

These three modules are similar to the i.f. Module LP1156 but include a long and medium wave oscillator coil matched to specific tuning capacitors.

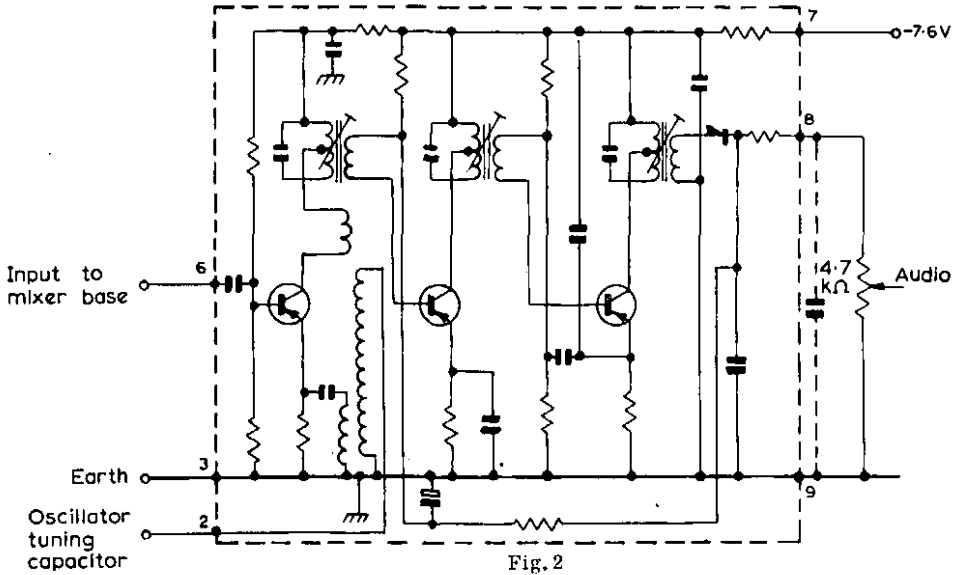
The LP1155 covers the band 540kHz to 1640kHz when used with an oscillator tuning capacitance varying from 34 to 144pF. The LP1157 requires an oscillator tuning capacitance of 45 to 183pF and the LP1158 requires an oscillator tuning capacitance of 23 to 103pF, for example the Mullard capacitor AC1033. Two stages of i.f. amplification using AF117 transistors and single tuned coils are preceded by an AF115 mixer and followed by OA90 diode detector. Particular attention has been paid to r.f. filtering. The supply line is decoupled within the module adjacent to the supply tag with further decoupling between the oscillator and mixer stages. The audio output from the diode is filtered by a capacitor-resistor network.

Connection to the module is by means of eight tinned brass tags which may also be used to mount the module to a printed board.

Four tags are also provided in the base of the can which may be bent down and used for additional mounting.

## CIRCUIT

The circuit diagram of the module is shown in Fig.2. The numbered connections in this diagram correspond to the tag numbers in Fig.1.



### CONNECTIONS

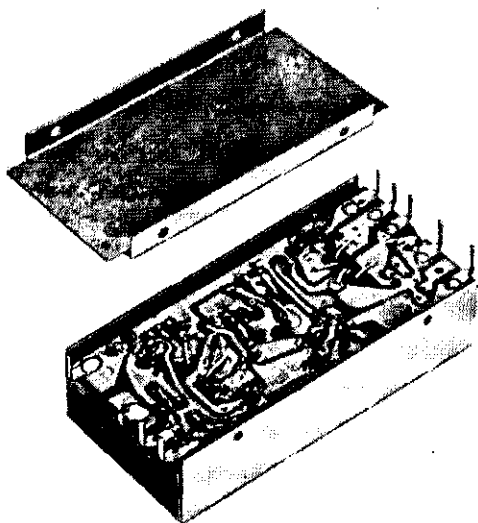
- |                                      |                        |
|--------------------------------------|------------------------|
| 1. -                                 | 6. Input to mixer base |
| 2. Oscillator section of tuning gang | 7. -7.6V supply        |
| 3. Earth                             | 8. Audio output        |
| 4. -                                 | 9. Earth               |
| 5. -                                 |                        |

### PERFORMANCE

These figures are based on initial production and may be amended. They are based on a supply voltage measured at the module of -7.6V.

