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OS300 20MHz DUAL TRACE OSCILLOSCOPE INSTRUCTION MANUAL

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Introduction

Section 1

The OS300 is a versatile general purpose dual trace oscilloscope intended for general laboratory, industrial, servicing and educational applications. The full 8 x 10cm rectangular tube provides a bright display against the calibration graticule.

It features two identical input channels with a maximum sensitivity of 2mV/cm and a bandwidth from D.C. to 20MHz. These channels may be displayed separately or together in dual trace mode. Alternatively they can be added or subtracted for sum or difference display. The timebase ranges from 0.2s/cm to $0.5\mu s/cm$ and a x 10 expansion facility extends this to 50ns/cm. Independent variable sensitivity and sweep rate controls are provided.

Particular attention has been paid to trigger performance, with D.C. and A.C. coupling available and a bright-line free-run facility to enable trace location in the absence of trigger. An active T.V. synch separator is provided for those working with video waveforms.

The OS300 includes many facilities such as a 1kHz calibrator, a D.C. coupled Z modulation input and a trace rotation control, usually found only on the more expensive instruments.

This compact instrument is readily portable. The internal construction is based largely on a single printed circuit board assembly to provide easy access for maintenance and minimum cost of ownership.

Specification

Section 2

DISPLAY

 8×10 cm rectangular mono-accelerator c.r.t. at 2kV e.h.t. Trace Rotation by front panel preset.

VERTICAL DEFLECTION Two identical input channels CH1 and CH2. Bandwidth (-3dB)

d.c. to 20MHz (2Hz to 20MHz on a.c.) Sensitivity 2mV/cm to 10V/cm in 1-2-5 sequence. Accuracy $\pm 3\%$

Variable Sensitivity > 2,5:1 range allows continuous adjustment of sensitivity from 2mV/cm to 25V/cm. Input Impedance $1M\Omega/28pF$ approx.

Input Coupling DC-GND-AC

Input Protection 400V d.c. or pk a.c.

DISPLAY MODES

Single Trace CH1 or CH2

- **Dual Trace** Chopped or Alternate modes automatically selected by the T.B. switch. Between 0.5μ s/cm and 0.2ms/cm the ALTERNATE MODE is selected. While on ranges slower than 0.2ms/cm CHOP MODE is selected. The CHOP frequency is 500kHz.
- Add CH1 and CH2 added to give the algebraic sum of the two channels.
- Invert CH2 CH2 may be inverted. When used in conjunction with Add mode it gives the algebraic difference of the two channels.
- X-Y CH2 input gives Y deflection and CH1 input gives X deflection.
- Bandwidth (-3dB) DC to 1MHz with less than 3° phase shift at 50kHz.

HORIZONTAL DEFLECTION

Timebase 0.5μ s/cm to 0.2sec/cm, 18 ranges in 1-2-5 sequence

Accuracy ±3%, (to 200ns/cm)

X Expansion x 10 push button gives fastest speed of 50ns/cm. Accuracy ±3% (50ns/cm range ±5%)

Variable Sweep > 2.5:1 allows continuous coverage from 0.5µs/cm to 0.5sec/cm.

TRIGGER

Variable level control with Bright Line ON/OFF facility. With Bright Line on, the timebase free-runs when insufficient signal (20Hz -20MHz) is present or when the selected level is outside the range of the input signal. **Source** Internal CH1 or CH2 or External.

Slope + or -.

Coupling DC, AC or TV (active sync. separator with line/frame selected by T.B. switch between 50 and 100µs/cm).

Sensitivity

Internal: DC coupled 2mm to 2MHz, 5mm to 20MHz. AC coupled 2mm, 10Hz–2MHz. 5mm, 4Hz–20MHz. External: DC coupled 100mV to 2MHz, 400mV to 20MHz. AC coupled 100mV, 10Hz to 2MHz, 400mV, 4Hz to 20MHz. External Input Impedance $100k\Omega/10pF$ approx. External Input Protection 250V d.c. or pk, a.c.

ADDITIONAL FACILITIES

Calibrator 1V, 2% squarewave at approx. 1kHz.
Ramp Output Approx. +3.5V ramp from 5kΩ.
Z Mod. Input DC coupled, 2V visible mod. sensitivity, +40V cut-off sensitivity, input impedance 10kΩ/10pF approx. Maximum input 100V d.c. or pk, a.c.

SUPPLY

100V, 120V, 220V and 240V ± 10% 45 to 440Hz approx. 40VA.

SAFETY

Designed for I.E.C.348 Cat. 1.

OPERATING TEMPERATURE RANGE 0 to +50°C (+15 to +35°C for full accuracy)

DIMENSIONS

140 x 305 x 460mm

WEIGHT 6kg approx.

ACCESSORIES SUPPLIED

Manual P.N. 80-OS300 Mains lead P.N. 402001

OPTIONAL ACCESSORIES Probe Kit PB12

A passive probe kit with switched X1 and X10 attenuations. X10 attenuation input impedance is $10M\Omega/11.5 pF$.

Probe Kit PB13

A X10 passive probe with 1.5m of cable. Input impedance $10M\Omega/11.5pF$.

Viewing Hood P.N. 41179.

Trolley

Type TR7. General Purpose.

Protective Carrying Case

P.N. 42610 A strong case which completely encloses the oscilloscope with 3 thicknesses of padding covering the front panel.

Tube Option

Long persistance c.r.t. P7 phosphor.

Rack Mount Kit

P.N. 450070.

Front Cover P.N. 450240.

Operation

Section 3

INTERNATIONAL SAFETY WARNING

(as required for I.E.C. 348 Class I)

This instruction manual contains information and warnings which must be observed by the user to ensure safe operation and retain the apparatus in a safe condition. The instrument has been designed for indoor use within the specified limits of temperature. It should not be switched on if there are obvious signs of mechanical damage and it should not be used under wet conditions.

GROUNDING

The instrument must be operated with a protective ground connected via the appropriate (yellow/green) conductor of the supply cable. This is connected to the instrument before the line and neutral supply connections when the supply socket is inserted into the plug on the back of the instrument. If the final connection between the instrument and the supply is made elsewhere, the user must ensure that the ground connection is made before line and neutral.

If any supply cable other than that supplied with the instrument is used, it must carry an adequate protective ground conductor.

Any interruption of the protective earth conductor inside or outside the instrument is likely to make the instrument dangerous. Intentional interruption is prohibited.

Signal connections into the instrument should be connected after and disconnected before the protective ground connection is made, i.e. the supply lead must be connected at all times that signal leads are connected.

LIVE PARTS

The instrument is safe to operate with the covers fitted and these must not be removed under normal usage. The covers protect the user from live parts and they should be removed only by suitably qualified personnel for maintenance or repair purposes. (see maintenance section).

VENTILATION

The OS300 relies on convection cooling and must not be operated in a position which restricts the external circulation of air.

3.1 CONNECTION TO THE SUPPLY

1. Before connecting the OS300 to the supply, check that the supply range switches are set to suit the supply voltage to be used and that the correct fuse is fitted. Note that the fuse has to be changed when switching between the 100V and 220V ranges. The switches and fuse holder are mounted on the back panel of the instrument. Do not operate the range selection switches while the OS300 is switched on.

3.2 OBTAINING A TRACE

- 1. After connection to the supply, switch on by turning the INTENSITY control clockwise away from the OFF position. Check that the POWER indicator L.E.D. lights.
- 2. Set the:

MODE switch to CH1 CH1 Y shift control (vert. arrows) to approx. mid setting. CH1 VAR SENS control fully clockwise to the CAL position. CH1 input coupling switch to GND. BRIGHT LINE button out (ON). X MAG. button out (X1) X shift control (horiz. arrows) to approx. mid setting. TIME/CM switch to 5µs. A horizontal trace should appear on the screen as the INTENSITY control is advanced.

- 3. Adjust the INTENSITY control to obtain a display of the required brightness.
- 4. Adjust the FOCUS control to obtain a sharply defined trace.
- 5. Adjust the CH1 Y shift control and the X shift control to centralize the trace on the screen.
- 6. Adjust the TRACE ROTATE preset control if necessary to align the trace with the center graticule line. It may be necessary to re-adjust this control only when the instrument is re-positioned as the beam deflection can be affected by earths magnetic field or other sources of magnetic radiation.
- NOTE: The OS300 should not be operated close to sources of alternating magnetic field such as large transformers as these may interfere with the trace.

3.3 SETTING UP THE Y CHANNELS

- 1. Using a coaxial input signal lead, connect a signal to the CH1 or CH2 input socket,
- 2. For
 - (a)Direct connection of the input signal, set the associated AC-Ground-DC slide switch to DC.
 - (b) Capacitive coupling of the input signal through an internal $0.1\mu F$ 400V capacitor, set the slide switch to AC.
- NOTE: When examining low amplitude a.c. signals superimposed on a high d.c. level, the slide switch should be set to AC and the sensitivity of the Y amplifier increased as in (4).
- 3. To locate the base line, set the slide switch to the GND setting. At this setting, the input signal is open circuit and the input to the amplifier is connected to ground.
- 4. To select sensitivity, set the VOLTS/CM switch to the required range. For calibrated operation, the VARiable SENSitivity control should be set fully clockwise to

Operation

the CAL position. This control can be used however to reduce the gain of the relevant amplifier and obtain any intermediate sensitivity between the calibrated switched ranges. To set to any particular calibrated sensitivity, the actual variation from the calibrated range can be set by viewing the CAL 1 Volt o/p on the 0.1V/cm or 0.2V/cm ranges. If the VAR SENS control is not moved, the sensitivity will differ from the calibrated value by approximately the same proportion on all settings of the VOLTS/CM switch.

To minimize pick-up at sensitive settings, it is essential to ensure that the ground lead connection is near to the signal point.

- 5. For vertical movement of the trace, adjust the Y shift controls (identified by the vertical arrows).
- 6. Any trace movement under no-signal conditions, when the setting of the VOLTS/DIV switch is altered, can be overcome by adjustment of the relevant preset front panel balance control.

This control will only need adjustment at infrequent intervals. Before adjusting the BAL control however, ensure that the input coupling switch is set to GND.

No adjustment should be made until a minimum of 15 min. warm-up time has lapsed after switch-on, or immediately after any large change of ambient temperature.

3.4 DISPLAY MODES

The MODE switch determines the form of the display.

- 1. For single trace display of one Y input against the timebase this switch should be set to CH1 or CH2 and the input signal applied to the appropriate input connector.
- 2. For dual trace simultaneous display of both Y inputs against the timebase, this switch should be set to DUAL. Two modes of beam switching are used and selected automatically by the sweep rate selected by the TIME/CM switch. The alternate mode is used at fast sweep rates between 0.2ms/cm and $0.5\mu s/cm$. At the slower rates from 0.2s/cm to 0.5ms/cm the chop mode operates at approx. 500kHz.
- 3. In the ADD mode, the single trace generated against the timebase is the algebraic sum of the CH1 and CH2 deflections.

If the INV CH2 button is operated the direction of Y deflection for that channel is reversed. If used in the ADD mode, this facility allows the difference between the CH1 and CH2 inputs to be displayed. The INV CH2 button has no effect on the polarity of internal CH2 trigger.

When examining small differences between large signals, the effect of small errors between the sensitivities of the two channels can be overcome by first connecting one input to both channels simultaneously and adjusting one or other of the VARiable SENSitivity controls to obtain a straight line.

4. In the X-Y mode, the timebase is disabled and the CH2 input is displayed as the vertical Y deflection against the CH1 input displayed as horizontal, X deflection. The CH1 shift control is inoperative and X position is determined only by the X shift control. The X10 MAG facility is also inoperative. X deflection sensitivity being determined by the CH1 controls only. The X bandwidth is limited to 1MHz and relative phase shift between X and Y deflections may exceed 3° above 50kHz.

