OPERATORS HANDBOOK

For

UNIVERSAL COUNTER-TIMERS

9901 and 9905

RACAL
The Electronics Group

OPERATORS HANDBOOK
FOR
UNIVERSAL COUNTER-TIMERS
9901 and 9905

RACAL-INSTRUMENTS LIMITED

Duke Street
Windsor, Berks
England

Tel: Windsor 69811
Telex 847013

Prepared by Central Handbooks Department
Racal Group Services Limited

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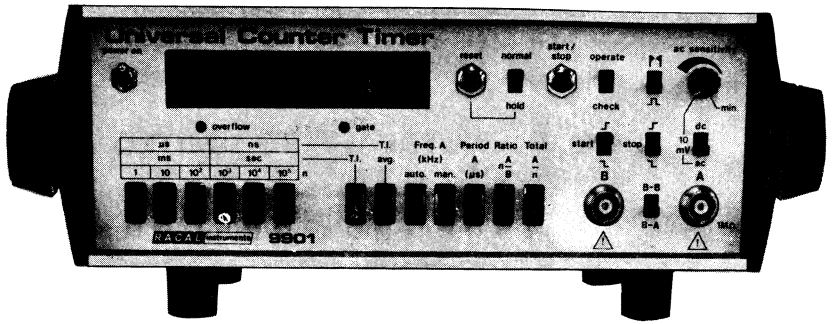
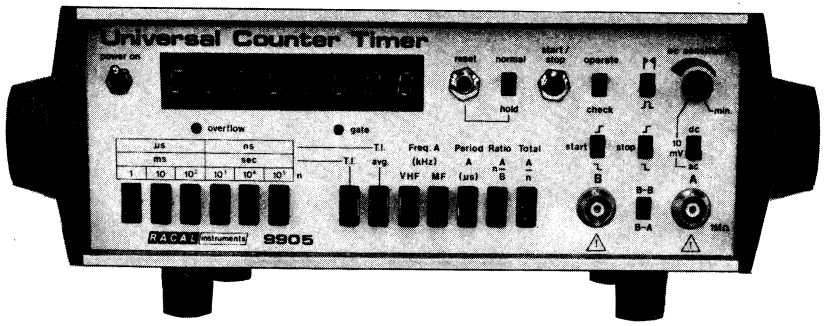




CONTENTS

TECHNICAL SPECIFICATION

NOTE: The data refers equally to 9901 and 9905 except where indicated otherwise.

1. GENERAL

Model 9901 is a 6 digit 50 MHz Autoranging Universal Counter Timer.

Model 9905 is an 8 digit 200 MHz Manual version with consequent extended ranges on all measuring functions.

2. MEASURING FUNCTIONS

Modes of Operation:

9901: Frequency (Manual), Frequency (Autoranging), Single and Multiple Period, Single and Multiple Ratio, Single and Double Line Time Interval, Single and Double Line Time Interval Averaging; Totalizing.

9905: Frequency (Manual), Single and Multiple Period, Single and Multiple Ratio, Single and Double Line Time Interval, Single and Double Line Time Interval Averaging, Totalizing.

3. DISPLAY

Format:

9901: Six digit in-line, LED seven segment display. Decimal point automatically positioned.

9905: Eight digit in-line, LED seven segment display. Decimal point automatically positioned.

Latch: The display is latched for Frequency, Period and Ratio measurement and automatically unlatched in all other modes.

Overflow Indicator: LED illuminated when overflow occurs.

Gate Indicator: LED illuminated when gate is open.

Display Time: Gate time plus 0.25s in Frequency, Period and Ratio modes.
2.0s in other modes. A switched hold position is provided.

Measurement Check: Counter reads 1 MHz.

Segment Check: Sets display LED's to 8 when Check and Reset selected.

Reset: Manual by push-button, or automatic.

4. CHANNEL A INPUT - A.C. COUPLED

Frequency Range:

9901: 10 Hz to 50 MHz

9905: 10 Hz to 200 MHz

Sensitivity:

9901: 10 mV r.m.s.

9905: 10mV r.m.s. to 150 MHz, 50 mV r.m.s. to 200 MHz (continuously variable by means of sensitivity control).

Maximum Input Level:
250V r.m.s. up to 10 kHz.
50V r.m.s. up to 100 kHz
10V r.m.s. above 100 kHz
400V d.c.

Input Impedance: 1 MΩ in parallel with 25pF

5. CHANNELS A & B - D.C. COUPLED

Frequency Range: DC to 10 MHz

Sensitivity: ± 0.25V about + 1V nominal or contact closure to earth.

Maximum Input Level: ± 35V

Pulse Duration: 50 ns minimum at trigger points.

Input Impedance: Approximately 10 kΩ
(Falling to 1 kΩ above approximately +5V).

6. FREQUENCY MEASUREMENT

Input:	Channel A	
Frequency Range:	9901:	DC to 50 MHz (direct)
	9905:	H.F. - d.c. to 30 MHz (direct) V.H.F. - 10 MHz to 200 MHz (prescaled by 4).
Coupling:	AC or DC	
Gate Times:	9901:	Manual: 1 ms to 100s in decade steps
		Automatic: (9901 only) Gate times up to 1s are selected automatically to avoid overspill. A 1kHz hysteresis avoids undesirable range changing at small frequency deviations.
	9905:	Manual: HF - 1 ms to 100s in decade steps VHF - 4 ms to 400s in decade steps
Accuracy:	± 1 count ± time base accuracy.	

7. SINGLE AND MULTIPLE PERIOD MEASUREMENT

Input Channel:	Channel A
Range:	9901: 1 µs to 1s 9905: 1 µs to 100s
Clock Unit:	1 µs
Coupling:	AC or DC
Periods Averaged:	1 to 10^5 in decade multiples
Accuracy:	$\pm \frac{0.3\%}{\text{Number of periods averaged}}$ ± freq. std. accuracy (at 50 m V r.m.s. ac input with 40 dB S/N ratio).
Bandwith:	Automatically reduced to 10 MHz (3 dB) when Period selected.

