PEAK PROGRAMME METERS ME12/9-10

Author   *M.J. Rawley*
First issue *January 1979*

AMENDMENT RECORD

Amendment no.	Remarks	Amended by	Date
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

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issue 1
January 1979

CHANGES

# PEAK PROGRAMME METERS — INTRODUCTION

ME12/9-10   1

INTRODUCTION

The ME12/9 and ME12/10 are a monophonic peak programme meter and a stereophonic peak programme meter respectively. They each comprise a meter and an amplifier. Except for the ME12/9G, the amplifier can be mounted on the rear of the meter.

Variations in the ME12/9 and the ME12/10 are variations only in the types of meter used. These types are illustrated below and details are given in the adjacent Table.
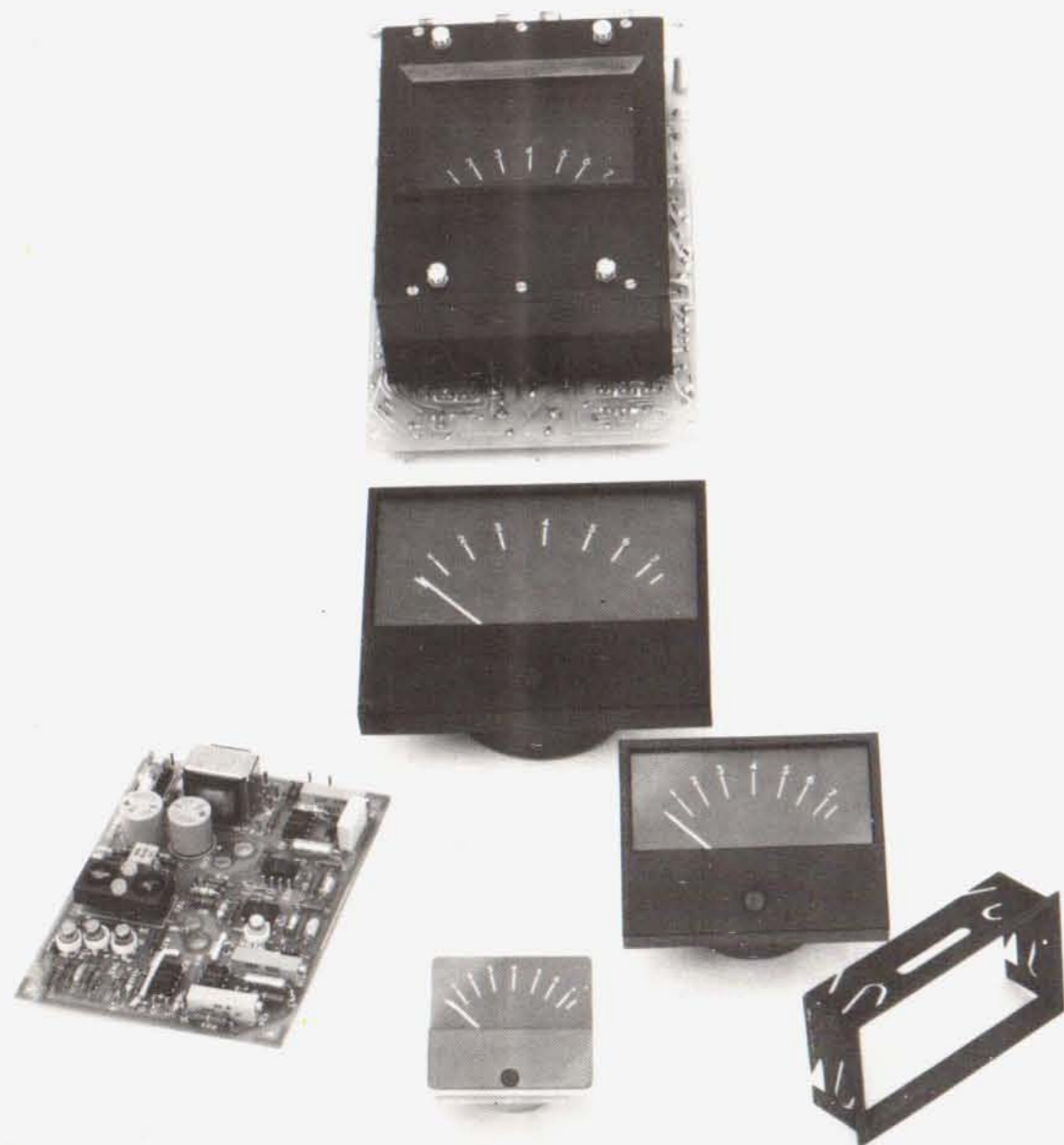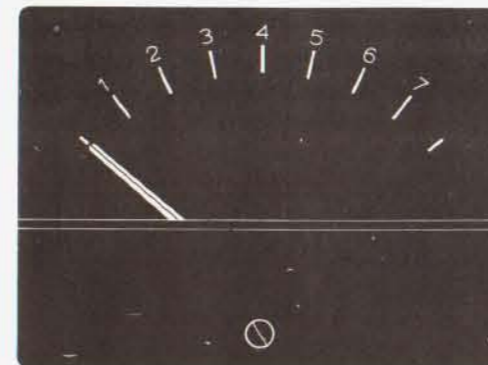
All meters are 1 mA f.s.d. and have a resistance of 600 ohms. The markings occur at the following percentages of f.s.d.

marking	%
1	10
2	22
3	35
4	51
5	67
6	80
7	93

CONTENTS

Author M.J. Rawley

METER TYPES

P.P.M. code	E.D. meter specification	Ernest Turner Type No.	Approximate Size (mm)	Brief description of distinguishing features
ME12/9A	1478	703	105 x 81	Large size — Black plastic case — glass meter panel
ME12/9B	1477	702	73 x 58	Medium size — Black plastic case — glass meter panel
ME12/9C	1499	643	102 x 78	Large size — Transparent all-plastic case
ME12/9D	1498	642	72 x 56	Medium size — Transparent all-plastic case
ME12/9E	1501	903	102 x 78	Large size — Transparent plastic case — glass meter panel
ME12/9F	1500	902	72 x 56	Medium size — Transparent plastic case — glass meter panel
ME12/9G	1497	640	46 x 40	Small size — Transparent all-plastic case
ME12/10A	1502	411 — 848 (ED 1502)	94 x 108	Red and green meter pointers
ME12/10B	1503	411 — 848 (ED 1503)	94 x 108	White and yellow meter pointers

FUNCTIONAL DESCRIPTION

Programme input →

INPUT PROCESSING
Accepts an audio signal at the following levels with respect to zero volume programme:-
a)   0 dB
b)   −20 dB.
c)   −43 dB*
and produces an output at −6 dB.
*The performance at this input level is restricted.

PEAK DETECTION
Accepts an audio signal at −6 dB with respect to zero volume programme. It produces a direct voltage output equal to the maximum peak voltage of the input. The charge and discharge time constants are selected during manufacture to give the P.P.M. its correct dynamic performance.
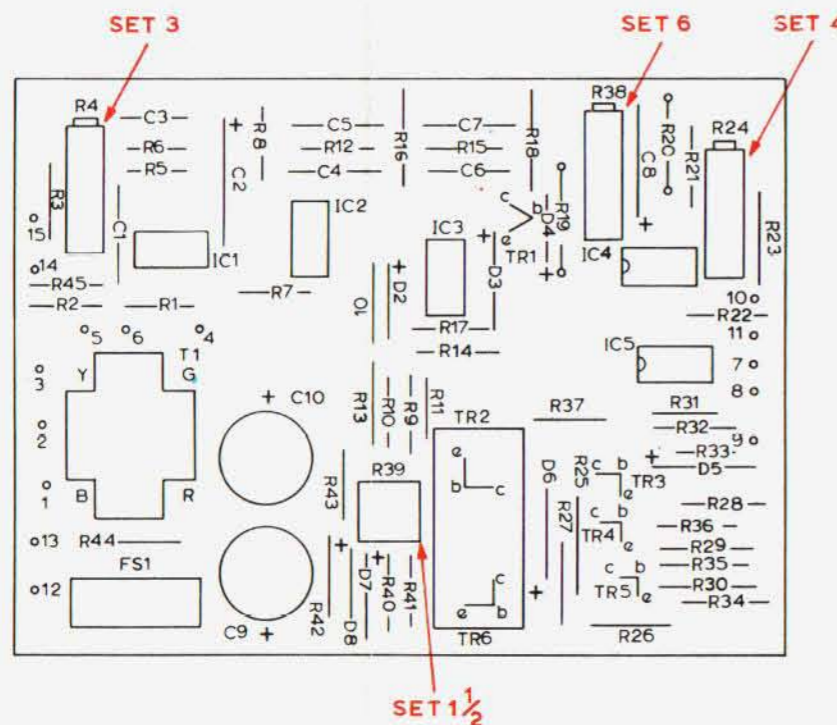
OUTPUT PROCESSING
Amplifies the input voltage into an output current with the pseudo-logarithmic law required by the P.P.M. Preset adjustments are provided to give the correct law.

COMPONENT LAYOUT

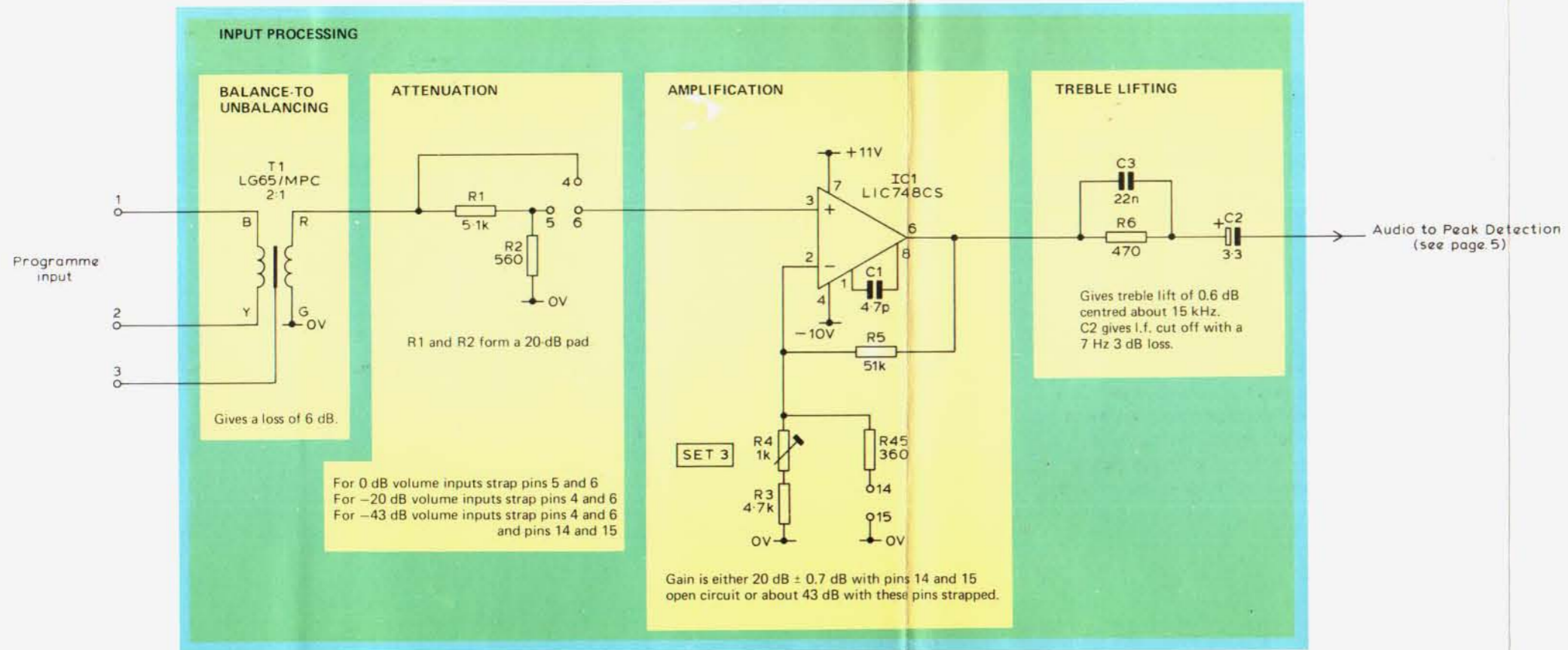SET 3   SET 6   SET 4   SET 1½

ALIGNMENT CHECK

Normally alignment is not required, but the following checks should be carried out if the meter is changed:

