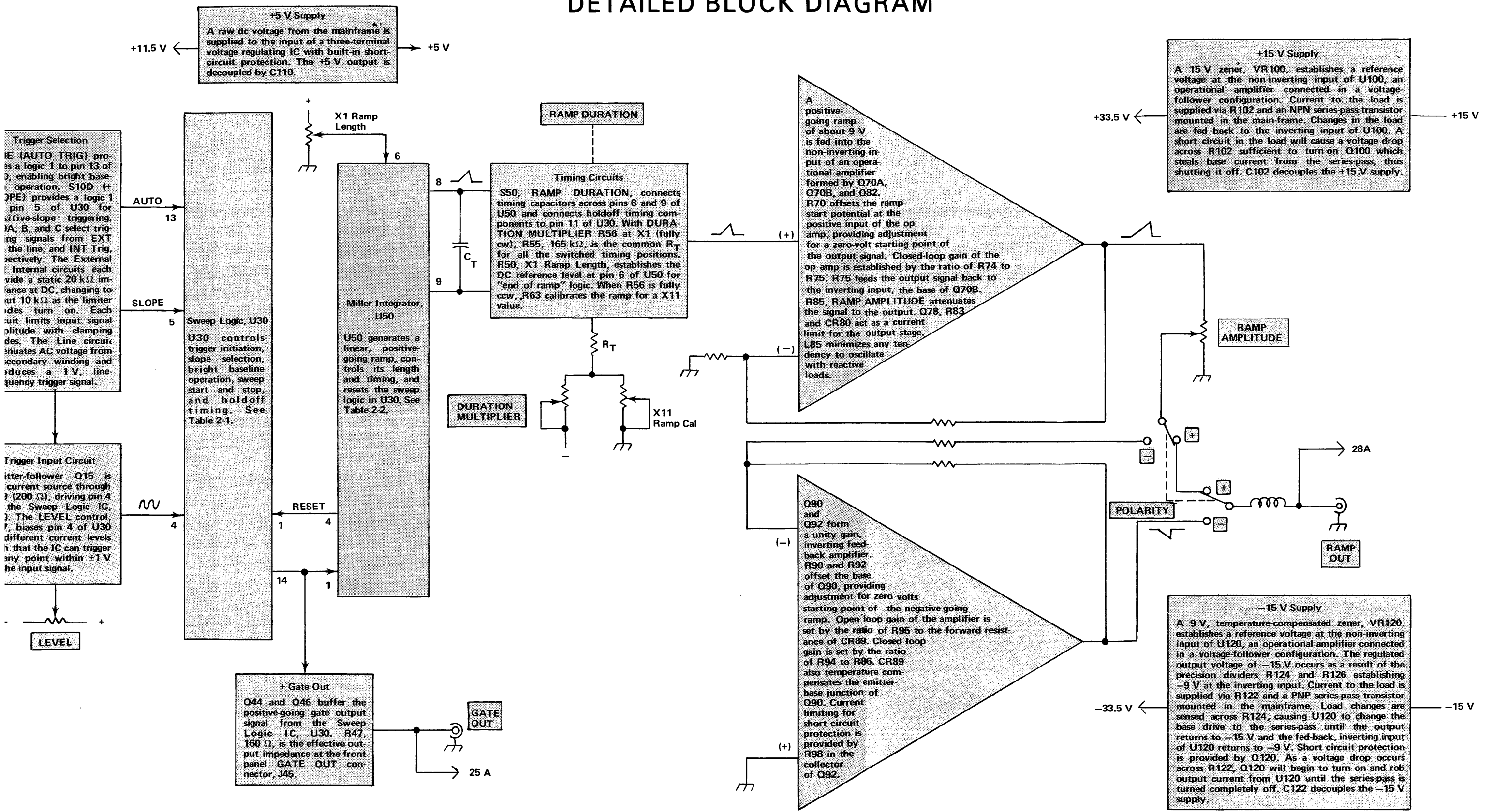
TABLE 2-2
Miller Integrator U50

Pin	Function
1, Sweep Gate In	Current into pin 1 results in a linear voltage ramp at pin 8.
2, Oscillation Suppressor	Connects discrete components to prevent oscillation of the integrator.
3, Ground	Provides a reference ground.
4, Delayed Gate Out	Provides reset logic to pin 1, U30 when output level on pin 8 reaches the level set on pin 6 by R50.
5, Not Used	Held at logic 1.
6, Ramp Length	Provides the DC reference level for the internal comparator to set up "end of ramp" logic.
7, Power Supply	Provides V_{CC} of +15 volts.
8, Output	Produces a linear voltage ramp out when current is gated into pin 1. Ramp is positive-going with an amplitude of approximately 0 to 9 volts.
9, Timing Current Summing node	Connects timing components which determine the ramp rate.
10, Substrate	≈ -13 mA from R42.

