9057 & 9059
Frequency Period Meter
Technical Manual

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23rd May 2018

Technical manual

9057 & 9059
Frequency-Period Meters

RACAL **Racal Instruments Limited** Duke Street, Windsor, Berks,
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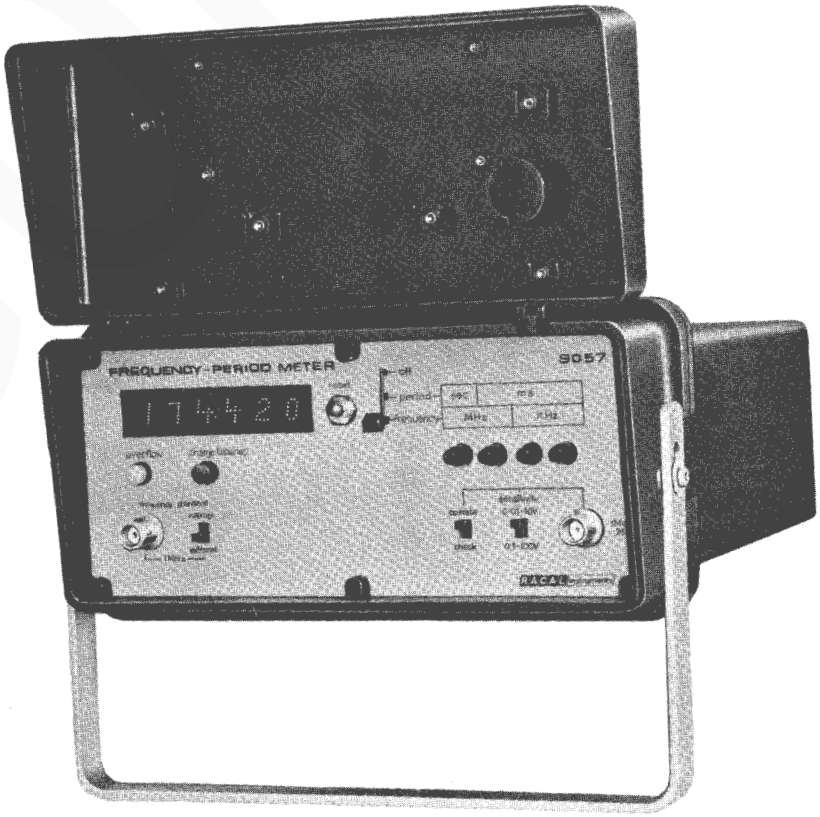
UNIVERSAL
FREQUENCY-PERIOD METER
9055
RACAL


FREQUENCY-PERIOD METER
9057
RACAL

CONTENTS LIST

SECTION 1

TECHNICAL SPECIFICATION

TECHNICAL SPECIFICATIONS

TYPES 9057 AND 9059

NOTE: The data applies to both models except where indicated otherwise.

1.1 FREQUENCY RANGE

Model 9057: 10Hz - 80MHz directly gated.

Model 9059: 10Hz - 80MHz Channel 'A' directly gated.
40MHz - 560MHz Channel 'B' prescaled by 10.

1.2 SIGNAL INPUT

Model 9057 and Model 9059 Channel 'A'

Sensitivity: Better than 10mV

Impedance: 1MΩ in parallel with 25 pF. a.c. coupled.

Signal Conditions: 9057 and 9059 Channel 'A'

Sensitivity Switch Setting	0.01	0.1
Signal Range (volts r.m.s.)	0.01 - 10V	0.1 - 100V
Maximum input before damage (volts r.m.s.)	250V below 100kHz Derate to 10V at 80MHz	250V below 100kHz Derate to 100V at 80MHz
D.C. Damage Overload	400V D.C.	

Connection: B.N.C. connector, front panel.

Model 9059 Channel 'B'

Sensitivity: Better than 10mV to 500MHz
falling to 50mV at 560MHz:

Impedance: 50Ω nominal

Signal Conditions: Channel 'B' (9059)

Sensitivity Switch Setting	0.01	0.1
Signal Range	0.01 - 0.5V	0.1 - 4V
Maximum input before damage (volts r.m.s.)	5V	5V
D.C. Damage Overload	50V D.C.	

1.3 FREQUENCY MEASUREMENT

Frequency Range:	Refer to 1.1
Accuracy:	± 1 count ± timebase accuracy.
Gate Times:	10ms, 100ms. 1s and 10s.
Self Check:	Internal 100kHz signal. (Does not operate on Channel 'B' of the 9059).

1.4 PERIOD MEASUREMENT

NOTE: On the 9059 the signal will be applied to Channel 'A'.

Range:	10Hz to 3 MHz
Periods Averaged:	1, 10, 100 or 1,000
Clock Units:	10 µs
Self Check:	Internal 100kHz signal.

1.5. TIME BASE

Frequency Standard	5 MHz Crystal Oscillator model 9440 or 9441 with proportional temperature control.
Warm-up Time	Typically 2 minutes for an accuracy of 1 part in 10^6 and 4 minutes for an accuracy of 1 part in 10^7.

	Ageing Rate	Better than 1 part in 10^8 per day on delivery, and typically better than 5 parts in 10^9 per day after 1 months operation.
	Temperature Performance	Better than 1 part in 10^8 per °C average over the range - 10 to 45°C.

1.6 EXTERNAL STANDARD INPUT

Frequency	1MHz
Minimum Level	100mV r.m.s. in 1 kΩcapacitively coupled.
Maximum Level	10V r.m.s. 100 V d.c.

1.7 DISPLAY

Format	Six digit in-line solid state numerical indicators plus overflow. Decimal point automatically positioned.
Latch	Previous measurement is displayed during period required to complete new measurement. Display is automatically up-dated at the end of each measurement.
Reset	Operation of the Reset push-button resets the display to zero and the instrument is then ready to commence new measurement.
Overflow	Overflow lamp lights if display reading exceeds 999999.

1.8 POWER SUPPLY

NOTE: The Battery Power Pack and A.C. Power Pack are offered as separate options One is necessary to operate the instrument.

Battery Operation

Power Source	Option 07-Battery Pack incorporating built-in charger.;
Fixing	Clamped to rear of counter by two finger-tightened screws.
Batteries	Eight re-chargeable nickel-cadmium 'D' size cells.
Operating Time	Approximately 5 hours at 25°C from fully charged condition.

Battery Protection	The battery load is automatically removed when voltage falls to about 4.5 V and a front panel lamp lights to indicate that batteries need re-charging. Alarm lamp will remain on for about 10 hours.
Charging Rates	Normal-Requires about 14 hours for complete re-charge. Rate cannot damage cells if inadvertently left on. Trickle-A trickle charge is automatically applied in the OPERATE mode if the mains input is left connected and the instrument switched off on the front panel. The pack can be left on trickle charge indefinitely.
Mains Input for Recharging	Voltage 115 V ± 10% and 230 V ± 10% at a frequency from 45 to 440Hz. Consumption approximately 9 VA.

A.C. Mains (Line) Operation

Power Source	Option 08-Mains Pack
Fixing	Clamped to rear of counter by two finger-tightened screws.
Output	+ 5 V d.c. at approximately 1.5A.
Mains Input	110, 120, 200, 220 and 240 V ± 6% at a frequency from 45 to 440 Hz. Consumption approximately 17VA.

ENVIRONMENTAL CONDTIONS

Operating Temperature	0°C to + 45°C.
Storage Temperature	-40°C to + 60°C.
Humidity	95% R.H. at 40°C.

MECHANICAL DETAILS

Construction	Both the Counter and Power Packs are contained in moulded cases of A.B.S. high impact material The Counter has a protective shower-resistant lid.
Dimensions	Height Overall 108mm ($4\frac{1}{4}$"). Width Overall 229mm (9"). Depth Overall including pack 298mm ($11\frac{11}{16}$").
Weight	Including Battery Pack-approximately 3.3 kg ($7\frac{1}{2}$ lbs) Including Mains Pack-approximately 2.5 kg ($5\frac{1}{2}$lbs).

ACCESSORIES

Issued with instrument	One handbook.
	One 6ft. long mains lead.
	One bag of spare fuses.
	Two B.N.C. plugs.

SECTION 2

DESCRIPTION

OPERATION & MAINTENANCE

CHAPTER 1

GENERAL DESCRIPTION

INTRODUCTION

1.1 The Frequency Period Meters Type 9057 and 9059 are compact portable instruments particularly suited to the needs of the communications industry. The instruments are available in either mains or battery-powered versions, with re-charging facilities provided in the battery pack.

FACILITIES

Type 9057

1.2 Direct frequency measurement is provided in the range 10Hz to 80MHz and period measurement from 10Hz to 3MHz, with four gate times. Sensitivity is better than 10mV over the frequency range. Input is on a single channel with a switched attenuator which permits a maximum input level of 100mV r.m.s. to be applied.

Type 9059

1.3 The 9059 is similar to the 9057, but with two input channels, the facilities on Channel 'A' being the same as for the 9057. The second input (Channel 'B') is provided with a separate switched attenuator feeding a pre-scaler assembly which extends the frequency range to 560MHz. The 10mV sensitivity is maintained up to 500MHz, decreasing to 50mV at 560MHz. The switched attenuator permits a maximum input level of 4V r.m.s. on Channel 'B'.

Display

1.4 The six-digit display employs in-line solid state numeric indicators with automatic positioning of decimal point. An "overflow" indicator lamp effectively extends the readout to seven digits.

CONSTRUCTION

1.5 The circuit assemblies are mounted on a main chassis which is secured to the rear of the front panel assembly, this complete assembly being inserted in a case which is attached to the front panel assembly by six screws. The power pack is secured to the rear of the instrument by hand-tightened bolts, the power connections between the two sections being made via an 8-way socket on the pack which mates with a fixed plug on the main chassis. The front panel has a hinged hood which can be closed to protect the panel when the instrument is not in use.

PARTS LISTS

1.6 Parts Lists for individual assemblies will be found preceding the layout and circuit diagrams for each assembly.

FREQUENCY STANDARD

1.6 The reference frequency is generated by a 5MHz plug-in Racal fast Warm-Up oscillator of high stability. A front panel socket with associated switch provides for the use of an external frequency standard if required. It should be noted that the accuracy of measurements made by the instruments is directly related to the accuracy of the frequency standard used.

POWER PACKS

1.7 The power packs are offered as options, thus allowing the customer to specify mains or battery operation, or to convert from one to the other.

Mains Power Pack

1.8 This operates from 100-130V or 200-250 a.c. supplies with voltage selector and input fuse accessible at the rear. A power cable and connector are supplied with the instrument.

Battery Pack

1.9 The Battery Pack Assembly contains eight 'D' size nickel cadmium cells arranged as two battery sections, each providing 5 volts. One section supplies 5 volts to the counter and timebase circuits and the other section 5 volts to the display assembly. Built-in charging facilities allow the batteries to be re-charged from an a.c. supply via the 3-pin plug on the rear panel, according to the position of the CHARGE/OPERATE switch. This switch must be set to OPERATE to use the instrument, and in this position the batteries will be trickle-charged whenever the front panel switch is at OFF (provided the a.c. supply is connected).

Battery Charging

1.10 To obtain the full charging rate for the batteries the rear panel switch should be set to CHARGE; the instrument is then inoperative. A red warning lamp on the rear panel of the Battery Pack is illuminated whilst the batteries are being charged at the maximum rate. A complete recharge at the full rate requires 14 hours. This charge rate cannot damage the cells even if inadvertently left on for long periods. Persistent overcharging will, however, re-duce the charge capacity of the batteries.

9059 VARIANT 1

This version is fitted with the Oscillator unit Type 9441 in place of the 9440, and is supplied with an antenna clipped into the hinged hood. The following military type numbers have been allocated:-

(a) Digital Frequency Period Meter 9059 Variant 1 (6625-99-628-5323)

(b) Mains Power Unit (Option 08) (6150-99-628-5325)

(c) Battery Power Unit (Option 07) (6116-99-628-5324)

CHAPTER 2

PREPARATION FOR USE

INTERNAL FUSE CHECK

2.1 To check the correct rating of the internal fuses refer to paragraphs 2.4 and 2.5.

MAINS PACK OPERATION

CAUTION: Mains voltages are exposed if the case is removed.

2.2 (1) Ensure that the fuselink on the rear panel of the mains pack is correctly rated for the mains supply voltage. (Para.2.4).

(2) Fit a suitable power plug to the power lead supplied. The lead is coded as follows:-

Brown (or red) . . . . . Line
Blue (or black) . . . . . Neutral
Green/Yellow (or green) . . . . . Earth (ground)

(3) Connect the mains pack to the counter, taking care to mate the 8-way plug and socket correctly, and tighten the two finger-screws.

(4) Connect the mains supply.

(5) Switch on the instrument using the OFF/PERIOD/FREQUENCY lever switch on the front panel.

BATTERY PACK OPERATION

2.3 (1) Ensure that the fuselinks in the battery pack are correctly rated.

(2) Connect the battery pack to the instrument and tighten the two finger-screws.

(3) Set the CHARGE/OPERATE switch on the Battery Pack to OPERATE.

(4) Switch on the instrument using the OFF/PERIOD/FREQUENCY lever switch on the front panel.

FUSELINK DATA

2.4

Location:	Ref:	Rating:
Mains Pack (internal)	FS1	2A
Mains Pack (external)	FS2	315mA (110/120V) 160mA (200/240V)

Location:	Ref:	Rating:	
Battery Pack (external)	FS1	5A	
High Speed Decade Assy.	FS1	1A	) Mounted on the Amplifier and
High Speed Decade Assy.	FS2	1A	) High Speed Decade Assembly p.c.b.

REMOVING THE CASE

2.5 (1) Ensure that the mains supply is not connected.

(2) Place the instrument, front panel cover downward on a bench and use a suitable screwdriver (posidriv) to remove the 6 screws located in the flange of the Front Panel Assembly.

(3) Carefully withdraw the instrument from the case.

NOTE: The battery or mains pack may be removed from the case by loosening the two finger-tightened screws.

SELF-CHECK

2.6 The instrument has a self-check facility which is selected by the OPERATE/SELF-CHECK slide switch. In the SELF-CHECK position the switch feeds the 100kHz reference signal from the frequency standard to the input amplifier. This permits performance checks to be made for both frequency and period measurements using an input signal of known frequency.

SELF-CHECK FREQUENCY

2.7 (1) Set the OFF/PERIOD/FREQUENCY lever switch to FREQUENCY.

(2) Set the OPERATE/SELF-CHECK switch to SELF-CHECK.

(3) Using the four push-buttons on the front panel, select in turn each of the available gate times (i.e. 10ms, 100ms, 1s and 10s) and check that the displays are in accordance with Table 1 below.

TABLE 1

Self-Check (Frequency Displays)

Gate Times	Units	Display
10ms	MHz	00.1000
100ms	MHz	0.10000
1s	kHz	100.000
10s	kHz	00.0000 (with overflow lamp illuminated)

SELF-CHECK PERIOD

2.8 (1) Set the OFF/PERIOD/FREQUENCY Meter to PERIOD.

(2) Set the OPERATE/SELF-CHECK switch to SELF-CHECK.

(3) Using the four push-buttons on the front panel select, in turn each of the available numbers of periods over which the measurement is to be made and check that the following displays are obtained.

TABLE 2

Self-Check (Period) Displays

Number of Periods	Units	Display
1	Sec	0.00001
10	ms	000.010
100	ms	00.0100
1000	ms	0.01000

NOTE: In both cases check that the decimal point is correctly positioned. If the above displays are not obtained the instrument should be investigated in accordance with the procedures in Chapter 6 - Maintenance.

CHAPTER 3

OPERATING INSTRUCTIONS

FRONT PANEL CONTROLS

3.1 (1) Function Switch Model 9057: A three-position lever switch which selects OFF/PERIOD/FREQUENCY.

Model 9059: A four-position lever switch which selects OFF/PERIOD/FREQUENCY 'A'/FREQUENCY 'B'

A bank of four push-buttons which selects any one of the four available gate times for frequency measurement or the number of periods for period measurements.

Frequency (Gate Times)
10ms
0.1s
1s
10s

Period (Number of Periods)
1
10
100
1000

(2) OPERATE/SELF-CHECK — A two position slide switch. In the lower position (CHECK) the 100kHz check signal is applied as the input signal. In the upper position (OPERATE) the instrument operates normally for frequency or period measurement.

(3) SENSITIVITY (Attenuator) Switch — A two-position slide switch which provides input attenuation with sensitivities of 10mV and 100mV Model 9059 has an additional Sensitivity switch for the Channel 'B' input.

(4) RESET Push-Button — Operation of the Reset push-button resets the display to zero and clears the instrument to commence a new measurement.

(5) OVERFLOW Lamps — The overflow lamp lights when the display reading exceeds 999999.

(6) CHARGE BATTERIES Lamp — When this lamp comes 'on' it indicates that the instrument has ceased to function due to automatic disconnection of the discharged batteries.

(7)	FREQUENCY STANDARD Switch	A two-position slide switch. In the upper position internal standard is selected, in the lower position external standard input is selected.

FRONT PANEL SOCKETS

3.2	(1) INPUT socket (Input 'A' on the 9059)	A BNC coaxial socket for connection of the 10Hz-80MHz signal under test. On the 9059 two input sockets are provided. (See Input 'B').
	(2) FREQUENCY STANDARD	A BNC socket which accepts a 1MHz external frequency standard when the FREQUENCY STANDARD switch is set to EXTERNAL. On the Model 9059 a 1MHz reference frequency output, derived from the internal frequency standard, is available at this socket when the FREQUENCY STANDARD switch is set to INTERNAL.
	(3) Input Socket 'B'	Model 9059 only. A BNC socket which accepts the 40MHz - 560MHz input signal.

REAR PANEL COMPONENTS

3.3 The power pack constitutes the rear portion of the instrument and the rear panel details for the two types of pack are as follows:-

Mains Pack

(a) Voltage Selector.

(b) Three-pin mains plug.

(c) Mains fuse.