- Sensitivity: Input =  $2.0\mu\text{V} \pm 6.0\text{dB}$  at 1.0MHz for 50mV audio output. The input is modulated 30% at 400Hz. The output is measured across a 4.7kΩ load.
- Bandwidth: 5.0kHz  $\pm$  1.0kHz at 6.0dB attenuation.
- Selectivity: Greater than 22dB at  $\pm 9.0\text{kHz}$  from centre frequency.
- Consumption: Approx. 3.3mA.





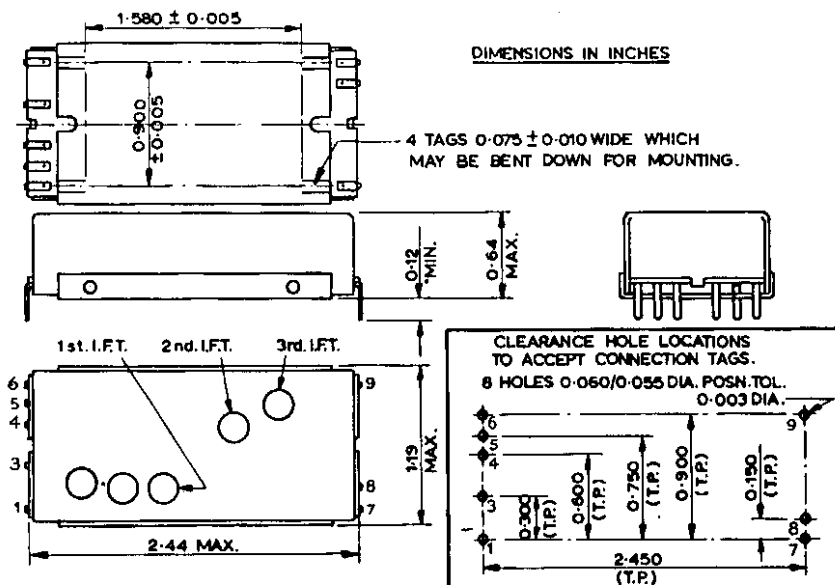
The Mullard LP 1156 i.f. module has been designed to have the widest possible application in a.m. radio receivers. It consists of a mixer stage followed by two i.f. stages and as the oscillator coil is not included in the module, the user may make his own choice of tuning components and frequency coverage.

The mixer stage uses an AF115 transistor and may be operated up to 13 Mc/s on oscillator fundamental or up to 26 Mc/s on second harmonic with suitable oscillator coils, tuning and coupling capacitors. Two stages of i.f. amplification using AF117 transistors and single tuned i.f. transformers are followed by an OA90 diode detector. Particular attention has been paid to r.f. filtering and screening. The supply line is decoupled within the module adjacent to the supply tag with further decoupling between the oscillator and mixer stages. The audio output from the diode is filtered by a capacitor resistor network and the whole unit is enclosed in a metal box.

Connection to the module is by means of eight tinned brass tags which may also be used to mount the module to a printed board.

Four tags are also provided in the base of the can which may be bent down and used for additional mounting.





## Performance

These figures are based on initial production and may be amended. For the purpose of these tests, the mixer collector is joined to the primary tap of the first I.F.T. (tag 4 joined to tag 1); the mixer emitter (tag 5) is decoupled to earth via a 0.022 $\mu$ F capacitor; the audio output is measured across a 4.7K $\Omega$  load; and the supply voltage is set to 7.6V.

- (a) Sensitivity 2.4 $\mu$ V  $\pm$  5dB at 470 Kc/s for 50mV output. The input is modulated 30% at 400~
- (b) Bandwidth 5.0 Kc/s  $\pm$  1.0 Kc/s at 6dB attenuation
- (c) Selectivity Greater than 22dB at  $\pm$  9 Kc/s from centre frequency
- (d) Consumption Approx. 3.3 mA. under no signal conditions

The Mullard LP1159 is a fully screened transistorised i.f. amplifier and mixer stage designed to cover the short, medium and long wave bands using external oscillator coils, which allows the user maximum flexibility in the choice of wave bands and frequency coverage.

The mixer stage uses an AF115 transistor which may be operated up to 13MHz on fundamental or 26MHz on second harmonic with suitable oscillator coils, tuning and coupling capacitors.

This stage is coupled to the first of two i.f. amplifiers by means of a double tuned i.f. transformer which achieves an adequate band width with extremely good skirt selectivity. In addition a damping diode is incorporated in this stage to extend the useful a.g.c. range.

The two stages of i.f. amplification using AF117 transistors are followed by an OA90 diode detector from which the filtered audio output is derived.