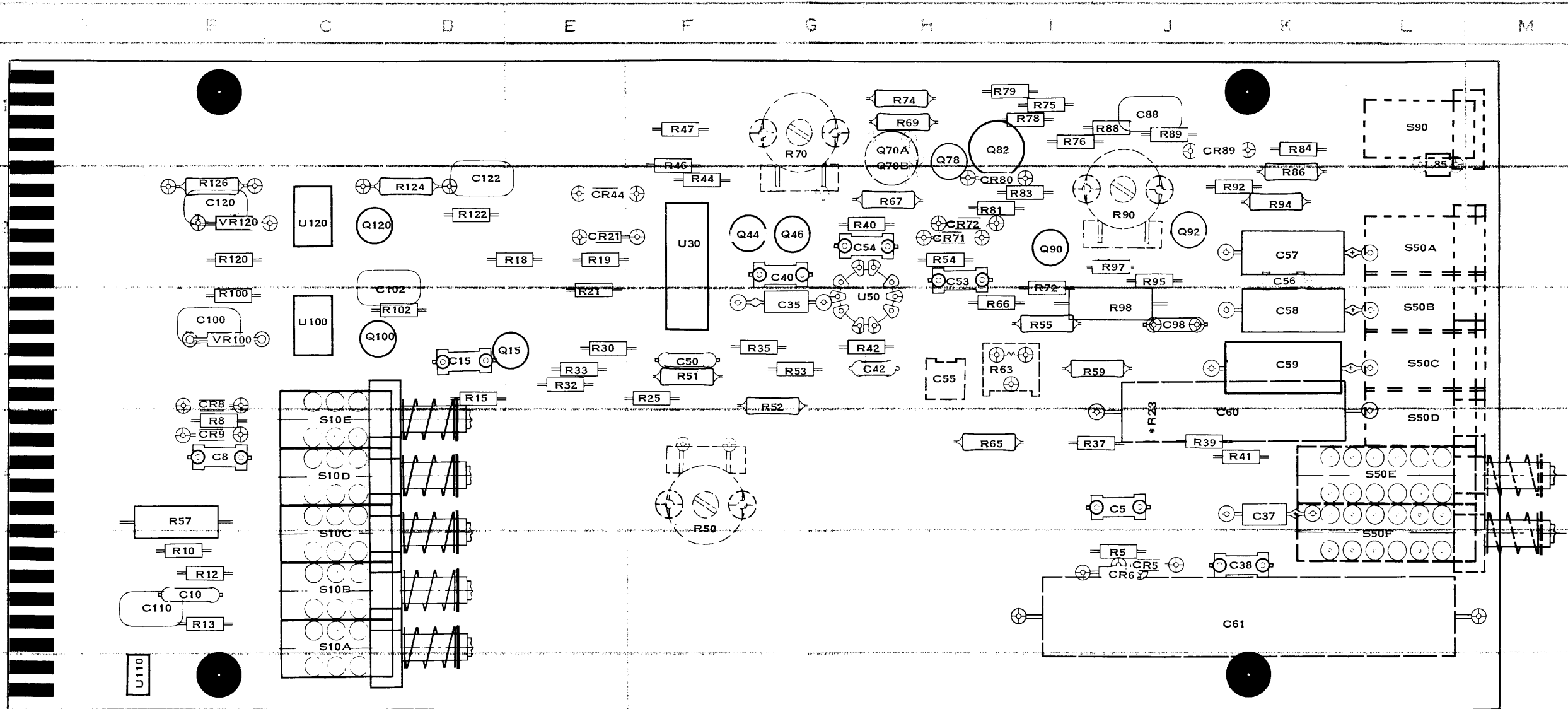
DETAILED BLOCK DIAGRAM



DETAILED BLOCK DIAGRAM



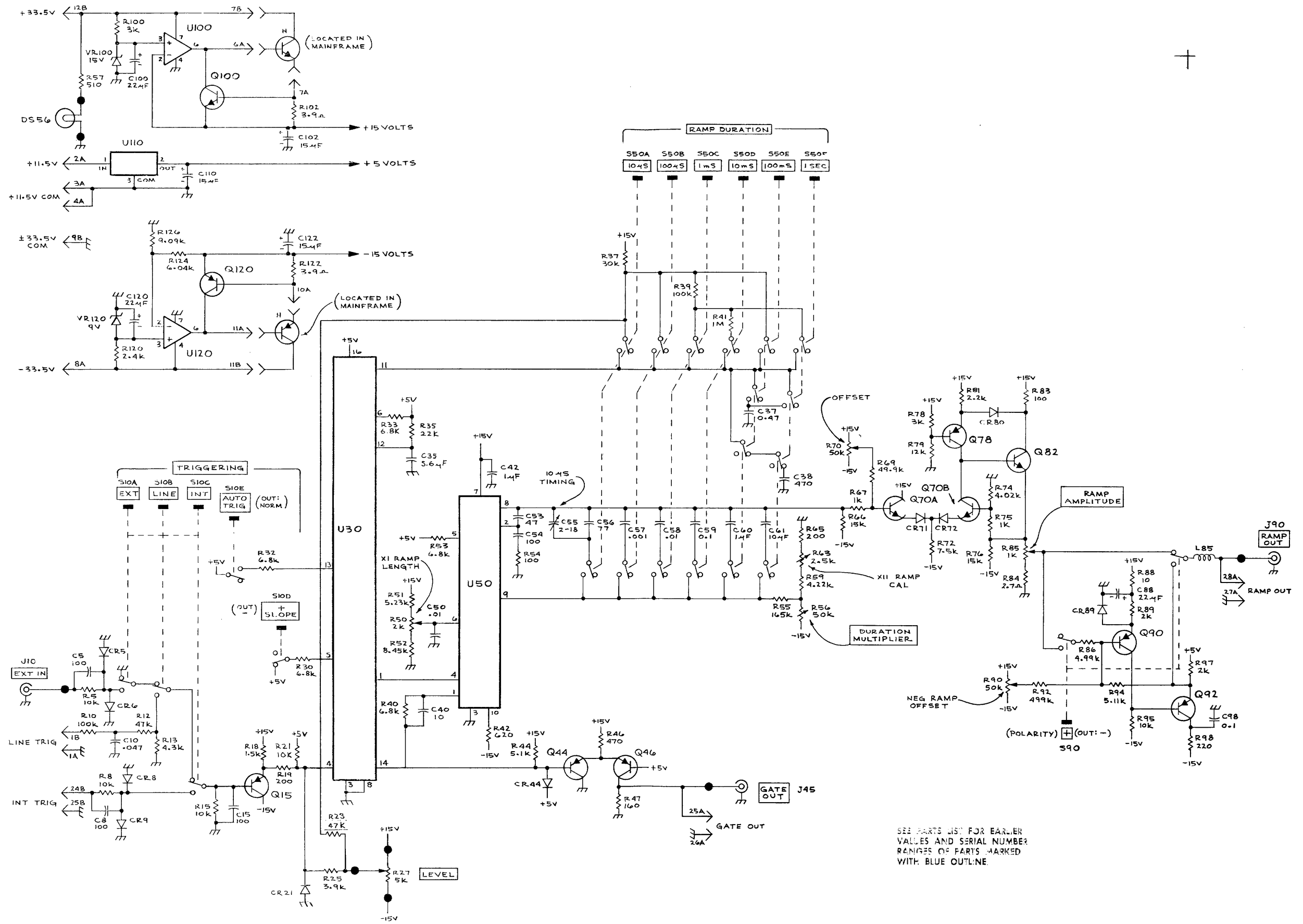
PARTS LOCATION GRID



*See Parts List for serial number ranges.

NOTE: COMPONENTS SHOWN WITH DASHED LINES ARE LOCATED ON BACK SIDE OF BOARD.

REV. B, AUG 1974



SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

MECHANICAL PARTS LIST

Replacement parts should be ordered from the Tektronix Field Office or Representative in your area. Changes to Tektronix products give you the benefit of improved circuits and components. Please include the instrument type number and serial number with each order for parts or service.

