TELEQUIPMENT

OSCILLOSCOPES
TYPES D65 & D66

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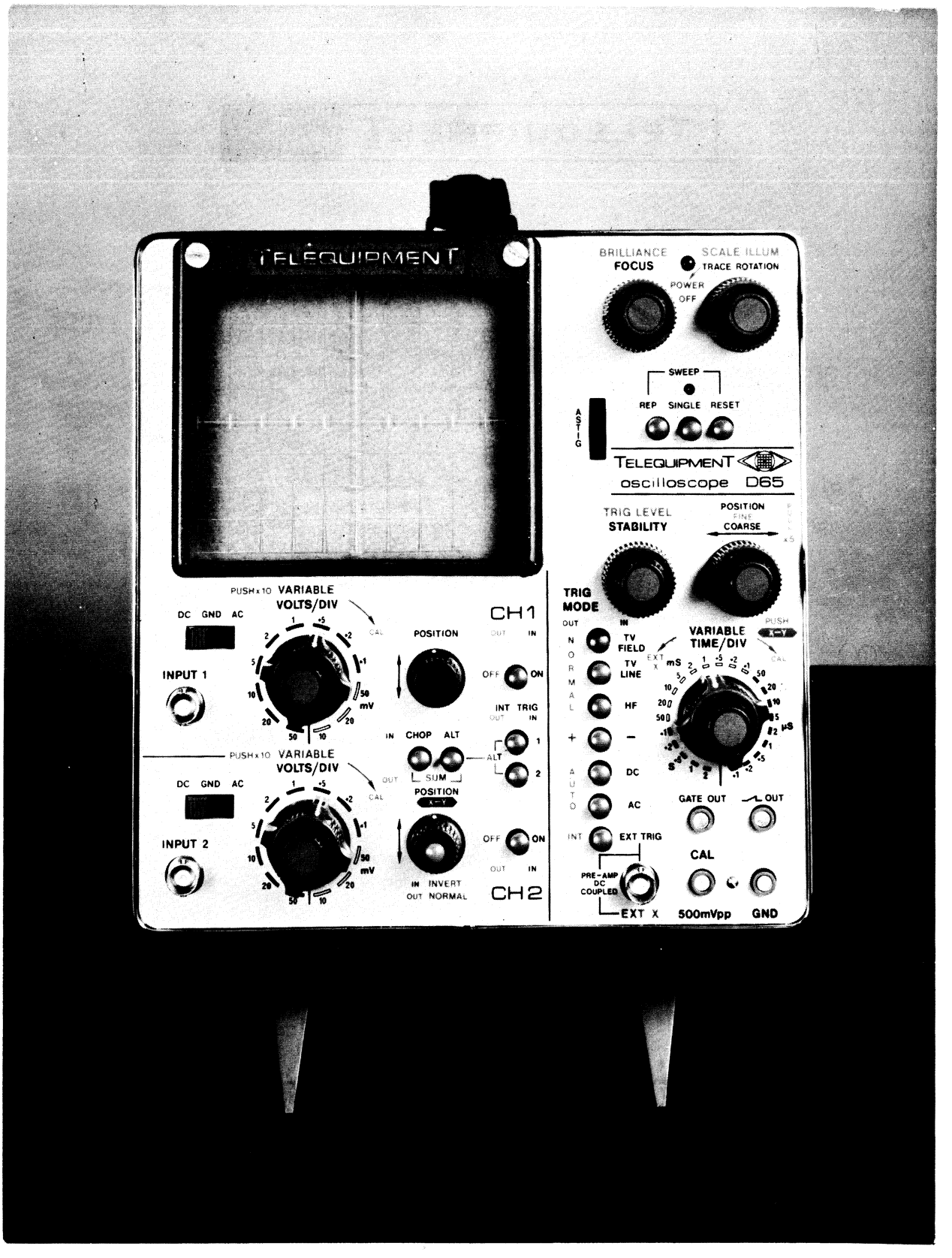
TELEQUIPMENT
BRILLIANCE
FOCUS
SCALE ILLUM
TRACE ROTATION
POWER
OFF
SWEEP
REP
SINGLE
RESET
ASTIG
TELEQUIPMENT
oscilloscope D65
TRIG LEVEL
STABILITY
POSITION
FINE
COARSE
PUSH x10 VARIABLE
VOLTS/DIV
DC GND AC
INPUT 1
CH1
POSITION
OUT IN
OFF ON
INT TRIG
IN CHOP ALT
SUM
ALT
1
2
PUSH x10 VARIABLE
VOLTS/DIV
DC GND AC
INPUT 2
POSITION
X-Y
OFF ON
IN INVERT
OUT NORMAL
CH2
TRIG MODE
NORMAL
TV FIELD
TV LINE
HF
DC
AC
AUTO
INT
EXT TRIG
PRE-AMP DC COUPLED
EXT X
VARIABLE TIME/DIV
PUSH X-Y
CAL
GATE OUT
OUT
CAL
500mVpp
GND

INTRODUCTION

The *D65* and D66 are *15 MHz* and 25 MHz, respectively, all solid-state dual-trace oscilloscopes, in most respects their features are similar, where there are differences the text in *ITALICS* relates to the *D65*. An 8 x 10 cm CRT provides a bright and clear display. The dual-trace vertical system displays either channel separately, adds channels algebraically, alternates between channels or chops between channels at approximately 150 kHz rate. Channel 2 can also be switched to become the horizontal amplifier to provide equal X – Y displays. The solid state design, using FET input circuitry, provides minimum drift and fast stabilization time.

The design of these instruments is subject to continuous development and improvement, consequently this instrument may incorporate minor changes in detail from the information contained herein, which would, in the main affect the Component List and Circuit Diagrams. The reader should pay particular attention to the notes at the beginning of Chapter 5.

Throughout this manual all references to the front panel controls are in full and in capital letters, e.g. POSITION.

NOTICE TO OWNER

In the event of this Instrument being returned to TELEQUIPMENT for servicing: the owner is requested to remove the power supply plug and *NOT* send the following items unless they are suspect, in order to prevent damage during transit and facilitate packaging:

Manual.
Probes.
Power Supply Lead.
Plug Assemblies.

CONTENTS

CHAPTER 1

SPECIFICATION

1.1 VERTICAL SYSTEM

Operating modes	Channel 1 Channel 2 (normal or inverted) Channels 1 & 2 Alternate Chopped (at 150 kHz approx.) Summed X – Y

3 dB bandwidth	*D65*	D66
D.C. Coupled	*D.C. – 15 MHz*	D.C. – 25 MHz
A.C. Coupled	*2 Hz – 15 MHz*	2 Hz – 25 MHz
Risetime X1	*23 ns nominal*	14 ns nominal
X10 A.C. or D.C. Coupled	*10 MHz approx.*	15 MHz approx.
Max. amplitude	*4 div at 15 MHz*	7 div at 25 MHz

X – Y	Via CH1 with CH2 input selected via timebase switch as horizontal amplifier.
Bandwidth (–3dB)	D.C. – 1 MHz
Phase error	Less than 1° at 25 kHz
Deflection factors	
Calibrated – accuracy ± 5%	10 mV – 50 V/div (12 ranges 1-2-5 steps)
Gain X10	1 mV – 5 V/div
Uncalibrated – with variable	Complete cover between steps and to 125 V/div
Signal Delay	200 ns
Input impedance	1 M Ω and 47 pF approx.
Maximum input – D.C., A.C. peak & Sum of	400 V peak

1.2 HORIZONTAL SYSTEM

Sweep generator	
Sweep rates	
Calibrated (23 ranges 1-2-5 steps)	2 s – 100 ns/div ± 5% without expansion; with X5 expansion ± 7%. Fastest calibrated sweep increases to *40 ns/div D65*, 20 ns/div D66.
Uncalibrated (with variable)	Complete cover between steps and to 5 s/div
Single Shot	With lock-out
External horizontal amplifier	
3 dB bandwidth	D.C. – 1 MHz
Risetime	350 ns nominal
Deflection factors	1 V/div approx. 200 mV/div approx. (with X5 expansion)
Input impedance	100 kΩ and 30 pF approx.
Maximum input	400 V peak

1.3 TRIGGER

Coupling	A.C. or D.C.
Source	CH1, CH2, alternate, and external
Internal	
Amplitude – Automatic	0.25 div (0.5 div at x10 gain) 40 Hz to 1 MHz } Alternate 0.25 div (0.5 div at x10 gain) D.C. to 1 MHz } 1.0 div rising to 0.5 div at 5 MHz
Trigger level HF	1 div from 1 MHz to > 25 MHz
External	
Amplitude	250 mV to ± 15 V at above frequencies
Impedance	100 kΩ and 30 pF

1.4 CATHODE RAY TUBE (CRT)

Type	
D65	*Single-gun with PDA*
D66	Single-gun with mesh PDA
Display area	8 x 10 cm
Phosphor	
Standard	P31
Special order	P7 or P11
Overall accelerating potential	
D65	*4 kV approx.*
D66	10 kV approx.
External intensity modulation	
Coupling	A.C. to Grid
Amplitude, peak to peak	50 V maximum 15 V for perceptible modulation at average brilliance
Time constant	10 ns

1.5 OUTPUTS, FRONT PANEL

Calibrator, peak to peak	500 mV square wave at supply frequency
Accuracy	2%
Sweep sawtooth	
Coupling	D.C.
Amplitude peak	10 V approx.
Minimum load	47 kΩ
Gate out	
Coupling	D.C.
Amplitude, peak	500 mV approx.

1.6 POWER REQUIREMENTS

Voltage	100 – 125 V in 5 V steps 200 – 250 V in 10 V steps
Frequency	48 – 400 Hz
Consumption	50 VA approx.

1.7 SIZE

Height	24 cm
Width	21 cm
Depth	37 cm

1.8 WEIGHT

11.5 kg

1.9 COOLING

Convection

1.10 TEMPERATURE LIMITS, ambient

Operating	–15 to +40°C approx.
Non-operating	–25 to +70°C approx.

CHAPTER 2
OPERATING INSTRUCTIONS

2.1 FUNCTION OF CONTROLS AND CONNECTORS

2.1.1 CRT

BRILLIANCE	varies the intensity of the display.
FOCUS	controls the definition of the display.
ASTIG	is used in conjunction with FOCUS for best overall definition.
TRACE ROTATION	rotates the traces about the horizontal axis of the CRT and is used to align the traces with the horizontal graticule divisions.
SCALE ILLUM	varies the intensity of the graticule illumination, as well as serving as the supply ON-OFF switch.

2.1.2 HORIZONTAL DISPLAY

POSITION	varies the location of the trace(s) in the horizontal axis, when *not* in the X – Y mode.
FINE	acts as a more sensitive position control as well as the X5 horizontal gain switch. When pulled out in the X5 position, all sweep speed calibrations must be divided by 5. In the X – Y mode, FINE inoperative, X5 gain operative.

2.1.3 SWEEP

TIME/DIV	controls the speed of the main sweep. The sweep rates indicated are only valid if VARIABLE is fully clockwise and FINE position is pushed in for X1 gain. If FINE position is pulled out and VARIABLE is at CAL, the calibrations should be divided by a factor of 5 to ascertain the sweep speed.
VARIABLE	enables speeds between that indicated by TIME/DIV and the next lower speed to be selected. The control also selects X – Y operation when the knob is pushed in.
LEVEL	selects the point on the signal waveform at which the sweep starts. In the AUTO position, ref. 2.1.4 below, the trigger oscillates recurrently at a low repetition rate in the absence of a triggering signal; when a suitable signal is applied, the circuit is automatically triggered at the mean level of the input waveform.
STABILITY	controls the sensitivity of the sweep generator; turned fully anti-clockwise prevents the sweep from running, while fully clockwise causes the sweep to free-run.
SINGLE SHOT	assists in viewing or photographing a non-recurrent signal. If a recurrent signal is applied to the oscilloscope, in the SINGLE SHOT mode, the sweep will run once each time RESET is pressed, when *not* in the X – Y mode.

2.1.4 TRIG MODE

TV F and TV L	facilitates triggering from TV FIELD (frame) or line pulses; the LEVEL control may require adjustment for best results. Polarity relates to the sense of video modulation.
HF	should be depressed for synchronization from high-frequency signals. LEVEL can be adjusted for a locked sweep.
±	provide triggering from the positive or negative-going slope of a waveform.
AUTO	obtained by releasing DC and AC buttons.
INT and EXT	enable the sweep to be triggered either internally, from the vertical amplifier, or externally.
AC or DC	relate to the coupling of the trigger circuit. For very low input frequency DC should be selected.

2.1.5 VERTICAL DISPLAY CH1 & CH2

OFF-ON	release of these buttons switches off the channel concerned. If both channels are switched off, a straight line trace results which cannot be shifted by the POSITION controls except when in the X – Y mode.
INT TRIG	selects triggering from either or both channels. When alternately triggering from both channels both INT TRIG buttons should be released; the displays should be partially superimposed.
CHOP-ALT-SUM	provides three display modes for the vertical channels. In the CHOP mode, the channels are alternately switched on and off at a frequency of about 150 kHz; this mode is suitable at the lower sweep speeds. In the ALT mode, each channel is alternately displayed for the duration of a sweep; the ALT mode is preferable at higher sweep speeds.

In the SUM mode, the display is the addition of the individual signals; CH1 POSITION is used to shift the trace, CH2 POSITION acts as a fine shift control. If INVERT is depressed, the resultant display is the difference between the two input signals.

POSITION — displaces each trace in the vertical direction except when both channels are off.

In the X – Y mode, irrespective of button settings, CH1 provides a vertical shift and CH2 a horizontal shift.

INVERT-NORMAL — The setting of this button determines whether the CH2 signal is displayed in the same polarity as the input signal, or inverted. The inverted setting is used to display the difference between two signals in the SUM mode.

VOLTS/DIV — provides twelve steps of attenuation of each channel's input signal. Calibrated sensitivities are only valid when VARIABLE is fully clockwise. The overall bandwidth is reduced to approximately 10 MHz.

VARIABLE — enables all deflection sensitivities, between that selected by the VOLTS/DIV switch and the next below, to be covered. The control must be fully clockwise for a calibrated display; for X10 gain the knob should be pushed in.

DC-GND-AC — selects the input signal coupling.