3.5 TIMEBASE AND X EXPANSION

The sweep speed of the internal timebase is determined by the setting of the TIME/CM switch. The VARiable SWEEP speed control should be set fully clockwise in the CAL position for calibrated operation of the timebase. This control is used to slow the sweep rate to obtain any intermediate sweep rate, between the calibrated ranges.

For horizontal shift of the trace, adjust the X shift control (horizontal arrows). If close examination of any portion of the trace is required, X10 expansion can be introduced by operation of the MAG button. This provides an effective trace length of 100cm and any portion of this may be selected for viewing on the screen by operation of the X shift control.

3.6 TRIGGER

The timebase may be triggered internally from the CH1 or CH2 signals by operation of the corresponding TRIGGER button, irrespective of whether the selected channel is being displayed. Alternatively, the timebase may be triggered from an external signal applied to the EXT TRIG sockets when both CH1 and CH2 buttons are operated simultaneously.

Trigger will occur at a level on the signal which may be set by the TRIG LEVEL control with the slope determined by the \pm button. When this button is out, it will occur on a positive-going transition of the signal through the trigger level. When it is pushed in, trigger will occur on the negative-going transition. Normally triggering can be obtained from internal deflection signals greater than 2mm pk/pk up to about 2MHz but the sensitivity reduces to about 1cm pk/pk at 20MHz. Corresponding external sensitivity is 0.25V pk/pk to 2MHz and 1.25V pk/pk at 20MHz.

With A.C. coupling, the low frequency sensitivity reduces to 1cm pk/pk at about 2Hz.

The Ext Trig input impedance is approx. 100k/10pF and care should be taken not to apply more than 250V d.c. or pk, a.c. to this socket.

When the BRIGHT LINE button is out or ON, the timebase will free run in the absence of a correct trigger signal, to display a bright line or unsynchronized display

Operation

until the level control is adjusted and/or the amplitude of the trigger signal is increased. This free-run action in the absence of correct trigger, helps in finding the trace and leads to ease of operation. If the timebase is required to free-run continuously, the LEVEL control should be set to either end of its rotation.

It is expected that the BRIGHT-LINE OFF mode will be selected only when the instrument is to be used to display signals at repetition rates less than 40Hz or faster than 2MHz. This will prevent additional free run sweeps from occurring between correctly triggered low frequency sweeps or erratic high frequency operation.

The coupling of the trigger signal may be selected as a.c. or d.c. by operation of the corresponding TRIGGER button. When both are pressed, an active synch. separator circuit is introduced to provide line or frame triggering for video waveforms. Field trigger occurs at low sweep rates up to 100μ s/cm and line trigger is automatically selected on fast sweep rates from 50μ s/cm. The trigger polarity should be selected for the polarity of the synch. pulses. At least 2mm pk/pk of synch. pulse amplitude is required with internal triggering or 0.25Vwith external.

Summarizing the use of the trigger controls for most applications:

- a) With BRIGHT LINE ON (button out), select the trigger source CH1, CH2 or EXT and the coupling required, a.c. or d.c.
- b) Select the trigger slope + or and adjust the trigger level control to obtain a stable trace, starting at the required point on the waveform.

3.7 ADDITIONAL FACILITIES

1. Calibrator

This output pin on the front panel provides a positive going 1V flat topped square wave at approx. 1kHz. It can be used to check the sensitivity of the instrument or to set to any particular calibrated sensitivity (see section 3.3.4). The rise time is approx. 2μ s and the output impedance is approx. 470Ω , providing approx. 2.3mA when shorted to ground.

The CAL output may be used also to set up passive probes (see section 3.7.4).

2. Ramp Output

This 4mm socket on the rear panel provides a d.c. coupled positive-going ramp generated by the

timebase of approx. +3.5V pk from an impedance of approx. 5k ohms. If a lower output level can be tolerated, distortion of fast ramp output signals due to capacitive loading can be avoided by adding resistive loading to attenuate the signal.

3. Z mod

This socket on the rear panel allows modulation of the brightness. The input is d.c. coupled into approx. $10k\Omega/10pF$. The sensitivity at normal brightness settings requires about 2V to provide visible modulation. Approx. +40V is required to provide full trace blanking.

Care should be taken not to apply more than 100V d.c. or pk, a.c. to this socket.

4. Use of the Passive Probe

A X10 passive probe may be used to extend the voltage range and increase the input impedance of the Y amplifiers. The input resistance of a Y channel is 10M ohms, shunted by approximately 28pF. The effective capacitance of the input lead must be added to this and the resultant impedance can often load the signal source. Therefore it is advisable to use a 1M ohms, X10 probe such as PB12 or PB13. This reduces the input capacitance and increases the input resistance, at the expense of a 10X reduction in sensitivity. The probe inserts a shunt RC network in series to form a 10:1 attenuator with the input RC of the Y channel. To obtain a flat frequency response it is necessary to adjust the capacitance of the probe to match the input capacitance of the Y channel as follows:

- 1. Set the Y channel VOLTS/CM switch to 20mV, the TIME/CM switch to 500µs and trigger from the appropriate channel.
- 2. Connect the probe to the CAL socket.
- 3. Adjust the probe compensation to obtain a level trace, i.e. flat top without overshoot or undershoot.
- 5. Camera

A camera may be used with the oscilloscope to record waveforms. This facility is particularly useful at slow timebase sweep rates. Suitable cameras utilizing Polaroid film may be obtained from Shackman and hand held against the tube face. Other oscilloscope cameras may be used but suitable adaptors must be obtained and should be discussed with the camera manufacturer.

Section 4



Fig. 1 Block Diagram www.SteamPoweredRadio.Com

Section 4

To aid component location, circuit references have been allocated in the following general pattern.

1	- 99	Components not mounted on printed circuit boards.
100	- 199	Components mounted on the attenuator assemblies.
200	- 299	Pre-amplifier and Ramp Generator components mounted on the daughter board.
300	- 399	Y Pre-amplifier and Beam Switch components mounted on the main board.
400	- 499	Y Amplifier and Y Output Amplifier components mounted on the main board.
500	- 599	Timebase and X Output Amplifier components mounted on the main board.
600	- 699	Trigger circuit components mounted on the main board.
700	- 799	Power supply and Modulation Circuit components on the main board.

4.1 GENERAL

Referring to the block diagram (Fig. 1) signals applied to the CH1 and CH2 input sockets pass into their respective attenuators and amplifiers. The VOLTS/CM switch controls the gain of the pre-amplifier in steps of 1.2.5 sequence to cover the ranges from 2mV/cm to 0.1V/cmand a $\div 100$ attenuator is introduced before the amplifier on the ranges 0.2V/cm to 10V/cm.

The Variable Gain control adjusts the amplifier gain to give 1 to 2.5 times reduction of gain on all settings of the Volts/cm switch. The fast electronic beam switch selects either the CH1 or the CH2 signal to be amplified further and passed to the Y deflection plates of the c.r.t.

A sample of each signal is taken and passed to the trigger switch bank where selection of CH1, CH2 or Ext trig source is made.

The selected signal is amplified and passed to the Schmitt trigger, the output of which clocks the timebase bistable "on". The ramp generator then begins to generate its linear ramp, which, after passing through the X amplifier, is applied to the X deflection plates of the c.r.t. and drives the electron beam linearly across the tube face. A portion of the signal from the ramp generator is fed back to the hold-off circuit, shutting the gate to prevent any further pulses from the Schmitt trigger from reaching the timebase bistable during the ramp period. When the ramp has reached the necessary maximum level, the timebase bistable is reset, and the ramp is quickly returned to its quiescent state. A timeconstant in the hold-off circuit retains this signal to inhibit another ramp from being initiated for a short period, until the ramp timing capacitor is discharged fully. Thus a ramp is generated at a rate set by the TIME/CM switch when the trigger signal reaches a predetermined level. This ramp sweeps the beam across the

c.r.t. face, returns and waits for the next input cycle to reach the set trigger point, so producing subsequent ramps. The timebase bistable is connected to a blanking amplifier whose function is to turn on the electron beam during the sweep and blank it off during the fly-back and subsequent waiting period.

At fast sweep rates for a dual trace display, the TIME/CM switch automatically selects the alternate sweep mode of control for the beam switch. At the end of each sweep, the signal from the timebase reverses the state of the beam switch bistable, causing alternate displays of the CH1 and CH2 signal on successive sweeps of the timebase. At slow sweep rates, the chop mode is selected, when the chop multivibrator free runs independently, causing the beam to switch on chop between CH1 and CH2 levels during the sweep.

A signal from the multivibrator also blanks the trace during each switching transitition. With CH1 or CH2 only selected, the beam switch bistable is held to select that channel only. In the X-Y mode, the bistable is held to select CH2 as the Y deflection signal, while an additional switch diverts the output from the CH1 preamplifier, to the X output amplifier as the X deflection signal in place of the normal ramp signal. The blanking amplifier is held in the bright-up state. When TV trigger mode is selected, an additional synch. separator circuit is introduced into the signal path leading into the trigger amplifier.

4.2 THE Y AMPLIFIERS AND BEAM SWITCH These circuits are shown in Fig. 4.

The attenuators and pre-amplifiers of channel 1 are identical to those of channel 2 and accordingly only channel 1 is described.

The input signal is applied to SKA and then to the attenuator via the 3 position slide switch, S101. This allows the input signal to be directly coupled through in the DC position or coupled via C105 in the AC position. In the central GND position, the input signal from SKA is left open circuited while the input to the attenuator is grounded.

On the most sensitive ranges, 2mV/cm to 100mV/cm, the VOLTS/CM switch, S102, couples the signal through directly to the pre-amplifier and the network resistor, RN101c, provides the input impedance. On the remaining ranges, S102 introduces R101a into the signal path to form a 100:1 attenuator with RN101b in parallel with RN101c.

High frequency compensation of the attenuator is provided by C101 and C104 while C102 with C106 allows the input capacitance of the attenuator to be set to equalise that of the unattenuated ranges.

Diodes, D201 and D202 with R207, provide input protection by limiting the input voltage appled to the amplifier to the voltages of zener diode, D203 and the positive supply line.

The input stage of the pre-amplifier is formed by the f.e.t. source followers, TR201 and TR202, and emitter followers, TR204 and TR203. Unbalance in this stage is corrected by the BAL control potentiometer, R301.

The input stage drives the divider network, RN201. The VOLTS/CM switch second wafer, S201, selects the necessary output, either directly via RN201 on the 2mV or 200mV ranges, or attenuated by 2.5, 5, 10, 25 or 50 times on the subsequent ranges. This network presents a constant output impedance and further attenuation is introduced by the shunt action of the VARIABLE sensitivity control, R217. The resultant signal is amplified by the integrated amplifier, IC301. The amplifier gain is determined by R309 and the preset, R302. The differential output is balanced by the bias through R308 from the preset, R307.

The differential output from IC301 (CH1) or from IC351 (CH2) is selected by the beam switch as the input for the subsequent shunt feedback amplifier stage formed by TR401, TR402. The signal input currents are defined by R316 and R317 and are summed with the Y shift currents defined by R318 and R319 from the CH1 shift control, R315. The corresponding components for channel 2 are R366, R367, R368, R369 and R365. Channel 2 only differs for channel 1 by the addition of the double pole changeover switch, S301, which reverses the output signals from IC351 in the INVERT mode.

The beam switch is formed by the 8 diode gate, D301, D302, D303, D304, D351, D352, D353, D354. The relative control potentials from IC501 allow either the signal current from IC301 and/or IC351 to reach the bases of TR401 and TR402, or divert those currents from the bases.

The outputs from the differential shunt feedback amplifier stage formed by TR401 and TR402, are fed to the gounded emitter amplifier stage, TR403 and TR404. This in turn feeds the differential cascode Y output stage TR405, TR406, TR407 and TR408 to drive the Y deflection plates of the c.r.t.

High frequency compensation of the output amplifier is provided by networks between the emitters of TR403 and TR404 and those of TR405 and TR406. Adjustment of this compensation is by C402 and C405.

