INSTRUCTION MANUAL

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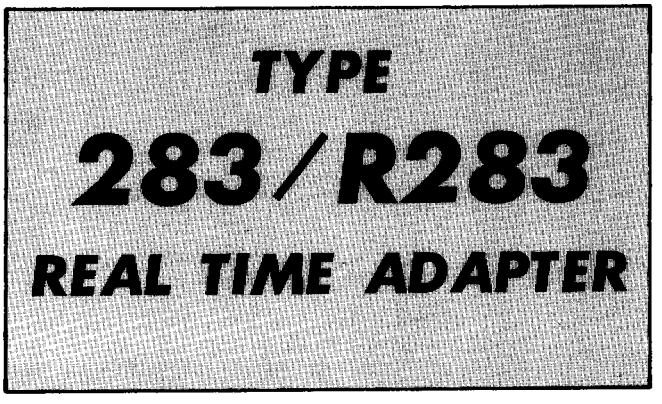

Tektronix, Inc.
S.W. Millikan Way ● P. O. Box 500 ● Beaverton, Oregon 97005 ● Phone 644-0161 ● Cables: Tektronix

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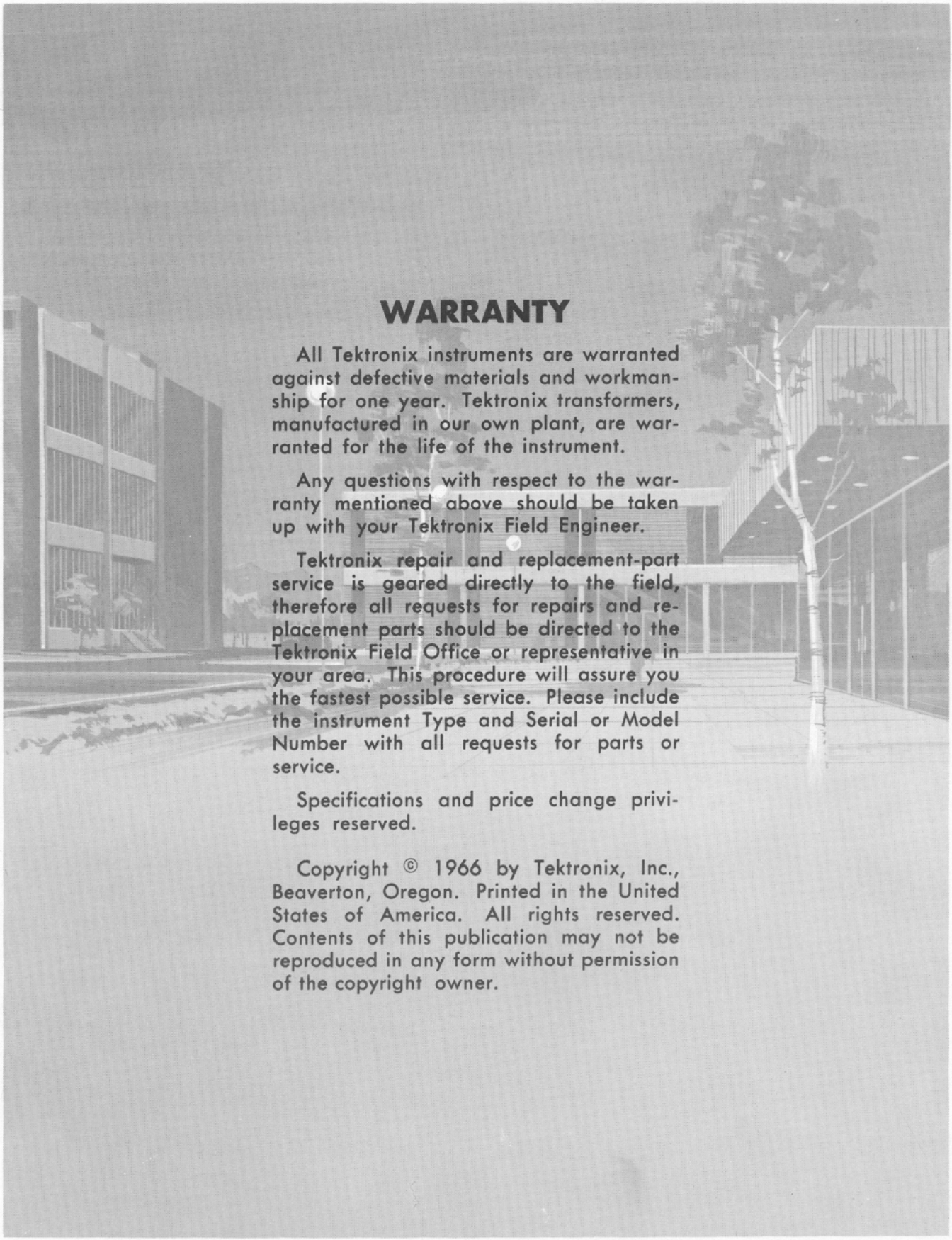


WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year. Tektronix transformers, manufactured in our own plant, are warranted for the life of the instrument.

Any questions with respect to the warranty mentioned above should be taken up with your Tektronix Field Engineer.

Tektronix repair and replacement-part service is geared directly to the field, therefore all requests for repairs and replacement parts should be directed to the Tektronix Field Office or representative in your area. This procedure will assure you the fastest possible service. Please include the instrument Type and Serial or Model Number with all requests for parts or service.

Specifications and price change privileges reserved.

CONTENTS

Abbreviations and symbols used in this manual are based on, or taken directly from, IEEE Standard 260 "Standard Symbols for Units" MIL-STD-12B and other standards of the electronics industry. Change information, if any, is located at the rear of this manual.

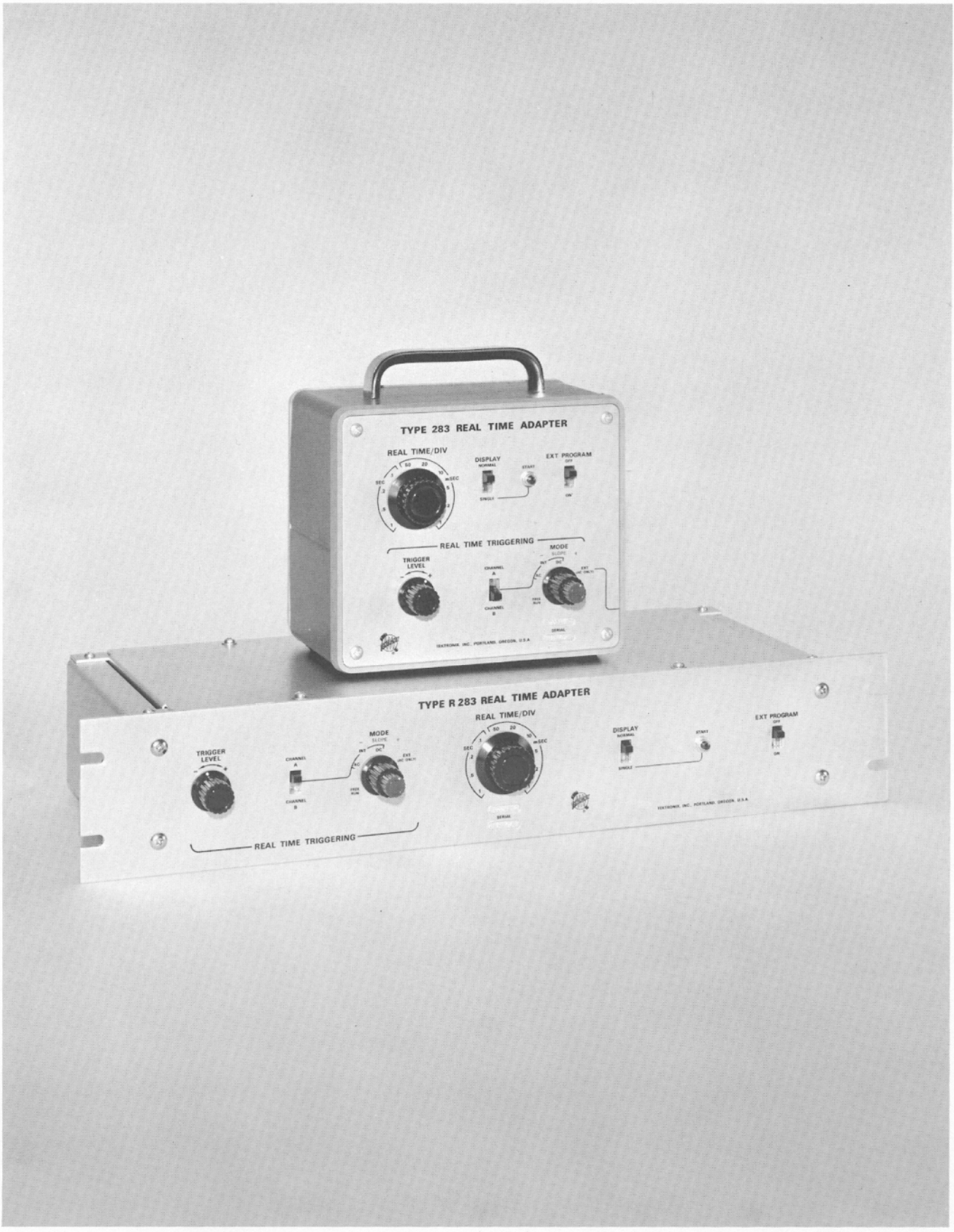


Fig. 1-1. Type 283 and R283 Real Time Adapters.

SECTION 1
CHARACTERISTICS

General

This manual pertains to two electrically identical instruments. They are the Type R283 Real Time Adapter for certain Tektronix 19 inch rack mounted sampling systems, and the Type 283 Real Time Adapter unit for certain Tektronix bench operated sampling oscilloscopes.

The two Real Time Adapter units are accessory items to the Tektronix Type 3T4 Programmable Sampling Sweep. The vertical unit must be the Type 3S76 Sampling Dual-Trace unit, the Type 3S3 Sampling Probe Unit or other Tektronix sampling unit that can operate in the 560-series Oscilloscopes and has vertical output signals. The adapter converts the sampling oscilloscope from equivalent time sampling to real time sampling with sweep rates of 1 millisecond to 1 second per division in a 1, 2, 5 sequence. Digital readout of the real time sampling measurements is provided by the Tektronix Type 6R1A Digital Unit when the plug-in units are operating in a Type 567 Readout Oscilloscope.

Real time sampling can be normally programmed from the Real Time Adapter front panel, or automatically programmed by a Tektronix Type 262 Programmer or other closure-type programmer. When a Real Time Adapter is properly connected between the programmable sampling sweep unit and a Type 262 Programmer, the Type 262 can control all the programmable functions of both the sampling sweep unit and the Real Time Adapter.

Electrical Characteristics

The following electrical characteristics apply over an ambient temperature range of 0° C to +50° C. These characteristics apply only after an instrument warm-up time of at least 5 minutes.

TABLE 1-1

ELECTRICAL CHARACTERISTICS

General Characteristics	Performance Requirement	Supplemental Information
Real Time Sweep Rates	1 ms/div to 1 s/div	Ten fixed rates in a 1, 2, 5 sequence.
Sweep Rate Accuracy:		
Digital Readout (Type 6R1A Time Measurement)	±0.1% added to the time measurement tolerances of associated Digital Unit.	Set by crystal controlled clock pulses. Not tested.
Oscilloscope CRT Time/Div		Tolerance limited by Type 3T4 samples/div accuracy and accuracy of HORIZ GAIN adjustment.
Trigger Sensitivity		
Internal: DC Coupled	≤0.5 major div deflection of CRT display from DC to 1 kHz.	
AC Coupled	≤0.5 major div deflection of CRT display at 1 kHz.	INT AC Low frequency —3 dB frequency ≈15 Hz.
External: AC Coupled only	≤0.5 V peak to peak at 1 kHz.	EXT AC Low frequency —3 dB frequency ≈150 Hz.
TRIGGER LEVEL Control Range		
Internal	The sweep can be started over a CRT vertical scan range of ≥ + and —8 major CRT divisions.	
External	The sweep can be started over a trigger signal voltage range of ≥ + and — 0.7 volt from ground using a 1 kHz square wave.	
Maximum external trigger signal voltage	±20 volts	Not tested
External Trigger input impedance	Initially 50 Ω changing to 1 kΩ with 50 ns time constant, then to several megohms with a 10 ms time constant.	Not tested
Single Display Start	One sweep is begun when START button is depressed.	

Operating Characteristics

Real Time Triggering

Modes—Free Run, Internal AC or DC, External AC Only.

Slope—+ or — both Internal and External.

Source—Internal: Channel A or Channel B of the oscilloscope vertical unit.

External: through a BNC connector.

Ext Equiv Time Trigger Input

A BNC connector feeds external trigger information directly to the Type 3T4 external trigger input connector when the Type 3T4 Time/Div switch selects the equivalent sweep rate, or when the Real Time Adapter EXT PROGRAM switch is at ON and the Type 3T4 Time/Div switch is at Remote Program. The EXT EQUIV TIME TRIGGER INPUT connector is automatically disconnected and left open circuited during real time sampling.

Operating Modes

The operating modes discussed here are those of the sampling oscilloscope as controlled by the Real Time Adapter. Control is possible only when the sampling sweep unit controls are properly set as stated in Section 2 under First Time Operation. The Real Time Adapter EXT PROGRAM switch must be at its OFF position.

1. Normal repetitive triggered real time display with the sweep rate and triggering controlled by the Real Time Adapter, including digital readout.

2. Single display, non-synchronous with vertical information, as started by either the Real Time Adapter or the sampling sweep START button. Digital readout not possible.

Other operating modes, when the Real Time Adapter EXT PROGRAM switch is at ON, are controlled by the Type 262 Programmer. Such operating modes include all remotely programmable functions of the sampling sweep unit as described on page 1-1 of the Type 3T4 instruction manual. Real Time Adapter real time triggering controls are not remotely programmable. However, the trigger circuit can be turned on by the Type 262. The Real Time Adapter clock rate is remotely programmable, so it is possible to remotely control real time sampling if the trigger circuit controls are manually operated, or if a remote triggering circuit provides the single display start signal to J260-26.

Power Requirements

Power for operation of the Real Time Adapter is provided by the oscilloscope through the sampling sweep unit and the cable connected to J250.

Mechanical Characteristics

Panel—R283: 3½ inches x 19 inches. 283: 7 inches x 5 inches. Anodized aluminum with silk screened lettering.

Depth—R283: 7¾ inches. Cable connectors require approximately two more inches. 283: 4½ inches.

Net Weight—R283: 4 pounds. 283: 3½ pounds.

Cabinet—R283: Aluminum. 283: Aluminum, vinyl blue wrap-around.

Standard Accessories

A list of the accessories shipped with the Type 283/R283 can be found in the Mechanical Parts List, section 7 of this book.

Optional Accessories

	Tektronix Part No.
1. 50 Ω coaxial cable, 42 inch length, with BNC connectors.	012-0057-00
2. GR Type 874 to BNC female connector adapter. GR Type 874 QBJA.	017-0063-00
3. GR Type 874 to BNC male connector adapter. GR Type 874 QBPA.	017-0064-00

See your Tektronix Field Engineer or Representative for other accessories suitable for use with the Real Time Adapter and sampling systems.

SECTION 2
OPERATING INSTRUCTIONS

The principles of real time sampling that relate to the Real Time Adapter and the Programmable Sampling Sweep are presented on pages 2-9, 2-10 and 3-2 of the Type 3T4 instruction manual.

Function of Front Panel Controls

REAL TIME/DIV — Ten position switch that sets the clock pulse period. See Table 3-1 (of the Circuit Description) which relates pulse period to time/div. Control sets the sampling display sweep rate from 1 ms/div to 1 s/div.

DISPLAY NORMAL/SINGLE — Two position slide switch that allows real time triggering in the NORMAL position, and allows single sweep non-synchronously triggered displays in the SINGLE DISPLAY position.

START — A pushbutton that starts a single sweep at the instant its contacts make, if the DISPLAY switch is at SINGLE.

EXT PROGRAM ON/OFF — Two position slide switch. When at the OFF position, the Type 283/R283 can control the Type 3T4 real time sampling. When at ON, connections are made that allow an external Type 262 (or other closure programmer) to operate the Type 3T4 for either equivalent time or real time sampling.

TRIGGER LEVEL — Adjustable control that sets the real time triggering comparator operation so CRT display begins at desired level of vertical signal.

CHANNEL A/CHANNEL B — Two position slide switch. CHANNEL A position selects vertical information from yellow lead, and CHANNEL B position selects vertical information from white lead of Vertical Signal Input cable that has Tektronix Part No. 012-0103-00.

MODE — Four position switch that selects operating mode of the real time triggering comparator. Positions are: FREE RUN, triggering circuit applies a sweep start signal to the sampling sweep unit continuously at approximately a 5 ms period for the purpose of placing a trace on the CRT in the absence of a triggering signal; INT AC and INT DC, the triggering comparator operation requires vertical information and proper adjustment of the TRIGGER LEVEL control before it can deliver sweep start signals to the sampling sweep unit with signals AC or DC coupled from the vertical unit; EXT (AC ONLY), the triggering comparator input information must arrive through the BNC connector EXT REAL TIME TRIGGER INPUT.

SLOPE + and — — Selects positive-going or negative-going triggering information to start the sampling sweep.

Connectors

BNC and multi-pin connectors of the Real Time Adapter are:

EXT REAL TIME TRIGGER INPUT — BNC connector that allows other than the vertical unit signals to operate the real time triggering comparator.

PROGRAMMER INPUT — 36-pin locking type female connector. Mates with cable (Tektronix Part No. 012-0109-00) to Type 262 Programmer. Circuits allow remote closure-type programming of both real time and equivalent time sampling.

EXT EQUIV TIME TRIGGER INPUT — BNC connector that passes external triggering information directly to the sampling sweep unit trigger Ext Input connector (in a 50 Ω cable) when the Real Time Adapter EXT PROGRAM switch is at ON.

REMOTE PROGRAM TO 3T4 — 36-pin locking type female connector. Mates with cable (Tektronix Part No. 012-0101-00) that attaches to J80 on front panel of Type 3T4. Cable provides —12.2 volts for Real Time Adapter operation, and logic connections that allow remote programming of the sampling sweep unit.

VERT SIGNALS IN AND CLOCK TO 3T4 — 14-pin locking type female connector. Mates with cable (Tektronix Part No. 012-0103-00) that sends clock pulses to sampling sweep unit trigger Ext Input connector, and receives vertical signals from the vertical unit front panel.

Special TRIGGER SOURCE DC Level Switch

The trigger comparator circuit can be made to operate from Tektronix vertical sampling units whose Vertical Signal output is either at zero volts or approximately +10 volts for a vertically centered display. The change in operation is made by changing the setting of the TRIGGER SOURCE DC LEVEL switch.

Changing the TRIGGER SOURCE DC LEVEL switch affects the front panel TRIGGER LEVEL control position for DC coupled center-screen triggering. Place the TRIGGER SOURCE DC LEVEL switch at 3S76-3S3 when operating with either of those plug-in units, and to ZERO VOLTS for all other vertical sampling units.

The TRIGGER SOURCE DC LEVEL switch is located on the back panel of the Type R283 and inside the case of the Type 283, near the TRIGGER LEVEL control.

First Time Operation

CAUTION

The inter unit cable, Part No. 012-0101-00 was modified to agree with the diagrams in this manual. If you are using a cable shipped prior to November 15, 1965, it is necessary to modify the lead connections in the 36 pin connector in accordance with the diagrams in this book. Nothing will be damaged by not rewiring, but the Real Time Adapter will not operate.

Connections to the Type R283 are normally included in the system equipment rack at the time the system is shipped. Connections to the Type 283 must be made at the time of use. Oscilloscope connections described here are assumed to be to the front panel of a Type 3T4 and the front panel of a Type 3S76.

Install the cable (Tektronix Part No. 012-0101-00) between the Type 283 REMOTE PROGRAM TO 3T4 connector and the Type 3T4 Remote Program connector. Install the cable (Tektronix Part No. 012-0103-00) between the Type 283 VERT SIGNALS IN AND CLOCK TO 3T4 connector and the Type 3S76; insert the white lead banana pin into the A Out jack and the yellow lead banana pin into the B Out jack. Connect the coaxial cable with BNC male connector to the Type 3T4 trigger Ext Input connector.