In the DC position the signal from the INPUT connector is coupled directly to the attenuator.

In the AC position a capacitor is inserted in series.

In the GND position the input to the attenuator is grounded; this position enables the 0 V D.C. level of a trace to be ascertained.

2.1.6 INPUT AND OUTPUT CONNECTORS

1. INPUTS

BNC — connectors are linked to the vertical channel attenuators via the DC-GND-AC switch described above.

EXT TRIG & EXT X — The BNC connector in the sweep section of the front-panel enables either external triggering signals to be applied or, in the EXT condition of the u/c speed it provides the EXT X input. The connector is DC coupled to both trigger and horizontal amplifier circuits. An external blocking capacitor may be required to remove the DC component. Input resistance is 100 kΩ.

A X5 amplification of the horizontal display is obtained by pulling out FINE position. If a dual-trace display is required on EXT X, the vertical display mode must be set to CHOP, the ALT and SUM mode will provide only one trace.

Z MOD — at the rear of the instrument, and connected via an isolating capacitor to the CRT Grid. A positive-going signal is thus necessary to intensify the trace while a negative-going signal will blank it.

2. OUTPUTS

CAL — socket provides a squarewave for checking the calibration of the vertical channels. The repetition rate is at supply frequency.

GATE OUT — provides fast-edged negative-going rectangular pulses lasting for the duration of the sweep.

The gate out signal or 0.5 V peak to peak 1 kHz squarewave is used for calibrating probes as follows.

1. Connect the probe to INPUT 1.
2. Set VOLTS/DIV to .1 (X10), 10 mV (X100).
3. Turn VARIABLE fully clockwise,
4. Set TIME/DIV to 1 ms.
5. Connect probe tip to the GATE OUT.
6. Adjust the probe trimmer for a square corner on the leading edge of the display as follows:

In the HZ1B probe, a screwdriver adjustment is provided through a hole in the probe body.

The GE81000 is calibrated as follows:

1. Slacken the narrower of the two knurled rings at the BNC connector end of the probe cable.
2. Rotate the adjacent broader ring until a square corner is obtained.
3. Tighten the narrow ring without disturbing the broad ring.

If a 1kHz squarewave is used, the amplitude should be about 500 mV and a few cycles of the waveform should be displayed. The above calibration procedure should be followed with X10 probe tip applied to the squarewave generator output. The compensation should be checked if the probe is transferred to INPUT 2.

SAWTOOTH — provides a positive-going ramp waveform when the sweep is running. A recurring sawtooth is produced when the STABILITY is fully clockwise for the sweep generator to free-run. The resistance of an applied load should exceed 47 kΩ to avoid loading the sweep generator.

3. GND — this is connected to the chassis of the instrument.

CHAPTER 3
CIRCUIT DESCRIPTIONS

3.1 BLOCK DIAGRAM

3.3.1 This chapter will assist the reader to comprehend the circuitry of the *D65* and D66. By referring to the Block Diagram, Figure 1 the reader will see the interfaces of the various circuits and signal paths, which will be dealt with in detail later.

3.1.2 The signal is fed, via the Attenuator, to the Vertical Amplifier. Its description covers the function of the 'Y' input pre-amplifiers, Delay line driver and Output amplifiers, Channel switching multivibrator and trigger pre-amplifier. The output is fed to the 'Y' plates of the CRT with a portion of it being fed to the trigger network.

3.1.3 The Trigger circuit provides pulses of suitable amplitude and polarity to trigger the timebase from internally or externally derived waveforms.

3.1.4 The Timebase description deals with the ALT pulse and Sweep generators, Gating and Hold-off bistables. This stage determines the start and finish of each sweep and generates a sawtooth waveform for the horizontal amplifier.

3.1.5 The Horizontal amplifier description covers the 'X' output, which amplifies the internal sawtooth waveform or an external 'X' signal and applies it in push-pull to the 'X' plates of the CRT.

3.1.6 The Unblanking amplifier description covers the CHOP and Sweep retrace blanking amplifiers. The output being fed to the CRT g2 electrode.

3.1.7 The Calibrator is included with the description of the Power supplies, its function is to provide a calibrated peak to peak squarewave at power-line frequency, for the purposes of checking the vertical amplifier and timebase calibration.

3.2 ATTENUATORS

The signals to be observed are connected to the instrument by BNC sockets, via switch S901, reference Figure 2, to two identical attenuators each comprising four frequency-compensated resistive dividers with ratios of 100:1, 10:1, 5:1 and 2:1. These are switched, singly or in tandem, and C902, C905, C908 and C912 serve to standardize the input time constants, C904, C907, C911 and C914 compensate the respective dividers.

NOTE: When VOLTS/DIV is set to 10, 20 or 50, connecting the above dividers in tandem, the overall bandwidth is reduced to approximately 10 MHz.

3.3 VERTICAL AMPLIFIER ('Y'-AMPLIFIER)

The circuits of channel 1 (CH1) and channel 2 (CH2) are identical, with Zener diodes D604 and D611 providing stabilized positive and negative voltages and D607 and D608 the shift voltages. CH1 is described below with reference to Figure 3, except where references are made to CH2.

3.3.1 The output from the attenuator is fed to the gate of TR601 via a protection circuit C601, C602, R601, R602a, R602b and R603, which prevents excessive voltage damaging the input FET.

3.3.2 TR601 and TR602 form a paraphase amplifier with their sources long-tailed through TR628. R624 provides variable gain control.

Compensation is provided by R625 for trace movement caused by varying R624. R622 compensates for supply voltage variation in conjunction with R626, R630, R632 and D604. Neutralization is effected by C604.

3.3.3 The output from the FET input stage is taken via emitter followers TR603 and TR604 to a gain stage, TR605 and TR606. In the emitter circuit R617 sets the X1 channel gain and R618 the X10. The collector outputs are connected to the switching stage, TR609 and TR611, via emitter followers, TR607 and TR608. These provide, in push-pull, the channel trigger signal. The Miller capacities of the above gain stage are neutralized by C603 and C609.

In CH2 the emitter followers TR625 and TR624 provide the horizontal signal in the X-Y mode.

3.3.4 TR609 and TR611 form a long-tailed pair, with C606 and R614 providing H.F. compensation. Their output feeds a shunt feedback amplifier, TR612 and TR613. The feedback resistors are split into pairs, R644, R650 and R658, R661; with the signal delay line compensation, at one end, being provided by C621, R656, C619, R655, C618, R654 and C617, R653 connected between the junctions of the above pairs. The compensation at the other end, reference Figure 4 (D66) and *Figure 13 (D65)* is provided by C751 and R751. The delay line is terminated at each end by R643, R659, R752 and R753.

3.3.5 The output from the delay line is fed to the emitter input of the output stage TR752 and TR753, and drives the 'Y' plates of the CRT Fig.8.

A portion of the output is taken via a balanced divider, R771, R773 and R772, R774 to switch, S751 which switches either the above portion of the signal or the channel signal from the emitter followers, TR607 and TR608, to a long-tailed pair, TR755, TR757, which drive the Trigger circuit.

3.3.6 The CH2 output, from TR625, TR624 also drives a separate long-tailed pair, TR754, TR756 which acts as a horizontal pre-amplifier in the X-Y mode. The X-Y gains are equalised with R787. The outputs from TR754, TR756 collectors drive the diode switching matrix in the horizontal output amplifier.

3.3.7 Channel switching is carried out by TR614 and TR615, which act as a bistable in the ALT mode and a free-running multivibrator in the CHOP mode, the current being provided via a long-tail TR616.

3.3.8 In the ALT mode a negative-going pulse coinciding with the start of the sweep flyback, is fed via D606 or D609, to the above bistable, causing it to switch. When TR614 is conducting, it passes current from the switching stage, TR609 and TR611, and allows the CH1 signal to pass to the shunt feedback amplifier, TR612 and TR613. At the same time TR615 is off, its collector rises to 16 V approx. taking the emitters of CH2 switching stage, TR626 and TR627 with it and so cutting off the current. Diodes D610 and D612 prevent the base-emitter junctions from breaking down in the reverse condition.

3.3.9 In the CHOP mode, R648 and R664 are returned to H.T. via R696, forming an astable multivibrator. The frequency is mainly determined by R648, R644, C613, C622, R647, R663 and R696.

3.3.10 In the SUM mode, the current supplied via TR616 is switched off, so both TR614 and TR615 are non-conducting. Both switching stages, TR609, TR611 and TR626, TR627 are required to be on, so extra current is bled from the 115 V line via R637 and R638. Current flows through the switching stages, via R646 and R662 through R673, to earth. Hence these signals are added at the bases of TR612 and TR613. CH2 signal can be inverted by switch, S604, to provide addition or subtraction of the two signals. Also in the SUM mode, CH2 POSITION becomes a very fine shift control. CH1 position being the coarse Shift Control.

3.3.11 The table below shows the state of the switched components for all switch combinations: followed by a resume on the part of circuit activated.

Condition A denotes R637, R638 connected to + 110 V.
Condition B denotes TR616 conducting.
Condition C denotes R673 connected to junction R646/R662.

		ALTernate			CHOP			SUM			X - Y		
CH1	CH2	A	B	C	A	B	C	A	B	C	A	B	C
On	Off	No	Yes	No	No	Yes	No	No	Yes	No	No	No	No
Off	On	No	Yes	No	No	Yes	No	No	Yes	No	No	No	No
On	On	No	Yes	No	No	Yes	No	Yes	No	Yes	No	No	No
Off	Off	No	Yes	No	No	Yes	No	No	Yes	No	No	No	No

1. CH1 ON, CH2 OFF.

TR614, TR609 and TR611 are conducting, this feeds the output of TR609 and TR611 to the bases of TR612 and TR613; TR626 and TR627 being reversed biased by the potential at TR615 collector.

2. CH1 OFF, CH2 ON.

TR615, TR626 and TR627 are conducting, so only the output of TR626 and TR627 may pass to the bases of TR612 and TR613; TR609 and TR611 being reversed biased by the potential at TR614 collector.

3. CH1 ON, CH2 ON. ALTERNATE.

TR614 and TR615 are connected to form a bistable circuit. At the end of each sweep, a negative-going pulse appears at the junction of D606 and D609 which reverses the state of the bistable. Hence TR614 and TR615 conduct alternately and allow the outputs, of CH1 and CH2 alternately, to reach the bases of TR612 and TR613.

4. CH1, CH2 CHOPPED.

R648 and R664 are returned to H.T. via R696 to form an astable multivibrator, which free runs at 150 kHz approx. Thus the outputs of CH1 and CH2 are successively switched into TR614 and TR615 at 150 kHz. At each transition a pulse is fed from the emitters of TR612 and TR613 via C642 to the unblanking amplifier Fig. 6, which blanks the CRT beam and thus provides automatic transient blanking in the chopped mode.

5. CH1, CH2 SUM.

The tail of the multivibrator and R633 are disconnected; TR614 and TR615 are non-conducting; R673 is connected to ground providing a current path for both channels simultaneously; TR609, TR611, TR626 and TR627 are conducting; extra current being fed to their collectors, via R637 and R638 from the + 110 V line, to maintain correct conditions. CH1 and CH2 may be used as a summing or differential (with INVERT pressed) amplifier. In this mode, the CH1 POSITION control provides a coarse shift, and CH2 POSITION control provides a very fine shift control (reference 3.3.10).

6. CH1 OFF, CH2 OFF.

TR614 and TR615 are non-conducting, preventing outputs from either CH1 or CH2 from reaching TR612 and TR613.

7. X - Y

When the X-Y switch is selected, the circuit is connected for X-Y operation as follows, regardless of any vertical amplifier mode switching. R641 is returned to ground, ensuring CH1 signal is connected to TR612 and TR613, and TR626 and TR627 are biased off; TR616 is non conducting and the junction of R646 and R662 is returned to H.T.

3.4 SWEEP TRIGGER

The bases of TR2 and TR3 trigger input amplifiers, reference Figure 5, are fed with internal or external trigger signals via switch, S4 which selects the source from either the collectors of TR755 and TR757 in the vertical amplifier or TR1 the external trigger amplifier. S2 selects the polarity of the signal on which the triggering occurs.

3.4.1 When switched in by S3a and S3b, R15, the LEVEL control varies the base potentials of TR2 and TR3 in antiphase. This alters the quiescent voltage on the base of TR4 and D.C. level of signal required to trip TR4 and TR5.

3.4.2 When S3a and S3b are open in the AUTO position, feedback is applied from TR4 collector via R27 and R9 to TR2 base and from TR5 collector via R26 and R23 to TR3 base. This feedback causes TR2, TR3, TR4 and TR5 to oscillate in the absence of a trigger input at a low frequency, primarily determined by C11, R26 and R27. Input signals overide the above oscillation and the circuit locks to the input frequency. The trigger sensitivity is set by R34. This adjusts the hysteresis of TR4 and TR5. R17 is set to provide a symmetrical operation of TR2 and TR3.

2.2 PRE-OPERATIONAL CHECK

2.2.1 Before connecting the instrument to the supply, check that the rear voltage-selector plug is indicating the local supply voltage or the nearest value to it. Check also that the fuse fitted is 500 mA for 100–125 V operation or 250 mA for 200–250 V.

NOTE: The 3-core supply lead is alternatively colour-coded as follows:

Line	Neutral	Earth Chassis
Brown Black	Blue White	Green/Yellow Green

2.2.2 Set the controls as follows:

1. CRT

BRILLIANCE	Fully anti-clockwise
FOCUS	Central
ASTIG	Central
TRACE ROTATION	As set
SCALE ILLUM	Fully anti-clockwise, POWER OFF.

2. HORIZONTAL DISPLAY

POSITION	Central
FINE	Central and pushed in.
STABILITY	Fully clockwise
TIME/DIV	5 ms
VARIABLE	Fully clockwise
LEVEL	Any position
TRIG MODE	All buttons out
SWEEP	REP.