1.   Check that, with no power, the mechanical zero of the meter is correct
2.   Apply power and terminate the input with 600 ohms. Check that the meter reads zero. If necessary adjust R24
3.   Apply 1-kHz tone at −4 dB. Check that the meter reads 3. If necessary adjust R4.
4.   Apply 1-kHz tone at +8 dB. Check that the meter reads 6. If necessary adjust R38.
5.   Apply 1-kHz tone at −10 dB. Check that the meter reads 1½. If necessary adjust R39.
6.   Check that the input levels are within specification for the following meter readings:

1	−12 ± 0.5 dB
2	−8 ± 0.2 dB
3	−4 ± 0.3 dB
4	0 ± 0.2 dB
5	+4 ± 0.3 dB
6	+8 ± 0.2 dB
7	+12 ± 0.5 dB

7.   Check that the frequency response is within the following limits:

40 Hz − 20 kHz	0 ± 0.3 dB
10 Hz	−2 ± 0.5 dB
5 Hz	−5 ± 0.8 dB

8.   Check that the fallback time of the meter from a reading of 7 to a reading of 1 lies between 2.5 and 3 seconds.
9.   If a Peak Programme Meter Tester (e.g. TE1/25) is available check the rise time. Set the level of 5-kHz tone to give a meter reading of 6 and measure the drop in indicated level for the following burst durations:

100 ms	0 ± 0.5 dB
10 ms	−2.5 ± 0.5 dB
5 ms	−4.0 ± 0.75 dB
1.5 ms	−9.0 ± 1.0 dB

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CHANGES

AM20/3 INPUT PROCESSING CIRCUIT

ME12/9-10 **3**

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INPUT PROCESSING

BALANCE-TO UNBALANCING

T1
LG65/MPC
2:1

B
R
Y
G
0V

Programme input

1
2
3

Gives a loss of 6 dB.

ATTENUATION

R1
5·1k
4
5
6

R2
560

0V

R1 and R2 form a 20-dB pad

For 0 dB volume inputs strap pins 5 and 6
For −20 dB volume inputs strap pins 4 and 6
For −43 dB volume inputs strap pins 4 and 6
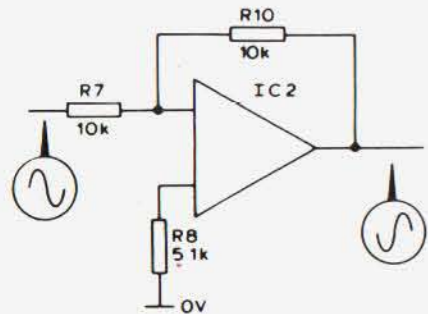and pins 14 and 15

AMPLIFICATION

+11V

IC1
LIC748CS

7
3
2
4
1
6
8

C1
4·7p

−10V

R5
51k

SET 3

R4
1k
R45
360

R3
4·7k
14

0V
15
0V

Gain is either 20 dB ± 0.7 dB with pins 14 and 15
open circuit or about 43 dB with these pins strapped.

TREBLE LIFTING

C3
22n

R6
470

+C2
3·3

→ Audio to Peak Detection
(see page 5)

Gives treble lift of 0.6 dB
centred about 15 kHz.
C2 gives l.f. cut off with a
7 Hz 3 dB loss.

REF	TYPE	BASE
IC1	LIC748CS	1 ⌐ 8, 4 ⌐ 5 view on top

REGULATION
The three supply rails on the AM20/3 are left floating.

12
+

24V-volt
input
at 30mA

FS1
100 mA

R44
100

There is a
3-volt drop
across R44.

C10
100

R43
100

R42
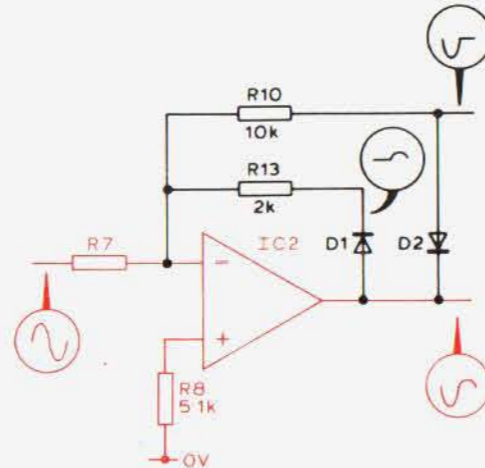820

D8
VZ18M4

D7
VZ10M4

C9
100

+11V
0V
−10V

−

1

This is a unity-gain inverting op-amp circuit. The gain is given by $R10 \div R7$. The value of R8, equal to R10 in parallel with R7, is chosen to minimise thermal drift.
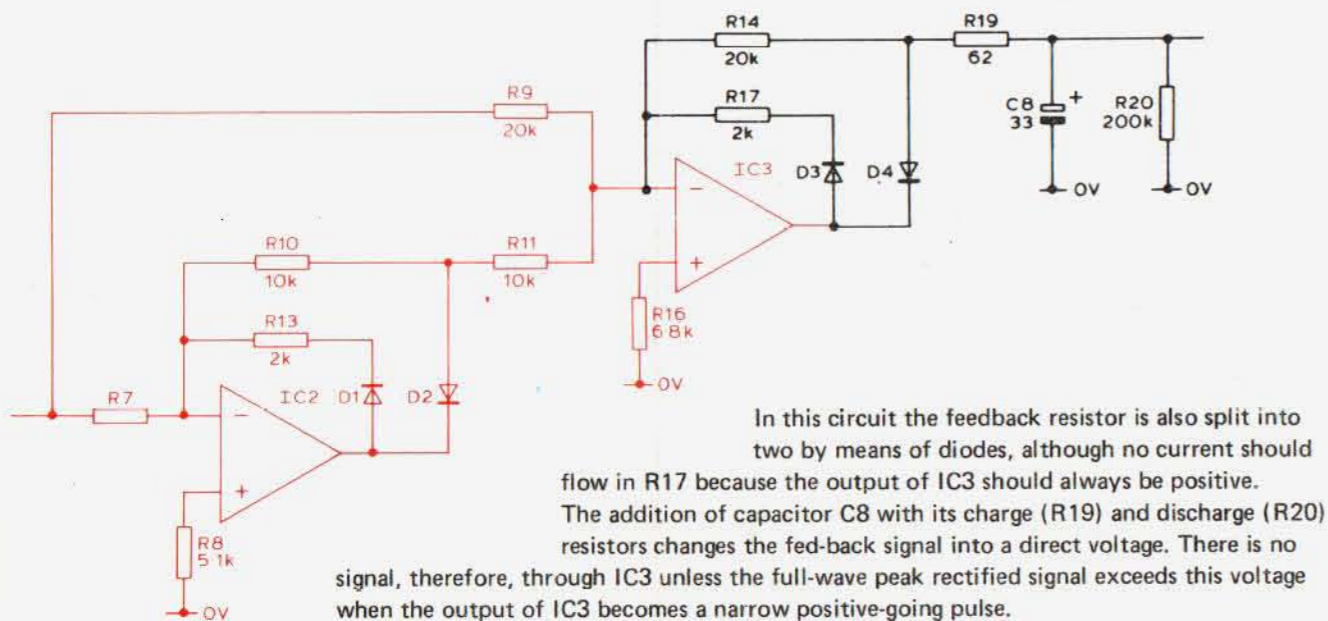
2

In this circuit the feedback resistor is split into two by means of diodes. This permits different gains on positive and negative half cycles. The high open-loop gain of the op-amp gives a sharp effective knee to the diode charactersitc.

3
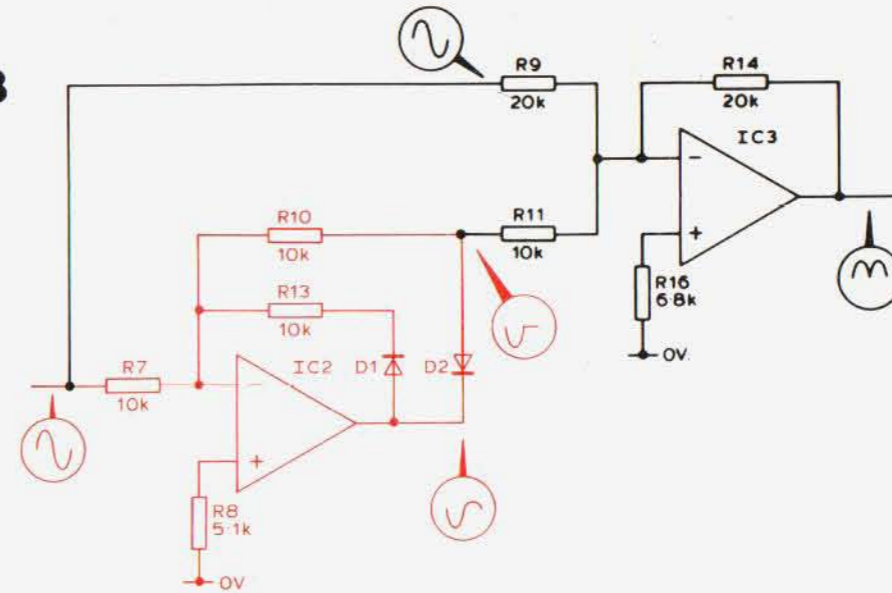
The output of IC3 is the sum of its inputs multiplied by their individual gains,
e.g. $o/p = -(a + 2b)$

or $o/p = -\left\{ \curlyvee +2 \curlyvee \right\} = -\bigvee = \mathcal{M}$

4

In this circuit the feedback resistor is also split into two by means of diodes, although no current should flow in R17 because the output of IC3 should always be positive. The addition of capacitor C8 with its charge (R19) and discharge (R20) resistors changes the fed-back signal into a direct voltage. There is no signal, therefore, through IC3 unless the full-wave peak rectified signal exceeds this voltage when the output of IC3 becomes a narrow positive-going pulse.