The sampling units can now be operated for real time sampling.

Control settings of the two sampling units are here described for a single trace display of a 6 Hz (1 Hz - 1 cps) sine wave with sufficient amplitude to cause at least one major division peak-to-peak deflection of the CRT beam. Control settings of the Real Time Adapter are here described to obtain three complete cycles of display starting on a positive slope so the Type 6R1A Digital Unit can read out the time of one complete cycle.

Type 3T4

Time/Div	Remote Program
Sweep Mode	Norm
Display Mag	1000 ×1
Delay	Optional
Position	Optional
Trigger Level	Counterclockwise from midrange for triggered operation
Trigger Int/Ext	+Ext
Recovery Time	Must be fully counterclockwise

Type 3S76

Use Channel A and set all controls except the Smooth/Normal control to suit the signal amplitude.

Smooth/Normal	Normal

Type 283

REAL TIME/DIV	50 mS
DISPLAY	NORMAL
EXT PROGRAM	OFF
TRIGGER SOURCE DC LEVEL	3S76-3S3
SLOPE	+
CHANNEL A/ CHANNEL B	CHANNEL A
TRIGGER LEVEL	Near midrange for triggered display that starts about 1/4 way up the plus slope

Type 6R1A

Mode	Time
Resolution	Lo One Sweep
Start-Slope	First +
Stop-Slope	Second +
Timing Start	A Trace 50%
Timing Stop	A Trace 50%
0% Zone	At first + peak
100% Zone	At 3rd minus peak

If all controls are correctly adjusted, and if the signal frequency is actually 6 Hz, the digital readout should be 0.166S.

Change the signal to 36 Hz, and set the Type 283 REAL TIME/DIV switch to 10 mSEC. Adjust the 0% and 100% zone positions as before and the digital readout should be 0.278 MS.

Set the Type 283 DISPLAY switch to SINGLE. The CRT display will disappear. Press the Type 283 START button a few times and note that a single display appears each time, but not time-coincident with the vertical information. Thus, the Type 283 START button does not allow a display that is armed and then triggered, but a single display that begins at the instant the START switch contacts make.

Return the DISPLAY switch to NORMAL, then the MODE switch to INT DC. Obtain a triggered display by adjustment of the TRIGGER LEVEL control. Position the display up and down the CRT and note that the point of display start remains fixed on the CRT left side. This is confirmation of the DC coupled triggering circuit.

False displays can be obtained with real time triggering that can not be proven false by the normal method of changing the vertical unit loop gain. Such an example is possible with an 80 kHz sine wave and the Type 283 REAL TIME/DIV switch set to either 5 or 10 mSEC. With the REAL TIME/DIV switch at 5 mSEC, a properly triggered display will present 9 complete sine wave cycles across the CRT. Changing the REAL TIME/DIV switch to 2 or 1 mSEC will produce multiple sine waves (4 or 5 all intermixed) to prove that the display at 5 mSEC was false. From this, we conclude that the Real Time Adapter is valuable for obtaining displays of sine wave signals of DC to only 2 or 3 kHz.

Remote Real Time Operation

Remote operation of the Type 283/R283 circuits is by use of a closure type programmer such as the Tektronix Type 262 Programmer. Remote programmer connections are made to the 36 pin J260 Programmer Input connector. The proper cable, with two 36 pin connectors, 10 feet long, to go

between a Type 283/R283 and a Type 262 can be ordered from your Tektronix Field Office or representative. Order by Tektronix Part No. 012-0109-00.

All circuits within the Type 262 that are to be grounded are to be connected to pin 16 of the Type 283/R283 J260. Pin 16, labeled CARRY OUT, is grounded by the Type 283/R283 EXTERNAL PROGRAM switch when placed to ON. If the EXTERNAL PROGRAM switch is at OFF, the remote closure programmer cannot control the Real Time Adapter. All leads within the Type 262 that are to be connected to ground (pin 16) must have a silicon diode (50 mA, 50 V) in series with its anode toward pin 16. Pins 10 and 11 must not contain diodes, but are to be connected directly together during remote real time sampling.

All pins of the Type 283/R283 J260 that are numbered to match pins of the Type 3T4 J80 front panel Remote Program connector can be used to program the Type 3T4 remotely through the Type 283/R283 for equivalent-time sampling. See Table 2-2, Table 2-3 and associated text on page 2-6 and 2-7 of the Type 3T4 instruction manual for proper closures and operating instructions. If a Type 262 is connected through a Type 283/R283 to perform remote equivalent-time sampling, the Real Time Adapter circuits are inactive. The connections are provided for those circumstances where a Type 262 performs a succession of tests including both real-time and equivalent-time sampling.

Real Time sampling remote programming closures are listed in Table 3-2 in this instruction manual.

SECTION 3
CIRCUIT DESCRIPTION

General

The circuits of the Type 283 Real Time Adapter and the Type R283 Real Time Adapter are identical. Each unit contains two independent circuits: the clock circuit and the trigger circuit. The clock circuit provides continuous, accurately timed pulses to the Type 3T4 Programmable Sampling Sweep unit external trigger input. These pulses are "sample" commands. Their rate is controlled by the REAL TIME/DIV switch to provide 1000 samples per 10 division sweep. The trigger circuit receives vertical signal information from the vertical sampling unit and triggers each sweep. The point along the slope of the vertical signal at which the sweep begins is determined by the SLOPE, TRIGGER LEVEL and TRIGGER SOURCE DC LEVEL controls.

The Types 3T4, 283/R283 and the vertical sampling unit operate as a real time sampling system. Since the circuit functions of the Type 283/R283 are extensions of the Type 3T4 circuits, it is well to be familiar with the Type 3T4 circuits before reading this circuit description. Some details of Real Time Sampling can be found in the Type 3T4 instruction manual on pages 2-9, 2-10, 3-1, 3-2 and 3-3.

Fig. 3-1 shows a block diagram of the Type 283/R283.

Trigger Circuit

The trigger circuit has four modes of operation. They are: EXT (AC ONLY), INT DC, INT AC and FREE RUN. In the EXT (AC ONLY), INT DC, and INT AC modes a single display start pulse is generated at a point on the slope of the incoming signal determined by the TRIGGER SOURCE DC LEVEL, SLOPE and TRIGGER LEVEL controls. In the INT DC and INT AC modes the incoming signal is the vertical signal from the vertical sampling unit. In the EXT (AC ONLY) mode, the triggering signal is applied to the REAL TIME TRIGGER INPUT. In the FREE RUN mode, the trigger circuit is converted to an astable multivibrator. The astable multivibrator provides continuous single display start pulses which start the sweep about once every 5 ms. This mode of operation is included to place a zero signal trace on the oscilloscope screen.

DC Operation. When the internal TRIGGER SOURCE DC LEVEL switch is at 3S76-3S3 and the MODE switch is at INT DC, the base of Q226 is grounded. Current flows in Q216 or Q226 depending upon the voltage level at the base of Q216. If Q216 base is also at ground, both transistors conduct equally (assuming equal DC β). If Q216 base is taken negative, Q226 will carry the total current available. Maximum current value is set by R222, the common emitter return resistor to the —12.2 volt supply. R222 sets the comparator maximum current to approximately 5.5 mA when both transistor bases are grounded.

The collector circuits of Q216 and Q226 are controlled by the SLOPE switch and the MODE switch. During AC, DC and EXT operation Q216 collector load resistor (R220) is shorted out of the circuit. As shown on the schematic diagram, Q216 collector is grounded and Q226 collector is connected to the cathode of tunnel diode D231. Q226 therefore controls the current through D231. When the signal at Q216 base is sufficiently negative, Q226 conducts causing D231 to switch to its high voltage state.

A DC mode cycle of operation depends upon the DC level of the incoming vertical signal. The input voltage from a Type 3S3 or a Type 3S76 vertical sampling unit rests at +10 volts when the vertical unit is properly balanced for a CRT centered display. This +10 volts is bucked back near ground by adjustment of the TRIGGER LEVEL control so the base of Q216 receives a ground referenced signal. As the AC signal component takes the base of Q216 positive (from ground), Q216 emitter also rises positive and takes the emitter of Q226 positive. Q226 stops conducting, which causes the voltage drop across D231 to become zero. (Q216 emitter can go sufficiently positive for this action even though the collector is grounded.) Q233 is not conducting when D231 voltage drop is zero.

As Q216 base goes negative, the grounded base of Q226 stops Q226 emitter from following Q216 base. Q226, therefore, conducts all the current and Q216 cuts off. At some point during the negative signal excursion, Q226 conducted enough current for D231 to switch to its high state. The voltage drop across D231 then places its cathode at approximately —0.52 volt. Approximately 0.25 volt is added to the —0.52 volt step across D231 by current in D232/R234 producing a saturation bias of approximately —0.77 volt at Q233 base. Q233 saturates which effectively grounds its collector, sending a Single Display Start pulse to the sampling unit through R236/SW238 and D238. R232 prevents D232/R234 current from keeping D231 in its high state. C232 and C233 assure that high frequency information reaches Q233 base in a physically short path at the time D231 switches states.

Thus operation of the comparator in the —INT DC mode causes Q226 collector to go negative when the input signal goes negative. Q226 negative output switches D231, which causes Q233 collector to rise from —12.2 volts to ground.

Switching the slope switch to + connects Q216 collector to the cathode of D231 and grounds Q226 collector. Now positive going signals will switch D231 and cause Q233 to saturate.

The two capacitors from the comparator transistor bases to ground (C214 and C228) bypass high frequency clock feed-through and assure that the circuit operates from incoming trigger signals only.

AC Operation. AC operation differs from DC operation in that the MODE switch places the base of Q226 at —4.8 volts. The —4.8 volts is supplied by a bypassed voltage divider consisting of R227, R228 and C227. The TRIGGER LEVEL control midrange voltage value is —6.1 volt allowing AC coupled signals greater than 8 volts peak to peak to

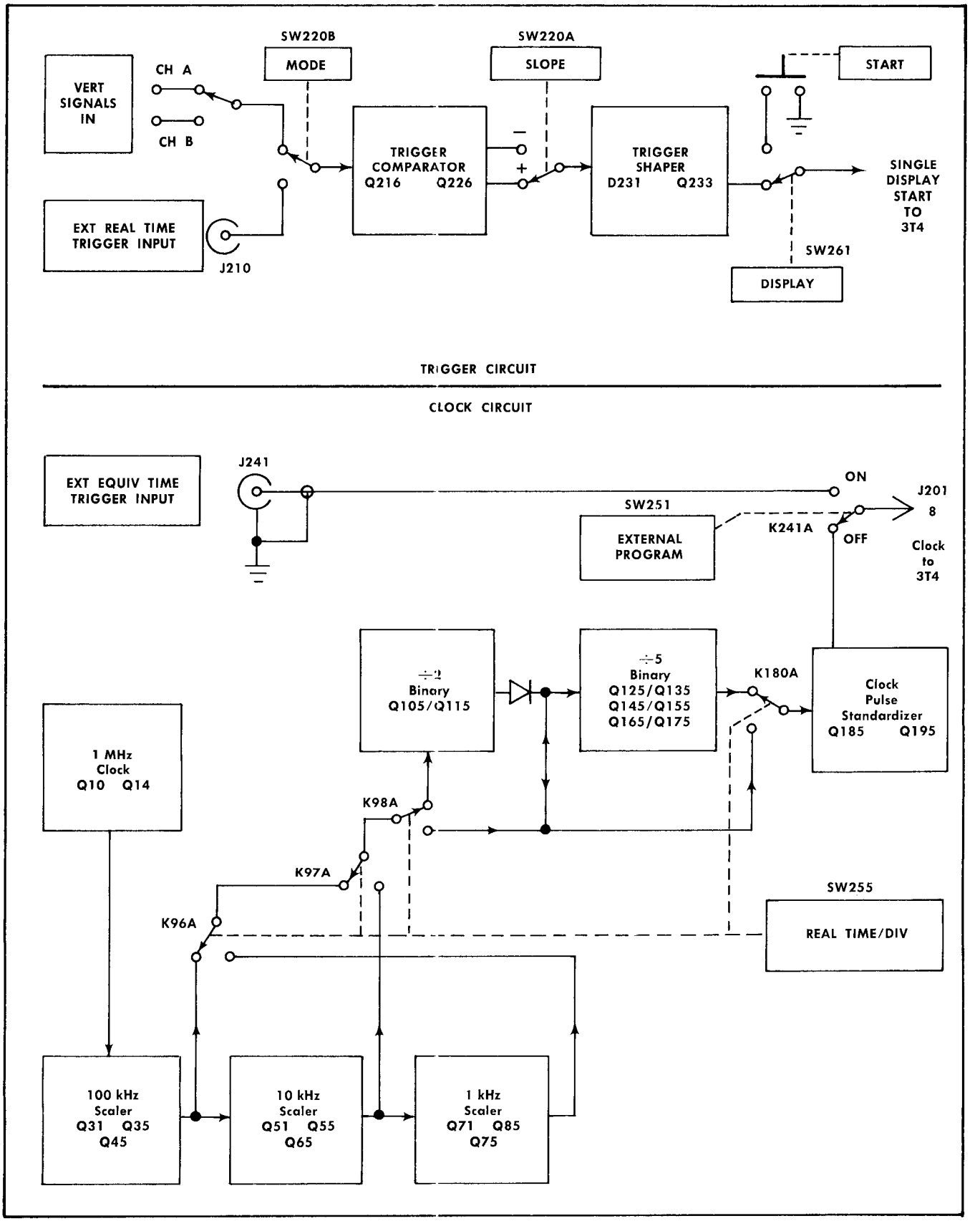


Fig. 3-1. Type 283/R283 complete block diagram.

properly drive the comparator. Circuit operation is the same as described for DC operation except that the D231 switching occurs when the signal at the base of Q216 passes through approximately —5 volts.

When the Type 283/R283 is used with a vertical unit which has a ground referenced vertical output signal, the TRIGGER SOURCE DC LEVEL switch should be set to ZERO VOLTS. In this mode, circuit voltages are identical to AC operation although the input is DC coupled.

External Operation. External operation is AC coupled only, through C218. Diodes D213 and D214 protect the two comparator transistor base-emitter junctions in the event the EXT REAL TIME TRIGGER INPUT jack receives a signal of 20 volts. 20 volts from a low impedance supply would damage at least one of the transistors during C218 charge time if the diodes were not in the circuit. R219 and C219 terminate the EXT REAL TIME TRIGGER INPUT jack with 51 ohms for fast rise pulses.

FREE RUN Operation. FREE RUN operation is included for the purpose of placing a trace on the CRT in the absence of a triggering signal. The comparator is converted to an astable multivibrator when the MODE switch inserts R220 (Q216 collector), C226 (from Q216 collector to Q226 base) and R229 (Q226 base). Incoming triggering signals are disconnected from Q216 base circuit. Q216 base is then connected directly to the —4.8 volts bypassed biasing network normally attached to Q226 base.

The astable oscillation rate (time of one square-wave period) is controlled by the RC time constant of R220, C226 and the base impedance of Q226 paralleled with 10 kΩ R229. As the MODE switch is set to FREE RUN, C226 (assumed to be discharged) applies a turn-on signal to Q226 base. The rise of Q226 emitter turns off Q216 current, causing R220 to add to the turn on signal through C226. About 2.5 ms later, C226 has charged enough to allow Q226 base to fall negative to a point where its emitter biases Q216 into conduction. Conduction of Q216 applies a negative signal to C226 that speeds the turn-off of Q226 in a regenerative manner. About 2.5 ms later, R229 has changed C226 charge sufficiently to bring Q226 back into conduction and one cycle is complete.

Q216 or Q226 drives tunnel diode D231 in an identical manner as previously described. Thus square wave signals with about a 5 ms period are applied to the Type 3T4 Single Display Start lead and produce a free run trace on the CRT.

Control Switching and Interconnections

The switching circuits contain several silicon disconnect diodes. These diodes permit more than one control circuit to be connected in parallel without interaction. For instance, if a Type 262 Programmer is connected, and if the programmer grounds pin 13 of J260, D253 prevents all other circuits at the anode side of D253 from also being grounded. Conversely, D251 (diagrammed at the EXTERNAL PROGRAM switch) grounds the lead of K241 when the EXTERNAL PROGRAM switch is set to OFF. Yet with the EXTERNAL PROGRAM switch at ON, D251 will prevent J260 pin 17 from being grounded if a programmer grounds only J260 pin 15.

All external programmer circuits that are used to operate the Type 283/R283 circuits must contain similar switching diodes. Such diodes are intended to prevent the REAL TIME/DIV switch from actuating external circuits when a programmer remains connected to J260 during front-panel real time sampling.

External switching circuits have a maximum of —12.2 volts in the open circuit condition. Maximum closed circuit current is approximately 45 mA.

Power Supply

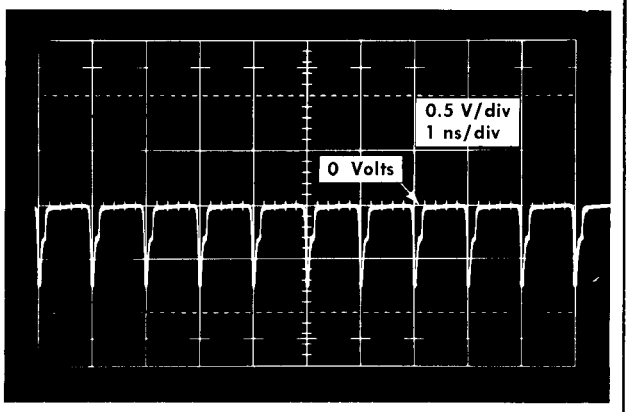
All circuits within the Type 283/R283 are supplied from the oscilloscope —12.2-Volt power supply. The Type 3T4 Time/Div switch applies power through the cable attached to its front panel Remote Program connector when the switch is at Remote Program. Power within the Type 283/R283 is applied directly to three circuits of the Trigger circuit and switched on or off for all other circuits by the EXTERNAL PROGRAM switch and Q244. The power to all other circuits may also be turned on or off by external programmer control through J260 pin 15 or pin 17. Pin 15 is to be grounded (to turn on Type 283 circuits) whenever the programmer (Type 262) controls the real time sweep rate. Pin 17 is to be grounded whenever the Type 283 REAL TIME/DIV switch is used to control the real time sweep rate.

Q244 and the two LC filters serve to isolate the clock circuit pulses from the trigger circuit. Q244 operates either at cut off or in saturation. Base current through R242, D251 and SW251 assure that the collector voltage is no more than a few millivolts less negative than the emitter voltage at —12.2 volts. The DC resistance of K241 and R241 assures Q244 base voltage will cut off any current whenever the EXTERNAL PROGRAM switch is at ON and pins 15 and 17 of J260 are not grounded.

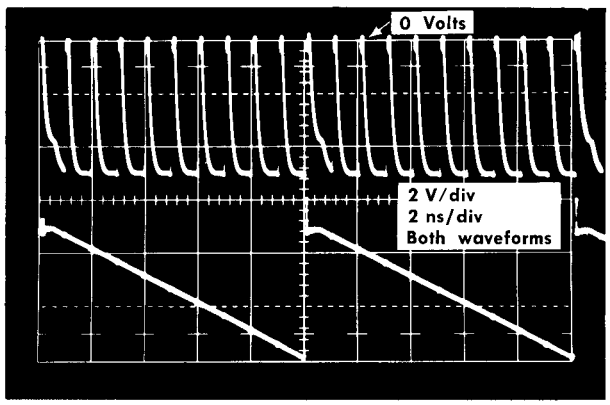
Clock Circuit

The clock circuit consists of a 1 MHz crystal-controlled clock, three ÷10 scalers, a ÷2 binary set, a ÷5 binary set series and an output multivibrator that provides constant amplitude clock pulses regardless of clock rate. The ÷10 scalers contain a constant current ramp delay circuit that combines with drive pulses to a reset multivibrator which puts out a pulse at the same time it resets the ramp voltage. Relay coil reed switches select the various scaler and binary output signals and couple them to the output multivibrator (Clock Standardizer). The Clock Standardizer sends proper amplitude and duration pulses to the sampling sweep unit external trigger input connector through K241A, which appears on the Trigger circuits schematic diagram.