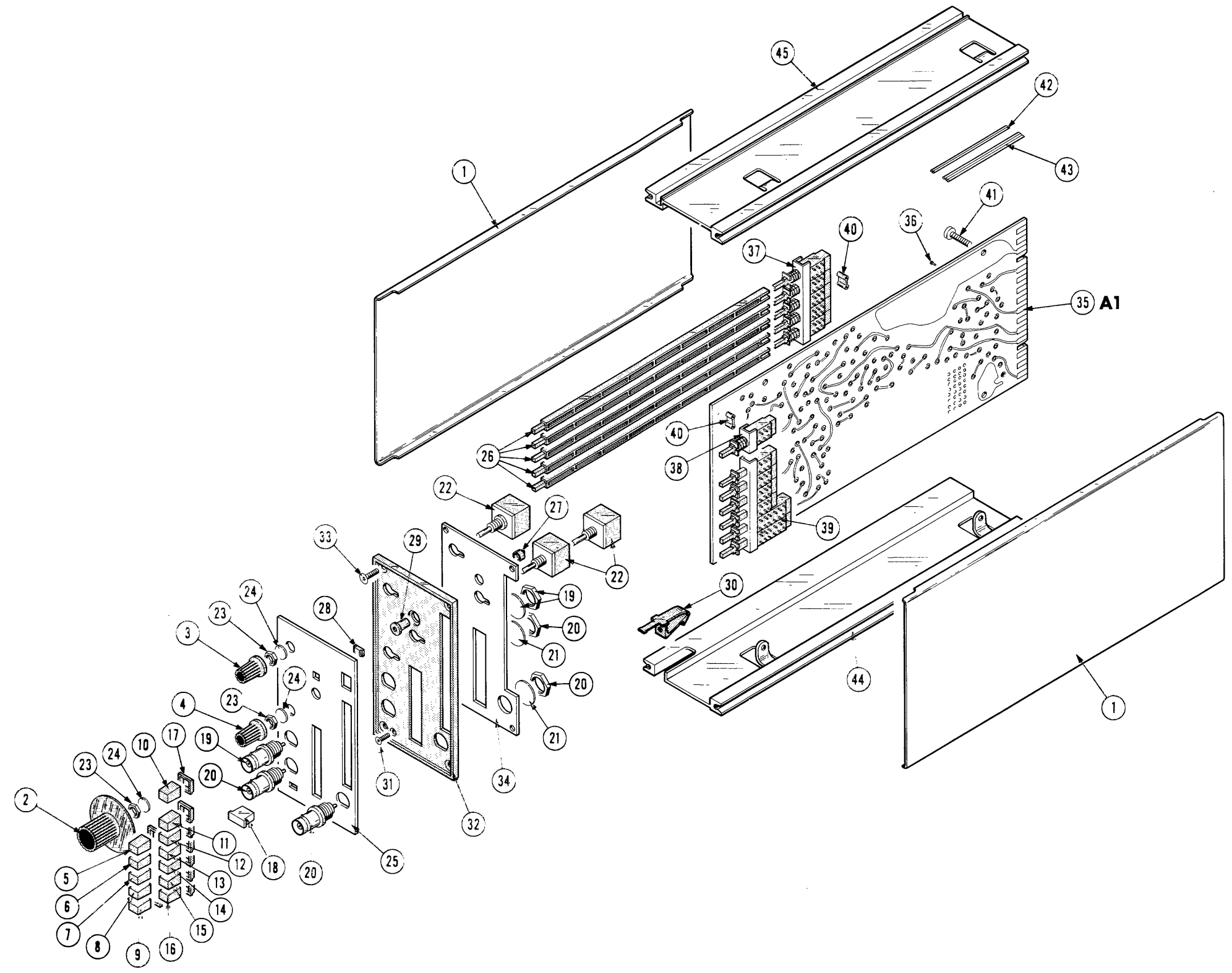
ABBREVIATIONS

BHB	binding head brass	h	height or high	OHB	oval head brass
BHS	binding head steel	hex.	hexagonal	OHS	oval head steel
CRT	cathode-ray tube	HHB	hex head brass	PHB	pan head brass
csk	countersunk	HHS	hex head steel	PHS	pan head steel
DE	double end	HSB	hex socket brass	RHS	round head steel
FHB	flat head brass	HSS	hex socket steel	SE	single end
FHS	flat head steel	ID	inside diameter	THB	truss head brass
Fil HB	fillister head brass	lg	length or long	THS	truss head steel
Fil HS	fillister head steel	OD	outside diameter	w	wide or width

Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Q † y	Description
		Eff	Disc		
1-1	337-1399-00	B010100	B029999	2	SHIELD, electrical, side
	337-1399-00	B030000		1	SHIELD, electrical, side
	337-1399-02	B030000		1	SHIELD, electrical, side w/insulator
-2	336-1428-00			1	KNOB, gray--MULTIPLIER
	- - - - -			-	knob includes:
-3	213-0153-00			1	SETSCREW, 5-40 x 0.125 inch, HSS
	366-0494-00			1	KNOB, gray--RAMP AMPLITUDE
	- - - - -			-	knob includes:
-4	213-0153-00			1	SETSCREW, 5-40 x 0.125 inch, HSS
	366-0494-00			1	KNOB, gray--LEVEL
	- - - - -			-	knob includes:
-5	213-0153-00			1	SETSCREW, 5-40 x 0.125 inch, HSS
	366-1257-26			1	PUSHBUTTON--AUTO TRIG
	266-1257-28			1	PUSHBUTTON-- + SLOPE
-6	366-1402-27			1	PUSHBUTTON--INT
-7	366-1257-23			1	PUSHBUTTON--LINE
-8	366-1257-24			1	PUSHBUTTON--EXT
-9	366-1402-26			1	PUSHBUTTON-- +
-10	366-1257-60			1	PUSHBUTTON--10 us
-11	366-1257-50			1	PUSHBUTTON--100 us
-12	366-1257-49			1	PUSHBUTTON-- lms
-13	366-1257-48			1	PUSHBUTTON--10 ms
-14	366-1257-47			1	PUSHBUTTON--100 ms
-15	366-1402-28			1	PUSHBUTTON--1 SEC
-16	426-0681-00			12	FRAME, pushbutton
-17	366-1422-00	B010100	B019999	1	KNOB, latch
	366-1422-01	B020000		1	KNOB, latch
	214-1840-00	XB020000		1	PIN, securing
-18	131-0955-00			1	CONNECTOR, receptacle, BNC, w/hardware
-19	131-0955-00			2	CONNECTOR, receptacle, BNC, w/hardware
-20	- - - - -			-	mounting hardware: (not included w/connector)
-21	210-0255-00			1	TEMPERATURE, lug, 0.391 inch ID, SE

FIGURE 1 EXPLODED (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Q † y	1	2	3	4	5	Description
		Eff	Disc							
1-22	- - - - -			3						RESISTOR, variable
	- - - - -			-						mounting hardware: (not included w/resistor)
-23	210-0583-00			1						NUT, hex., 0.25-32 x 0.312 inch
-24	210-0940-00			1						WASHER, flat, 0.25 ID x 0.375 inch OD
-25	333-1641-00			1						PANEL, front
-26	384-1060-00			5						SHAFT, extension, 7.875 inches long
-27	200-0935-00			1						CAP., lampholder
-28	378-0635-00			1						LENS, indicator light
-29	352-0157-00			1						LAMPHOLDER
-30	214-1513-00	B010100	B019999	1						LATCH, plug-in retaining
	214-1513-01	B020000		1						LATCH, plug-in retaining
	- - - - -			-						mounting hardware: (not included w/latch)
-31	213-0254-00			1						SCREW, thread forming, 2-56 x 0.25 inch, 100 deg csk, FHS
-32	386-2345-00			1						SUBPANEL, front
	- - - - -			-						mounting hardware: (not included w/subpanel)
-33	213-0229-00			4						SCREW, thread forming, 6-20 x 0.375 inch, 100 deg csk, FHS
-34	337-1690-00			1						SHIELD, rear subpanel
-35	- - - - -			1						CIRCUIT BOARD ASSY--MAIN(See A1 electrical list)
	- - - - -			-						circuit board assy includes:
-36	136-0252-04			62						SOCKET, pin connector
-37	260-1437-00			1						SWITCH, push--TRIGGERING MODE
-38	260-1208-00			1						SWITCH, push-RAMP POLARITY
-39	260-1438-00			1						SWITCH, push-RAMP DURATION
-40	361-0384-00			16						SPACER, switch, brown
	- - - - -			-						mounting hardware: (not included w/ckt board assy)
-41	213-0146-00			4						SCREW, thread forming, 6-20 x 0.312 inch, PHS
-42	175-0825-00			ft						WIRE, electrical, 2 wire ribbon, 2.75 inches long
-43	175-0826-00			ft						WIRE, electrical, 3 wire ribbon, 6 inches long
-44	426-0724-00			1						FRAME SECTION, bottom
-45	426-0725-00			1						FRAME SECTION, top