4.3 THE TRIGGER CIRCUITS

These circuits are shown in Fig. 5.

The Trigger Source switches, S502 and S503, connect the required trigger signal via the Trigger Coupling switches, S504 and S505, to the trigger buffer amplifier formed by TR601 and TR602. S502 selects the differential CH1 signal via R313 and R314 from IC301 (Fig. 4). S503 selects the equivalent CH2 signal via R363 and R364 from IC351. Where both S502 and S503 are selected, both of the above signals are disconnected and the single-sided input from the EXT TRIG input socket SKC is selected.

If You Didn't Get This From My Site, Then It Was Stolen From... www.SteamPoweredRadio.Com When the AC coupling switch, S504, is out, the trigger signals are directly coupled-through, but when this switch is in, AC coupling is introduced via C603 and C604 (C601 on External). TR601 and TR602 form a differential buffer amplifier with the DC balance controlled by the TRIGGER LEVEL control, R602. The differential output from this stage is applied to the comparator, IC602, which has positive feedback applied by R623 to form a Schmitt trigger circuit. The changeover switch, S506, reverses the output from TR601 and TR602 to determine the trigger slope.

When both S504 and S505 are "in" (AC and DC in for TV mode), the junction of R603 and C610 is connected to the -11V supply. D601 and D608 are brought into conduction while D602 and D604 are reverse biased. This diverts the output of the trigger amplifier away from IC602, into TR605, which amplifies the positive tips of the video waveform only. TR605 is prevented from saturation by feeding back the peak detected synch. pulses via TR607 and TR606 to the emitter of TR605. These pulses are amplified by IC601b and applied via R617 and D603 to the Schmitt trigger, IC602. IC601a is used in conjunction with S504 and S505 to disable the synch. separator when AC or DC is selected.

At the fast timebase sweep speeds, S 262a is open and TR603 is cut off. However, at speeds of 100μ s/cm and slower, R608 is connected to +11V and TR603 is switched on. This effectively grounds C609 to introduce an RC integrating time constant into the synch. pulse signal time path in the TV mode to separate out frame trigger.

4.4 TIMEBASE GENERATOR AND AMPLIFIER

The square wave trigger output from IC602 is applied (with d.c. bias of zener diode, D605) as the clock to the D type TTL flip-flop, IC501a. A positive-going trigger edge will clock the bistable, driving \overline{Q} low. In the waiting state, \overline{Q} was high (+4.5V), turning on TR261 via R507 and R262, holding the input, and hence the output, of the operational amplifier, IC261 at OV. This timebase amplifier is connected as a direct voltage follower.

When the trigger signal sends \overline{Q} of IC501a low, the timebase clamp transistor, TR261, is turned off. Part of the constant current generated by TR264 flows through the resistor network, RN272, to charge C263 at a constant rate. The resultant positive-going linear ramp voltage generated at the input of IC261 is buffered by that amplifier to generate the low impedance ramp output.

The timebase range switch, S262, selects the tap point on the network, RN272, to vary the ramp slope in the 1.2.5 sequence over a range of three decades. On all fast sweep ranges, TR262 is biased-off but on ramps 0,5ms/cm and slower, S262c connects R263 to +11V. TR262 is turned on and C264 is effectively connected in parallel with C263 to slow the sweep rate 1000 times.

The constant current into the ramp generator is derived from the current mirror circuit formed by TR262 and TR264. The variable gain control, R261, provides an approximate 3:1 range of variation in this current, R506 provides a preset calibration control on the slow sweep rates, only when S262c is closed.

When the ramp reaches its maximum level the negative bias, introduced by R521 and R519, is overcome and TR503 turns on, driving the reset input of the timebase bistable low. As the bistable switches, \overline{Q} returns high and TR261 conducts to discharge the timing capacitor(s) and the sweep is complete. However, a hold-off action takes place to inhibit trigger signals during sweep and this remains for a short period after a sweep to ensure that the ramp potential is fully reset before the next sweep can be triggered. As the ramp goes positive, D506 conducts to charge C502, reverse biasing D503 and turning on TR502. At the end of sweep when the timebase bistable is reset, Q goes low and the D input follows via the action of D508 and R511. The ramp output returns rapidly toward 0V but TR502 remains in conduction for a period determined by C502 and R518. Only when TR502 turns off can R516 and D507 take the D input high for the bistable to respond to the next clock input.

TR501 acts in a way similar to TR262 (described above) to introduce additional hold-off time through C501 on the slower half of the timebase ranges.

The bright line facility causes the timebase to free-run in the absence of trigger signals. The square wave output from the Schmitt trigger, IC602, is coupled via C615 into the peak detector diodes, D606 and D607, to generate a positive-going signal into the -ve input of IC601c driving its output negative. In the absence of such trigger signals for a period determined by C618 with R627 and R626, the output of IC601c goes positive. When TR502 turns off at the end of the holdoff period, D509 conducts to turn on TR504, driving the set input low to initiate another sweep.

This free-run condition is removed as soon as IC601c detects an output from the Schmitt trigger. It can be inhibited also with a positive bias via R625 if the BRIGHT LINE OFF switch, S501, is operated.

The X output amplifier is formed by the shunt feedback stage of TR509/TR511 driving single sided into the amplifier stage, TR513 and TR514. The collector output of this stage drives the X deflection plates of the c.r.t. directly from TR514 and via emitter follower TR515 from TR513. The gain introduced by TR509/TR511 is defined in the x10 magnification mode by the input resistance, R539, and the feedback resistance, R552, with the preset, R553. In this mode the transistor switch, TR512, is biased off. However, in the normal x1 magnification mode S507 is open and the current in R548 turns on TR512, introducing R544 with preset, R511, as additional feedback to reduce the gain of the amplifier accordingly.

The X shift control, R271, introduces an additional bias input via R541 and emitter follower TR506, through the potential divider R569/R545.

4.5. MODE CONTROL CIRCUITS

The display mode is controlled by S261 (Fig. 5) which defines the state of three control lines according to the following table.

Mode	L1	L2	L3	Q	Q
				IC50	01b
X-Y	+11V	0	+11V	L	Н
CH1	0	+11V	0	Н	L
Dual	+11V	+11V	0	Switc	hing
CH2	+11V	0	0	L	Н
Add	0	0	0	Н	Н

These lines in turn control the function of the beam switch and other necessary signal switching.

Section 4.2 described the signal switching action of the beam switch diodes, D301 to D304 and D351 to D354. These are controlled by the Q and \overline{Q} outputs of the beam switch bistable, IC501b. In the CH1 mode L1 is open, allowing R525 to take the set input of the bistable low, Q is high and \overline{Q} is low, selecting the channel 1 signal for Y display. In the CH2 and X-Y modes, L1 is at +11V and R514 takes the set input high but L2 is open and R524 takes the reset input low to reverse the bistable and select the channel 2 signal.

In the Add mode, both L1 and L2 are open so that both set and reset are applied to the bistable, Q and \overline{Q} are high and both channel signals are added into the shunt feedback stage of the Y amplifier (Fig. 4). In this mode only, L1, L2 and L3 are open, removing the bias through D401, D402 or D403 and defined by R401 and R402 via D405 and D406. This offsets the additional bias introduced by the selection of both channel signals.

Only in the X-Y mode, L3 is held at +11V toturn on the diode gate of D515 and D514, so coupling the channel 1 preamplifier signal of IC301, via TR506 and R547 into the X output amplifier. At the same time D504 conducts to turn off the gain switching transistor, TR512, thereby selecting x 10 X magnification irrespective of the position of S507.

D501 conducts allowing current through R509 to turn on TR261, clamping the ramp generator so that no signal is fed into the X amplifier via R539. Finally, current through R512 turns on TR504, holding the timebase bistable set "on" to provide continuous brightbright-up of the trace.

In the Dual mode, both L1 and L2 are held at +11V so that the beam switch bistable, IC501, is free of set or reset signals. Thus it can respond to clock signals and as its D input is connected to its Q output its state reverses on each clock input.

On the fast sweep ranges (0.2ms/cm and above), the clock input is derived via emitter follower, TR505, directly from the Q output of the timebase bistable. Thus the beam switch operates in the alternate mode. The Y deflection is switched between channels at the

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end of each sweep. TR507 and TR508 form a freerunning emitter coupled multivibrator but on the above ranges, S262 - is open such that R534 is disconnected and the multivibrator is paralyzed.

On the slow ranges (0.5ms/cm and below), R534 is connected to +11V and the multivibrator runs. During each sweep period, the multivibrator provides continuous clock inputs to the beam switch bistable so that the beam deflection signal is made to chop between the two channel signals. The beam switching is inhibited between sweeps as the emitter follower, TR505, clamps high the clock input to the beam switch bistable. In all modes but Dual, L1 or L2 are low and D512 or D513 conducts to inhibit the action of the multivibrator.

IC601d is used for the 1kHz calibrator. It is connected as an oscillator with positive feedback via R629 and negative feedback via R633. This with C617 defines the frequency as approx. 1kHz. The output is buffered by the transistor switch, TR604, which defines the calibrator output amplitude via the potential divider of R638 and R643 with preset, R641.

4.6 THE POWER SUPPLIES AND C.R.T. CIRCUITS

These circuits are shown in Fig. 6. The following d.c. supplies are generated in the power supply circuit from secondary windings on the supply transformer, T1.

+210V, +11V, +7V, -5V, -11V, -1850V.

The +210V line is used primarily in the X and Y output amplifiers. The -1850V line is the cathode supply for the c.r.t. In addition, a +5V line is generated in the time-base area from the +11V line by IC552 (Fig. 5).

The incoming a.c. supply from the supply connector, PLM, is switched by S1 and fused by FS1 before reaching the two supply range switches, S2 and S3. S2 connects the two primary windings of T1 in series or in parallel for 120V or 240V operation while S3 selects the necessary tap for 100V or 220V operation.

The output from the 210V secondary is bridge rectified by the four bridge connected diodes, D722 to D725, into the reservoir capacitor, C705. The resultant d.c. voltage, protected by FS701 feeds the h.t. regulator for the +210V supply. D730 is the reference for this supply, buffered by emitter follower, TR711, and the Darlington pair, TR713. The return of the rectified 210V supply is via the -11V line to balance load currents in the low voltage supplies.

The four low voltage supplies are derived from a single 25V secondary of transformer, T1. Its output is bridge rectified by bridge connected diodes, D726 to D729, into the reservoir capacitor, C704.

The distribution with respect to the OV line of the voltage across this capacitor is determined by the -11V shunt regulator and the +11V series regulator. The -11V reference is provided by the zener diode, D711, with temperature compensation diodes, D713 and D714, and

the shunt transistor, TR712, conducts to maintain the -11V line at the correct potential.

The -5V line is derived from this -11V line by the zener diode, D712, with the compensation diode, D720, followed by the emitter follower, TR709.

With the negative side of the unstabilized supply across C704 defined at -11V by that stabilizer, the positive side is applied to the series regulator, IC702, which takes up all variation in the unstabilized supply to define the +11V line. This is a 15V regulator with 'low'. pin 3, reurned to a -4V potential defined from the -5V supply by R735 and R734.

The +7V supply is provided from the +11V supply by a further 12V series regulator, IC701, operating with respect to the -5V line.

All the above outputs are connected to the subsequent oscilloscope circuitry via split pads in the copper track pattern. These are normally bridged by solder but can be used to isolate each line to assist fault finding.