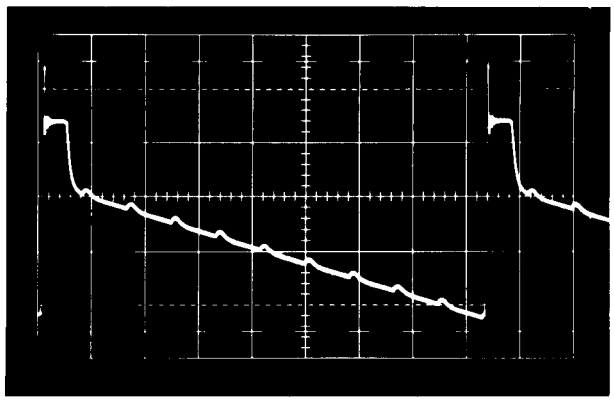
Oscillator. The 1 MHz Clock is a modified Colpitts crystal controlled oscillator with the crystal operating in a parallel mode between Q10 base and ground. Q10 static current value is limited by R13. Its value is determined by the voltage at Q10 base, set by the divider R10/R11. C13 provides positive feedback to sustain oscillations that begin when power is applied. Q10 current pulses produce negative-going voltage pulses of approximately —0.8 volt across Q14 base-emitter junction. R14 assures that Q14 is cut off when Q10 is not conducting. Q10 is the oscillator; Q14 is an amplifier/inverter that provides positive pulses to the 100 kHz Scaler. Both Q10 and Q14 operate in a non-linear mode so that pulses from Q14 collector are definitely not sinusoidal (see Fig. 3-2).



A. Q10 collector signal.



B. Upper, TP14; lower, Q35 emitter.



C. Algebraically added Q35 base and emitter signals. Vertical and horizontal deflection factors not calibrated.

Fig. 3-2. Clock and 100 kHz Scaler signals.

Test Point TP14 is a convenient test oscilloscope signal source for checking the Clock output pulses. Since Q14 is driven alternately from cut-off to saturation, the signal at TP14 swings from about −5.2 volts to essentially ground. Fig. 3-2 shows the signals at both the oscillator collector and at the non-linear amplifier collector, TP14. The Clock pulses combine (at Q35 base) with a negative going ramp (at Q35 emitter) in the 100 kHz Scaler described below.

100 kHz Scaler. Q35 and Q45 form a reset multivibrator that is adjusted to produce one positive output pulse for each ten input clock pulses. It is Q35 base-emitter signals that determine when the multivibrator will put out a pulse. The two input signals to Q35 come from Q14 collector through R18 and from the ramp generator C33/Q31.

Assume the two signals at Q35 base-emitter junction have just caused a regenerative action. The following conditions exist: 1) both transistors are cut off. 2) Q35 base voltage is swinging from −4.87 to −4.45 volts (the 5.2-volt pulses at TP14 shown in Fig. 3-2B are attenuated by R18/R43/R44). 3) Q31 is charging C33 at a constant rate, causing Q35 emitter voltage to fall in a negative direction. Q35 emitter signal is shown in Fig. 3-2B. The two Q35 signals were combined algebraically to form one composite waveform shown in Fig. 3-2C. The composite waveform shows that the reset multivibrator is keyed into conduction by the clock signal.

Should the oscillator stop, and if Q14 is not conducting, the scaler circuits will not recycle. If the oscillator stops, and after Q31 has charged C33 sufficiently negative to cause Q35 to conduct, the current passed by Q31 is so small that the voltage drop across R34 will not cause Q45 to conduct. Q45 is caused to conduct only when the clock signal at Q35 base increases Q35 current to the point where R34 voltage drop exceeds about −0.5 volt. Q35 emitter is bypassed for clock pulses by C33 so the stage gain is sufficient for a clock pulse to turn Q45 on.

As Q45 conducts, its collector voltage applies additional turn-on signal to Q35 base so that both transistors quickly saturate. The charge obtained by C33 during the ramp run-down is shorted by Q35 emitter-collector path in series with Q45 base-emitter path. Q45 base current is essentially the current available from C33 (R34 does not conduct much of the current because of the low voltage across it from Q45 base-emitter diode voltage). Once C33 is discharged, the small current allowed by Q31 cannot maintain Q45 in conduction. Q45 collector voltage then goes negative, turning Q35 completely off. Q31 current then again charges C33 negatively for another cycle.

A reset multivibrator cycle of operation relies upon the C33/Q31 ramp signal to prevent Q35/Q45 conduction until after 9 clock pulses have occurred. The ramp current will not fire the reset multivibrator alone. The ramp must reach a voltage level that causes Q35 to conduct slightly before the 10th clock pulse will cause both Q35 and Q45 to conduct.

Ramp Generator. The constant current mentioned above for C33/Q31 is controlled in the following manner. Q23 is an emitter follower with a low impedance output that is the voltage reference for Q31 (and Q51 and Q71) base. Should Q31 base current change, Q23 emitter will supply the current with essentially no change in voltage.

Q23 emitter sets Q31 base voltage at −6.2 volts, approximately 6 volts more positive than the −12.2-volt supply. Q31 emitter return resistance to the −12.2-volt supply then sets the current through Q31 by Ohm's law. (R32 + R30/R31 and 6 volts minus Q31 base-emitter junction voltage drop.) Q31 collector operates as a typical "pentode-like" high impedance, allowing its collector voltage (across C33) to change without changing the current value. Thus, a con-

stant current is established by Q23/Q31 for the purpose of charging C33 linearly. The ramp-slope of C33 charge can be changed by changing Q31 emitter return resistance at R30, the 100 kHz CAL control.

10 kHz and 1 kHz Scalers. The remaining two scaler circuits function in an identical manner to that of the 100 kHz Scaler just described. The major difference is the ramp capacitor size and the ramp current value that establishes different ramp slopes for longer periods of multivibrator lock-out delay.

The 100 kHz Scaler drives the 10 kHz Scaler through D45. The resistive voltage dividers between the —12.2-volt supply and ground on both sides of silicon diode D45 are identical. Therefore, the quiescent voltage values on both sides of D45 are identical. The diode then completely disconnects Q35 base circuit from Q55 base circuit, unless D45 anode reaches a point about 0.5 volt more positive than its cathode. The clock pulses at Q35 base circuit are approximately +0.42 volts peak; less than enough to turn D45 on. Thus D45 effectively isolates the clock pulses from the 10 kHz Scaler, but connects Q45 collector positive signal to Q55 base through R48 at the time of each 100 kHz Scaler output pulse. (D65 isolates Q75 base from 100 kHz Scaler output pulses.)

All three scaler circuit output pulses are selected by reed relays to operate the remainder of the clock circuits.

D45 and D65 serve a second function. They disconnect any shunt capacitive loads on the binary and clock standardizer circuits from Q45 and Q65 collector circuits. Some positions of the REAL TIME/DIV switch connect enough shunt capacitance to D45 and D65 cathodes so that the scaler output pulse lasts longer at the diode cathode than at the anode. The slow rate of fall, if applied to Q45 (or Q65) collector, would alter the ÷10 action of the scaler to ÷11 at some sweep rates. The 1 kHz Scaler does not need the disconnect diode, because the slow ramp rate of at C73 is not affected by the various shunt capacitive loads at Q85 collector.

The 1 kHz Scaler has a capacitor (C75) between base and emitter of Q75. C75 serves to cancel some noise modulation at Q75 base that would otherwise add noticeable jitter to the 1 kHz Scaler output pulses.

Binary Set Circuits. These circuits are bistable multivibrators. Each binary remains with one of a pair of transistors conducting until a positive pulse arrives. Stable conduction of only one transistor at a time is assured by voltage divider resistors from each transistor collector to the other transistor base and then to ground.

Using the ÷2 binary as an example, if Q105 is conducting, its base receives a steady turn-on signal from current in R114 and R115. Q105 collector is saturated to a voltage of about —0.3 volt. R105/R106 assures that Q115 base does not have a turn-on signal.

The binary state is switched by a positive pulse that arrives through steering diode D114. The diode couples the positive pulse through C115 to Q105 base which starts to turn Q105 off. As Q105 collector goes negative, R105 and C105 couple a turn-on signal to Q115 base. The positive change in Q115 collector voltage adds to the positive trigger signal and the set changes states in a fast regenerative action.

Each binary set changes states with a single input lead positive pulse. Its output is from only one of the transistors. Positive-going output pulses from Q115 are AC coupled to the single input lead of the first set in the ÷5 binary series. Thus, the ÷5 binary series receives one positive input pulse for each two positive input pulses to the ÷2 set.

÷5 Binary Set Series. The ÷5 binary set series is three ÷2 sets in series, with feedback applied from Q165 to Q135 and Q155. Feedback assures that the three sets do not count to 8, but that rather they all reset to zero after 5 input pulses. Input to the ÷5 binary series is to Q125/Q135. The ÷5 series output pulse is taken from Q175.

There is one isolation diode between the ÷2 and the ÷5 series input. D120 conducts only when Q115 collector signal goes positive. It does not conduct when K98 couples positive scaler pulses into the ÷5 series, thus preventing false triggering of the ÷2 set. Two other isolation diodes, D135 and D155 assure that positive signals pass only one way in the feedback path from Q165 to Q135 and Q155.

Clock Pulse Standardizer. The Clock Pulse Standardizer multivibrator transistors Q185 and Q195 do not conduct in their quiescent state. Positive pulses that arrive through C181/R181 cause the circuit to put out fast positive pulses. The incoming pulses arrive at the base of Q185. As Q185 conducts, Q195 also conducts. C193 assures fast turn on of both transistors in normal regenerative action. Output pulse duration at Q195 collector is approximately 2 to 4 μs and is controlled primarily by the L/R time constant of LR184. The output pulse to the sampling sweep unit has a pulse duration of approximately 0.4 μs due to the differentiation by C195 and R196. C186/R186 decouple the

TABLE 3-1

Relay Closures & Clock Pulse Periods for each Real Time Sweep Rate

Real Time/ Div	Relay Coils Energized	Clock Pulse Period
1 ms/div	K96, K98, K180	10 μs
2	K96, K180	20
5	K96, K98	50
10	K96	100
20	K97, K180	200
50	K97, K98	500
0.1 s/div	K97	1 ms
0.2	K180	2
0.5	K98	5
1.0	None	10

—12.2-volt supply lead to Q185 and keep the high current of each output pulse confined to the immediate area of the standardizer circuit.

Relay Switching. Positive pulses out of the 100 kHz Scaler, 10 kHz Scaler and 1 kHz Scaler are relay switched to the clock circuits. When the front-panel REAL TIME/DIV switch is set for a real time sweep rate of 1 ms, the 100 kHz Scaler output is fed directly to the Clock Pulse Standardizer. Thus the clock pulses sent to the sampling sweep unit have a 10 μs period. Table 3-1 lists the relay closures and clock pulse period for each position of the REAL TIME/DIV switch.

Remote operation of the Type 283/R283 clock circuits is done by grounding certain pins of J260. Table 3-2 lists the correct pins of J260 that must be grounded to pin 16 for each Real Time/Div sweep rate.

TABLE 3-2

Real Time/Div Operation by Remote Type 262

Real Time/ Div	J260 Remote Ground Closures to Pin 16
1 ms/div	24, 14, 13, 15, 25, 5
2	24, 13, 15, 25, 7
5	24, 14, 15, 25, 6
10	24, 15, 25, 5
20	22, 13, 15, 25, 7
50	22, 14, 15, 25, 6
0.1 s/div	22, 15, 25, 6
0.2	13, 15, 25, 6
0.5	14, 15, 25, 6
1.0	15, 25, 5

SECTION 4

MAINTENANCE

This section of the manual shows the parts location of all components on the circuit board. Maintenance suggestions for soldering and repairs are contained in the Type 3T4 instruction manual. If trouble develops in the Type 283/R283, refer to the Circuit Description for aid in locating and correcting the trouble.

CAUTION

The glass reed switches are fragile. Do not hang a test oscilloscope probe on a reed switch lead. If testing for signals at a reed switch, hold the probe tip against the soldered connection at the laminated board.

NOTES

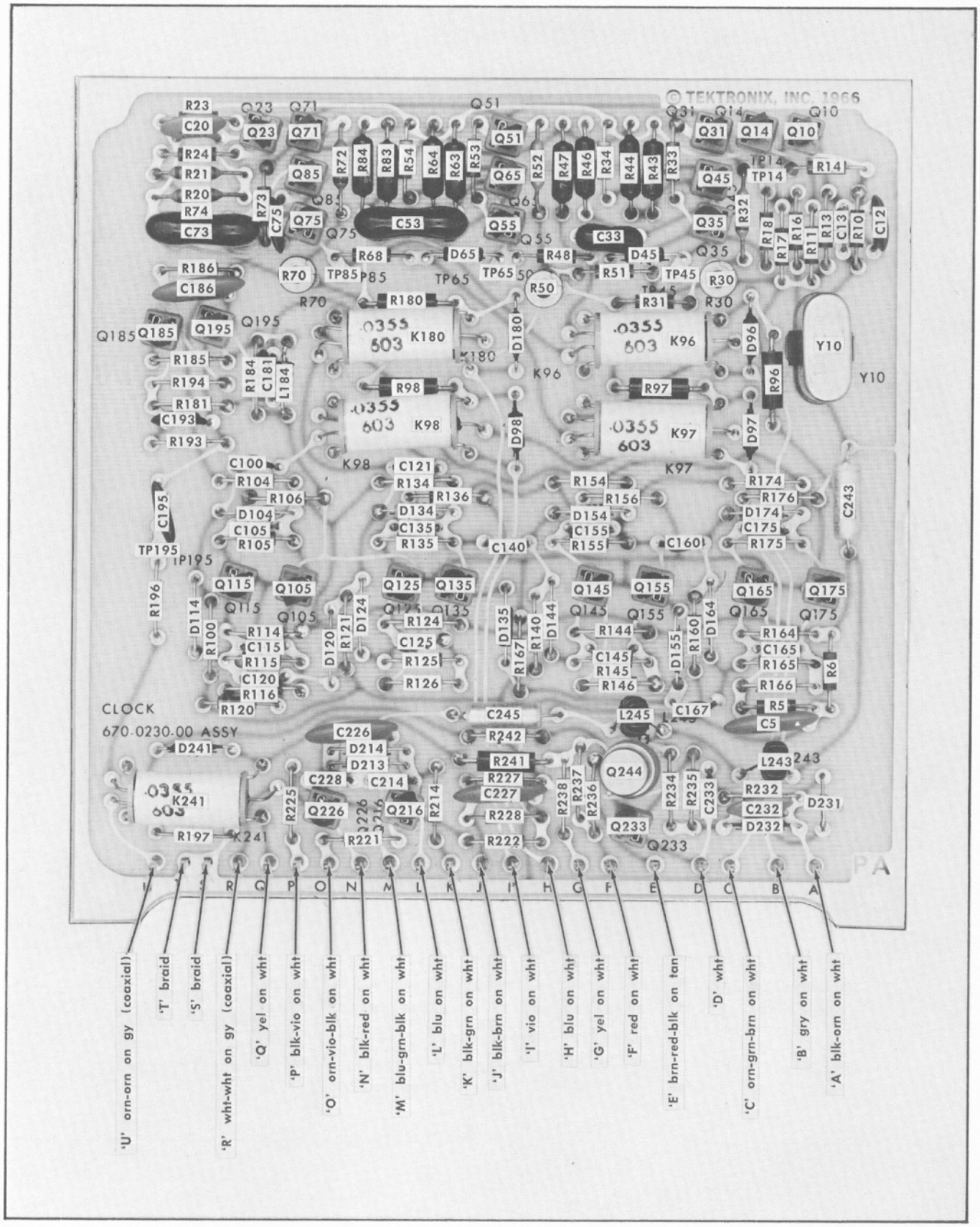


Fig. 4-1. Location of parts on the Type 283/R283 circuit board.

SECTION 5

CALIBRATION

The Real Time Adapter is a stable device, and should not require frequent recalibration. It is suggested the recalibration procedure that follows be used after changing any parts during maintenance.

Do not set any internal adjustments to midrange as a preliminary to recalibration. Presetting internal adjustments to midrange will only lengthen the time required for recalibration.

Equipment Required

Equipment required for a complete recalibration of the Type 283/R283 Real Time Adapter is listed below. Alternate equipment may be substituted for that listed, if performance specifications of the substituted equipment equal or exceed those required by the particular test. All test equipment must be calibrated and in good working order.

1. A Tektronix Type 567 or RM567 Readout Oscilloscope with a Type 3T4, a Type 3S76 and a Type 6R1A Digital Readout Unit. These items must be calibrated and operating as a unit.

2. A test oscilloscope with a bandwidth of at least 15 MHz, a maximum sweep rate of 1 μs/div, and a vertical added mode of operation, deflection factor .1 V/div minimum. A Tektronix 540-series, such as the 545B Oscilloscope, with a Type 1A2 Dual Trace Plug-In Unit recommended.

3. A 10× Probe for use with the test oscilloscope. A Tektronix P6006 10× Passive Probe (with BNC connector), Tektronix Part No. 010-0127-000 recommended.

4. A 1× Probe for use with the test oscilloscope. A Tektronix P6028 1× Passive Probe (with BNC connector), Tektronix Part No. 010-0074-00 recommended.

5. An accurate frequency source. Capable of 1-μs time marks with an accuracy of 0.01% and an amplitude approximately 1 volt. A Tektronix Type 184 Time-Mark Generator recommended.

6. A coaxial cable with BNC connectors. Tektronix Part No. 012-0057-00.

7. A sine wave signal generator capable of providing 1 kHz signals with amplitude adjustable to 5 volts. A Heath IG-72 Audio Generator recommended.

8. A 10× Probe for the vertical sampling unit, such as a Tektronix P6034 10× Probe. Tektronix Part No. 010-0110-00.

9. A Probe Tip to BNC adapter for use with P6034. Tektronix Part No. 013-0084-00.

10. Two BNC cable to clip lead adapters. Tektronix Part No. 013-0076-00.

11. A square wave generator capable of 1 kHz repetition rate at an amplitude of 1.4 volts. A Tektronix 106 Square-Wave Generator recommended.

12. A 50 Ω Termination, GR to BNC (mid-line). Tektronix Part No. 017-0083-00.

13. A BNC T Male to 2 Female adapter, Tektronix Part No. 103-0030-00 and a BNC Female adapter, Tektronix Part No. 103-0028-00.

14. A small screwdriver for the internal adjustments.

15. A bench multimeter for setting the Type 3S76 DC Offset for zero volts at the monitor jack.

CALIBRATION RECORD AND INDEX

This Abridged Calibration Procedure is provided to aid in checking the operation of the Type 283. It may be used as a calibrating guide by the experienced calibrator, or it may be used as a calibration record. Since the step numbers and titles used here correspond to those used in the complete Calibration Procedure, the following procedure serves as an index to locate a step in the complete Calibration Procedure.

Type 283 Serial No. _____

Calibration Date _____

☐ 1. Check Oscillator (page 5-4)

1 MHz within ±0.1%.

☐ 2. Adjust 100 kHz CAL, R30 (page 5-5)

One 100 kHz Scaler pulse each 10 μs.

☐ 3. Adjust 10 kHz CAL, R50 (page 5-5)

One 10 kHz Scaler pulse each 100 μs.

☐ 4. Adjust 1 kHz CAL, R70 (page 5-5)

One 1 kHz Scaler pulse each 1 ms.

☐ 5. Check Clock Pulses Period For Each REAL TIME/DIV Switch Position (page 5-6)

One pulse per graticule division using Table 5-1.

☐ 6. Check Clock Pulse Output Amplitude (page 5-6)

Pulse amplitude must be between 100 and 300 mV into Type 3T4 input.

☐ 7. Check Trigger Circuit FREE RUN Operation (page 5-7)

Square-wave cycle of 4 to 6 ms period with a peak to peak amplitude of 12 volts on the test oscilloscope.