Battery Pack

(a) CHARGE/OPERATE Switch: this two-position toggle switch must be in the OPERATE position to supply power to the instrument.

(b) Three-pin mains plug (for battery charging).

(c) Mains fuse.

OPERATING PROCEDURES

GENERAL INFORMATION

3.4 The frequency of a signal can be measured in one of two ways; either directly, by counting the number of cycles of that signal which occur during a known period (the reading is displayed in units of frequency i.e. Hz, kHz, etc.) or by measuring the period of the signal and displaying the reading in units of time, the reciprocal of which gives the frequency. The period measurement method is available for input signal frequencies in the range 10Hz to 3MHz, and is particularly recommended for frequencies lower than 10kHz.

FREQUENCY MEASUREMENT

3.5 (1) Connect the unknown signal to the input socket.

(2) Ensure that the function switch is set to FREQUENCY or FREQ A. (On battery pack operation ensure the switch on the battery pack is set to OPERATE).

(3) Select maximum attenuation which allows the display to operate.

(4) Select, using the bank of push-buttons on the front panel the gate time which allows the reading to fill all six windows of the display without overflow.

PERIOD MEASUREMENT

3.6 (1) Connect the unknown signal (max.frequency 3MHz) to the input socket.

(2) Set the Function switch to PERIOD.

(3) Select maximum attenuation which allows the display to operate.

(4) Select the number of cycles to be timed by depressing the appropriate Gate Time push-button. For maximum "resolution" select a gate time which fills all windows of the display without overflow.

OVERSPILL

3.7 To obtain high resolution when measuring higher frequencies it may be necessary to "overspill" one or more of the left-hand digits. First of all, select a short gate time and record the most significant digits displayed, then select a push-button giving a longer gate time to display the less significant digits to the required resolution.

CHAPTER 4

PRINCIPLES OF OPERATION

GENERAL

4.1 The instrument employs conventional digital counting techniques. In frequency measurement, clock pulses, generated at a known p.r.f. by a standard oscillator, are used to open a gate for a specified period. During this period pulses derived from the unknown signal are accumulated in the six counting decades and displayed in the six window readout as a measure of frequency. For period measurement the clock pulses are fed directly into the counting decades via the gate which is held open for a single period or a specified number of periods of the unknown input signal. In this way the number of clock pulses accumulated when the gate is open, is displayed as a measure of the period of the input signal. The following paragraphs 4.3 to 4.5 describe the basic operating principles for both frequency and period measurement with reference to the Simplified Block Diagram (Fig.2.1).

4.2 The control logic of the instrument incorporates a number of gates which form an electronic changeover circuit. This changeover circuit carries out the appropriate routeing of the signal in accordance with the setting of the Function switch on the front panel.

FREQUENCY MEASUREMENT

4.3 Signals in the frequency range 10Hz - 80MHz are applied to the input socket of model 9057 (or input socket 'A' on model 9059). Signals in the frequency range 40MHz - 560MHz are applied to input socket 'B' in model 9059. Signals in the range 10Hz - 80MHz are applied directly to the Amplifier and High Speed Decade Assembly whilst signals in the range 40MHz - 560MHz are applied via the 560MHz Amplifier and Pre-scaler. Either input may be attenuated by 20dB by appropriate setting of the Channel Sensitivity switch.

4.4 The unknown signal is amplified and shaped to provide a pulse for every complete cycle of that signal. The resulting train of pulses (p.r.f. equal to the frequency of the input signal) is fed via the electronic changeover switch to the signal input of the gating circuits. Clock pulses, in the form of 100Hz square wave output from the frequency standard, are fed via the changeover switch to the Time Base Divider, a selected output of which is then routed by the Control Circuit to the 'control' input of the gating circuit.

4.5 The Time Base Divider consists of divide-by-ten stages which provide an output pulse for every 1, 10, 100 or 1000 periods of the 100kHz frequency standard. This enables gate times of 10ms, 100ms, 1s or 10s to be selected by the bank of four push-buttons in conjunction with the control logic.

4.6 When the gating control circuitry in the Amplifier and High Speed Decade Assembly is opened by a gate-time signal from the timebase in the Control Assembly, the

unknown signal is released to the counting decades for a precise time interval, determined by the gate time setting. At the end of the gating period, the count is stopped and the total is transferred via the readout stages to the display.

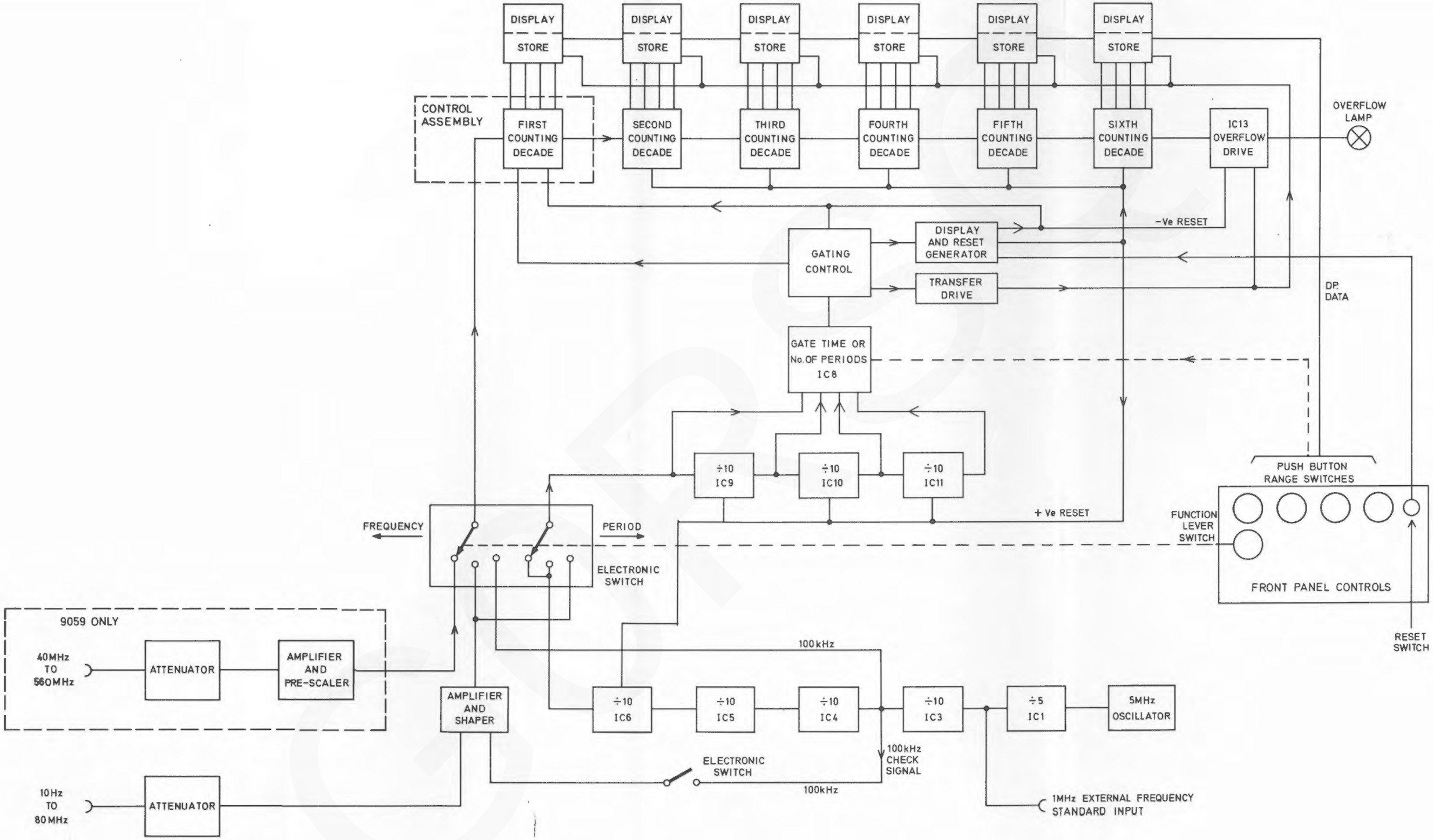
4.7 Operation of the Reset push-button resets the display to zero and clears the instrument to commence a new measurement. All timing processes are referenced to the very stable 100kHz signal derived from the Frequency Standard oscillator.

SELF-CHECK

4.8 In the CHECK mode the instrument operates as for frequency or period measurement except that the 100kHz signal derived from the Frequency Standard takes the place of the input signal. This self-check arrangement does not apply to Channel 'B' of the 9059.

PERIOD MEASUREMENT

4.9 The input is amplified and shaped, as in frequency measurement, to provide a train of pulses having a p.r.f. equal to that of the input signal. These pulses are routed by the electronic changeover switch to the Time Base Divider where they are used to control the gating time. The signal to the gating control circuitry is provided by the 100kHz output of the frequency standard and 10μs clock pulses are accumulated in the six counting decades for the duration of 1, 10, 100, or 1000 periods of the input signal. These clock pulses are displayed as the period measurement.



WOH2105

Simplified Block Diagram Type 9057/9059

Fig.2·1

CHAPTER 5

TECHNICAL DESCRIPTION

INTRODUCTION

5.1 The design of the 9057/9059 Mains/Battery Counters is such that all electronic components are mounted on printed circuit boards, the assemblies are:-

(a) Attenuator Assembly 19-0620)
) Model 9059 only
(b) 560 MHz Amplifier and Pre-scaler 19-0604)

(c) Control Assembly 19-0608

(d) Attenuator Assembly 11-0756

(e) Amplifier and High Speed Decade Assembly 19-0605

(f) Readout Assembly 11-0754

(g) 5 MHz Oscillator Model 9440

(h) Mains Power Pack
or
(j) Battery Power Pack.

ATTENUATOR ASSEMBLY 19-0620 Fig.4.1 (Model 9059 only)

5.2 Input signals in the range 40 MHz to 560 MHz are connected to Channel 'B' input of Model 9059 only. The slide switch offers direct coupling to the Amplifier and Pre-scaling Assembly or 20dB attenuation may be switched in using conventional means.

AMPLIFIER AND PRE-SCALER ASSEMBLY 19-0604 Fig. 4.3 (Model 9059 only)

5.3 The input signal in the frequency range 40 MHz - 560 MHz is applied to pin 1 of the p.c.b. Q1 to Q6 form the input amplifier which has a gain of approximately 14.

5.4 Q2 and Q5 are biasing transistors to the bases of Q3 and Q6. C6 and C12, pre-set capacitors to the emitters of Q1 and Q4 respectively, provide compensation at the higher frequencies.

5.5 Q7, Q8 and the tunnel diode D1 form the square wave shaping circuit, transistor Q7 provides a high input impedance to the tunnel diode whilst Q8 ensures a constant current bias supply. This square wave circuit which determines the sensitivity of the complete assembly, provides the fast edges to drive Q9, Q10 and IC1 at the lower frequencies.

5.6 IC1 is a decade divider, the output of which is buffered by Q12. C29 and R42 integrate the signal from Q12 to generate pulses at the output (pin 4) of the p.c.b.

CONTROL ASSEMBLY 19-0608 Fig. 4.5

Internal/External Frequency Standard

5.7 The output of the 5 MHz internal frequency standard oscillator Model 9440 connects to pin 22 of the p.c.b. and thence to the base of Q1. Q1 and Q3 form an amplifier and wave shaping network to provide a square wave to pin 1 of the divide by five integrated circuit IC1. IC1 divides the 5 MHz signal from the oscillator down to 1 MHz.

5.8 The 1 MHz reference is available at pin 36 for external use via the front panel frequency standard socket when Internal Standard is selected.

5.9 The input from a 1 MHz external frequency standard appears at pin 17 of the p.c.b. Q2 and Q4 amplify and shape the signal to produce a square wave output to IC2d.

Internal/External Selection

5.10 With the internal/external switch set to INTERNAL pins 34 and 35 are linked providing a path for the 5V supply through R15 to earth. Pin 35 of the p.c.b. and pins 1 and 2 of IC2a are at logic '0', pin 12 of IC2d is at logic '0'.

5.11 Logic '0' at pin 12 of IC2d closes IC2d gate thus inhibiting the 1MHz output from the external frequency standard. The logic '0' state at pins 1 and 2 of IC2a result in a logic '1' output at pin 3 of IC2a and pin 5 of IC2b which opens IC2b gate. As IC2c gate is open due to logic '0' on pin 12 of IC2d the 1 MHz signal from IC1 passes through IC2b and IC2c to pin 1 of IC3.

5.12 With the internal/external switch in the EXTERNAL position pin 34 and 35 of the p.c.b. are open circuit. Pin 35 is at logic '1' (no current flow through R5) therefore pins 1 and 2 of IC2a are at logic '1' and pin 12 of IC2d at logic '1'.

5.13 The logic '1' state at pins 1 and 2 of IC2a results in a logic '0' state at the output of IC2a and pin 5 of IC2b which closes IC2b gate and inhibits the 1 MHz signal from IC1. IC2c gate is open due to logic '0' on pin 5 of IC2b and as IC2d gate is open due to logic '1' on pin 12 the signal from the 1 MHz external frequency standard passes through IC2d and IC2c to pin 1 of IC3.

Frequency Standard Division

5.14 IC3, IC4, IC5 and IC6 are decade dividers which divide the 1 MHz from either frequency standard to provide 100 Hz clock pulses for frequency measurement at pin 11 of IC6.

5.15 Two 100 kHz outputs are taken from IC3, one output is taken to the main gate control for period measurement whilst the other provides the signal input for the self check facility.

Function/Selection (Refer to Fig.2.2 on Page 5-5)

5.16 IC7 on the Control Assembly 19-0608 forms with IC1 and IC2 of the Amplifier and High Speed Decade Assembly 19-0605 the electronic changeover switch for frequency or period measurement selection.

5.17 With the lever switch on the front panel set to PERIOD, pin 33 of the p.c.b. is at logic state '0' (taken to earth via the lever switch), therefore pin 1 of IC7a is at logic '0', closing gate IC7a gate and inhibiting the 100 Hz signal from IC6.

5.18 Pin 11 of IC7d is at logic '1', this is taken to IC1b of the Amplifier and High Speed Decade Assembly opening that gate and allowing the input signal which has been amplified and shaped to pass to IC7c of the Control Assembly.

5.19 IC7c gate is open (pin 1 of IC7a at logic '0', therefore pin 10 of IC7c is at logic '1') and the input signal is applied via IC1c and IC7c to the Time Base Divider.

5.20 In the period measurement mode pins 12 and 13 of IC7d are at logic '0' resulting in logic '1' at the output pin 11. This is taken to pin 1 of IC1a of the Amplifier and High Speed Decade Assembly via pin 15 of the p.c.b. to open IC1a gate. IC2b gate is open due to logic '1' on pin 9 (from IC2a) and logic '1' on pin 12 (no current flow through R45) and the 100 kHz from the Frequency Standard passes to the High Speed Decade via IC1a and IC2b.

5.21 With the front panel switch in the FREQUENCY position, pin 33 of the p.c.b. is at logic state '1' (no current flow through R17), therefore pin 1 of IC7a is at logic '1' and IC7a gate is open. Pin 14 of the p.c.b. is also at logic '1' (pin 11 of IC7d is at logic '0', therefore pin 12 of IC1c of Amplifier and High Speed Decade Assembly is at logic '0' resulting in logic '1' output from IC1c to pin 14 of p.c.b. 19-0605) which opens IC7c gate allowing the 100 Hz from the decade dividers to pass to the Time Base Divider.

5.22 As IC1b of the High Speed Decade Assembly is closed, the input signal path to the Time Base Divider via pin 14 of the p.c.b. is inhibited. IC1a of the High Speed Decade Assembly is also closed due to logic '0' on pin 1 via pin 15 of p.c.b. thus inhibiting the 100 kHz signal path to the High Speed Decade.

5.23 IC2a is open due to logic '1' on pins 1, 2 and 4. Logic '1' from pin 3 of IC1a opens IC2b gate and the input signal passes through IC2a and IC2b to the High Speed Decade.

Time Base Fig.4.5

5.24 This consists of three Decade Counters IC9, IC10 and IC11 which divide either the 100 Hz output of the frequency standard to provide gate times of 10ms, 100ms, 1s

or 10s for frequency measurement, or the input signal by 1, 10, 100 or 1000 for period measurement. In both cases the selected output from the divider chain is used to control the Gate Time Control Bistable on the Amplifier and High Speed Decade Assembly.

Time Base Selection

5.25 Selection of a particular time base is carried out by operating the bank of four push buttons on the front panel in conjunction with the time base selection gates which are:-

(a) Four two-input nand gates IC8a, IC8b, IC8c and IC8d.

(b) One four-input nand gate IC12a.