8. TIME INTERVAL SINGLE AND DOUBLE LINE

Input Channel:	Single Line: Channel B Double Line: Start Channel B: Stop Channel A
Time Range:	9901: 100 ns to 10^4s (2.8 hours approximately) 9905: 100 ns to 10^6s (280 hours approximately)
Clock Units:	100 ns to 10 ms
Coupling:	DC
Start/Stop Signals:	Electrical or contact
Manual Start/Stop:	By single push button on front panel
Trigger Slope Selection:	Electrical. Positive or negative slopes can be selected on both Start and Stop signals. Contact. Opening or closure can be selected on both Start and Stop signals.
Accuracy:	± 1 count ± trigger error* ± frequency std accuracy.
Bounce Protection:	A 10 ms dead time is automatically included when contact operation is selected.

9. TIME INTERVAL AVERAGING SINGLE AND DOUBLE LINE

Input Channel:	Single Line: Channel B Double Line: Start Channel B: Stop Channel A
Time Range:	9901: 150 ns to 0.1s 9905: 150 ns to 10s
Dead Time between Intervals:	150 ns minimum
Clock Unit:	100 ns
Time Intervals Averaged:	1 to 10^5 in decade multiples.

* For trigger error see page Tech Spec. (5)

Accuracy: ± Frequency standard accuracy ± system error ± averaging error

System error: 10 ns per input channel. This is the difference in delays between start and stop signals and can be minimised by matching externally.

Averaging Error: $\frac{\text{Trigger error + 100 ns}}{\sqrt{\text{(Intervals Averaged)}}}$

Trigger Error (in ns): $\frac{5}{\text{Signal Slope at trigger point (V/µs)}}$

10. RATIO

One Frequency Input: Channel A

Other Frequency Input: Channel B

Frequency Range (channel A) 9901: DC to 50 MHz

9905: DC to 30 MHz

Frequency Range (channel B) DC to 10 MHz

Accuracy: ± 1 count ± trigger error on channel B (see above)

Reads: $\frac{\text{Frequency A} \times n}{\text{Frequency B}}$

Multiplier n: 1 to 10^5 in decade multiples

11. TOTALIZING

Input Channel: Channel A (DC to 10 MHz)

Maximum Rate: 10^7 events per second

Pulse Width: 50 ns minimum at trigger points

Prescaling: Events can be prescaled in decade multiples (n) from 1 to 10^5

Reads: $\frac{\text{Number of input events}}{n}$ ± 1 count

Manual Start/Stop: Single push button on front panel.

Electrical Start/Stop: By electrical signal applied to Channel B. Specification as for Time Interval, single line working.

12. FREQUENCY STANDARD

See also Option 04A and 04B

Frequency: 5 MHz

Temperature Stability: ± 8 parts in 10^6 over temperature range 0°C to +55°C
± 3 parts in 10^6 over temperature range + 20°C to + 40°C

Average Ageing Rate: ± 1 part in 10^6 per month three months after delivery but less than ± 1 part in 10^5 in the first year.

Frequency Standard Output: 1 MHz t.t.l. compatible rectangular wave.

13. EXTERNAL STANDARD

Frequency: 1 MHz

Input Socket: Applied to channel B input socket and provides external standard for Frequency and Period measurement only.

14. EXTERNAL SIGNALS

Data Outputs: Eight digits with overflow and decimal points in serial BCD form at standard t.t.l. levels. Refer to tables at the end of Chapter 2.

Other Outputs: Function and timebase data. Schmitt trigger outputs from both channels.

Inputs: Reset and print hold.

Accessories: See Option 01.

POWER REQUIREMENTS

Voltage Ranges (a.c.): Eight ranges are selected by transformer connection connection and link:-

94V to 106V	200V to 225V
106V to 119V	212V to 239V
118V to 132V	223V to 251V
188V to 212V	235V to 265V

Frequency: 45 to 450 Hz

Consumption: 20 VA approximately.

16. ENVIRONMENTAL & SAFETY SPECIFICATIONS

Operating Temperature Range: 0°C to +55°C

Storage Temperature Range: -40°C to +70°C

Humidity: 95% r.h. at +40°C

Mechanical: Tested in accordance with IEC 68 (BS 2011 recommendations)

Safety: Meets IEC 348 (BS4743) recommendations

17. MECHANICAL

Dimensions:

Height:	83mm (case only). 110mm overall.
Width:	240mm (case only). 284mm overall.
Depth:	268mm

Weight: 2.7 kg

18. ACCESSORIES

Accessories Supplied: Operating handbook and spare fuses.

Accessories Available: 19-inch rack mounting kit. (11-1126)
Ridged Carrying Case. (15-0451)
Padded Carrying Case (15-0144).
Data Output Connector (23-5747)

19. OPTION 01 SERIAL TO PARALLEL INTERFACE

Data and Control Information: 8 decades of data in 4 line BCD weighted 1248, 3 line decimal point position, print command, print hold, reset, overflow and time-base information. All logic levels t.t.l. compatible.

20. OPTION 04A FREQUENCY STANDARD 9442

Frequency: 5 MHz.

Ageing Rate: ± 3 parts in 10^9/day after 3 months continuous operation.

Warm-up Time: Better than ±2 parts in 10^7 within 6 minutes.

Temperature Stability: Better than ±3 parts in 10^9 per °C over the range -10°C to +45°C.

21. OPTION 04B FREQUENCY STANDARD 9421

Frequency: 5 MHz.

Ageing Rate: ±5 parts in 10^{10}/day after 3 months continuous operation.

Warm-up Time: Better than ±1 part in 10^7 within 20 minutes.

Temperature Stability: Better than ±6 parts in 10^{10} per °C over the range -10°C to +45°C.

CHAPTER 1

GENERAL DESCRIPTION

INTRODUCTION

1.1 The 9901 and 9905 are compact universal counter timers, powered from a.c. mains, and with a comprehensive range of facilities. The two instruments differ in that the 9901 has a frequency autoranging facility and the 9905 provides an extended (VHF) frequency range, with prescaling and reduced sensitivity above 150MHz. In all other respects the instruments are operationally identical.

OPERATING FACILITIES

1.2 (a) Frequency measurement:-

'A' Channel, AC mode:	9901	10Hz - 50MHz
	9905	10Hz - 30MHz (HF range)
		30MHz - 200MHz (VHF range)
'A' and 'B' Channels, DC mode:		d.c. to 10MHz.

On the 9901 an AUTO facility automatically selects the optimum resolution up to a one second gate time.