3. VERTICAL DISPLAY CH1 & CH2

OFF-ON	ON
INT TRIG	1
CHOP-ALT-SUM	CHOP
POSITION	Central
INVERT-NORMAL	NORMAL
VOLTS/DIV	0.2 V
VARIABLE	Fully clockwise
DC-GND-AC	GND

2.3 OPERATION

1. Plug into the supply and switch on with the SCALE ILLUM.
2. Allow a few minutes for warm-up then adjust CRT and POSITION controls for a two-trace display. Adjust TRACE ROTATION if necessary to make the traces horizontal.
3. Apply the supply frequency squarewave from the CAL 500 mV peak to peak socket to both INPUT connectors via co-axial leads and switch DC-GND-AC to DC. Rotate STABILITY anti-clockwise to lock display.
4. If the supply frequency is 50 Hz, 2.5 cycles of the calibrator waveform will be displayed, each display being 2.5 div in amplitude.

The power cord should be secured, by the nuts & screws provided, to comply with local legislation.

3.4.3 When S1a, and b are in the NORMAL position, TR4 and TR5 form a Schmitt trigger. The constant amplitude rectangular-wave output at the collector of TR5 is differentiated by C15 and R38. The resulting bidirectional pulses are applied to the series clipper D1 which provides the collector of TR68 in the sweep circuit with negative-going trigger pulses.

In the TV positions of S1a, b and c, R25 is disconnected from the emitter of TR4; TR4 converts into a sync separator with C12 being switched across R31. TR5 changes into an inverter with decoupling capacitor C16 being switched across the emitter resistors R36, R25 and R34. In the TV F position of S1a, the differentiating time-constant of C15 and R38 is increased by the addition of R39

3.4.4 With S1c set to HF, R32 is added in series with R34 across C14; this converts TR4 and TR5 into a free-running oscillator whose frequency is adjusted by R15, the LEVEL control, to synchronise with the HF trigger input.

3.5 SWEEP GENERATOR. (TIMEBASE)

The sweep generator, reference Figure 6, consists of a Miller integrator TR71 and emitter follower TR72; and two bistables, a gating bistable TR66, TR68 and hold-off bistable TR73, TR74, connected between the Miller output and input.

3.5.1 Initially, for an incoming trigger pulse to fire the sweep the following conditions apply:

Diodes D67, D68 and TR69 are conducting and clamp the drain of TR71 at + 2.5 V approx. The hold-off bistable is held with TR73 off, TR74 on and the gating bistable with TR66 on, TR68 off.

3.5.2 A negative-going trigger pulse causes TR66 to switch off, TR68 on, and D66 to conduct. Hence current flowing through R84 diverts from D67, D68 to D66. This open circuits D67, D68 and releases the gate of TR71. TR71 drain starts to rise, due to Miller action, taking TR72 base and emitter with it and cutting off TR69. This rising sawtooth voltage passes through D71 until eventually TR73 base becomes sufficiently positive to switch the bistable over. Hence TR74 switches off, TR73 on and the negative voltage step at TR73 collector causes TR68 to switch off and TR66 on. TR68 collector goes positive, switching D66 off, D67 and D68 on and starting the flyback.

3.5.3 Current flows through R84, D67, D68 into the timing capacitor C_t, to commence flyback. When TR72 emitter has fallen sufficiently taking TR69 emitter with it then TR69 conducts and clamps C_t at the initial start potential. This potential is determined by the resistor ratios R85, R86 and R94 and R95.

3.5.4 During the flyback period. D71 is off due to the charge on the hold off capacitor C_h. This charge leaks away through R104, R105, R106, R107 and R112 until eventually TR73 switches off, TR74 on and the initial conditions (3.5.1) are restored.

3.5.5 When the sweep is switched to single-shot mode, TR73 base is prevented from switching at the end of the flyback and is clamped by diode D72. The bistable is switched over by pressing RESET, this applies a negative-going pulse to TR73 base and causes the collector current to switch off and TR74 to conduct.

The circuit is then ready for the next incoming trigger pulse to fire the sweep.

3.6 HORIZONTAL AMPLIFIER (X-AMPLIFIER)

The horizontal amplifier reference Figure 6, consists of a pre-amplifier TR76, followed by a cascode connected long tailed pair output stage, TR77, 78, 79 and 81.

3.6.1 The pre-amplifier TR76, is a shunt feedback stage in which the sweep and shift voltages are mixed via R103, R122 on its base. In the EXT X position; TR1 is connected in place of the sweep signal. This converts the external high impedance input into a low impedance suitable for mixing with the shift voltage at TR76 base. The TR76 collector output is fed to the base of TR78 via diode D76. TR78 and TR79 form the bottom half of a cascode amplifier, their collectors driving the emitters of TR77 and TR81, tail current being supplied via TR82.

3.6.2 Gain control is provided, in the X1 condition by R132; in the X5 position by R131. The output from TR77 and TR81 collectors driving the CRT X plates.

3.6.3 In the sweep and EXT X positions D76, D81, D74, D78 are conducting. D77, D82, D79, D75 are off. The signal is fed to the base of TR78 via D76 and DC to the base of TR79 via D81.

3.6.4 In the X-Y mode D74 and D78 are not conducting, D75 and D79 are conducting allowing the push pull output from CH2 to be fed to the bases of TR78 and TR79. Also D76 and D81 are not conducting, D77 and D82 are conducting, shorting out the signal on TR76 collector.

3.7 UNBLANKING AMPLIFIER

The amplifiers for unblanking comprise TR65, TR67 and for chopped blanking TR62 and TR64, reference Figure 6.

3.7.1 In the absence of a sweep TR66 conducts, causing current to flow through TR65 making TR65 collector, TR67 emitter and the CRT g2 electrode negative with respect to the CRT a1 electrode, blanking the trace.

3.7.2 When the sweep starts TR66 switches off; TR65 current ceases; hence its collector goes to H.T. causing TR67 emitter and CRT g2 to follow. The potentials of a1 and g2 electrodes are equalized so unblanking the trace.

3.7.3 Chopped blanking pulses are fed from the TR616 collector (fig 3), via C642, to the cascode circuit TR62 and TR64, which amplifies the pulse.

The collector of TR64 falls; allowing D64 to conduct and pass the blanking pulses, via TR67 to the CRT g2 electrode to blank the trace.

3.8 CRT CIRCUIT

3.8.1 The cathode is connected, reference Figure 8 (D66) and *Figure 14 (D65)* via a zener diode, D301, across which the brilliance control is connected to the -H.T. supply. This allows the brilliance control circuit to be low impedance.

3.8.2 Unblanking pulses are connected to g2. a1 is taken to H.T.

3.8.3 Variable voltages are supplied to a3 and S for optimum astig and geometry adjustment.

3.9 POWER SUPPLIES

Two separate circuits are used for the D66 and *D65*, reference Figures 9 and *15* respectively.

3.9.1 A centre tapped low voltage winding is full wave rectified and R-C smoothed to provide ± 12.5 volts and ± 14 volts.

3.9.2 An H.T. winding is voltage doubled using a full wave doubler then R-C smoothed to provide the positive H.T. supply.

3.9.3 A high voltage winding is full wave voltage doubled to provide the EHT negative supply for the CRT and a voltage quadrupler (D66) or *doubler (D65)* provides the high voltage PDA supply for the CRT.

3.9.4 A 500 mV calibrator waveform is supplied by clipping the supply waveform and referring the amplitude to a zener diode.

CHAPTER 4

MAINTENANCE AND CALIBRATION

4.1 GENERAL

4.1.1 The entire solid-state design of the instrument should render frequent re-adjustment of the internal preset controls unnecessary; however, to ensure full measurement accuracy, it is desirable to make an occasional check, reference 4.3.2, 4.3.3. on the vertical amplifier sensitivity and timebase sweep speed. The internally generated 500 mV peak to peak calibration waveform may conveniently be used for these checks.

4.1.2 Should a more complete calibration be required, such as in the event of transistor replacement, reference should be made to the appropriate procedure in the Calibration paragraph of this Chapter.

Before it is assumed that a fault condition exists, control settings should be verified with reference to the Pre-Operational checks, paragraph 2.2.

4.2 MECHANICAL

4.2.1 LOCATION OF PRESET CONTROLS

Attenuator trimmers are accessible from the left hand side, front, after the covers have been removed. PC.110 and PC.112 which carry the circuits for the timebase, power supplies and storage are situated on the right hand side; PC.115, the vertical amplifier is on the left hand side. The boards are marked with a legend to facilitate component identification.

4.2.2 ACCESS TO INTERIOR

The cabinet sides are removed as follows:

1. Disconnect the power supply.
2. Loosen the two handle-clamp securing screws.
3. Ease the top of each side outwards.
4. Unhook the bottom of each side from the locating slots. The chassis base cover plate is secured by six fixing screws, one at each corner and one half-way along each side.

4.2.3 CRT REMOVAL

1. Remove both cabinet sides, as described above.
2. Remove the rear cover (four screws).
3. Unplug the PDA cap.

CAUTION: Earth both male and female connectors on the cap and CRT respectively, ensuring that the residual charge has been fully dissipated.

4. Unplug the 12-pin CRT base connector.
5. Unplug trace rotation coil plug, from the left-hand board.
6. Unplug five CRT side pin connectors (D66).
7. Remove the three screws holding the mumetal screen.
8. Remove the CRT and screen from the instrument by moving the CRT and screen towards the rear to clear the front panel; moving the forward end of the CRT to the left.
9. Remove adhesive tape and rear location moulding from the CRT (D66).
10. Remove CRT from screen.
11. Remove trace rotation coil and rubber packing from CRT.

4.2.4 CRT FITTING

Reverse the order detailed above 4.2.3. Ensure that the CRT forward end is located in the rubber moulding behind the front panel. If the trace rotation control does not provide an adequate range of adjustment reverse the trace rotation plug.

4.3 CALIBRATION

4.3.1 The following procedure enables a full calibration of the instrument to be accomplished. If any operations are carried out in isolation, regard should be paid to the risk of interaction with other adjustments also to control settings and waveforms applied in earlier steps.

The following tools and equipment shall be required:

1. Calibrator, Telequipment Type C1A or Item 2.
2. Time Marker Generator and an accurate voltage source.
3. Signal Generator.
4. Terminator, 50 Ω. If alternative to 1 above is used, a suitable matching terminator should be used.
5. Variac with a ± 10% facility.
6. Oscilloscope with 100 mV/Div sensitivity.
7. Voltmeter.
8. X1 Probe.
9. X10 Probe.
10. Non capacitive trimming tool.
11. Screwdrivers with various width blades.

4.3.2 SWEEP SPEED CHECK

1. Switch CH1 and CH2 on.
2. Set VOLTS/DIV to 100 mV.
3. Turn VARIABLE fully clockwise and release for X1.
4. Set DC-GND-AC to DC.
5. Push FINE for X1.
6. Set TIME/DIV to 10 ms.
7. Turn VARIABLE (speed) fully clockwise.
8. Connect INPUT 1 & 2 to CAL.
9. Adjust STABILITY for locked display.
10. Check Sweep Speed = 1 cycle/2 divs. for 50 Hz supply
    3 cycles/5 divs. for 60 Hz supply
    for 400 Hz supply set TIME/DIV to 1 ms
    check Sweep Speed = 2 cycles/5 divs.

4.3.3 GAIN CHECK

1. Repeat 1 through 5 above.
2. Connect CAL to INPUT 1.
3. Adjust CH1 POSITION, Trigger and Sweep controls for convenient display.
4. Check amplitude = 5 divs. if incorrect adjust R617.
5. Connect CAL to INPUT 2.
6. Adjust CH2 POSITION, Trigger and Sweep controls for convenient display.
7. Check amplitude = 5 divs., if incorrect adjust R691.

NOTE: VARIABLEs must remain fully clockwise.

4.3.4 PROBES

Reference 2.1.6, sub-para 2, GATE OUT.

4.3.5 PRELIMINARY PROCEDURE

1. With the instrument disconnected from the power supply, remove the cabinet sides as detailed in 4.2.2.
2. Insert the voltage-selector plug in the rear panel with the arrow indicating the nominal voltage of the local A.C. supply or the nearest value to it.
3. Connect the Oscilloscope's power cable to a Variac. The cores of the cable are alternatively colour-coded as follows.

LINE	NEUTRAL	EARTH (Chassis)
Brown Black	Blue White	Green/Yellow Green

4. Set all preset pots to mid position.
5. Set front-panel controls as follows:

POSITION (CH1 & 2)	Central
OFF-ON (CH1 & 2)	OFF
ALL VARIABLES	fully clockwise
STABILITY	fully clockwise
POSITION (horizontal)	Mid position
FINE	Central and pushed in
All push buttons	released

6. Connect the Variac to the power supply, switch on power supply and allow oscilloscope to warm up.
7. Adjust the Variac to give the same voltage as that indicated by the voltage-selector plug.
8. Adjust BRILLIANCE for reasonable setting.
9. Adjust FOCUS and ASTIG.

4.3.6 SWEEP AND TRIGGER

1.0 To set auto and trigger sensitivity R17 and R34. PC110

1.1 Set VARIABLE (speed) to EXT X.

1.2 Release all Buttons.

1.3 Press EXT TRIG.

1.4 Set CH1 and CH2 DC-GND-AC to GND.

1.5 Connect Test Oscilloscope to TR3 collector tag 62. PC110. (Reference Fig 10)

1.6 Set Oscilloscope to 0.1 volts/div and 20 ms/div.

1.7 Turn R34 fully anti-clockwise.

1.8 Adjust R17 to the centre of the range over which a continuous oscillation, at 1 MHz approximately, is observed on the Test Oscilloscope.

