MODEL bwd 5S/1

DELAYED SWEEP

TIME BASE PLUG-IN

INSTRUMENT HANDBOOK

Applicable to Serial No. .....

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TIME BASE PLUG-IN

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DELAYED SWEEP TIME BASE PLUG-IN

1. GENERAL

Plug-in provides four time base facilities : -

1.1 Normal Triggered Time Base

The 22 range switch provides sweep speeds from 200 nano sec/cm to 10 sec/cm in conjunction with the vernier control. x5 expansion increases the highest speed to 40 nano sec/cm. Triggering is available from the internal amplifiers or externally, either AC or DC coupled, together with high or low frequency selection. Line frequency is also available by main frame switching.

1.2 Single Stroke Time Base

All the normal functions are provided, but the trace is locked off to the right of the CRT (and blanked) and can only be reset in readiness for the next trigger pulse by pressing the Reset button.

1.3 Free Running

Trace appears irrespective of input trigger selection or setting and time base re-initiates immediately hold off period is complete.

1.4 Delay Time Base

6 delay ranges are provided and are continuously adjustable from 1uSec. to 1 Sec. The trace is triggered by the output pulse of the delay circuit. The delay circuit may be triggered by all the selection facilities provided for the normal triggered time base.

2. SPECIFICATION

2.1 Time Base (Non-Delayed, Single Stroke, Free Run or Delayed Modes)

Range :	200 nano seconds to 2 sec/cm in 22 switched ranges with an uncalibrated 5-1 vernier control extending range down to 10 sec/cm.
Calibration :	3% from 0.5uSec to 0.5 sec/cm at x1 magnification. 5% at all other settings and x5 magnification except as under. 10% at x5 magnification of 0.2uSec/cm range.
	NOTE : Calibration is denoted as the accuracy between the 2nd and 9th graticule lines (applicable to main frame).
Expansion :	x1 to x5 switched. Calibration as above. x5 expansion increases sweep speed to 40 nano sec/cm.
Blanking :	Direct coupled to CRT.

2.2 Delaying Sweep

Range :	1uSec to 1 Sec in 6 decade ranges with 10 turn calibrated control providing continuously variable selection.
Calibration :	Within 10% over the vernier range of 10 to 100 for each switch range up to 5uSec. Calibration is normally better than 3% from 5uSec to 100mSec.

2.3 TRIGGER FACILITIES (NON DELAYED, SINGLE STROKE OR DELAYED MODE ONLY)

These are selected by one variable control with a switch facility and 5 slider switches, two mounted on the main frame and three on Plug-in. The facilities are tabulated below : -

Main Frame Switches		5S/1 Switches			
Upper Beam	EXTx10 gain) AC or DC	AC)	INT	+	NORM
Lower Beam	EXT x1 gain) coupled	DC)			FAST
	LINE	EXT		–	SLOW

Variable Control (TRIGGER LEVEL)

Fully anti-clock (switched) AUTO (Vari-Rate) maintains a bright trace at all time base speeds. ROTATION of LEVEL SELECT control provides selection of trigger point over a 6cm deflection on CRT or ±5V & ±50V Ext. Any combination of the above facilities is available providing an extremely flexible triggering arrangement capable of accommodating any signal that the CRT can display.

Sensitivity is shown below for the various inputs. Non-Delayed, Delayed Sweep or Single Stroke operation.

2.4 INTERNAL. All sensitivies + or - selection (using 5B or 5D plug-in amplifier)

AUTO min level 2 mm
" 1cm deflection 10 Hz to 30MHz, AC coupled, 5Hz DC coupled.
LEVEL SELECT 1 cm deflection DC to 20MHz
" 3 cm deflection DC to 30MHz
Min level select ± 3cms.

NORM position connects the selected signal directly to the trigger circuit,
SLOW position provides an HF cut off above 2kHz - 3db (6db/octave)
FAST position provides an LF cut off below 2kHz - 3db (6db/octave)

2.5 EXTERNAL. Main Frame Sockets, all sensitivities, + or - selection.

Input Impedance 1MΩ shunted by <30pF.
Input coupling DC or AC (3db down at 2Hz).

AUTO (X10 gain)	min. input 0.2V p-p. 50 Hz to 1MHz.
"	1V p-p Input 10Hz to 30MHz.
LEVEL SELECT	1V p-p DC to 20MHz.
" "	Range X10 gain ± 5V p-p.
" "	Range X1 gain ± 50V p-p.
LINE	+ or - selection with phase control of trigger point by Level Select control.

2.6 HORIZONTAL AMPLIFIER (Input on Main Frame)

Bandwidth	DC or 2Hz (AC coupled) to 4MHz-3db. Referred to 6 cm. deflection at 50kHz.
Sensitivity	Switched 100mV, 500mV, 1V and 5V/cm. Switched by X1 & X5 magnification on 5S/1 & X1 and X10 input on 521 main frame.

2.6 HORIZONTAL AMPLIFIER (Contd.)

Input Impedance	1MΩ and < 30pF (on main frame).
Deflection	+ve input deflects spot to right.

3. FUNCTION OF CONTROLS

3.1 Front panel controls are grouped for ease of use and are clearly designated. The functions of these controls are as described below and shown oposite on drawing.

3.2 TIME/CM (TIME BASE) SWITCH

When the Time Base Vernier control is fully clockwise in the CAL position, the 22 time base speeds on this control will be accurate to specification. The switch speeds represent the fastest speed on each range.

3.3 T.B. VERNIER (co-axial with TIME/CM Switch)

Varies the Time Base speed over a range greater than X5 to provide a continuously variable range in conjunction with the TIME/CM switch of 10 sec/cm to 0.2μSec/cm. Anti-clockwise rotation of the Time Base Vernier Control will reduce the selected time base speed, e.g. on the 1mSec range the Vernier will vary the time base from 1mSec down to slower than 5mSec/cm when fully anti-clockwise.

3.4 Function and RANGE Selector

Fully anti-clockwise Switch selects TRIG position. In this position time base operates as a normal non-delayed triggered time base. All triggering facilities and trace magnification are available as specified.

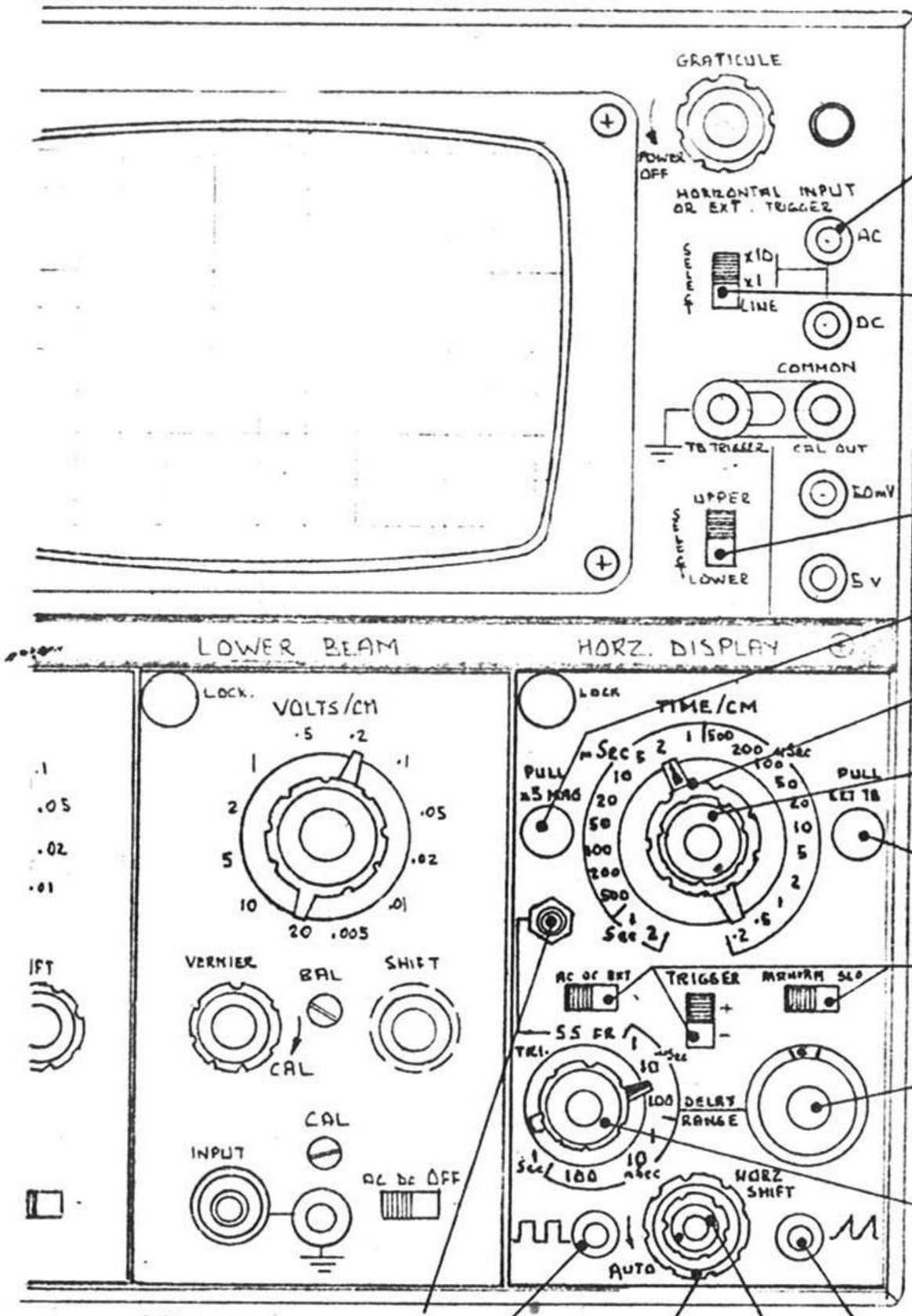
S.S. (Single Stroke) is the second position in which all the non-delayed time base facilities are available, but trace remains locked out to right of CRT and blanked out after each stroke. To reset time base for next display, RESET BUTTON must be pressed.

The third function is F.R. (Free Running). The Time Base calibration remains correct, but no trigger signal is required to initiate the trace which repeats continuously. Both the sawtooth waveform and the blanking waveform are available at the front panel to synchronise external circuits to the time base. The blanking pulse may be used as a clock pulse, thus maintaining automatic locking to any circuits driven by it.