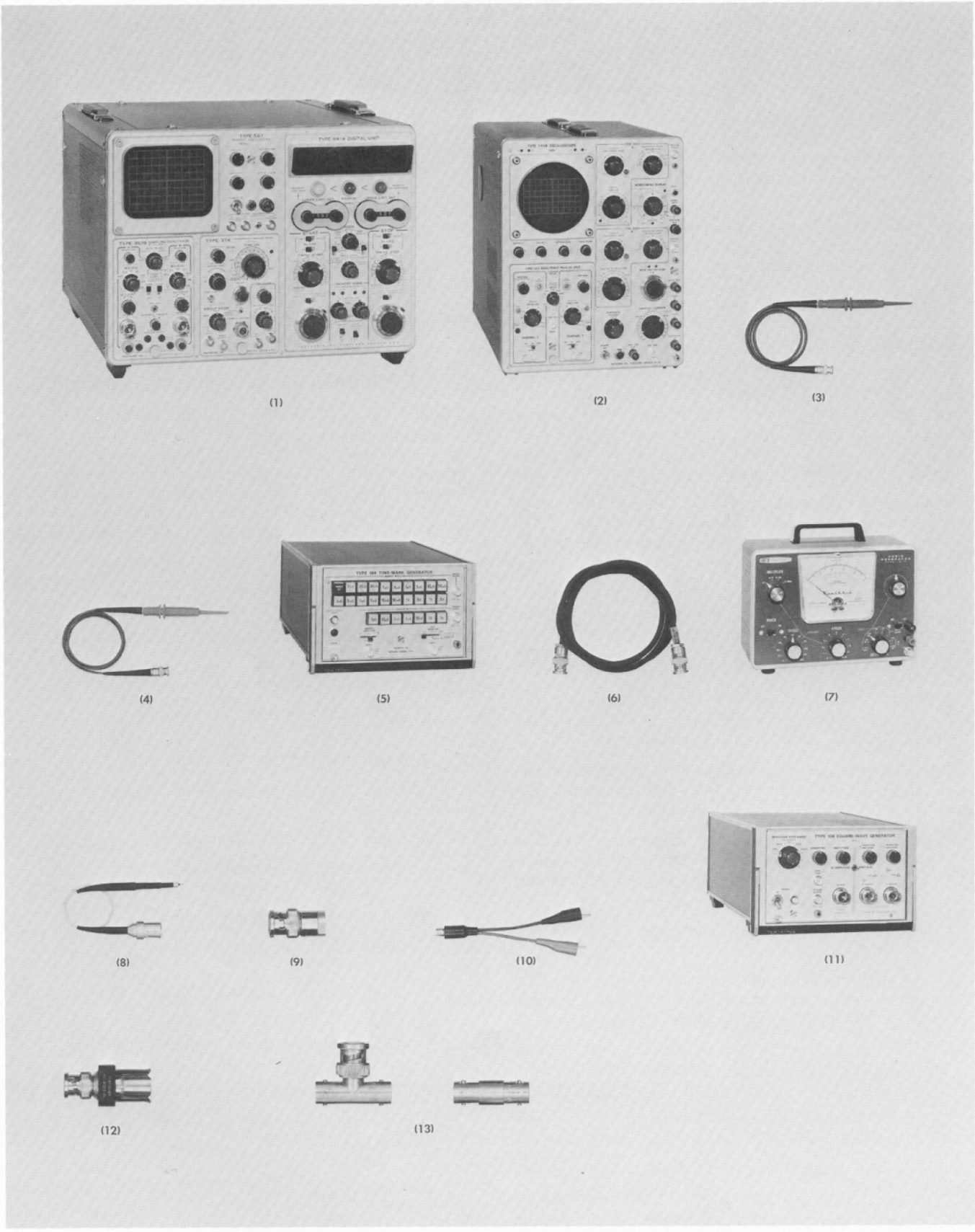


Fig. 5-1. Equipment required for calibration.

☐ 8. Check Internal Trigger Sensitivity (page 5-8)

Both positive and negative triggering on AC or DC with a display amplitude of 0.5 major division, 1 kHz signal.

☐ 9. Check Single Display Operation (page 5-8)

One sweep is displayed when START button is depressed.

☐ 10. Check External Trigger Sensitivity (page 5-8)

Both positive and negative triggering with a signal amplitude of 0.5 V peak to peak applied at the EXT REAL TIME TRIGGER INPUT connector.

☐ 11. Check Trigger Level Range (Internal AC) (page 5-8)

Trace disappears with a display amplitude of 16 major divisions at either limit of the TRIGGER LEVEL control.

☐ 12. Check Trigger Level Range (External AC) (page 5-9)

Trace disappears with 1.4 V pulse, 1 kHz repetition rate, applied at the EXT REAL TIME TRIGGER INPUT connector at either limit of the TRIGGER LEVEL control.

NOTES

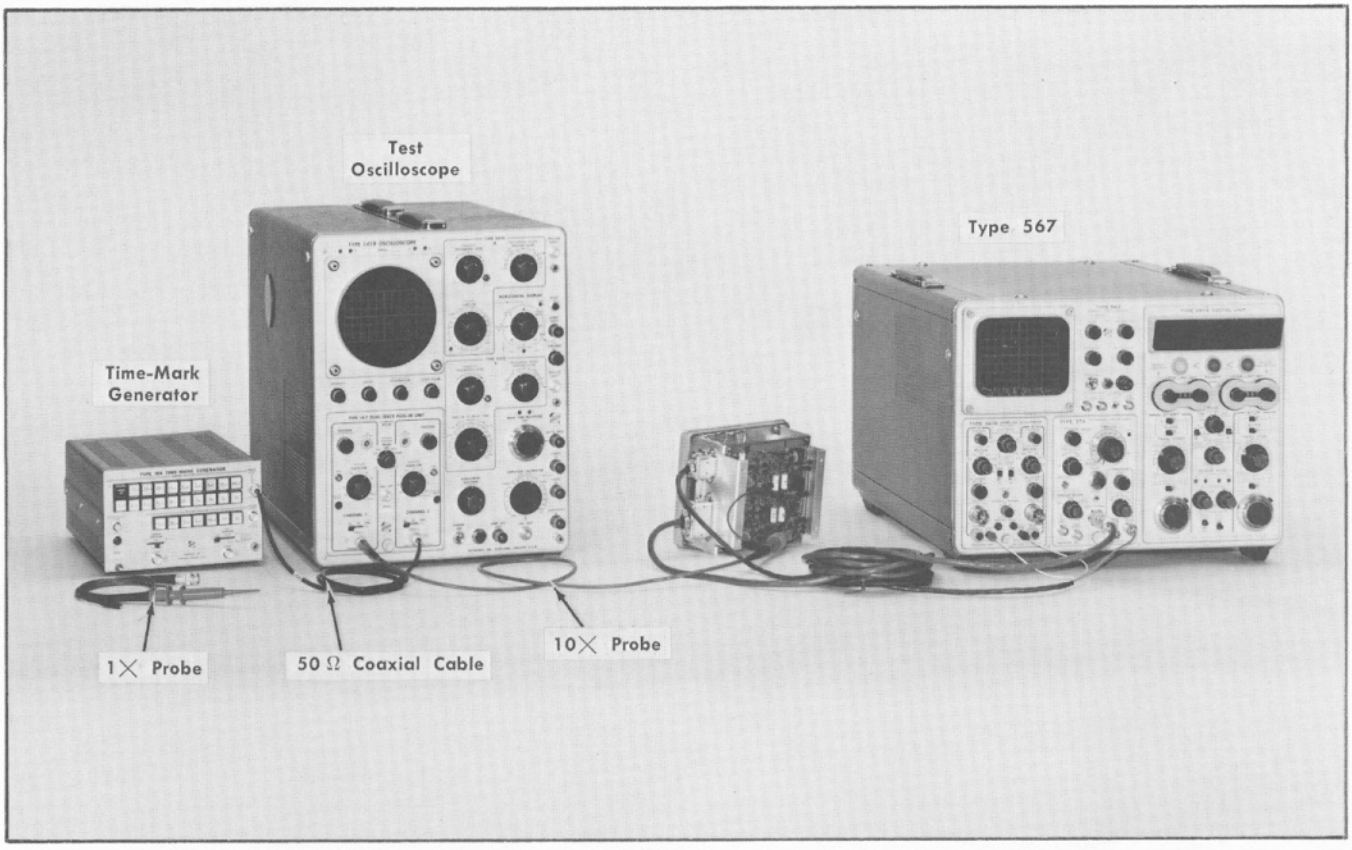


Fig. 5-2. Test equipment setup for steps 1 through 6.

Preliminary Control Check

Check all front-panel controls for proper indexing. Check the variable TRIGGER LEVEL control for smooth operation. Correct any defects found. Remove the wrap-around case from the Type 283 by removing the four bottom rubber feet. (Remove the Type R283 covers by removing four screws from each panel.)

Control Settings:

Type 283

REAL TIME/DIV	1 S
DISPLAY	NORMAL
EXT PROGRAM	OFF
TRIGGER LEVEL	Midrange
CHANNEL A/ CHANNEL B	CHANNEL A
MODE	INT AC
SLOPE	+

Type 3T4

Time/Div	Remote Program
Trigger	+ Ext
Recovery Time	Fully counterclockwise

Test Oscilloscope

Mode	Add
Volts/cm (both channels)	.5
Input coupling (both channels)	AC
Triggering	— Int, AC
Time/Cm	1 ms

Connections:

Install the cable (Part No.) 012-0101-00 between the Type 283 Real Time Adapter J250 connector and the Type 3T4 front-panel REMOTE PROGRAM connector J80.

Install the cable (Part No.) 012-0103-00 between the Type 283 Real Time Adapter J201 and the Type 3T4 Trigger EXT INPUT connector; place the white lead in the Type 3S76 A OUT connector and the yellow lead in the B OUT connector.

Attach the 10× Probe to the Test Oscilloscope Channel 1 input connector.

Connect the Time Mark Generator Marker Output connector to the Test Oscilloscope Channel 2 input connector, use a 50 Ω coaxial cable.

1. Check Oscillator

a. Use the setup shown in Fig. 5-2 and connect the 10× Probe to TP14, see Fig. 5-3.

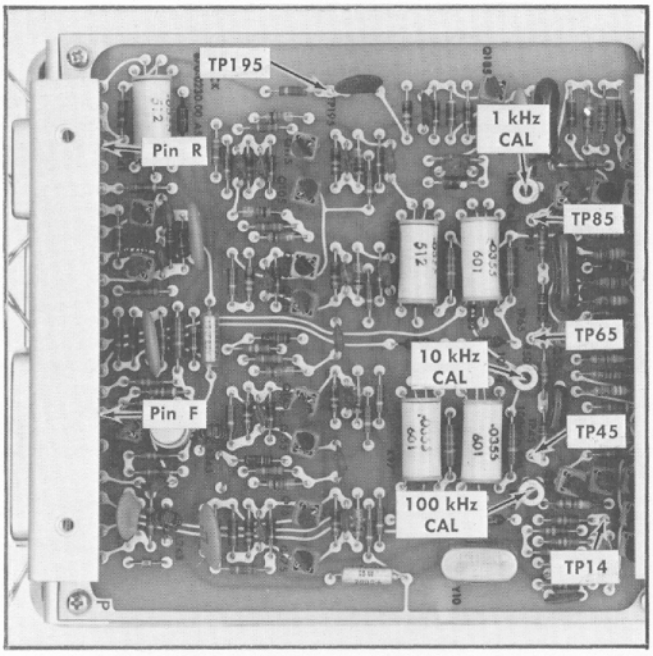


Fig. 5-3. Location of Type 283 Test Points and Adjustments.

b. Set the Time Mark Generator controls to deliver 1 μs time-marks.

c. Trigger the Test Oscilloscope display on the beat frequency (difference frequency between the oscillator and the Time Mark Generator). If the beat frequency is less than 1 kHz (greater than 1 cycle per cm), the oscillator is operating correctly. Fig. 5-4 shows a typical display of the beat frequency.

d. Disconnect the 10× Probe from TP14 and the Time Mark Generator signal from the Test Oscilloscope.

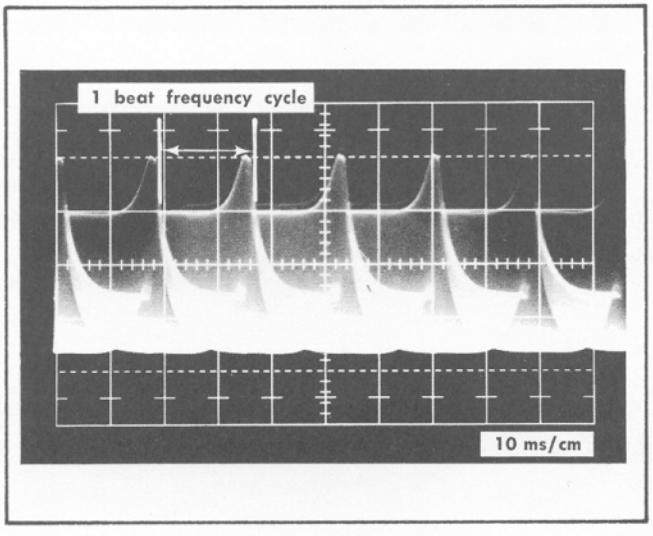


Fig. 5-4. Typical Test Oscilloscope display of beat frequency, step 1.

2. Adjust 100 kHz CAL, R30

a. Set the Test Oscilloscope Time/cm switch to 10 μs, the vertical unit Mode switch to CH 1 and Volts/cm switch to .1 (1 volt/cm with the 10× Probe). Connect the 10× Probe to TP45, see Fig. 5-3.

b. If the Test Oscilloscope display is other than one large 10 μs marker per centimeter with nine low amplitude 1 μs markers between each two large pulses (see Fig. 5-5), adjust the 100 kHz CAL, R30, halfway between the points of eight 1 μs markers and ten 1 μs markers.

c. Disconnect the 10× Probe from TP45.

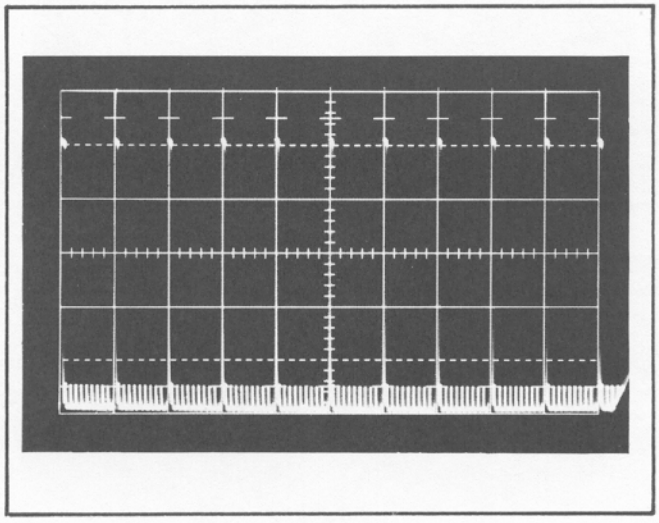


Fig. 5-5. Typical Test Oscilloscope display for scaler adjustments.

3. Adjust 10 kHz CAL, R50

a. Set the Test Oscilloscope Time/cm switch to .1 ms and connect the 10× Probe to TP65, see Fig. 5-3.

b. If the Test Oscilloscope display is other than one large 100 μs marker per centimeter with nine low amplitude 10 μs markers between each two large pulses, adjust the 10 kHz CAL, R50, halfway between the points of eight 10 μs markers and ten 10 μs markers.

c. Disconnect the 10× Probe from TP65.

4. Adjust 1 kHz CAL, R70

a. Set the Test Oscilloscope Time/cm switch to 1 ms and connect the 10× Probe to TP85, see Fig. 5-3.

b. If the Test Oscilloscope display is other than one large 1 ms marker per centimeter with nine low amplitude 100 μs markers between each two large pulses, adjust the 1 kHz CAL, R70, halfway between the points of eight 100 μs markers and ten 100 μs markers.

c. Disconnect the 10× Probe from TP85.

5. Check Clock Pulses Period For Each REAL TIME/DIV Switch Position

a. Connect the 10× Probe to TP195, see Fig. 5-3, and set the Test Oscilloscope Volts/cm switch to .2.

b. Set the Test Oscilloscope Time/cm switch and the Type 283 REAL TIME/DIV switch according to Table 5-1. Check for 1 pulse per graticule division at each position of the REAL TIME/DIV switch, see Fig. 5-6.

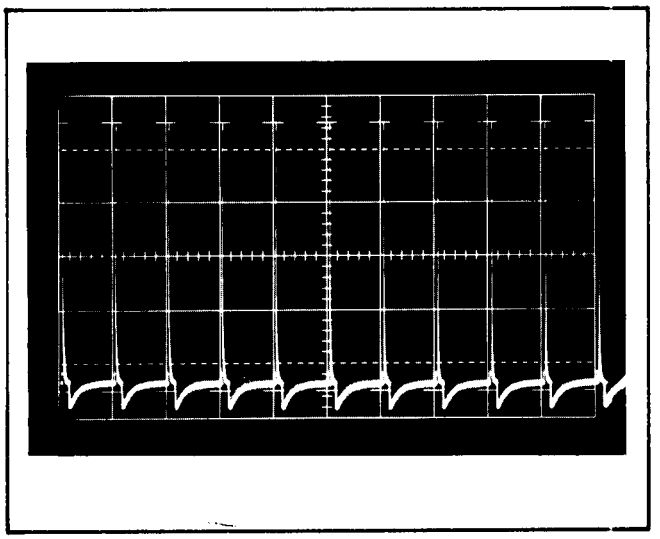


Fig. 5-6. Typical Test Oscilloscope display for checking REAL TIME/DIV switch.

TABLE 5-1

Checking REAL TIME/DIV Switch

REAL TIME/DIV Switch Position	Test Oscilloscope Time/cm
1 S	10 ms
.5	5 ms
.2	2 ms
.1	1 ms
50 mS	.5 ms
20	.2 ms
10	.1 ms
5	50 μs
2	20 μs
1	10 μs

c. If the display is other than one pulse per graticule division, check that the binary circuits are working correctly.

d. Disconnect the 10× Probe from TP195 and the Test Oscilloscope vertical unit input.

6. Check Clock Pulse Output Amplitude

a. Attach the 1× Probe to the Test Oscilloscope vertical input. Connect the 1× Probe ground clip to the Type 283 chassis and the Probe tip to Pin R, see Fig. 5-3.

b. Set the Type 283 REAL TIME/DIV switch to 1 ms, the Test Oscilloscope Time/cm switch to 10 μs and the vertical unit Volts/cm switch to .1.

c. Adjust the Test Oscilloscope Triggering controls for a stable display. The pulse amplitude must be between 100 and 300 mV peak to peak, or between 1 and 3 major graticule divisions, see Fig. 5-7.

d. Disconnect the 1× Probe from Pin R and the Test Oscilloscope vertical unit input connector.

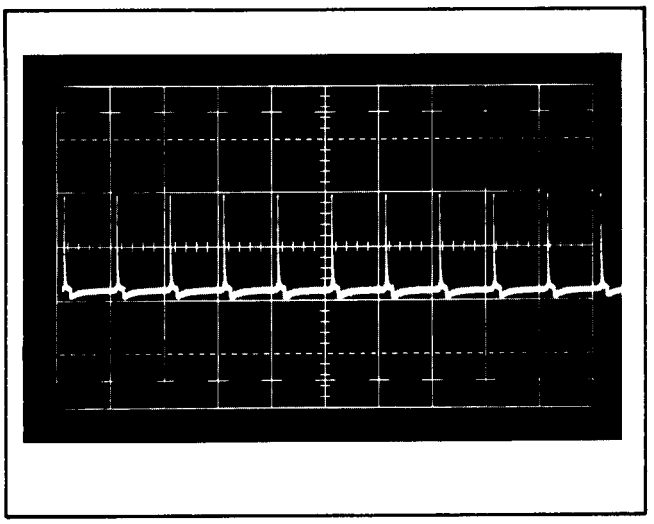


Fig. 5-7. Typical Test Oscilloscope display for measurement of Clock Pulse Output Amplitude.