The grid and cathode supplies for the c.r.t. are derived via the voltage doubler circuit, D718, D719, C711 and C712, from the 950V secondary of T1. The negative side of the unstabilised supply developed across C711 and C712 is held at approx. -2000V with respect to 0V by the series zener diode, D706, which is returned to the stabilised cathode potential of -1850V. Subsequent variations in the unstabilized supply are developed across the series regulator, TR707, of the e.h.t. regulator. The feedback path of this regulator uses the current from the -1850V line defined by the resistors R715, R714 in parallel with R744 (the FOCUS pot.) and RN720e. The latter being within the e.h.t. network. This current is returned to the +7V line via R731, R725 and R726. If the resultant potential of the tap point defined by the preset, R725, is not at approx. -4.5V, the current in transistor, TR706 will change to correct the stabilizing voltage across TR707. TR706 and TR707 are connected in cascode.

The heater of the c.r.t. is supplied directly from an independent 6.3V secondary winding of T1.

The OS300 employs a novel modulation circuit to control the grid potential with respect to the cathode potential. The transistor pair, TR703 and TR704, generate an essentially constant current from the collector of TR703. This generates a constant voltage across RN720 and preset, R713, and is returned to ground via the output of the bright-up amplifier. Thus signal variations from this amplifier which operates with respect to 0V are transferred with the large negative d.c. offset to the collector of TR703, to be applied to the grid of the c.r.t., via the emitter follower, TR716.

In more detail, the constant current from TR703 is defined by the emitter resistance, RN720c and the base potential, from the divider, RN720a and RN720b.

This constant current source is returned to the -200V line (negative of D706) so that the collector of TR703

(the c.r.t. grid) can move negative from the cathode. The collector potential is protected by D705 against excessive swing during switch-on or switch-off conditions. While RN720d and R713 generate the necessary large d.c. potential to couple the bright-up signals to the grid, the high frequency components are by-passed through C702.

The bright-up signal amplifier is formed by the cascode transistor pair, TR701 and TR702, with shunt feedback via R704. It responds to the sum of three inputs. The first is a d.c. bias via R707 from the INTENSITY control, R745. The second is the external Z Modulation signal from SKG, via R703. The third is the composite signal from the collector of TR507 (Fig. 5 see section 4.5), which provides bright-up during each timebase sweep with blanking of each chop transistion if approp-

riate. Diodes, D701 and D702, provide protection against excessive external inputs and with R702, prevent saturation of TR702.

The focus electrode of the c.r.t. is supplied from the focus control potentiometer, R744, with a portion of the -1850V supply. The astig. electrode is supplied from preset, R708 driven from the +210V supply via the divider network R746, R747.

Minor angular misalignment of the gun assembly of the c.r.t. or the effects of externally applied magnetic fields, axial to the c.r.t. can be corrected by the trace rotation coil. This coil is round the neck of the c.r.t. and the current is determined by the TRACE ROTATION control, R737, connected between the $\pm 11V$ supplies and driving emitter followers, TR714 and TR715.

Section 5



Fig. 2 Internal Assembly - top view

Section 5

5.1 GENERAL

Figs. 2 and 3 show the internal location of the major components, sub-assemblies and preset controls. No regular maintenance is required apart from routine recalibration. The construction of the instrument is such that full access to all calibration controls and to most components can be obtained once the two halves of the case have been removed. (See section 5.2)

Supply voltage adjustment is made by the two selector switches on the rear panel. The supply fuse is mounted adjacent to these switches and the supply connector. This connector should be removed or the instrument switched off before operating the switches. For 100 or 120V operation a 500mA, 20mm slo-blo fuse is required (Part No. 33685), for 200 or 220V operation a 250mA, 20mm slo-blo fuse is required (Part No. 33684). The internal H.T. fuse is a 100mA, 20mm fuse (Part No. 32958).

5.2 REMOVAL OF THE CASE AND SUB-ASSEMBLIES

WARNING

DANGEROUS VOLTAGES ARE EXPOSED ONCE THE CASE IS REMOVED. MAINTENANCE SHOULD BE CARRIED OUT ONLY BY QUALIFIED PERSON-NEL. PARTICULAR CARE SHOULD BE TAKEN ON THE TUBE BASE AND THE E.H.T. AREA OF THE MAIN PRINTED BOARD WHERE VOLTAGES IN EXCESS OF 2000V ARE PRESENT. THESE VOLTAGES MAY BE RETAINED AS STORED CHARGE FOR UP TO ONE MINUTE AFTER THE SUPPLY IS DISCONNECTED.

(a) To remove the Case (Top section)

DISCONNECT FROM THE SUPPLY. Remove the two fixing screws at the top front sides and lift the top cover up and forward to clear the front moulded frame and the rear plastic moulded cover.

(b) To remove the Case (Lower section) and Handle assembly

DISCONNECT FROM THE SUPPLY. Remove the two fixing screws at the top front sides and proceed to remove the top cover as detailed in (a) above. Rest the instrument upside down and remove the screw from the centre of the front frame, securing the cover. Lift the lower cover up and forward to clear the front moulded frame and the rear plastic cover. It may assist this operation if the screws holding the rear moulding are slackened but not removed.

(c) Removal of the C.R.T.

Remove the case as described in (a) and (b) above. Disconnect the trace rotation coil leads from pins 734 and 735 on the main printed circuit board. Unplug the tube base assembly. The base itself is carried on a small printed board which has been designed to allow access on two edges to facilitate withdrawal from the c.r.t. pins. Remove the single clamp fixing screw (see Fig. 2) and rotate the two clamp sections approx 30° to free the clip from the centre panel. Once the tube and clamp assembly are free the clamp itself can be slackened on the tube. Slide the tube backward through the center panel until the c.r.t. face plate is clear of the front mounting clip. The tube can then be lifted up and drawn forward, to clear the top edge of the front panel and frame moulding of the instrument. Withdraw the tube from the shield and the two part clamp.

When fitting a new tube operate in the reverse order to the above instructions, with the exception of the tube clamp and center panel fixing screw. On reassembly the fixed part (rear) of the c.r.t. clamp is located in the slotted locating holes in the bulkhead and the retaining screw is fitted. The tube is then held forward against the graticule in the front moulding while the clamping ring is rotated to hole and lock the tube in place. Do not over tighten this ring.

Check the polarity of re-connection of trace rotation coil leads. Clockwise rotation of the front panel preset control should cause a corresponding movement of the trace.

(d) Removal of the Attenuator assembly

Should it be necessary during repair to remove the attenuator and screens around the pre-amplifier for access to components on that board or on the front of the main board, proceed as follows.

Remove the collet fitted knob on the timebase switch. Access to the collet securing screw or nut is by prising off the clip in the centre cap on the knob. Remove the small push on knobs on the two Variable Sensitivity controls, the Mode switch, the Trigger Level, the Variable Sweep and X Shift controls. Unsolder and, using a desoldering tool clear the solder from the three screens where they are earthed onto the pre-amplifier board. Unsolder and remove the wires from the CAL 1V pin and the EXT trigger connection on the input printed circuit board. Unsolder also the two signal connections to pins 201 and 231 on the pre-amplifier board.

The sub section front panel, carrying with it the two attenuator volts/cm switches, the two AC/GND/DC switches and the input coupling printed board can now be un-latched by springing the four latch fingers away from the moulded frame and withdrawing the complete unit.

Re-assembly is the reverse of the aforementioned. Since the two attenuator switch wafers are symmetrical the shaft can be inserted in either of the two possible alignment positions.

(e) Removal of the Input Coupling Switch printed circuit assembly

If it is necessary to gain access to the small printed

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Fig. 3 Internal Assembly - bottom view

board which carried the input selection switches and the A.C. coupling capacitors for each Y channel, together with the input network for the External trigger signal proceed as follows. Using a desoldering tool, unsolder the tags of the input screen, clear the holes of solder and remove the screen. Unsolder and remove the two wires connecting the input printed board with the two attenuator wafer sections of each volts/cm switch. Desolder the three input B.N.C. sockets from this board and the three screen grounding points. The board should then be free for removal by easing upward, off the screen tags, then rotated to enable the switch sliders to clear the front moulding, and so withdrawn.

Re-assembly is the reverse of this sequence.

(f) Removal of the C.R.T. Control Potentiometer board

If it is necessary to gain access to the control pots. proceed as follows. Remove the push on knobs on the Focus and the Intensity controls. Ease the spacer retaining ears out of the printed board, so freeing the board from its retaining plastic spacer. Separate the two control pot shafts from the moulded shaft couplers. Full access to both the component side and the track side of the board is now facilitated and the faulty component can be readily accessed.

5.3 FAULT FINDING

Before any fault location is attempted, it is suggested that all supply voltages are checked. Subsequent signal voltages and waveforms should then be checked according to the following list, which may be used as a general guide and aid to servicing. Note that the typical voltages for un-stabilized supplies are quoted for nominal mid-range supply voltages.

If a fault cannot be cleared it is recommended that the instrument is returned to the manufacturer for repair (see section 7).

When faults have been cleared it is recommended that the setting-up procedure of section 5.4 is followed.

For checking the supply lines there is a double row of test pins, separated by bridged split pads. These pins will give outputs of +11V, -11V, +210V, +7V and -5V and if required the currents drawn by each line can quickly be measured simply by breaking the solder shorting the split pad for normal working operation, and inserting a current measuring meter between the two pins. In all five cases the line feed is nearer to the rear of the instrument, while the line load is connected to the forward pin.

Normal Operating Conditions

Unless otherwise specified the controls are set for single channel operation with the trace centered and timebase running. Potentials are specified with respect to ground and should be measured with a high impedance voltmeter, digital voltmeter or oscilloscope as appropriate. a) Supplies Unregulated 30V d.c. across C704 from 25V r.m.s. secondary voltage.

268V d.c. across C705 from 210V r.m.s. secondary voltage

2.5kV d.c. across C711 + C712 from 950V r.m.s. secondary voltage.

Stabilized

+210V	± 21V
+11V	± 0.5V
+7V	+0.4V, -0.6V
-5V	-10.4V, -0.6V
-11V	±0.5V

Note: EHT regulator should be set for collector of TR707 to be at +405V for nominal supply voltage.

Sensitivity

b) Y Amplifier Test Point D.C. Level TR203/204 Collector +7V IC301, pin 1 +1V ±0.8V

IC301, pin 1	+1V ±0.8V	-
IC301, pin 14	+1V ±0.8V	2mV/cm
IC301, pins 7, 8	+3.5V	65mV/cm each side
TR401/402 Collect	tor +3.7V	40mV/cm each side
TR403/404 Collect	tor +7.7V	140mV/cm each side
TR405/406 Collect	tor +12.6V	-
TR4057/408 Base	+15.6V	
TR407/408 Collect	tor +115V	6.8V/cm each side

c) Ramp Generator	
Test Point	Signal
Across R265 or R266	0.8V d.c. at "cal" 0.3V d.c. at min.
IC261 pin 3 and pin 6	+3.7V ramp from 0.1V level
TR264 Collector	+3.7V ramp from base level between 0 and +4V dependent on sweep rate selected.

d) X Amplifier		
Test Point	D.C. level	Signal
TR512 Collector	+0.65V (Centre Screen)	500mV/cm 6.0V ramp
TR511 Emitter	+3.7V (Centre Screen)	500mV/cm 6.0V ramp
TR514 Base TR513/513	-3.0V +118V	_ 12V/cm each side 140V ramp each side

e) Trigger Amplifie	r		
Test Point	D.C. Level	Signal	
TR601/602 Base	0V on Ext. 0V on Int A.C.	65mV/cm each side	
	+3.5V on IntD.C	. 65mV/cm each side	
TR601/602 Collector	-4.8V	25mV/cm each side	

On TV mode:- TR601 and TR602 collector drops to between -8.5V and -10.5V dependent on the setting of the Trig. Level Control.