1.9 Turn R34 slightly clockwise.

1.10 Reset R17 to the centre of the oscillation range.

1.11 Repeat 1.7 through 1.9 until the oscillation develops into a triangular waveform at 20 Hz approx.

1.12 Adjust R17 and R34 to give a symmetrical waveform of 70 mV peak to peak.

2.0 To set gate potential: R93. PC110

2.1 Connect Test Oscilloscope to Tag 21, PC110.

2.2 Turn STABILITY fully anti-clockwise.

2.3 Turn VARIABLE (speed) fully clockwise.

2.4 Adjust R93 for 2 V negative potential with respect to GND.

3.0 To set sweep length: R106. PC110

3.1 Connect Test Oscilloscope to Tag 23, PC110.

3.2 Turn STABILITY fully clockwise.

3.3 Adjust R106 for a total sweep amplitude of 10 V.

3.4 Disconnect Test Oscilloscope.

3.5 Release EXT TRIG.

3.6 Set CHOP-SUM-ALT to ALT.

4.3.7 VERTICAL AMPLIFIER (supply variation compensation)

1.0 To set CH1 supply variation: CH1 on, CH2 off. PC115

1.1 Set VOLTS/DIV to 10 mV.

1.2 Set DC-GND-AC to DC.

1.3 Connect Calibrator to INPUT 1.

1.4 Set calibrator to 5 mV peak to peak, 1 kHz squarewave.

1.5 Press VARIABLE for X10 gain.

1.6 Set POSITION to centre of range.

1.7 Adjust R642 until trace appears.

1.8 Set R618 for 5 div deflection approximately.

1.9 Adjust STABILITY for free-run trace.

1.10 Set DC-GND-AC to GND.

1.11 Adjust R642 to centralize trace.

1.12 Reduce supply voltage by 10%.

1.13 Note direction, if trace moves in the vertical axis.

1.14 Adjust R622 slightly to move trace in the direction noted in 1.13 above.

1.15 Increase supply to normal.

1.16 Adjust R642 to centralize trace.

1.17 Repeat 1.12 through 1.16 until trace movement is reduced to a minimum, when the Variac setting is varied between ± 10%.

2.0 To set CH2 supply variation: CH1 off, CH2 on. PC115

2.1 Set VOLTS/DIV to 10 mV.

2.2 Set DC-GND-AC to DC.

2.3 Connect Calibrator to INPUT 2.

2.4 Set Calibrator to 5 mV peak to peak 1 kHz squarewave.

2.5 Press VARIABLE for X10 gain.

2.6 Set POSITION to centre of range.

2.7 Adjust R669 until trace appears.

2.8 Set R693 for a 5 div deflection approximately.

2.9 Adjust STABILITY for free-run trace.

2.10 Remove signal by earthing input.

2.11 Adjust R669 to centralize trace.

2.12 Reduce supply voltage by 10%.

2.13 Note direction, if trace moves in the vertical axis;

2.14 Adjust R697 slightly to move trace in the direction noted in 2.13 above.

2.15 Increase supply to normal.

2.16 Adjust R669 to centralize trace.

2.17 Repeat 2.12 through 2.16 until trace movement is reduced to a minimum, when the Variac setting is varied between ± 10%.

2.18 Disconnect Calibrator.

3.0 To check supply fluctuation.

3.1 Switch CH1 on and check CH2 is on.

3.2 Alter Variac setting rapidly between ± 5%.

3.3 Check that both traces do not bounce more than 1mm. If bounce is excessive repeat Op. 1.0 & 2.0 above.

4.3.8 CRT (Geometry)

1.0 To set geometry R301. PC112

1.1 Connect Signal Generator to INPUT 1.

1.2 Set Signal Generator to at least 100 kHz sinewave.

1.3 Switch CH2 off.

1.4 Set TIME/DIV for close spaced raster, 10 sinewaves/div approximately.

1.5 Push FINE for X1 gain.

1.6 Set CH1 VOLTS/DIV to 10 mV.

1.7 Adjust Signal Generator's amplitude to provide a raster with top and bottom edges just visible in the display area.

1.8 Adjust R301 for minimum curvature at the edges of the raster.

1.9 Disconnect the Signal Generator.

4.3.9 VERTICAL AMPLIFIER (D.C. and L.F. setting)

1.0 To set CH1 VARIABLE and POSITION balance: R625 and R642. PC115

1.1 Check CH1 on, CH2 off.

1.2 Set VARIABLE fully clockwise.

1.3 Set VOLTS/DIV to 10 mV.

1.4 Set DC-GND-AC to GND.

1.5 Adjust POSITION to align trace with graticule centre line.

1.6 Push VARIABLE for X10 gain.

1.7 Adjust R642 to centralize trace.

1.8 Release VARIABLE for X1 gain.

1.9 Repeat 1.5 through 1.8 until no trace movement occurs when operating VARIABLE.

1.10 Push VARIABLE for X10 gain.

1.11 Turn VARIABLE fully anti-clockwise.

1.12 Adjust R625 to centralize trace.

1.13 Turn VARIABLE fully clockwise.

1.14 Repeat 1.11 through 1.13 until there is no movement when VARIABLE is turned through its range.

2.0 To set CH2 POSITION balance: R669. PC115

2.1 Switch CH2 on.

2.2 Push both VARIABLES for X10 gain.

2.3 Set both DC-GND-AC to GND.

2.4 Turn both VARIABLES fully clockwise.

2.5 Set CHOP-SUM-ALT to ALT.

2.6 Centralize both traces.

2.7 Set CHOP-SUM-ALT to SUM.

2.8 Adjust R669 to centralize trace.

2.9 Repeat 2.5 through 2.8 until no trace movement occurs.

3.0 To set CH2 VARIABLE balance: R701. PC115

3.1 CH1 off. Check CH2 is on.

3.2 Set VARIABLE fully clockwise.

3.3 Set VOLTS/DIV to 10 mV.

3.4 Set DC-GND-AC to GND.

3.5 Adjust POSITION to align trace with graticule centre line.

3.6 Push VARIABLE for X10 gain.

3.7 Turn VARIABLE fully anti-clockwise.

3.8 Adjust R701 to centralize trace.

3.9 Repeat 3.6 through 3.8 until there is no movement when VARIABLE is turned through its range.

4.0 To set CH1 X1 gain: R617. PC115

4.1 Switch CH1 on, CH2 off.

4.2 Set VOLTS/DIV to 10 mV.

4.3 Release VARIABLE for X1 gain.

4.4 Press INT TRIG 1.

4.5 Set TIME/DIV to 1 ms.

4.6 Set DC-GND-AC to DC.

4.7 Connect Calibrator to INPUT 1.

4.8 Set Calibrator to 50 mV peak to peak 1 kHz square-wave.

4.9 Adjust R617 to give 5 div amplitude.

5.0 To set CH1 X10 gain: R618. PC115

5.1 Set Calibrator to 5 mV peak to peak.

5.2 Push VARIABLE for X10 gain.

5.3 Adjust R618 to give 5 div amplitude.

6.0 To set CH2 X1 gain: R691. PC115

NOTE: Operations 6.0 and 7.0 assume that CH1 gain, Ops 4.0 and 5.0 have been accurately set.

6.1 Switch CH1 off, CH2 on.

6.2 Set both VOLTS/DIV to 10 mV.

6.3 Turn VARIABLE fully clockwise.

6.4 Set DC-GND-AC to DC.

6.5 Release VARIABLE for X1 gain.

6.6 Press INT TRIG 2.

6.7 Set CHOP-SUM-ALT to ALT.

6.8 Adjust POSITION to centralize traces.

6.9 Connect Calibrator to INPUT 2.

6.10 Set Calibrator to 50 mV peak to peak 1 kHz squarewave.

6.11 Adjust R691 for 5 div amplitude.

6.12 Switch CH1 on.

6.13 Connect Calibrator to INPUT 1 & 2.

6.14 Check channels for identical traces.

7.0 To set CH2 X10 gain: R693. PC115

7.1 Set Calibrator to 5 mV peak to peak.

7.2 Push both VARIABLES for X10 gain.

7.3 Adjust R693 for 5 div amplitude.

7.4 Check channels for identical traces.

8.0 To set CH1 input and neutralizing capacities: C601 and C604. PC115

8.1 Connect Calibrator to INPUT 1.

8.2 Switch CH1 on, CH2 off.

8.3 Press INT TRIG 1.

8.4 Turn VARIABLE fully clockwise.

8.5 Set VOLTS/DIV to 10 mV.

8.6 Release VARIABLE for X1 gain.

8.7 Set DC-GND-AC to DC.

8.8 Set Calibrator to 50 mV, 1 kHz squarewave.

8.9 Adjust C604 for square corner with a non-capacitive trimming tool.

8.10 Turn VARIABLE fully anti-clockwise.

8.11 Adjust C601 for square corner (increase signal amplitude if required).

8.12 Turn VARIABLE fully clockwise.

8.13 Repeat 8.8 through 8.11 until a square corner is maintained at the extreme positions of the VARIABLE control.

9.0 To set CH2 input and neutralizing capacities: C634 and C636. PC115

9.1 Connect Calibrator to INPUT 2.

9.2 Switch CH2 on, CH1 off.

9.3 Press INT TRIG 2.

9.4 Turn VARIABLE fully clockwise.

9.5 Set VOLTS/DIV to 10 mV.

9.6 Release VARIABLE for X1 gain.

9.7 Set DC-GND-AC to DC.

9.8 Set Calibrator to 50 mV 1 kHz squarewave.

9.9 Adjust C636 for square corner with a non-capacitive trimming tool.

9.10 Turn the VARIABLE fully anti-clockwise.

9.11 Adjust C634 for square corner (increase signal amplitude if required).

9.12 Turn VARIABLE fully clockwise.

9.13 Repeat 9.8 through 9.11 until a square corner is maintained at the extreme positions of the VARIABLE control.

4.3.10 ATTENUATOR (adjustment)

1.0 To set CH1 Attenuator compensation. PC73

1.1 Switch CH1 on.

1.2 Connect Calibrator to INPUT 1.

1.3 Press INT TRIG 1.

1.4 DC-GND-AC. Set CH1 to DC, CH2 to GND.

1.5 Turn VARIABLE fully clockwise.

1.6 Set VOLTS/DIV to Col. 1 below.

1.7 Set Calibrator to Col. 2.

1.8 Adjust trimmer, Col. 3, for square corner.

1.9 Repeat 1.6 through 1.8 until trimmers in Col.3 have been adjusted.

VOLTS/DIV	Squarewave 1 kHz	Adjust
1	2	3
Volt	Volt	
20 m	0.1	C914
50 m	0.25	C911
0.1	0.5	C907
0.2	1	C912
0.5	2.5	C908
1	5	C904

1.10 Connect a compensated X10 probe between Calibrator and INPUT 1.

1.11 Repeat 1.6 through 1.8 with reference to table below.

VOLTS/DIV	Squarewave 1 kHz	Adjust
1	2	3
Volt	Volt	
0.1	5	C905 (0.2 V probe)
1	50	C902 (1.0 V probe)

1.12 Disconnect Calibrator and probe.

2.0 To set CH2 Attenuator compensation. PC73

2.1 Connect Calibrator to INPUT 2.

2.2 Check CH2 is on.

2.3 Press INT TRIG 2.

2.4 DC-GND-AC. Set CH1 to GND, CH2 to DC.

2.5 Carry out operation 1.5 through 1.12 above, using the respective CH2 controls.

4.3.11 HORIZONTAL AMPLIFIER (gain & timing)

1.0 To set sweep speed and trace length: C65, C67, C207, R106, R131, R132. PC110

1.1 Push FINE for X1 gain.

1.2 Set TIME/DIV for 1 ms.

1.3 Connect Marker Generator to INPUT 1.

1.4 Set Marker Generator to 1 ms.

1.5 Switch CH1 on.

1.6 Press INT TRIG 1.

1.7 Adjust R132 for correct timing, 1 pulse/div.

1.8 Adjust R106 for 10.2 div trace length.

1.9 Set TIME/DIV for 0.1 μs.

1.10 Adjust C67 for 10.2 div.

1.11 Set Marker Generator to 100 μs.

1.12 Set TIME/DIV to 1 ms.

1.13 Pull FINE out for X5 gain.

1.14 Adjust R131 for 2 markers/div.

1.15 Disconnect Marker Generator.

1.16 Connect Signal Generator to INPUT 1.

1.17 Push FINE X1 gain.

1.18 Set TIME/DIV to 0.1 μs.

1.19 Set Signal Generator to 10 MHz sinewave.

1.20 Adjust C65 for linearity of timing at the start of the trace.

1.21 Adjust C207 (T/D switch) for 1 cycle/div.

2.0 To set EXT X compensation: C2. PC110

2.1 Connect Calibrator to EXT X socket.

2.2 Set Calibrator to approximately 700 mV peak to peak, 100 kHz squarewave.

2.3 Set VARIABLE (speed) to EXT X.

2.4 Pull FINE for X5 gain.

2.5 Observe trace equals 3.5 divs approximately.

2.6 Adjust C2 to remove over and under shoot.

2.7 Disconnect Calibrator.

2.8 Push FINE for X1 gain.

2.9 Turn VARIABLE (speed) fully clockwise.

4.3.12 SWEEP (Single Shot adjustment)

1.0 Set Single shot: R112. PC110

1.1 Switch CH1 on, CH2 off.

1.2 Press INT TRIG 1.

1.3 Set DC-GND-AC to AC.

1.4 Connect Signal Generator to INPUT 1.

1.5 Set Signal Generator to 50 mV squarewave, 1-20 kHz to give 5 divisions display.

1.6 Set TIME/DIV to 1 ms.

1.7 Press AC (Trig Mode).

1.8 Adjust STABILITY and LEVEL for locked display.

1.9 Press SINGLE SHOT.

1.10 Turn R112 slightly anti-clockwise.

1.11 Press RESET.

1.12 Observe if single sweep occurs.

1.13 Repeat 1.9 through 1.12 until single sweep fails to occur and note slot position of R112.

1.14 Set TIME/DIV to 0.1 μs.

1.15 Turn R112 slightly clockwise.

1.16 Press RESET.

1.17 Observe Neon.

1.18 Repeat 1.15 through 1.17 until single sweep fails to occur and note slot position of R112.

NOTE: The sweep and neon light should be too fast to observe, however, failure to single sweep is indicated by the neon remaining on.

1.19 Set R112 midway between positions noted in 1.13 and 1.18.

1.20 Set DC-GND-AC to GND.

1.21 Press RESET, observe neon light.

1.22 Set DC-GND-AC to AC.

1.23 Observe neon extinguishes, indicating sweep has occurred.

1.24 Disconnect Signal Generator.

1.25 Press REP.

4.3.13 X–Y MODE (CH2 gain)

1.0 To set X–Y gain: R787. T/D switch

1.1 Connect Calibrator to INPUT 2.

1.2 Set Calibrator to 50 mV peak to peak at 1 kHz squarewave.

1.3 Set VOLTS/DIV to 10 mV.

1.4 Push VARIABLE (speed) for X – Y operation.

1.5 Adjust R787 for 5 div trace on X axis.

1.6 Release VARIABLE (speed).

4.3.14 VERTICAL AMPLIFIER (Pulse Response)

1.0 To set CH1 neutralization C605 and C608. PC115

1.1 Connect Calibrator to 50Ω Terminator.

NOTE: Reference 4.3.1. Item 4.