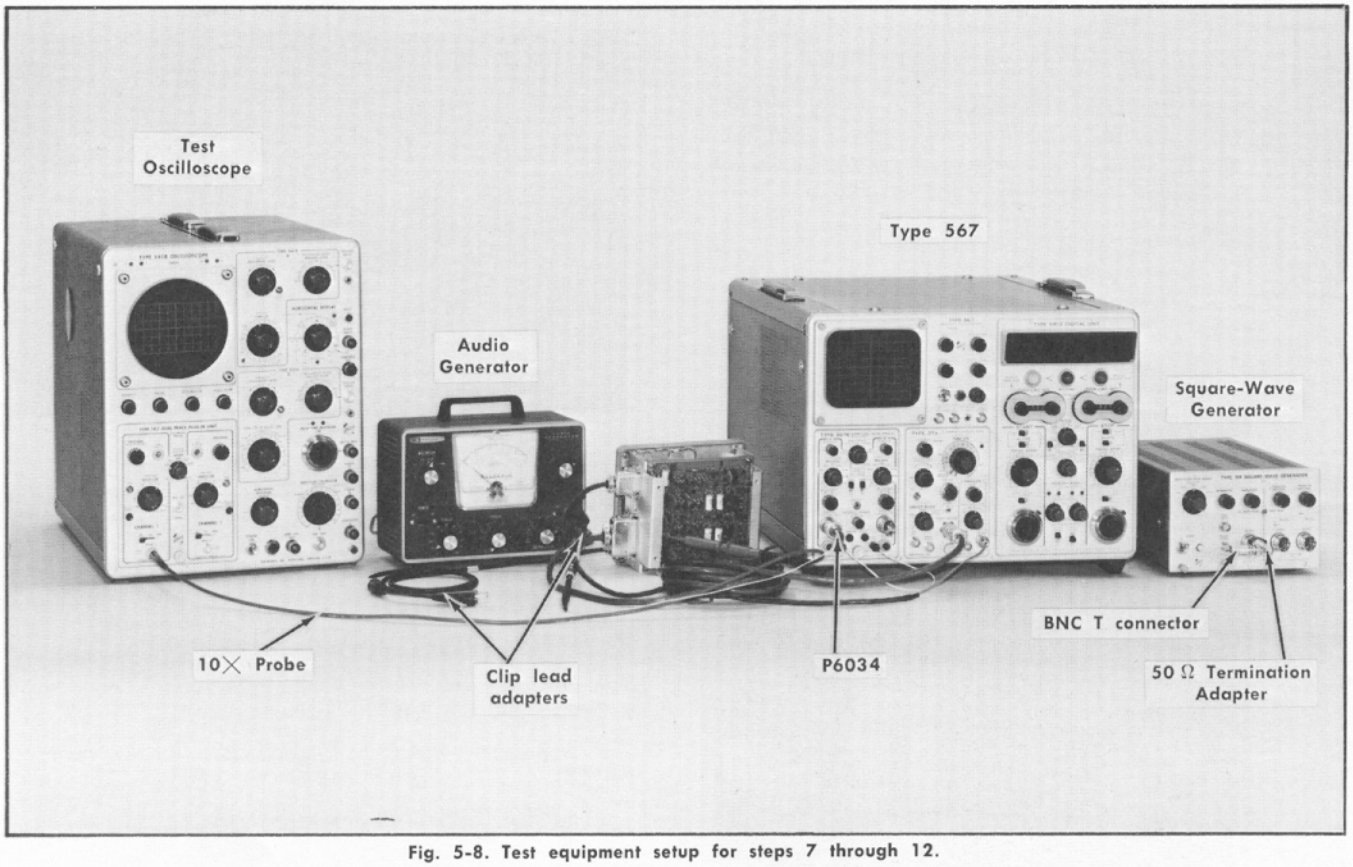


Fig. 5-8. Test equipment setup for steps 7 through 12.

Control Settings:

Type 283

REAL TIME/DIV	1 mS
DISPLAY	NORMAL
EXT PROGRAM	OFF
TRIGGER LEVEL	Midrange
CHANNEL A/ CHANNEL B	CHANNEL A
MODE	FREE RUN
SLOPE	+

Type 3S76

DC Offset (both channels)	Zero volts at ×100 Offset Monitor jacks (Check with multimeter)
Position (both channels)	Midrange
MV/Div	100
2-200 Var	Calib
Mode	A Only
Normal-Smooth	Normal
Norm/Inv	Norm
Internal Trigger	Off

Type 3T4

Position	Midrange
Display Mag	1000 ×1
Sweep Mode	Norm
Time/Div	Remote Program
Delay	Optional
Trigger Level	About 9 o'clock
Int/Ext	+Ext
Recovery Time	Fully counterclockwise

Test Oscilloscope

Mode	CH 1
Volts/cm (Channel 1)	.5
Input Coupling (Channel 1)	AC
Triggering	+Int, AC
Time/cm	1 ms

Connections:

Leave the Type 283 as connected to the Type 3T4 and Type 3S76.

Attach the 10× Probe to the Test Oscilloscope Channel 1 input connector.

Attach the 10× P6034 Probe to the Type 3S76 Input A connector. Connect the Probe to the Audio Generator through the Probe tip to BNC adapter and the BNC to Clip Lead adapter.

Attach the coaxial cable with BNC connectors to the Type 283 EXT REAL TIME TRIGGER INPUT connector. Attach a BNC to Clip Lead adapter to the coaxial cable.

7. Check Trigger Circuit FREE RUN Operation

a. Use the setup shown in Fig. 5-8 and set the Audio Generator output to zero.

b. Adjust the Type 3T4 Trigger Level control fully counterclockwise to stop the sweep, then clockwise about 3 to 5 degrees past the point at which the trace appears.

c. Connect the Test Oscilloscope 10× Probe to Pin F, see Fig. 5-9. The Test Oscilloscope display should show between about 2 and 4 complete square wave cycles with a peak-to-peak amplitude of 12 volts, see Fig. 5-10.

d. Disconnect the 10× Probe from Pin F.

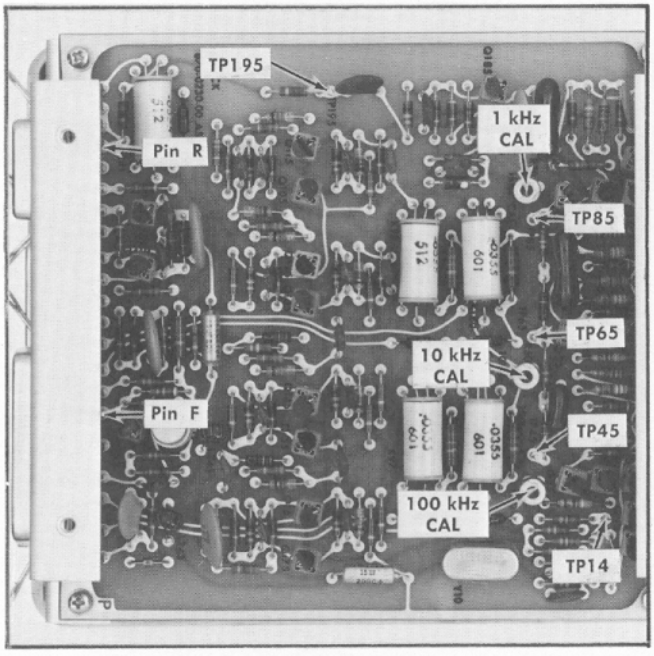


Fig. 5-9. Location of Test Points and Adjustments.

8. Check Internal Trigger Sensitivity

a. Set the Audio Generator frequency to 1 kHz and adjust the output amplitude for a (jumbled) display amplitude of 0.5 major division.

b. Set the Type 283 MODE switch to INT AC and adjust the TRIGGER LEVEL control for a stable display. The sweep should start on the positive going portion of the 1 kHz sine wave.

c. Set the SLOPE switch to — and adjust the TRIGGER LEVEL control for a stable display. The sweep should start on the negative going portion of the sine wave.

d. Set the MODE switch to INT DC and adjust the TRIGGER LEVEL control for a stable display that starts on the negative going portion of the sine wave.

e. Set the SLOPE switch to + and adjust the TRIGGER LEVEL control for a stable display that starts on the positive going portion of the sine wave.

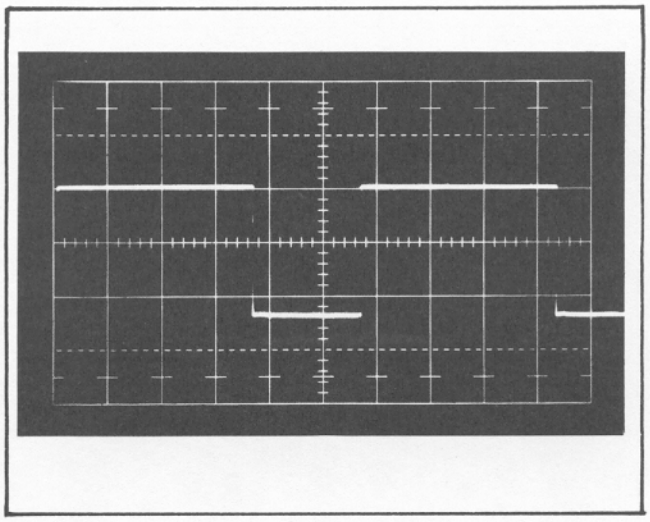


Fig. 5-10. Test Oscilloscope display described in step 7c.

9. Check Single Display Operation

a. Set the Type 283 TRIGGER LEVEL control fully counterclockwise and the DISPLAY switch to SINGLE.

b. Depress the START button and check for one sweep on the CRT.

c. Set the DISPLAY switch to NORMAL.

10. Check External Trigger Sensitivity

a. Connect the Audio Generator output to both the P6034 Probe and the Type 283 EXT REAL TIME TRIGGER INPUT connector. Use a coaxial cable with BNC connectors and a BNC to Clip Lead Adapter.

b. Set the Type 3S76 MV/Div switch to 50 and adjust the Audio Generator output amplitude and the Type 283 TRIGGER LEVEL control for 1 major division on the CRT or 0.5 volt peak to peak 1 kHz sine wave.

c. Set the Type 283 MODE switch to EXT (AC ONLY) and adjust the TRIGGER LEVEL control for a stable display, that starts on the positive going portion of the sine wave.

d. Set the SLOPE switch to — and adjust the TRIGGER LEVEL control for a stable display, that starts on the negative going portion of the sine wave.

e. Disconnect the Audio Generator from the Type 283 EXT REAL TIME TRIGGER INPUT connector. Leave it connected to the P6034 Probe.

11. Check Trigger Level Range (Internal)

a. Set the Type 283 MODE switch to INT AC. Set the Type 3S76 MV/Div switch to 100 and adjust the Audio Generator output amplitude for a display amplitude of 8 major divisions of 1 kHz sine wave.

b. Change the Type 3S76 MV/Div switch to 50. The display amplitude should be 16 major divisions peak to peak.

c. Turn the Type 283 TRIGGER LEVEL control fully counterclockwise, check that the trace disappears, then turn the TRIGGER LEVEL control fully clockwise and check that the trace disappears.

d. Disconnect the Probe from the Audio Generator and the P6034 Probe.

12. Check Trigger Level Range (External)

a. Connect the (Type 106) Square-Wave Generator High Amplitude Output connector to the Type 283 EXT REAL TIME TRIGGER INPUT connector and to the Type 3S76 Input A connector as follows: attach the 50 Ω Midline Termination to the Square-Wave Generator Output, the BNC T connector to the termination, the 10× P6034 Probe from the Type 3S76 Input A to one connector on the BNC T connector, and the coaxial cable from the Type 283 EXT REAL TIME TRIGGER INPUT connector to the other connector on the BNC T connector.

b. Set the Square-Wave Generator for a 1 kHz repetition rate. Set the Type 3S76 MV/Div switch to 50 and adjust the Square-Wave Generator amplitude control for a display amplitude of 2.8 major divisions (1.4 volts peak to peak).

c. Set the Type 283 MODE switch to EXT (AC ONLY) and turn the TRIGGER LEVEL control fully counterclockwise. Check that the trace disappears; then turn the TRIGGER LEVEL control fully clockwise and check that the trace disappears.

This completes the calibration of the Type 283. Disconnect all test equipment and replace the wrap-around case (or top and bottom panels). If the instrument has been completely calibrated to the tolerances given in this procedure, it will perform to the limits given in the Characteristics section of the Instruction Manual.

NOTES

NOTES

ABBREVIATIONS AND SYMBOLS

A or amp	amperes
AC or ac	alternating current
AF	audio frequency
α	alpha—common-base current amplification factor
AM	amplitude modulation
$\approx$	approximately equal to
β	beta—common-emitter current amplification factor
BHB	binding head brass
BHS	binding head steel
BNC	baby series "N" connector
$\times$	by or times
C	carbon
C	capacitance
cap.	capacitor
cer	ceramic
cm	centimeter
comp	composition
conn	connector
$\sim$	cycle
c/s or cps	cycles per second
CRT	cathode-ray tube
csk	countersunk
Δ	increment
dB	decibel
dBm	decibel referred to one milliwatt
DC or dc	direct current
DE	double end
°	degrees
°C	degrees Celsius (degrees centigrade)
°F	degrees Fahrenheit
°K	degrees Kelvin
dia	diameter
$\div$	divide by
div	division
EHF	extremely high frequency
elect.	electrolytic
EMC	electrolytic, metal cased
EMI	electromagnetic interference (see RFI)
EMT	electrolytic, metal tubular
ε	epsilon—2.71828 or % of error
$\geq$	equal to or greater than
$\leq$	equal to or less than
ext	external
F or f	farad
F & I	focus and intensity
FHB	flat head brass
FHS	flat head steel
Fil HB	fillister head brass
Fil HS	fillister head steel
FM	frequency modulation
ft	feet or foot
G	giga or 10^9
g	acceleration due to gravity
Ge	germanium
GHz	gigahertz
GMV	guaranteed minimum value
GR	General Radio
$>$	greater than
H or h	henry
h	height or high
hex.	hexagonal
HF	high frequency
HHB	hex head brass
HHS	hex head steel
HSB	hex socket brass
HSS	hex socket steel
HV	high voltage
Hz	hertz (cycles per second)
ID	inside diameter
IF	intermediate frequency
in.	inch or inches
incd	incandescent
∞	infinity
int	internal
$\int$	integral
k	kilohms or kilo (10^3)
k Ω	kilohm
kc	kilocycle
kHz	kilohertz
L	inductance
λ	lambda—wavelength
$\gg$	large compared with
$<$	less than
LF	low frequency
lg	length or long
LV	low voltage
M	mega or 10^6
m	milli or 10^{-3}
MΩ or meg	megohm
μ	micro or 10^{-6}
mc	megacycle
met.	metal
MHz	megahertz
mm	millimeter
ms	millisecond
-	minus
mtg hdw	mounting hardware
n	nano or 10^{-9}
no. or #	number
ns	nanosecond
OD	outside diameter
OHB	oval head brass
OHS	oval head steel
Ω	omega—ohms
ω	omega—angular frequency
p	pico or 10^{-12}
/	per
%	percent
PHB	pan head brass
ϕ	phi—phase angle
π	pi—3.1416
PHS	pan head steel
+	plus
$\pm$	plus or minus
PIV	peak inverse voltage
plstc	plastic
PMC	paper, metal cased
poly	polystyrene
prec	precision
PT	paper, tubular
PTM	paper or plastic, tubular, molded
pwr	power
Q	figure of merit
RC	resistance capacitance
RF	radio frequency
RFI	radio frequency interference (see EMI)
RHB	round head brass
ρ	rho—resistivity
RHS	round head steel
r/min or rpm	revolutions per minute
RMS	root mean square
s or sec.	second
SE	single end
Si	silicon
SN or S/N	serial number
$\ll$	small compared with
T	tera or 10^{12}
TC	temperature compensated
TD	tunnel diode
THB	truss head brass
θ	theta—angular phase displacement
thk	thick
THS	truss head steel
tub.	tubular
UHF	ultra high frequency
V	volt
VAC	volts, alternating current
var	variable
VDC	volts, direct current
VHF	very high frequency
VSWR	voltage standing wave ratio
W	watt
w	wide or width
w/	with
w/o	without
WW	wire-wound
xmfr	transformer

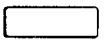
PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial or model number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number
*000-0000-00	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, Inc., or reworked or checked components.
Use 000-0000-00	Part number indicated is direct replacement.
	Screwdriver adjustment.
	Control, adjustment or connector.

SECTION 6

ELECTRICAL PARTS LIST

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.		Description		S/N Range
			Capacitors		
Tolerance ±20% unless otherwise indicated.					
C5	283-0081-00	0.1 μF	Cer	25 V	+80%—20%
C12	283-0054-00	150 pF	Cer	200 V	5%
C13	283-0065-00	0.001 μF	Cer	100 V	5%
C20	283-0004-00	0.02 μF	Cer	150 V	
C33	283-0594-00	0.001 μF	Mica	100 V	1%
C53	283-0593-01	0.01 μF	Mica	100 V	5%
C73	283-0593-01	0.01 μF	Mica	100 V	5%
C75	283-0054-00	150 pF	Cer	200 V	5%
C100	283-0077-00	330 pF	Cer	500 V	5%
C105	283-0047-00	270 pF	Cer	500 V	5%
C115	283-0047-00	270 pF	Cer	500 V	5%
C120	283-0077-00	330 pF	Cer	500 V	5%
C121	283-0077-00	330 pF	Cer	500 V	5%
C125	283-0047-00	270 pF	Cer	500 V	5%
C135	283-0047-00	270 pF	Cer	500 V	5%
C140	283-0077-00	330 pF	Cer	500 V	5%
C145	283-0047-00	270 pF	Cer	500 V	5%
C155	283-0047-00	270 pF	Cer	500 V	5%
C160	283-0077-00	330 pF	Cer	500 V	5%
C165	283-0047-00	270 pF	Cer	500 V	5%
C167	283-0077-00	330 pF	Cer	500 V	5%
C175	283-0047-00	270 pF	Cer	500 V	5%
C181	283-0077-00	330 pF	Cer	500 V	5%
C186	283-0081-00	0.1 μF	Cer	25 V	+80%—20%
C193	283-0115-00	47 pF	Cer	200 V	5%
C195	283-0060-00	100 pF	Cer	200 V	5%
C210	283-0059-00	1 μF	Cer	25 V	+80%—20%
C214	283-0065-00	0.001 μF	Cer	100 V	5%
C218	283-0059-00	1 μF	Cer	25 V	+80%—20%
C219	283-0000-00	0.001 μF	Cer	500 V	
C226	283-0081-00	0.1 μF	Cer	25 V	+80%—20%
C227	283-0081-00	0.1 μF	Cer	25 V	+80%—20%
C228	283-0032-00	470 pF	Cer	500 V	5%
C232	283-0004-00	0.02 μF	Cer	150 V	
C233	283-0065-00	0.001 μF	Cer	100 V	5%
C243	290-0135-00	15 μF	Elect.	20 V	
C245	290-0135-00	15 μF	Elect.	20 V	

Diodes

Ckt. No.	Tektronix Part No.	Description	S/N Range
D45	*152-0185-00	Silicon	Replaceable by 1N3605
D65	*152-0185-00	Silicon	Replaceable by 1N3605
D96	*152-0107-00	Silicon	Replaceable by 1N647
D97	*152-0107-00	Silicon	Replaceable by 1N647
D98	*152-0107-00	Silicon	Replaceable by 1N647
D104	*152-0075-00	Germanium	Tek Spec
D114	*152-0075-00	Germanium	Tek Spec
D120	*152-0075-00	Germanium	Tek Spec
D124	*152-0075-00	Germanium	Tek Spec
D134	*152-0075-00	Germanium	Tek Spec
D135	*152-0185-00	Silicon	Replaceable by 1N3605
D144	*152-0075-00	Germanium	Tek Spec
D154	*152-0075-00	Silicon	Tek Spec
D155	*152-0185-00	Silicon	Replaceable by 1N3605
D164	*152-0075-00	Silicon	Tek Spec
D174	*152-0075-00	Silicon	Tek Spec
D180	*152-0107-00	Silicon	Replaceable by 1N647
D213	*152-0185-00	Silicon	Replaceable by 1N3605
D214	*152-0185-00	Silicon	Replaceable by 1N3605
D231	152-0081-00	Tunnel	TD-2 2.2 mA
D232	*152-0107-00	Silicon	Replaceable by 1N647
D238	152-0066-00	Silicon	1N3194
D241	*152-0107-00	Silicon	Replaceable by 1N647
D251	152-0066-00	Silicon	1N3194
D253	152-0066-00	Silicon	1N3194
D254	152-0066-00	Silicon	1N3194
D255	152-0066-00	Silicon	1N3194
D256	152-0066-00	Silicon	1N3194
D259	152-0066-00	Silicon	1N3194
D260	152-0066-00	Silicon	1N3194
D261	152-0066-00	Silicon	1N3194