(b) Period Measurement: 1 to 10^5 periods in decade steps, a.c. or d.c. coupled.

(c) Ratio Measurement: Refer to Chapter 4.

(d) Time Interval, single or double line, with manual or electrical start/stop and trigger slope selection. Electrical start/stop signals can be from either Pulse (⎍⎍) or Contact Closure (⏐◀) source. Fixed bounce protection is included to minimise the effects of contact bounce in the customer's equipment when using contacts.

(e) Totalize will provide the total of a succession of events, using either manual or electronic start/stop signals.

NOTE: The front panel symbol ⚠ advises the user to consult the handbook for further details.

CHECK FACILITIES

1MHz Readout

1.3 When the OPERATE/CHECK switch is set to CHECK the 1MHz internal reference signal is fed through the instrument to provide an operational check on 'Frequency' and 'Period' modes.

Segment Check

1.4 With CHECK selected the instrument will display 'all eights' when the RESET button is pressed, thus checking all segments in the display LED's.

AC POWER SUPPLY

1.5 The instrument will operate from a.c. supplies between 94 and 265 volts, 45 to 450Hz. A tapping and link on the internal mains transformer must be correctly set according to the users supply voltage. A label fixed to the rear panel should indicate the selected voltage range. Spare labels are supplied with the instrument for voltage ranges other than 223-251V.

FREQUENCY STANDARD

1.6 A discrete component 5 MHz oscillator is fitted in the basic versions of the instrument, but at customer's option a high stability fast-warm-up oscillator unit from the Racal range may be fitted. The optional unit should be serviced only by Racal Instruments or authorized agent. An aperture in the rear panel provides access for oscillator calibration.

1.7 An external standard, which will over-ride the internal standard, can be applied via the front panel 'B' input socket for use on Frequency and Period mode. A 1 MHz reference, derived from the standard in use, is available via a rear panel BNC socket.

CARRYING HANDLE

1.8 The instrument is fitted with a combined carrying handle and bench stand. To adjust the stand, press in the two handle bosses simultaneously while setting the stand to the desired position.

MAINTENANCE

1.9 The customer is recommended to take advantage of the servicing facilities offered by Racal Instrument Ltd., and agents. A comprehensive Maintenance Manual is, however, available for purchase from Racal Instruments Limited.

CHAPTER 2

PREPARATION FOR USE

REMOVAL OF COVERS

WARNING: DANGEROUS AC VOLTAGES ARE EXPOSED WHEN COVERS ARE REMOVED WITH AC SUPPLY CONNECTED.

2.1 (1) Set the POWER switch to 'off', switch off the a.c. supply at the supply point and unplug the power lead.

(2) Remove the rubber plugs (located near to the rear end) from both side panels of the instrument and slacken, by about two turns, the screws revealed.

(3) Grip the rear panel assembly and ease it back from the main case to the maximum extent available (about 5 mm).

(4) The rear edge of either cover can now be lifted and the cover withdrawn outwards and rearwards. To replace the covers reverse the above procedure.

TRANSFORMER VOLTAGE SELECTION

2.2 The instrument will normally be dispatched with the transformer primary tapping set to the 223V to 251V range. To check the selection proceed as follows.

(1) Unplug the power cable from the supply and remove the top cover (see previous paragraph).

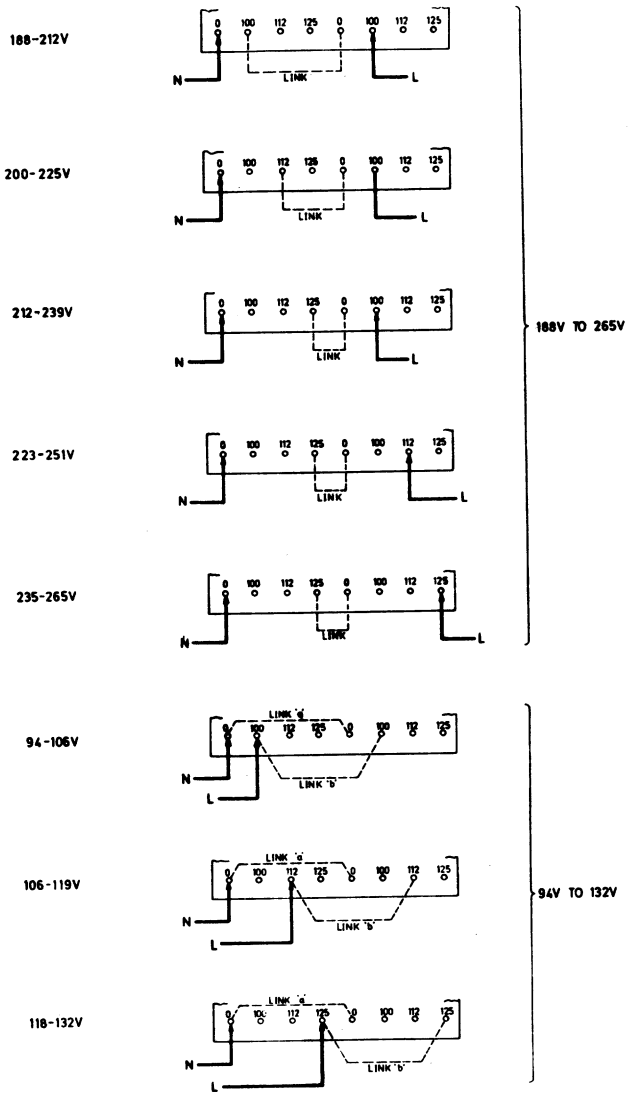
(2) Refer to the diagrams on the next page and:-

(a) Note the diagram which corresponds to the local a.c. supply voltage.

(b) Connect the correct link(s) and make the required line lead (L) connection as indicated in the appropriate diagram.

(3) Verify that the label on the rear panel indicates correctly the selected voltage range. Alternative labels are provided with the instrument for ranges other than 223V to 251V.

(4) Replace the top cover.



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Mains Transformer Voltage Selection Diagrams

Fig. 1

POWER FUSE

2.3 Check that the power fuse on the rear panel is correctly rated for the supply voltage, as follows. The fuse is a glass cartridge type, 5 x 20 mm.