1.2 Connect Terminator to INPUT 1.

1.3 Set Calibrator to 1 MHz squarewave.

1.4 Switch CH1 on, CH2 on.

1.5 Press INT TRIG 1.

1.6 DC-GND-AC. Set CH1 to DC, CH2 to GND.

1.7 Set VOLTS/DIV to 10 mV.

1.8 Set TIME/DIV to 0.2 μs.

1.9 Adjust CH1 squarewave amplitude for a 5 div trace.

1.10 Adjust C605 and C608 to minimize interaction of CH1 trace on CH2.

NOTE: The physical settings of C605 and C608 should be approximately equal; this is determined by the relative positions of the rotor and stator vanes.

2.0 To set CH2 neutralization; C625 and C631. PC115

2.1 Connect Calibrator to 50Ω Terminator.

2.2 Connect Terminator to INPUT 2.

2.3 Set Calibrator to 1 MHz squarewave.

2.4 Press INT TRIG 2.

2.5 DC-GND-AC. Set CH1 to GND, CH2 to DC.

2.6 Set VOLTS/DIV to 10 mV.

2.7 Set TIME/DIV to 0.2 μs.

2.8 Adjust CH2 squarewave amplitude for a 5 div trace.

2.9 Adjust C625 and C631 to minimize interaction of CH2 trace on CH1.

NOTE: The physical settings of C625 and C631 should be approximately equal; this is determined by the relative positions of the rotor and stator vanes.

3.0 Set H.F. frequency response: C606, C619, C621, C632, R614, R681, R656, L752 & L753. PC115

CAUTION: The resultant settings of this procedure are extremely critical. Inaccuracies will have an adverse affect on bandwidth and pulse response.

3.1 Connect Calibrator to INPUT 1 via terminator. Reference 4.3.1. Item 4.

3.2 Set TIME/DIV to 5 μs.

3.3 Turn R614 fully clockwise.

3.4 Turn C606 until stator and rotating vanes are visible.

3.5 Screw out cores of L752 & L753.

3.6 Set Calibrator to 100 kHz of 3 div amplitude approximately.

3.7 Press INT TRIG 1.

3.8 Set DC-GND-AC to DC.

3.9 Adjust STABILITY for a locked display.

3.10 Adjust C619 for corners without overshoot.

3.11 Set Calibrator to 1 MHz squarewave.

3.12 Set TIME/DIV to 0.2 μs.

3.13 Adjust R656 and C621 alternatively for optimum squarewave.

NOTE: Turn R656 clockwise until a point is reached immediately prior to the squarewave deterioration.

3.14 Set TIME/DIV to 5 μs.

3.15 Check for flatness of wave top.

3.16 Repeat 3.12 through 3.15 until a squarewave is displayed.

3.17 Set TIME/DIV to 0.2 μs.

3.18 Adjust C606 for maximum overshoot.

3.19 Turn R614 slightly anti-clockwise to eliminate the H.F. oscillation on the trailing edge of the first overshoot.

3.20 Adjust C606 to eliminate overshoot.

3.21 Gradually screw in the cores of L752 and L753 alternately until the leading edge of the squarewave is vertical without overshoot.

3.22 Connect Calibrator to INPUT 2.

3.23 Press INT TRIG 2.

3.24 Adjust STABILITY for a locked display.

3.25 Turn R681 fully clockwise.

3.26 Adjust C632 for maximum overshoot.

3.27 Turn R681 slightly anti-clockwise to eliminate H.F. oscillation on the trailing edge of the first overshoot.

3.28 Adjust C632 to eliminate overshoot.

3.29 Check CH1 and CH2 for similar pulse responses.

3.30 Check that the 3 dB bandwidths of both channels are better than,
for *D65 15 MHz at X1 gain and 10 MHz at X10;*
D66 25 MHz at X1 gain and 15 MHz at X10.

4.3.15 CALIBRATOR

1.0 To set internal 500 mV calibrator: R416. PC112

1.1 Connect Calibrator to INPUT 1.

1.2 Set VOLTS/DIV to 100 mV.

1.3 Turn VARIABLE fully clockwise.

1.4 Press INT TRIG 1.

1.5 Set CH1 DC-GND-AC to DC.

1.6 Set Calibrator to an accurate 500 mV peak to peak squarewave.

NOTE: The precise amplitude of display should be 5 divisions if 4.3.6 Op. 4.0 has been correctly carried out.

1.7 Connect CAL to INPUT 1.

1.8 Adjust R416 for exactly the same amplitude as found in Op. 1.6.

CHAPTER 5
COMPONENT LIST

Values of resistors are stated in ohms or multiples of ohms; ratings at 70°C are in watts or sub-multiples of watts. Values of capacitors are stated in sub-multiples of farads; ratings at 70°C are in volts or kilovolts.

Whenever possible, exact replacements for components should be used, although locally available alternatives may be satisfactory for standard components.

Any order for replacement parts should include:

1. Instrument Type.
2. Instrument Serial Number.
3. Component Circuit Reference.
4. Component Part Number.
5. Component Value.

NOTE: Where the component details of the D65 & D66 differ, the circuit reference are quoted in the component list, less details which are listed in the relevant appendix of this chapter.

CIRCUIT REFERENCE BLOCKS

The table below gives the blocks of circuit references, so that the reader can relate the items listed in this Chapter and their location in the circuitry and printed circuit boards in Chapter 6.

Circuit Reference		Circuit	Figure	P.C. Board No.
From	To			
1	50	Sweep Trigger	5	110
51	150	Sweep Generator, Horizontal and Blanking Amp.	6	110
201	250	Time/div	7	116
301	400	CRT	8 & *14*	110 & 112
401	600	Power supply	9 & *15*	112
601	750	Vertical Amp. input	3	115
751	900	Vertical Amp. output	4 & *13*	119
901	999	Attenuator	2	73

ABBREVIATIONS

C	Carbon	Ge	Germanium	Se	Selenium
CP	Carbon preset			Si	Silicon
CV	Carbon variable	MF	Metal film	SM	Silver Mica
CER	Ceramic	MO	Metal oxide	WW	Wire-wound
CT	Ceramic trimmer	PE	Polyester	WWP	Wire-wound preset
CM	Cermet thick film	PP	Polypropylene	WWV	Wire-wound variable
E	Electrolytic	PS	Polystyrene.		

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All requests for repairs or replacement parts should be directed to the Tektronix Field Office or representative in your area. This procedure will assure you the fastest possible service, except in the U.K.

ELECTRICAL

CIR REF	PART NUMBER	DESCRIPTION VALUE F	TYPE	TOL %	RATING V	
C2	281-0156-00	1.4-6.4 p	PP		500	
C3	281-0729-00	1.5 μ	CER	20	63	
C4	281-0729-00	1.5 μ	CER	20	63	
C6	281-0734-00	100 n	CER		30	
C7	281-0678-00	3 p	CER	0.1 p	500	
C8	281-0678-00	3 p	CER	0.1 p	500	
C11	290-0399-00	8 μ	E		25	
C12	290-0546-00	15 μ	E		16	
(1120) C13	285-0982-00	82 p	PS	1 p	350	
C14	285-0850-00	1 n	PS	5	125	
C15	285-0854-00	100 p	PS	2	350	
C16	290-0497-00	100 μ	E		25	
C60	285-0854-00	100 p	PS	2 p	350	
C61	281-0678-00	3 p	CER	0.1 p	500	
C62	285-0854-00	100 p	PS	2 p	350	
C63	285-0867-00	20 p	PS	1 p	350	
C64	281-0710-00	10 n	CER		250	
C65	281-0154-00	2-12 p	PP		500	
C66	285-0842-00	15 p	PS	1 p	350	
C67	281-0154-00	2-12 p	PP		500	
C68	285-0776-00	27 p	PS	1 p	350	
C69	285-0915-00	100 n	PE	20	100	
(765) C70	285-0946-00	470 n	PE	20	250	
C71	285-0869-00	47 p	PS	2 p	350	
C72	281-0734-00	100 n	CER		30	
C73	285-0873-00	200 p	PS	5	350	
C74	285-0869-00	47 p	PS	2 p	350	
C75	285-0791-00	470 n	PE	10	125	
C76	281-0734-00	100 n	CER		30	
(740) C201	285-0869-00	47 p	PS	2 p	350	
C202	285-0844-00	39 p	PS	2 p	350	
C203	285-0769-00	10 n	PE	20	400	
C204	285-0990-00	1 μ	PE	20	160	
C205	285-0941-00	80 p	PS	1 p	350	
C206	285-0942-00	10 n	PS	1	125	

CIR REF	PART NUMBER	DESCRIPTION VALUE F	TYPE	TOL %	RATING V	
C207	281-0732-00	3-12 p	CT		350	
C208	285-0943-00	1 μ	PC	1	63	
C209	285-0866-00	10 p	PS	1 p	350	
C301	285-0796-00	100 n	PE	20	250	(1051)
C302	285-0796-00	100 n	PE	20	250	
C303	285-0796-00	100 n	PE	20	250	
C304	285-0772-00	100 n	PE	10	400	
C305	285-0796-00	100 n	PE	20	250	
C306	281-0682-00	20 n	CER		2 k	
C307						
C402						(856)
C403						
C404	290-0540-00	15 μ	E		450	
C405	290-0540-00	15 μ	E		450	
C406	290-0540-00	15 μ	E		450	
C407	290-0624-00	2.2 m	E		40	(749)
C408	290-0624-00	2.2 m	E		40	(749)
C409	290-0540-00	15 μ	E		450	
C410						(856)
C411						
C412	290-0500-00	470 μ	E		100	
C413	290-0500-00	470 μ	E		100	
C414	290-0624-00	2.2 m	E		40	
C415	290-0624-00	2.2 m	E		40	(749)
C416	290-0624-00	2.2 m	E		40	
C417	285-0874-00	470 p	PS	5	125	
C418	290-0547-00	330 μ	E		160	
C419	290-0624-00	2.2 m	E		40	(749)
C421	290-0547-00	330 μ	E		160	
C422	290-0624-00	2.2 m	E		40	(749)
C423	290-0624-00	2.2 m	E		40	(749)
C424	281-0734-00	100 n	CER		30	

CIR REF	PART NUMBER	VALUE F	DESCRIPTION TYPE	TOL %	RATING V
C600	285-0796-00	100 n	PE	20	250
C601	281-0157-00	5.5-65.5 p	PP		500
C602	285-0845-00	68 p	PS	2 p	350
C603	281-0723-00	1.8 p	CER	0.1 p	500
C604	281-0156-00	1.4-6.4 p	PP		500
C605	281-0156-00	1.4-6.4 p	PP		500
C606	281-0157-00	5.5-65.5 p	PP		500
C607	281-0734-00	100 n	CER		30
C608	281-0156-00	1.4-6.4 p	CER		500
C609	281-0723-00	1.8 p	CER	0.1 p	500
(1079) C610	285-0791-00	470 n	PE	20	250 V
C611	285-0790-00	10 n	PE	20	125
(1120) C612	285-0788-00	100 n	PE	10	125
C613	285-0854-00	100 p	PS	2 p	350
C616	281-0710-00	10 n	CER		250
C617	281-0676-00	2.2 p	CER	0.1 p	500
C618	281-0713-00	10 p	CER	0.25 p	750
C619	281-0155-00	2-22 p	PP		500
C620	281-0734-00	100 n	CER		30
C621	281-0155-00	2-22 p	PP		500
C622	285-0854-00	100 p	PS	2p	350
(765) C623	281-0734-00	100 n	CER		30
C624	290-0494-00	47 μ	E		25
C625	281-0156-00	1.4-6.4 p	CER		500
C626	281-0734-00	100 n	CER		30
C627	281-0723-00	1.8 p	CER	0.1 p	500
C628	285-0790-00	10 n	PE	20	125
(1120) C629	285-0788-00	100 n	PE	10	125
(765) C630	285-1046-00	100 n	PE	20	160
C631	281-0156-00	1.4-6.4 p	PP		500
C632	281-0157-00	5.5-65.5 p	PP		500
C633	281-0723-00	1.8 p	CER	0.1 p	500
C634	281-0156-00	1.4-6.4 p	PP		500
C635	285-0845-00	68 p	PS	2 p	350
C636	281-0157-00	5.5-65.5 p	PP		500
C637	281-0710-00	10 n	CER		250
C638	290-0493-00	22 μ	E		16
C639	281-0710-00	10 n	CER		250
C641	285-0994-00	470 n	PE	20	100
C642	281-0734-00	100 n	CER		30

CIR REF	PART NUMBER	VALUE F	DESCRIPTION TYPE	TOL %	RATING V
C751	281-0678-00	3 p	CER	0.1 p	500
C752	285-0795-00	220 n	PE	20	250
C753	281-0710-00	10 n	CER		250
C754	281-0710-00	10 n	CER		250
C755	281-0713-00	10 p	CER	0.25p	750
C756	281-0713-00	10 p	CER	0.25p	750
C757	285-0920-00	56 p	PS	2 p	350
*C901	285-0772-00	100 n	PE	10	400
*C902	281-0145-00	6-25 p	CT		500
*C903	285-0810-00	820 p	PS	5	125
*C904	281-0136-00	3-10 p	CT		500
*C905	281-0145-00	6-25 p	CT		500
*C906	285-0869-00	47 p	PS	2 p	350
*C907	281-0136-00	3-10 p	CT		500
*C908	281-0145-00	6-25 p	CT		500
*C909	285-0842-00	15 p	PS	1 p	350
*C911	281-0136-00	3-10 p	CT		500
*C912	281-0136-00	3-10 p	CT		500
*C913	283-0653-00	5 p	SM	10	350
*C914	281-0145-00	6-25 p	CT		500