Connectors

J201	131-0436-00	14 contact, ribbon type female
J210	131-0106-00	Coaxial, 1 contact, female
J241	131-0106-00	Coaxial, 1 contact, female
J250	131-0294-00	36 contact, chassis mtd., female
J260	131-0294-00	36 contact, chassis mtd., female

Relays

K96	*108-0355-00	Coil, Reed
K96A	260-0721-00	Reed
K97	*108-0355-00	Coil, Reed

Relays *(Cont)*

Ckt. No.	Tektronix Part No.	Description	S/N Range
K97A	260-0721-00	Reed	
K98	*108-0355-00	Coil, Reed	
K98A	260-0721-00	Reed	
K180	*108-0355-00	Coil, Reed	
K180A	260-0721-00	Reed	
K241	*108-0355-00	Coil, Reed	
K241A	260-0721-00	Reed	

Inductors

L184	108-0226-00	100 μH	
L243	*120-0382-00	Toroid, 14 turns, single	
L245	*120-0382-00	Toroid, 14 turns, single	

Transistors

Q10	151-0190-00	Silicon	2N3904
Q14	151-0188-00	Silicon	2N3906
Q23	151-0188-00	Silicon	2N3906
Q31	151-0190-00	Silicon	2N3904
Q35	151-0190-00	Silicon	2N3904
Q45	151-0188-00	Silicon	2N3906
Q51	151-0190-00	Silicon	2N3904
Q55	151-0190-00	Silicon	2N3904
Q65	151-0188-00	Silicon	2N3906
Q71	151-0190-00	Silicon	2N3904
Q75	151-0190-00	Silicon	2N3904
Q85	151-0188-00	Silicon	2N3906
Q105	151-0188-00	Silicon	2N3906
Q115	151-0188-00	Silicon	2N3906
Q125	151-0188-00	Silicon	2N3906
Q135	151-0188-00	Silicon	2N3906
Q145	151-0188-00	Silicon	2N3906
Q155	151-0188-00	Silicon	2N3906
Q165	151-0188-00	Silicon	2N3906
Q175	151-0188-00	Silicon	2N3906
Q185	151-0190-00	Silicon	2N3904
Q195	151-0188-00	Silicon	2N3906
Q216	151-0190-00	Silicon	2N3904
Q226	151-0190-00	Silicon	2N3904
Q233	151-0188-00	Silicon	2N3906
Q244	*151-0136-00	Silicon	Replaceable by 2N3053

Resistors

Ckt. No.	Tektronix Part No.	Description			S/N Range
Resistors are fixed, composition, ±10% unless otherwise indicated.					
R5	315-0103-00	10 kΩ	1/4 W		5%
R6	315-0182-00	1.8 kΩ	1/4 W		5%
R10	315-0513-00	51 kΩ	1/4 W		5%
R11	315-0753-00	75 kΩ	1/4 W		5%
R13	315-0682-00	6.8 kΩ	1/4 W		5%
R14	315-0101-00	100 Ω	1/4 W		5%
R16	315-0163-00	16 kΩ	1/4 W		5%
R17	315-0223-00	22 kΩ	1/4 W		5%
R18	315-0273-00	27 kΩ	1/4 W		5%
R20	321-0274-00	6.98 kΩ	1/8 W	Prec	1%
R21	321-0262-00	5.23 kΩ	1/8 W	Prec	1%
R23	315-0682-00	6.8 kΩ	1/4 W		5%
R24	315-0101-00	100 Ω	1/4 W		5%
R30	311-0633-00	5 kΩ		Var	
R31	315-0752-00	7.5 kΩ	1/4 W		5%
R32	321-0282-00	8.45 kΩ	1/8 W	Prec	1%
R33	315-0101-00	100 Ω	1/4 W		5%
R34	315-0471-00	470 Ω	1/4 W		5%
R43	321-0260-00	4.99 kΩ	1/8 W	Prec	1%
R44	321-0275-00	7.15 kΩ	1/8 W	Prec	1%
R46	321-0260-00	4.99 kΩ	1/8 W	Prec	1%
R47	321-0275-00	7.15 kΩ	1/8 W	Prec	1%
R48	315-0273-00	27 kΩ	1/4 W		5%
R50	311-0633-00	5 kΩ		Var	
R51	315-0752-00	7.5 kΩ	1/4 W		5%
R52	321-0282-00	8.45 kΩ	1/8 W	Prec	1%
R53	315-0101-00	100 Ω	1/4 W		5%
R54	315-0471-00	470 Ω	1/4 W		5%
R63	321-0260-00	4.99 kΩ	1/8 W	Prec	1%
R64	321-0275-00	7.15 kΩ	1/8 W	Prec	1%
R68	315-0273-00	27 kΩ	1/4 W		5%
R70	311-0614-00	30 kΩ		Var	
R72	321-0382-00	93.1 kΩ	1/8 W	Prec	1%
R73	315-0101-00	100 Ω	1/4 W		5%
R74	315-0472-00	4.7 kΩ	1/4 W		5%
R83	321-0260-00	4.99 kΩ	1/8 W	Prec	1%
R84	321-0275-00	7.15 kΩ	1/8 W	Prec	1%
R96	301-0271-00	270 Ω	1/2 W		5%
R97	301-0271-00	270 Ω	1/2 W		5%
R98	301-0271-00	270 Ω	1/2 W		5%
R100	315-0682-00	6.8 kΩ	1/4 W		5%
R104	315-0222-00	2.2 kΩ	1/4 W		5%
R105	315-0103-00	10 kΩ	1/4 W		5%

Resistors *(Cont)*

Ckt. No.	Tektronix Part No.		Description		S/N Range
R106	315-0222-00	2.2 kΩ	1/4 W	5%	
R114	315-0222-00	2.2 kΩ	1/4 W	5%	
R115	315-0103-00	10 kΩ	1/4 W	5%	
R116	315-0222-00	2.2 kΩ	1/4 W	5%	
R120	315-0682-00	6.8 kΩ	1/4 W	5%	
R121	315-0682-00	6.8 kΩ	1/4 W	5%	
R124	315-0222-00	2.2 kΩ	1/4 W	5%	
R125	315-0103-00	10 kΩ	1/4 W	5%	
R126	315-0222-00	2.2 kΩ	1/4 W	5%	
R134	315-0222-00	2.2 kΩ	1/4 W	5%	
R135	315-0103-00	10 kΩ	1/4 W	5%	
R136	315-0222-00	2.2 kΩ	1/4 W	5%	
R140	315-0682-00	6.8 kΩ	1/4 W	5%	
R144	315-0222-00	2.2 kΩ	1/4 W	5%	
R145	315-0103-00	10 kΩ	1/4 W	5%	
R146	315-0222-00	2.2 kΩ	1/4 W	5%	
R154	315-0222-00	2.2 kΩ	1/4 W	5%	
R155	315-0103-00	10 kΩ	1/4 W	5%	
R156	315-0222-00	2.2 kΩ	1/4 W	5%	
R160	315-0682-00	6.8 kΩ	1/4 W	5%	
R164	315-0222-00	2.2 kΩ	1/4 W	5%	
R165	315-0103-00	10 kΩ	1/4 W	5%	
R166	315-0222-00	2.2 kΩ	1/4 W	5%	
R167	315-0153-00	15 kΩ	1/4 W	5%	
R174	315-0222-00	2.2 kΩ	1/4 W	5%	
R175	315-0103-00	10 kΩ	1/4 W	5%	
R176	315-0222-00	2.2 kΩ	1/4 W	5%	
R180	301-0271-00	270 Ω	1/2 W	5%	
R181	315-0102-00	1 kΩ	1/4 W	5%	
R184	315-0271-00	270 Ω	1/4 W	5%	
R185	315-0102-00	1 kΩ	1/4 W	5%	
R186	315-0270-00	27 Ω	1/4 W	5%	
R193	315-0103-00	10 kΩ	1/4 W	5%	
R194	315-0472-00	4.7 kΩ	1/4 W	5%	
R196	315-0152-00	1.5 kΩ	1/4 W	5%	
R197	315-0510-00	51 Ω	1/4 W	5%	
R210	315-0102-00	1 kΩ	1/4 W	5%	
R213	311-0011-00	5 kΩ	Var		
R214	315-0682-00	6.8 kΩ	1/4 W	5%	
R218	315-0102-00	1 kΩ	1/4 W	5%	
R219	315-0510-00	51 Ω	1/4 W	5%	
R220	315-0102-00	1 kΩ	1/4 W	5%	
R221	315-0470-00	47 Ω	1/4 W	5%	
R222	315-0222-00	2.2 kΩ	1/4 W	5%	
R225	315-0470-00	47 Ω	1/4 W	5%	

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Resistors (Cont)

Ckt. No.	Tektronix Part No.		Description	S/N Range
R227	315-0132-00	1.3 kΩ	1/4 W	5%
R228	315-0202-00	2 kΩ	1/4 W	5%
R229	315-0103-00	10 kΩ	1/4 W	5%
R232	315-0302-00	3 kΩ	1/4 W	5%
R234	315-0273-00	27 kΩ	1/4 W	5%
R235	315-0101-00	100 Ω	1/4 W	5%
R236	315-0101-00	100 Ω	1/4 W	5%
R237	315-0472-00	47 kΩ	1/4 W	5%
R238	315-0223-00	22 kΩ	1/4 W	5%
R241	301-0271-00	270 Ω	1/2 W	5%
R242	315-0102-00	1 kΩ	1/4 W	5%

Switches

	Unwired	Wired		
SW210	260-0447-00		Slide	CH A - CH B
SW220A, SW220B	260-0788-00		Rotary	SLOPE MODE
SW229	260-0675-00		Slide	TRIGGER SOURCE DC LEVEL
SW238	260-0247-00		Push Button	START
SW251	260-0447-00		Slide	EXT PROGRAM
SW255	260-0789-00		Rotary	REAL TIME/DIV
SW261	260-0447-00		Slide	DISPLAY

Test Points

TP14	*214-0579-00	Pin, Test Point
TP45	*214-0579-00	Pin, Test Point
TP65	*214-0579-00	Pin, Test Point
TP85	*214-0579-00	Pin, Test Point
TP195	*214-0579-00	Pin, Test Point

Crystal

Y10	158-0014-00	1 MHz

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations which appear on the pullout pages immediately following the Diagrams section of this instruction manual.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the Description column.

Assembly and/or Component
Detail Part of Assembly and/or Component
mounting hardware for Detail Part
Parts of Detail Part
mounting hardware for Parts of Detail Part
mounting hardware for Assembly and/or Component

Mounting hardware always appears in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation.

Mounting hardware must be purchased separately, unless otherwise specified.

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial or model number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

ABBREVIATIONS AND SYMBOLS

For an explanation of the abbreviations and symbols used in this section, please refer to the page immediately preceding the Electrical Parts List in this instruction manual.

INDEX OF MECHANICAL PARTS LIST ILLUSTRATIONS

(Located behind diagrams)

SECTION 7

MECHANICAL PARTS LIST

FIG. 1 283 MECHANICAL PARTS

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5	Description
1-1	366-0117-00			1		KNOB, charcoal—REAL TIME/DIV
	- - - - - -			-		knob includes:
	213-0004-00			1		SCREW, set, 6-32 x 3/16 inch, HSS
-2	260-0789-00			1		SWITCH, unwired—REAL TIME/DIV
	- - - - - -			-		mounting hardware: (not included w/switch)
-3	210-0590-00			1		NUT, hex., 3/8-32 x 7/16 inch
-4	366-0173-00			1		KNOB, charcoal—TRIGGER LEVEL
	- - - - - -			-		knob includes:
	213-0004-00			1		SCREW, set, 6-32 x 3/16 inch, HSS
-5	- - - - - -			1		RESISTOR, variable
	- - - - - -			-		mounting hardware: (not included w/resistor)
-6	210-0207-00			1		LUG, solder, 3/8 ID x 5/8 inch OD, SE
	210-0012-00			1		LOCKWASHER, internal, 3/8 ID x 1/2 inch OD
-7	210-0590-00			1		NUT, hex., 3/8-32 x 7/16 inch
-8	366-0140-00			1		KNOB, red—SLOPE
	- - - - - -			-		knob includes:
	213-0004-00			1		SCREW, set, 6-32 x 3/16 inch, HSS
-9	366-0250-00			1		KNOB, charcoal—MODE
	- - - - - -			-		knob includes:
	213-0004-00			1		SCREW, set, 6-32 x 3/16 inch, HSS
-10	260-0788-00			1		SWITCH, unwired—MODE
	- - - - - -			-		switch includes:
-11	- - - - - -			1		ROD, extension
-12	- - - - - -			1		SCREW, set
	- - - - - -			-		mounting hardware: (not included w/switch)
-13	210-0255-00			1		LUG, solder, 3/8 inch
-14	210-0590-00			1		NUT, hex., 3/8-32 x 7/16 inch
-15	260-0447-00			1		SWITCH, slide—CHANNEL A CHANNEL B
	- - - - - -					mounting hardware: (not included w/switch)
-16	210-0406-00			2		NUT, hex., 4-40 x 3/16 inch
-17	260-0447-00			1		SWITCH, slide—DISPLAY
	- - - - - -			-		mounting hardware: (not included w/switch)
-18	210-0406-00			2		NUT, hex., 4-40 x 3/16 inch
-19	260-0447-00			1		SWITCH, slide—EXT PROGRAM
	- - - - - -			-		mounting hardware: (not included w/switch)
-20	210-0406-00			2		NUT, hex., 4-40 x 3/16 inch

FIG. 1 283 MECHANICAL PARTS *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
1-21	260-0247-00			1	SWITCH, push button—START
	- - - - - -			-	mounting hardware: (not included w/switch)
-22	210-0940-00			1	WASHER, flat, 1/4 ID x 3/8 inch OD
-23	210-0583-00			1	NUT, hex., 1/4-32 x 5/16 inch
-24	260-0675-00			1	SWITCH, slide—TRIGGER SOURCE DC LEVEL
	- - - - - -			-	mounting hardware: (not included w/switch)
-25	210-0406-00			2	NUT, hex., 4-40 x 3/16 inch
-26	333-0955-01			1	PANEL, front
	- - - - - -			-	mounting hardware: (not included w/panel)
-27	211-0565-00			4	SCREW, 6-32 x 1/4 inch, THS
-28	200-0278-01			1	COVER, front
-29	407-0291-00			1	BRACKET
	- - - - - -			-	mounting hardware: (not included w/bracket)
-30	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
-31	407-0216-00			1	BRACKET
	- - - - - -			-	mounting hardware: (not included w/bracket)
-32	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
-33	131-0106-00			1	CONNECTOR, coaxial, 1 contact, BNC
	- - - - - -			-	connector includes:
	- - - - - -			1	NUT
	- - - - - -			-	mounting hardware: (not included w/connector)
-34	210-0255-00			1	LUG, solder, 3/8 inch
-35	131-0106-00			1	CONNECTOR, coaxial, 1 contact, BNC
	- - - - - -			-	connector includes:
-36	- - - - - -			1	NUT
	- - - - - -			1	LOCKWASHER
-37	131-0436-00			1	CONNECTOR, 14 pin, female
	- - - - - -			-	mounting hardware: (not included w/connector)
-38	211-0062-00			2	SCREW, 2-56 x 5/16 inch, RHS
-39	210-0001-00			2	LOCKWASHER, internal, #2
-40	210-0405-00			2	NUT, hex., 2-56 x 3/16 inch
-41	131-0294-00			2	CONNECTOR, 36 pin, female
	- - - - - -			-	mounting hardware for each: (not included w/connector)
-42	211-0062-00			2	SCREW, 2-56 x 5/16 inch, RHS
-43	210-0001-00			2	LOCKWASHER, internal, #2
-44	210-0405-00			2	NUT, hex., 2-56 x 3/16 inch

FIG. 1 283 MECHANICAL PARTS *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5	Description
1-45	670-0230-00			1		ASSEMBLY, circuit board—CLOCK
	- - - - - -			-		assembly includes:
	388-0804-00			1		BOARD, circuit
-46	136-0183-00			1		SOCKET, transistor, 3 pin
-47	136-0220-00			24		SOCKET, transistor, 3 pin
-48	214-0579-00			5		PIN, test point
-49	124-0506-00			21		PIN, connector
-50	136-0234-00			2		RECEPTACLE
-51	352-0096-00			1		HOLDER, crystal
	- - - - - -			-		mounting hardware: (not included w/assembly)
-52	211-0116-00			4		SCREW, sems, 4-40 x 5/16 inch, PHB
-53	179-1105-00			1		CABLE HARNESS
	- - - - - -			-		cable harness includes:
-54	131-0371-00			21		CONNECTOR, single contact
-55	380-0094-00			1		HOUSING, wrap-around
-56	348-0025-00			4		FOOT, rubber
	- - - - - -			-		mounting hardware for each: (not included w/foot)
-57	211-0504-00			1		SCREW, 6-32 x 1/4 inch, PHS
-58	210-0586-00			1		NUT, keps, 4-40 x 1/4 inch
-59	367-0007-00			1		HANDLE
	- - - - - -			-		mounting hardware: (not included w/handle)
-60	212-0001-00			2		SCREW, 8-32 x 1/4 inch, PHS
-61	200-0278-02			1		COVER, rear
	- - - - - -			-		mounting hardware: (not included w/cover)
-62	210-0803-00			4		WASHER, flat, 0.150 ID x 3/8 inch OD
-63	211-0507-00			4		SCREW, 6-32 x 5/16 inch, PHS
-64	348-0025-00			4		FOOT, rubber
	- - - - - -			-		mounting hardware for each: (not included w/foot)
-65	211-0504-00			1		SCREW, 6-32 x 1/4 inch, PHS