Supply Range	Fuse Rating	Racal Part No.
188V - 265V	100mA anti-surge	23-0033
94V - 132V	200mA anti-surge	23-0027

POWER LEAD

2.4 Fit a suitable plug to the power lead in accordance with the standard colour code:-

Brown ..... Line
Blue ..... Neutral
Green/Yellow ..... Earth (Ground)

SELF CHECK

2.5 (1) Connect the a.c. supply.

(2) Set the POWER switch to ON.

(3) Set the CHECK/OPERATE switch to CHECK.

(4) Depress the FREQ. 'A' MAN button (9901) or the HF button (9905) and verify that the GATE indicator illuminates.

(5) The instrument should now read 1000kHz. Refer to Table 1 and check the display and decimal points (Freq. column) for each of the 'n' range buttons.

(6) Depress the PERIOD 'A' button and verify the readout and decimal points according to the Period column of Table 1.

(7) Briefly hold in the RESET button and check that the display reads 'all eights' (segment check).

TABLE 1

SELF CHECK READOUT

Range 'n' Selected	Gate Time	Display (± 1 count)			
		Frequency		Period	
		9901	9905	9901	9905
1	1ms	001000.	00001000.	000001.	As 9901 but
10	10ms	01000.0	0001000.0	00001.0	two additional
10^2	100ms	1000.00	001000.00	0001.00	'0's at left
10^3	1sec	*000.000	01000.000	001.000	hand end.
10^4	10sec	*00.0000	1000.0000	01.0000	
10^5	100sec	*0.00000	*000.00000	1.00000	

NOTE: With readouts marked (*) the most significant digit will overspill and the OVERFLOW lamp will illuminate after the appropriate gate time.

(8) 9901 Only. Depress the FREQ AUTO button and verify that display reads 1000.00. This checks that the AUTO facility has selected the optimum time base range (10^2) for the 1MHz signal.

(9) Finally set the CHECK/OPERATE switch to OPERATE in readiness for normal use.

CONNECTION OF EXTERNAL FREQUENCY STANDARD AND 1MHz OUTPUT

2.6 The requirements for the external reference frequency source are given in the Technical Specification. It should be borne in mind that the accuracy of measurement is directly related to the accuracy of the frequency standard used.

2.7 The connection for the external frequency standard is the front panel 'B' input socket, as this socket is not used for measurement in Frequency and Period modes. When the frequency standard signal is applied, the instrument will automatically change to external standard operation. The 1MHz reference output is available via the BNC socket on the rear panel.

DATA OUTPUT CONNECTIONS

Data and command information is provided on a 28-way edge connector accessible via a removable cover on the rear panel. The facilities and pin connections are listed in Table 2 below. The logic for time base and function data is given in Tables 3 and 4, and supplementary information in the Appendix to this chapter.

TABLE 2

Data Output Socket

Pin	Facility	Pin	Facility
1	-5V (nominal)	A	0V
2	+5V (nominal)	B	$\overline{\text{Overflow}}$
3	Key Way	C	Key Way
4	$\bar{4}$ (BCD)	D	$\bar{1}$ (BCD)
5	$\bar{8}$ (BCD)	E	$\bar{2}$ (BCD)
6	$\overline{\text{External Hold Input}}$	F	10kHz Sync.
7	$\overline{\text{External Reset Input}}$	H	$\overline{\text{Main Gate}}$
8	Auto (9901 only)	J	Not used
9	$\bar{c}$ } Function	K	$\bar{z}$ } Time Base
10	$\bar{b}$ } Information	L	$\bar{y}$ } Information
11	$\bar{a}$ } (See Table 3)	M	$\bar{x}$ } See Table 4
12	$\overline{\text{Ro}}$	N	Not used
13	$\overline{\text{Hold/Reset}}$	P	Schmitt 'B' } See
14	Prescale (9905 only)	R	Schmitt 'A' } NOTE

NOTE: 1. Schmitt 'A' and Schmitt 'B' outputs on pins R and P show the states of the d.c. channel Schmitt triggers.

2. The Overflow level on pin B is a static indication.

FUNCTION AND TIMEBASE LOGIC CODES

Function Data

Function information format : 3 lines coded as follows. The table gives the logic available at the edge connector. The inverse levels are applied to the C.D.I. chip in the instrument.

TABLE 3

Function Information

Function	Code $\bar{a}$	$\bar{b}$	$\bar{c}$
Frequency	1	1	1
Average Period	0	1	1
Totalize $\frac{A}{n}$	0	1	0
Ratio $n\frac{A}{B}$	1	1	0
T.I. (single line or double line not averaged)	0	0	1
T.I. (single line or double line averaged)	1	0	1

Time Base Selection Data Output

Time Base information : 3 lines coded as follows.

TABLE 4

Time Base Selection

Code $\bar{x}$	$\bar{y}$	$\bar{z}$	Frequency Gate Time	Multiplier 'n'	Time Interval Clock
1	1	1	1ms	1	0.1μs
0	1	1	10ms	10_2	1μs
1	0	1	100ms	10_3	10μs
0	0	1	1 sec	10_4	100μs
1	1	0	10 sec	10^5	1ms
0	1	0	100 sec		10ms

APPENDIX 1

DATA, TIME BASE AND CONTROL PRINCIPLES

FUNCTION AND TIME BASE CODES

A1. The function and time base requirements are applied internally to the C.D.I. chip on a six-line code. The inverse states of this code are fed out to the rear Data Output connector. The function and time base information codes are given in Tables 3 and 4 on the previous page.

DATA OUTPUT FORMAT

A2. In standard format the b.c.d. output data is available at the 28-way edge connector in a bit parallel byte serial form. The data is sequenced by a 10 kHz synchronising signal. The data presentation is delayed 0.5 µs from the negative edge of the synchronising signal. An additional synchronising pulse (Ro) determines the first state (10^0 digit). Accessories are available to give data output in parallel format (for printers etc.) or IEC/ASCII bus compatible format. (Options)

A3. The ten data output states are as follows: the timing is shown in Fig. 2.

States	Facility
1 to 8	Digit (display information).
9	Overflow for 10^3, 10^4, 10^6 and 10^7 digits on pins D, E, 4 and 5 respectively.
10	Decimal point position in kHz units, plus overflow information for 10^5 digit, via pin 5.