5
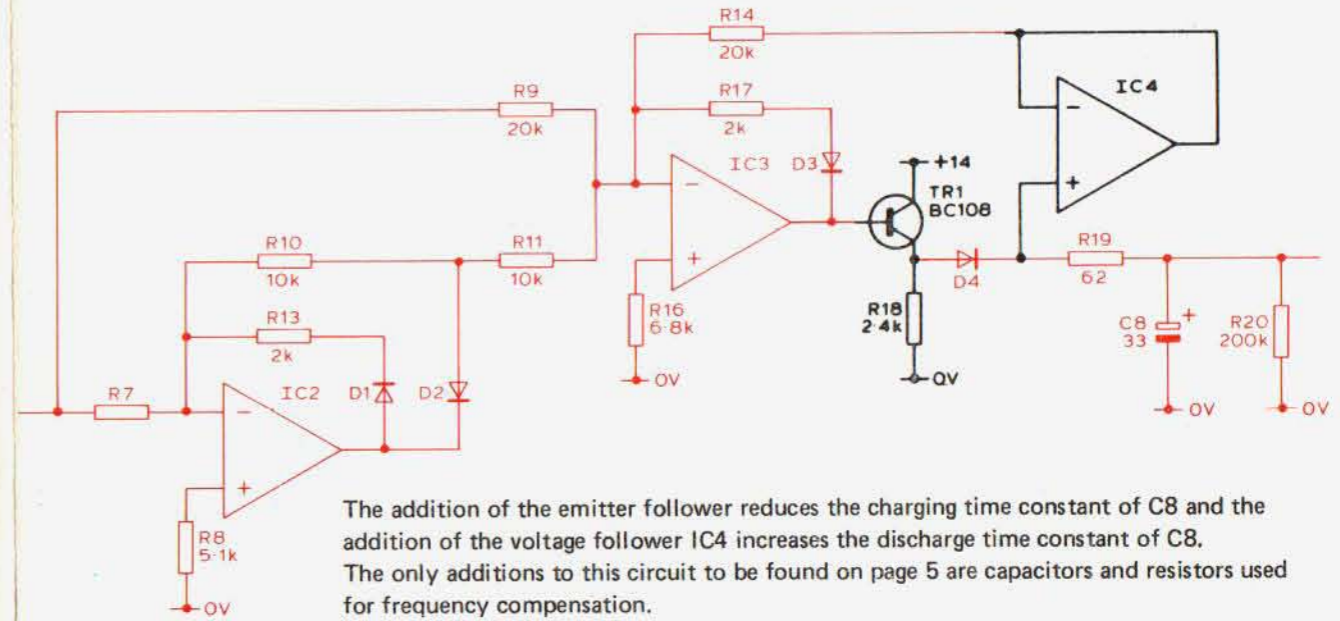
The addition of the emitter follower reduces the charging time constant of C8 and the addition of the voltage follower IC4 increases the discharge time constant of C8. The only additions to this circuit to be found on page 5 are capacitors and resistors used for frequency compensation.

PEAK DETECTION

SUMMING AND COMPARISON

VOLTAGE FOLLOWER

R14
20k

feedback

IC4
LIC741CS

2 −

3 +

6

R9
20k

R17
2k

IC3
LIC748CS

D3
IN916

EMITTER
FOLLOWER

+11V

TR1
BC108

PEAK VOLTAGE STORE

HALF-WAVE RECTIFICATION

R10
10k

R11
10k

2 −

6

8

R19
62
a.o.t.

Direct voltage to
Output Processing
(see page 7)

R13
2k

IC2
LIC748CS

D1
IN916

D2
IN916

R15
2·2k

R16
6·8k

1

C7
4·7p

+

D4
IN916

R18
2·4k

C8
33

+

R20
200k
a.o.t.

Audio from
Input Processing
(see page 3)

R7
10k

2 −

6

8

C6
150p

0V

0V

0V

0V

R12
2·2k

R8
5·1k

3 +

1

C5
4·7p

0V

C4
150p

| REF	TYPE	BASE
TR1	BC108	c / b / e — view on base
IC2 IC3	LIC748CS	1 — 8, 4 — 5
IC4	LIC741CS	view on top

DESCRIPTION OF PPM LAW CIRCUIT

The gain of IC5 is the ratio of the effective feedback resistance (see circuit blocks **a** to **f**) to the input resistance (R21).

The value of the feedback resistance, and hence the gain, varies with the value of the output voltage, as shown in the input/output curves given alongside. The effect of the circuit blocks on gain is described in terms of an output voltage becoming progressively more negative as the PPM input signal increases.

(a)   Positive output voltages are inhibited by the use of diode D5.

(b)   The circuit of this block modifies the gain over the range $0 \geqslant V_o \geqslant -1.1$ volts. A simplified circuit diagram of blocks **(b)** and **(c)** is given here and the following points should be noted about this diagram:

1. For the given range in V_o, the diagram is drawn with vertical position corresponding to the voltage.

2. Transistor TR6 is connected as a diode.

3. Transistor TR2 is used with its collector and its emitter reversed. This reduces the gain but is immaterial as the collector current is less than 4 μA.

4. The open-circuit voltage at the junction of TR6 and R40 in the voltage divider chain, R41, TR6 and R40, is -1.1 volts.
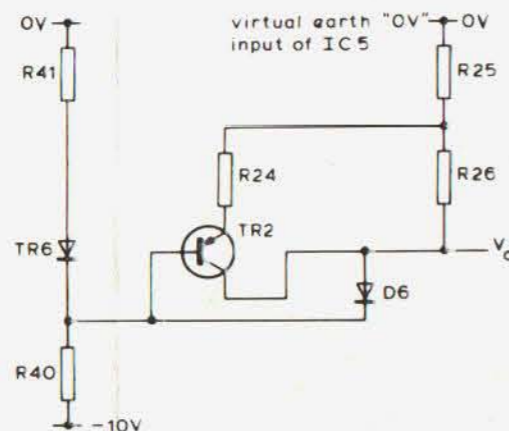
Circuit block **(b)** affects the gain of IC5 over two ranges:

(b1) $0 \geqslant V_o \geqslant -0.4$ volts
Diode D6 is forward-biassed pulling V_{TR2b} up to 0.7 volts below V_o. The emitter voltage of TR2 is 0.7 volts more positive, i.e. $V_{TR2e} \approx V_o$, which effectively puts R27 in parallel with R26, giving IC5 a gain of 3.95.

(b2) $-0.4 \geqslant V_o \geqslant -1.1$ volts
The forward bias on D6 and the base-emitter junction voltage of TR2 is reduced over this range of V_o and hence the shunting effect of R27 is reduced. The gain of IC5 rises over this range to 5.4.

(c) $-1.1 \geqslant V_o \geqslant -2.45$ volts
Resistors R25 and R26 in series give a gain of 5.4.

(d) $-2.45 \geqslant V_o \geqslant -3.45$ volts
As V_o becomes more negative, TR5 is brought into conduction as V_o falls to more than 0.7 volts below V_{TR5b}. From this point, the slope of the curve changes to:
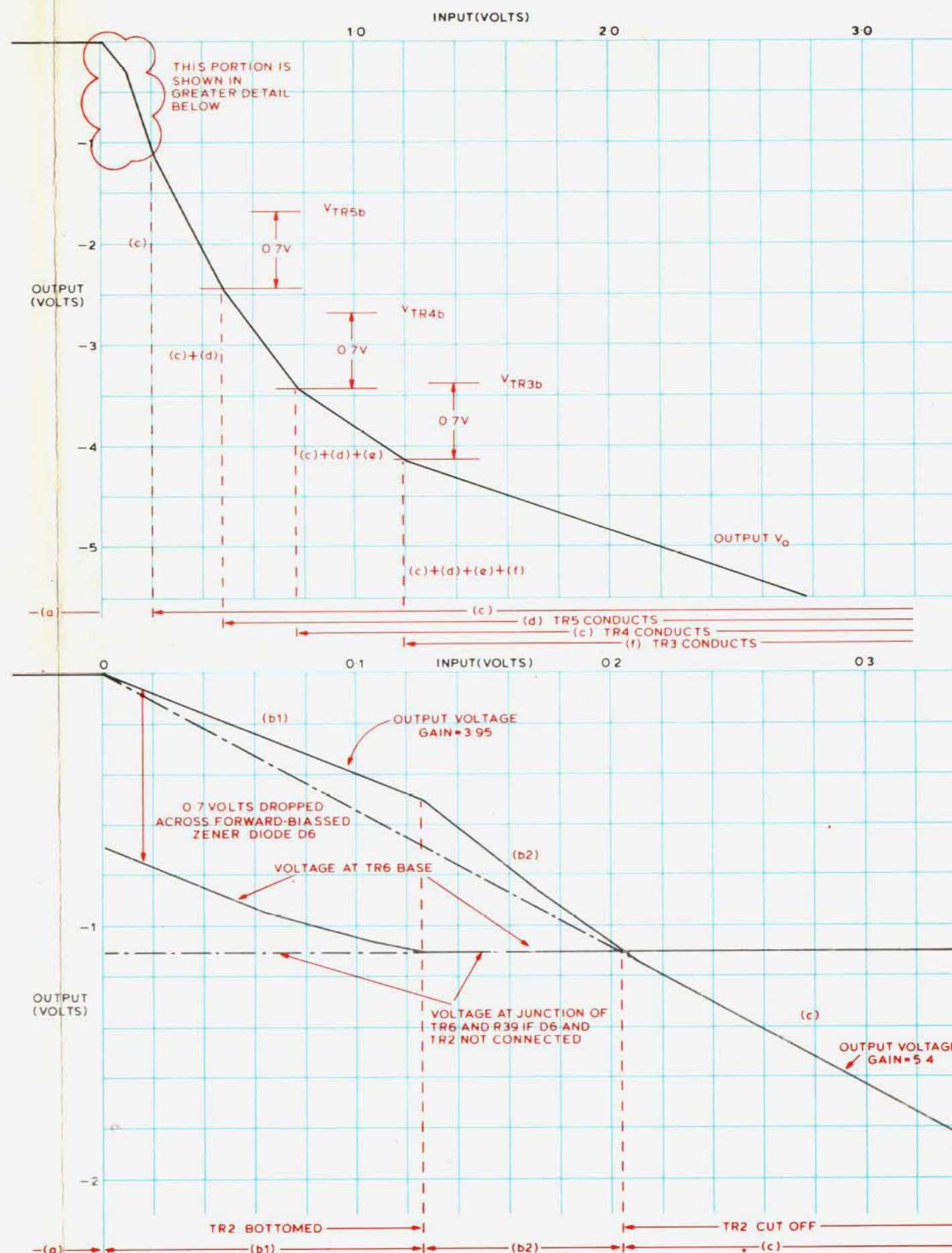
$$\frac{(R25 + R26) \, R30}{R25 + R26 + R30} \div R21$$
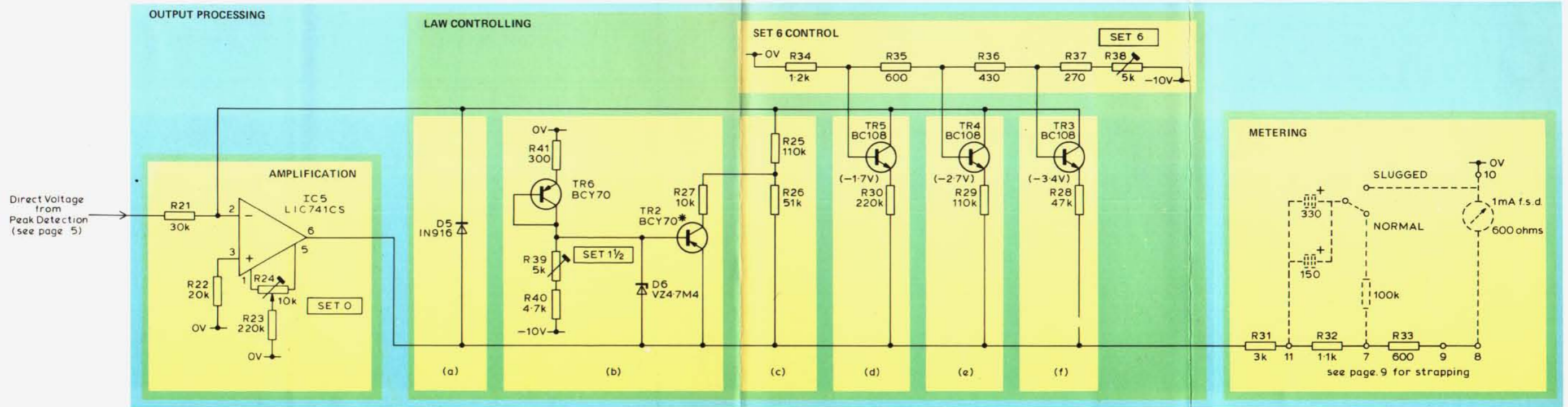
(e) $-3.45 \geqslant V_o \geqslant -4.15$
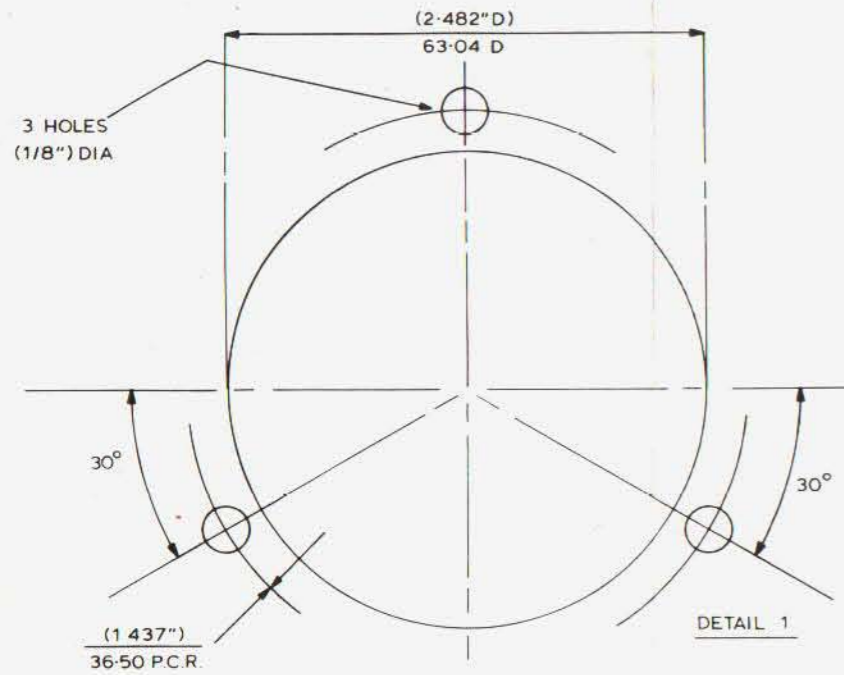The slope of the curve falls again as TR4 is brought into conduction.