* Two per instrument

CIR REF	PART NUMBER	VALUE V	DESCRIPTION	TYPE	TOL %	RATING	
D1	152-0062-01		1N914	Si		75 V	
D2	152-0062-01		1N914	Si		75 V	
D3	152-0370-00		AAY30	Ge			(765)
D64	152-0062-01		1N914	Si		75 V	
D66	152-0062-01		1N914	Si		75 V	
D67	152-0483-00		25 pA leakage current at − 6 V and 25 °C				
D68	152-0062-01		1N914	Si		75 V	
D69	152-0494-00	75	Zener	Si	5	700 mW	
D71	152-0062-01		1N914	Si		75 V	
D72	152-0062-01		1N914	Si		75 V	
D73	152-0062-01		1N914	Si		75 V	
D74	152-0062-01		1N914	Si		75 V	
D75	152-0062-01		1N914	Si		75 V	
D76	152-0062-01		1N914	Si		75 V	
D77	152-0062-01		1N914	Si		75 V	
D78	152-0062-01		1N914	Si		75 V	
D79	152-0062-01		1N914	Si		75 V	
D81	152-0062-01		1N914	Si		75 V	
D82	152-0062-01		1N914	Si		75 V	
D83	152-0062-01		1N914	Si		75 V	
D84							
D85	152-0062-01		1N914	Si		75 V	
D301	152-0344-00	100	Zener	Si			(1026)
D401							
D402							
D403	152-0341-00	450	Rectifier	Si		500 mA	
D404	152-0515-00	6 k	Rectifier	Si		8 mA	
D405	152-0515-00	6 k	Rectifier	Si		8 mA	
D406	152-0341-00	450	Rectifier	Si		500 mA	
D407	152-0339-00	50	Rectifier	Si		500 mA	
D408	152-0339-00	50	Rectifier	Si		500 mA	
D410	152-0515-00	6 k	Rectifier	Si		8 mA	
D411	152-0515-00	6 k	Rectifier	Si		8 mA	
D412	152-0339-00	50	Rectifier	Si		500 mA	
D413	152-0339-00	50	Rectifier	Si		500 mA	
D414	152-0062-01		1N914	Si		75 V	
D415	152-0062-01		1N914	Si		75 V	
D416	152-0062-01		1N914	Si		75 V	

	CIR REF	PART NUMBER	VALUE	DESCRIPTION	TYPE	TOL %	RATING
(862)	D601	152-0554-00		BAY74	Si		
(862)	D603	152-0554-00		BAY74	Si		
	D604	152-0348-00	6.2 V	Zener	Si	5	330 mW
	D605	152-0062-01		1N914	Si		75 V
	D606	152-0062-01		1N914	Si		75 V
	D607	152-0062-01		1N914	Si		75 V
	D608	152-0062-01		1N914	Si		75 V
	D609	152-0062-01		1N914	Si		75 V
(862)	D610	152-0554-00		BAY74	Si		
	D611	152-0348-00	6.2 V	Zener	Si	5	330 mV
(862)	D612	152-0554-00		BAY74	Si		
	DL751	119-0155-00	200 ns	Delay line			
	F401	159-0077-00		Fuse 1.25" delay 200 – 250 V			250 mA
		159-0079-00		Fuse 1.25" delay 100 – 125 V			500 mA
	L61	108-0482-00	160 µH	Fixed inductor			
	L601	108-0482-00	160 µH	Fixed inductor			
	L602	108-0482-00	160 µH	Fixed inductor			
	L603	108-0665-00		60 turns on 220 Ω			
	L751	108-0662-00	100 Ω	Trace rotation coil 945 turns			
	L752	114-0301-00	4.7 µH	Variable inductor			
	L753	114-0301-00	4.7 µH	Variable inductor			
	LP401	150-0095-00	14 V	LES			750 mW
	LP402	150-0081-00	14 V	Capless			750 mW
	LP403	150-0081-00	14 V	Capless			750 mW

CIR REF	PART NUMBER	DESCRIPTION VALUE ohms	TYPE	TOL %	RATING W
	R1	317-0104-01	100 k	C	5	125 m
	R2	317-0224-01	220 k	C	5	125 m
	R3	317-0104-01	100 k	C	5	125 m
	R4	316-0273-01	27 k	C	10	250 m
	R5	317-0271-01	270	C	5	125 m
	R6	317-0152-01	1.5 k	C	5	125 m
	R7	317-0273-01	27 k	C	5	125 m
	R8	317-0222-01	2.2 k	C	5	125 m
	R9	317-0182-01	1.8 k	C	5	125 m
	R10	316-0225-01	2.2 M	C	10	250 m
(1091)	R11	317-0911-01	910	C	5	125 m
	R12	317-0332-01	3.3 k	C	5	125 m
	R13	317-0821-01	820	C	5	125 m
	R14	317-0222-01	2.2 k	C	5	125 m
	*R15	311-1208-00	2.2 k	CV	20	250 m
	R16	317-0821-01	820	C	5	125 m
	R17	311-0719-00	470	CP	20	250 m
	R18	317-0222-01	2.2 k	C	5	125 m
	R19	317-0821-01	820	C	5	125 m
(1091)	R20	317-0221-01	220	C	5	125 m
	R21	317-0332-01	3.3 k	C	5	125 m
	R22	317-0222-01	2.2 k	C	5	125 m
	R23	317-0182-01	1.8 k	C	5	125 m
	R24	317-0102-01	1 k	C	5	125 m
	R25	317-0272-01	2.7 k	C	5	125 m
	R26	317-0273-01	27 k	C	5	125 m
	R27	317-0153-01	15 k	C	5	125 m
	R28	317-0393-01	39 k	C	5	125 m
	R29	317-0221-01	220	C	5	125 m
	R31	317-0223-01	22 k	C	5	125 m
	R32	317-0392-01	3.9 k	C	5	125 m
	R33	317-0222-01	2.2 k	C	5	125 m
	R34	311-0717-00	220	CP	20	125 m
	R35	317-0471-01	470	C	5	125 m
	R36	317-0682-01	6.8 k	C	5	125 m
	R37	317-0103-01	10 k	C	5	125 m
	R38	317-0222-01	2.2 k	C	5	125 m
	R39	317-0224-01	220 k	C	5	125 m
	R41	317-0182-01	1.8 k	C	5	125 m
	R42	317-0182-01	1.8 k	C	5	125 m
	R60	317-0332-01	3.3 k	C	5	125 m
	R61	317-0124-01	120 k	C	5	125 m
	R62	317-0681-01	680	C	5	125 m
	R63	317-0124-01	120 k	C	5	125 m
	R64	317-0104-01	100 k	C	5	125 m

CIR REF	PART NUMBER	DESCRIPTION VALUE ohms	TYPE	TOL %	RATING W	
	R65	317-0104-01	100 k	C	5	125 m	
	R66	315-0514-01	510 k	C	5	250 m	(1064)
	R67	307-0147-00	8.2 k	MO	5	1.5	
	R68	315-0152-02	1.5 k	C	5	250 m	
	R69	317-0123-01	12 k	C	5	125 m	
	R70	317-0123-01	12 k	C	5	125 m	
	R71	307-0142-00	4.7 k	MO	5	1.5	
	*R72	311-1208-00	22 k	CV	20	250 m	
	R74	317-0472-01	4.7 k	C	5	125 m	
	R75	317-0103-01	10 k	C	5	125 m	
	R76						
	R77	317-0103-01	10 k	C	5	125 m	
	R78	307-0144-00	10 k	MO	5	1.5	
	R79	317-0473-01	47 k	C	5	125 m	
	R80						
	R81	317-0331-01	330	C	5	125 m	
	R82	317-0680-01	68	C	5	125 m	
	R83	317-0361-01	360	C	5	125 m	
	R84	317-0563-01	56 k	C	5	125 m	
	R85	317-0392-01	3.9 k	C	5	125 m	
	R86	317-0103-01	10 k	C	5	125 m	
	R87	317-0101-01	100	C	5	125 m	
	R88	317-0273-01	27 k	C	5	125 m	
	R89	316-0103-01	10 k	C	10	250 m	
	R91	317-0154-01	150 k	C	5	125 m	
	R92	317-0104-01	100 k	C	5	125 m	
	R93	311-0802-00	4.7 k	CP	20	250 m	
	R94	317-0272-01	2.7 k	C	5	125 m	
	R95	317-0392-01	3.9 k	C	5	125 m	
	R96	316-0106-01	10 M	C	10	250 m	
	R97	316-0225-01	2.2 M	C	10	250 m	
	R98	317-0183-01	18 k	C	5	125 m	
	R99	317-0333-01	33 k	C	5	125 m	
	R101	317-0223-01	22 k	C	5	125 m	
	R102	317-0105-01	1 M	C	5	125 m	
	R103	321-0289-48	10 k	MF	1	125 m	
	R104	317-0563-01	56 k	C	5	125 m	
	R105	317-0393-01	39 k	C	5	125 m	
	R106	311-0750-00	22 k	CP	20	250 m	
	R107	317-0223-01	22 k	C	5	125 m	
	R108	317-0183-01	18 k	C	5	125 m	
	R109	317-0472-01	4.7 k	C	5	125 m	
	R110	317-0392-01	3.9 k	C	5	125 m	
	R111	317-0332-01	3.3 k	C	5	125 m	
	R112	311-0750-00	22 k	CP	20	250 m	
	R113	317-0332-01	3.3 k	C	5	125 m	
	R114	317-0103-01	10 k	C	5	125 m	
	R115	317-0472-01	4.7 k	C	5	125 m	
	R116	317-0512-01	5.1 k	C	5	125 m	
	†R118	311-1209-00	5 k	CV	20	250 m	
	R119		1 k	CV	20	250 m	
	R120	317-0680-01	68	C	5	125 m	
	R121	317-0682-01	6.8 k	C	5	125 m	

* Concentric pot † Dual with S67

CIR REF	PART NUMBER	VALUE ohms	DESCRIPTION TYPE	TOL %	RATING W
R122	321-0289-48	10 k	MF	1	125 m
R123	316-0273-01	27 k	C	10	250 m
(950) R124	317-0681-01	680	C	5	125 m
R125					
R126	317-0273-01	27 k	C	5	125 m
R127	316-0683-01	68 k	C	10	250 m
R128	317-0101-01	100	C	5	125 m
R129	317-0124-01	120 k	C	5	125 m
R130	317-0561-01	560	C	5	125 m
R131	311-0712-00	100	CP	20	250 m
R132	311-0913-00	1.5 k	CP	20	250 m
R133	317-0101-01	100	C	5	125 m
R134	317-0471-01	470	C	5	125 m
R135					
(740) R136	321-0114-48	150	MF	1	125 m
R137					
(740) R138	321-0844-48	2.2 k	MF	1	125 m
R139	317-0331-01	330	C	5	125 m
R140	317-0331-01	330	C	5	125 m
R141					
R143	321-0210-48	1.5 k	MF	1	125 m
R144	317-0471-01	470	C	5	125 m
R145	321-0877-48	62 k	MF	1	125 m
R146	317-0272-01	2.7 k	C	5	125 m
R147	317-0272-01	2.7 k	C	5	125 m
R151	317-0272-01	2.7 k	C	5	125 m
(740) R152	317-0224-01	220 k	C	5	125 m
R202	317-0242-01	2.4 k	C	5	125 m
R203	317-0302-01	3 k	C	5	125 m
R204	317-0392-01	3.9 k	C	5	125 m
R205	317-0153-01	15 k	C	5	125 m
R206	321-0351-48	44.2 k	MF	1	125 m
R207	316-0394-01	390 k	C	10	250 m
R208	311-1211-00	100 k	CV	20	1
R209	324-0585-40	12.1 M	MF	1	1
R211	324-0556-40	6.04 M	MF	1	1
R212	324-0614-40	3.6 M	MF	1	1
R213	324-0489-40	1.21 M	MF	1	1
R214	321-0460-48	604 k	MF	1	125 m
R215	321-0935-48	360 k	MF	1	125 m
(1151) R216	321-0393-48	121 k	MF	1	125 m
R217	321-0364-48	60.4 k	MF	1	125 m
R218	321-0364-48	60.4 k	MF	1	125 m

CIR REF	PART NUMBER	VALUE ohms	DESCRIPTION TYPE	TOL %	RATING W
R301	311-0765-00	100 k	CP	20	250 m
R302	311-0854-00	100 k	CV	20	100 m
R303					
*R304	311-1210-00	1 M	CV	20	2
R305					
*R306	311-1210-00	1 M	CV	20	2
R307	316-0106-01	10 M	C	10	250 m
R308	316-0105-01	1 M	C	10	250 m
R309					
R310	316-0222-01	2.2 k	C	10	25 m (1026)
†R401	311-1213-00	100	CV	20	1
R402	303-0151-01	150	C	5	1
R403	317-0472-01	4.7 k	C	5	125 m
R404	315-0271-02	270	C	5	250 m
R405	315-0560-01	56	C	5	250 m
R406	315-0271-02	270	C	5	250 m
R407	317-0222-01	2.2 k	C	5	125 m
R408	307-0331-00	39	MO	5	1.5
R409	316-0270-01	27	C	10	250 m
R411	317-0183-01	18 k	C	5	125 m
R413	307-0351-00	120	MO	5	3.25
R414	315-0680-01	68	C	5	250 m
R415	316-0220-01	22	C	10	250 m
R416	311-0735-00	10 k	CP	20	250 m
R440					
R449					