The next 6 positions select the Delay Ranges for the Delayed Time Base function. The knob indicates the range available on the 10 turn Vernier, e.g. if it is between 10 and 100μSec then 100 on the Vernier will be 100μSec delay whilst 10 would be 10μSec delay. All other readings in between are a direct indication of the delay between these limits. Calibration is adjusted to make the 10 turn dial direct reading between 10 and 100 for each range. The display Time Base is triggered by a pulse at the end of the delaying period.

3.5 AUTO & LEVEL Control (Red co-ax knob)

Fully anti-clock and switched to AUTO, any signal greater than 0.2cm in amplitude will trigger the time base. With no input signal the time base initiates itself automatically to produce a base line. The automatic rate increases as the Time Base speed range increases.



AC or DC COUPLED EXT TRIG or HORZ AMP INPUT SOCKETS.

EXT TRIGGER or HORZ AMP X10 X1 or LINE FREQ SELECTOR SWITCH.

AMPLIFIER TRIGGER SOURCE SELECTOR.

X5 MAG P-P SWITCH

MAIN TIME BASE RANGE SWITCH.

MAIN TIME BASE VERNIER.

INT-EXT TIME-BASE PUSH PULL SWITCH.

TRIGGER SOURCE, SLOPE, & COUPLING SWITCHES.

10 TURN DELAY VERNIER MULTIPLIER.

NORM SS, FR or DELAY RANGE FUNCTION SWITCH.

SINGLE STROKE RESET BUTTON

HORZ POSITION (GREY KNOB)

TIME BASE SAWTOOTH OUTPUT

TIME BASE GATE PULSE OUTPUT

TRIGGER LEVEL SELECT CONTROL (RED KNOB)

MAIN FRAME FITTED WITH DELAYED SWEEP TIME BASE PLUG-IN TYPE 5S/1

3.5 AUTO & LEVEL Control (Cont.)

When control is switched out of the Auto position, it selects the LEVEL on a displayed waveform up to ±3cms amplitude which will initiate the trigger the time base circuits.

3.6 HORZ. SHIFT

Grey co-ax knob at the bottom of the panel moves the trace horizontally on the CRT.

3.7 Pull X5 MAG.

When the Time Base is in use, this control varies the length of the trace from 10 cms to 50 cms, providing X5 magnification. When an external Horizontal Input is used, the MAG control varies the sensitivity from 100mV to 500mV per cm. approximately at X10 input selection on main frame and 1V to 5V at X1 selection.

3.8 ± Switch

Selects the positive (+) or negative (-) slope of the displayed signal or external trigger waveform to initiate the time base.

3.9 AC-DC-EXT Switch

Selects the trigger source from internal amplifiers in the AC or DC positions or external signals in the EXT position via the Main Frame input sockets. (AC or DC coupled as selected by main frame input socket).

NOTE: AC. INT should normally be used when AUTO triggering is employed unless frequencies below 10Hz are being displayed.

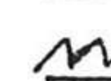
3.10 NORM-FAST-SLOW Switch

Selects the full frequency range of the trigger signal in NORM position, frequencies above 2kHz are attenuated in the SLOW POSITION and attenuated below 2kHz in the FAST POSITION.

3.11 EXT T.B. Switch

When pushed in, internal time base is displayed and Horizontal Input from Main Frame is coupled to trigger circuit selection switches. When pulled out, Time Base is switched off and Main Frame Horizontal Input is coupled to output amplifier for external horizontal display.

3.12 FRONT PANEL SOCKETS


Time Base Output Pulse

A positive going sawtooth waveform swinging between -2V to -0.5V. Output DC coupled at low impedance. Minimum output load 100kΩ.


Time Base Blanking Pulse

Positive going during trace, swinging between +0.75V and +2V. Low output impedance (1.0kΩ) minimum load 10kΩ.

4. FIRST TIME OPERATION.

Description is based on an oscilloscope main frame and 2 x 5A, B or D amplifier plug-ins and the 5S/1 in the R.H. cavity.

4.1 NORMAL TRIGGERED OPERATION (Non delayed).

Set controls as follows -

Main Frame Amplifier Selector	UPPER
5S/1 Controls -	
TIME/CM	1mSec
X5 MAG	X1 (pushed in).
EXT T.B.	INT (pushed in).
INT-EXT-TRIGGER	INT-AC
+-	+
NORM-FAST-SLOW	NORM
Function Switch	TRIG
VERNIER/MULTIPLIER	any Position
TRIG LEVEL	AUTO (fully anticlock)
Position	CENTRED.

4.2 Apply 1kHz sine wave signal to L.H. amplifier adjust amplitude of display for 6 cms. Centre trace with position control.

To check trigger operation first note how the trace initiates from the centre of the rising slope of the waveform, now change ± selector to -, the trace now initiates from centre of the falling slope. Rotate TRIG LEVEL knob (red) clockwise away from the AUTO position. The display will initially disappear then reappear as the knob is rotated, the trigger point moving slowly down the slope of the displayed sine wave until at the bottom the trace, it again disappears and will remain off until the LEVEL control is returned to select an 'on the screen' section of the waveform. Changing over the ± switch back to + will now permit the LEVEL control to select any point on the rising face of the waveform.

Return the LEVEL control to AUTO.

4.3 EXTERNAL trigger in the normal mode may now be selected by pulling out EXT TB knob and switching TRIGGER source to EXT, leave all other controls in existing positions. Jumper signal applied to vertical amplifier across to EXTERNAL TRIGGER INPUT AC socket on the main frame. If signal level is below 5V p - p switch Selector to X10, if above 5V p-p to X1.

All the checks relating to internal trigger may now be repeated for EXT trigger including + or - selection and level selection. After checking return selector switch on 5S/1 to INT AC and push in EXT TB button.

4.4 SINGLE STROKE OPERATION (Non delayed)

With all controls set as in 4.1 switch mode to S.S. Trace will lock out at right of screen. Remove signal from vertical amplifier input (switch input selector to OFF). Press RESET button on 5S/1, trace will be ready for trigger pulse but still blanked out. Apply signal to vertical amplifier, trace will traverse CRT once and remain locked out. It will not reset until RESET button is again pressed.

4.5 FREE RUNNING OPERATION (Non delayed)

All controls set as in 4.1 then switch mode selector to F.R. Trace will appear but will not lock to any input waveform either externally or internally. However, the pulse from the ⎍⎍ output socket on 5S/1 may be used as a clock pulse to drive other equipment with the result that they will always remain locked to the 521 display irrespective of the time base frequency.

4.6 DELAY TRIGGERED OPERATION

When the six delay ranges are selected the AUTO facility is changed to a PRESET condition. Trigger sensitivity is optimised but without trigger input signal the trace will not be initiated.

The DELAY RANGE switch in conjunction with its associated VERNIER (MULTIPLIER) control covers the range 1µSec to 1Sec.

To check operation set controls as follows -

Main Frame	
Amplifier Trigger Selector	UPPER
5S/1 Controls	
TIME/CM	100µSec/cm.
X5 MAG.	X1 (pushed in)
EXT T.B.	INT (pushed in)
INT-EXT TRIGGER	INT AC
+-	+
NORM-FAST-SLOW	NORM
FUNCTION SWITCH	100µSec to 1mSec range
VERNIER (MULTIPLIER)	10 (fully clockwise)
TRIGGER LEVEL	AUTO (becomes PRESET in this mode)
POSITION	To centre trace

4.7 Apply a 1kHz pulse or square wave to the L.H. vertical amplifier. Adjust for 2-6cm deflection. Positive going edge of input signal will appear on the first & tenth graticule lines approx. indicating a delay of 1mSec (100µSec x Vernier/Multiplier reading of 10). Rotation of VERNIER/MULTIPLIER will cause waveform to move across screen from left to right. When VERNIER/MULTIPLIER is reading 5 the leading edge of the displayed waveform is in the centre of the screen indicating a delay of 5x100µSec = 500µSec. When the reading is 2 the waveform will line up with the 2nd cm mark from the RIGHT - a delay of 200µSec.

If the DELAY RANGE is switched to 1mSec to 10mSec range one waveform will move across the screen between each major digit on the VERNIER/MULTIPLIER range switch indicating a maximum delay of 10 - 1 delay input frequency. The next range provides a 100 - 1 delay range of the input signal, i.e. 10mSec to 100mSec and the final range covers 100mSec to 1 sec. A maximum delay of 1000 - 1 of the 1kHz input waveform. It will be noted that the trace brightness diminishes as the delay is increased due to the reduced repetition rate of the time base. Under normal triggered conditions the trace would scan approx 500 times per second. With a 100mSec delay applied to the signal the trace will scan only 10 times per second resulting in an apparent trace brightness reduction of 50 times.

4.8 Triggering of the DELAYED time base is the same as for normal non-delay trigger with AC or DC coupling internal or external selection + or - slope etc. The full range of facilities is detailed below : -

Trigger Source : INT.AC. connects to either internal amplifier. Low frequency response is -3db at 5Hz.

INT.DC. directly coupled to internal amplifiers for very low frequency triggering. AUTO condition still operates in the DC coupled position.

EXT. AC or DC coupled as determined by the input socket selected on the main frame or the AC-DC switch on the rack mounted main frame.

+ or - : Slope selection of internal or external waveform.

NORM-FAST-SLOW switch selects the input coupling to the trigger amplifier. NORM is straight through, FAST puts a small capacitor in the signal path to attenuate all signals below 2kHz whilst SLOW integrates the input signal to remove high frequency components above 2kHz. The SLOW position is extremely useful when displaying noisy low frequency signals on those with superimposed R.F. present which causes erratic triggering in the NORM condition. FAST may also be an advantage when triggering from narrow pulses at low repetition rates.

4.9 x5 MAG

This control increases the horizontal sweep by a factor of 5, e.g. 100uSec becomes 20uSec/cm when the knob is pulled out. Trace length and shift range increases by x5 enabling the entire magnified sweep to be paraded across the screen to view any portion of it.

At 0.2uSec/cm the magnified sweep speed becomes 40 nano Sec/cm providing adequate resolution of a 10 nano Sec risetime waveform.

4.10 An external Time Base may be applied to the horizontal display by pulling out the EXT. T.B. knob and feeding the desired signal into the AC or DC HORIZONTAL INPUT Sockets on the main frame. The x1 or x10 selection plus the x1 or x5 magnification of the 5S/1 plug-in permits signals to be displayed from 100mV to 50V p-p within the 10 cm limits of the graticule.