FIG. 2 R283 MECHANICAL PARTS

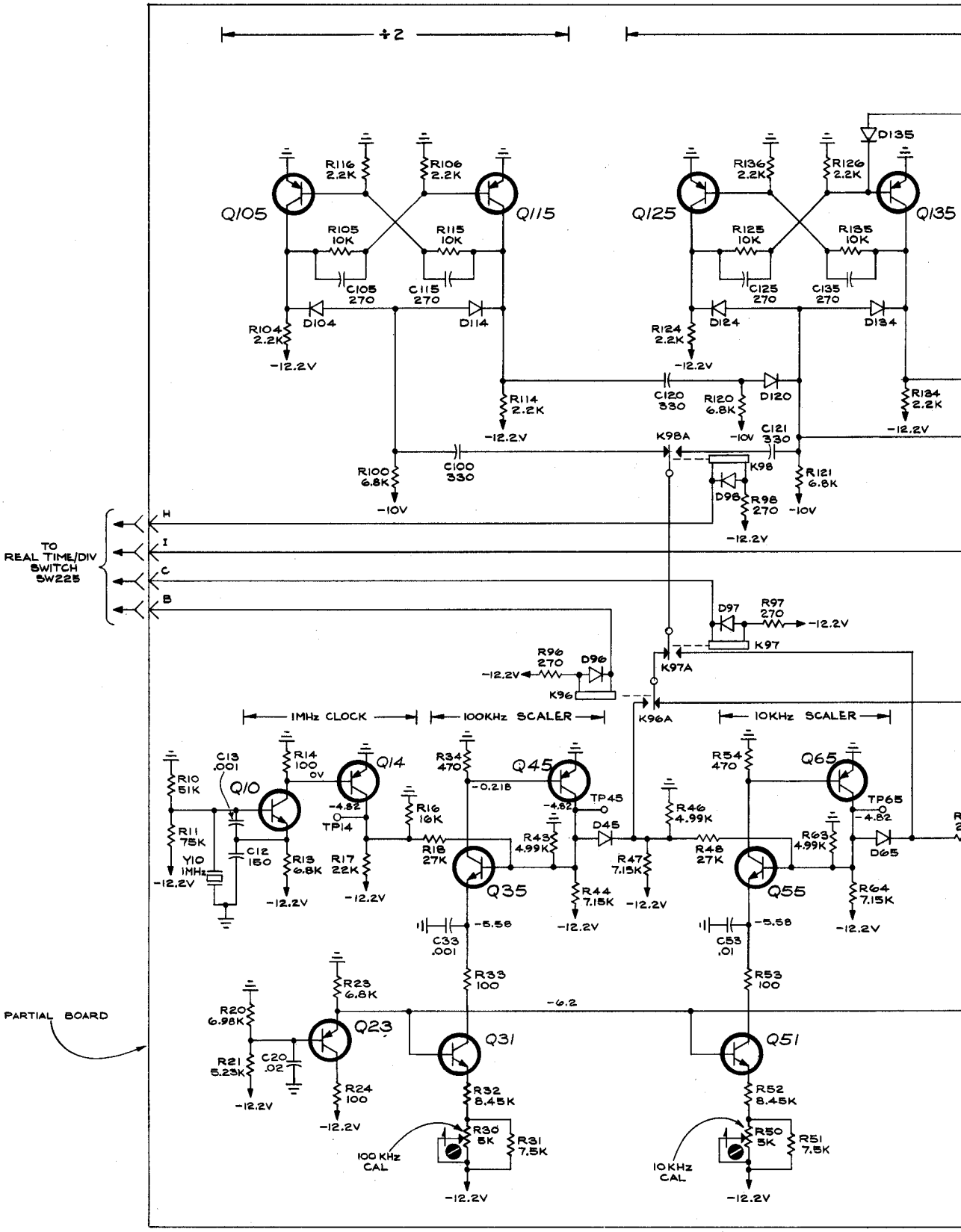
Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5	Description
2-1	366-0173-00			1		KNOB, charcoal—TRIGGER LEVEL
	- - - - - -			-		knob includes:
	213-0004-00			1		SCREW, set, 6-32 x 3/16 inch, HSS
-2	- - - - - -			1		RESISTOR, variable
	- - - - - -			-		mounting hardware: (not included w/resistor)
-3	210-0207-00			1		LUG, solder, 3/8 ID x 5/8 inch OD, SE
	210-0012-00			1		LOCKWASHER, internal, 3/8 ID x 1/2 inch OD
-4	210-0590-00			1		NUT, hex., 3/8-32 x 7/16 inch
-5	260-0447-00			1		SWITCH, slide—CHANNEL A CHANNEL B
	- - - - - -			-		mounting hardware: (not included w/switch)
-6	210-0406-00			2		NUT, hex., 4-40 x 3/16 inch
-7	366-0140-00			1		KNOB, red—SLOPE
	- - - - - -			-		knob includes:
	213-0004-00			1		SCREW, set, 6-32 x 3/16 inch, HSS
-8	366-0250-00			1		KNOB, charcoal—MODE
	- - - - - -			-		knob includes:
	213-0004-00			1		SCREW, set, 6-32 x 3/16 inch, HSS
-9	260-0788-00			1		SWITCH, unwired—MODE
	- - - - - -			-		switch includes:
-10	- - - - - -			1		ROD, extension
-11	- - - - - -			1		SCREW, set
	- - - - - -			-		mounting hardware: (not included w/switch)
-12	210-0255-00			1		LUG, solder, 3/8 inch
-13	210-0590-00			1		NUT, hex., 3/8-32 x 7/16 inch
-14	366-0117-00			1		KNOB, charcoal—REAL TIME/DIV
	- - - - - -			-		knob includes:
	213-0004-00			1		SCREW, set, 6-32 x 3/16 inch, HSS
-15	260-0789-00			1		SWITCH, unwired—REAL TIME/DIV
	- - - - - -			-		mounting hardware: (not included w/switch)
-16	210-0590-00			1		NUT, hex., 3/8-32 x 7/16 inch
-17	260-0447-00			1		SWITCH, slide—DISPLAY
	- - - - - -			-		mounting hardware: (not included w/switch)
-18	210-0406-00			2		NUT, hex., 4-40 x 3/16 inch
-19	260-0247-00			1		SWITCH, push button—START
	- - - - - -			-		mounting hardware: (not included w/switch)
-20	210-0940-00			1		WASHER, flat, 1/4 ID x 3/8 inch OD
-21	210-0583-00			1		NUT, hex., 1/4-32 x 5/16 inch

FIG. 2 R283 MECHANICAL PARTS *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty 1 2 3 4 5	Description
2-22	260-0447-00			1	SWITCH, slide—EXT PROGRAM
	- - - - - -			-	mounting hardware: (not included w/switch)
-23	210-0406-00			2	NUT, hex., 4-40 x 3/16 inch
-24	260-0675-00			1	SWITCH, slide—TRIGGER SOURCE DC LEVEL
	- - - - - -			-	mounting hardware: (not included w/switch)
-25	210-0406-00			2	NUT, hex., 4-40 x 3/16 inch
-26	333-0956-01			1	PANEL, front
	- - - - - -			-	mounting hardware: (not included w/panel)
-27	212-0067-00			4	SCREW, 8-32 x 3/8 inch, THS
-28	386-1081-00			1	PLATE, front sub-panel
-29	386-1082-00			2	PLATE, side
-30	386-1083-00			1	PLATE, rear
-31	211-0507-00			16	SCREW, 6-32 x 5/16 inch, PHS
-32	210-0457-00			8	NUT, keps, 6-32 x 5/16 inch
-33	200-0675-00			2	COVER
	- - - - - -			-	mounting hardware for each: (not included w/cover)
-34	210-0803-00			4	WASHER, flat, 0.150 ID x 3/8 inch OD
-35	211-0507-00			4	SCREW, 6-32 x 5/16 inch, PHS
-36	131-0106-00			2	CONNECTOR, coaxial, 1 contact, BNC
	- - - - - -			-	each connector includes:
	- - - - - -			1	NUT
	- - - - - -			-	mounting hardware for each: (not included w/connector)
-37	210-0255-00			1	LUG, solder, 3/8 inch
-38	131-0436-00			1	CONNECTOR, 14 pin, female
	- - - - - -			-	mounting hardware: (not included w/connector)
-39	211-0062-00			2	SCREW, 2-56 x 5/16 inch, RHS
-40	210-0001-00			2	LOCKWASHER, internal, #2
-41	210-0405-00			2	NUT, hex., 2-56 x 3/16 inch
-42	131-0294-00			2	CONNECTOR, 36 pin, female
	- - - - - -			-	mounting hardware for each: (not included w/connector)
-43	211-0062-00			2	SCREW, 2-56 x 5/16 inch, RHS
-44	210-0001-00			2	LOCKWASHER, internal, #2
-45	210-0405-00			2	NUT, hex., 2-56 x 3/16 inch
-46	441-0678-00			1	CHASSIS
	- - - - - -			-	mounting hardware: (not included w/chassis)
-47	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
-48	211-0507-00			2	SCREW, 6-32 x 5/16 inch, PHS

FIG. 2 R283 MECHANICAL PARTS *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
2-49	670-0230-00			1	ASSEMBLY, circuit board—CLOCK
	- - - - - -			-	assembly includes:
	388-0804-00			1	BOARD, circuit
-50	136-0183-00			1	SOCKET, transistor, 3 pin
-51	136-0220-00			24	SOCKET, transistor, 3 pin
-52	214-0579-00			5	PIN, test point
-53	214-0506-00			21	PIN, connector
-54	136-0234-00			2	RECEPTACLE
-55	352-0096-00			1	HOLDER, crystal
	- - - - - -			-	mounting hardware: (not included w/assembly)
-56	211-0116-00			4	SCREW, sems, 4-40 x 5/16 inch, PHB
-57	179-1052-00			1	CABLE HARNESS
	- - - - - -			-	cable harness includes:
-58	131-0371-00			21	CONNECTOR, single contact
-59	343-0004-00			1	CLAMP, cable, plastic
	- - - - - -			-	mounting hardware: (not included w/clamp)
-60	211-0507-00			1	SCREW, 6-32 x 5/16 inch, PHS
-61	210-0863-00			1	WASHER, "D" shape
-62	210-0457-00			1	NUT, keps, 6-32 x 5/16 inch



SEE PA
SEMICON

TYPE 283/R283 REAL TIME ADAPTER

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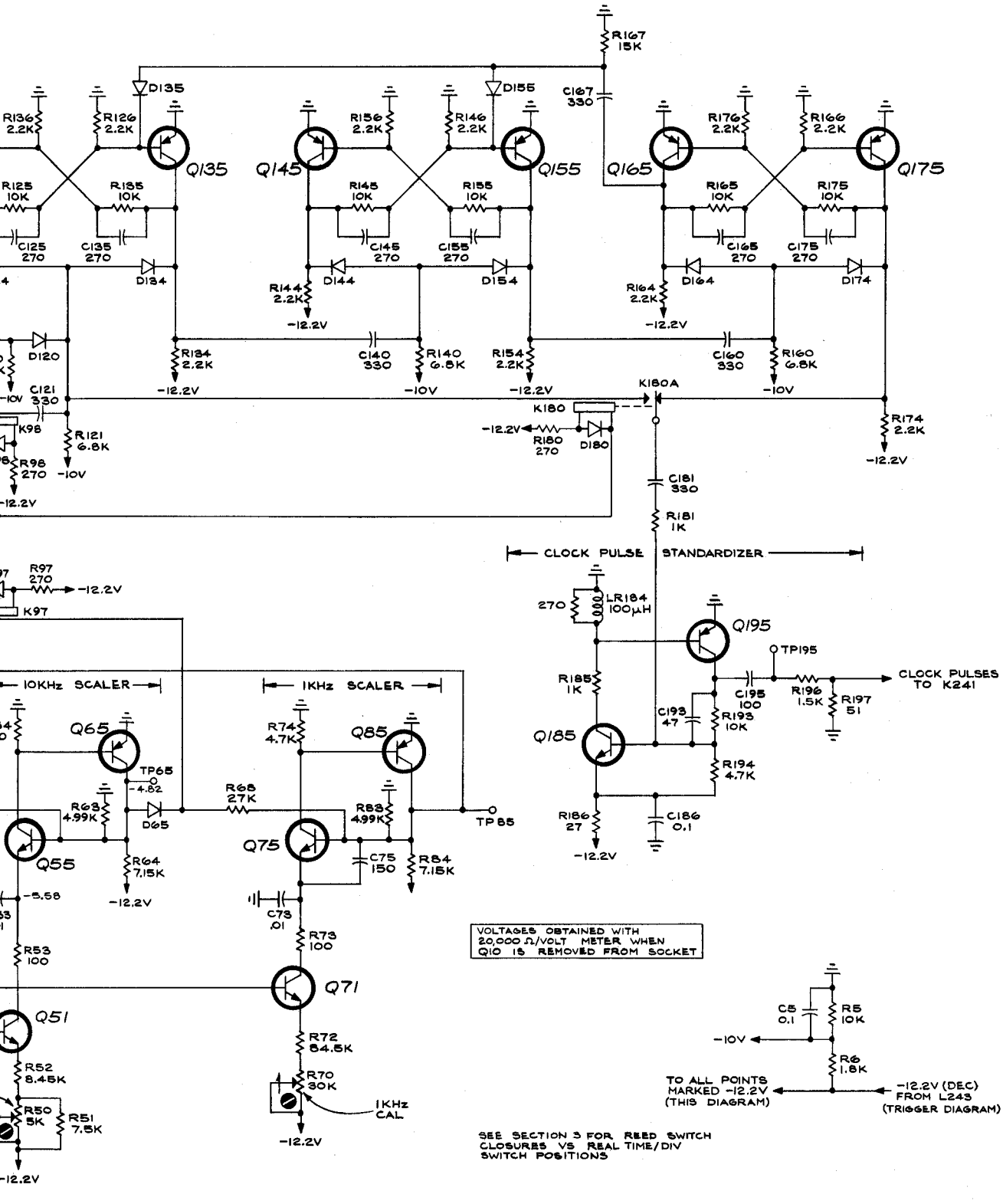

SEE PARTS LIST FOR SEMICONDUCTOR TYPES

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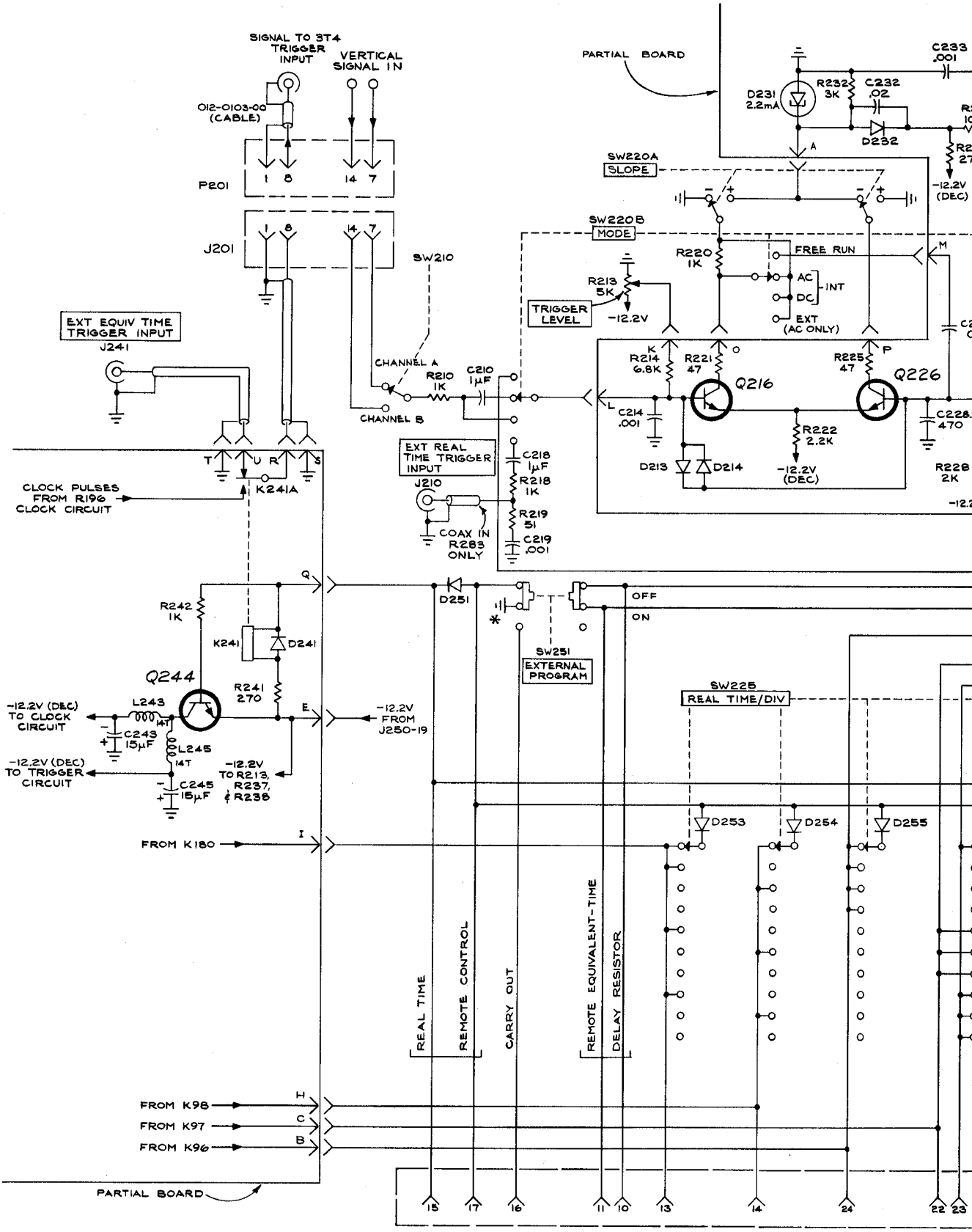
CLOCK CIRCUIT



TYPE 283/R283 REAL TIME ADAPTER

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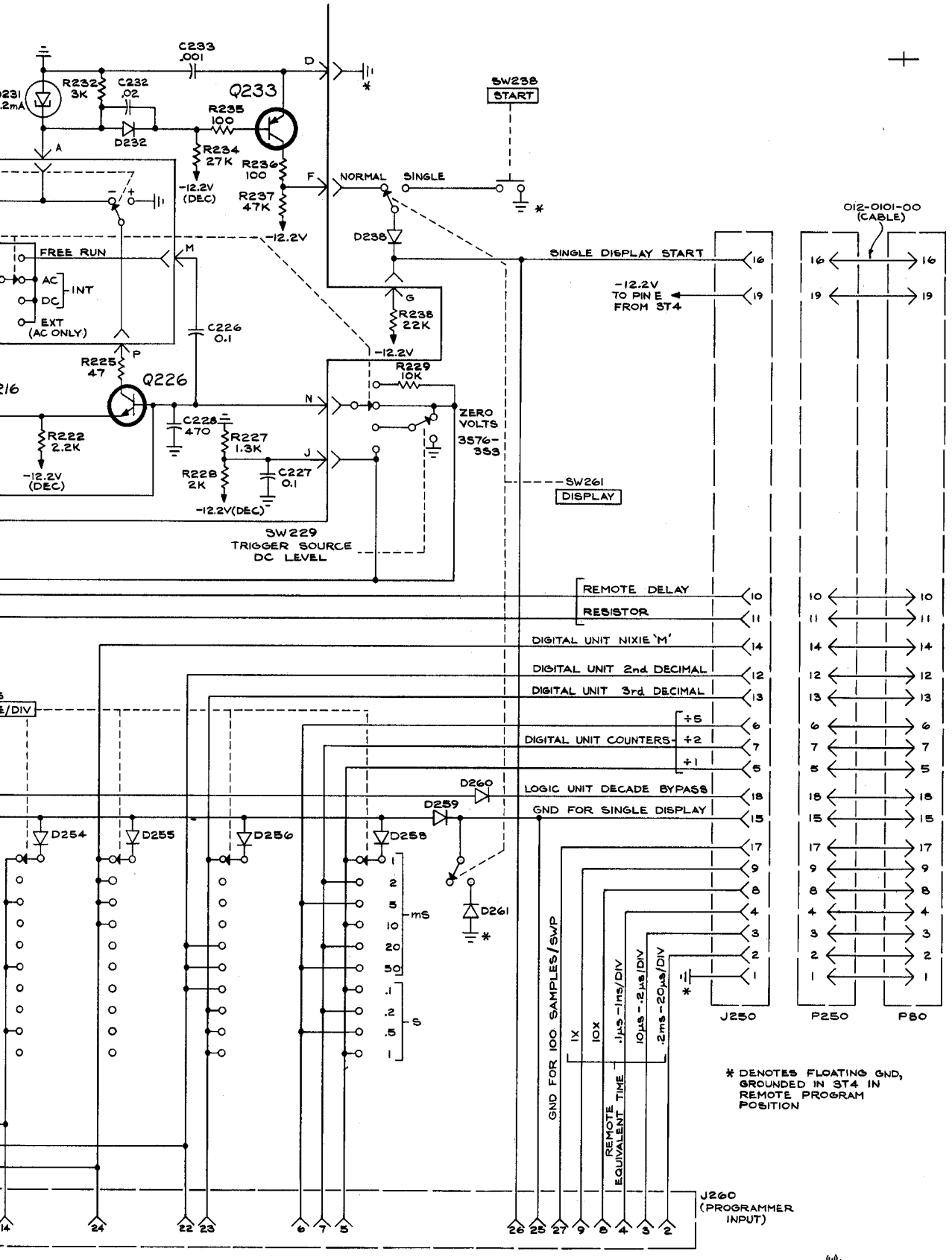