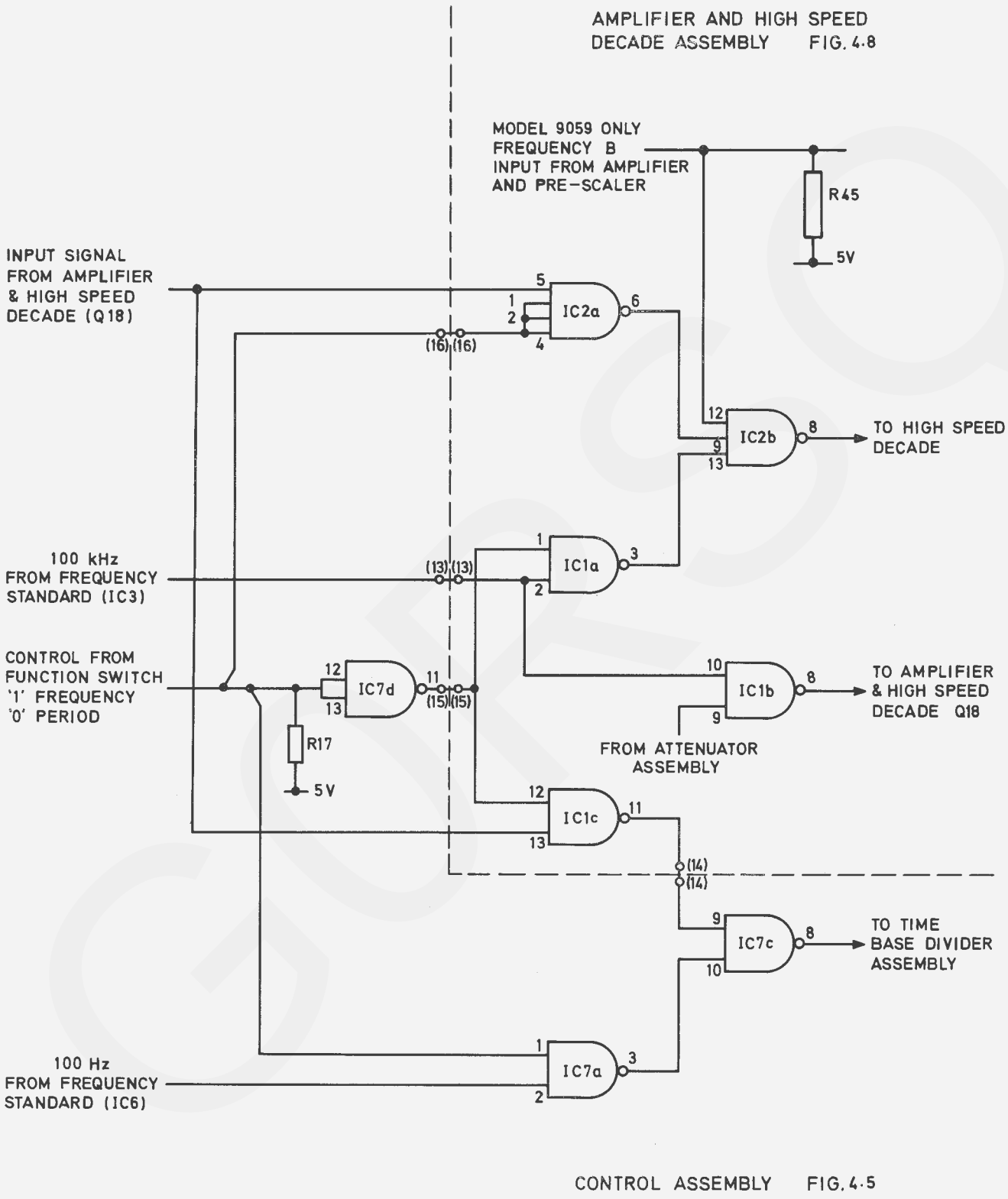
5.26 If, for example, a gate time of 10ms is selected for a frequency measurement (or a single period for period measurement) logic '1' is applied to pin 10 of IC8c to open that gate allowing the 100 Hz signal to pass to the gate time control circuits via IC12a. Gates IC8a, IC8b and IC8d will be closed due to logic '0' on pins 2, 4 and 12 respectively thus inhibiting the other inputs to the gate time control circuits.

5.27 A "Reset" pulse generated either manually by the Reset push button on the front panel or automatically at the end of a measurement cycle, sets the divider stages IC9, IC10 and IC11 to the '999' condition i.e. the output of each stage is set to logic '1'. The leading edge of the first pulse (derived from the frequency standard or the input signal) sets the output of IC7c to logic '1'. This means, at this instant all four outputs from the divider chain are at logic '1', thus ensuring that the output of IC12a is at logic '1' before the trailing edge of the first pulse is generated.

5.28 Immediately the output of IC7c goes to logic '0' the divider chain registers 0, 0, 0 and all four outputs of the divider chain are at logic '0' which ensures that the output of IC12a returns to logic '0'. This action provides the first negative edge which opens the High Speed Decade via the gate time control circuitry. A second negative edge from the output of IC12a is required to close the High Speed Decade, this is generated after a period determined by the particular time base output selected by the bank of push buttons on the front panel.

INPUT ATTENUATOR ASSEMBLY 19-0662 Fig.4.6

5.29 Signals in the Frequency range 10 Hz to 80 MHz are applied to the input socket. The slide switch offers direct coupling to the Amplifier and High Speed Decade Assembly or 20dB attenuation via the attenuator network. The attenuator also provides bias for the input amplifier of the Amplifier and High Speed Decade Assembly by biasing the F.E.T. Q5 to zero volts.


AMPLIFIER AND HIGH SPEED
DECADE ASSEMBLY FIG. 4.8
MODEL 9059 ONLY
FREQUENCY B
INPUT FROM AMPLIFIER
AND PRE-SCALER
R45
5V
INPUT SIGNAL
FROM AMPLIFIER
& HIGH SPEED
DECADE (Q18)
IC2a
IC2b
TO HIGH SPEED
DECADE
100 kHz
FROM FREQUENCY
STANDARD (IC3)
IC1a
CONTROL FROM
FUNCTION SWITCH
'1' FREQUENCY
'0' PERIOD
IC7d
R17
5V
IC1b
TO AMPLIFIER
& HIGH SPEED
DECADE Q18
FROM ATTENUATOR
ASSEMBLY
IC1c
IC7c
TO TIME
BASE DIVIDER
ASSEMBLY
100 Hz
FROM FREQUENCY
STANDARD (IC6)
IC7a
CONTROL ASSEMBLY FIG. 4.5

AMPLIFIER AND HIGH SPEED DECADE ASSEMBLY 19-0605 Fig.4.8

5.30 Input signals in the range 10 Hz - 80 MHz are coupled to the amplifier board via pin 31 to the gate of the F.E.T. Q5. Q5 is biased to zero volts by the resistors in the attenuator assembly and Q6 provides a constant current source.

5.31 Q5 is connected as a source follower and with the emitter follower Q7 provides a high input impedance to low impedance conversion at near unity gain.

5.32 D4, Q3, D5 and Q4 form a limiting circuit by clipping the positive and negative excursions of the input signal.

5.33 The output of Q7 is coupled via C1 and C2 to the feedback amplifier Q8 and Q9. The output of Q9 is coupled via C9 and C10 to a second feedback amplifier Q11 and Q12. This arrangement of feedback amplifiers provides a well defined gain at the collector of Q12.

5.34 Q13 is an emitter follower stage which provides a low impedance source for the Schmitt trigger circuit Q14 and Q15. The emitter of Q13 provides a convenient test point for the amplifier stages. R26 in the base circuit of Q13 provides adjustment of the Schmitt trigger input bias to the base of Q14.

5.35 Q14 and Q15 shape the waveform into square pulses with fast rise time edges which are coupled via the emitter follower Q16 to the differentiating network C29 and R38.

5.36 The negative differentiated pulse only is amplified by Q18, thus a narrow pulse appears at the collector of Q18 for every cycle of the amplifier input signal.

5.37 The output of Q18 is applied, by the function logic, to either IC3b or the Control Board Assembly via pin 14 of the p.c.b.

Check Signal

5.38 The 100 kHz check signal is applied via pin 13 of the p.c.b. to pin 10 of IC1b. With the front panel OPERATE/SELF-CHECK switch in the SELF-CHECK position IC1b gate opens and applies the 100 kHz self-check signal to the base of Q8.

Auxiliary -6.2V Supply

5.39 An auxiliary 6.2V negative supply is provided to supplement the battery or mains pack supply to the F.E.T. Q5, Q13, Q14 and Q15. The 6.2V negative supply is generated by Q17, Q19 and T1. A 100 kHz output from IC3 of the Control Assembly is applied to T1 via Q17 and Q19.

5.40 D9 and D11 on the secondary of T1 rectify the signal and provide a -6.2 volts via the smoothing circuit to Q14, Q15, Q13 and Q6, the constant current regulator for Q5.

Automatic Cut-out

5.41 The Automatic Cut-out removes the load from the battery pack when the batteries reach the discharged condition (below 4.5V) and illuminates the 'charge batteries' warning lamp on the front panel.

5.42 Q1 and Q2 form a cross coupled bistable circuit having their respective emitters coupled to earth via the front panel lever switch.

5.43 When the instrument is switched on, the emitter of Q1 going to earth switches Q1 'on' and places the +5V supply No.1 across RLA/2 operating the relay and closing contacts RLA1 and RLA2 to provide a path for the power supplies to the p.c.b.'s and the display assembly.

5.44 When the battery voltage falls below 4.5V, the voltage at the junction of R53 and D3 will fall and the resulting drop in base voltage to Q1 will cut Q1 off. Relay RLA/2 will drop out, opening RLA1 and RLA2 which removes the load from the power supply. When Q1 cuts off, the base voltage to Q2 increases the current through Q2 to light the 'charge batteries' lamp on the front panel. The lamp is connected between pin 19 and 23 of the p.c.b.

5.45 D2 at the collector of Q2 isolates the base of Q1 from the 'charge batteries' lamp supply.

Gating Control (Fig.4.5 and Fig.4.8)

5.46 Before a measurement can take place, the display, the time base divider chain and control logic must be reset to their appropriate standby states. This is carried out by the positive and negative-going RESET pulses. The negative pulse is generated at the collector of Q10 and taken to pin 1 of the amplifier and High Speed Decade Assembly p.c.b. This negative pulse clears IC3a on the High Speed Decade Assembly and IC13b on the Control Assembly setting their respective Q outputs to zero. The High Speed Decade bistables IC3, IC4, IC5 and the overflow drive are also set to zero. The positive reset pulse appears at the collector of Q9 and is taken to pin 4 of the p.c.b. where it connects to the Readout Assembly and is used to set the counting decades in the display assembly to zero. The positive reset pulse is also used to set the time base divider outputs to "all 9's".

5.47 The output of the time base divider chain, is taken from IC12a to the clock input (pin 1) of IC3a on the Amplifier and High Speed Decade Assembly.

5.48 IC3a is a divide-by-two package which divides the clock input from IC12a on the Control Assembly to provide a logic '1' output at Q for the duration of the main gate period. This is applied to the J and K inputs of IC3b.

5.49 When the gate time has expired the Q output of IC3a goes to logic '0' closing IC3b and stopping the count.

5.50 At the end of the main gate period the $\overline{Q}$ output of IC3a goes to logic '1' and connects via pin 5 of the p.c.b. to the clock input of IC13b and the base of Q7 on the Control Assembly.

5.51 C9 and R22 present a positive spike to the base of Q7 which switches on. The negative-going spiked output of Q7 is the transfer pulse which is used to update the display at the end of the main gate period.

5.52 Logic '1' to the clock input of IC13b changes the $\overline{Q}$ to logic '0'. One $\overline{Q}$ output is taken to pin 3 of the p.c.b. whilst the other switches off Q5 allowing C10 to charge via R26 and R23.

NOTE: The time taken to charge C10 sets the display time.

5.53 Whilst C10 is charging, Q6 and Q8 are switched off, Q9 is on and Q10 is off. When the display time has expired i.e. C10 charged, Q6 and Q8 switch on, Q9 switches off and Q10 switches on. The negative reset pulse is taken from the collector of Q10 to clear IC13b and is also taken via pin 4 of the p.c.b. to clear IC3a on the Amplifier and High Speed Decade Assembly. The positive reset pulse is taken from the collector of Q9 and applied to the time base divider chain and the display assembly.

5.54 The $\overline{Q}$ output of logic '0' to pin 3 of the p.c.b. is taken to the J and K inputs of IC3a on the Amplifier and High Speed Decade Assembly to ensure a main gate period is not generated during the display time.

Sampling Rate

5.55 The sampling rate of the instrument depends upon two factors, the selected gate time and the period for which the completed reading is displayed before the next measurement is allowed to commence. The display time is governed by the time taken to charge C10 and different values of R26 will, therefore, vary the sampling rate.

Manual Reset

5.56 By pressing the RESET button on the front panel, Q9 is switched off and the positive and negative reset pulses are generated.

READOUT ASSEMBLY 11-0754 Fig.4.10

5.57 The instrument has a six digit in-line solid state latched display. The display comprises hybrid micro-circuits consisting of a MS1 decoder/driver circuit and an array of "Ga As P" light-emitting diodes. The decoder/driver provides 5 bits of latch memory for the BCD and decimal point data, a BCD-to-4 x 7 decoder, and LED drivers.

5.58 IC3b, IC4a, IC5a, IC4b and IC5b of the Amplifier and High Speed Decade Assembly are divide-by-two integrated circuits connected to form the first decade divider.

5.59 The 8421 weighted BCD outputs are taken via pins 7, 9, 8 and 6 to the Control Circuit Assembly and thence to the display package.

5.60 The BCD outputs assume logic '1' or '0' states as the count progresses from 0 to 9 as indicated in Fig.2.3.

5.61 The output of the high speed decade is taken from pin 8 of IC5b via pin 10 of the p.c.b. to the next decade divider on the display assembly.

Overflow Indication Fig.4.5

5.62 At the end of a measurement cycle the negative reset pulse to pin 5 of IC7d on the control Assembly ensures a logic '1' to input pin 9 of IC12b. Pin 10, 12 and 13 arenormally at logic '1' therefore the output of IC12b pin 8 is always at logic '0' after the reset pulse. IC7b and IC12b remain in this condition unless an output pulse from the most significant decade of the Display Assembly appears at the OVERFLOW input to the Control Assembly, indicating that the display counter chain has overflowed.

5.63 This pulse is differentiated by C14 and R35, the positive spike is clamped by D6 and the negative input to IC12b causes pin 8 of IC12b to go to logic '1'. Pins 4 and 5 of IC7b are both now at logic '1' since the collector of Q10 is normally high, thus pin 9 of IC12b goes to logic '0'. IC7b and IC12b remain in this condition unless a reset pulse appears at pin 5 of IC7b. IC12b thus applies logic '1' to pin 2 of IC13a from the time an overflow occurs to the next reset pulse.

5.64 The logic '1' applied to pin 2 of IC13a after overflow, is transferred to the Q output pin 5 of IC13a when the transfer pulse is generated at the end of the gate time. This logic '1' switches on Q11 and lights the lamp.

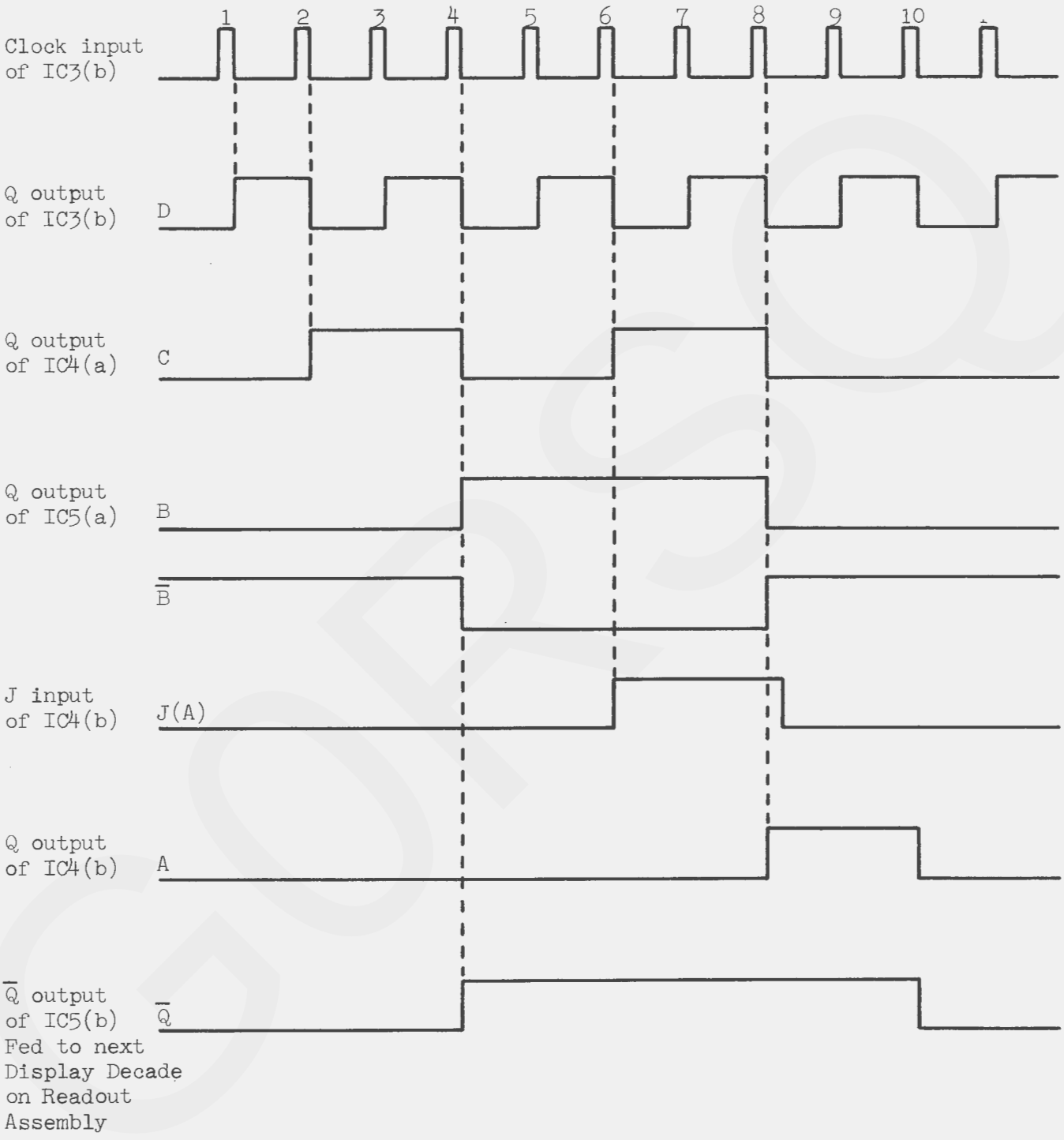
FREQUENCY STANDARD

5.65 This is provided by a 5 MHz Racal fast warm-up oscillator Model 9440 which has a stability better than 1 part in 10^6 over the complete operating temperature range. The oscillator which is of the plug-in type has a B7G base. For further details refer to para. 1.6 of the Technical Specification.