(f) $-4.15 \geqslant V_o$
The slope of the curve falls to its least value as TR3 is brought into conduction.

OUTPUT PROCESSING

LAW CONTROLLING

SET 6 CONTROL

SET 6

0V R34 R35 R36 R37 R38
1·2k 600 430 270 5k −10V

AMPLIFICATION

IC5
LIC741CS

Direct Voltage
from
Peak Detection
(see page 5)

R21
30k

R22
20k

R24
10k

SET 0

R23
220k

0V

0V

D5
1N916

0V

R41
300

TR6
BCY70

R39
5k

SET 1½

R40
4·7k

−10V

TR2
BCY70*

R27
10k

D6
VZ4·7M4

R25
110k

R26
51k

TR5
BC108
(−1·7V)

R30
220k

TR4
BC108
(−2·7V)

R29
110k

TR3
BC108
(−3·4V)

R28
47k

METERING

SLUGGED

0V
10

1mA f.s.d.

330

NORMAL

600 ohms

150

100k

R31
3k 11

R32
1·1k 7

R33
600 9 8

(a) (b) (c) (d) (e) (f)

see page 9 for strapping
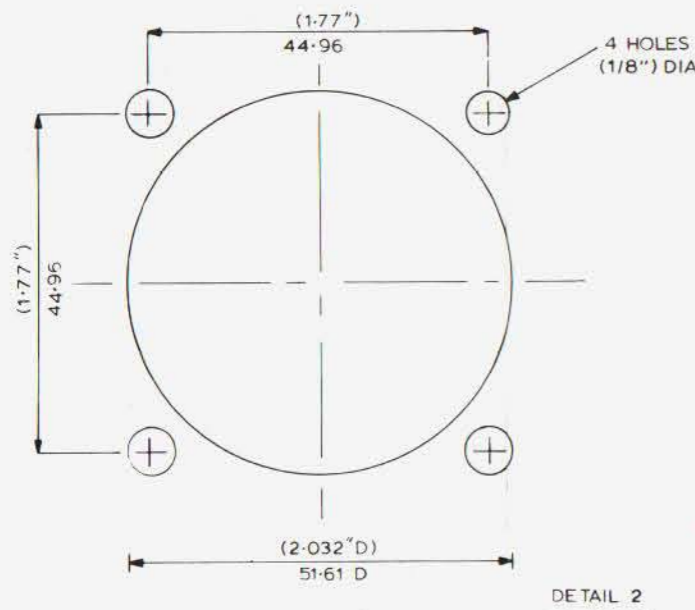
COMPONENTS FOR SLUGGED OPERATION
330 μF ± 10% 6 V Union Carbide Type K330J6KS
150 μF ± 10% 6 V Union Carbide Type K150J6KS
100 kΩ ± 2% Resistor Type MR25
Single-pole changeover switch.

REF	TYPE	BASE
TR2 TR6	BCY70	c, b, e view on base
TR3 TR4 TR5	BC108	
IC5	LIC741CS	1 8 4 5 view on top

(2·482"D)
63·04 D

3 HOLES
(1/8") DIA

30°   30°

(1·437")
36·50 P.C.R.

DETAIL 1

(1·77")
44·96

4 HOLES
(1/8") DIA

(1·77")
44·96

(2·032"D)
51·61 D

DETAIL 2

(0·78"R)
1·98 R

(1·432"D)
36·37 D

PANEL DETAIL   DETAIL 3

| PANEL CUTOUT FOR | | ERNEST TURNER |
PPM CODE	E.D. METER SPEC	INSTRUMENT STYLE
ME12/9A	1478	703
ME12/9C	1499	643
ME12/9E	1501	903
ME12/9B	1477	702
ME12/9D	1498	642
ME12/9F	1500	902
ME12/9G	1497	640

8mm

40mm

15mm   10mm

1 HOLE
3mm DIA

32 mm R.
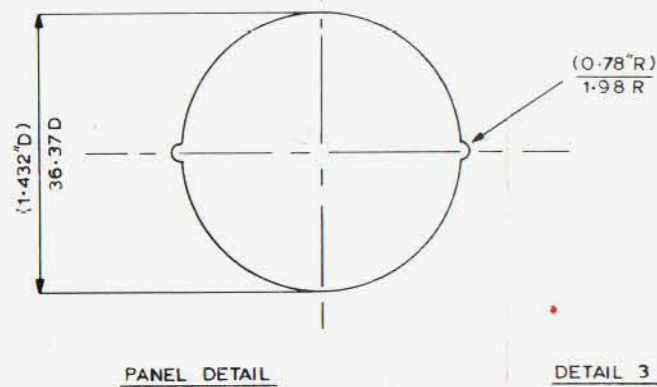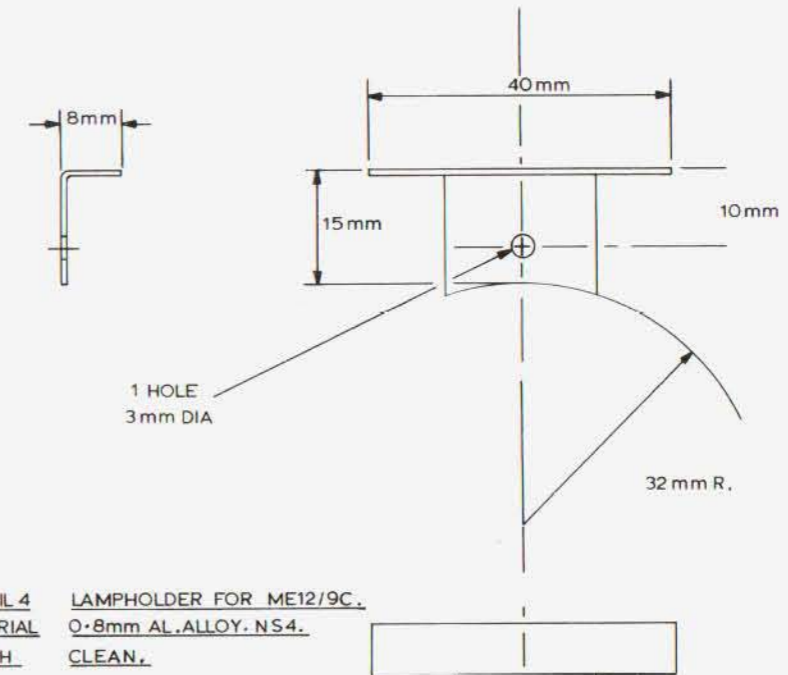
DETAIL 4   LAMPHOLDER FOR ME12/9C.
MATERIAL   0·8mm AL.ALLOY. NS4.
FINISH   CLEAN.

SCALE 1:1

12mm

60 mm

22·5   22·5

10mm   6mm
           3mm

11mm   11mm

2 HOLES 3mm DIA
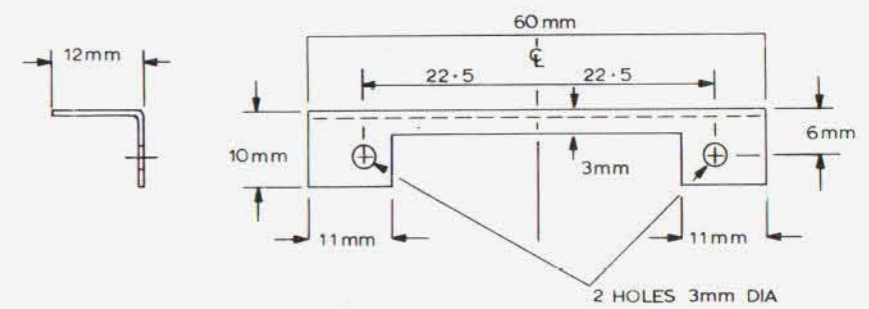
DETAIL 5   LAMPHOLDER FOR ME12/9D.
MATERIAL   0·8mm AL.ALLOY. NS4.
FINISH   CLEAN

SCALE 1:1

Metric dimensions in millimetres.
Normal tolerances :
ho decimal place :– ± 1mm
one decimal place : ± 0·3mm
two decimal places : ± 0·1mm
unless otherwise stated.