The 5S/1 Delay Time Base will be found to be a very stable, flexible unit capable of triggering from virtually any waveform that can be displayed from DC to over 30MHz.

5. CIRCUIT DESCRIPTION

The circuit can be sub-divided into six sections as follows : -

a) Trigger amplifier and shaper (Q401-406)
b) Main Time Base (Q408,9,13-17)
c) AUTO circuit (Q407)
d) Blanking Generator (Q410-12)
e) Delay Time Base (Q501-506)
f) Horizontal Amplifier (Q418-423)

5.1 Trigger Amplifier and Shaper

Trigger signals arrive from two sources in the oscilloscope main frame. From the internal

5.1 Trigger Amplifier and Shaper (Cont.)

amplifiers via pin 12 or from the EXT trigger input via pin 6 on interconnecting plug PL401. S402 A and B selects the required source which is then fed via R401 to the coupling switch S401 A and B. C402 is placed in series in the FAST position and R408 in the SLOW position to integrate the waveform in conjunction with C403. Input F.E.T. Q401 source follower supplies the trigger amplifier Q402 and 403 via R406. + or - slope selection is made at the collectors without switching the actual signal path. The amplifier output load is R413 in parallel with R499. As shown in the circuit Q402 is switched to R410 by S403, D401 is conducting and as the potential on Q402 collector is higher than the function of R413 and 499 diode D402 is reversed biased. Q403 is therefore the trigger amplifier with its collector current passing through D403, D404 being o/c. Input signals to Q403 are applied via its common emitter coupling to Q402. Balance between the two halves is preset by RV401.

RV402A Level Select control has switch S404A coupled to it. Fully anticlockwise it is opened and no DC level is applied to Q403 base so the potential is slightly positive to ground as set by RV401 to bring the circuit into balance.

When the Level Control is rotated S404A closes, a DC potential is applied to Q403 base and combined in the transistor with the input trigger signal. This enables the waveform to be varied about the switching point of the following Schmitt trigger thus providing selection of the trigger point.

Emitter follower Q404 isolates the amplifier from Q405 and 406 Schmitt trigger a circuit which generates a fixed amplitude fast rise and fall wave from any shape or amplitude input.

When S404A is closed the action is as follows: with Q405 conducting, its collector will bottom and Q406 will be cut off by the voltage divider action across R419 and R422/RV403. A negative going input signal from the trigger amplifier will cut off Q405, its collector will rise pulling Q406 base positive, so turning Q406 on producing a negative pulse at the collector. As the emitters are coupled together, the current through Q406 will now hold Q405 off until its base is driven above the common emitter potential and the switching action is reversed.

5.2 MAIN TIME BASE CIRCUIT

The Time Base sawtooth generator consists of Q408 and 409 bi-stable trigger, Q414 Miller sawtooth generator and Q417 emitter follower with associated clamping diodes D505, 6, 7, 10 and 11. The function is as follows -

Assuming Q408 is conducting, Q409 will be cut off, its collector will rise and D411 will conduct, pulling the gate of Q415 and hence the base of Q414 positive. The collector of Q414 will fall to approximately +5V together with Q417 base. At this point diode D410 connected into the emitter load of Q417 passes below zero and starts to conduct pulling D411 to a lower conduction level.

In this direct coupled quiescent state, the trace will be ready for a trigger input pulse via S501 B or C. A negative pulse on Q408 base will cause the collector to rise taking Q409 base positive. This causes current to flow through Q409 into the emitter resistor R431, biasing Q408 off further and a rapid cumulative action occurs

5.2 MAIN TIME BASE CIRCUIT (Cont.)

in which Q408 cuts off and Q409 saturates. D411 becomes reverse biased, Q415 is left with its gate at -1.5V approximately and connected through the timing resistor R456 to R463 to a negative potential on RV405 which will pull Q415 and thereby Q410 towards cut-off. However, the timing capacitors selected by S405D are effectively in circuit between the base and collector of the Miller Transistor Q414 and prevent a sudden rise at Q414 collector by the action of the negative feedback applied.

Q415 FET source follower presents a high impedance to the charging circuit enabling high value charging resistors to be utilised with small high stability timing capacitors. Q417 emitter follower provides a low output impedance to charge the capacitors and drive the output and gating circuits. As Q415 gate and Q414 base fall, Q414 collector rises and via Q417, D412 and C425 a charge is applied to the selected timing capacitor on S405D. The result of this negative feedback is to linearise the charging rate to the timing capacitor and to produce a positive going sawtooth waveform at the collector of Q414 and base of Q417 where it appears at low impedance at its emitter. The sawtooth continues to rise until the potential at the junction of R454 and R455 reaches approx. -4V. Q416 and D406 then conduct and charge C416 to C419 as selected by S405A. It also takes the base of Q408 positive to its emitter potential and continues positively until Q408 conducts causing its collector to fall cutting off Q409 and at the same time transferring the emitter current from Q409 to Q408. D411 conducts pulling the gate of Q415 positively, Q414 collector falls, rapidly discharging the timing capacitor until Q417 emitter falls sufficiently to cause D410 to conduct to pull D411 back to a quiescent condition and stabilise the circuit ready for the next trigger pulse. This will initiate the next trace once the hold-off capacitors C416, 419 have discharged sufficiently through R426 and the base current of Q408.

5.3 When Function Switch S501 is switched to S.S. (single stroke), all conditions exist as previously described except that S501A opens the signal path between Q416 emitter and diode D406. The result is that when the sawtooth waveform rises, the clamping action which reverts Q408 and 9 back ready to receive a trigger pulse, does not occur and the sawtooth continues to rise until Q417 saturates and its base-collector diode forward conducts and clamps the output at approx. +51V. By this time the trace is well off the CRT to the right and blanked out by the horizontal deflection plate cut off limit. To reset the time base, push button S507 is connected across S501A and when pressed allows the circuit to resume its correct condition with the trace blanked and awaiting a trigger pulse.

5.4 In the F.R. (free running) mode the trigger input to Q408 is disconnected and the base of Q408 at the junction of R424 and R425 is taken slightly negative by R502 brought into circuit by S501C. The time base action is as before until the end of the hold off period when the base of Q408, instead of being held by D405 in a condition that will allow the time action to be initiated by a negative trigger pulse, is instead pulled negatively by the current through R502 sufficiently to cause Q408 and 9 to switch over and start another time base run up.

5.5. AUTO Time base operation is obtained by allowing the clamping network for Q408 base to run down at a controlled rate until the time base automatically turns itself on if no trigger pulse arrives during the run down. Q407 clamp discharges C415 and C411 - 414 as selected by S405B and holds the top of R424 at -.2V during the normal sweep period as its base is held negative to its emitter by current through R423 and Q409. During the return trace Q409 rises cutting off Q407 thus permitting C415 and C411 to 414 as selected to charge negatively through R424, 5 and 6. When the junction of R424 and 5 falls below the emitter potential of Q408 it ceases to conduct, its collector rises and the cumulative switching action described in 5.2 occurs with the resultant sawtooth sweep generation. During this period Q407 is pulled into conduction to discharge the AUTO capacitors in readiness for the next run down.

The progressive reduction in capacitor value as the sweep speed rises results in a bright reference base line at all time base speeds and provides more reliable triggering at very high frequencies.

The AUTO facility is eliminated when the delay sweep is in use to prevent the time base tripping during the delay period, this is accomplished by S501F wafer which shorts out Q407. S404B also shorts out Q407 when Level Selection of the trigger waveform is in use.

5.6 C.R.T. Blanking by the Time Base circuit is accomplished by directly coupling the C.R.T. blanking electrode via R409.to Q411 and 412 collectors which are driven between the clamping diode limits of +12V (D409) and +50V (D408). Q412 is driven by Q410 via R435 common emitter resistor and conducts during return trace, but it biased off during the forward trace. C421 and C423 speed up capacitors ensure sharp turn on and turn off times of the blanking waveform.

5.7 DELAY TIME BASE

This section is contained on a separate P/C board located at the bottom of the plug-in It consists of a bi-stable switch Q502 and 3, diode gate D504, Miller run-up transistor Q504, emitter follower Q505, Q506 constant current source, and gating transistor Q501.
The operation is as follows -

In the quiescent stage awaiting a trigger pulse Q502 will be conducting, Q503 cut off and D504 is therefore conducting. Q504 will also be conducting with its collector bottomed and Q505 emitter follower coupling this level back to the input of Q502 via R500, D502.

The input trigger level is held slightly positive by the clamping voltage from Q410 emitter, R501 and R503. Trigger pulses from Q406, via C409 and S501B are applied to Q502 base through D502 gating diode. A negative going pulse will cut Q502 off permitting its collector to rise and via R508/C501 Q503 base will be pulled positively causing it to conduct. As its collector falls the divider R512, 509 across to Q502 base will cause it to fall cutting it off further. This results in a cumulative action which leaves Q502 cut off and Q504 saturated with its collector at +0.2V approx.

5.7 TIME DELAY BASE (Cont.)

Diode D504 is coupled to Q504 through a divider R514 and 515 which will now bias D504 off leaving Q504 free to produce a timing waveform. The base is returned to -50V via R516 timing resistor which tends to bias Q504 out of conduction. As its collector rises the selected timing capacitor C504 to 510 feeds back the rising waveform via Q505 in antiphase to the negative going base supply. This results in a very linear rise of voltage at the collector which is controlled only by the value of the timing capacitor and resistor and not by the characteristics of the transistor Q504.

The rising voltage is coupled directly to Q505 emitter follower. The emitter output is used in three ways; to charge the timing capacitors C504 - 510; to charge via D506 the selected hold off capacitor C514 to 519, and emitter load RV501 ten turn control picks off a voltage across the divider chain and feeds it back to Q501 base. When the pick off voltage rises above +0.6V, Q501 conducts, its collector falls until Q503 starts to cut off. Its collector rises and pulls Q502 base positive. Another cumulative action occurs resulting in Q502 conducting with its collector saturated and Q503 cut off. The sharp fall at Q502 collector is differentiated by C500 and fed via S501C to Q408 to initiate the Main Time Base.

As Q504 rises it pulls D504 into conduction via R514. This causes Q504 to conduct and rapidly discharge the selected timing capacitor. Q505 emitter falls biasing off D506 charging diode, and continues to fall until D505 conducts, pulls D504 negatively thus reducing the conduction through it. Q504 continues to fall until D504 conduction reaches a point where current through Q504 is stabilised by the forward current through D504 from R514 and 515 and the reverse bucking current from D505. With D506 disconnected the hold off capacitors C514 to 519 will discharge through R523 and reverse bias diode D502 during the period the timing capacitors are discharging in readiness for the next timing cycle. The hold-off capacitors continue to fall until they cause D501 to forward bias and conduct, so clamping the input level of D502 in readiness for a trigger pulse.