POWER SUPPLIES

Mains Pack Assembly 11-0758 Fig.4.12

5.66 Single phase mains input is applied to the Mains Pack Assembly via the flying lead to the rear panel. Adjustment is provided for inputs of 110V, 120V, 200V, 220V and 240V with protection on the live side provided by FS2 (110/120V - 315 mA: 200/240V - 100 mA).



WOH 2105

Fig. 2.3 Counting Decade Waveforms

5.67 The secondary of T1, input transformer is applied to the full-wave rectifier circuit the output of which is approximately 7.5V d.c.

5.68 The 2A fuse FS1 is provided for overload protection of the mains pack.

Battery Pack Assembly 11-0759 Fig. 4.14

5.69 The battery pack consists of two sets of 5V batteries and a charging unit. When fully charged the batteries can supply power to the instrument for approximately five hours.

5.70 The battery load is removed by an automatic cut out in the instrument which operates when the battery voltage falls to approximately 4.5 volts (discharged condition). This is indicated by a front panel 'charge batteries' light which remains on for at least ten hours after the counter cuts off.

5.71 Two charging rates are available, selected by a two position toggle switch on the rear panel which is marked CHARGE/OPERATE.

5.72 In the CHARGE position the batteries are placed in series and the output of the full wave rectifier circuit is applied via the constant current regulator Q3. Resistor R4 in the emitter of Q3 determines the charging current which is approximately 350 mA. This corresponds to a mains supply current of approximately 40mA.

5.73 With the rear panel toggle switch in the 'Operate' position, a trickle charge of approximately 40mA d.c. is applied to the batteries when the instrument is switched off at the front panel and the mains supply is left connected. One battery is trickle charged via R2/D2 and the other via R3/D1.

5.74 THE1 is a thermal cut out mounted internally so that the charging circuit is disabled above 60°C. This provides protection for the pack in the event of inadvertent overcharging of the batteries by continuous use of the higher charge mode.

5.75 FS1 is mounted internally on the p.c.b. to provide protection only to the battery cells in the event of a short circuit. This fuse should be checked if a fault indicating zero output voltage occurs.

5.76 Packs are normally dispatched with the input transformer set to 230V a.c. Packs set to 115V a.c. are also available.

5.77 Charge Warning Lamp. On later models the indicator lamp LP1 (connected between pins 14 and 15 in Fig. 4.14) is mounted on the rear panel of the Battery Power Pack. This lamp illuminates whenever the internal batteries are being charged at the full charge rate.

Power Transformer Connections

5.78 The transformer has a series/parallel primary. Conversion from 230V a.c. working to 115V a.c. working requires modification to the internal wiring, as follows:-

230V a.c. Operation		115V a.c. Operation	
Primary Connection	Component	Primary Connection	Component
A	mains fuse tag	A & C	mains fuse tag
B & C	to Pin 7 of p.c.b.		and Pin 7 of p.c.b.
D	to neutral mains socket	B & D	to neutral mains socket

CHAPTER 6

MAINTENANCE

TEST EQUIPMENT REQUIRED

6.1	(a)	Multimeter:	20kΩ/volt D.C. voltage range 0-250V Example: AVO 8
	(b)	Oscilloscope:	Bandwidth: D.C. to 50 MHz. Sensitivity: 50 mV/cm.
	(c)	1 MHz Frequency Standard:	Accuracy better than ± 1 part in 10^6. Output 1V r.m.s. nominal.
	(d)	HF Signal Generator:	Upper frequency limit not to be less than 560 MHz. Output from 5 mV r.m.s. into 50Ω.
	(e)	L.F. Signal Generator:	To cover frequencies down to 10 Hz. Signal/Noise ratio better than 40dB.
	(f)	Millivoltmeter:	Range: 1mV to 3V Frequency response: 1 to 560 MHz. Example: Racal Airmec 301A.
	(g)	Stabilized D.C. Power Supply:	Variable 0 to +5V, 2A max. Example: Farnell L30 BT.
	(h)	Coaxial Lead:	50 ohm BNC to BNC connection approx. 1 metre (3 ft) long.
	(j)	Coaxial Lead:	BNC to 'open end' to which is connected 0.1μF capacitor and 100Ω resistor in series.
	(k)	Extension leads with 8-way connectors:	Power Pack d.c. connector three core with 8-way connectors (Part No.23-3050 and 23-3051). wired according to Fig.4.15.
	(l)	BNC 'T' Piece and 50Ω Terminating Pad.	

USE OF TEST EQUIPMENT

6.2 The test equipment listed in para.6.1 will be connected directly to the instrument under test and used according to the manufacturers instructions.

REMOVAL OF CASE

6.3 Remove the case of the instrument as described on page. 2-2.

FUSE CHECK

6.4 Check that the fuses are correct and securely fitted. See paras.2.4 and 2.5 on pages 2-1 and 2-2 and Fig.2.5 at the end of this chapter.

GENERAL PERFORMANCE CHECK

6.5 Before commencing any setting up procedures ensure the instrument is serviceable and that the power supply voltages are correct.

SELF CHECK

6.6 Carry out the self-check procedures as given on pages 2-2 and 2-3.

POWER SUPPLY CHECKS

6.7 Mains (A.C.) Powered Instruments

(1) Detach the Mains Pack and centre section of the instrument case from the Front Panel Assembly.

(2) Use the Extender Leads with 8-way connectors to connect the Power Pack to the Main Chassis Assembly.

(3) Ensure the Mains Pack input links are correct for the local supply voltage (Chapter 5, para.77 refers).

(4) Connect the instrument to the mains supply, switch the FUNCTION switch to FREQUENCY or FREQUENCY 'A' and note that the display illuminates.

(5) On the Amplifier and High Speed Decade Assembly check that the voltage between pin 19 and pin 18 of the p.c.b. is +5V d.c. + 0.25V d.c. and that the voltage between pin 26 and pin 18 is also +5V d.c. ± 0.25V d.c.

6.8 Battery Powered Instruments

(1) Follow the procedure outlined in para.6.7 substituting Battery Pack for Mains Pack.

(2) In the event of a zero voltage output condition, the fuse FS1 on the Charge Regulator Assembly should be checked before investigating the batteries or charging supply.

6.9 Charge Batteries Lamp

NOTE: The Battery Pack is detatched from the instrument for this test. Connect the Farnell L30 BT Stabilised Power Supply to the instrument as follows:-

(1) One 5V d.c. output to pin 8 of the Power Connector (Power Supply No. 1).

(2) The other 5V d.c. output to pin 7 of the Power Connector (Power Supply No. 2).

(3) The 0V output to pin 6 (0V) of the Power Connector.

(4) Switch on the stabilised Power Supply.

(5) Switch the OPERATE/CHECK switch to CHECK.

(6) Switch the Function switch to FREQUENCY or PERIOD and note that the display operates.

(7) Reduce the output from the stabilised Power Supply to Power Supply No. 1 until the 'CHARGE BATTERIES' lamp on the front panel illuminates.

(8) Check that the output voltage from the stabilised Power Supply is in the range 4.3 to 4.7V d.c. and verify that the display is extinguished.

PERFORMANCE TESTS

NOTE: If during the Performance Tests commencing at para. 6.12 the required results are not obtainable, it may be necessary to adjust the Schmitt trigger on the Amplifier and High Speed Decade Assembly (refer to para. 6.16).

6.10 Setting-up Internal Frequency Standard

Equipment Required: 1 MHz frequency standard accurate to $\pm$ 1 part in 10^8.

Procedure

(1) Ensure that the instrument has been switched on for at least one hour. For battery instruments see Note below.

(2) Connect the 1 MHz frequency standard to the BNC input socket of Model 9057 (Channel 'A' input socket Model 9059).

(3) Set the Function Switch to FREQUENCY (Model 9057) or FREQUENCY 'A' (Model 9059).

NOTE: When calibrating the frequency standard in a battery operated instrument ensure that the battery voltage is not near the discharged level (minimun level 4.75V). If a new battery pack is fitted the instrument should be switched on for at least one hour before commencing calibration.

(4) Press Button 2 (MHz) on the Push Button Range Switch to check the 1 MHz display.

(5) Press Button 4 (kHz).

(6) Carefully adjust the internal oscillator for a display reading of ±3 parts in 10^7 (Refer to Fig.2.4 Service View: Chassis Upperside).

NOTE: The displayed reading should be five 0's with the least significant digit reading 0, 1, 2 or 3 or five 9's with the least significant digit reading 9, 8 or 7.

6.11 External Frequency Standard Input

(1) Set the Function Switch to FREQUENCY (9057) or FREQUENCY 'A' (9059)

(2) Set the Operate/Check switch to CHECK.

(3) Set the Internal/External Switch to EXTERNAL.

(4) Apply the 1 MHz frequency standard to the 1 MHz External Frequency Standard input socket at a level of 80mV r.m.s.

(5) Press Button 3 (kHz) on the Push Button Range Switch.

(6) Check that the display reads 100.000.

ATTENUATOR CHECKS

6.12 Equipment: Signal Generator
'T' piece and 50Ω load.

6.13 Attenuator 19-0662

(1) Apply a signal of 80 MHz at 10 mV r.m.s. into a 50Ω termination to the input socket ('A' input on 9059).

(2) Set the Slide Switch Attenuator to 0.01 - 10V.

(3) Set the Function Switch to FREQUENCY or FREQUENCY 'A'.

(4) Press the 10 ms (MHz) Range Switch Push Button.

(5) Check for correct display of the input frequency.

(6) Reduce the input from the signal generator until the display ceases to operate then carefully increase the input for a correct and stable display (threshold). Note the output level setting of the signal generator.

(7) Switch the slide switch Attenuator to 0.1 to 100V and check that the display does not operate.

(8) Carefully increase the level of input signal to obtain a correct and stable display. Note the output level setting of the signal generator.

(9) The input voltage level required to operate the display in (8) should be 20dB ± 4dB higher than that required to operate the display in (6).

6.14 Attenuator 19-0620 (Model 9059 only)

(1) Apply a signal of 480 MHz at 10 mV r.m.s. to the 9059 Channel 'B' input (no 50Ω termination required).

(2) Set Channel 'B' Slide Switch Attenuator to 0.01 - 5V.

(3) Set the Function Switch to Frequency 'B'.

(4) Press the 10 ms (MHz) Range Switch Push Button.

(5) Check for correct display of the input frequency.

(6) Reduce the input from the signal generator until the display ceases to operate then carefully increase the input for a correct and stable display. Note the output level setting of the signal generator.

(7) Set the Channel 'B' Slide Switch Attenuator to 0.1 to 5V and check that the display does not operate.

(8) Carefully increase the level of input signal for a correct and stable display. Note the output level setting of the signal generator.

(9) The input voltage required to operate the display in (8) should be 20dB ± 3dB higher than that required to operate the display in (6).

SENSITIVITY CHECK

6.15 In the following checks the signal generator must be calibrated by an electronic voltmeter to ensure an accurate 10mV input.

Equipment Required:

(a) Signal Generator and 50 ohm pad.

(b) Electronic Voltmeter.

(c) 15pF Capacitor.

Procedure

(1) On the 9057 (or 9059 Channel 'A') set the Sensitivity Switch to 0.01 - 10V.

(2) Connect the signal generator to the input of the electronic voltmeter with a 15pF capacitor shunting the 50 ohm input of the voltmeter this simulates the instrument input conditions.

(3) Set the signal generator output to exactly 10mV on the voltmeter. Note the exact reading on the signal generator control.

(4) Connect the signal generator via the BNC 'T' piece with the 50 ohm load to the input socket of the 9057 or (9059 Channel 'A').

(5) Set the 9057/9059 Function Switch to FREQUENCY or FREQUENCY 'A'.

(6) Set the signal generator frequency and the 9057 Push Button Range Switch to the settings listed in Table 3. Check that in each instance a stable and accurate display is obtained.

TABLE 3

9057 and 9059 Channel 'A' Sensitivity Check

Push Button Range	Input Frequencies	Remarks
10s kHz (4) 1s kHz (3) 100ms MHz (2) 10ms MHz (1)	10 Hz 100 Hz, 100 kHz 100 kHz, 1 MHz 1 MHz, 10 MHz Continue the frequency sweep in 10 MHz steps to 80 MHz	Sensitivity switch set to 0.01 - 10V Input Level to be not higher than 10mV r.m.s.

(7) On Model 9059 transfer the signal generator to the Channel 'B' input socket (50 ohm load not required).

(8) Set the Function Switch to FREQUENCY 'B'.

(9) Repeat operation (6) but in accordance with details in Table 4.

TABLE 4

9059 Channel 'B' Sensitivity Check

Push Button Range Switch	Input Frequencies	Remarks
1s kHz (3)	Greater than 40 MHz (check overflow lamp illuminated)	Sensitivity Switch set to 0.01 - 10V.
100ms MHz (2)	40 MHz to 90 MHz	Input level to be not higher than 10mV r.m.s.
10ms MHz (1)	100 MHz to 500 MHz	
10mS MHz (1)	500 MHz to 560 MHz	Input Level to be not higher than 40mV r.m.s.

SETTING UP THE SCHMITT TRIGGER (Q14 and Q15 Amplifier and High Speed Decade)

6.16 Equipment Required: Signal Generator
'T' Piece and 50Ω load.

Procedure

(1) Connect the signal generator to the 9057 input socket (9059 Channel 'A') and apply a signal of 10 MHz at a level of 10 mV.

(2) Set the Slide Switch Attenuator to 0.01 - 10V.

(3) Set the Function Switch to FREQUENCY or FREQUENCY 'A'.

(4) If necessary adjust R26 on the Amplifier and High Speed Decade Assembly for a stable display. (Refer to Fig.2.4).

(5) Slowly reduce the input from the signal generator until the Schmitt Trigger fails to operate and the display becomes erratic.

(6) Carefully re-adjust R26 until the Schmitt Trigger action recommences and the display is stabilized.

(7) Repeat the procedures in (5) and (6) until the lowest possible voltage has been found at which the Schmitt trigger will operate, thus achieving the most sensitive condition.

AMPLIFIER AND PRE-SCALER ASSEMBLY 19-0604 (9059 only)

6.17 CAUTION: The Amplifier and Pre-Scaler has been carefully aligned by the manufacturer to ensure optimum performance. No attempt should be made to re-align the assembly. If this assembly is suspect it is recommended that the instrument be returned for servicing to Racal Instruments Limited, or to an authorized agent.

Equipment Required: Signal Generator
Oscilloscope.

(1) Apply a signal in the frequency range 40 MHz to 500 MHz to Channel 'B' input socket.

(2) Connect the high impedance probe of the oscilloscope to the Amplifier and High Speed Decade input from the Amplifier and Pre-Scaler Assembly. (Refer to Fig.4.15, the Amplifier and Pre-Scaler output coaxial lead connects to pins 27 and 28 on the Amplifier and High Speed Decade Assembly).

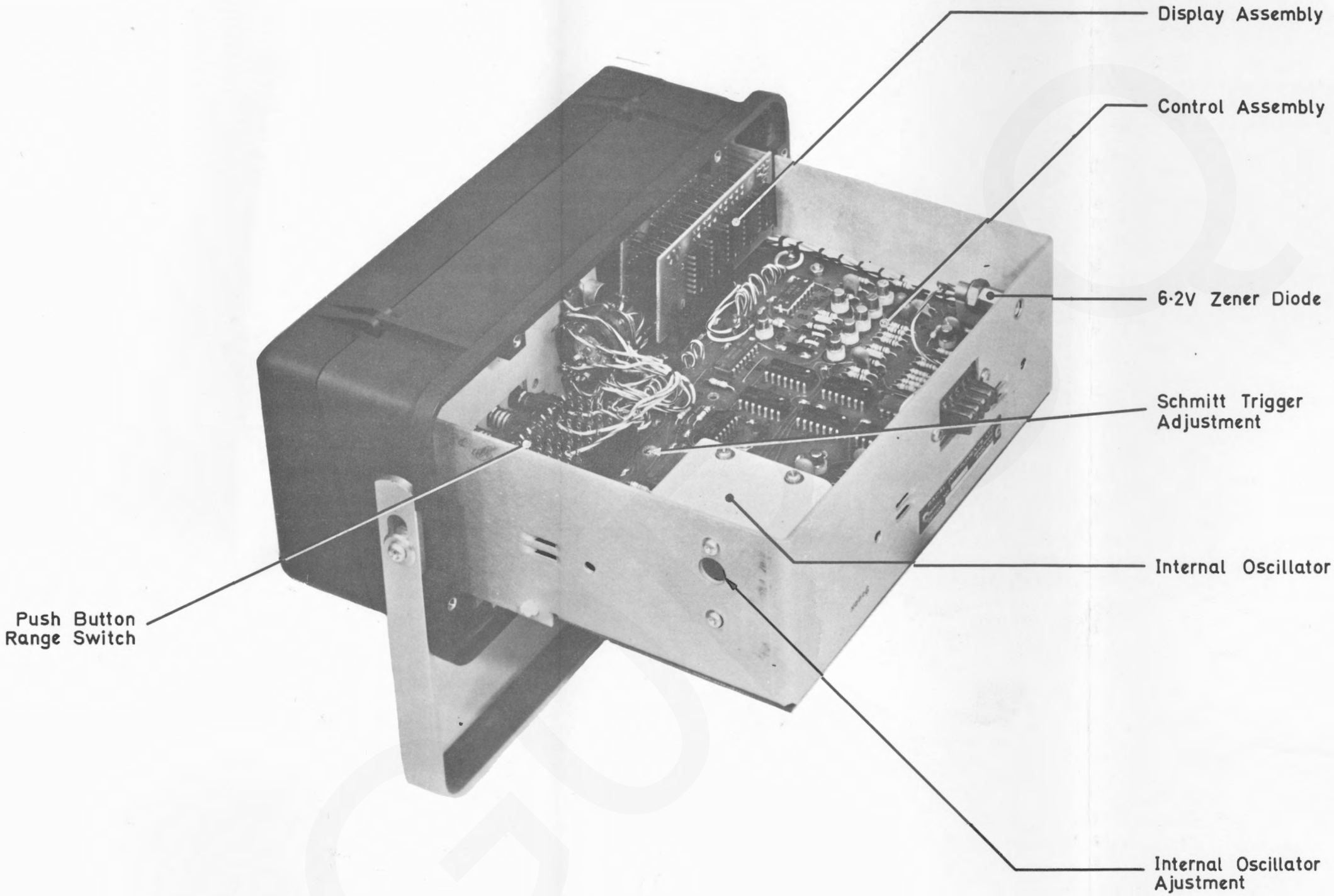
(3) Switch the Function Switch to Frequency 'B'.