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CHANGES

ASSEMBLY

ME12/9-10   9

BOTTOM NUT ON METER
TERMINALS TO BE ADJUSTED
IF NESSARY TO GIVE CLEARANCE
BETWEEN BACK OF METER AND BOARD.
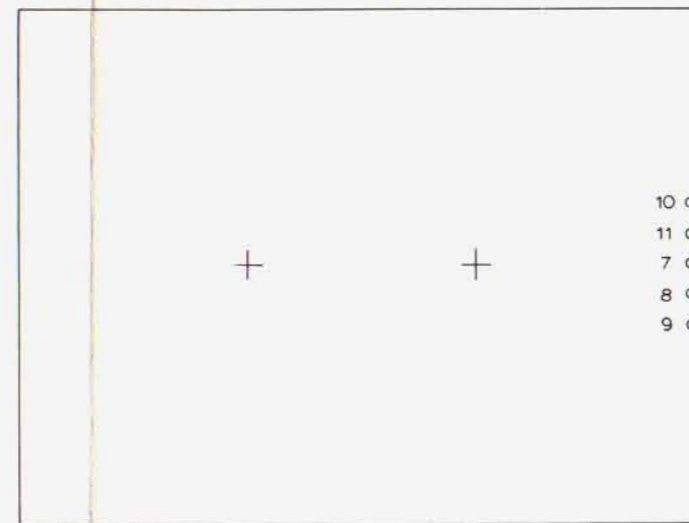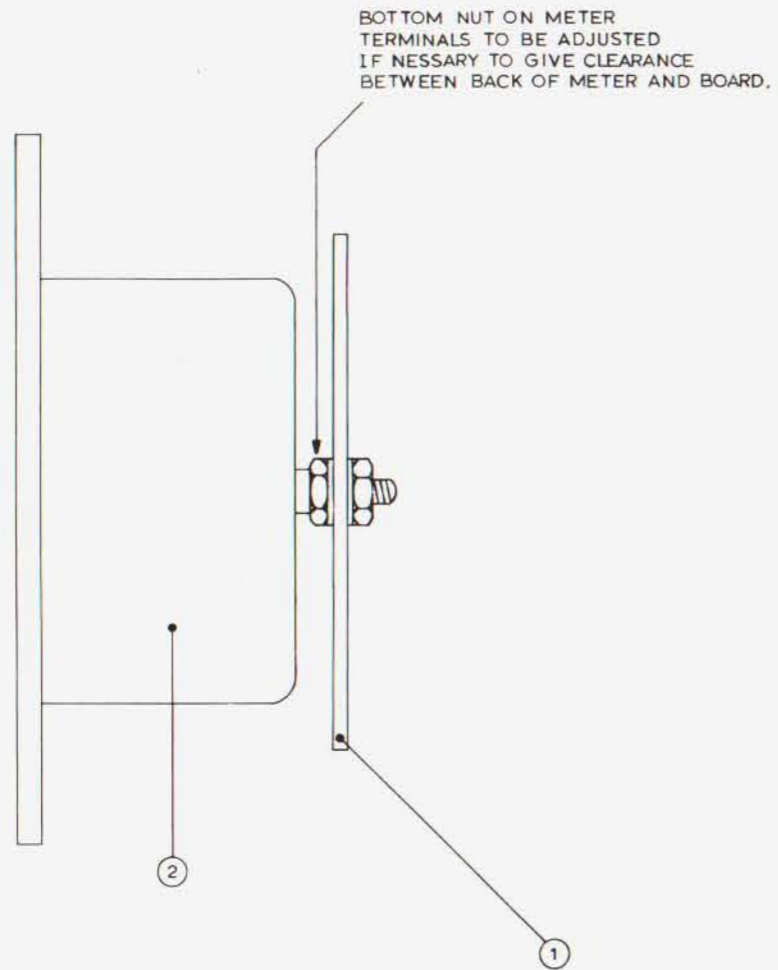
FOR STRAPPING. SEE NOTE 1

10 ○
11 ○
7 ○
8 ○
9 ○

1 METER CONNECTION

a. FOR METER ATTACHED TO P.C.B. STRAP PINS 8-9

b. FOR METER EXTERNAL TO P.C.B. CONNECT METER
   BETWEEN PIN 9 & 10. (+ ve)

c. FOR METER ATTACHED TO P.C.B. AND A SLAVE
   METER CONNECT SLAVE BETWEEN 7 & 8 (+ ve)

2. ASSEMBLY TO BE IN ACCORDANCE WITH EA 10484
   NOTE 1.

SLOT IN BODY OF ADAPTOR
TO ENABLE DIAL TO BE
ILLUMINATED

LAMPHOLDER BRACKET
PAGE 8 DETAIL 1

2 LAMPHOLDERS
BULGIN LV564

ALTERNATIVE ASSEMBLY SHOWING
METER ILLUMINATION

LARGER CLIPS ARE TURNED
OUTWARDS TO SECURE
ADAPTOR TO PANEL

SLOT IN BODY OF
ADAPTOR TO ENABLE
DIAL TO BE ILLUMINATED

(4·24")
107·70

(3·76")
95·50

(0·28")   (·821")
0·71   20·62
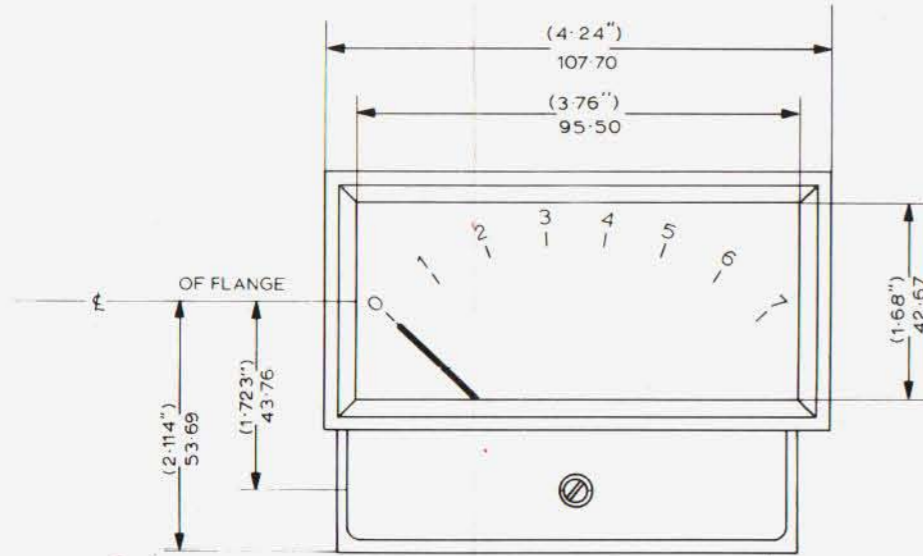
(4·096")
104·04"

(1·68")
42·67

(2·16")
54·86

(1·723")
43·76

OF FLANGE

(2·114")
53·69

(2·0")
50·80

MAX PANEL THICKNESS
(3/16") 4·75mm

(2·135"±·035")
54·23 ±·889

SMALLER CLIPS ARE
TURNED INWARDS TO
SECURE INSTRUMENT
IN ADAPTOR

REGISTER PLATE

PANEL APERTURE TO BE
(4·127" x 2·031")
104·83mm x 51·59mm
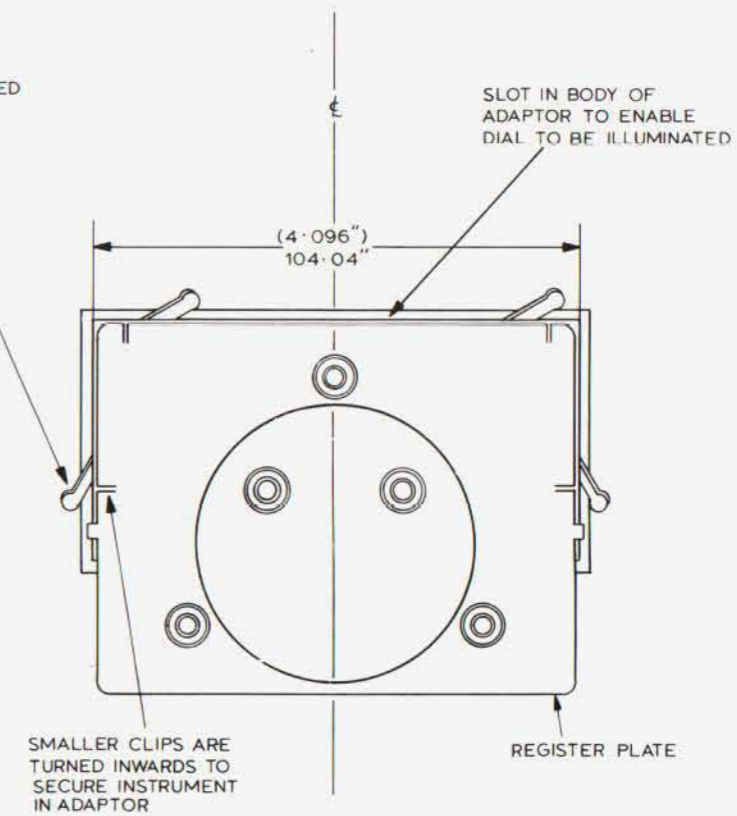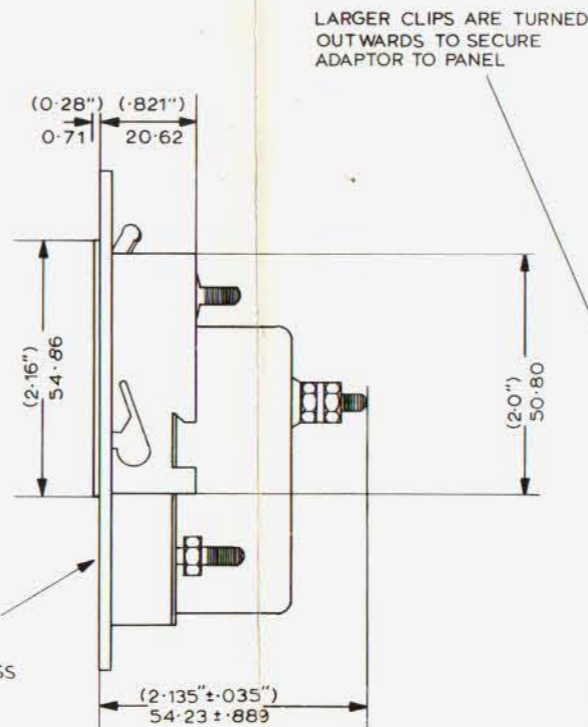
THE ADAPTOR IS MANUFACTURED
BY ERNEST TURNER INSTRUMENTS LTD
FOR METER TYPES 642 AND 902

NOTE
ALL DIMENSIONS ARE FOR REFERENCE
PURPOSE ONLY

FINISH — SPRAYED MATT BLACK

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CHANGES

FLUSH FITTING ADAPTOR FOR ME12/9D and F

ME12/9-10   11

SLOT IN BODY OF ADAPTOR
TO ENABLE DIAL TO BE
ILLUMINATED

LAMPHOLDER BRACKET
DETAIL 5 PAGE 8

2 LAMPHOLDER
BULGIN LV564

ALTERNATIVE ASSEMBLY SHOWING
METER ILLUMINATION

LARGER CLIPS ARE
TURNED OUTWARDS
TO SECURE ADAPTOR
TO PANEL

(3·02″)
76·71

(2·54″)
64·52

(1·094″)
27·79

(1·575″)
40·0

OF FLANGE

AMPERES

(1·60″)
38·10

(1·156″)
29·36

(028″) (075″)
0·71   19·05

(1·41″)
35·81

(2·058″±035″)
52·27±·889

(2·86″)
72·64

SMALLER CLIPS ARE
TURNED INWARDS TO
SECURE INSTRUMENT
IN ADAPTOR

REGISTER PLATE

PANEL APERTURE TO BE
(2·891″x 1·441″)
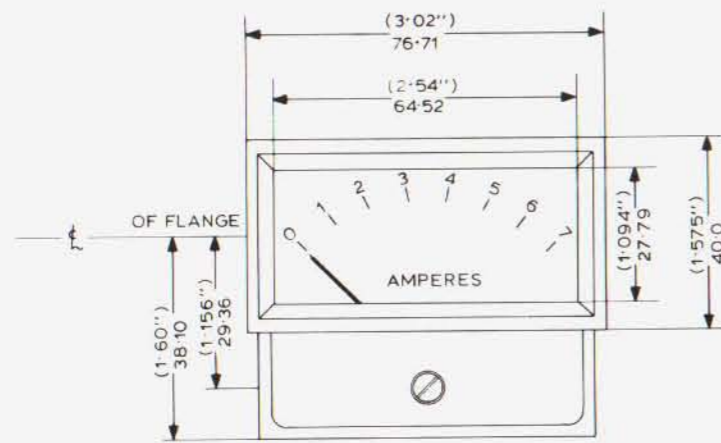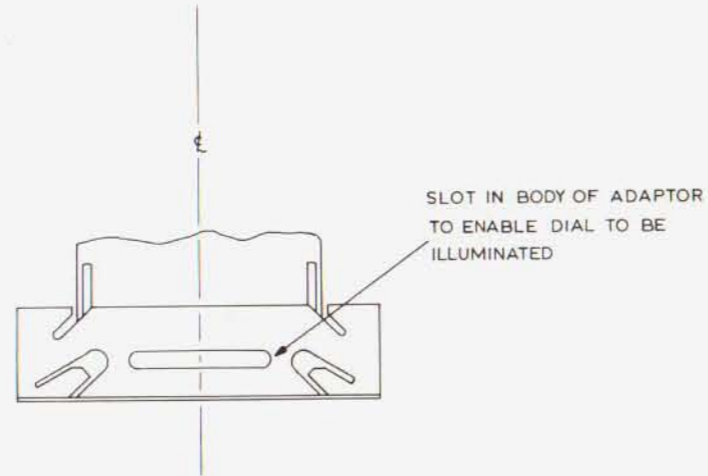73·43mm x 36·6mm