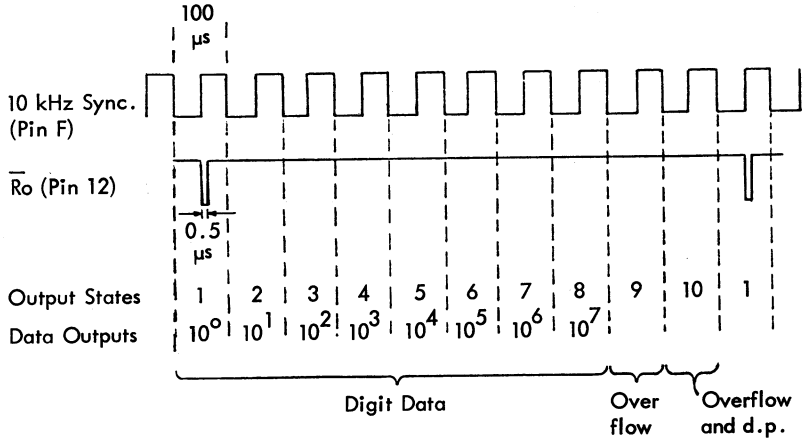


Fig. 2 Data Sequence Diagram

INTERNAL CONTROL SEQUENCE

A4. Figure 3 shows the control sequence diagrammatically (not to scale).

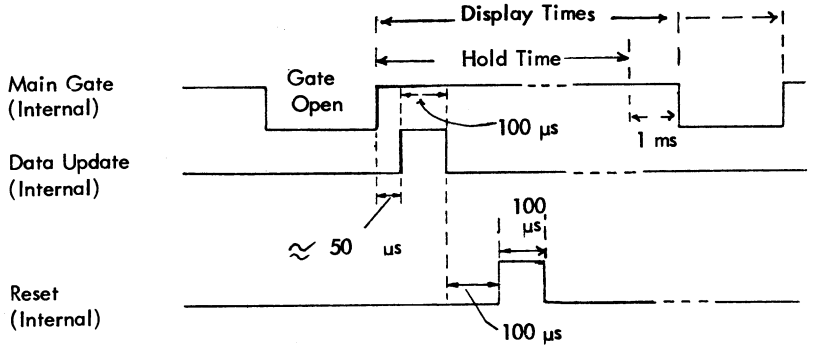


Fig. 3 Control Sequence Diagram

NOTE: The longer display time applies to the latched modes.

External Hold

A5. If, when used with external circuitry, it is required to extend the cycle time, the external hold, (logic '0', pin 6) must be applied within the gate or hold time. In order to initiate a new cycle of measurement, the external hold must go 'high' for not less than 200 µs.

External Reset

A6. External reset is achieved by the application of logic '0 to pin 7 of the connector for a period of not less than 5ms; on reverting to '1' level this will reset the display to 'all zeros' and initiate a new measurement cycle.

CHAPTER 3

DESCRIPTION OF CONTROLS

Function Push-Button Switch Bank:

This bank of seven push button switches, located near the centre of the front panel, select the following measurement modes:-

(i) T.I.

Provides time interval measurement between two successive events. The events may be on one line (B-B) or separate lines (B-A), with start and stop slopes of the same or opposite polarity.

(ii) T.I. Avg.

This mode is suitable for the measurement of short repetitive events, with start/stop controls as in T.I. By averaging over a number of events the resolution is increased.

(iii) FREQ. 'A'

Provides frequency measurement of the 'A' channel input with readout in kHz.

9901 AUTO and MANUAL Modes

With the MAN (manual) switch depressed, the required gate time can be selected from the Range ('n') buttons. With the AUTO switch depressed, the instrument will automatically select the gate time (.01, 0.1 or 1 second) which gives optimum resolution on the display.

Function Push-Button Switch Bank (Cont'd.):

9905 VHF and MF Modes

The AUTO/MANUAL facility is not fitted. Instead, these switches are marked VHF and HF, and serve as frequency range selectors. With HF selected the 'A' input range is 10Hz to 30MHz, directly gated. With VHF selected the 'A' range is 30MHz to 200MHz, prescaled by 4.

(iv) PERIOD 'A'

Provides period measurement on 'A' channel signal with readout in microseconds.

(v) RATIO n $\frac{A}{B}$

Refer to Chapter 4, para. 4.9.

(vi) TOTAL $\frac{A}{n}$

Provides accumulated total of events applied to Channel 'A', with prescaling by the factor 'n' according to the switch selected in the Range switch bank.

Time Base Range Push-Buttons:

This bank of six 'n' switches offers a choice of gate times. The multiplier 'n' associated with each switch may also be defined as follows:-

(a) The number of periods averaged on 'period average' measurement.

(b) The 'A' input prescale factor on 'totalise'.

(c) The 'B' input prescale factor on 'ratio'.

(d) The number of intervals averaged on 'time interval average'.

(e) The switch bank also is used to select the clock unit on 'time interval'.

START Slope Switch:

A slide switch which selects either positive-going or negative-going trigger edge for start of time interval, time interval average, and totalize measurements. Applies to the 'B' channel only.

STOP Slope Switch·

Selects the required 'stop' trigger edge polarity on time interval, time interval average, and totalize.

Line Selection

Position B-B selects single line 'start/stop' for time interval measurement (Channel 'B').
Position B-A selects 'start' Channel 'B' and 'stop' Channel 'A' on time interval measurements.

AC/DC Switch:

This switch selects either a.c. or d.c. coupling in the 'A' channel amplifier.

Operation on DC Mode

The use of d.c. mode is recommended in the following circumstances:-

(a) For signals having a slow rate of rise and fall (e.g. sinusoidal signals of frequency lower than 10 Hz).

(b) For signals of rectangular waveform which have a mark/space ratio other than 1 : 1, provided the frequency is less than 10 MHz.

Pulse/Contact Switch:

This switch selects the input timing mode for the 'A' and 'B' channel d.c. amplifiers.

(a) Pulse (⎍⎍) position. The position is for operation with electronically derived signals.

(b) Contact (⏐⏐) position. This position is used for measurement where the timing signals are obtained from contacts. The Start/Stop switches must be set so that ⎍ is used for contact closing and ⎍ for contact opening. A capacitor is introduced internally to reduce the effects of contact bounce.

OPERATE/CHECK Switch:

OPERATE is normal setting. CHECK provides a 1 MHz readout of the internal reference frequency for self-check of counting and display circuits.