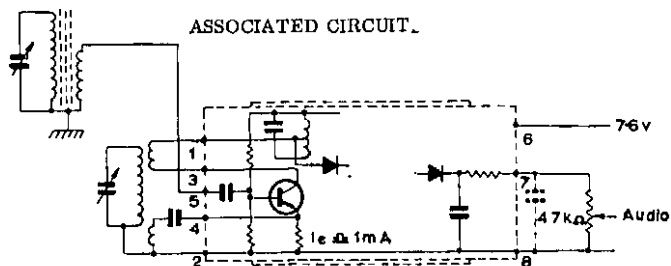
Particular attention has been paid to r.f. filtering within the module, the supply line being decoupled adjacent to the supply tag with further de-coupling for the mixer/oscillator stage. The audio output is filtered by a resistor capacitor network and the whole unit is enclosed in a metal screening box which is internally connected to the positive line.

Connection to the module is by means of eight tinned tags which may also be used to mount the module to a printed circuit board.

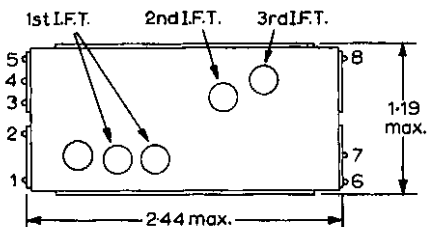
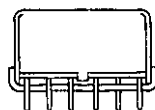
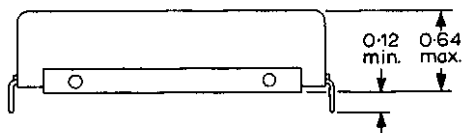
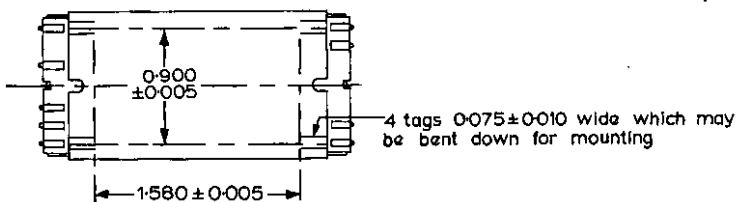
## PERFORMANCE

Sensitivity (at 470kHz for 50mV output. Input modulated 30% at 400Hz)	1.3 $\mu$ V $\pm$ 5dB
Bandwidth (at -6dB) typ.	6.0 kHz
Selectivity (at $\pm$ 9kHz from centre frequency) typ.	30 dB
A.G.C. range typ.	58 dB
Consumption approx.	3.3 mA

**NOTE** For the purpose of these tests, tags 1 and 4 are connected together and the mixer emitter is connected to earth via a 0.022 $\mu$ F capacitor. The audio output is measured across a 4.7k $\Omega$  load.

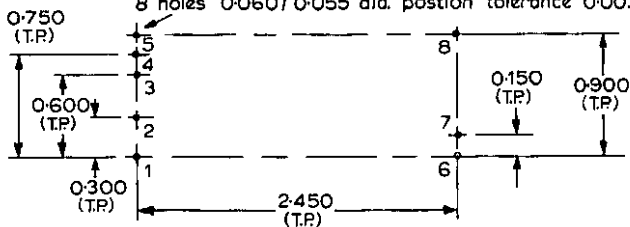


OUTLINE AND DIMENSIONS



Dimensions in inches

Clearance hole locations to accept connection tags  
8 holes 0.060/0.055 dia. position tolerance 0.003 dia.



B7177

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# I. F. MODULES

# LP1164 LP1165

Fully screened intermediate frequency modules for amplification and detection of f.m. signals at 10.7MHz and a.m. signals at 470kHz. The first stage is used as an i.f. amplifier for f.m. and a self-oscillating mixer for a.m. operation, in conjunction with an external oscillator coil.

	LP1164	LP1165	
Supply voltage	9.5	7.0	V
Supply current (approx.)	7.0	3.5	mA
A.M. operation			
Typical sensitivity for 50mV output	1.0	1.3	$\mu$ V
-6dB bandwidth	6.5	6.5	kHz
Attenuation at $\pm$ 9kHz	30	30	dB
F.M. operation			
Typical sensitivity for 30mV output	120	240	$\mu$ V
A.F. output at limiting	150	75	mV
-3dB bandwidth	300	300	kHz
Attenuation at $\pm$ 300kHz	35	35	dB

Further details may be obtained from the Consumer Electronics Division.