MAX PANEL THICKNESS
(3/16″) 4·75mm
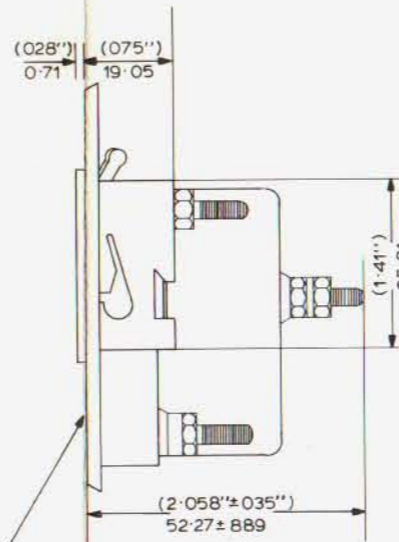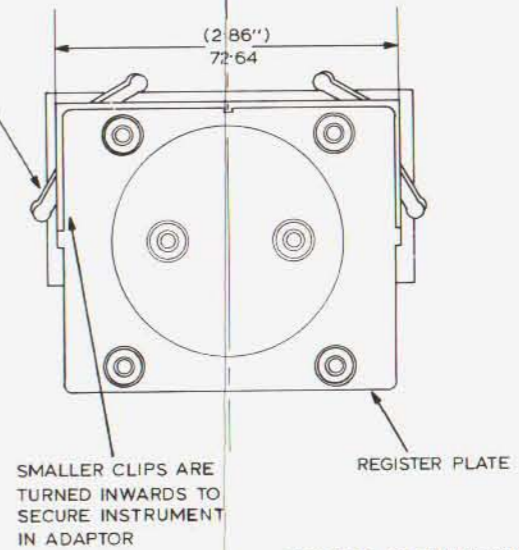
ADAPTOR IS MANUFACTURED BY
ERNEST TURNER INSTRUMENTS LTD
FOR METER TYPES 642 AND 902
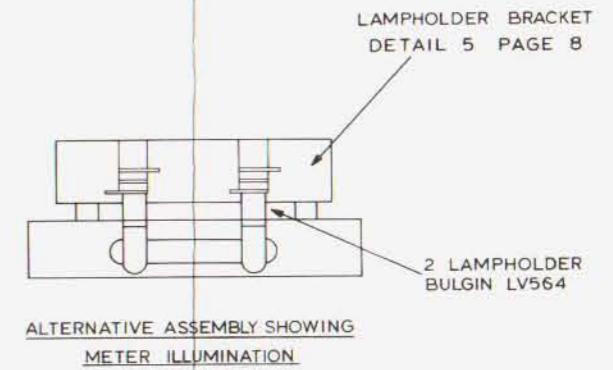
NOTE
ALL DIMENSIONS ARE FOR REFERENCE
PURPOSE ONLY

FINISH — SPRAYED MATT BLACK

Component height is

B SET 0   B SET 6   B SET 1½

B SET 3

5 BAL

A SET 3

A SET 0   A SET 6   A SET 1½
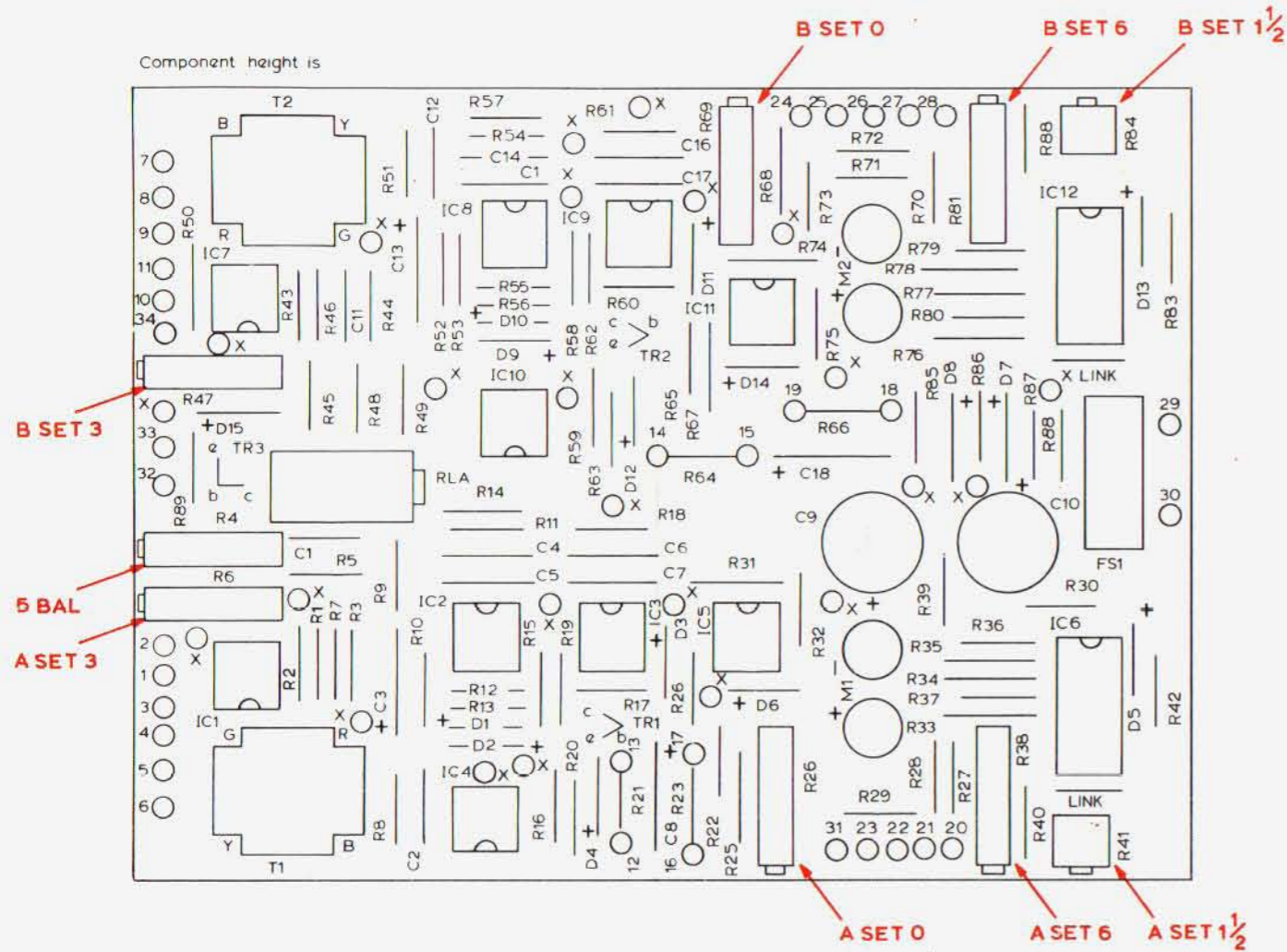
For pin assignments, see pages 12,15,16 and 17.

REGULATION AND MODE SWITCHING

The AM20/4 can be powered from a floating 24-volt supply.

An external mode switch controls relay RLA.

30 — FS1 100mA A/S — R88 20 — +13V

24V at 60mA

R89 10k   D12 DA000   1250 RLA/2   TR3 BFY51   C10 220   R87 100   R86 680   D7 VZ18M4   D8 VZ10M4   C9 220   0V

M/S   A/B   32   33

29 — −10V
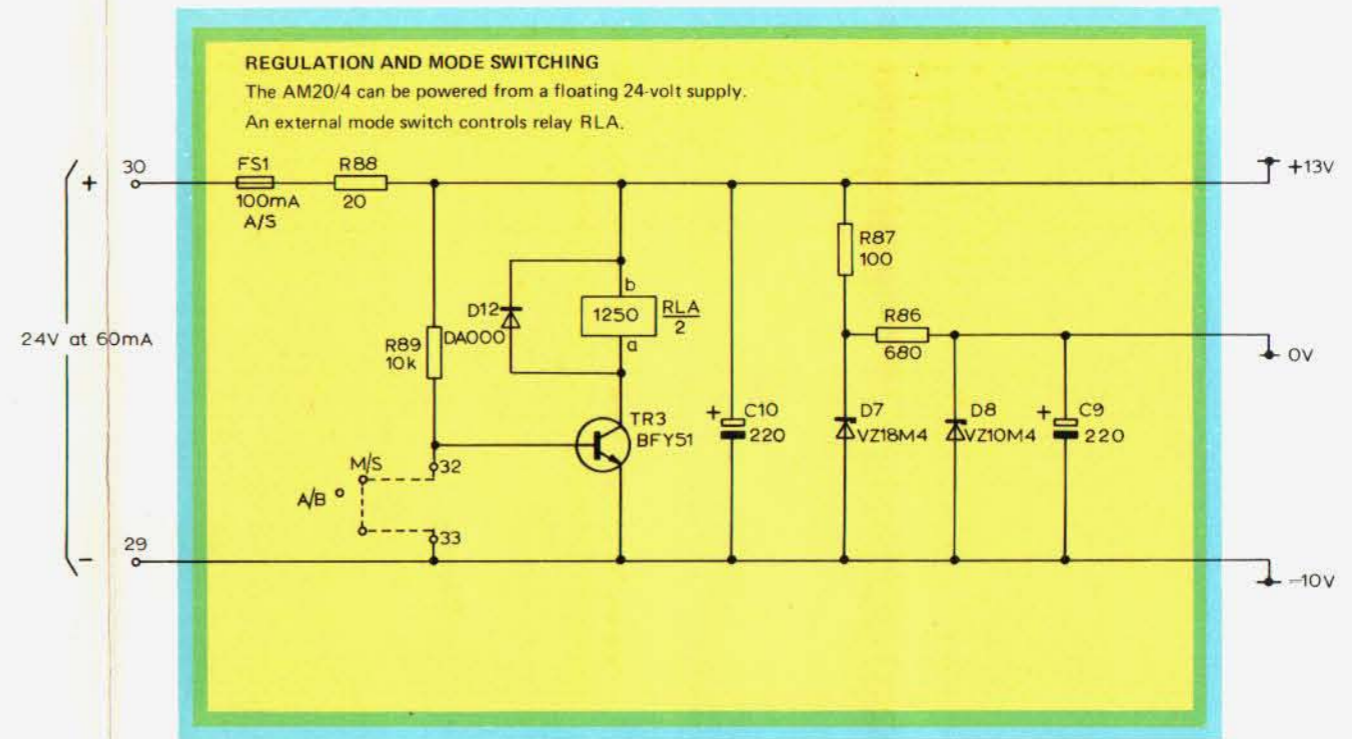
REF	TYPE	BASE
TR3	BFY51	b c e — view on base

ALIGNMENT CHECK

Normally alignment is not required, but the following checks should be carried if the meter is changed:

1. Check that, with no power applied, the mechanical zeros of the meter are correct and that the meter is in the *A/B* mode.

2. Apply power and terminate each of the inputs with 600 ohms. Check that both pointers read zero. If necessary adjust R26 (*A SET 0*) and R69 (*B SET 0*).

3. Apply 1-kHz tone at −4 dB to both inputs. Check that both pointers read 3. If necessary adjust R6 (*A SET 3*) and R47 (*B SET 3*).

4. Apply 1-kHz tone at +8 dB to both inputs. Check that both pointers read 6. If necessary adjust R38 (*A SET 6*) and R81 (*B SET 6*).