(4) The output from the Amplitude and Pre-Scaler Assembly should be a pulsed signal with an excursion from less than +0.4V d.c. to greater than +2.5V d.c. at one tenth the p.r.f. of the input signal.

MISCELLANEOUS SERVICING INFORMATION

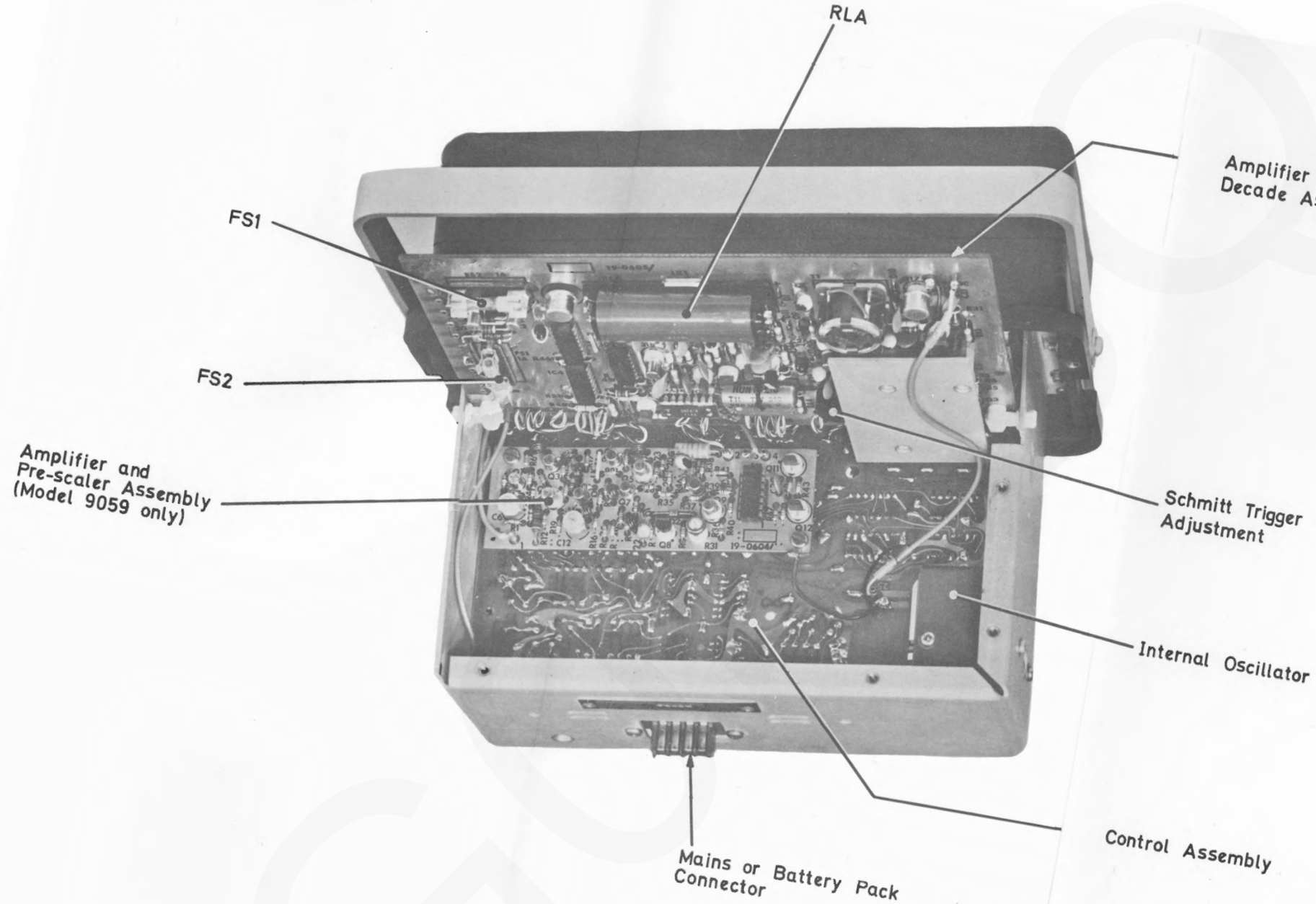
6.18 Tunnel Diode Replacement

The tunnel diode D1 in the Amplifier and Pre-scaler Assembly is fitted by a special technique to ensure optimum performance. If servicing of this component is required it is recommended that the work be carried out by Racal Instruments Service Department.



Service View Chassis Upperside

Fig. 2·4



Service View Chassis Underside

SECTION 4

PARTS LISTS

CIRCUIT DIAGRAMS

AND

LAYOUTS

ORDERING OF SPARE PARTS

1. To be assured of satisfactory service when ordering replacement parts, the customer is requested to include the following information.

   (a) Instrument type and serial number.

   (b) The type reference of the Assembly in which the particular item is located (for example, "19-0608").

   (c) The Racal Part number and circuit reference of each item being ordered.

   It should be noted that a minimum charge of £5 sterling is applicable to all orders.

SECTION 4

CONTENTS

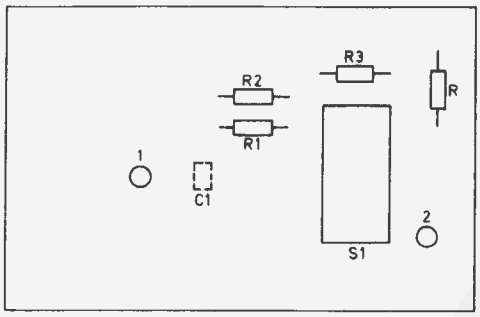
(Listed in Order of Assembly Reference)

PARTS LIST FOR FIG. 4.1

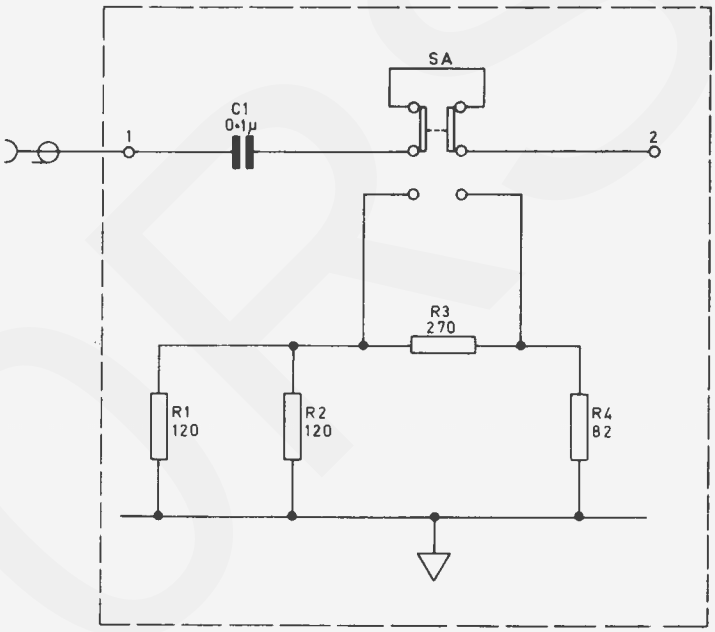
ATTENUATOR BOARD ASSEMBLY 19-0620

(Fitted in 9059 only)

Pt No.	Description	Rat	Tol	Value	Component References
	Resistors				
20-0121	Carbon Film	1/10	10	120	R1, R2
20-0271	Carbon Film	1/10	10	270	R3
20-0820	Carbon Film	1/10	10	82	R4
	Capacitors				
21-1622	Ceramic	100V	20	0.1µ	C1
	Switch				
23-4060	Sensitivity, slide, 2 c/o				SA



19-0620/1
1



19-0620/2
1

WOH 2105 | 19-0620
1

Circuit and Layout
Attenuator Assembly : 19-0620

Fig.4·1

PARTS LIST FOR FIG. 4.3

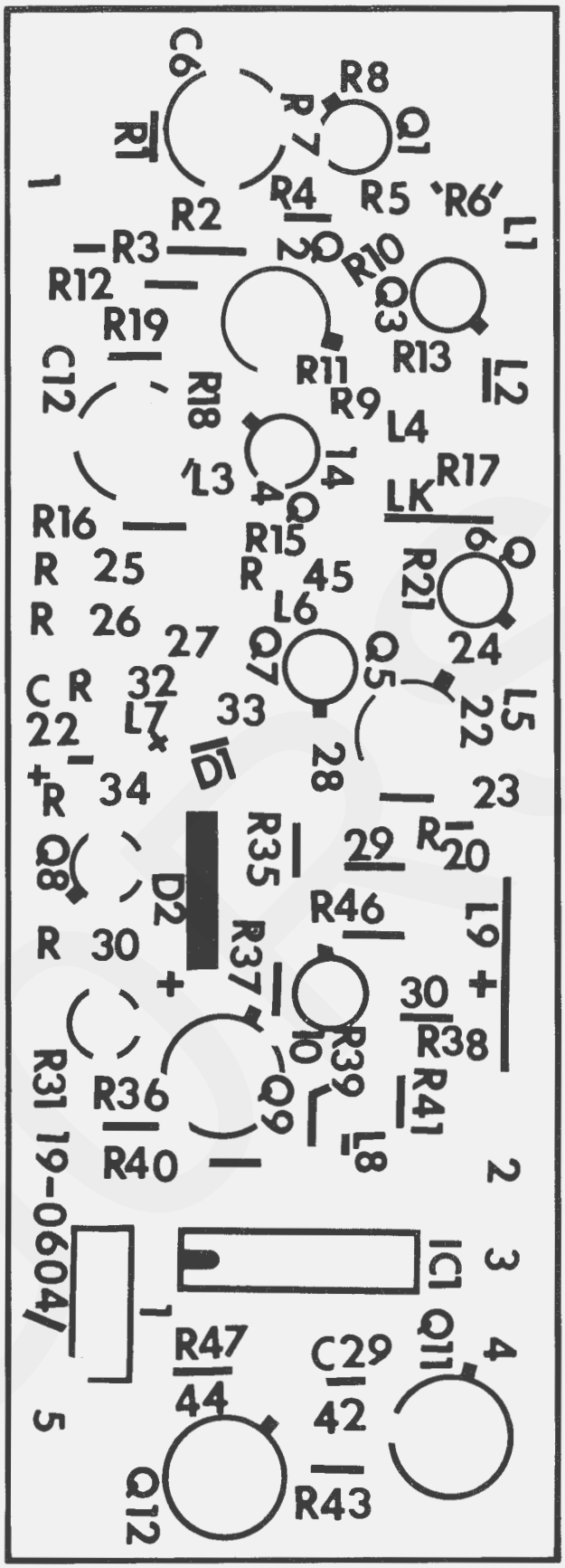
AMPLIFIER AND PRE-SCALER ASSEMBLY 19-0604

(Fitted in 9059 only)

Pt. No.	Description	Rat	Tol	Value	Component References
	Resistors				
20-1513	Carbon Film	1/10	5	39	R8,R19
20-1514	Carbon Film	1/10	5	100	R27,R33
20-1516	Carbon Film	1/10	5	220	R10 R30,R32
20-1517	Carbon Film	1/10	5	330	R16,R26,R43
20-2680	Carbon Film	¼	5	68	R38
20-1521	Carbon Film	1/10	5	1k	R9,R20,R36 R47
20-1522	Carbon Film	1/10	5	12	R14,R28
20-1524	Carbon Film	1/10	5	150	R6,R17,R21,R13,R24
20-1525	Carbon Film	1/10	5	18	R2,R4
20-1526	Carbon Film	1/10	5	22	R45,R46
20-1527	Carbon Film	1/10	5	270	R1
20-1528	Carbon Film	1/10	5	2.2k	R11,R22
20-1530	Carbon Film	1/10	5	390	R34
20-1532	Carbon Film	1/10	5	470	R37,R44
20-1542	Carbon Film	1/10	5	4.7k	R42
20-1540	Carbon Film	1/10	5	27	R7,R18
20-1545	Carbon Film	1/10	5	1.5k	R12,R23,R39 R40.
20-1546	Carbon Film	1/10	5	56	R29,R35
20-1554	Carbon Film	1/10	5	680	R5,R15,R25
20-1555	Carbon Film	1/10	5	15k	R41
20-3470	Metal Oxide	½	5	47	R3
20-7025	Variable			200	R31
	Capacitors				
21-1038	Tantalum	6V	±20	47µ	C22,C30
21-1520	Ceramic		±10	100p	C29
21-1626	Monolithic	100V	±20	0.01µ	C1-C5,C7-C11 incl. C13-C17 inc C19,C20,C21 C24,C25,C26 C27,C28,C31
21-1704				15p	C23*
21-1703				10p	C23*
21-1702	Ceramic	100V	±10	22p	C23*
21-1705				33p	C23*
21-1704				15p	C18*
21-1703				10p	C18*
21-1702				22p	C18*
21-1705				33p	C18*
21-6004	Trimmer			3.5/13p	C6,C12

* Selected by factory test.

Pt No.	Description	Rat	Tol	Value	Component References
	Diode				
22-2006	Tunnel				D1
	Voltage Regulator				
22-1801		2.7V			D2
	Integrated Circuit				
22-4508	÷10 600MHz				IC1
	Transistors				
22-6010	Silicon				Q8
22-6017	Silicon				Q11,Q12
22-6039	Silicon				Q1,Q3,Q4 Q6,Q7,Q10
22-6041	Silicon				Q2,Q5,Q9
	Inductors				
23-7034	Choke R.F.			3.3µH	L9
17-3068	Choke R.F.				L1-L5, L7
17-3117	Choke R.F.				L6
17-3067	Choke R.F.				L8
17-3118	Choke R.F.				L10