5.8 HORIZONTAL AMPLIFIER

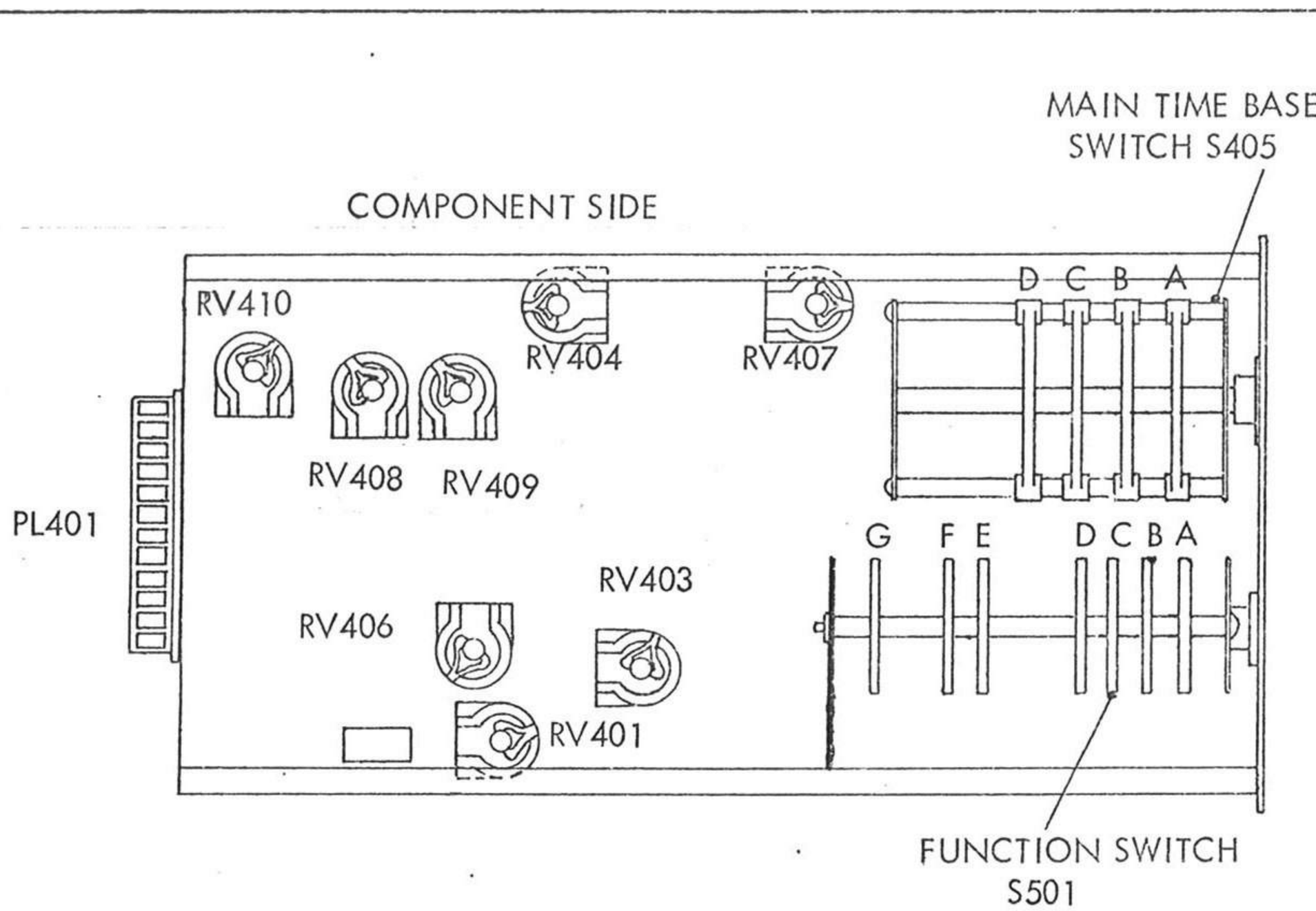
S406D selects internal or external signals for Horizontal Display. The T.B. signal is divided down by R464, C443, R465, and shift injection resistor R467. Q418 emitter follower drives the differential pair Q419, and Q421 with the Horizontal gain preset controls RV408 and 409 for X1 and X5 gain located between their emitters.

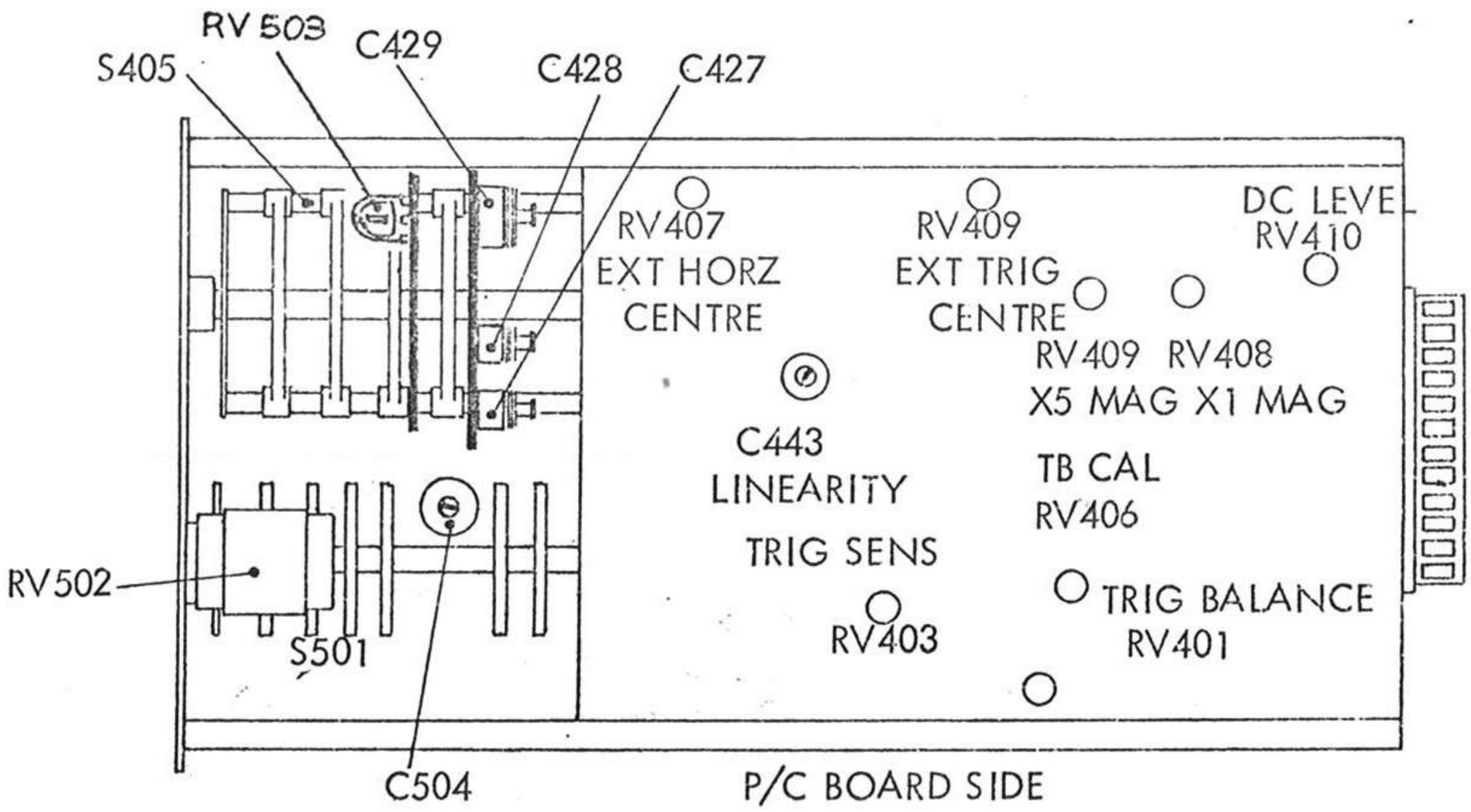
The Main Frame output amplifiers are driven by emitter followers Q422 and Q423. DC output level is set by Q420 via the base divider R478 and RV410. External Horizontal input signals are centred about zero by RV407.

6. ALIGNMENT PROCEDURE

The following instruments are required to completely align and check a bwd 5S/1 Delay Time Base Plug-in.

bwd 521 main frame fitted with 1 x 5D or 5B amplifier plug-in.
Pulse generator with decode outputs from 100 nano Sec to 1 pulse/sec with better than 0.1% accuracy.
Wide band RF generator covering 100kHz to 30MHz.
Sine/Square wave generator 1Hz to 1MHz (bwd 140A)





5S/1 PLUG-IN SHOWING LOCATION
OF CONTROLS & SWITCHES.

6.1 PROCEDURE MAIN TIME BASE (Fitted to the 521 main frame with 5B or 5D amplifier)

Turn T.B. range switch to 1mSec/cm. Vernier to CAL, Mode Switch to NORM. Feed 1kHz pulse to vertical channel, adjust RV408 for a trace length of 10.5 cms. approx. at X1 magnification. Now adjust T.B. Vernier control to display 1 pulse/cm precisely. Pull out X5 MAG knob, adjust RV409 for 1 pulse/5cms.

TRACE CENTREING. This control is on the main frame, main P/C board. T.B. to 1mSec; expansion to X1. Move shift and check approx. equal movement, recentre. Expand to X5, note whether trace expands equally either side of centre. Adjust RV6 for best compromise between equal shift and symmetrical expansion.

DC LEVEL ADJUST. Feed in a 10MHz input signal, T.B. to 0.2μSec, MAG to X5. Adjust RV410 for best trace linearty when display is moved across CRT with the Horizontal Shift control.

Return to X1 MAG, Vernier to CAL. T.B. at 1mSec. Input 1kHz. Adjust RV405 for 1 pulse/cm; as CRT deflection system has a slight compression over the first and last cm of deflection, always calibrate between 2nd and 9th cm lines.. Check below 1mSec for time base calibration to specification and above at 100 μSec. The following table indicates the input frequency and adjustment necessary to align the time base speeds. Higher speeds may then be adjusted individually by capacitors mounted on the rear of the time base switch.