IC602, pin 9. Trigger output switches between -2V and -5.6V levels.

f) Timebase Control

.)	
Test Point	Signal
IC501, pin 14	+5V, ±0.25V
IC501, pin 1	+5V (+1V at end of ramp)
IC501, pin 2	+4V (0V during hold-off)
IC501, pin 3	Trigger pulses between $-0.5V$ and $+2.8V$ levels
IC501, pin 4	+5V (0V during reset by bright line)
IC501, pin 5	+0.2V between sweeps +4.5V during sweeps
IC501, pin 6	+4.5V between sweeps +0.2V during sweeps
IC501, pins 8,9	Beam switched between +0.2V and +4.3V levels
IC501, pins 10, 13	-0.6V or 4.5V depending on mode switch setting
IC501, pin 11	Chop/alt. pulses between +0.2V and +4.7V levels
IC601, pin 8	+0.5V triggered or bright line off +0V bright line operating
IC601, pin 9	0V triggered or bright line off +9.5V bright line operating

g) Bright-Up Amplifier

Test Point	Signal
TR507 Collector	Switching signal +4.8V (blank) to 0V (Bright up)
TR702 Base Collector	+2V Between +6V and +48V dependent on intensity
RN720, pin 4	-2kV
RN720, pin 5	+50V with respect to pin 4
RN720, pin 6	+340V with respect to $-1850V$

5.4 SETTING UP PROCEDURE

The following procedure details the adjustments necessary to recalibrate the OS300 and set all the preset controls to achieve the specified performance. Inability to make these adjustments or failure to meet the specification after those adjustments have been made should be considered as a fault and the operating conditions should be checked according to section 5.3.

The procedure should be followed in the specified order.

- a. Test Equipment
 - Multirange Test Meter including 2.5kVcapability at 20kΩ/V
- Variable Autotransformer, output voltage 100– 270V at 5A.
 - 3. Sine/square wave signal generator, 10Hz to 100kHz, 20mV 5V.
 - 4. Source of voltage and time calibration signals, such as Bradley Oscilloscope Calibrator type 192.
 - 5. Square wave generator, 500kHz, 100mV into 50Ω , rise time less than 50ns with square corner and flat top.
 - RF Sinewave, Constant Amplitude Signal Generator. 25mV to 5V pk/pk 50kHz to 15MHz.
 - 7. 10:1 passive probe (PB12 or PB13).

b. Set EHT.

Set the incoming a.c. supply via the auto-transformer to the nominal center voltage of the selected range. Set to mid brilliance on the c.r.t. Monitor the collector voltage of TR707. Adjust R725 for this voltage to be $\pm 405V \pm 5V$. Remove the voltmeter. The instrument may now be operated directly from the uncontrolled supply.

c. Set Intensity Range.

Set to X-Y mode with inputs grounded and center the spot on the screen. Monitor the collector voltage of TR702. Adjust the intensity control for this voltage to be +15V and then adjust R713 for the intensity of the spot to be near cut off. Remove the voltmeter.

d. Astigmatism

Display a mid-frequency sinusoidal signal in the normal sweep mode on one channel, approx. 2cm pk to pk and 4cm period. Set the Variable sensitivity control fully counterclockwise. Set to a fairly low brilliance and adjust both the Focus control and R708 (Astig.) for the sharpest trace over the whole of its length. Reset the Variable sensitivity to Cal.

e. Trace Rotation

Ground the input and set the horizontal trace to the center line. Adjust the Trace Rotation preset control to align the trace with the center graticule line.

Section 5

f. Input Balance

Select CH1 and with the input grounded, adjust the preset Bal control for no vertical movement of the trace between the 0.1V/cm and the 0.2V/cm ranges. Repeat for CH2.

g. Trigger Balance

Set R357 for no vertical movement of the channel 2 trace when Invert is selected. Connect a sinusoidal input, AC coupled, to CH1 and set the trace for about 5cm pk to pk signal and one cycle displayed. Adjust R307 such that there is no change of trigger point as the Trigger Coupling is switched between AC and DC. Note that the relevant shift control may have to be operated to return the trace to the centre of the screen when R357 or R307 are adjusted.

h. Timebase Calibration

Ensure that the Variable Sweep is set fully clockwise to Cal. Apply 0.1ms calibrated time markers to either channel input. Set the timebase to 0.1ms/cm and obtain a centered triggered trace. Apply X10 Magnification and set R553 for 10cm spacing between the time markers.

Return to X1 Magnification and set R551 for 1cm spacing between markers.

Apply 1ms/cm time markers and set the timebase to 1ms/cm. Set R506 for 1cm spacing between the time markers.

All other timebase ranges can be checked for accuracy.

i. X-Y Calibration

Ensure that the CH1 Variable Sensitivity control is set fully clockwise to Cal. Select X-Y and apply a calibrated 100mV square wave to Channel 1 input. Select 20mV/cm Ground Channel 2. Set R302 for a 5cm horizontal trace length.

j. Channel 1 Calibration

Select CH1. With 100mV input at 20mV/cm as i. above, set R415 for a 5cm vertical amplitude signal.

All other sensitivity ranges can be checked for accuracy.

k. Ensure that the CH2 Variable Sensitivity control is set fully clockwise to Cal. Transfer the 100mV calibration signal to channel 2 and set to display that channel at 20mV/cm. Set R352 for a 5cm vertical amplitude signal.

All other sensitivity ranges can be checked for accuracy.

1. Attenuator Compensation

Apply a square wave input to CH1 at approx. 1V pk/pk and 1kHz. Select 0.2V/cm and adjust C101 on the CH1 attenuator assembly to obtain a square-topped displayed pulse. Access is through the screw driver/trim tool hole in the pre-amplifier board.

Repeat for CH2.

m. Input Capacitance Equalization

Select 100mV/cm on CH1 with the Variable Sensitivity control set fully counterclockwise and monitor a 10V 1kHz square wave via a 10:1 probe. Adjust the capacitive compensation of the probe for a flat-topped displayed pulse. Select 200mV/cm, reset the Variable Sensitivity to Cal and adjust C102 for a similar flat top to the pulse. Access is through the screw driver/trim tool hole in the pre-amplifier board.

Repeat for channel 2.

n. Pulse Response and Bandwidth Monitor a fast rise square wave input signal to examine the edge in detail on the 20mV/cm and 0.5μ s/cm ranges.

Adjust C405 for a flat top following the transition and C402 for the optimum corner to the pulse.

Connect a constant amplitude sinusoidal generator and set the input for 5cm pk/pk at 50kHz. Increase the frequency and check that the loss of amplitude is less than 3dB at 20MHz (>3.5cm pk/pk).

o. Calibrator

Monitor a calibrated 1V pk/pk square wave input and set the sensitivity and variable sensitivity controls for a full 8cm pk/pk display. Disconnect the external input and connect the Y input to the OS300 Calibrator output. Adjust R641 for a similar 8cm signal amplitude.

Section 6

SPARES ORDERING

When ordering spare parts, always give the following information:

1) Instrument model number

- 2) Serial number
- 3) Gould part number
- 4) Schematic reference number
- 5) Description of part

In its program of developing new and better products, Gould may make changes in component types and other parts. In most cases these components will be interchangeable with those in instruments already in the field. However, where necessary, minor modifications may be required. Contact your Gould Service Center for advice.

Most components have internationally available equivalents.

ABBREVIATIONS USED FOR COMPONENT DESCRIPTIONS

RESISTORS

CC	Carbon Composition	½₩	10%	unless otherwise stated
CF	Carbon Film	1/4W	5%	unless otherwise stated
MO	Metal Oxide	1/2W	2%	unless otherwise stated
MF	Metal Film	₩	1%	unless otherwise stated
WW	Wire Wound	6W	5%	unless otherwise stated
CP	Control Potentiometer		20%	unless otherwise stated
PCP	Preset Potenitometer T	ype MPD, PC	20%	unless otherwise stated
CAPACITORS			. 0.00	
CE(1)	Ceramic		+80%	
	a .	5001/	+1001	uplace otherwise stated

CE(1)	Ceramic		- 25%	
CE(2)	Ceramic	500V	±10%	unless otherwise stated
CE(3)	Ceramic	50V		unless otherwise stated
SM	Silver Mica			
PF	Plastic Film		±10%	unless otherwise stated
PS	Polystyrene			
PE	Polyester		±10%	unless otherwise stated
PC	Polycarbonate			
P	Electrolytic (Aluminium)		+50%	
E	Electrolytic (Aluminium)		- 10%	
Т	Tantalum		+50%	
			- 10%	

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CIRCUIT COMPONENTS LIST FOR OS300

Ref	Value	Description	To/ %±	Rating	Part No	Ref	Value	Description	To/ %±	Rating	Part No
RESIST	ORS										
R101	22	CF			28710	R301 R302	10k 220	PCP PCP			44959 36262
R103	22	CF			28710	1002	220				00202
R105	22	CI			20/10	R306	1k	CF			21799
R133	22	CF			28710	R307	10k	PCP			36267
K155	22	Cr			20/10	R307	22k	CF			21812
D161	1001	OF		1 337	19061	R308			2		38572
R151	100k	CF		1W	19061	K309	120	CF	2		38372
R201	1k8	CF			28725	R311	10	CF			21793
	10	CF			21793	R312	10	CF			21793
R202	10	Cr			21795	R312	100	CF			21793
Daga	11.6	OF			21901						
R204	1k5	CF			21801	R314	100	CF			21794
R205	4k7	CF			21805	R315	4k7	CP	2	A4	/450060
R206	47	CF			28714	R316	3k3	MF	2 2		38606
R207	470k	CC			4906	R317	3k3	MF	2		38606
R208	150	CF			28719	R318	7k5	CF			40297
						R319	7k5	CF			40297
R210	820	CF			28724						
R211	510	CF			29434	R351	10k	PCP			44959
R212	820	MF	2		38592	R352	220	PCP			36262
R213	820	MF	2 2 2 2		38592						
R214	1k5	MF	2		38598	R356	1 k	CF			21799
R215	1k5	MF	2		38598	R357	10k	PCP			36267
R216	180	CF			21795	R358	33k	CF			21812
R217	4k7	CP			44980	R359	120	MF	2		38572
R231	1k8	CF			28725	R361	10	CF			21793
R232	10	CF			21793	R362	10	CF			21793
						R363	100	CF			21794
R234	1k5	CF			21801	R364	100	CF			21794
R235	4k7	CF			21805	R365	4k7	CP		A4	/450060
R236	4k7	CF			28714	R366	3k3	MF	2		38606
R237	470k	CC			4906	R367	3k3	MF	2		38606
R238	150	CF			28719	R368	7k5	CF	2		40297
11250	150	0.			20/1/	R369	7k5	CF			40297
R240	820	CF			28724	1(50)	183	C1			40277
R240	510	CF			29434	R401	2k2	MF	2		38602
R241	820	MF	2		38592	R401	2k2	MF	2 2		38602
R242	820	MF			38592	R402	2k2	CF	2		21803
R243	1k5	MF	2		38598	R403	2k2 2k2	CF			21803
R244	1k5	MF	2 2 2		38598	R404	2k2 2k7	MF	2		38604
R245	180	CF	2		21795	R405		CF	2		28714
R240	4k7	CP			44980	R408	47		2		38604
K247	4K /	Cr			44900		2k7	MF	2		
R261	10	CF			21702	R408	1k5	CF			21801
	10				21793	R409	1k5	CF			21801
R262	470	CF			21797	R410	1k8	CF			28725
R263	4k7	CF			21805	R411	1k8	CF		½W	18553
Dare					01700	R412	390	MF	2		38584
R265	1k	CF			21799	R413	1k8	CF		½₩	18553
R266	1k	CF			21799	R414	390	MF	2		38584
R267	10	CF			21793	R415	100	PCP			36261
R268	100	CF			21794	R416	47	CF			28714
R269	47k	CP			44477	R417	150	MF	2		38574
R270	4k7	CP			44981	R418	270	MO			26742
R271	2k2	CP			44982	R419	10	CF			21793