Segment Check

To check all LED segments in the display, press the RESET button while in CHECK mode. This will produce an "all 8" display.

START/STOP Push-Button:

Provides manual start/stop on Time Interval and Totalize modes.

NORMAL/HOLD Switch:

In the NORMAL position the instrument provides continuous updating of the display. In the HOLD position the display is held but a single shot update can be obtained by depressing the adjacent RESET button.

RESET Push-Button:

When the RESET button is depressed and released the instrument will clear down to zero and initiate a new measurement. The RESET button is also used in the segment check.

AC SENSITIVITY Control:

This is a potentiometer providing manual variation of sensitivity in the 'A' input when the AC/DC switch is set to AC. The most sensitive position is fully anticlockwise. The control is also useful in filtering out h.f. interference on lower frequency measurements.

POWER ON/OFF Switch:

Switches off the internal d.c. supplies.

INDICATORS

OVERFLOW:

The OVERFLOW indicator will illuminate when the count exceeds the capacity of the display.

GATE:

The GATE indicator illuminates when the counter gate is 'open'. Thus the illumination period is related to gate time selected.

REAR PANEL ITEMS

1 MHz O/P Socket:	A 1 MHz reference signal derived from the frequency standard in use is available at this BNC socket.
Data Output Connector:	The facilities provided by the 28-way edge connector are listed in Table 2, in Chapter 2.
Power Plug:	A three-core power lead is supplied with the instrument.
Power Fuse:	Fuse ratings are annotated on the rear panel.
Osc. Adjust:	This aperture provides access to the calibration adjustment in the 5 MHz reference oscillator. Calibration must be carried out in accordance with instructions in the maintenance manual.

CHAPTER 4

OPERATING INSTRUCTIONS

POWER SUPPLY

4.1 Before operating a new instrument, or at a new location, check that the mains voltage selection is correct (check rear panel label) and that the fuse has the specified rating.

FREQUENCY MEASUREMENT

4.2 In this mode the unknown frequency is gated to the counter decades for the gating period selected by the chosen Range push-button (n). For frequencies below 10kHz the use of period mode will give greater resolution.

(1) Set the POWER switch to ON.

(2) Set the following controls:-

(a) Function switch to FREQUENCY - 'A' MAN. (9901) or, on the 9905, select required range, VHF or HF.

(b) AC/DC switch to AC or DC, as required.

(c) If using AC mode set the SENSITIVITY control initially to the maximum clockwise position.

(d) CHECK/OPERATE switch to OPERATE.

(e) HOLD/NORMAL switch to NORMAL.

(f) Pulse/Contact switch to Pulse (⎍).

(3) Connect the unknown signal to the 'A' input socket.

(4) If counting is not satisfactory adjust the SENSITIVITY control anti-clockwise towards the 10mV setting until a stable reading is obtained.

(5) Select the 'n' push-button which fills the display, or switch to AUTO (9901 only) for optimum resolution. The frequency readout is in kHz.

(6) If operating on HOLD, press and release the RESET button to obtain a new reading.

PERIOD MEASUREMENT

4.3 This mode is recommended for measuring low frequencies in the range 1Hz to 10kHz with improved resolution. The incoming unknown signal is taken to the time-base decade dividers, the output of which (selected by the Range push-buttons) is used to gate the internal frequency standard to the counter decades. The display indicates the actual value of the period of the incoming signal in microseconds. Greater accuracy is obtained by selecting a longer gate time, thus taking the measurement over a greater number of periods.

Period Operation

4.4 (1) Set the POWER switch to ON.

(2) Set the following controls:-

(a) Function switch to PERIOD 'A'.

(b) AC/DC switch to AC or DC, as required.

(c) If using AC mode, set the SENSITIVITY control initially to maximum clockwise.

(d) PULSE/CONTACT switch to PULSE (⌐¬).

(e) CHECK/OPERATE switch to OPERATE.

(f) HOLD/NORMAL switch to NORMAL.

(3) Connect the unknown signal to the 'A' input socket.

(4) Select the number of periods to be timed, by depressing the relevant Range push-button. A greater number of periods gives increased resolution, but longer measuring time.

(5) Adjust the SENSITIVITY control anticlockwise to obtain steady counting. This control is useful in filtering out h.f. interference on low frequency measurements.

(6) If operating on HOLD press and release the RESET button to obtain a new reading.

TIME INTERVAL (T.I. and T.I. Average)

4.5 In this mode the instrument is effectively serving as a stop watch by counting clock pulses derived from the frequency standard. The time interval may be

controlled by successive events on a single line (such as pulse widths) in which case Input 'B' is used with the B-B/B-A switch set to B-B.

4.6 For timing events on separate lines the B-B/B-A switch must be set to B-A. The 'start' signal applied to the 'B' Input and the 'stop' signal to the 'A' input. Trigger slopes can be selected by the START/STOP slope switches.

4.7 The T.I. mode is most suited to the measurement of single intervals such as pulse widths. A range of widths from 100 ns to several hours may be measured by selecting the appropriate clock unit. The maximum clock rate is 100 ns, therefore resolution on short duration pulses is likely to be unsatisfactory, but can be improved by the use of T.I. Average mode, which increases resolution by the averaging of the inherent ±1 count 'gate uncertainty' factor over a number of time intervals (1 to 10^5). It should be noted, when time averaging, that the repetition rate of the pulses under measurement must not be synchronous with the frequency standard in use.

NOTE: On Time Interval Average (single line) the ⌐ to ⌐ and ¬ to ¬ measurement is effectively equivalent to Period mode. Therefore the user is recommended to use Period for this particular type of measurement as the accuracy is greater and the measurement time reduced.

Time Interval Operation

4.8 (1) Set the POWER switch to ON.

(2) Set the following controls:-

(a) Function: depress the required T.I. or T.I. Avg. button (see NOTE above).

(b) Pulse/Contact switch: as required.

(c) B-B/B-A switch: for single line select B-B. For double line select B-A, and AC/DC switch to DC.

(d) START and STOP slope switches: select required triggering polarities (not required for manual timing).

(e) HOLD/NORMAL switch: select NORMAL.

(3) Connect the input(s) for electronic timing. For single line timing connect the external signals to Input 'B'. For double line connect the 'start' line to 'B' and the 'stop' line to 'A'.