6.2

T.B. SPEED	INPUT	ADJUST
2 Sec/cm	1 Sec)	
1 Sec	1 Sec)	
500mSec *	1 Sec)	
200mSec	1 Sec)	
100mSec	10Hz)	RV 504
50mSec	10Hz)	Adjusts
20mSec	10Hz)	Calibration
10mSec	100Hz)	of
5mSec *	100Hz)	this
2mSec	100Hz)	Range
1mSec	1kHz)	
500μSec	1kHz)	*Adjusted by RV503
200μSec	1kHz)	
100μSec	10kHz)	
50μSec *	10kHz)	
20μSec	10kHz)	located on P/C
10μSec	100kHz)C429	board at rear
5μSec	100kHz)	of T.B. switch
2μSec	100kHz)	
1μSec	1MHz)	
.5μSec	1MHz	C428
.2μSec	10MHz	C427

6.3 HORIZONTAL AMPLIFIER CENTRING

Pull out EXT T.B. switch. Adjust RV407 to obtain equal shift either side of CRT centre.

6.3 Horizontal Amplifier Centring (Cont'd)

NOTE : CRT geometry tolerance allows spot to be located ± 1 cm of CRT centre and display is adjusted above to expand symmetrically around centre determined by the CRT gun structure.

6.4 Delay Time Base

Remove centre plug-in from the main frame - (instrument can be operated quite safely with plug-in removed).

After accurately calibrating the main time base return the time base range switch to 100uSec/cm time base vernier to CAL. Feed in a 1kHz pulse to vertical amplifier, pulse will appear on 1st and 10th cm lines. Now turn DELAY RANGEswitch to 100uSec to 1mSec range and VERNIER/MULTIPLIER to read 10. Adjust RV502 at rear of lower board in 5S/1 plug-in until the R.H. pulse on CRT coincides with the 10th graticule mark. Access to RV502 can be readily obtained between the amplifier and time base plug-in units.

Turn the VERNIER/MULTIPLIER control around to zero noting the position of the displayed pulse at each major division on the dial. It should correspond to a cm graticule line, i.e. 7 on dial will line up with the 7th graticule mark from the RIGHT, 3 will correspond to the 3rd mark from the right. Between 1 and 0 the scale compresses, however, this overlap section between the ranges is not calibrated.

Check operation on other ranges (other than 1-10uSec range) and optimise RV502 if necessary for best overall accuracy (specified at 10%)

Finally turn DELAY RANGE to 1 to 10uSec. Set VERNIER/MULTIPLIER to 10 and main time base to 1uSec/cm. Increase input frequency to 100kHz. Now adjust C504 until pulse corresponds to 10th cm line of graticule.

C504 is mounted on DELAY RANGE switch near front of plug-in and is accessible from outside of instrument.

All ranges are now aligned.

6.5 Trigger Circuit Alignment

Set controls as follows : -

Time Base :	1mSec/cm
Mode Switch :	TRIG
Trigger Source :	+
Trigger Slope :	NORM
TRIG LEVEL :	AUTO
POSITION :	To Centre Trace
x5 MAG :	Pushed In
EXT T.B. :	Pushed In.

Feed in 1kHz sine wave to amplifier and adjust for 3 cm deflection. Slide ± switch to - to check operation. Now reduce input level continuously changing ± switch back and forth. When trace fails to lock on either + or - adjust RV401 Trigger. Centreing to obtain equal locking sensitivity on both + or -. When locking fails on both + and - adjust RV403 Trigger Sensitivity until lock is obtained then continue reducing input and

6.5 TRIGGER CIRCUIT ALIGNMENT (Cont.)

readjusting both RV401 and 403 to obtain the highest sensitivity of operation on both + and - slope positions. Max sensitivity is less than 2mm deflection.

Increase input again for 6 cm deflection, turn TRIG LEVEL control clockwise and check full 6 cm range available on both + and - positions.

6.6 Return control to AUTO jumper across input signal to vertical amplifier to EXT TRIGGER AC input socket on the main frame. Set input signal level to 1V P-P, Input SELECTOR on main frame to x10 and source selector on 5S/1 to EXT. Check operation of + and - switch and again reduce input progressively until trace fails to lock on + or - position.

Adjust RV404 Ext Trig centreing located at centre top of P/C board for equal trigger lock as amplitude is reduced.

6.7 The 5S/1 plug-in is now fully aligned and may be checked for full triggering performance against the specification detailed in Section 2.

7. GUARANTEE

The equipment is guaranteed for a period of twelve (12) months from the date of purchase, against faulty materials and workmanship, with the exception of Cathode Ray Tubes, which are covered by their manufacturer's own warranty.

Please refer to Guarantee Registration Card No.....which accompanied instrument for full details of conditions of warranty.

As the policy of the manufacturer is one of continuing research and development, the company reserves the right to supply the latest equipment and made amendments to circuits and parts without notice.

B.W.D. ELECTRONICS PTY.LTD.

REPLACEABLE PARTS

1. This section contains information for ordering replacement parts, it provides the following details : -

   (a) Description of part (see list of abbreviations).
   (b) Typical manufacturer or supplier of the part (see list of abbreviations).
   (c) Manufacturer's Part Number, and
   (d) Defence Stock Number, where applicable.

2. Ordering - Please quote Model Type No., e.g. bwd 511, Serial No. Circuit Reference No. and component details as listed in parts list.

COMPONENT DESIGNATORS

A	Assembly	H	Heater	RV	Resistor Variable
B	Lamp	J	Jack (socket)	S	Switch
C	Capacitor	L	Inductor	T	Transformer
D	Diode	M	Meter	TH	Thermistor
DL	Delay Line	P	Plug	V	Valve
E	Misc. Elect. Part	Q	Transistor	VDR	Voltage Dependent Resistor
F	Fuse	R	Resistor		

ABBREVIATIONS

Amp	Ampere	L	Inductor
C	Capacitor	lin	Linear
cc	Cracked Carbon	Log	Logarithmic Taper
c	Carbon	m	Milli = 10^{-3}
cd	Deposited Carbon	MHz	Mega Hertz = 10^{6}Hz
comp	Composition	MF	Metal Film
CDS	Ceramic Disc Capacitor	ma	Milli Ampere
cer	ceramic	MΩ	Meg Ohm = $10^{6}\Omega$
Com	Common	mfr	Manufacturer
DPST	Double Pole Single Throw	MO	Metal Oxide
DPDT	Double Pole Double Throw	MHT	Polyester/Paper Capacitor
elec	Electrolytic	MPC	Metalised Polyester Capacitor
F	Farad	Ne	Neon
f	Fuse	NPO	Zero temperature co-efficient
FET	Field Effect Transistor	nsr	Not separately replaceable
Ge	Germanium	NC	Normally Closed
H	Henry(ies)	NO	Normally Open
H.S.	High Stability	ns	Nano second
HTC	High Temp Coating	obd	Order by Description
ins	Insulated	OD	Outside Diameter
kHz	Kilo Hertz = 10^{3}Hz	p	Peak
KΩ	Kilo Ohm = $10^{3}\Omega$	pf	pico farad = 10^{-12}F

COMPONENT ABBREVIATIONS (cont.)

PL	Plug
PS	Socket
Preset	Internal Preset
PYE	Polyester
pot	Potentiometer
prec	Precision
PC	Printed circuit
PIV	Peak Inverse Voltage
PYS	Polystyrene
p-p	Peak to Peak
P.Shaft	Plain Shaft
Q	Transistor
R	Resistor
rot	rotary
R log	Reverse Logarithmic Taper
rms	Root Mean Squared
SPDT	Single Pole Double Throw
SPST	Single Pole Single Throw
S.Shaft	Slotted Shaft
Si	Silicon
Ta	Tantalum
tol	Tolerance
trim	trimmer
V	Volt(s)
var	variable
vdcw	Volts Direct Current Working
w	Watt(s)
ww	Wire Wound
Z	Zener
*	Factory Selected value, nominal value may be shown
* *	Special component, no part no. assigned

MANUFACTURERS ABBREVIATIONS

AB	A.B. Electronics
AEE	AEE Capacitors
AN	Anodeon
AST	Astronic Imports
AWA	Amalgamated Wireless of Aust.
ACM	Acme Engineering Pty.Ltd.
AMP	Aircraft Marine Products(Aust.) P/L
AR	A. & R. Transformers
AUS	Australux Fuses
AWV	Amalgamated Wireless Valve Co.
ACA	Amplifier Co. of Aust.
ARR	Arrow
BWD	B.W.D. Electronics Pty.Ltd.
BL	Belling & Lee Pty.Ltd.
BR	Brentware (Vic.) Pty.Ltd.
BU	Bulgin
CF	Carr Fastener
CAN	Cannon Electrics Pty.Ltd.
CIN	Cinch
DAR	Darstan
DIS	Distributors Corporation Pty.Ltd.
ELN	Elna Capacitors (Sonar Elec.P/L)
ETD	Electron Tube Dist.
F	Fairchild Australia Pty.Ltd.
GRA	General Radio Agencies
GE	General Electric (USA)
GEC	General Electric Co. (UK)
GES	General Electronic Services
HW	Hurtle Webster
HOL	R.G. Holloway
H	Haco Distributors (National)
HS	Hawker Sidney
J	Jabel
McH	McKenzie & Holland(Westinghouse)
MAS	Master Instrument Co.Pty.Ltd.
MOR	Morganite (Aust.) Pty.Ltd.
MSP	Manufacturers Special Products (AWA)
McM	McMurdo (Aust.) Pty.Ltd.
MOT	Motorola
NU	Nu Vu Pty.Ltd.
NAU	A.G. Naunton Pty.Ltd.
NS	National Semiconductor
PA	Painton
PAL	Paton Elect. Pty.Ltd.
PI	Piher Resistors (Sonar Electronics)
PH	Philips Electrical Industries Pty.Ltd.
PL	Plessey Pacific
PRO	Procel
PV	Peaston Vic.
RC	Radio Corporation (Electronic Inds.)
RCA	Radio Corporation of America
RHC	R.H. Cunningham
STC	Standard Telephone & Cables
SI	Siemens Electrical Industries
SIM	Simonson Pty.Ltd.
SE	Selectronic Components
SON	Sonar Electronics
TR	Trimax Erricson Transformers
TI	Texas Instruments Pty.Ltd.
TH	Thorn Atlas
UC	Union Carbide
W	Wellyn Resistors (Cannon Elec. P/L)
WH	Westinghouse
Z	Zephyr Prod. Pty.Ltd.