Section 6

Section 6

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	OS300	(Cont.)										
	Ref	Value D	escription	To/ %±	Rating	Part No	Ref	Value	Description	To/ %±	Rating	Part No
	RESIST	DRS (Cont.)										
	R421	10	CF			21793	R534	6k8	CF			21807
	R422	270	MO			26742	R535	1k	CF			21799
	R422 R423	82	CF			28717	R536	10	CF			21793
	R423 R424	02	Cr	A.O.T.		20/1/	R537	10	CF			21793
	K424			A.O.1.			R538	10	CF			21793
	D 101		OF			20710						
	R426	120	CF			28718	R539	470	CF			21797
	R427	120	CF			28718						
	R428	22	CF			28710	R541	10k	CF			21809
	R429	39k	CF		1 W	19056	R542	47	CF			28714
							Dett	150				
	R432	22	CF			28710	R544	470	CF			21797
	R433	47	CF			28714	R545	3k	MF	2		38605
	R434	47	CF			28714	R546	6k8	CF			21807
							R547	2k2	CF			21802
	R437	100	CF			21794	R548	8k2	CF			21808
	R438	100	CF			21794	R549	6k8	CF			21807
	R439	270	CF		1 W	19036						
	R440	270	CF		1W	19036	R551	1 k	PCP			36264
	R440 R441	270	CF		1 W	19036	R552	12k	CF			21810
				5	1 **		R552	4k7	PCP			36266
	R442	2k2	MO	5 5		44986						
	R443	2k2	MO	5		44986	R554	680	CF			28723
	R444	47	CF			28714	R555	47	CF			28714
	R445	47	CF			28714	R556	2k7	CF			28726
							R557	1k8	CF			28725
	R503	470	CF			21797	R558	10	CF			21793
	R504	56k	CF			28729	R559	100	CF			21794
	R505	27k	CF			21813	R560	68k	CF			21816
	R506	10k	PCP			36367	R561	100	CF			21794
	R507	4k7	CF			21805	R562	10k	CF			21809
							R563	390	CF		½W	18545
	R508	4k7	CF			21805					72 VV	
	R509	33k	CF			21814	R564	33k	CF			21814
	R510	10	CF			21793	R565	2k2	CF			21802
	R511	10k	CF			21809	R566	100k	MO			28822
	R512	33k	CF			21814	R567	390	CF		1/2W	18545
	R513	5k6	CF			21806	R568	22k	CF			21812
	R514	1k5	CF			21801	R569	510	MF		¼W	38587
	R515	1k5	CF			21801	R570	18k	CF			21811
	R516	1k	CF			21799	R571	820	CF			28724
	R517	22k	CF			21812	R572	22k	CF			21812
	R518	22k	CF			21812	R573	4k7	CF			21805
	R519	3k9	CF			21804	R574	12k	CF		1 W	19051
							R575	12k	CF		1 W	19051
	R520	2k2	CF			21802				6		
	R521	1k	CF			21799	R576	10k	MO	5		44987
	R522	2k2	CF			21801	R577	10k	MO	5		44987
	R523	4k7	CF			21805						
	R524	3k9	CF			21804	R600	22k	CF			21812
	R525	3k9	CF			21804	R601	10k	CF			21809
	R526	2k2	CF			21802						
	R527	680	CF			28723	R603	3k3	CF			21803
	R528	680	CF			28723	R604	4k7	CF			21805
	R529	1k	CF			21799	R605	2k2	CF			21802
	R529	56	CF			28715	R606	10k	CF			21802
	K550	50	CI.			20715	R607	2k2	CF			21809
	R532	180	CF			21795	R608	2k2 4k7	CF			21802
		180										
	R533	1k2	CF			21800	R609	470	CF			21797
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Section 6

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OS300 (Cont.)

Ref	Value	Description	Tol %±	Rating	Part No	Ref	Value	Description	To/ %±	Rating	Part No
RESISTO	ORS (Cont.)										
R610	10	CF			21793	R721	180	CF		½₩	18541
R611	680	CF			28723	R722	1 k	CF			21799
R612	680	CF			28723	R723	2k2	CF			21802
R613	68k	CF			21816	R724	5k6	CF			21806
R614	10	CF			21793	R725	47k	PCP			38261
R615		CF			21810	R726	33k	MF	2		38630
	12k				21797	R727	150	CF	2		28719
R616	470	CF				R728	68	CF			28715
R617	2k7	CF			28726						
R618	47k	CF			21815	R729	680	CF			28723
R619	3k3	CF			21803	R730	1k	CF			21799
R620	1 M	CF			31840	R731	10k	CF	2		38618
R621	3k3	CF			21803	R732	47k	CF			21815
R622	1k8	CF			28725	R733	22k	CF	10		3433
R623	270k	CF			32356	R734	68	CF			28716
R624	10	CF			21793	R735	1k5	CF			21801
R625	1M	CF			31840	R736	1 k	CF			21799
R626	1 M	CF			31840	R 737	10k	PCP			44959
R627	680k	CF			31839						
R628	1 M	CF			31840	R 739	47	CF		1/2W	18534
R629	1M	CF			31840						
R630	100k	CF			21819	R741	5k6	CC	5	1 W	2363
R631	33k	CF			21814	R742	220k	MF	2		38650
R632	300k	CF	2		38653	R743	33M	MG	2 5	½₩	43008
R633	15k	CF	2		28727	R744	1M	CP	0		4/44460
		CF			21807	R745	10k	CP	With S1		4/44461
R634	6k8					R746	82k	CF	with 51	4	21818
R635	10	CF			21793	R740	120k	CF			21818
R636	68k	CF			21816						
R637	2k2	CF			21802	R748	100k	CF			21819
R638	3k9	CF			21804						
R639	10k	CF			21809	RN101		Resistor	Network		A 3/43194
R640	39k	CF			28728						
R641	2k2	PCP			36265	RN201		Resistor	Network	ŀ	43/44651
R642	56k	CF		1/2W	19058						
R643	470	CF			21797	RN231		Resistor	Network	1	43/44651
R644	3k3	CF			21803						
R645	10k	CF			21809	RN261		Resistor	Network	1	43/38692
1015	ION				21007						
R701	1k	CF			21799	RN720		Resistor	Network	4	3/44608
R702	680	CF			28723	111720		1(0313(01)	ICT WOIN		10,11000
R702	10k	CF		1W	2882	CARACI	TOPS				
R703	22k	CF		1 **	21812	CAPACI C101		Trimmer			29421
R704		CF			21812		6pF				29421
	5k6					C102	6pF	Trimmer	A.O.T.		29421
R706	470	CF			21797	C103	(00 F	DC	A.U.1.		40(2)
R707	5k6	CF			21806	C104	680pF	PC		40017	40631
R708	220k	PCP			36270	C105	0.1µF	CE(2)		400V	44966
					21002	C106	6.8pF	CE(2)			22362
R710	2k2	CF			21802						
						C133			A.O.T.		
R713	470k	PCP			36271						
R714	1 M	CF		½W	18588	C135	$0.1 \mu F$	PE		400V	44966
R715	680k	CF			31839		100				
R716	33M	MG	5	½W	43008	C151	2.2pF	SM			815
R717	33M	MG	5	½W	43008						
						C201	10µF	E		25V	32180
R719	18k	CF		1/2W	18565	C202	CE(3)	0.01µF		50V	
						0202	0.2(0)	0.01		501	

Section 6

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OS300 (Cont.)

Ref	Value D	escription	To/ %±	Rating	Part No	Ref	Value	Description	To/ %±	Rating	Part No
CAPACI	TORS (Cont.	.)									
C203	5600pF	CE(2)			22394	C605	22pF	CE(3)			42412
C204	1000pF	CE(2)			42432	C606	$0.1 \mu F$	CE(2)		100V	37018
						C607	$0.1 \mu F$	CE(2)		100V	37018
C231	10µF	E		25V	32180						
C232	0.01µF	CE(3)			42444	C609	$0.1 \mu F$	CE(2)		100V	37018
C233	5600pF	CE(2)			22394	C610	0.01µF	CE(3)			42444
0200	50000	02(2)			2207	C611	22pF	CE(3)			42412
C237	0.01µF	CE(3)			42444	C612	$0.1 \mu F$	CE(2)		100V	37018
0257	0.01µ1	CL(5)			12111	C613	0.01µF	CE(3)			42444
C263	1200pF	PS		63V	37455	C614	47pF	CE(3)			42416
C263	1200 pr $1 \mu \text{F}$	PE		100V	41743	C615	0.1µF	CE(2)		100V	37018
		CE(3)		100 v	42444	C616	$0.01 \mu F$	CE(2) CE(3)		1001	42444
C265	$0.01 \mu F$			100V	37018	C617	0.047µF			100V	39192
C266	0.01µF	CE(2)		100 v	42444	C618	0.047µF			100V	39192
C267	0.01µF	CE(3)								100 v	42420
C268	0.01µF	CE(3)			42444	C619	100pF	CE(3)			
						C620	0.01µF	CE(3)			42444
C301	0.01µF	CE(3)			42444						22104
C302	0.01µF	CE(3)			42444	C622	2.2µF	E			32194
C351	0.01µF	CE(3)			42444	C701	0.01µF	CE(3)			42444
C352	0.01µF	CE(3)			42444	C702	2200pF	PE			4/44990
						C703	2200pF				4/44990
C401	0.01µF	CE(3)			42444	C704	1000µF				44992
C402	27pF	Trimme	r		32519	C705	33µF	E		350VA	3/44991
C403	47pF	CE(3)			42416						
C404	120pF	CE(3)			42421	C708	$10\mu F$	E		25V	32180
C405	10/65pF	Trimme	r		30286	C709	2200pF	PE		4kV A	4/44990
C406	10,00 -		A.O.T.			C710	10µF	E		25V	32180
C400	0.1µF	CE(2)	1.0.1.	100V	37018	C711	0.1µF	PE		1.5kV	40075
C407	5600pF	CE(2)		1007	42441	C712	$0.1 \mu F$	PE			40075
C409	5600pF	CE(3)			42441	C713	0.22µF	PE		100V	44370
0409	5000pr	01(5)			42441	C714	0.01µF	CE(3)		1001	42444
C411	5600pF	CE(2)			22394	C715	0.22μ F	PE		100V	44370
C411 C412	3000pr	CL(2)	A.O.T.		22394	C715	0.22μ F	CE(3)		100 •	42444
C412			A.O.1.			C717	56pF	CE(3)			42417
0501	0.22.5	PE		100V	44370	C718	22pF	CE(3)			42412
C501	0.22µF			100 v							22394
C502	1000pF	CE(3)			42433	C719	5600pF	CE(2)			22394
C503	0.01µF	CE(3)			42444						
C504	0.01µF	CE(3)			42444	TRANSI	STORS				
						TR201	}	Dual F.E	.T.		44704
C506	10pF	CE(3)			42408	TR202	Į				
C507	0.01µF	CE(3)			42444	TR203	ļ	AE38			44627
C508	0.01µF	CE(3)			42444	TR204	1				11027
C509	0.01µF	CE(3)			42444						
C510	560pF	CE(3)			42429	TR231	l	DUAL F	БТ		44704
C511	3300pF	CE(3)			42438	TR232	5	DUALF	.E.I.		44/04
C512	5600pF	CE(2)			22394	TR233	1	1 520			44607
						TR234	ſ	AE38			44627
C514	120pF	CE(3)			42421		5				
C515	150pF	CE(3)			42422	TR261		MPS2369	Select	ted	44953
C516	150pF	CE(3)			42422	TR262		BC547B			44951
						TR263		BC558C			44952
C601	0.22µF	PE		250V	39201	TR264		BC558C			44952
C602	100pF	CE(3)			42420						
C603	2.2µF	E		63V	32194	TR401		BF371			36275
C604	2.2µF	Ē		63V	32194	TR402		BF371			36275
0001	~	~		001		111102		51 5/1			56215

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Section 6

NOTE: When ordering, all part numbers shown in this manual shall be prefixed with AD2, i.e., 37898 should be AD237898.