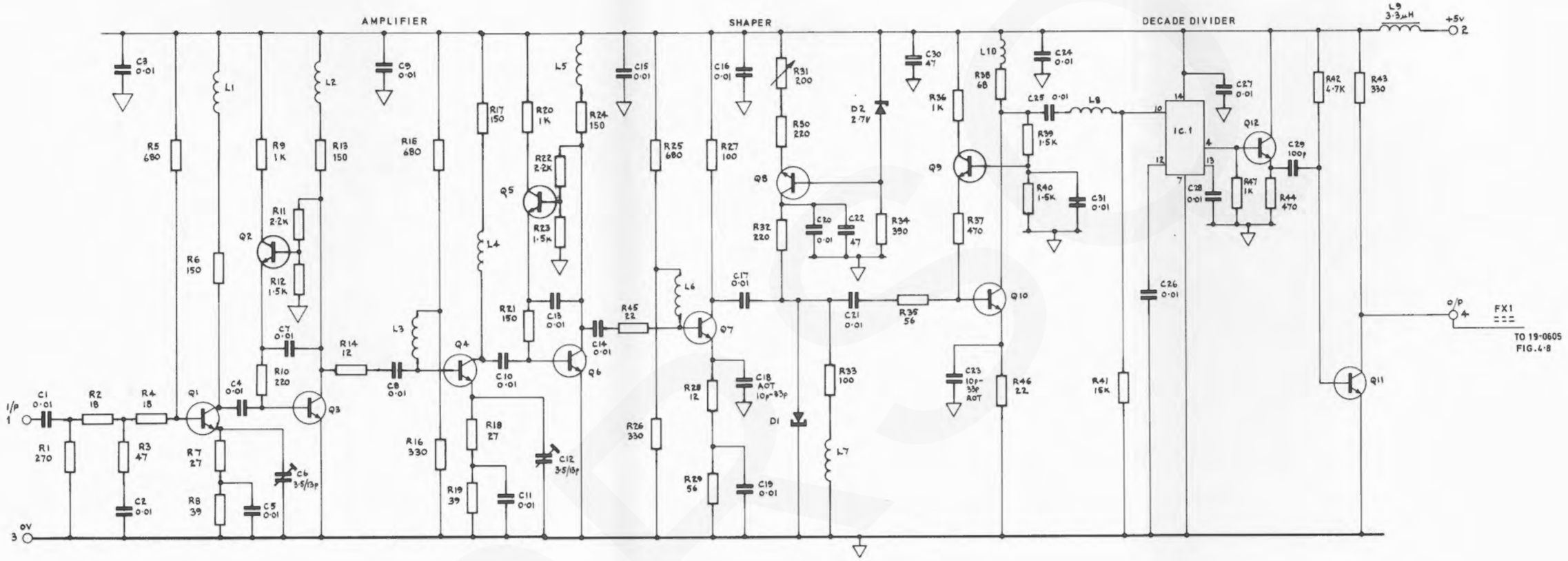


19-0604
1

WOH 2105

Layout : Amplifier and
Pre-Scaler Assembly
19-0604

Fig. 4.2



WOH 2105	19-0604
1 2 3	

Circuit : Amplifier and Pre-Scaler Assembly
19-0604

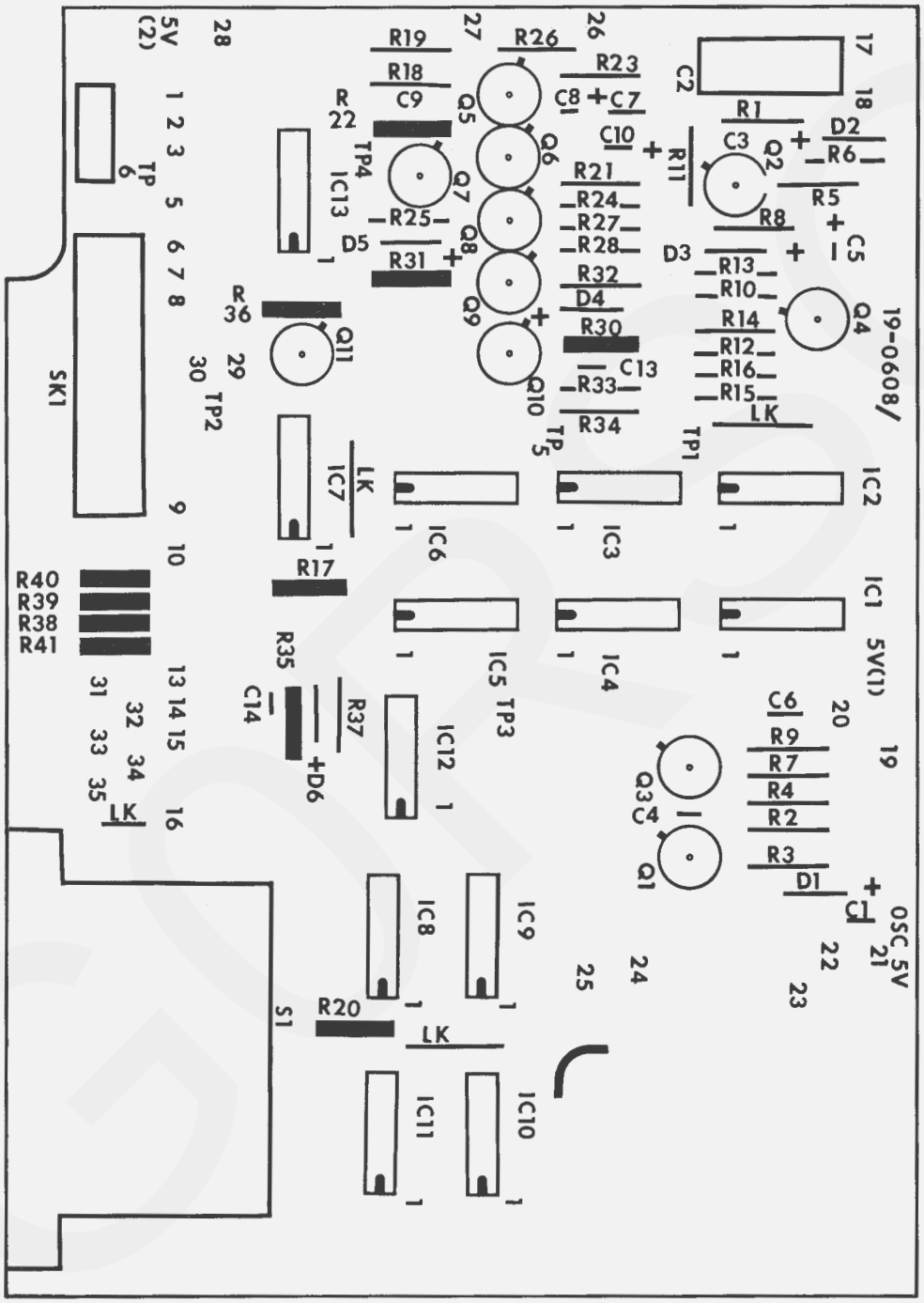
19-0604 **Fig.4.3**

PART LIST FOR FIG.4.5

CONTROL ASSEMBLY 19-0608

Pt. No.	Description	Rat	Tol %	Value	Component References
	Resistors				
20-2101	Carbon Film	1/4	5	100	R13,R21,R24
20-2102	Carbon Film	1/4	5	1k	R1,R4,R22,R25 R28,R31,R32, R34.
20-2103	Carbon Film	1/4	5	10k	R18,R26,R30, R33,R37-R41 incl.
20-2122	Carbon Film	1/4	5	1.2k	R8,R10
20-2152	Carbon Film	1/4	5	1.5k	R27
20-2182	Carbon Film	1/4	5	1.8k	R3,R6
20-2221	Carbon Film	1/4	5	220	R19
20-2272	Carbon Film	1/4	5	2.7k	R12,R14
20-2391	Carbon Film	1/4	5	390	R16
20-2392	Carbon Film	1/4	5	3.9k	R5
20-2471	Carbon Film	1/4	5	470	R11
20-2472	Carbon Film	1/4	5	4.7k	R2,R7,R15,R17 R20,R23,R35
20-2561	Carbon Film	1/4	5	560	R9
20-2681	Carbon Film	1/4	5	680	R36
	Capacitors				
21-1003	Tantalum	10V	20	15µ	C5
21-1004	Tantalum	6V	20	22µ	C8,C10
21-1510	Ceramic		10	15p	C3
21-1520	Ceramic		10	100p	C13
21-1528	Ceramic		10	470p	C9,C14
21-1532	Ceramic			0.1µ	C1,C4
21-1616	Ceramic	12V		0.1µ	C6,C7
21-5505	Polycarbonate		20	0.47µ	C2

Pt. No.	Description	Rat	Tol %	Value	Component References
	Diodes				
22-0001	Germanium				D4,D5
22-1029	Silicon				D1,D2,D3,D6
	Integrated Circuits				
22-4044					IC2,IC7,IC8
22-4048					IC13
22-4049					IC1,IC3,IC4 IC5,IC6,IC9 IC10,IC11
22-4056					IC12
	Transistors				
22-6017	Silicon				Q1,Q2,Q3,Q4 Q7-Q11 incl
22-6041	Silicon				Q5
22-6058	Silicon				Q6
	Miscellaneous				
23-4067	Switch-Push Button				SW1
23-5600	Edge Connector (10 way)				

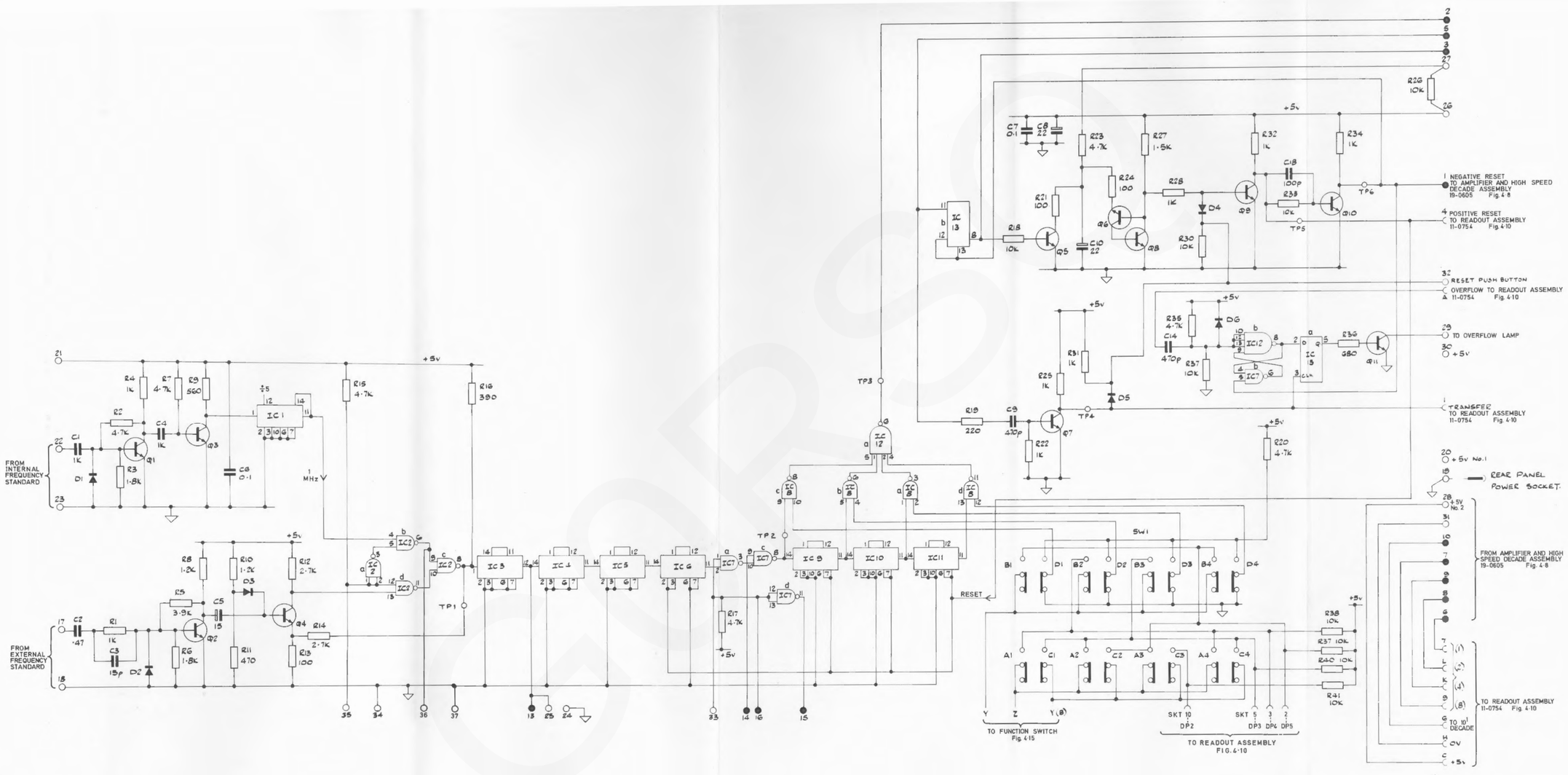


19-0608
1

WOH 2105

Layout : Control Assembly
19-0608

Fig. 4.4



WOH 2105 | 19-0608
1 | 2 | 3 |

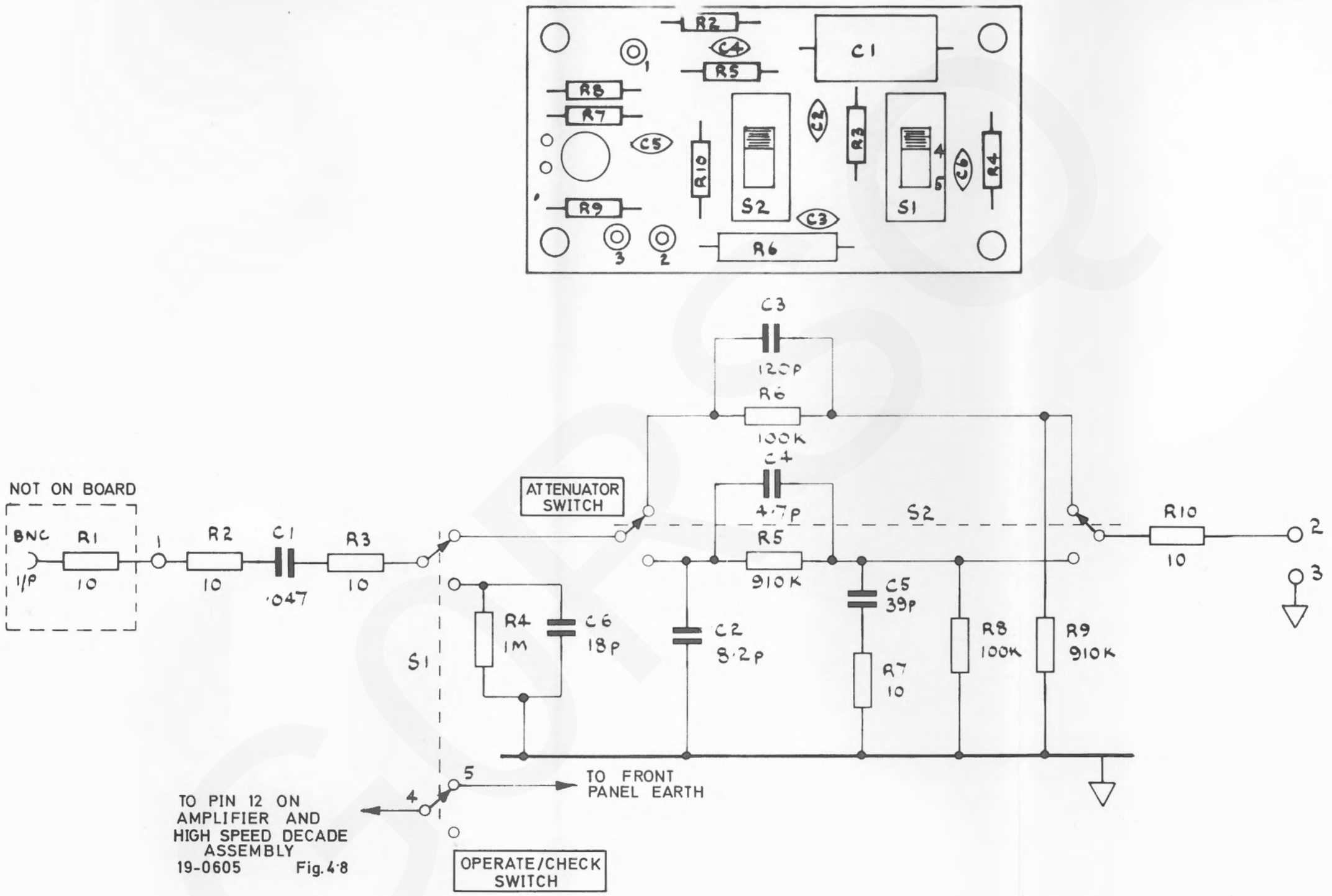
Circuit : Control Assembly
19-0608

19-0608 Fig.4·5

PARTS LIST FOR FIG.4.6

INPUT ATTENUATOR 19-0662

Pt No.	Description	Rat	Tol	Value	Component References
	Resistors				
20-2100	Carbon Film	1/4	5	10	R2,R3,R7,R10
20-2104	Carbon Film	1/4	5	100k	R8
20-2105	Carbon Film	1/4	5	1M	R4
20-2914	Carbon Film	1/4	5	910k	R5,R9
20-4658	Metal Oxide	1W		100k	R6
	Capacitors				
21-1504	Ceramic		±½p	47p	C4
21-1515	Ceramic		±10%	39p	C5
21-1521	Ceramic		±10%	120p	C3
21-1507	Ceramic		±10%	8.2p	C2
21-1511	Ceramic		±10%	18p	C6
21-4527	Polyester		±20%	.047	C1
	Miscellaneous				
23-4060	Switch Slider				S1