PARTS LIST MODEL 5S/1

DELAY TIME BASE PLUG-IN DRG.826

CCT Ref	DESCRIPTION				Mfr. or Supplier	PART No.	
		RESISTORS					
R400							
R401	47Ω	½W	5%	CC	PI		
R402	330KΩ	½W	5%	CC	PI		
R403	47Ω	½W	5%	CC	PI		
R404	47Ω	½W	5%	CC	PI		
R405	100KΩ	½W	5%	CC	PI		
R406	47Ω	½W	5%	CC	PI		
R407	10Ω	½W	5%	CC	PI		
R408	22KΩ	½W	5%	CC	PI		
R409	3.9KΩ	½W	5%	CC	PI		
R410	100Ω	½W	5%	CC	PI		
R411	1KΩ	½W	5%	CC	PI		
R412	4.7KΩ	½W	5%	CC	PI		
R413	680Ω	½W	5%	CC	PI		
R414	47Ω	½W	5%	CC	PI		
R415	22KΩ	½W	5%	CC	PI		
R416	82KΩ	½W	5%	CC	PI		
R417	3.3KΩ	½W	5%	CC	PI		
R418	100Ω	½W	5%	CC	PI		
R419	1.8KΩ	½W	5%	CC	PI		
R420	470Ω	½W	5%	CC	PI		
R421	220Ω	½W	5%	CC	PI		
R422	15KΩ	½W	5%	CC	PI		
R423	47KΩ	½W	5%	CC	PI		
R424	33KΩ	½W	5%	CC	PI		
R425	1KΩ	½W	5%	CC	PI		
R426	220KΩ	½W	5%	CC	PI		
R427	1KΩ	½W	5%	CC	PI		
R428	820Ω	½W	5%	CC	PI		
R429	47KΩ	½W	5%	CC	PI		
R430	6.8KΩ	½W	5%	CC	PI		
R431	10KΩ	½W	5%	CC	PI		
R432	3.9KΩ	½W	5%	CC	PI		
R433	1KΩ	½W	5%	CC	PI		
R434	22KΩ	½W	5%	CC	PI		
R435	220Ω	½W	5%	CC	PI		
R436	1.8KΩ	½W	5%	CC	PI		
R437	6.8KΩ	½W	5%	CC	PI		
R438	56KΩ	½W	5%	CC	PI		
R439	1.5KΩ	½W	5%	CC	PI		

PARTS LIST MODEL 5S/1

DELAY TIME BASE PLUG-IN DRG. 826

CCT Ref		DESCRIPTION			Mfr. or Supplier	PART No.	
		RESISTORS					
R440	1.5KΩ	½W	5%	CC	PI		
R441	12KΩ	½W	5%	CC	PI		
R442	4.7K	½W	5%	CC	PI		
R443	47KΩ	½W	5%	CC	PI		
R444	150Ω	½W	5%	CC	PI		
R445	8.2KΩ	½W	5%	CC	PI		
R446	47KΩ	½W	5%	CC	PI		
R447	12KΩ	½W	5%	CC	PI		
R448							
R449	150Ω	½W	5%	CC	PI		
R450	100KΩ	½W	5%	CC	PI		
R451	220Ω	½W	5%	CC	PI		
R452							
R453	150Ω	½W	5%	CC	PI		
R454	8.2KΩ	½W	5%	CC	PI		
R455	12KΩ	½W	5%	CC	PI		
R456	100KΩ	½W	1%	MO	Electrosil	TR5	
R457	100KΩ	½W	1%	MO	Electrosil	TR5	
R458	500KΩ	¼W	1%	MO	Electrosil	TR5	
R459	1MΩ	¼W	1%	MO	Electrosil	TR5	
R460	1MΩ	¼W	1%	MO	Electrosil	TR5	
R461	4.7MΩ	½W	5%	CC	PI		
R462	5MΩ	C21	1%	HS	WEL	C21	
R463	10MΩ	½W	1%	CC	PI		
R464	120KΩ	½W	5%	CC	PI		
R465	6.8KΩ	½W	5%	CC	PI		
R466	680KΩ	½W	5%	CC	PI		
R467	330KΩ	½W	5%	CC	PI		
R468	100KΩ	½W	5%	CC	PI		
R469	100Ω	½W	5%	CC	PI		
R470	4.7KΩ	½W	5%	CC	PI		
R471	33KΩ	½W	5%	CC	PI		
R472	1KΩ	½W	5%	CC	PI		
R473	47Ω	½W	5%	CC	PI		
R474	10KΩ	½W	5%	CC	PI		
R475	10KΩ	½W	5%	CC	PI		
R476	1KΩ	½W	5%	CC	PI		
R477	1.2KΩ	½W	5%	CC	PI		
R478	18KΩ	½W	5%	CC	PI		
R479	47Ω	½W	5%	CC	PI		

PARTS LIST MODEL 5S/1

DELAY TIME BASE PLUG-IN DRG.826

CCT Ref	DESCRIPTION				Mfr. or Supplier	PART No.	
	RESISTORS						
R480	4.7KΩ	½W	5%	CC	PI		
R481	47Ω	½W	5%	CC	PI		
R482	1KΩ	½W	5%	CC	PI		
R483	22KΩ	½W	5%	CC	PI		
R484	47Ω	½W	5%	CC	PI		
R485	56KΩ	½W	5%	CC	PI		
R486							
R487	10Ω	½W	5%	CC	PI		
R488	10Ω	½W	5%	CC	PI		
R489	10Ω	½W	5%	CC	PI		
R490							
R491	10Ω	½W	5%	CC	PI		
R492	10Ω	½W	5%	CC	PI		
R493	10Ω	½W	5%	CC	PI		
R494	10Ω	½W	5%	CC	PI		
R495	33Ω	½W	5%	CC	PI		
R496	10Ω	½W	5%	CC	PI		
R497	10K	½W	5%	CC	PI		
R498							
R499	2.2KΩ	½W	5%	CC	PI		
R500	2.2KΩ	½W	5%	CC	PI		
R501	1.8KΩ	½W	5%	CC	PI		
R502	330KΩ	½W	5%	CC	PI		
R503	15KΩ	½W	5%	CC	PI		
R504	33K	½W	5%	CC	PI		
R505	560Ω	½W	5%	CC	PI		
R506	680Ω	½W	5%	CC	PI		
R507	1.5KΩ	½W	5%	CC	PI		
R508	22KΩ	½W	5%	CC	PI		
R509	470KΩ	½W	5%	CC	PI		
R510	10Ω	½W	5%	CC	PI		
R511	470KΩ	½W	5%	CC	PI		
R512	22KΩ	½W	5%	CC	PI		
R513	1.2KΩ	½W	5%	CC	PI		
R514	3.9KΩ	½W	5%	CC	PI		
R515	100KΩ	½W	5%	CC	PI		
R516	270KΩ	½W	5%	CC	PI		
R517	47KΩ	½W	5%	CC	PI		
R518	4.7KΩ	½W	5%	CC	PI		
R519	5.6KΩ	½W	5%	CC	PI		

PARTS LIST MODEL 5S/1

DELAY TIME BASE PLUG-IN DRG.826

CCT Ref	DESCRIPTION				Mfr. or Supplier	PART No.	
		RESISTORS					
R520	10KΩ	½W	5%	CC	PI		
R521	33KΩ	½W	5%	CC	PI		
R522	1.5KΩ	½W	5%	CC	PI		
R523	100KΩ	½W	5%	CC	PI		
R524	100Ω	½W	5%	CC	PI		
R525	33Ω	½W	5%	CC	PI		
R526	220Ω	½W	5%	CC	PI		
		CAPACITORS					
C400							
C401	0.1μF	100V	10%	PYE	SON	Type N	
C402	100pF	500V	5%	N750	AC	CDS	
C403	0.01μF	100V	10%	PYE	SON	Type N	
C404	125μF	16V	elec		PH	C426AR/E125	
C405	0.0022μF	500V	20%	CDS	AC	CDS	
C406	0.0022μF	500V	20%	CDS	AC	CDS	
C407	10μF	64V	elec		PH	C426AR/H10	
C408	0.22μF	630V	20%	MPC	PH	C280/CG/P220K	
C409	15pF	500V	5%	N330	AC	CDS	
C410	100pF	500V	5%	N750	AC	CDS	
C411	0.1μF	100V	10%	PYE	SON	Type N	
C412	1μF	40V	elec		PH	C426AR/G1	
C413	10μF	64V	elec		PH	C426AR/H10	
C414	100μF	6.4V	elec		PH	C426AR/C100	
C415	0.01μF	160V	10%	PYE	PH	C296AA/10K	
C416	33pF	500V	5%		AC	N750 CDS	
C417	330pF	630V	5%	PYS	AC	TCS606	
C418	0.033μF	160V	10%	PYE	PH	C296AA/A33K	
C419	5μF	64V	elec		PH	C426AR/H5	
C420	10pF	500V	10%	NPO CDS	AC	CDS	
C421	68pF	500V	5%	N750 CDS	AC	N750 CDS	
C422	22pF	500V	5%	N330 CDS	AC	N330 CDS	
C423	100pF	500V	5%	N750 CDS	AC	N750 CDS	
C424	22pF	500V	5%	N330 CDS	AC	N330 CDS	
C425	0.0022μF	500V	20%		AC	curve YY CDS	
C426	220pF	630V	5%	PYS	AC	TCS604	
C427	2-20pF	TRIMMER			PH	C010EA/20E	
C428	2-20pF	TRIMMER			PH	C010EA/20E	
C429	5-60pF	TRIMMER			PH	C010GA/60E	

PARTS LIST MODEL 5S/1

DELAY TIME BASE PLUG-IN DRG.826

CCT Ref	DESCRIPTION				Mfr. or Supplier	PART No.	
	CAPACITORS						
C430	82pF	500V	N750	Cer Disc	AC	CDS	
C431	0.01μF	+½%-1½%	400V	PYS	AC	TCS/D424	
C432	1μF	200V	10%	PYE	SON	Type N	
C433	SELECT ON TEST			PYE	PH		
C434	5.6pF	500V	10%	NPO CDS	AC	NPO CDS	
C435	0.1μF	100V	10%	PYE	SON	Type N	
C436	0.01μF	100V	10%	PYE	SON	Type N	
C437	0.1μF	100V	10%	PYE	SON	Type N	
C438	0.22μF	630V	10%	MPC	PH	C280/CG/P220K	
C439							
C440							
C441	0.1μF	100V	10%	PYE	SON	Type N	
C442							
C443	2-20pF	TRIMMER			PH	C010EA/20E	
C444	0.1μF	100V	10%	PYE	SON	Type N	
C445							
C446	0.1μF	100V	10%	PYE	SON	Type N	
C447)							
C448)							
C449)							
C450)							
C451)							
C452)							
C453)							
C454)							
C455)							
C456)	NOT USED						
C457)							
C458)							
C459)							
C460)							
C461)							
C462)							
C463)							
C464)							
C465)							
C466)							
C467)							
C468)							
C469)							