OS300	(Cont.)
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Ref Val	lue Description		Part No	Ref	Value	Description	Part No
TRANSISTO							
TR403	BF371		36275	D301		IN4148	23802
TR404	BF371		36275	D302		IN4148	23802
TR405	AE13		31254	D303		IN4148	23802
TR406	AE13 ∫			D304		IN4148	23802
TR407	BF468		40056				
TR408	BF468		40056	D351		IN4148	23802
				D352		IN4148	23802
TR501	BC547B		44951	D353		IN4148	23802
TR502	MPS2369		36625	D354		IN4148	23802
TR503	MPS2369		36625				
TR504	BC547B		44951	D401		IN4148	23802
TR505	2N3904		24146	D402		IN4148	23802
TR506	BC558C		44952	D403		IN4148	23802
TR507	BC557B		44950	D404	5V1	ZENER	33928
TR508	BC557B		44950	D405		IN4148	34701
TR509	BC547B		44951	D406		IN4148	34701
70611	21/2004		24146	D501		IN4148	23802
TR511	2N3904		24146	D501		1114140	23802
TR512	2N3904		21533	D502		11/1/10	22002
TR513	NSD459		40054	D503		IN4148	23802
TR514	NSD459		40054	D504		IN4148	23802
TR515	BF393		450226	D505		IN4148	23802
TR601	BC558C		44952	D507		IN4148	23802
TR602	BC558C		44952	D508		IN4148	23802
TR603	BC547B		44951	D509		IN4148	23802
TR604	BC557B		44950	2007			20002
TR605	2N3904		24146				
TR606	2N3904		24146	D511		IN4148	23802
TR607	2N3906		21533	D512		IN4148	23802
TROO7	21(3)00		21555	D513		IN4148	23802
TR701	MPS2369	Selected	44953	D514		IN4148	23802
TR702	BFR86B	Beleeted	44954	D515		IN4148	23802
TR702	BFR86B		44954	D516		IN4148	23802
TR704	BC558C		44952	D517		IN4148	23802
11/04	DC556C		44)52	D518		IN4148	23802
TR706	BC547B		44951	D519		IN4148	23802
TR707	BUX87		44955	D520		IN4148	23802
11/07	DOXOT		++>55	DCOO			
TR709	BC328		38414	D522			
TR711	BC558C		44952				
TR712	TIP29A		38419	D522		IN4148	23802
TR713	TIP112		40519	D523		IN4148	23802
TR714	BC547B		44951				
TR715	BC557B		44950	D601		IN4148	23802
TR716	2N6518		36472	D602		IN4148	23802
11(/10	2110510		50172	D603		IN4148	23802
DIODES				D604		IN4148	23802
D201	IN3595		29330	D605	5V1	ZENER	33928
D201	IN3595		29330	D606		IN4148	23802
D202 D203 6V			33931	D607		IN4148	23802
D205 0V	LENDIN		55751	D608		IN4148	23802
D231	IN3595		29330	D609	4V7	ZENER	40049
D231	IN3595		29330	D610		IN4148	23802
D232 D233 6V			33931	D611		IN4148	23802
	aradBadia Com		55751	2011			25002
 V StoomDow	araduadia ('am						

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NOTE: When ordering, all part numbers shown in this manual shall be prefixed with AD2, i.e., 37898 should be AD237898.

OS300 (Cont.)							
Ref	Value	Description		Part No	Ref	Value	Description	Part No
DIODES	(Cont.)				MISCEL	LANEOUS		
D701		IN4148		23802	L401		15µH	44993
D701		IN4148		23802	L402		15µH	44993
D704		L.E.D.		43847	V1	ſ	Mullard 56825GY	
		BAX17		402022	V I	1		44022
D705	1501	ZENER		37559		1	Normal Version	44932
D706	150V	LENEK		37339		L	Mullard 56825GM Long Persistence	44933
D708		IN4148		23802		÷	Long reisistence	++)55
D709	200V	ZENER		40052	T1			A1/44961
D711	9V1	ZENER		33934	S1		With R745	A4/44461
D/II		LENLIN		0070			while R745	
D712		IN14140		23802	S2			A4/4069
D713		IN4148			S3			A4/4069
D714		IN4148		23802				
D715	200V	ZENER		40052	S101			A4/44965
D716	200V	ZENER		40052	S102			44978
D717	200V	ZENER		40052				
D718	12kV			44550	S131			A4/44965
D719	12kV			44550				
D720		IN4148		23802	S201			40048
D721		BAX17		402022				
D722		IN4004		450266	S231			40048
D723		IN4004		450266				10010
D724		IN4004		450266	S261			A4/44476
D725		IN4004		450266	S262			A4/44979
D726		IN4004		450266	5202			A-1/
D720		IN4004 IN4004		450266	S301			A 4/20720
		IN4004 IN4004		450266	3301			A4/38729
D728				450266	0501/5	04		
D729	20017	IN4004			S501/5	06		A4/38728
D730	200V	ZENER		40052	S507			A4/38729
INTEGR	ATED CIRCU	JITS			SKA			1222
IC261		LF351		40130	SKB			1222
					SKC			1222
IC301		LM733CN		40084	SKD			37293
10501		LINITODOLI			SKE			
IC351		LM733CN		40084	SKE			31229
					SKG			37293
IC501		74LS74N	Not Motorola	36732	SKH			37293
								01200
IC552		LM78LO5		40406	PLM			44960
IC601		MC3401P		40061		250mA	For 250V Supply	33684
IC602		LM710CN		40083	F1	500mA	For 110V Supply	33685
							e e e e e e e e e e e e e e e e e e e	20000
IC701		MC78L12 A	ACP	40060	F701	100mA		39258
IC702		LM351P15		40059				