(4) Press the Range (n) button which provides the appropriate readout. The guide lines from the T.I. buttons indicate the time units of the display.

(5) For manual timing press the START/STOP push-button, as required.

(6) If operating on HOLD press and release the RESET button to initiate a new (non-manual) timing process.

RATIO n $\frac{A}{B}$

4.9 In this mode, two unknown signals are fed to inputs 'A' and 'B'. Generally the higher frequency is fed via input socket 'A' to the counter decades and the lower frequency is fed through input socket 'B' to the time-base decades, but this input arrangement may be reversed, as for example, when the lower frequency has a smaller amplitude (e.g. 10 mV) and the higher frequency a considerably larger amplitude. The display indicates the ratio $n\frac{A}{B}$ and the reading must be divided by the factor 'n' to obtain the ration $\frac{A}{B}$.

Ratio Operation

4.10 (1) Set the POWER switch to ON.

(2) Set the following controls:-

(a) The FUNCTION switch to RATIO n $\frac{A}{B}$.

(b) The AC/DC switch to AC or DC as appropriate.

(c) The Pulse/Contact switch to Pulse

(d) CHECK/OPERATE switch to OPERATE.

(e) HOLD/NORMAL switch to NORMAL.

(3) Connect the input signals to sockets 'A' and 'B'. (See para. 4.9 above).

(4) Press the range (n) button which gives a full display without overspill.

(5) If on AC adjust the SENSITIVITY control as necessary.

(6) If on HOLD press the RESET button for a new reading.

(7) To obtain the true ratio the displayed reading must be divided by the factor 'n' indicated above the selected Range button.

TOTALIZE $\frac{A}{n}$

4.11 In this mode, signals on input socket 'A' are prescaled and taken to the counter decades. The count can be controlled manually by the START/STOP button, or electrically by timing signals connected to socket 'B'. This mode permits a number of events occurring with random timing to be counted over a chosen period.

(1) Set the POWER switch to ON and other controls as follows:-

(a) The Function switch to TOTAL $\frac{A}{n}$.

(b) The AC/DC switch to DC.

(c) The B-B/B-A switch to B-B.

(d) The CHECK/OPERATE switch to OPERATE.

(e) The Pulse/Contact switch as required.

(f) The HOLD/NORMAL switch to NORMAL.

(g) The START and STOP slope switches to select the required trigger edge polarities.

(2) Connect the signal to be totalized to socket 'A' and the electrical timing signals (if used) to socket 'B'.

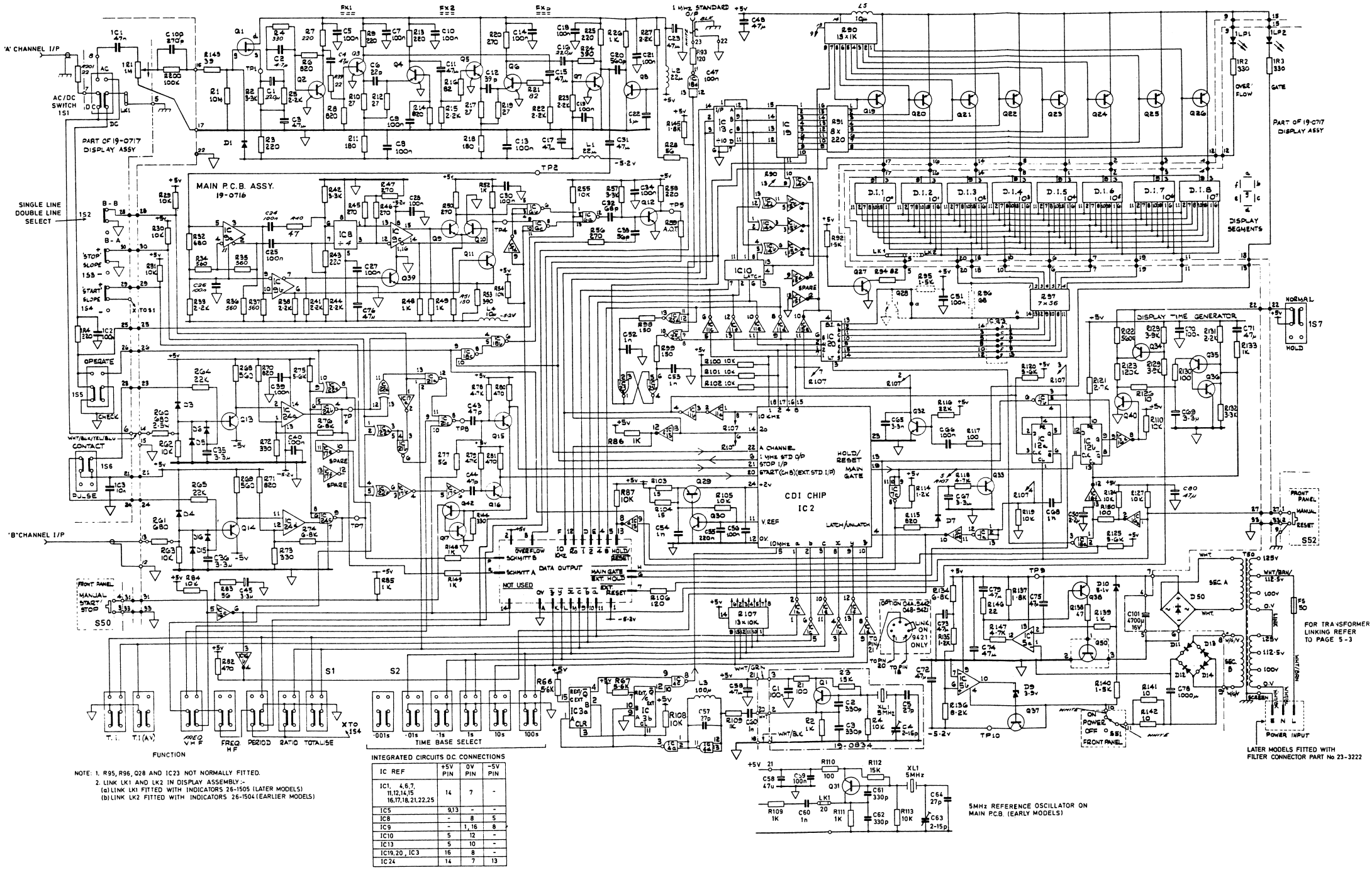
(3) Press the Range push-button which will provide suitable units for the count. For example, if the 10^3 button is depressed the display will be in units of 1000(within the accuracy of measurement).