* Dual with R306 † with R761 and S402

CIR REF	PART NUMBER	VALUE ohms	DESCRIPTION TYPE	TOL %	RATING W	
	R601	317-0105-01	1M	C	5	125 m	
	R602 A	310-0679-00	111 k	CM	1	250 m	
	R602 B		900 k				
	R603	317-0154-01	150 k	C	5	125 m	
	R604	317-0271-01	270	C	5	125 m	
	R605	317-0221-01	220	C	5	125 m	
	R606	317-0751-01	750	C	5	125 m	
	R607	317-0472-01	4.7 k	C	5	125 m	
	R608	317-0681-01	680	C	5	125 m	
(1079)	R609	317-0331-01	330	C	5	125 m	
	R610	317-0221-01	220	C	5	125 m	
	R611	317-0561-01	560	C	5	125 m	
	R612	317-0103-01	10 k	C	5	125 m	
	R613	317-0911-01	910	C	5	125 m	
	R614	311-0717-00	220	CP	20	250 m	
	R615	317-0472-01	4.7 k	C	5	125 m	
	R616	317-0681-01	680	C	5	125 m	
	R617	311-0719-00	470	CP	20	250 m	
	R618	311-0712-00	100	CP	20	250 m	
	R619	317-0561-01	560	C	5	125 m	
	R620	317-0331-01	330	C	5	125 m	
	R621	317-0103-01	10 k	C	5	125 m	
	R622	311-0717-00	220	CP	20	250 m	
	R623	317-0911-00	910	C	5	125 m	
(740)	*R624	311-1212-00	500	CV	−0 +40	125 m	
	R625	311-0712-00	100	CP	20	250 m	
	R626	317-0271-01	270	C	5	125 m	
	R627	317-0221-01	220	C	5	125 m	
	R628	317-0271-01	270	C	5	125 m	
	R629	317-0751-01	750	C	5	125 m	
	R630	317-0681-01	680	C	5	125 m	
	R631	317-0820-01	82	C	5	125 m	
	R632	317-0391-01	390	C	5	125 m	
	R633	315-0821-01	820	C	5	250 m	
	R634	317-0473-01	47 k	C	5	125 m	
	R635	317-0684-01	680 k	C	5	125 m	
(1203)	R636						
	R637	303-0183-01	18 k	C	5	1	
	R638	303-0183-01	18 k	C	5	1	
	R639	317-0104-01	100 k	C	5	125 m	
	R640	317-0392-01	3.9 k	C	5	125 m	
	R641	317-0561-01	560	C	5	125 m	
	R642	311-0717-00	220	CP	20	250 m	
	R643	321-0097-48	100	MF	1	125 m	
	R644	317-0471-01	470	C	5	125 m	
	R645	317-0242-01	2.4 k	C	5	125 m	
	R646	317-0102-01	1 k	C	5	125 m	
	R647	317-0223-01	22 k	C	5	125 m	
	R648	317-0102-03	10 k	C	5	125 m	
	R649	317-0104-01	100 k	C	5	125 m	
	R650	317-0471-01	470	C	5	125 m	
	R651	317-0122-01	1.2 k	C	5	125 m	
	R652	311-1028-00	100 k	CV	20	250 m	
	R653	317-0152-01	1.5 k	C	5	125 m	
	R654	317-0223-01	22 k	C	5	125 m	
	R655	317-0103-01	10 k	C	5	125 m	
	R656	311-0735-00	10 k	CP	20	250 m	
	R657	317-0221-01	220	C	5	125 m	
	R658	317-0471-01	470	C	5	125 m	
	R659	321-0097-48	100	MF	1	125 m	
	R660	317-0221-01	220	C	5	125 m	
	R661	317-0471-01	470	C	5	125 m	
	R662	317-0102-01	1 k	C	5	125 m	
	R663	317-0223-01	22 k	C	5	125 m	
	R664	317-0103-01	10 k	C	5	125 m	
	R665	317-0180-01	18	C	5	125 m	
	R666	317-0821-01	820	C	5	125 m	
	R667	317-0221-01	220	C	5	125 m	
	R668	317-0393-01	39 k	C	5	125 m	
	R669	311-0717-00	220	CP	20	250 m	
	R670	317-0122-01	1.2 k	C	5	125 m	
	R671	317-0393-01	39 k	C	5	125 m	
	R672	311-1306-01	100 k	CV	20	250 m	
	R673	315-0470-01	47	C	5	250 m	(927)
	R674						(1203)
	R675	317-0105-01	1 M	C	5	125 m	
	R676						(1203)
	R677	317-0221-01	220	C	5	125 m	
	R678	317-0271-01	270	C	5	125 m	
	R679	317-0820-01	82	C	5	125 m	
	R680	317-0101-01	100	C	5	125 m	
	R681	311-0717-00	220	CP	20	250 m	
	R682	317-0472-01	4.7 k	C	5	125 m	
	R683	317-0681-01	680	C	5	125 m	
	R684	317-0561-01	560	C	5	125 m	
	R685	317-0103-01	10 k	C	5	125 m	
	R686	317-0911-01	910	C	5	125 m	
	R687	317-0751-01	750	C	5	125 m	
	R688	317-0472-01	4.7 k	C	5	125 m	
	R689	317-0681-01	680	C	5	125 m	
	R690	317-0331-01	330	C	5	125 m	
	R691	311-0719-00	470	CP	20	250 m	
	R692	317-0331-01	330	C	5	125 m	(1079)
	R693	311-0712-00	100	CP	20	250 m	
	R694	317-0561-01	560	C	5	125 m	
	R695	317-0103-01	10 k	C	5	125 m	
	R696	317-0123-01	12 k	C	5	125 m	
	R697	311-0717-00	220	CP	20	250 m	
	R698	317-0911-01	910	C	5	125 m	
	*R699	311-1212-00	500	CV	−0 +40	125 m	(740)
	R700	317-0101-01	100	C	5	125 m	
	R701	311-0712-00	100	CP	20	250 m	
	R702	317-0751-00	750	C	5	125 m	
	R703	317-0271-01	270	C	5	125 m	
	R704	317-0221-01	220	C	5	125 m	
	R705	317-0271-01	270	C	5	125 m	
	R706	317-0154-01	150 k	C	5	125 m	
	R707 A	310-0679-00	111 k	CM	1	250 m	
	R707 B		900 k				
	R708	317-0105-00	1 M	C	5	125 m	
	R709	317-0180-01	18	C	5	125 m	

* Log inverse pot

CIR REF	PART NUMBER	DESCRIPTION VALUE ohms	TYPE	TOL %	RATING W
R751	317-0471-01	470	C	5	125 m
R752	321-0100-48	107	MF	1	125 m
R753	321-0100-48	107	MF	1	125 m
R754					
R755					
R756					
R757	317-0680-01	68	C	5	125 m
R758	317-0331-01	330	C	5	125 m
R759	317-0471-01	470	C	5	125 m
*R761	311-1213-00	250	CV	20	1
R762					
R763	321-1296-48	12 k	MF	1	125 m
R764	321-0874-48	39 k	MF	1	125 m
R765	307-0257-00	940	MO	5	1.5
R766	317-0470-01	47	C	5	125 m
R767	317-0470-01	47	C	5	125 m
R768	307-0257-00	940	MO	5	1.5
R769	317-0103-01	10 k	C	5	125 m
R771	317-0683-01	68 k	C	5	125 m
R772	317-0683-01	68 k	C	5	125 m
R773					
R774					
R775	317-0271-01	270	C	5	125 m
R776	317-0152-01	1.5 k	C	5	125 m
R777	317-0471-01	470	C	5	125 m
R778	317-0332-01	3.3 k	C	5	125 m

* with R401 and S402

CIR REF	PART NUMBER	DESCRIPTION VALUE ohms	TYPE	TOL %	RATING W	
R779	303-0103-01	10 k	C	5	1	
R781	303-0273-01	27 k	C	5	1	
R782	317-0271-01	270	C	5	125 m	
R783	317-0152-01	1.5 k	C	5	125 m	
R784	317-0471-01	470	C	5	125 m	
R785	317-0332-01	3.3 k	C	5	125 m	
R786	317-0222-01	2.2 k	C	5	125 m	(810)
R787	311-1091-00	6.8 k	CP	20	250 m	(810)
R790						
R791						
**R901	322-0605-43	10.1 k	MF	0.25	250 m	
**R902	322-0624-43	990 k	MF	0.25	250 m	
**R903	322-0608-43	111 k	MF	0.25	250 m	
**R904	322-0621-43	900 k	MF	0.25	250 m	
**R905A	310-0680-00	250 k	CM	1	250 m	
** B		800 k				
** C		1 M				
** D		500 k				
**R909	316-0470-01	47	C	10	250 m	

CIR REF	PART NUMBER	DESCRIPTION
S1		
S2	260-1296-00	Push (7 – button)
S3		
S4		
S61	311-1211-00	Rotary (with R208)
S62	260-1295-00	Push (3 – button)
S66	260-1106-02	Push (1 – button)
S67	311-1209-00	Pull (with R118 and R119)
S201	260-1297-00	Rotary (23 – position)
S402	311-1213-00	Rotary with R401 & R761

CIR REF	PART NUMBER	DESCRIPTION	
S601	260-1299-00	Push (1 – button)	
S602	260-1299-00	Push (1 – button)	
S603	260-1204-00	Push (2 – button)	
S604	260-1298-00	Push (1 – button)	
S605	260-1298-00	Push (1 – button)	
S606	260-1298-00	Push (1 – button)	
S751	260-1089-00	Push (2 – button)	
**S901	260-1136-01	Slide (3 – position) if Front Panel Slot 15mm by 7mm	
	or		
	260-1307-00	Slide (3 – position) for Front Panel Slot 14mm by 14.8mm	
**S902	260-1051-01	Rotary (12 – position)	
T401	120-0731-01	Power transformer	(740)

** Two per instrument

CIR REF	PART NUMBER	DESCRIPTION	MATERIAL	TYPE	
TR1	151-0317-00	BC 109C	Si	NPN	
TR2	151-0242-00	2N3904	Si	NPN	
TR3	151-0242-00	2N3904	Si	NPN	
TR4	151-0242-00	2N3904	Si	NPN	
TR5	151-0242-00	2N3904	Si	NPN	
TR62	151-0317-00	BC 109C	Si	NPN	
TR64	151-0257-00	2N1990U	Si	NPN	
TR65	151-0257-00	2N1990U	Si	NPN	
TR66	151-0317-00	BC 109C	Si	NPN	
TR67	151-0257-00	2N1990U	Si	NPN	
TR68	151-0317-00	BC 109C	Si	NPN	
TR69	151-0317-00	BC 109C	Si	NPN	
TR71	151-1052-00	FET BFW1052	Si	N-Channel	
TR72	151-0317-00	BC 109C	Si	NPN	
TR73	151-0317-00	BC 109C	Si	NPN	
TR74	151-0317-00	BC 109C	Si	NPN	
TR75	151-0127-03	BSX20	Si	NPN	(759)
TR76	151-0317-00	BC 109C	Si	NPN	
TR77	151-0257-00	2N1990U	Si	NPN	
TR78	151-0317-00	BC 109C	Si	NPN	
TR79	151-0317-00	BC 109C	Si	NPN	
TR81	151-0257-00	2N1990U	Si	NPN	
TR82	151-0317-00	BC 109C	Si	NPN	
TR601					
TR602	151-1036-00	FET, TEK.	Si	N-Channel	
TR603	151-0127-02	BSX20	Si	NPN	
TR604	151-0127-02	BSX20	Si	NPN	
TR605	151-0127-02	BSX20	Si	NPN	
TR606	151-0127-02	BSX20	Si	NPN	
TR607	151-0127-02	BSX20	Si	NPN	
TR608	151-0127-02	BSX20	Si	NPN	
TR609	151-0127-02	BSX20	Si	NPN	
TR611	151-0127-02	BSX20	Si	NPN	

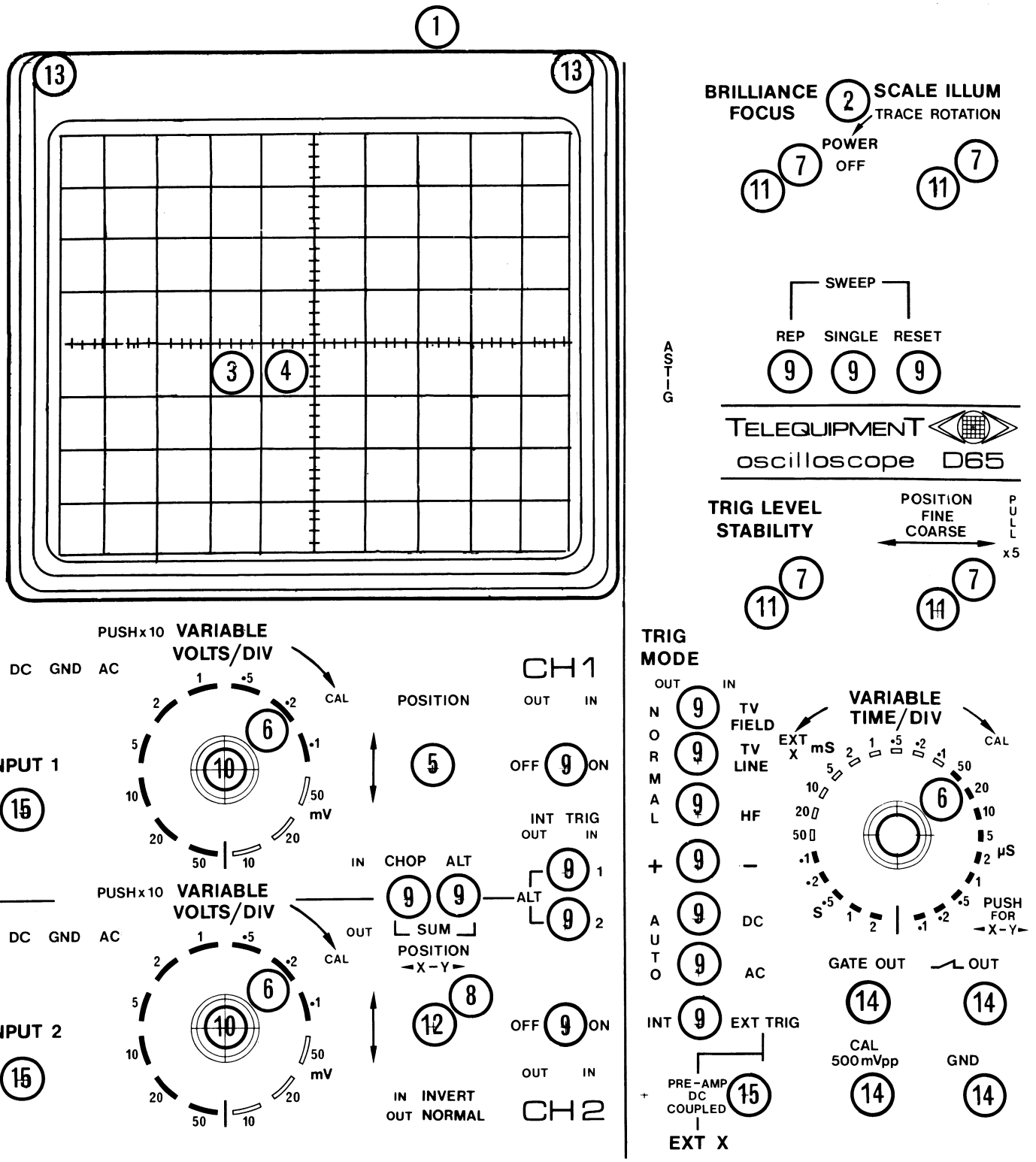
CIR REF	PART NUMBER	DESCRIPTION	MATERIAL	TYPE
(759) TR612	151-0127-03	BSX20	Si	NPN
(759) TR613	151-0127-03	BSX20	Si	NPN
TR614	151-0242-00	2N3904	Si	NPN
TR615	151-0242-00	2N3904	Si	NPN
TR616	151-0127-02	BSX20	Si	NPN
TR617	151-1036-00	FET, TEK.		N-Channel
TR618				
TR619	151-0127-02	BSX20	Si	NPN
TR621	151-0127-02	BSX20	Si	NPN
TR622	151-0127-02	BSX20	Si	NPN
TR623	151-0127-02	BSX20	Si	NPN
TR624	151-0127-02	BSX20	Si	NPN
TR625	151-0127-02	BSX20	Si	NPN
TR626	151-0127-02	BSX20	Si	NPN
TR627	151-0127-02	BSX20	Si	NPN
TR628	151-0127-02	BSX20	Si	NPN
TR629	151-0127-02	BSX20	Si	NPN
TR751	151-0127-02	BSX20	Si	NPN
TR752	151-0310-00	E1530	Si	NPN
TR753	151-0310-00	E1530	Si	NPN
TR754	151-0320-01	MPS6518 Motorola	Si	PNP
(759) TR755	151-0320-01	MPS6518 Motorola	Si	PNP
TR756	151-0320-01	MPS6518 Motorola	Si	PNP
TR757	151-0320-01	MPS6518 Motorola	Si	PNP
V61	150-0069-00	Neon Capless 3L		
V301				