5. Apply 1-kHz tone at −10 dB to both inputs. Check that both pointers read 1½. If necessary adjust R41 (*A SET 1½*) and R84 (*B SET 1½*).
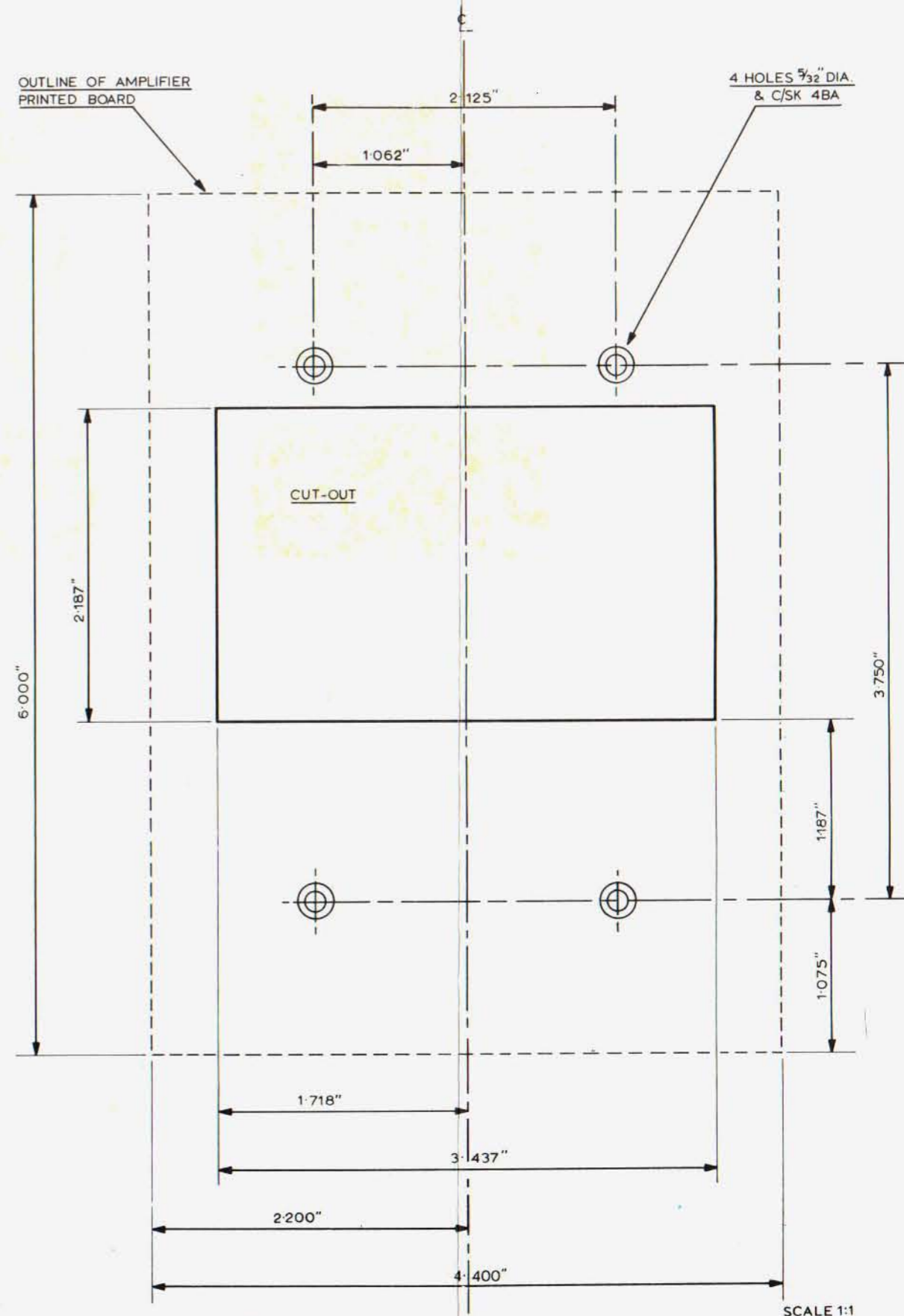
6. Switch the meter to the *M/S* mode. Feed in-phase 1-kHz tone to both inputs at −3 dB. Check that the A:M pointer reads 4 and that the B:S pointer reads 0. If necessary remove link between pins 10 and 11 to make it easier to adjust R4 (*S BAL*). Replace link between pins 10 and 11. Switch back to the *A/B* mode.

7. Check that the input levels of 1-kHz tone to give the readings below are within the specified limits:

1	−12 ± 0.5 dB
2	−8 ± 0.2 dB
3	−4 ± 0.3 dB
4	0 ± 0.2 dB
5	+4 ± 0.3 dB
6	+8 ± 0.2 dB
7	+12 ± 0.5 dB

8. Check that the frequency response of both halves of the unit is:

40 Hz to 20 kHz	0 ± 0.3 dB
10 Hz	−2 ± 0.5 dB
5 Hz	−5 ± 0.8 dB

9. Check that the fallback time of the pointers from a reading of 7 to a reading of 1 lies between 2.5 and 3 seconds.

10. If a Peak Programme Meter Tester (e.g. TE1/25) is available, check the rise time. Set the level of the 5 kHz tone to read 6 on both pointers and measure the drop in indicated level for the following burst durations:

100 ms	0 ± 0.5 dB
10 ms	−2.5 ± 0.5 dB
5 ms	−4.0 ± 0.75 dB
1.5 ms	−9.0 ± 1.0 dB

SCALE 1:1

FUNCTIONAL BLOCK DIAGRAM

A:M INPUT PROCESSING
Accepts an *A* stereophonic signal at zero volume and produces an output of either *A* or *M* at −6 dB with respect to zero volume programme. A *B* input from the B:S Input Processing is required to produce an M output. The output is selected by means of a relay circuit.

A:M PEAK DETECTION
Accepts an audio signal at −6 dB with respect to zero volume programme and produces a direct voltage output equal to the maximum peak voltage of the input. The charge and discharge time constants are chosen during manufacture to give the P.P.M. its correct dynamic performance.
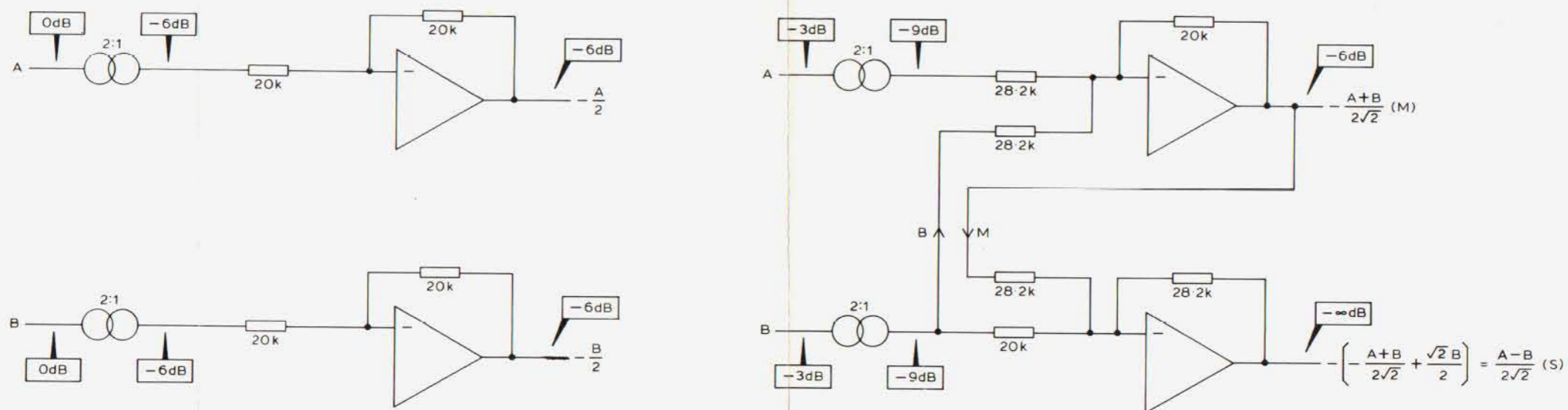
A:M OUTPUT PROCESSING
Amplifies the input voltage into an output current with the pseudo-logarithmic law required by the P.P.M.
Preset adjustments are provided to give the correct law.

B:S INPUT PROCESSING
A similar arrangement as the A:M Input Processing, which requires an *M* input to produce an *S* output. (See below).

B:S PEAK DETECTION
(See above).

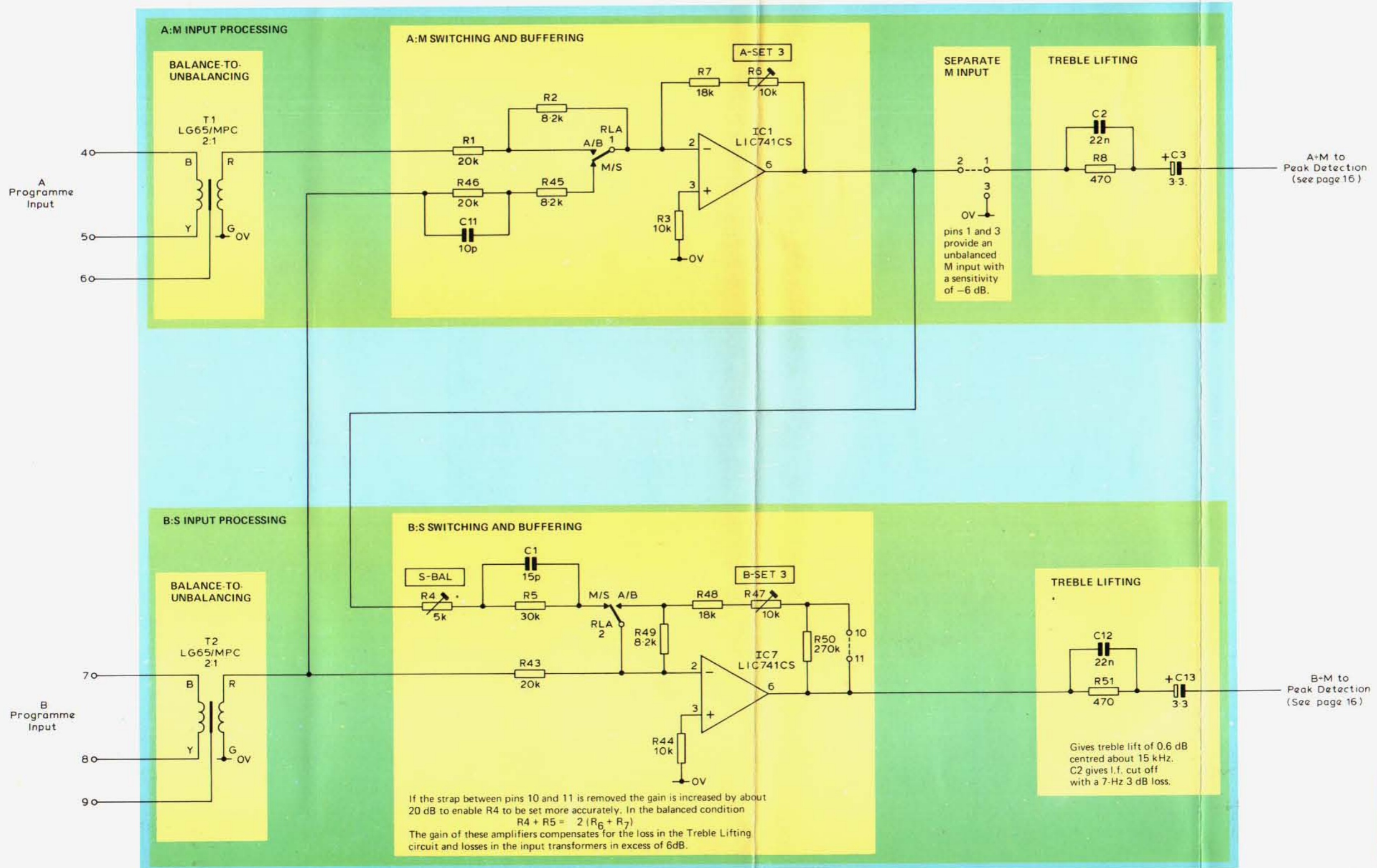**B:S OUTPUT PROCESSING**
(See above).