Section 6



6.8

Fig. 4 Y Amplifier Circuit Diagram



Fig. 5 Timebase and Trigger Circuit Diagram

6.9



6.10

Fig. 6 Power Supply and C.R.T. Circuit Diagrams



(3) E Ercconn (87 (12) 53 đ 9 0000 -D-3 6.11 0 20 -10 0

Fig. 7 Mechanical View

A0/44581 A0/44575 A2/44976 A3/44976 A3/44976 A2/44976 A2/44976 A2/44966 A1/44466 A1/44466 A1/44466 A1/44468 A2/450009 A3/44973 A3/44973 A3/44973 A3/44973 A3/44973 A3/44973 A3/44973 A3/44973 A3/44973 A3/44973 A3/44973 A3/44973 A3/44973 A3/44973 A3/44973 A3/44973 A3/44973 A3/44973 A3/44973 A3/44973 A3/44973 A3/44973 A3/44973 A3/44973 A3/44973 A3/44973 A3/44967 A3/44967 A3/44967 A3/44967 A3/44967 A3/4402010 A4/402010 A4/402010 A4/402010 A4/402010 A4/402010 A4/402010 A4/402010 A4/402010 A4/402010 A4/402010 A4/402010 A4/402010 A4/402010 A4/402010 A4/402010 A4/402010 A4/402010 A4/402010 A4/402010 A4/402010 A4/402010 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/402000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/4000 A4/40000 A4/40000 A4/40000 A4/40000 A4/40000 A4/40000 A4/40000 A4/40000 A4/40000 A4/400000 A4/400000 A4/400000 A4/4000000 A4/40000000 A4/40000000000	 A0/44581 Frame/Paral Mou A1/44778 Panel Front Switt A2/44975 Coverlay - Poush B A2/44975 Coverlay - Fouxlo A2/44975 Coverlay - Fouxlo A2/44975 Coverlay - Fouxlo A2/44467 Side Support A2/44469 Side Support A1/44460 Side Support A1/44460 Rear Cover A1/44460 Rear Cover A2/450009 Clamp C.R.T. Mol A2/450009 Base C.R.T. Mol A2/450009 Clamp C.R.T. Mol A2/450009 Clamp C.R.T. Mol A2/450009 Clamp C.R.T. Mol A2/4470 Spring A1/44467 Base Flandle A1/44467 Al/44467 A3/4471 Support Moulded A1/44468 Base C.R.T. Mol A2/450099 Clamp C.R.T. Mol A1/44467 Case Bottom A3/4471 Cover Handle A1/44468 Spring A3/4471 Cover Handle A1/44468 Spring A3/4471 Cover Handle A1/44468 Spring A3/4470 Spring Math A3/4470 Spring Math A3/4470 Spring Math A3/4471 Cover Handle A1/44468 Spring A3/4470 Spring Math A3/4470 Screw Ma X I01 A3/44064 Graticule Blue A4/40060 Knob I0mm D' A4/4008 Knob I0mm A4/49063 Connumer A4/49063 Connumer A4/49063 Connumer A4/49063 Connumer A3/49064 Screw Ma X I01 A3/49064 Screw Ma X I01 A4/49063 Connumer A4/49063 Connume	Ref.	Part No.	Description	No. Off
 AI/4478 Panel Font Swite AJ/44975 Coverlay - Switch AJ/44975 Coverlay - Switch AJ/44974 Coverlay - Switch AJ/44974 Coverlay - Switch AJ/441401 Subport AJ/44466 Hatsink AJ/44466 Hatsink AJ/44466 Rear Cover AJ/44969 Rear Cover AJ/44969 Rear Cover AJ/44973 Screen Altenuate AJ/44973 Screen Altenuate AJ/4470 Spindle Moulder AJ/4470 Spindle Moulder AJ/4470 Spindle Moulder AJ/4470 Spindle Moulder AJ/44470 Spindle Moulder AJ/44475 Spindle Moulder AJ/44476 Base Fuse Softma 110 AJ/44475 Spindle Moulder AJ/44475 Spindle Moulder AJ/44476 Base Handle AJ/44469 AJ/44476 Base Handle AJ/44475 Base Handle AJ/44476 Base Handle AJ/44469 Handle AJ/44469 Handle AJ/44469 Handle AJ/44469 Grangle Button Handle AJ/44469 Cose Top AJ/444646 Crasticule Bulee AJ/44064 Granicule Auber AJ/4402009 Kuob 10mm D' AJ/4402009 Kuob 10mm D' AJ/44963 Ruob 10mm AJ/4963 Ruob 10mm AJ/4963 Ruob 10mm AJ/4963 Ruob 10mm AJ/4963 Bush Heyco KD 	 AI/4478 Panel Font Swite AJ/44975 Coverlay - Switch AJ/44974 Coverlay - Switch AJ/44974 Coverlay - Switch AJ/44073 Side Support AJ/4405 Side Support AJ/4405 Side Support AJ/4406 Coverlay - Fould AJ/4406 Side Support AJ/4406 Coverlay - Switch AJ/4406 Side Support AJ/4406 Rear Cover AJ/4406 Fuse Different AJ/4406 Fuse Different AJ/4406 Comector Suppl AJ/4406 Fuse Different AJ/4400 Commetor Suppl AJ/4446 Base Cover AJ/44475 Side Busc Cover AJ/4446 Careen Manua AJ/44475 Screen Altennatic AJ/4446 Case Bottom AJ/4446 Case Bottom AJ/4446 Case Bottom AJ/4446 Screen BN.C. AJ/4446 Screen BN.C. AJ/4446 Base Handle AJ/4446 Case Bottom AJ/4446 Screen Mandle AJ/4446 Screen MA X Bin AJ/44964 Screw MA X 101 AJ/49064 Screw MA X 101 AJ/44964 Screw MA X 101 AJ/4	1	A0/44581	Frame/Panel Moulding	-
 A2(44975 A2(44975 Coverlay - Push B A3(44976 A14470 Side Support A2(4457) Fouse Bupport A2(44457) Side Support A2(44457) Support Mouldin A2(44960 Connector Suppl 40068 Fuse Holder A3684 Fuse Sobma 110 A2(45008) Base C.R.T. Mouldin A2(44703) Screen Timebase A3(4475) Screen Timebase A3(44467) Sase Bottom A3(44466) A3(44467) Sase Bottom A3(44466 A3(44467) Sase Bottom A3(44466) A3(44964) Screw M3 X & Baja Vasher M4 X B Paja 33004 Screw M3 X & Baja Vasher M4 Wave A3(44964) Screw M3 X & Baja A3(44964) Screw M3 X & Baja A3(44964) A4(44060) A3(44964) A4(44064) A3(44964) Screw M3 X & Baja A3(44964) A4(44064) A4(44064) A4(44064) A4(44064) A4(44064)	 A2(44975 A2(44975 Coverlay - Switch A3(44976 A3(44976 A50043 Side Support A50043 Side Support A1(41401) Support Mouldin A2(44457) Panel Rear A1(41401) Support Mouldin A2(44456) Fues Floider A3686 Fues Floider A3685 Fues Stoma 2100 A2(4476) Rear Cover A1(4496) Rear Cover A4972 Screen Attenuato A3(4472) Screen Attenuato A3(4475) Spindle Moulded A4(4476) A4(4476) Spindle Moulded A4(4476) Spindle Moulded A4(4476) Spindle Moulded A4(4476) Screen Attenuato A3(4472) Screen Attenuato A3(4472) Screen Attenuato A3(4472) Screen Attenuato A3(4472) Screen Attenuato A3(4475) Spindle Moulded A4(4476) Screen Attenuato A3(4473) Screen Attenuato A3(4475) A3(4476) A3(4475) A3(4475) A3(4475) A4(475) A4(475) A4(476) A4	5	A1/44478	Panel Front Switches	-
 A2/44976 A2/44976 Coverlay - Fouxl A2/44974 Coverlay - Fouxl A2/402007 Side Support A2/44466 Heatsink A1/41401 Support Mouldin A2/44466 Heatsink A1/44969 Fuse Somma 250 or 33684 Fuse Somma 250 or 33684 Fuse Somma 250 or 33685 Fuse Somma 210 A2/45008 Base C.R.T. Mouldar A2/4470 Base Holder A2/4471 Corent Tittebaat A3/4473 Screen Tittebaat A3/44466 Case Bottom A3/44466 Aa/44466 Base Handle A3/44467 Case Bottom A3/44468 Base Handle A3/44466 Aa/44468 Base Handle A3/44467 Case Bottom A3/44468 Spring A1/44468 Spring A3/44468 Base Handle A3/44471 Cover Handle A3/44468 Spring A3/44468 Spring A3/44468 Spring A3/44468 Spring A3/44468 Spring A3/44468 A3/44468 Spring A3/44468 Spring A3/44468 A4/4468 Spring A3/44468 A4/4468 A4/402010 Knob 15mm U A4/4469 A4/4469 A4/4469 A4/4469 A4/4469 A4/4469 A4/4469 A4/442000 A4/44200 <li< td=""><td> A2/44976 A2/44976 Coverlay - Fouxl BA2/44974 A2/402007 Side Support A2/402007 Side Support A2/40208 Side Support A1/41401 Support Mouldin A2/44466 Heatsink A1/41401 Support Mouldin A2/44466 Heatsink A1/41405 Stear Cover A49660 Connector Suppl 40068 Fuse Softma 250 or 33685 Fuse Softma 250 or 33685 Fuse Softma 210 A2/450095 Ciamp C.R.T. Moulder A3/44973 Screen B.N.C. A4/4456 Spindle Moulded A3/4471 Spindle Moulded A4/4456 Spindle Moulded A1/44467 Case Bottom A3/4471 Screen B.N.C. A4/4456 Spindle Moulded A1/44467 Case Bottom A3/4471 Cover Handle A1/44468 A3/4471 Screen B.N.C. A4/4456 Spindle Moulded A3/4471 Screen B.N.C. A4/4456 Screw MA X R Pain 33045 Screw MA X 101 A3/49564 Graticule Blue A49/4068 Carticule Amber A49/4068 Carticule Amber A4966 Graticule Blue A4973 Screw MA X 101 A4973 Cap Dimm A494366 Screw MA X 120 Screw Bay Hayco KD A4/4963 A494363 Screw Bay KNOb Dimm A4/4963 S</td><td>3</td><td>A2/44975</td><td></td><td>-</td></li<>	 A2/44976 A2/44976 Coverlay - Fouxl BA2/44974 A2/402007 Side Support A2/402007 Side Support A2/40208 Side Support A1/41401 Support Mouldin A2/44466 Heatsink A1/41401 Support Mouldin A2/44466 Heatsink A1/41405 Stear Cover A49660 Connector Suppl 40068 Fuse Softma 250 or 33685 Fuse Softma 250 or 33685 Fuse Softma 210 A2/450095 Ciamp C.R.T. Moulder A3/44973 Screen B.N.C. A4/4456 Spindle Moulded A3/4471 Spindle Moulded A4/4456 Spindle Moulded A1/44467 Case Bottom A3/4471 Screen B.N.C. A4/4456 Spindle Moulded A1/44467 Case Bottom A3/4471 Cover Handle A1/44468 A3/4471 Screen B.N.C. A4/4456 Spindle Moulded A3/4471 Screen B.N.C. A4/4456 Screw MA X R Pain 33045 Screw MA X 101 A3/49564 Graticule Blue A49/4068 Carticule Amber A49/4068 Carticule Amber A4966 Graticule Blue A4973 Screw MA X 101 A4973 Cap Dimm A494366 Screw MA X 120 Screw Bay Hayco KD A4/4963 A494363 Screw Bay KNOb Dimm A4/4963 S	3	A2/44975		-
 A3/44974 A3/44974 Coverky-F. Focuki A2/40457 Panel Rear A50043 Side Support A1/41401 Support Mouldin A1/4466 Heatsink A1/4466 Rear Cover A4966 Comector Suppl A0068 Fuse S0mA 250 or 33685 Fuse S0mA 210 A2/45009 Cars Molder A2/45009 Cars Manual 10 A2/45009 Cars Manual 10 A2/45009 Cars Manual 10 A3/4470 Spinde Moulded A3/44470 Spinde Moulded A3/44470 Spinde Moulded A3/4471 Screen B.N.C. A4/44568 Base Handle A1/44467 Cars Bottom A3/4471 Cover Handle A1/44469 Handle Asy. A3/4470 Spinde Moulded A3/4470 Spinde Moulded A4/44568 Spinde Moulded A4/44568 Spinde Moulded A4/44568 Spinde Moulded A4/44568 Spinde Moulded A3/4471 Cover Handle A1/44467 Carny Harsink 33017 Screw M4 X 101 A4957 Gramp Harsink A49495 Gramp Harsink A49466 Granticute Blue A4/492005 Knob Push But A49467 Granticute Blue A49467 Granticute Blue A49467 Granticute Blue A49467 Granticute Blue A49470 Maber Af Y 101 A49467 Granticute Blue A49467 Granticute Blue A44790 A44490<!--</td--><td> A3/44974 Coverky - Foculy A2/40207 Side Support A2/44457 Panel Rear A50043 Side Support A50043 Side Support A50043 Side Support A1/44466 Heatsink A1/44466 Fuse 250mA 250 or 33685 Fuse 250mA 250 or 33685 Fuse 250mA 250 or 33685 Fuse 500mA 110 A2/450089 Base Cover A44467 Screen BN.C. A1/44467 Spring Moulded A1/44467 Base Handle A1/44467 Case Bottom A3/4473 Screen Inchease A3/4473 Spring A4/44468 Case Bottom A3/44469 Base Handle A1/44461 Case Bottom A3/44475 Base Handle A1/44468 Case Bottom A3/44468 Case Bottom A3/44468 Case Bottom A3/44468 Case Bottom A4/4456 Spring A4/4456 Spring A4/4456 Spring A4/4469 Granp Heatsink A3004 Screw M4 X 101 A3/49064 Screw M4 X 101 A3/49064 Screw M4 X 101 A3/49064 Screw M4 X 101 A3/49054 Screw M4 X 101 A3/49054 Screw M4 X 101 A3/49054 Screw M4 X 101 A3/44054 Screw M4 X 101 A4/4056 Masher M4 Pain A4/40500 Kaob 10mm D' A4/40500 Screm BN C. 50 A4/410500 Kaob 10mm A4957 Cop 10mm A4953 Cap 10mm A4953 Screw M3 X 101 Screw M4 X 11 Screw M4 X 11 Screw M4 X 11 Screw M4 X 101 Screw M4 X 101</td><td>4</td><td>A2/44976</td><td></td><td>-</td>	 A3/44974 Coverky - Foculy A2/40207 Side Support A2/44457 Panel Rear A50043 Side Support A50043 Side Support A50043 Side Support A1/44466 Heatsink A1/44466 Fuse 250mA 250 or 33685 Fuse 250mA 250 or 33685 Fuse 250mA 250 or 33685 Fuse 500mA 110 A2/450089 Base Cover A44467 Screen BN.C. A1/44467 Spring Moulded A1/44467 Base Handle A1/44467 Case Bottom A3/4473 Screen Inchease A3/4473 Spring A4/44468 Case Bottom A3/44469 Base Handle A1/44461 Case Bottom A3/44475 Base Handle A1/44468 Case Bottom A3/44468 Case Bottom A3/44468 Case Bottom A3/44468 Case Bottom A4/4456 Spring A4/4456 Spring A4/4456 Spring A4/4469 Granp Heatsink A3004 Screw M4 X 101 A3/49064 Screw M4 X 101 A3/49064 Screw M4 X 101 A3/49064 Screw M4 X 101 A3/49054 Screw M4 X 101 A3/49054 Screw M4 X 101 A3/49054 Screw M4 X 101 A3/44054 Screw M4 X 101 A4/4056 Masher M4 Pain A4/40500 Kaob 10mm D' A4/40500 Screm BN C. 50 A4/410500 Kaob 10mm A4957 Cop 10mm A4953 Cap 10mm A4953 Screw M3 X 101 Screw M4 X 11 Screw M4 X 11 Screw M4 X 11 Screw M4 X 101 Screw M4 X 101	4	A2/44976		-
A2(402007) Side Support A50043 Side Support A1(41401) Support Mouldin A2(44457) Fanel Rear A1(41401) Side Support A2(44456) Fuse Flodes Fuse Flodes (4068) Fuse Flodes Fuse S00m A110 A2(450008) Fuse S00m A110 A2(44071) Cover Handle A1(44457) Screen Timebase A3(44758) Screen M.N.C. A3(44758) Screen M.N.C. A3(444758) Screen M.N.C. A3(44476) Clamp Heatsink 33004 Screw M3 X & Pa 33004 Screw M	A2/402007 Side Support 450043 Side Support Mouldin A2/44457 Panel Rear A1/41401 Support Mouldin A2/44066 Fush Heatsink A1/44966 Connector Suppl 40068 Fuse Softma 250 a3684 Fuse Softma 250 a374973 Screen Attenuato A3/44973 Screen Attenuato A3/44476 Spindle Moulded A4/44466 Caser Dime Aasy A1/44468 Sping A1/44468 Button Handle A1/44468 Caser Dime Aasy A3/44471 Cover Handle A1/44468 Caser Dime Aasy A3/44475 Base Handle A1/44468 Caser Dime Aasy A3/44475 Base Handle A3/44471 Cover Handle A1/44468 Caser Dime Aasy A3/44475 Base Handle A1/44468 Caser Dime Aasy A4/447090 Screw M3 X & Pa 33016 M3 Plan Washer A3/34964 Caser M4 X & Pa 33016 M3 Plan Washer A3/44006 Caser Dime Panel A3/44064 Caser Dime Di A3/449064 Craticule Blue A4/42010 Knob 15mm Di A4957 Cop Dimm Di A4958 Cap Dimm Wi A4958 Wi Wi Wi A4958 Cap Dimm Wi A4958 Cap Dimm Wi A4958 Wi Wi Wi A4958 Wi Wi Wi A4958 Wi Wi Wi A4958 Wi Wi A4958 Wi A495	S	A3/44974	Coverlay - Focus/Brill	-
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