WOH 2105	19-0662
1	

Circuit and Layout: Attenuator Assembly
19-0662

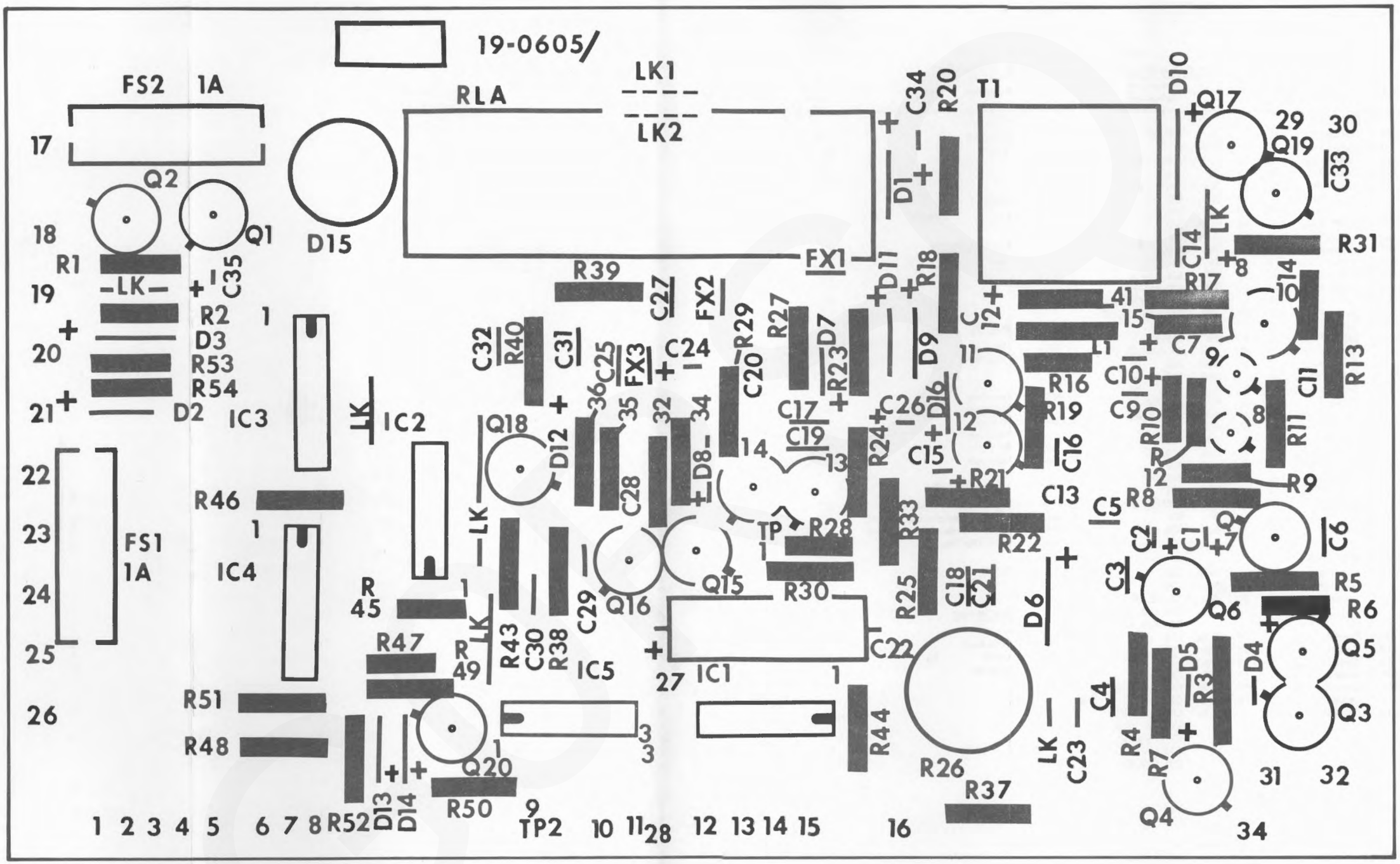
19-0662 Fig. 4.6

PARTS LIST FOR FIG. 4.8

AMPLIFIER AND HIGH SPEED DECADE ASSEMBLY 19-0605

Pt. No.	Description	Rat	Tol	Value	Component References
	Resistors				
21-0102	Carbon Film	1/4	5	1k	R28,R9
21-0103	Carbon Film	1/4	5	10k	R15
20-0122	Carbon Film	1/5	10	1.2k	R10
20-0220	Carbon Film	1/5	10	22	R16
20-0221	Carbon Film	1/5	10	220	R14
20-0331	Carbon Film	1/5	10	330	R12
20-0471	Carbon Film	1/5	10	470	R45
20-0472	Carbon Film	1/5	10	4.7k	R47
20-0562	Carbon Film	1/5	10	5.6k	R6
20-2101	Carbon Film	1/4	5	100	R23
20-2102	Carbon Film	1/4	5	1k	R1
20-2103	Carbon Film	1/4	5	10k	R31,R44
20-2121	Carbon Film	1/4	5	120	R 8, R13
20-2151	Carbon Film	1/4	5	150	R2,R21,R36,R54
20-2181	Carbon Film	1/4	5	180	R46,R48,R50,R52
20-2182	Carbon Film	1/4	5	1.8k	R7
20-2220	Carbon Film	1/4	5	22	R20,R39
20-2221	Carbon Film	1/4	5	220	R4,R40,R43,R51
20-2332	Carbon Film	1/4	5	3.3k	R38
20-2331	Carbon Film	1/4	5	330	R19
20-2392	Carbon Film	1/4	5	3.9k	R24
20-2470	Carbon Film	1/4	5	47	R27,R35
20-2471	Carbon Film	1/4	5	470	R5,R29,R32
20-2472	Carbon Film	1/4	5	4.7k	R17
20-2560	Carbon Film	1/4	5	56	R22,R53
20-2561	Carbon Film	1/4	5	560	R18,R41
20-2681	Carbon Film	1/4	5	680	R30
20-2682	Carbon Film	1/4	5	6.8k	R25,R37
20-2821	Carbon Film	1/4	5	820	R11
20-2820	Carbon Film	1/4	5	82	R33,R34
20-3560	Metal Oxide	1/2	5	56	R3
20-6545	Variable	1/4	20	4.7k	R26
	Capacitors				
21-1044	Tantalum			220p	C22
21-1037	Tantalum	15V	20	10µ	C26
21-1038	Tantalum	6.3V	20	47µ	C1,C2,C8,C9 C10,C12,C15, C24,C34,C35.
21-1505	Ceramic		10	5.6p	C16
21-1510	Ceramic		10	15p	C29
21-1513	Ceramic		10	27p	C11
21-1521	Ceramic		10	120p	C7
21-1528	Ceramic		10	470p	C5
21-1532	Ceramic		10	1000p	C23
21-1616	Ceramic	12V		0.1µ	C3,C4,C6,C13 C14,C17,C18, C19,C20,C21, C25,C27,C30, C31,C32,C33.

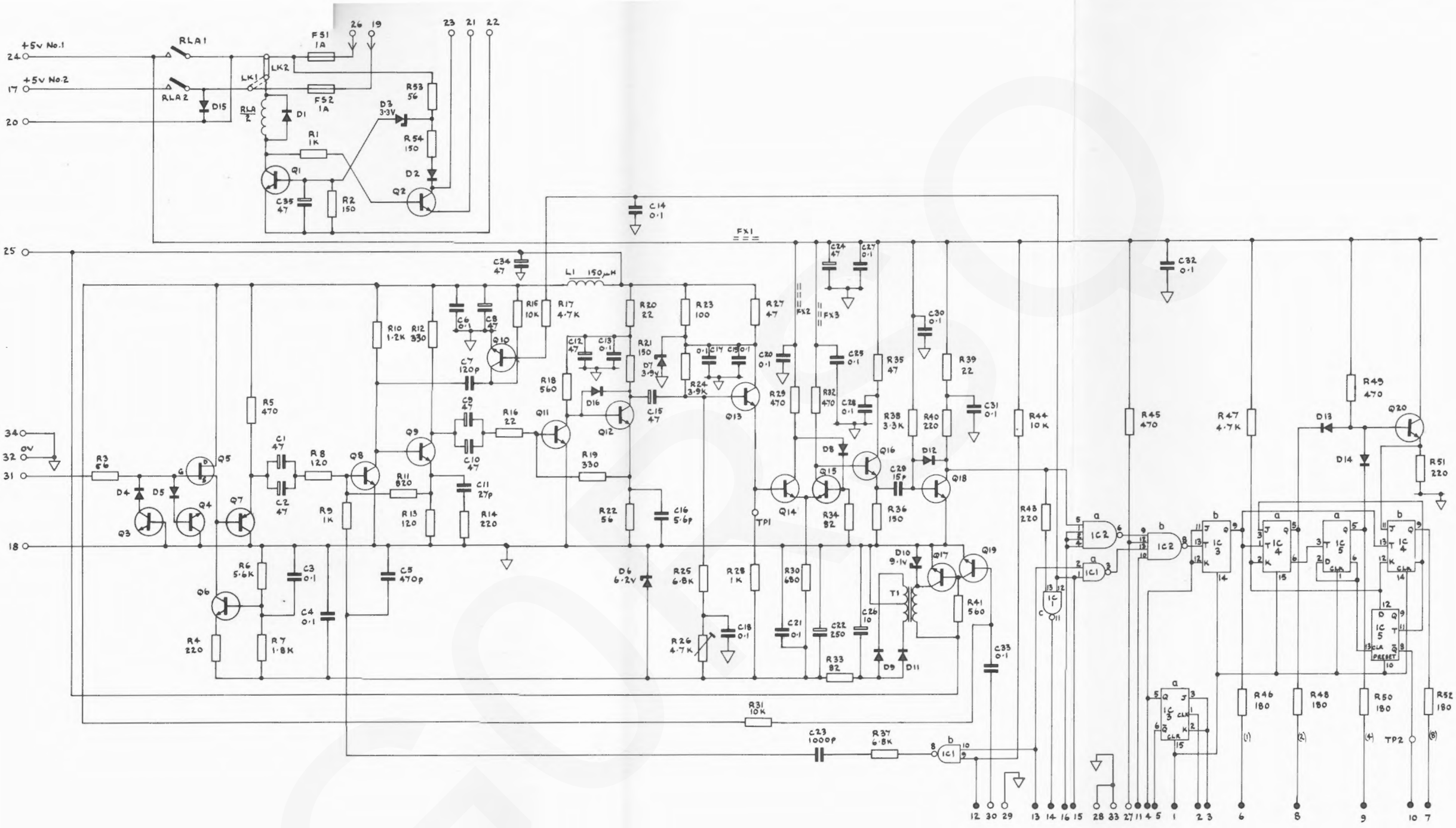
Pt No.	Description	Rat	Tol	Value	Component References
	Diodes				
22-0001	Germanium				D12
22-1029	Silicon				D1,D2,D4,D5, D8,D9,D11,D13 D14,D16.
	Rectifier				
22-1612	Silicon	100V			D15
	Voltage Regulators				
22-1803	3.3V				D3
22-1810					D6
22-1805					D7
22-1814					D10
	Transistors				
22-6009	Silicon npn				Q13
22-6017	Silicon npn				Q6,Q10,Q11,Q12, Q14,Q15,Q16,Q19 Q20.
22-6018	Silicon pnp				Q7
22-6047	Silicon npn				Q1,Q2
22-6044	Silicon npn				Q17
22-6057	Silicon npn				Q3,Q4
22-6101	FET				Q5
22-6059	Silicon npn				Q8,Q9,Q18
	Integrated Circuits				
22-4044	Quad 2 input Pos Nand Gate				IC1
22-4092	Balanced Modulator Demodulator				IC2
22-4093	Balance Modulator Demodulator				IC3,IC4
22-4048	Dual D Flip Flop				IC5
	Inductor				
23-7057			20	150µ	L1
	Miscellaneous				
23-7509	Relay				RLA
23-8000	Ferrite Bead				FX1,FX2,FX3
23-0006	Fuselink	1A			FS1,FS2
23-0039	Fuseholder				for FS1,FS2



WOH 2105	19-0605
2	

Layout Amplifier and High Speed Decade Assembly
19-0605

19-0605 Fig. 4.



WOH 2105 | 19-0605
2

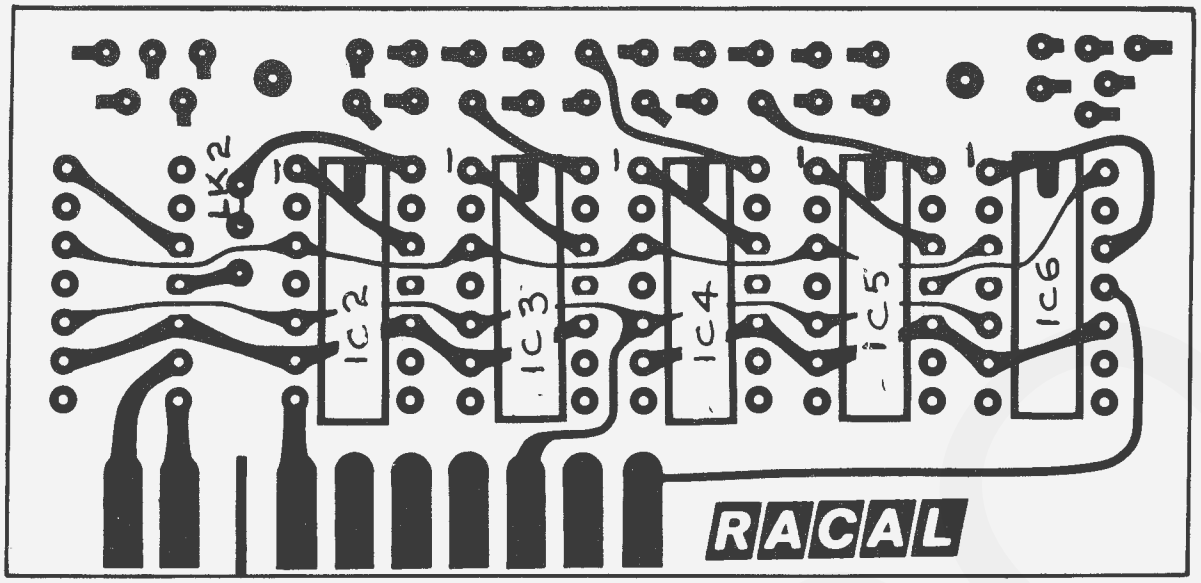
Circuit: Amplifier and High Speed Decade Assembly 19-0605

19-0605 Fig.4.8

PARTS LIST FOR FIG.4.10

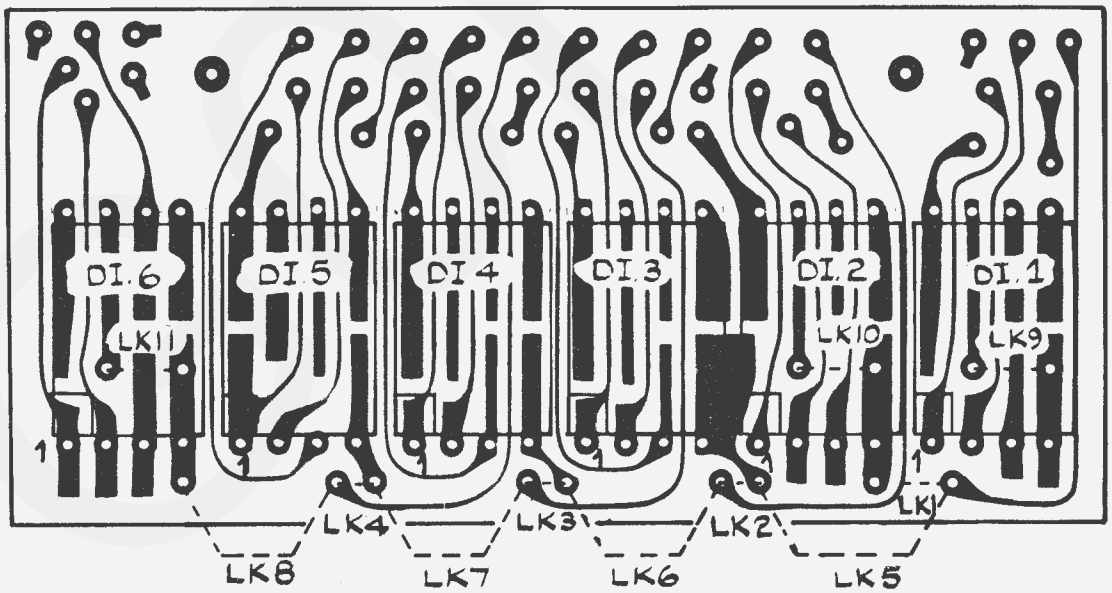
READOUT ASSEMBLY 11-0754

Pt. No.	Description	Rat	Tol	Value	Component References
	Integrated Circuits				
22-4049	Decade Counter				IC2, IC3, IC4 IC5, IC6
	Digital Indicators				
26-1500	Digital Decade				DI1-DI6



19-0607
1	

Display Counter Assembly
19-0607



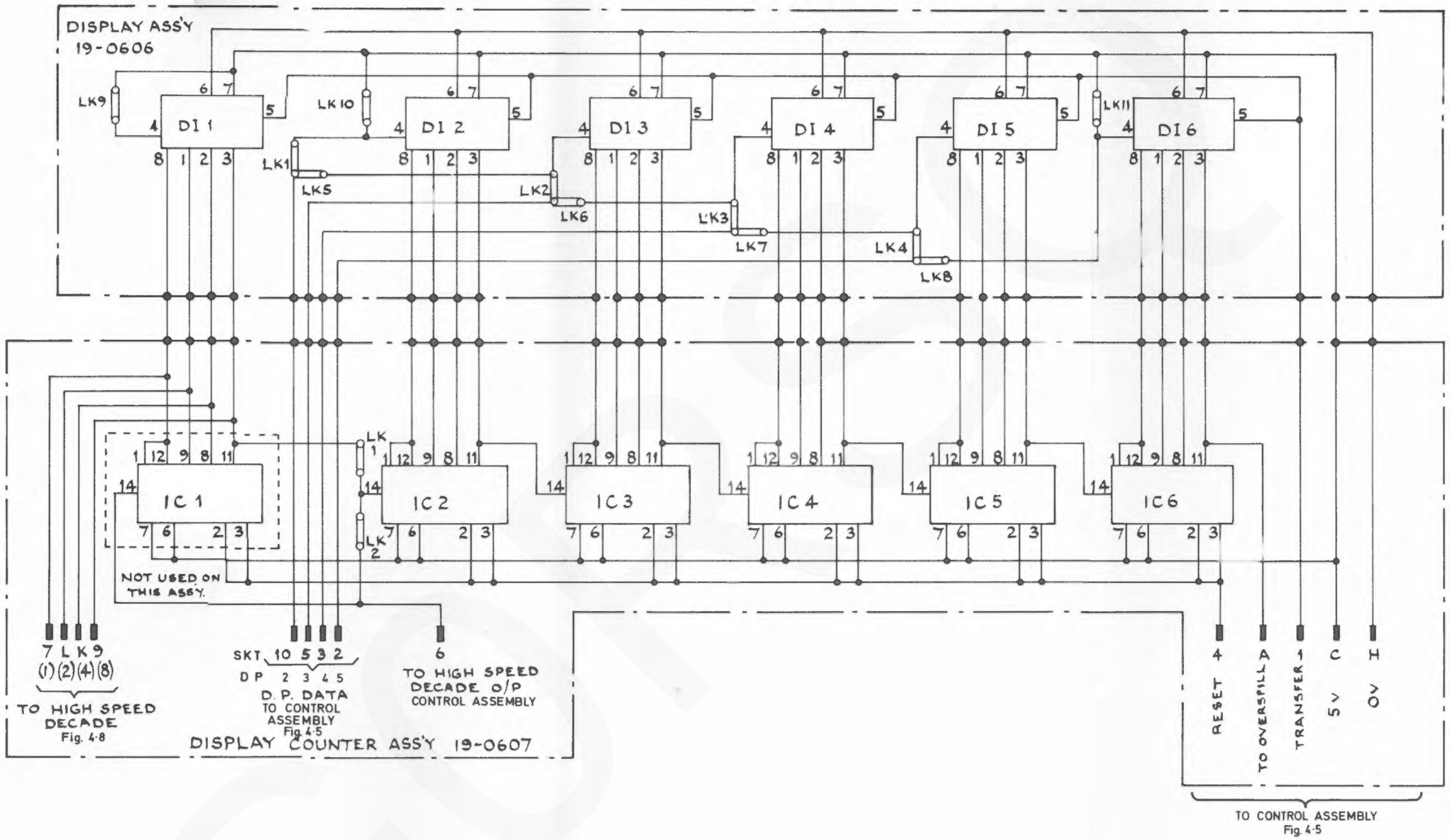
19-0606
1	

Display Assembly
19-0606

WOH 2105

Layout : Readout Assembly
11-0754

Fig. 4.9



WOH 2105	11-0754
1	

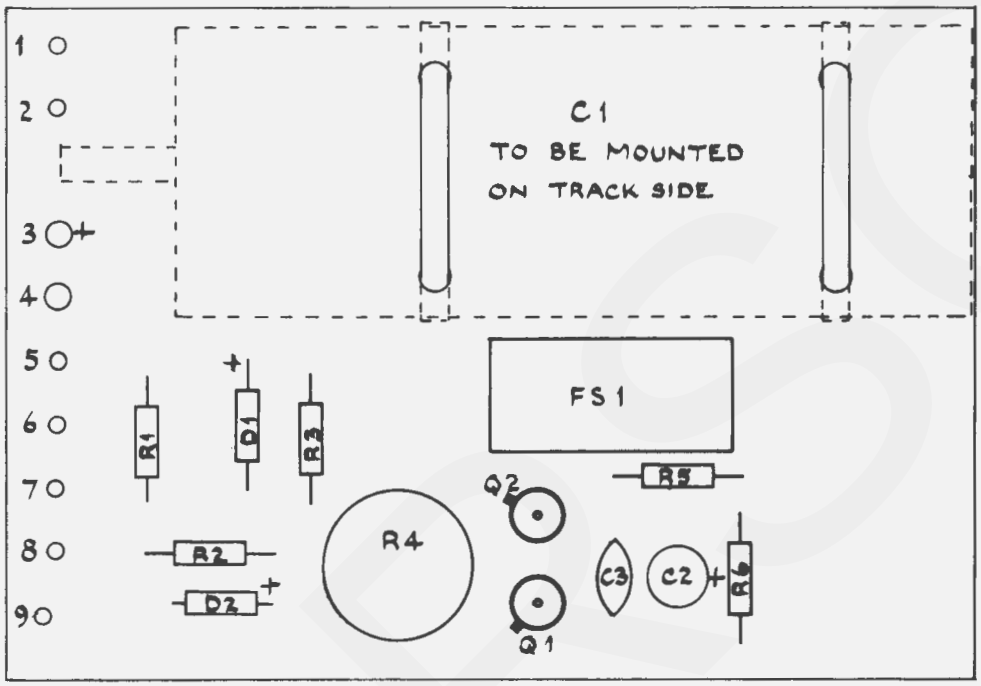
Circuit: Readout Assembly
11-0754

11-0754 Fig.4.10

PARTS LIST FOR FIG.4.12

MAINS PACK ASSEMBLY 11-0758

Pt. No.	Description	Rat	Tol	Value	Component References
Chassis Mounted Items					
	Miscellaneous				
22-1650	Rectifier Bridge				D3
17-4038	Transformer				T1
23-0019	Fuse	160mA			FS2
23-0014	Fuse Holder				
23-3036	Socket 8way				
23-9022	Selector Voltage				
POWER SUPPLY BOARD 19-0664					
	Resistors				
20-2152	Carbon Film	1/4	5	1.5k	R3
20-2122	Carbon Film	1/4	5	1.2k	R2
20-2181	Carbon Film	1/4	5	180	R6
20-2221	Carbon Film	1/4	5	220	R1
20-2681	Carbon Film	1/4	5	680	R5
20-6542	Variable	$\frac{1}{4}$	20	1k	R4
	Capacitors				
21-0578	Electrolytic	16V	+50 -10	10,000p	C1
21-1038	Tantalum	6V	20	47µ	C2
21-1545	Ceramic	25V	+50 -25	0.01	C3
	Voltage Regulators				
22-1805		400mW	5	3.9V	D1
22-1803		400mW	5	3.3V	D2
	Transistors				
22-6058	Silicon				Q1
22-6044	Silicon				Q2
	Miscellaneous				
23-0008	Fuselink			2A	FS1
23-0034	Fuseholder				