STANDARD ACCESSORIES

CARTON ASSEMBLY
(Part No. 065-0151-00)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty						Description
					1	2	3	4	5	
2-	070-1352-00			1						MANUAL, instruction (not shown)

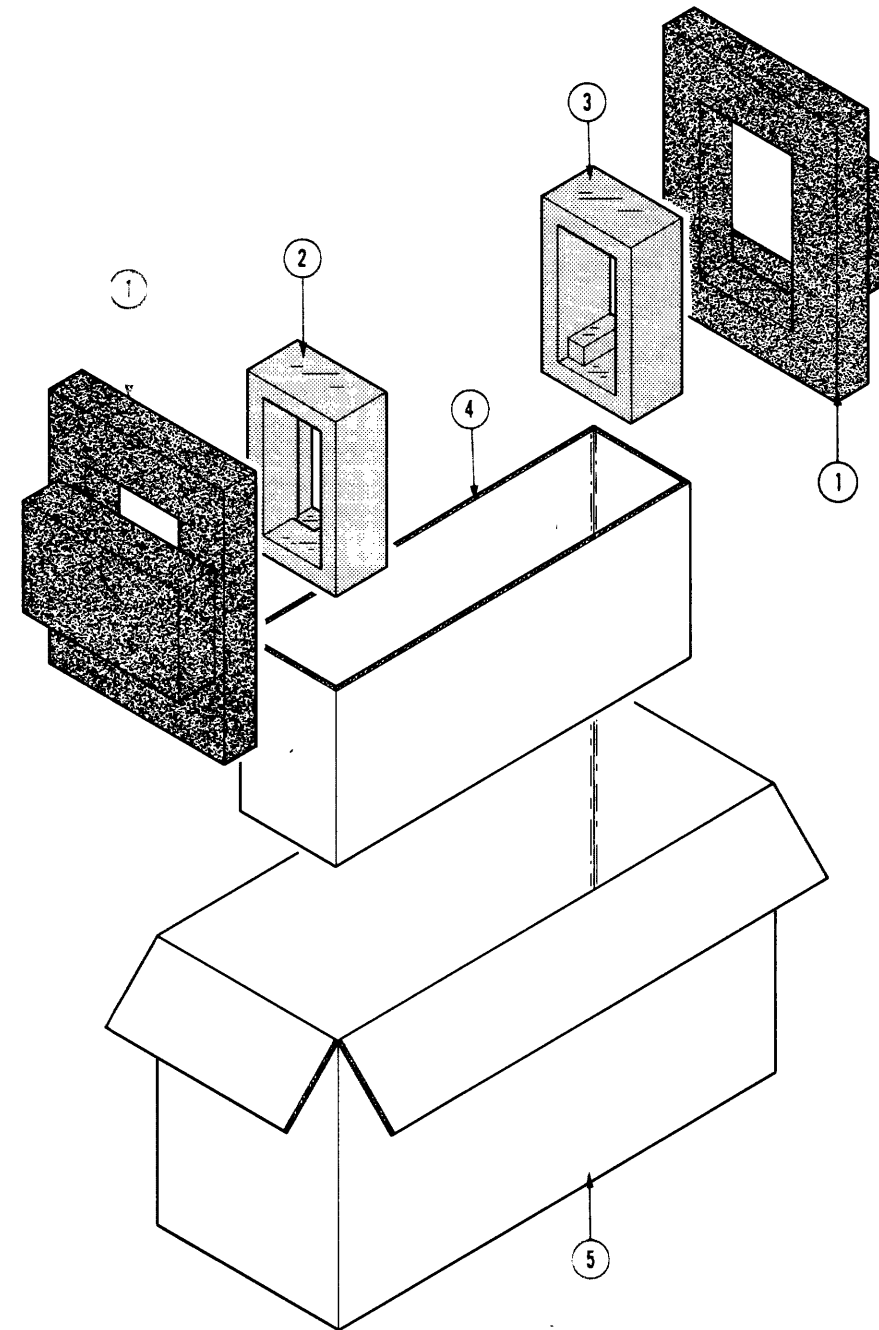


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty						Description
					1	2	3	4	5	
2-	065-0151-00			1						CARTON ASSEMBLY
-	-----			-						carton assembly includes:
-1	004-0282-00			2						FRAME
-2	004-0243-00			1						END CAP, front
-3	004-0242-00			1						END CAP, rear
-4	004-1093-00			1						PAD SET, 1 piece
-5	004-0612-00			1						CARTON