PARTS LIST MODEL 5S/1

DELAY TIME BASE PLUG-IN DRG.826

CCT Ref	DESCRIPTION				Mfr or Supplier	PART No.	
	CAPACITORS						
C470) C471) C472) C473) C474)	NOT USED						
C500	5.6pF	500V	10%	NPO CDS	AC	NPO CDS	
C501	22pF	500V	5%	N330 CDS	AC	N330 CDS	
C502	0.1μF	100V	10%	PYE	SON	Type N	
C503	100pF	500pFV	5%	N750 CDS	SON	N750 CDS	
C504	5 - 60pF	TRIMMERS			PH	C010GA/60E	
C505	68pF	500V	5%	N330 CDS	AC	N330 CDS	
C506	0.001μF	400V	$+\frac{1}{2}-1\frac{1}{2}\%$	PYS	AC	TCS/D412	
C507	0.01μF	400V	$+\frac{1}{2}-1\frac{1}{2}\%$	PYS	AC	TCS/D424	
C508	0.1μF	100V	± 1% selected		SON	Type N	
C509	1μF	100V	± 1% selected		SON	Type N	
C510	10μF	35V	10%	TANTALUM	UC	K10J35KS	
C511	0.01μF	160V	10%	PYE	SON	Type N	
C512	0.0022μF	500V	10%	CDS	AC	NPO CDS	
C513	0.01μF	100V	10%	PYE	SON	Type N	
C514	68pF	500V	5%	N750	AC	N750 CDS	
C515	0.001μF	500V	20%	CDS	AC	Curve YY CDS	
C516	0.01μF	160V	10%	PYE	PH	C296/AA/10K	
C517	0.1μF	100V	10%	PYE	SON	Type N	
C518	1μF	100V	10%	PYE	SON	Type N	
C519	10μF	64V	elec		PH	C426AR/H10	
C520							
	POTENTIOMETER						
RV401	47KΩ	LIN PRESET		C	PH	E097AD/47K	
RV402A	25KΩ	'A' curve REAR with DPST Switch		C	DUC		
RV402B	100KΩ	'A' curve FRONT " " "		C	DUC	DUAL	
RV403	22KΩ	LIN PRESET		C	PH	E097AD/22K	
RV404	22KΩ	LIN PRESET		C	PH	E097AD/22K	
RV405	50KΩ	'A' curve REVERSE DSPT switch		C	W	93P63RR	
RV406	100KΩ	LIN PRESET		C	PH	E097AD/100K	
RV407	22KΩ	LIN PRESET		C	PH	E097AD/22K	
RV408	2.2KΩ	LIN PRESET		C	PH	E097AD/2K2	
RV409	470Ω	LIN PRESET		C	PH	E097AD/470E	
RV410	22KΩ	LIN PRESET		C	PH	E097AD/22K	
RV501	10KΩ	10 turn Minature		WW	Bourne	Type 3507	
RV502	10KΩ	TRIM POT		WW	Darstan	P109/6	
RV503	1MΩ	LIN PRESET		C	PH	PT-10V	

PARTS LIST MODEL 5S/1

DELAY TIME BASE PLUG-IN DRG.826

CCT Ref.	DESCRIPTION				Mfr. or Supply	PART No.	
			DIODES				
D401-411 D501-506	75V PIV	30mA		SI	PH	IN4148	
D412	6V2	ZENER DIODE		400mV	PH	BZY88 C6V2	
			TRANSISTORS				
Q401	N CHANNEL FET			SI	TI	2N3819	
Q402	20V	Vce	hfe40	SI NPN	F	AY1119	
Q403	20V	Vce	hfe40	SI NPN	F	AY1119	
Q404	20V	Vce	hfe40	SI NPN	F	AY1119	
Q405	12V	Vce	hfe30	SI NPN	F	2N3646	
Q406	12V	Vce	hfe30	SI NPN	F	2N3646	
Q407	-25V	Vce	hfe100	SI PNP	F	AY1114	
Q408	12V	Vce	hfe60	SI NPN	F	AX1207	
Q409	12V	Vce	hfe30	SI NPN	F	2N3646	
Q410	12V	Vce	hfe30	SI NPN	F	2N3646	
Q411	-60V	Vce	hfe100	SI PNP	F	2N3645	
Q412	60V	Vce	hfe100	SI NPN	F	AY1101	
Q413	-40V	Vce	hfe50	SI PNP	F	2N3644	
Q414	60V	Vce	hfe100	SI NPN	F	AY1101	
Q415	N CHANNEL FET				TI	2N3819	
Q416	60V	Vce	hfe100	SI NPN	F	AY1101	
Q417	60V	Vce	hfe100	SI NPN	F	AY1101	
Q418	60V	Vce	hfe100	SI NPN	F	AY1101	
Q419	60V	Vce	hfe100	SI NPN	F	AY1101	
Q420	25V	Vce	hfe100	SI NPN	F	AY1113	
Q421	60V	Vce	hfe100	SI NPN	F	AY1101	
Q422	60V	Vce	hfe100	SI NPN	F	AY1101	
Q423	60V	Vce	hfe100	SI NPN	F	AY1101	
Q501	12V	Vce	hfe30	SI NPN	F	2N3646	
Q502	12V	Vce	hfe30	SI NPN	F	2N3646	
Q503	12V	Vce	hfe30	SI NPN	F	2N3646	
Q504	60V	Vce	hfe100	SI NPN	F	AY1101	
Q505	60V	Vce	hfe100	SI NPN	F	AY1101	
Q506	60V	Vce	hfe100	SI NPN	F	AY1101	
			SUNDRIES				
S501	1 Pole 9 Position 7 Deck F Type				MSP	SR65A	
S401	2 Pole 3 Position Slide Switch				H	RQ1535	
S402	2 Pole 3 Position Slide Switch				H	RQ1535	

PARTS LIST MODEL 5S/1

DELAY TIME BASE PLUG-IN DRG.826

CCT Ref	DESCRIPTION	Mfr. or Supplier	PART No.	
	SUNDRIES			
S403	2 Pole 2 Position Slide Switch	SATO		
S404	DPST REAR OF RV402A & B			
S405	24 Way 4 Deck Switch	AB Elec	BWD SR64	
S406	6 Pole 2 Position Slide Switch	MSP	Type 62 AK53840	
S407	2 Pole 2 Way Slide Switch	MSP	70/78	
S507	Push Button minature N/O Switch	Bulgin	MP16 black	
P401	24 Way Red Range Plug	McM	RP24	
	Printed Circuit Board	PROCEL	160/087	
	Printed Circuit Board	PROCEL	160/088	
	Printed Circuit Board	PROCEL	160/078A	
	4 mm Red Sockets	GRA	GR165	
	Minature 10 Turn Dial Indicator	BOURNE	H491-3	
	ALL OTHER ITEMS ORDER BY DESCRIPTION			

MODIFICATIONS

ISSUE 1 10/74

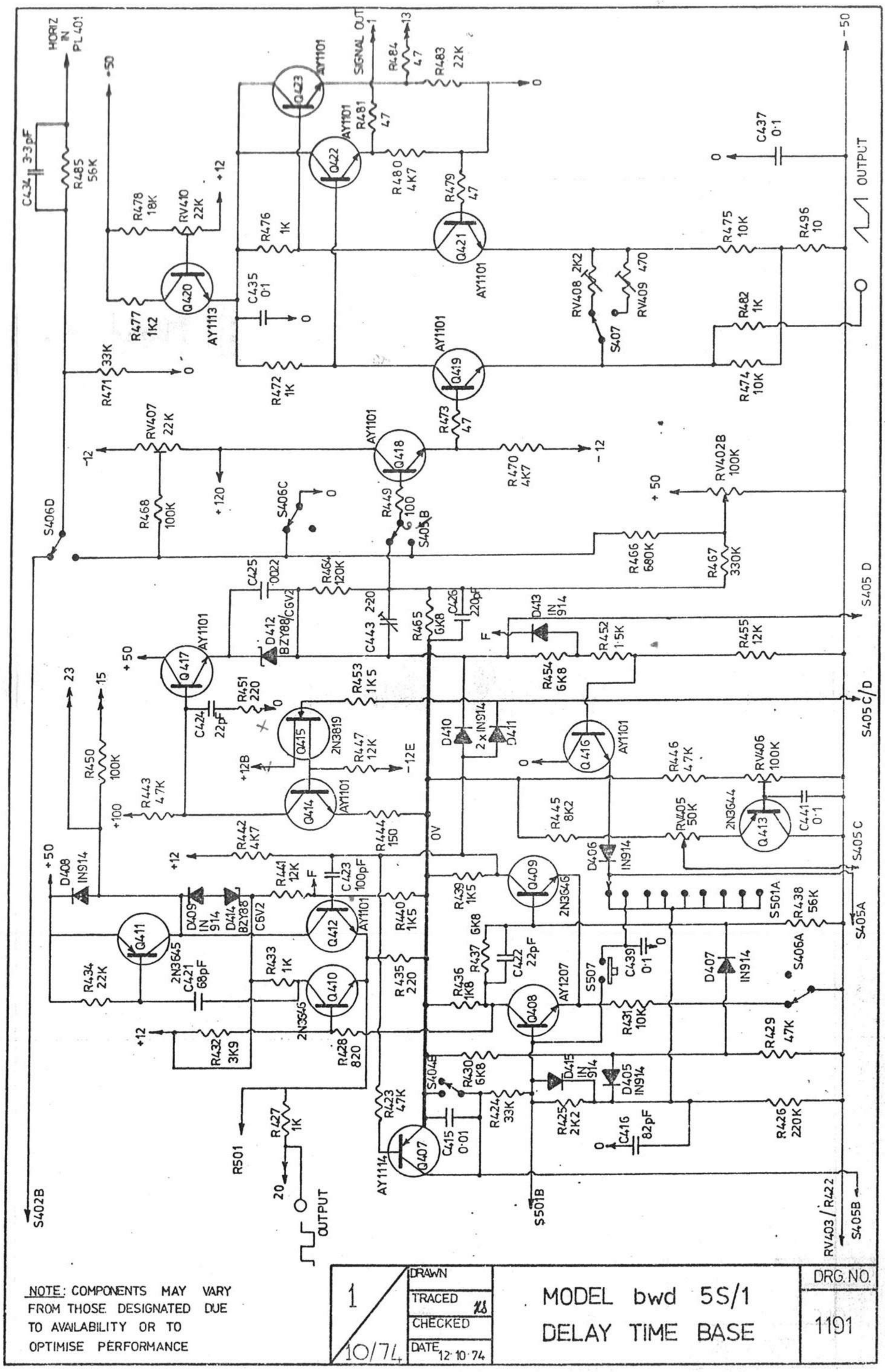
REDRAWN FROM DRG. NO. 826

SWITCHES

S401 A & B	NORM - FAST - SLOW
S402A & B	TRIGGER SELECTOR
S403	+ OR −
S404A & B	AUTO. LEVEL SELECT
S405A-D	TIME BASE RANGE
S406A-D	INT.-EXT. TIME BASE
S407	x 1 AND x 5 MAG.
S501A-F	DELAY TIME BASE RANGE
S507	SINGLE STROKE RESET