SIMPLIFIED CIRCUIT OF A/B : M/S SWITCHING

These two simplified circuits of the Input Processing shows the circuit differences between the A/B and the M/S modes. They also show the levels involved to obtain A, B and M outputs of −6 dB, assuming that the A and B inputs are the same signal. The M output is known as A + B −3 dB. This 3 dB is implied by the $\sqrt{2}$.

In the full circuit, shown on page 15, some of the resistor values are greater than those shown here. This is because some gain is required from the amplifiers to compensate for the loss in Treble Lifting and the loss in excess of 6 dB in the input transformers.
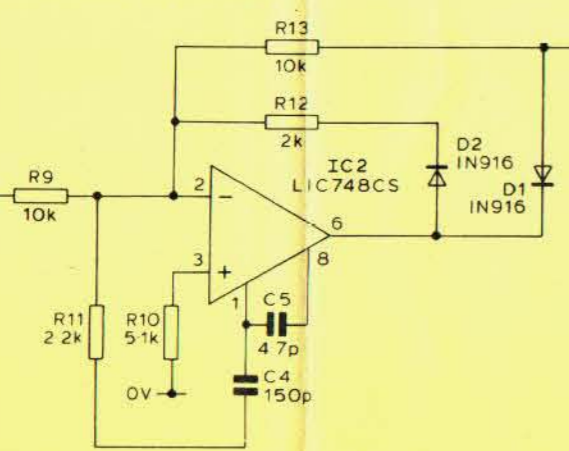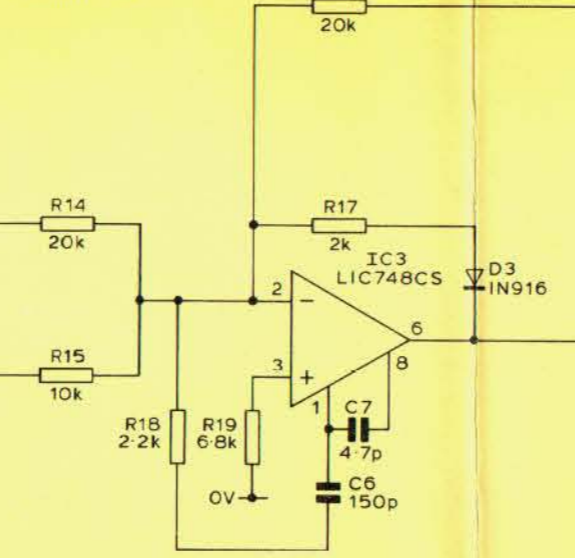
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CHANGES
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AM20/4 INPUT PROCESSING CIRCUIT

ME 12/9-10   **15**

A:M INPUT PROCESSING

BALANCE-TO-UNBALANCING

T1
LG65/MPC
2:1

A Programme Input

A:M SWITCHING AND BUFFERING

A-SET 3

R7 18k   R6 10k

R2 8·2k

R1 20k

RLA A/B 1

R46 20k   R45 8·2k

C11 10p

M/S

IC1 LIC741CS

R3 10k

0V

SEPARATE M INPUT

OV

pins 1 and 3 provide an unbalanced M input with a sensitivity of −6 dB.

TREBLE LIFTING

C2 22n

R8 470   + C3 3·3

A+M to Peak Detection (see page 16)

B:S INPUT PROCESSING

BALANCE-TO-UNBALANCING

T2
LG65/MPC
2:1

B Programme Input

B:S SWITCHING AND BUFFERING

S-BAL

C1 15p

R4 5k   R5 30k

M/S A/B

RLA 2

R49 8·2k

R43 20k

B-SET 3

R48 18k   R47 10k

R50 270k   10 11

IC7 LIC741CS

R44 10k

0V

TREBLE LIFTING

C12 22n

R51 470   + C13 3·3

B+M to Peak Detection (See page 16)

Gives treble lift of 0.6 dB centred about 15 kHz. C2 gives l.f. cut off with a 7-Hz 3 dB loss.

If the strap between pins 10 and 11 is removed the gain is increased by about 20 dB to enable R4 to be set more accurately. In the balanced condition

$$R4 + R5 = 2(R_6 + R_7)$$

The gain of these amplifiers compensates for the loss in the Treble Lifting circuit and losses in the input transformers in excess of 6dB.

REF	TYPE	BASE
IC1 IC7	LIC741CS	1 — 8 / 4 — 5 view on top

A:M PEAK DETECTION

HALF-WAVE RECTIFICATION
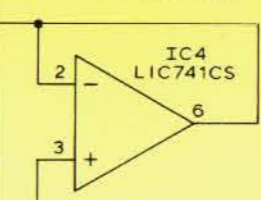
A÷M from
Input Processing
(see page 15)

R9 10k
R13 10k
R12 2k
IC2 LIC748CS
D2 1N916
D1 1N916
R11 2·2k
R10 5·1k
C5 4·7p
C4 150p
0V

SUMMING AND COMPARISON

R16 20k
R14 20k
R17 2k
R15 10k
IC3 LIC748CS
D3 1N916
R18 2·2k
R19 6·8k
C7 4·7p
C6 150p
0V

EMITTER FOLLOWER

+14V
TR1 BC108
R20 2·4k
0V
D4 1N916

VOLTAGE FOLLOWER

IC4 LIC741CS
2 − 3 + 6

PEAK VOLTAGE STORE

R21 62 a.o.t.
C8 33
R23 200k a.o.t.
0V 0V

B:S PEAK DETECTION

HALF-WAVE RECTIFICATION

B÷S from
Input Processing
(see page 15)

R52 10k
R56 10k
R55 2k
IC8 LIC748CS
D9 1N916
D10 1N916
R54 2·2k
R53 5·1k
C15 4·7p
C14 150p
0V

SUMMING AND COMPARISON

R59 20k
R57 20k
R60 2k
R58 10k
IC9 LIC748CS
D11 1N916
R61 2·2k
R62 6·8k
C17 4·7p
C16 150p
0V

EMITTER FOLLOWER

+14V
TR2 BC108
R63 2·4k
0V
D12 1N916

VOLTAGE FOLLOWER

IC10 LIC741CS
2 − 3 + 6

PEAK VOLTAGE STORE

R64 62 a.o.t.
C18 33
R66 200k a.o.t.
0V 0V
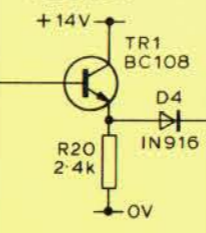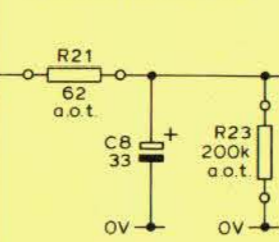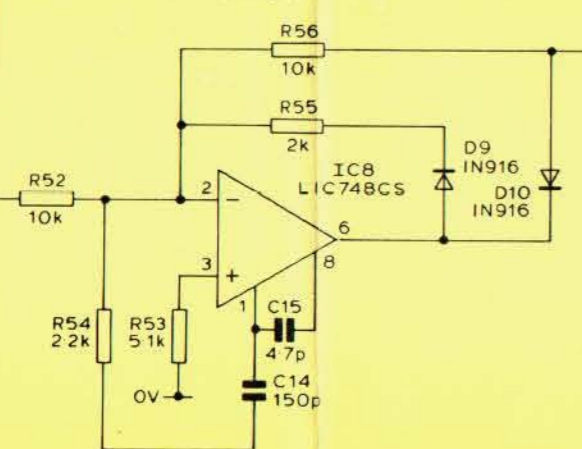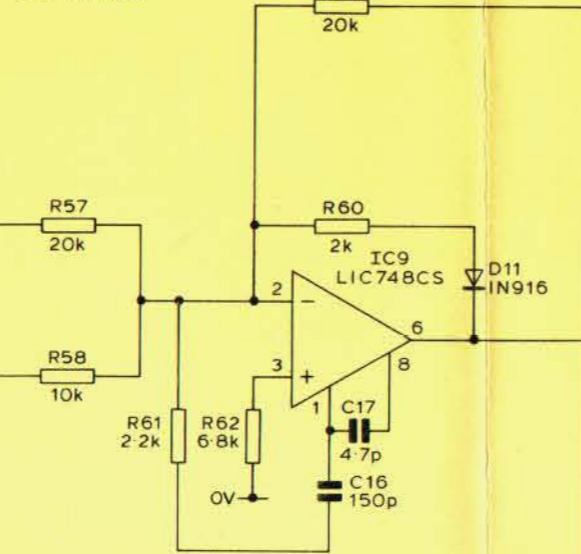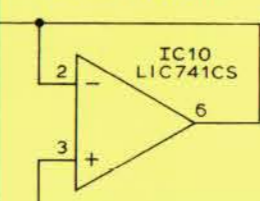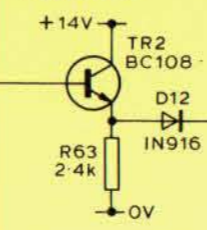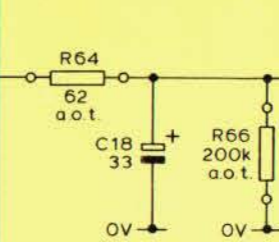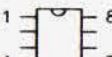
REF	TYPE	BASE
TR1 TR2	BC108	view on base
IC2 IC3 IC8 IC9	LIC748CS	view on top
IC4 IC10	LIC741CS	view on top

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CHANGES
AM20/4   OUTPUT PROCESSING CIRCUITS
ME12/9-10   17

A:M OUTPUT PROCESSING

LAW CONTROLLING

SET 6 CONTROL

A SET 6

0V   R39   1·2k   R36   600   R37   430   R38   5k   −10V

AMPLIFICATION

R22   30k
2
IC5
LIC741CS
6
3   +   5
1   R26   10k
R24   20k
R25   220k
A SET 0
0V

(a)   D6   IN916

(b)
0V   R42   300
11   10   IC6 CA3096AE   12
R41   5k   A SET 1½
R40   4·7k
−10V
IC6   14   15   13
D5   VZ4·7M4

R30   10k

(c)   R31   110k   R32   51k

(d)   IC6   3   1   2   R35   220k

(e)   IC6   6   5   4   R34   110k

(f)   IC6   9   8   7   R33   47k

METERING
SLUGGED
0V   31
1mA f.s.d.
600 ohms
330
NORMAL
150
100k
R27   3k   20   R28   1·1k   21   R29   600   22   23

B:S OUTPUT PROCESSING

LAW CONTROLLING

SET 6 CONTROL

B SET 6

0V   R82   1·2k   R79   600   R80   430   R81   5k   −10V

AMPLIFICATION

R65   30k
2
IC11
LIC741CS
6
3   +   5
1   R69   10k
R67   20k
R68   220k
B SET 0
0V

(a)   D14   IN916

(b)
0V   R85   300
11   10   IC12 CA3096AE   12
R84   5k   B SET 1½
R83   4·7k
−10V
IC12   14   15   13
D13   VZ4·7M4

R73   10k

(c)   R74   110k   R75   51k

(d)   IC12   3   1   2   R78   220k

(e)   IC12   6   5   4   R77   110k

(f)   IC12   9   8   7   R76   47k

METERING
SLUGGED
0V   24
1mA f.s.d.
600 ohms
330
NORMAL
150
100k
R70   3k   28   R71   1·1k   27   R72   600   26   25

REF	TYPE	BASE
IC5 IC11	LIC741CS	1—8 4—5 view on base
IC6 IC12	CA3096AE	1—16 8—9 view on top