NOTE: If the range n = 1 is used a count of 1 will be displayed when the main gate opens.

(4) If operating on HOLD, press and release the RESET button before taking a reading.

(5) If manual control is being used press START/STOP button to commence counting and again to terminate counting. The display will be held for about four seconds before automatically clearing.

(6) In order to obtain the true total the displayed reading must be multiplied by the scaling factor 'n' indicated above the selected Range button.



NOTE: 1. R95, R96, Q28 AND IC23 NOT NORMALLY FITTED.

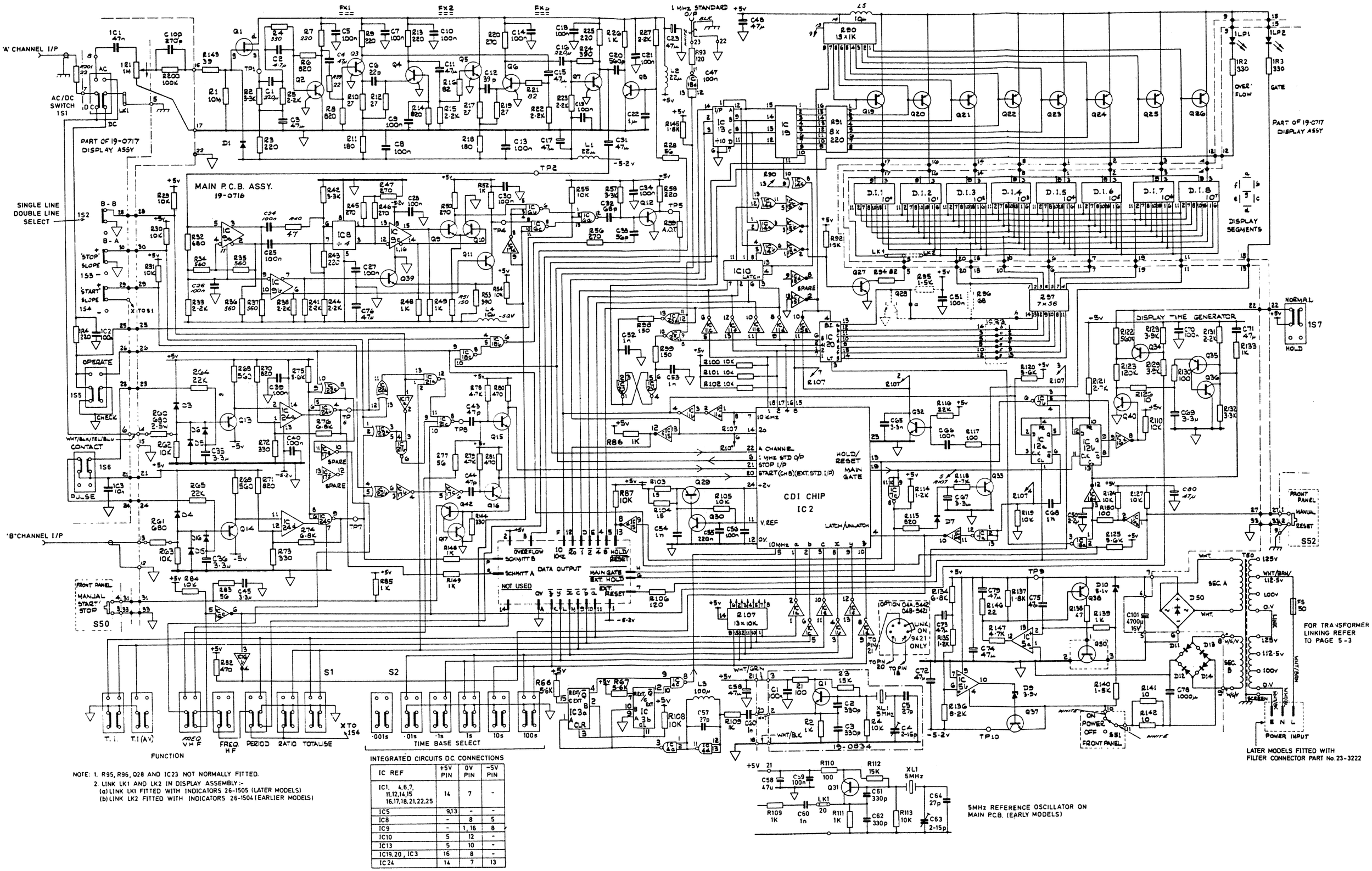
2. LINK LK1 AND LK2 IN DISPLAY ASSEMBLY:-
   (a) LINK LK1 FITTED WITH INDICATORS 26-1505 (LATER MODELS)
   (b) LINK LK2 FITTED WITH INDICATORS 26-1504 (EARLIER MODELS)

INTEGRATED CIRCUITS DC CONNECTIONS

IC REF	+5V PIN	0V PIN	-5V PIN
IC1, 4,6,7, 11,12,14,15 16,17,18,21,22,25	14	7	-
IC5	9,13	-	-
IC8	-	8	5
IC9	-	1, 16	8
IC10	5	12	-
IC13	5	10	-
IC19,20, IC3	16	8	-
IC24	14	7	13

WOH 6201	9905
1 2 3 4 5	

Overall Circuit 9905 Fig. 4



NOTE: 1. R95, R96, Q28 AND IC23 NOT NORMALLY FITTED.

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   (a) LINK LK1 FITTED WITH INDICATORS 26-1505 (LATER MODELS)
   (b) LINK LK2 FITTED WITH INDICATORS 26-1504 (EARLIER MODELS)

INTEGRATED CIRCUITS D.C. CONNECTIONS

IC REF	+5V PIN	0V PIN	-5V PIN
IC1, 4,6,7, 11,12,14,15 16,17,18,21,22,25	14	7	-
IC5	9,13	-	-
IC8	-	8	5
IC9	-	1, 16	8
IC10	5	12	-
IC13	5	10	-
IC19,20, IC3	16	8	-
IC24	14	7	13

WOH 6201	9905
1 2 3 4 5	

Overall Circuit 9905 Fig. 4