CONTROLS

RV401	TRIGGER CENTREING
RV402A	TRIGGER LEVEL
RV402B	HORIZONTAL SHIFT
RV403	TRIGGER SENSITIVITY
RV404	EXTERNAL TRIGGER CENTRE
RV405	TIME BASE VERNIER
RV406	TIME BASE CALIBRATE
RV407	HORIZONTAL AMPLIFIER CENTRE
RV408	x 1 MAG.
RV409	x 5 MAG.
RV410	OUTPUT D.C. LEVEL
RV412	HORIZONTAL CALIBRATE
RV501	DELAY VERNIER (10 TURN)
RV502	DELAY CALIBRATE PRESET



NOTE: COMPONENTS MAY VARY FROM THOSE DESIGNATED DUE TO AVAILABILITY OR TO OPTIMISE PERFORMANCE

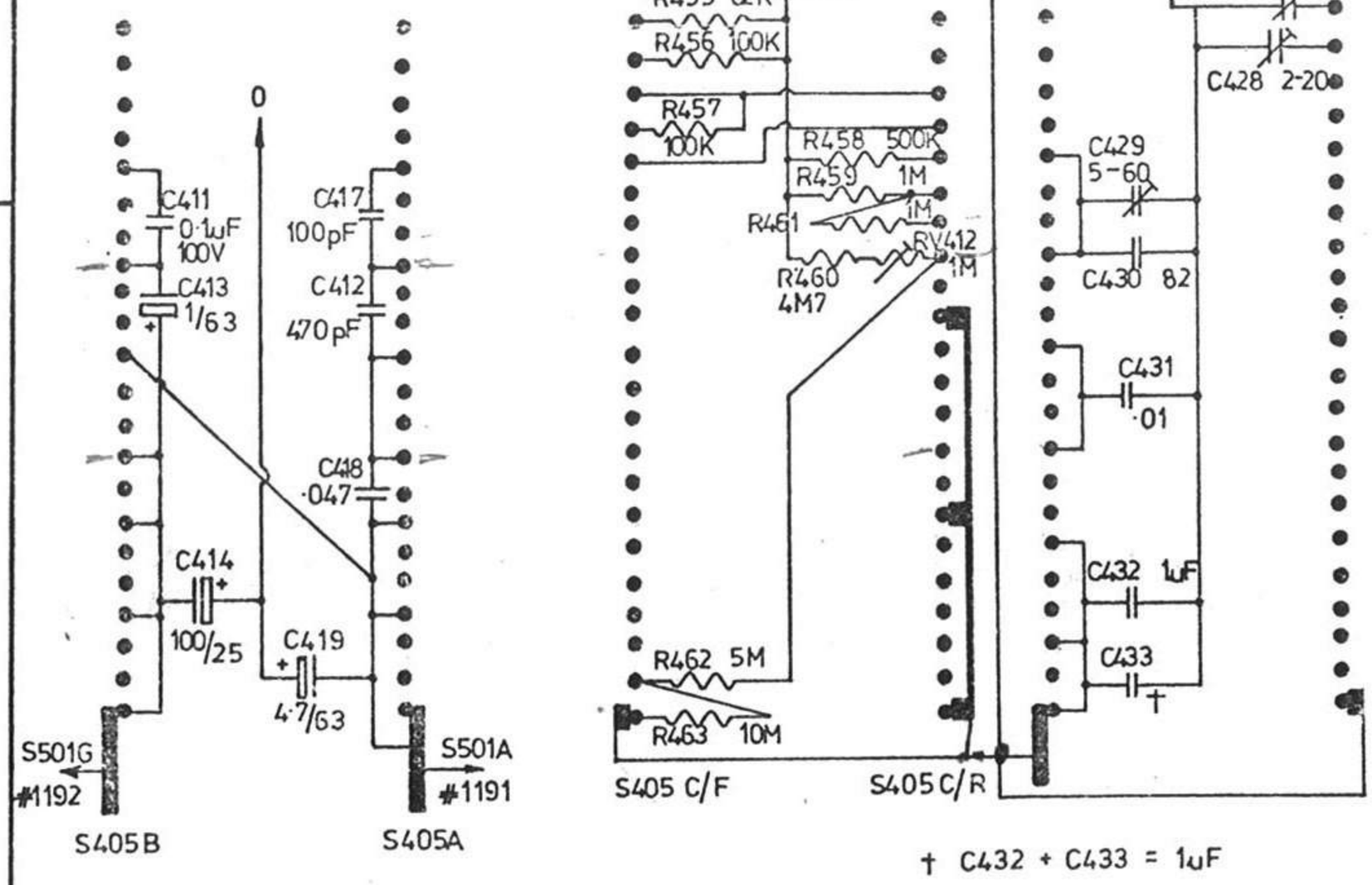
1 / 10/74	DRAWN	MODEL bwd 5S/1 DELAY TIME BASE
	TRACED RS	
	CHECKED	
	DATE 12·10·74	

DRG. NO. 1191

MODIFICATIONS

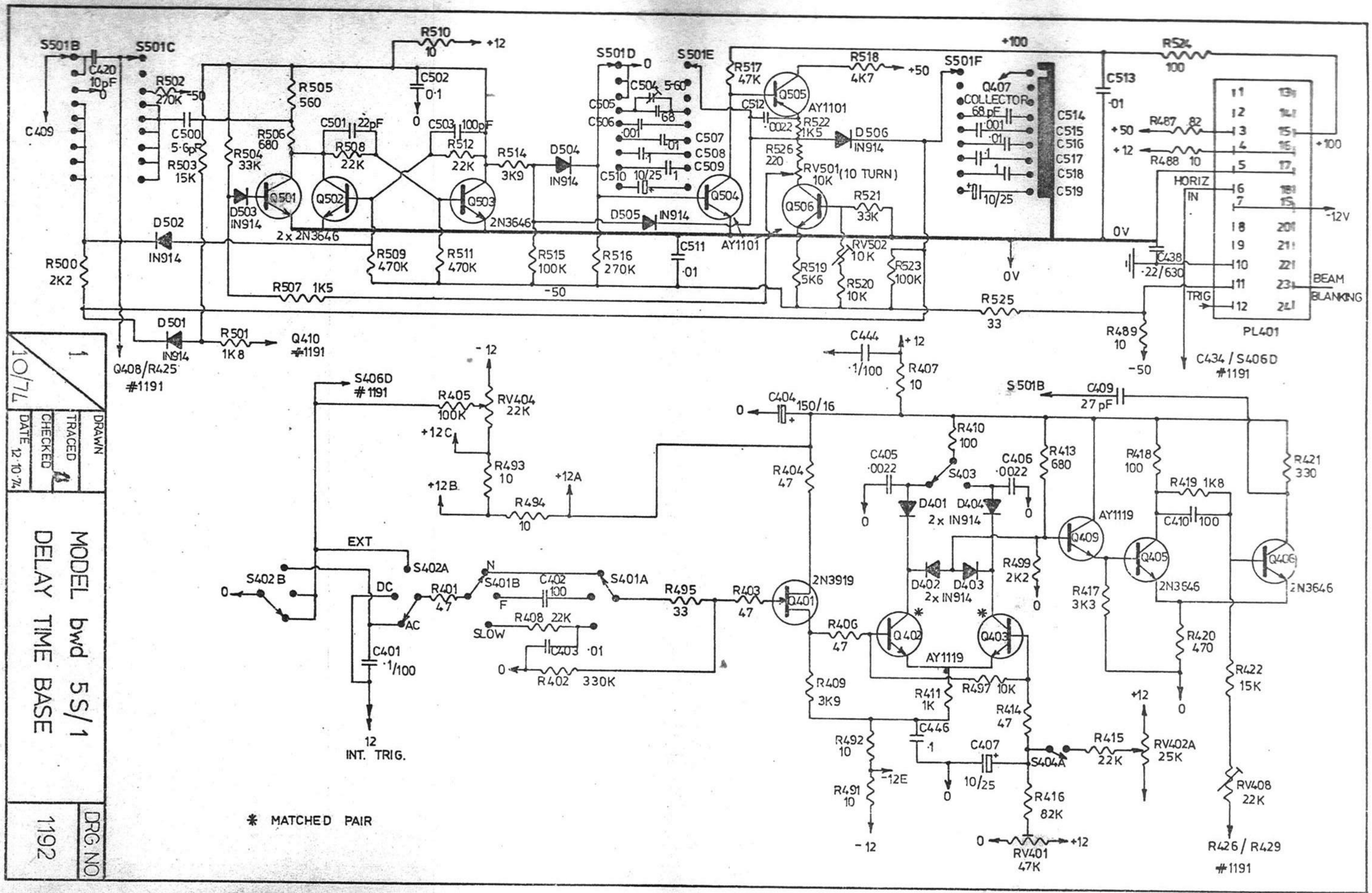
ISSUE 1 10/74

REDRAWN FROM
DRG. NO. 826



† C432 + C433 = 1μF

NOTE 1 TIME BASE RANGE SWITCH



DRAWN	TRACED	CHECKED	DATE 12·10·74

MODEL bwd 5S/1

DELAY TIME BASE

DRG. NO. 1192