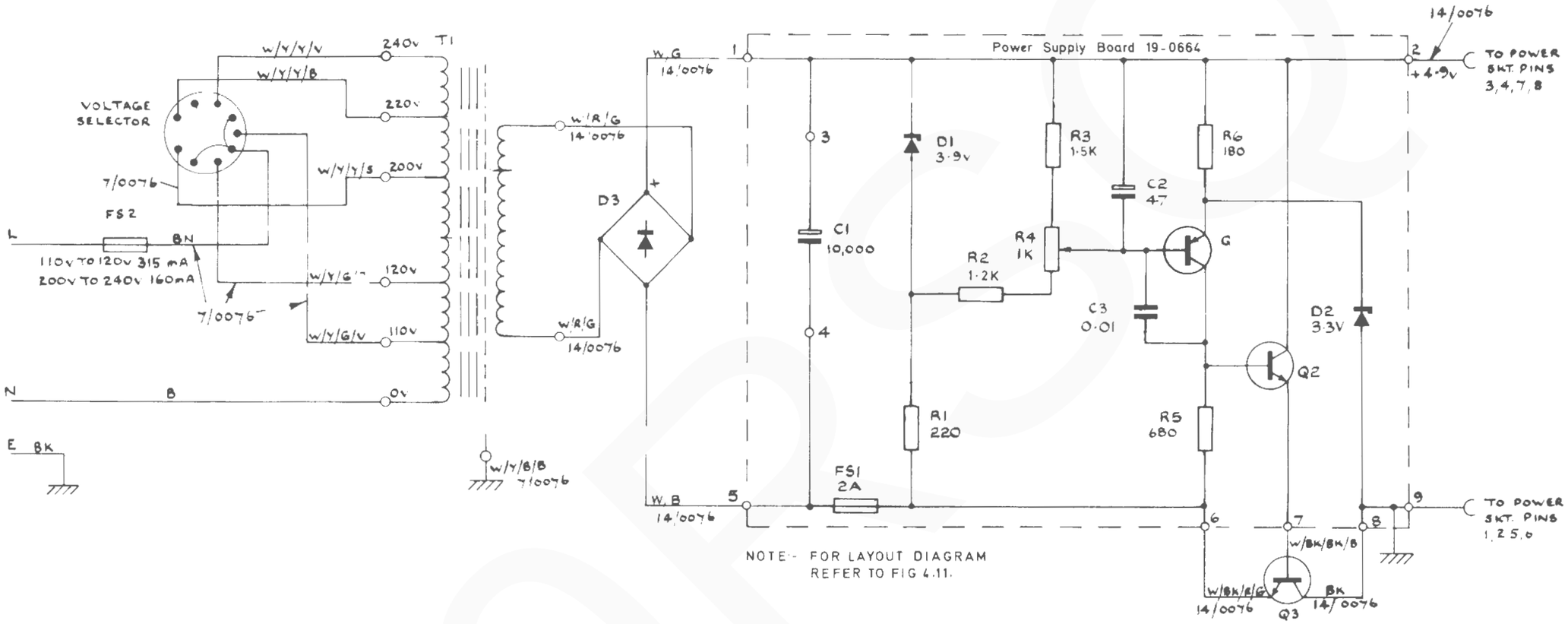


19-0664
2

WOH 2105

Layout : Power Supply Board
19-0664

Fig.4.11



WOH 2105	11-0758
2 3	

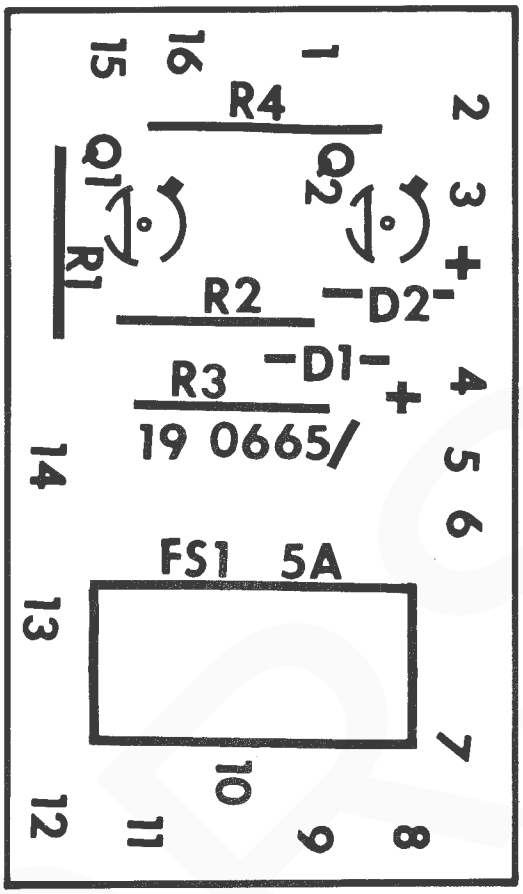
Circuit : Mains Pack Assembly
11-0758

11-0758 Fig. 4·12

PARTS LIST FOR FIG. 4.14

BATTERY PACK ASSEMBLY 11-0759

Pt. No.	Description	Rat	Tol	Value	Component References
	Chasis Mounted Items				
22-1653	Rectifier Bridge				D3
17-4051	Transformer				T1
22-6104	Silicon Transistor				Q1
23-0019	Fuse	160mA			FS2 (115V)
	or				
23-0029	Fuse	80mA			FS2 (230V)
23-0014	Fuse Holder				
23-2502	Battery				
23-3036	Socket				
23-3050	Socket 8 way				
23-4043	Switch toggle				S1
26-3007	Charge Warning Lamp: 12V				LP1
	CHARGE REGULATOR ASSEMBLY 19-0665				
	Resistors				
20-3820	Metal Oxide	½	5	82	R1
20-3331	Metal Oxide	½	5	330	R2
20-5044	Wire Wound	25	10	2.2	R4
20-2680	Metal Oxide	½	5	68	R3
	Diodes				
22-1029	Silicon				D1, D2
	Transistors				
22-6017	Silicon				Q1, Q2
	Miscellaneous				
23-0010	Fuselink	5A			FS1
23-0034	Fuseholder				
23-9048	Bead Ceramic				Fitted to R4
23-9065	Thermostat				THE 1

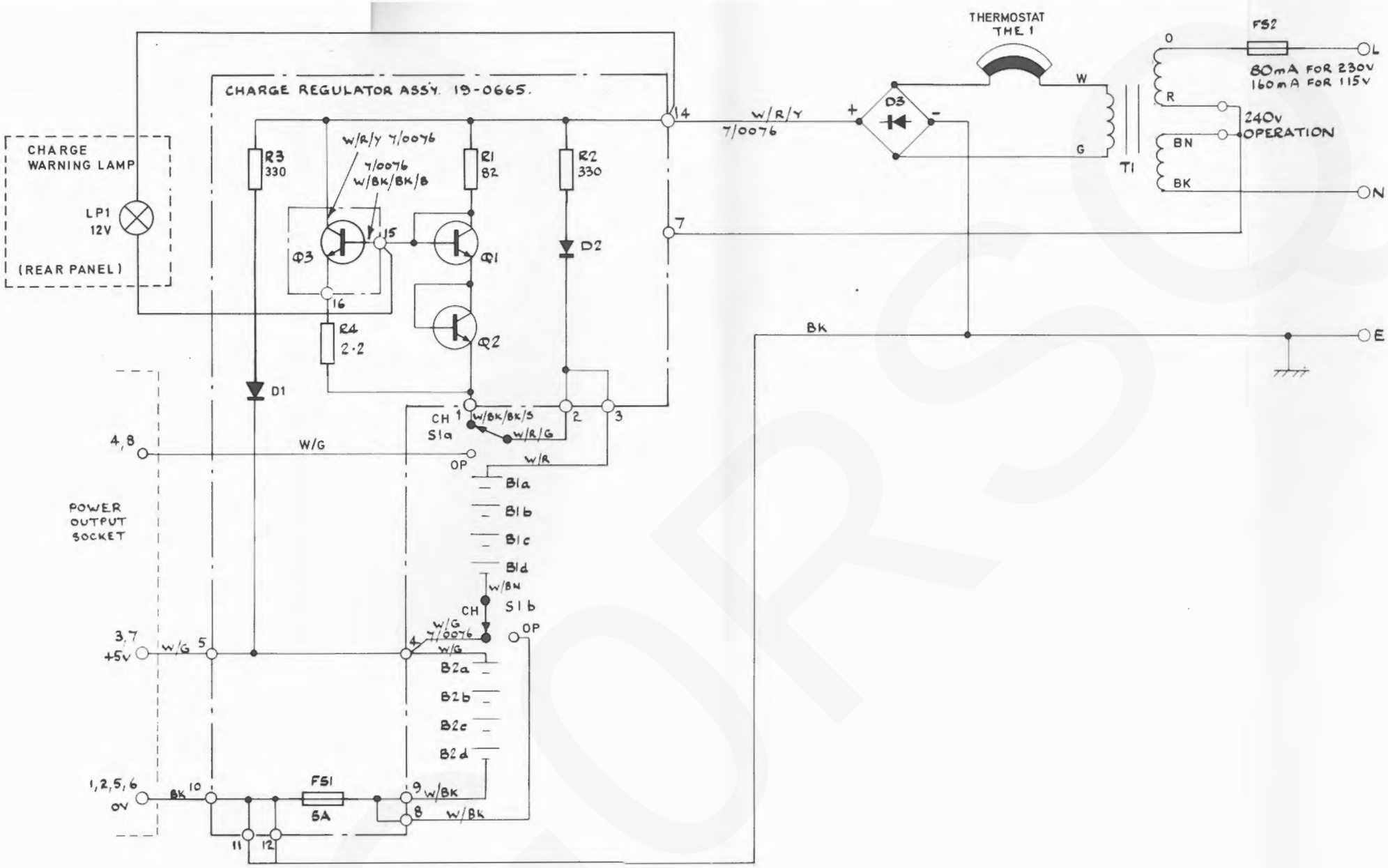


19-0665	
2	

WOH 2105

Layout : Charge Regulator Assembly
19-0665

Fig. 4.13



NOTE:- FOR LAYOUT DIAGRAM REFER TO FIG. 4.13

WOH 2105	11-0759
2 3 4 5 6	

Circuit : Battery Pack Assembly
11-0759

11-0759 Fig. 4.14

PARTS LIST

CHASSIS ASSEMBLIES

(MODEL 9057 PARTS LIST 11-0757)
(MODEL 9059 PARTS LIST 11-0760)

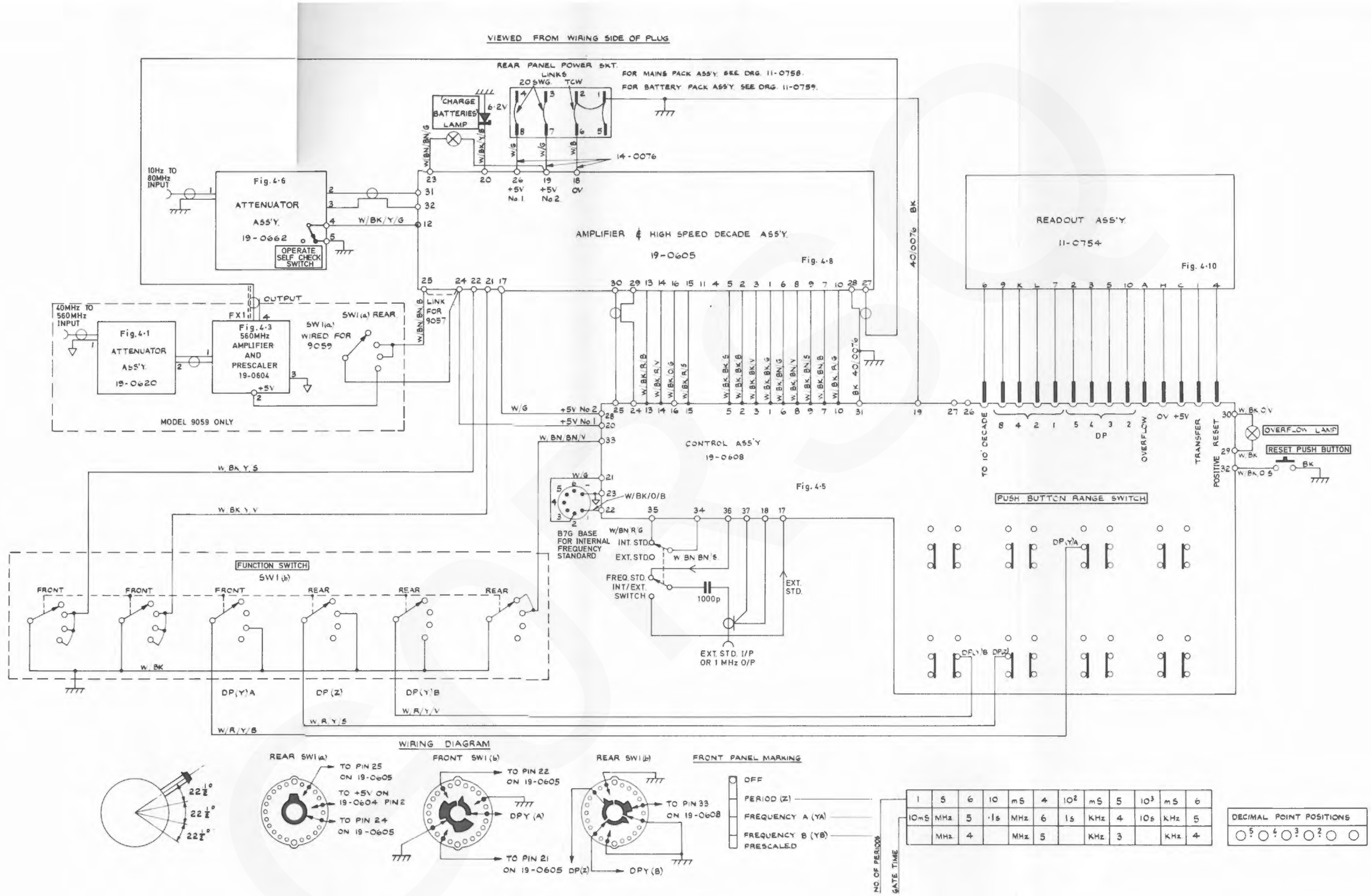
Pt. No.	Description	Rat	Tol	Value	Component References

NOTE: The following components are common to both instruments except where indicated otherwise.

22-1852	Zener Diode			6.2V	
23-1016	Lampholder			Red	
23-1017	Lampholder			Orange	
23-3005	Socket BNC				
23-3051	Plug 8 way				
23-4013	Switch Push button				
23-4042	Switch slide				
23-3009	Lamp			60mA 5V	
23-8000	Ferrite Bead on 19-0604 pin 4 (9059 only)				

Internal Frequency Standard

Frequency Standard Type 9440



1	5	6	10	mS	4	10^2	mS	5	10^3	mS	6
10mS	MHz	5	·1s	MHz	6	1s	KHz	4	10s	KHz	5
	MHz	4		MHz	5		KHz	3		KHz	4

WOH 2105	9057/9059
1	3

Interconnections : Type 9057 / 9059

Fig.4.15

SECTION 5

APPENDICES

AND

CHANGE INFORMATION

FREQUENCY-PERIOD METER 9059

AMENDMENT

FAST WARM UP OSCILLATOR UNIT

The standard oscillator unit is now the Type 9441, which is a direct replacement for the 9440. The technical specification details remain unchanged.