CIR REF	PART NUMBER	VALUE	DESCRIPTION TYPE	TOL %	RATING	
C307	285-0869-00	47 p	PS	2 p	350 V	(740)
C402	285-0837-00	20 n	PE		5 kV	(856)
* C403	285-1035-00	2.2 n	PS		2 kV	
C410	285-0837-00	20 n	PE		5 kV	(856)
D84	152-0468-00		BAX16 Si		150 V	
R76	317-0821-01	820	C	5	125 mW	
R80	317-0221-01	220	C	5	125 mV	
R125	308-0733-00	4.3 k	WW	5	6 W	(732)
R135	308-0733-00	4.3 k	WW	5	6 W	(732)
R137	323-0797-48	68 k	MF	1	500 mW	(740)
R141	303-0223-01	22 k	C	5	1 W	(1202)
R303	316-0275-01	2.7 M	C	10	250 mW	
R305	316-0684-01	680 k	C	10	250 mW	
R636	315-0155-02	1.5 M	C	5	250 mW	(1203)
R674	315-0473-02	47 k	C	5	250 mW	(1203)
R676	315-0105-02	1 M	C	5	250 mW	(1203)
R754	317-0122-01	1.2 k	C	5	125 mW	
R755	307-0264-00	2.2 k	MO	5	1.5 W	
R756	317-0122-01	1.2 k	C	5	125 mW	
R762	307-0253-00	220	MO	5	1.5 W	
R773	317-0223-01	22 k	C	5	125 mW	
R774	317-0223-01	22 k	C	5	125 mW	
R790	307-0327-00	560	MO	5	1.5 W	
R791	307-0327-00	560	MO	5	1.5 W	
V301	154-0657-00		Type D14-180			

* On earlier instrument

COMPONENTS FOR D66 ONLY

CIR REF	PART NUMBER	VALUE	DESCRIPTION TYPE	TOL %	RATING
(856) C402	285-0992-00	25 n	PE	10	5 kV
(856) C403	285-0992-00	25 n	PE	10	5 kV
(856) C410	285-0992-00	25 n	PE	10	5 kV
(856) C411	285-0992-00	25 n	PE	10	5 kV
D401	152-0515-00	6 kV	Rectifier Si		8 mA
D402	152-0515-00	6 kV	Rectifier Si		8 mA
R76	317-0102-01	1 k	C	5	125 mW
R80	317-0681-01	680	C	5	125 mW
(732) R125	308-0732-00	3.3 k	WW	5	6 W
(732) R135	308-0732-00	3.3 k	WW	5	6 W
(740) R137	322-0699-48	51 k	MF	1	250 mW
(1202) R141	303-0203-01	20 k	C	5	1 W
R303	316-0395-01	3.9 M	C	10	250 mW
R305	316-0104-01	100 k	C	10	250 mW
R309	316-0104-01	100 k	C	10	250 mW
R440	316-0474-01	470 k	C	10	250 mW
R449	316-0474-01	470 k	C	10	250 mW
(1203) R636	317-0105-01	1 M	C	5	125 mW
(1203) R674	317-0433-01	43 k	C	5	125 mW
(1203) R676	317-0564-01	560 k	C	5	125 mW
R754	316-0122-01	1.2 k	C	10	250 mW
R755	307-0326-00	1.2 k	MO	5	1.5 W
R756	316-0122-01	1.2 k	C	10	250 mW
R762	307-0284-00	540	MO	5	3.5 W
R773	317-0333-01	33 k	C	5	125 mW
R774	317-0333-01	33 k	C	5	125 mW
V301	154-0653-00		Type D14-200		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CAL
500mVpp
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GND
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MECHANICAL

	PART NO.	DESCRIPTION	LOCATION *
	*Numbers quoted refer to the front panel (opposite).		
	200-1187-00	Bezel, Lighthood	1
	378-0597-00	Bulb, neon	2
	344-0202-00	Clip Spire (SCG 1697)	rear panel, 15
	131-1020-00	Connector female, PCB, Quick Release Amp	
(744)	390-0250-00	Cover, Rear	
	390-0448-00	Cover RHS	
	390-0448-01	Cover LHS	
	343-0212-00	Ends, Handle	
	348-0169-00	Feet, raising front	
	348-0168-00	Feet, fixed rear	
	378-0605-02	Filter	3
(760)	331-0232-02	Graticule	4
	348-0160-00	Grommet	CRT
	367-0101-02	Handle	
	366-1239-00	Knob, Grey	5
	366-1352-00	Knob, Grey	6
	366-1353-00	Knob, Grey	7
	366-1365-00	Knob, Grey	8
	366-1414-01	Knob, Push Button, Grey/Red	9
	366-1240-00	Knob, Red	10
(1198)	366-1481-00	Knob, Red	Time/Div Variable
	366-1355-00	Knob, Red	11
	366-1364-00	Knob, Red	12
(730)	161-0084-00	Lead c/w Socket (U.K.)	Power
	161-0084-01	Lead c/w Socket (U.S.A.)	Power
	220-0607-00	Nut (Special)	13
	131-1021-00	Pin PCB. Quick Release Amp.	
	134-0100-00	Plug RA2134 (Aerial Pressings)	Trace ROT
	134-0102-00	Plug 7 pin	Voltage Selector
	213-0248-00	Screw, set 3 mm Lg.	5, 8, 10, 11, 12
	213-0249-00	Screw, set 5 mm 1g.	6, 7
	136-0381-02	Socket Assy.	rear panel
	131-0645-00	Socket, Side Pin, plastic Moulding	CRT
	131-0659-00	Socket Side Pin, rubber cover	CRT
	136-0457-01	Socket Assembly Grey	14
	131-0651-00	Socket BNC	15
	136-0295-00	Socket, R557	PC115
(852)	361-0537-01	Spacer	
	361-0283-00	Spacer Mounting	PC115
	361-0266-00	Spacer 6BA (.7/8)	PC110, PC111
	361-0243-00	Spacer 6BA (3/4)	
	385-0213-00	Spacer, Hex 6BA (82 mm)	PC116
	385-0214-00	6BA Threaded Hex. Spacer	PC112
	361-0429-00	Spacer 6BA	rear panel
	214-1092-00	Tag, Stocko 6326A	
	210-1075-00	Washer, foot packing	

ASSEMBLIES

ASSEMBLY	PART NUMBER	INCLUDES CIR REF.	
Attenuator	262-0942-00	C901 to C909, C911 to C914, R624, R699, R901 to R905 S902.	
Single-Shot	262-0935-00	R98, R99, R101, R102, S62 a & b, V61.	
'Y' Amp Cableform	644-0027-01	*C614, *C623, C755, C756, R633, R652, R672, R673, R771 to R779, R781 to R785, TR754 to TR757, S601, S602, S751. * Mounted on S603.	
Timebase Switch	262-0934-00 or 262-0934-01	D74 to D79, D81, D82, C201 to C208, R126, R127, R129, R202 to R209, R211 to R218, R673, R786, R787, S66, S201.	
PC110	670-1615-00	C2 to C4, C6 to C8, C11 to C16, C60 to C71, C74, C75, C304, C305, D1, D64, D66 to D69, D71 to D73, D83, D85, D301, L61, R1 to R9, R10 to R19, R21 to R29, R31 to R39, R60, R62, R65, R67 to R72, R74 to R80, R82 to R89, R91 to R97, R103 to R116, R120 to R125, R128, R130 to R141, R143 to R145, R147, R152, R302, R303, R304, R305, R306, R317, R325. S1, TR1 to TR5, TR62, TR64 to TR69, TR71 to TR79, TR81, TR82.	(823) (740)
PC117	262-0944-00	S604, S605 and S606.	

CHAPTER 6
CIRCUIT DIAGRAMS

To minimize the risk of misinterpretation of component values on circuit diagrams, the decimal point has been replaced by the multiplier or sub-multiplier of the basic unit. For instance, 2.2 megohms is shown as 2M2 and 1.8 picofarads is shown as 1p8.

To aid the reader further, in addition to the block Circuit Reference Table in Chapter 5.1, to locate a component in the circuit diagrams, a table is provided at the top of each circuit diagram, in which the circuit reference will appear, where practicable, directly above the component being sought.

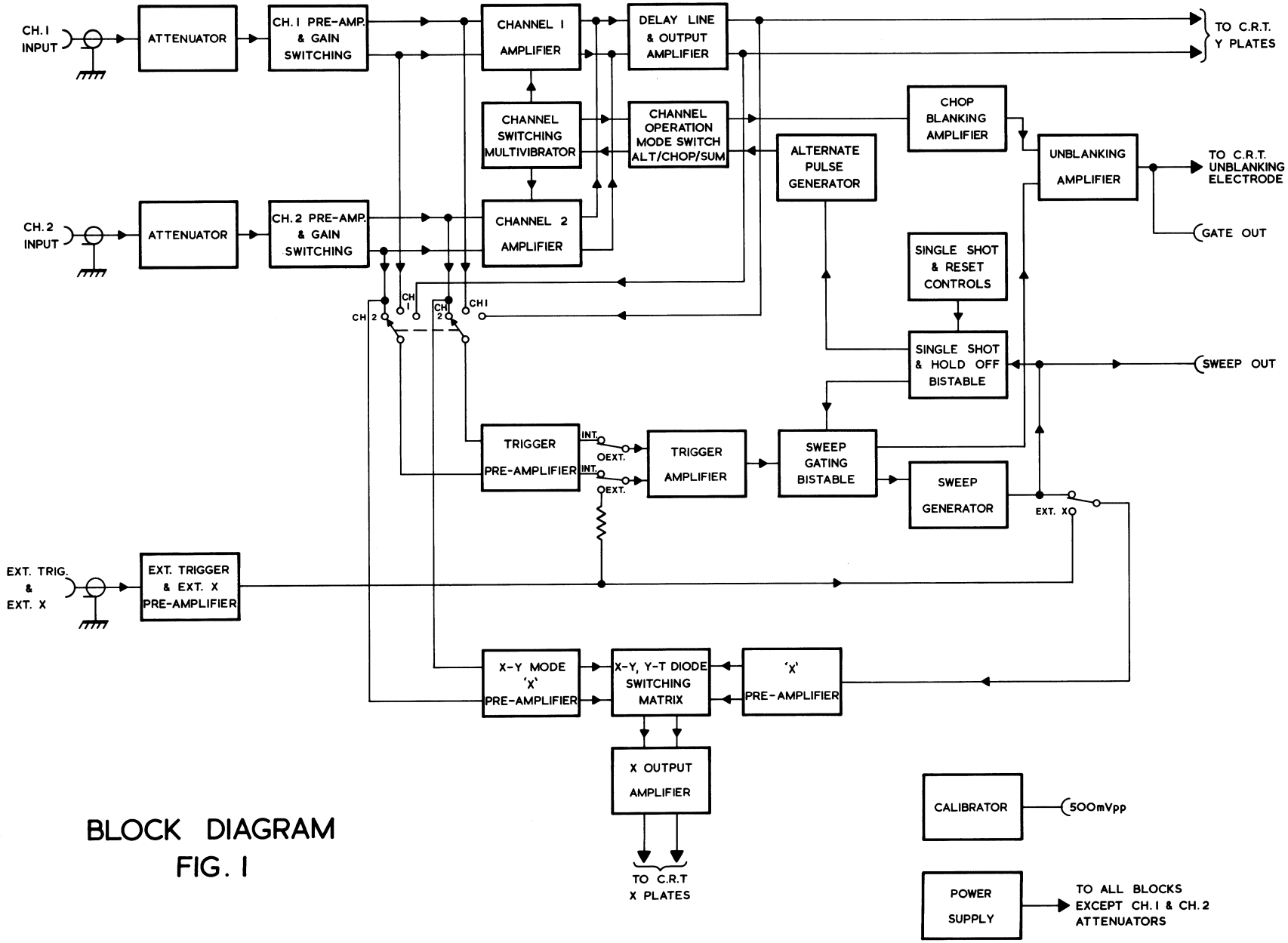
PRINTED CIRCUIT

Blue shows the rear track as seen through the board. Red, the component side track, and those components referred to in Chapter 4.

D65

The following circuits for *D65* differ from the D66 and the diagrams will be found at the end of the Chapter.

Circuit	*Figure*
CRT	13
Power Supply	15
Vertical Amp: Output	14



BLOCK DIAGRAM
FIG. 1