SEE PARTS LIST FOR SEMICONDUCTOR TYPES

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TRIGGER & SWITCHING

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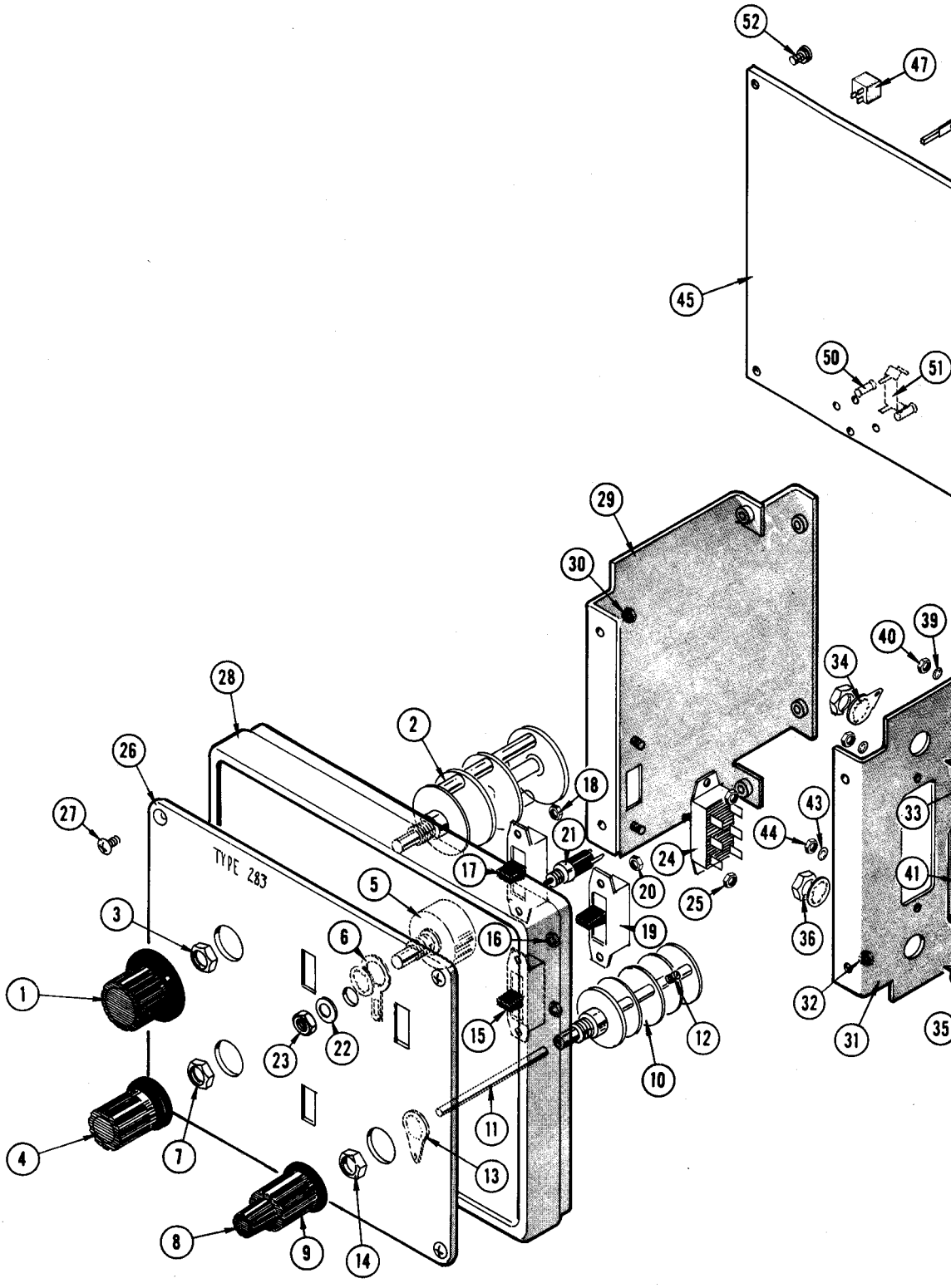
FIG. 1 283 MECHANICAL PA



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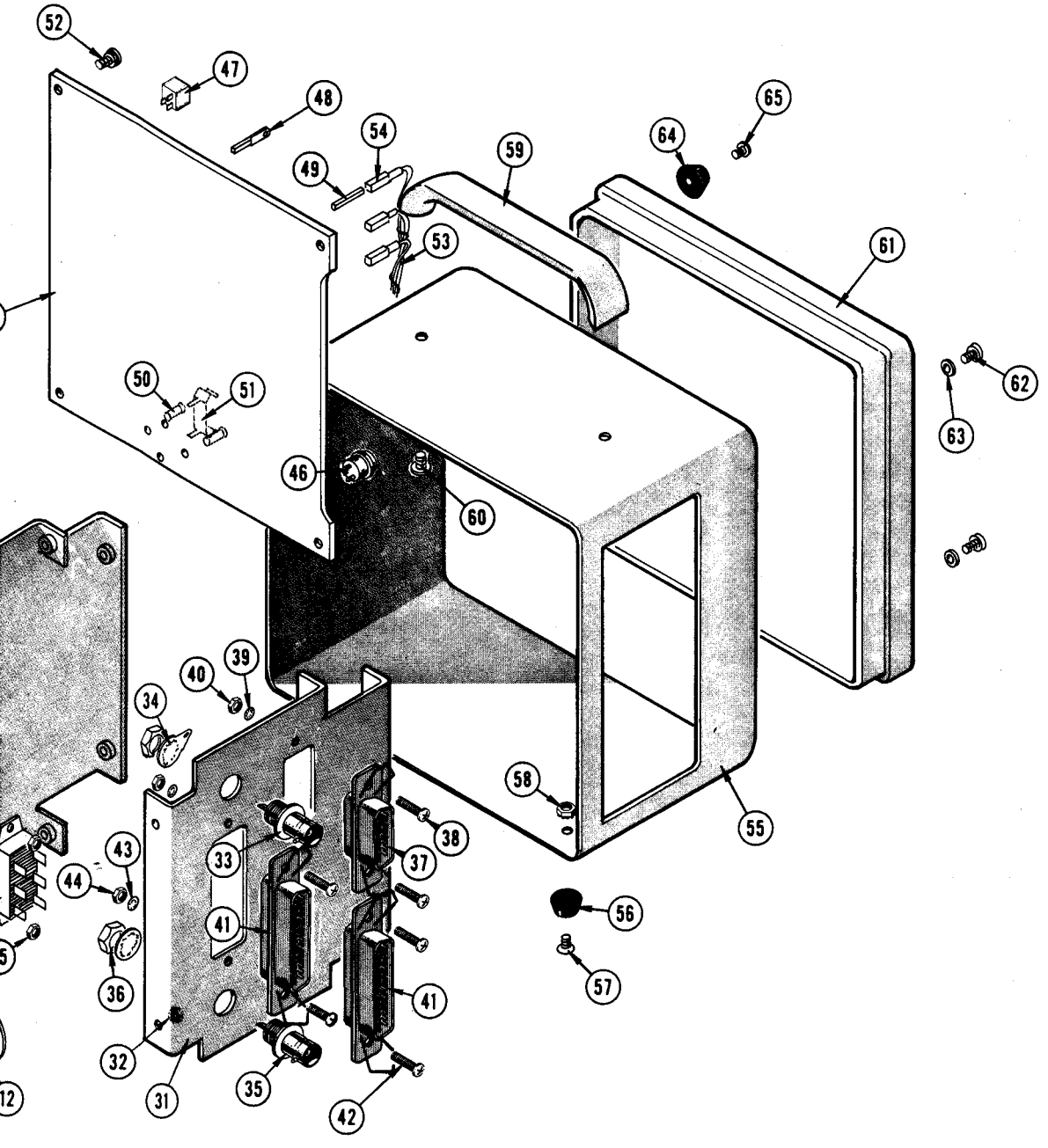
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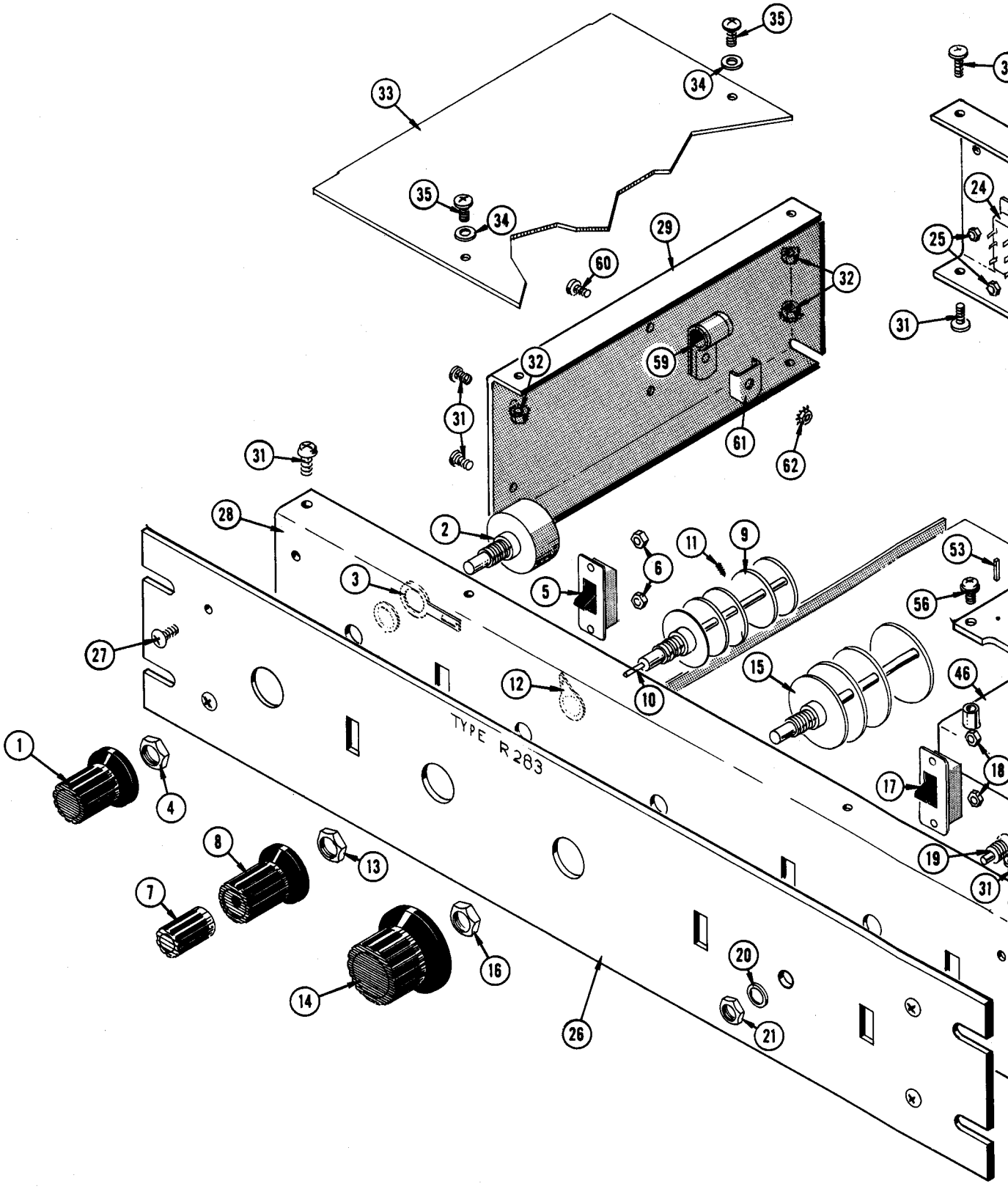
FIG. 2 R283 MECHANICAL PA



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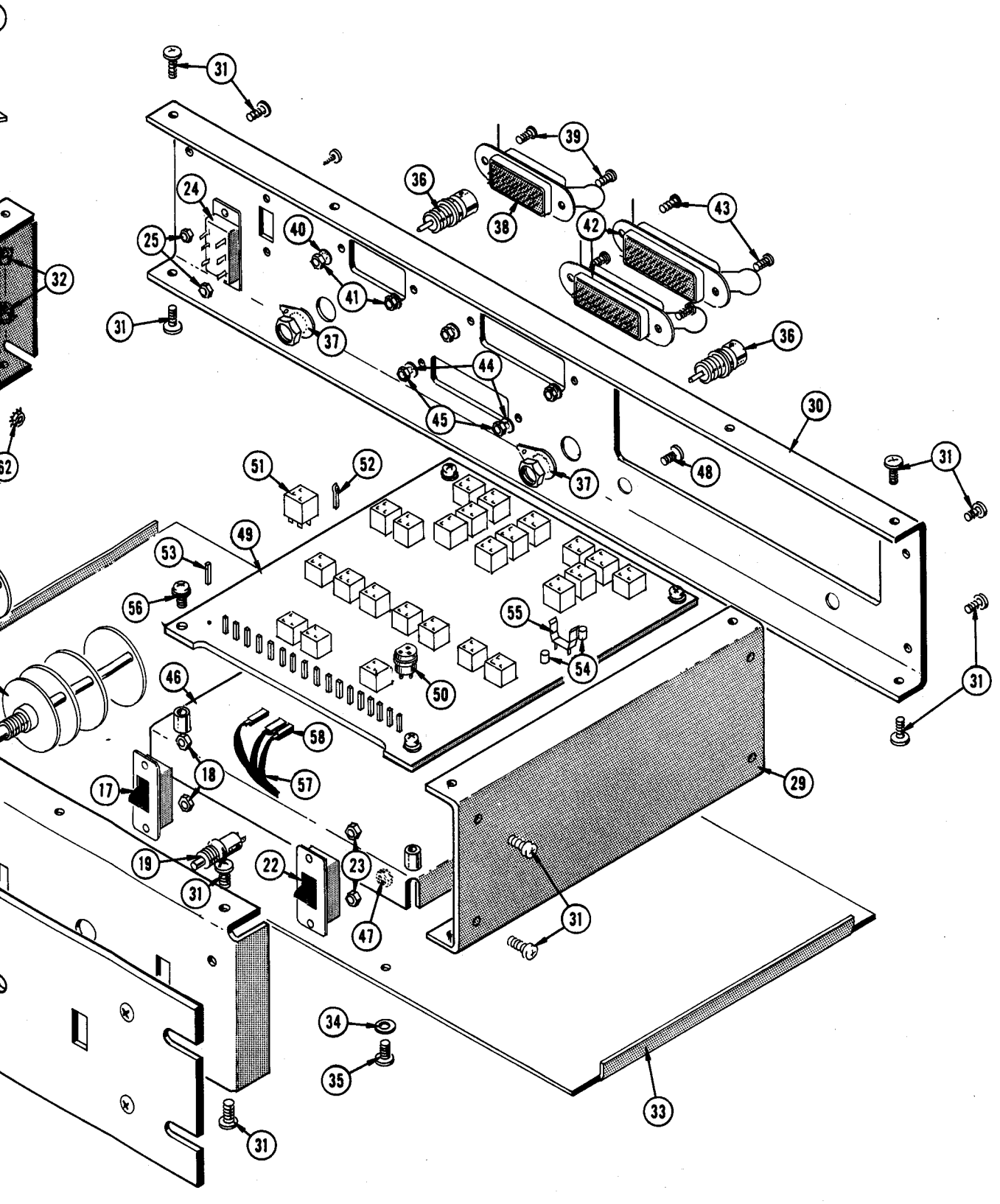

TYPE 283/R283 REAL TIME ADAPTER

FIG. 3 283 STANDARD ACCESSORIES

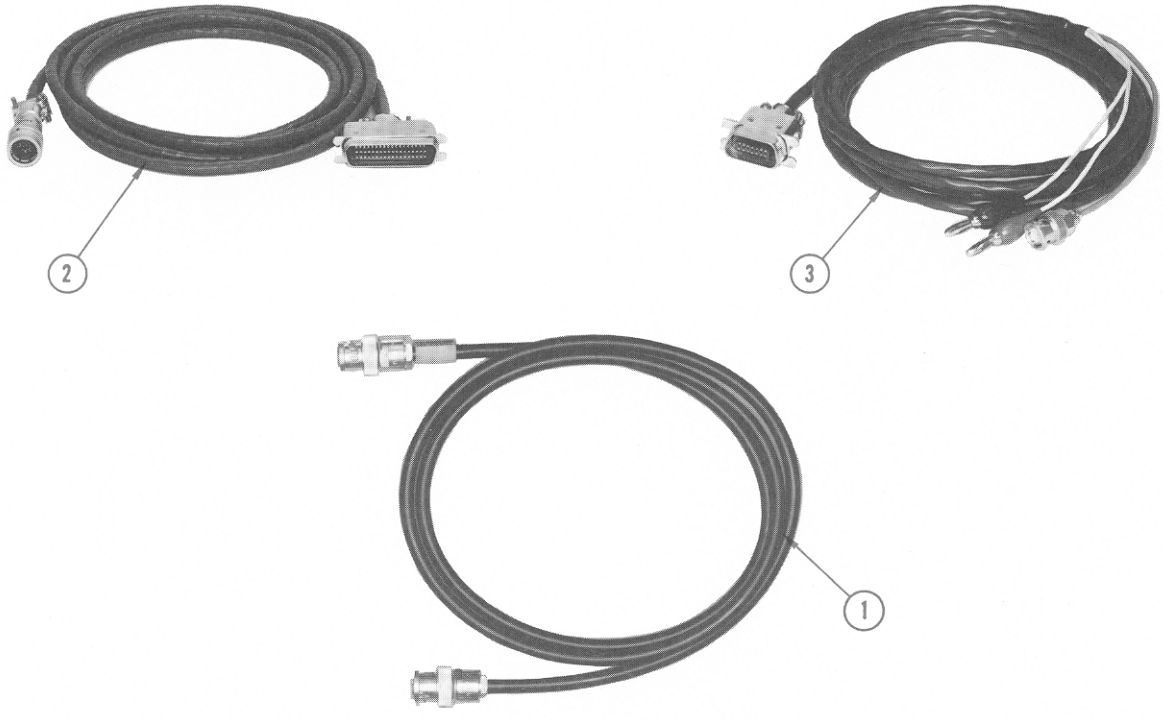

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5	Description
3-1	012-0057-00			1		CABLE ASSEMBLY, BNC
-2	012-0101-00			1		CABLE ASSEMBLY, remote programming
-3	012-0103-00			1		CABLE ASSEMBLY, 10 feet, special purpose
	070-0618-00			2		MANUAL, instruction (not shown)

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FIG. 4 R283 STANDARD ACCESSORIES

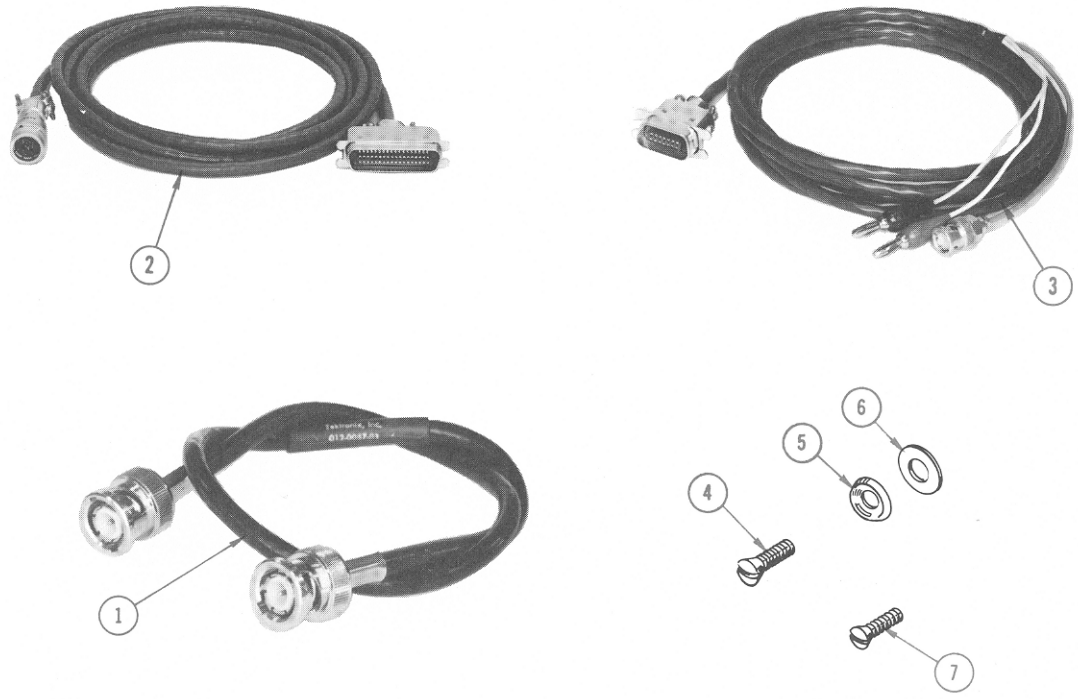

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5	Description
4-1	012-0057-01			1		CABLE ASSEMBLY, BNC
-2	012-0101-00			1		CABLE ASSEMBLY, remote programming
-3	012-0103-00			1		CABLE ASSEMBLY, 10 feet, special purpose
-4	212-0512-00			4		SCREW, 10-32 x 1/2 inch, OHS
-5	210-0833-00			4		WASHER, steel, finishing, #10
-6	210-0917-00			4		WASHER, teflon, 5/8 OD x 0.191 ID x 0.125 inch thick
-7	212-0561-00			4		SCREW, 12-24 x 1/2 inch, OHS
	070-0618-00			2		MANUAL, instruction (not shown)

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MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages. If it does not, your manual is correct as printed.

K4XL's  BAMA

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