The Mullard LP1166 is a fully screened transistorised i.f. amplifier and mixer stage designed to cover the short, medium and long wave bands using external oscillator coils. The circuit connections have been arranged so that either inductively coupled or Colpitts oscillator circuits may be employed, thus allowing the user maximum flexibility in the choice of tuning components.

The mixer stage uses an AF115 transistor which may be operated up to 13MHz on fundamental or 26MHz on second harmonic with suitable oscillator coils, tuning and coupling capacitors. Two stages of i.f. amplification using AF117 transistors and single tuned i.f. transformers are followed by an OA90 diode detector.

Particular attention has been paid to r.f. filtering within the module, the supply line being decoupled adjacent to the supply tag with further decoupling for the mixer/oscillator stage. The audio output is filtered by a resistor capacitor network and the whole unit is enclosed in a metal box which may be connected to any suitable point of low r.f. potential.

Connection to the module is by means of eight tinned tags which may also be used to mount the module to a printed board.

#### PERFORMANCE

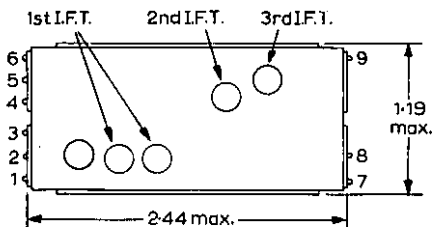
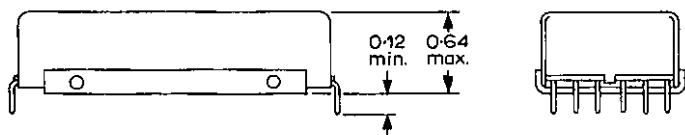
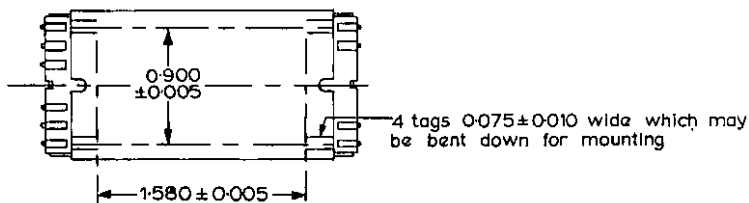
Sensitivity (at 470kHz for 50mV output. Input modulated 30% at 400Hz)	2.0 $\mu$ V $\pm$ 5dB
Bandwidth (at -6dB)	5.0 $\pm$ 1.0 kHz
Selectivity (at $\pm$ 9kHz from centre frequency)	> 22 dB
Consumption, approx.	3.3 mA

**NOTE** For the purpose of these tests the top end of the first i.f. transformer primary is connected to decoupled supply line and the mixer emitter is decoupled to tag 6 via a 0.022 $\mu$ F capacitor. The audio output is measured across a 4.7k $\Omega$  load.



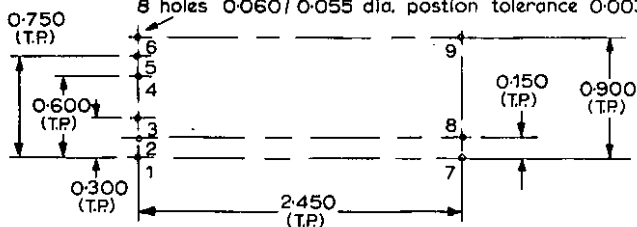


OUTLINE AND DIMENSIONS



Dimensions in Inches

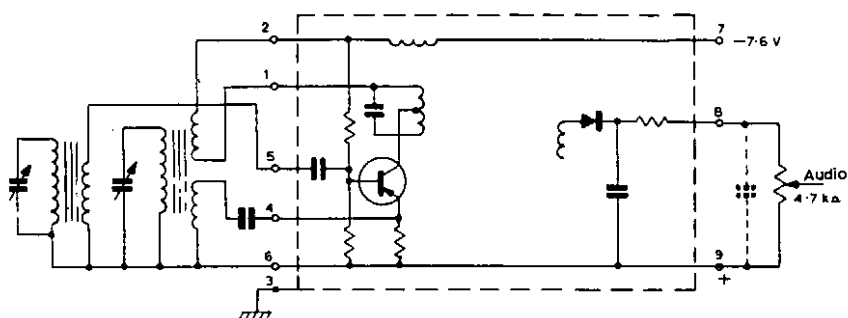
Clearance hole locations to accept connection tags  
8 holes 0.060 / 0.055 dia. position tolerance 0.003 dia.



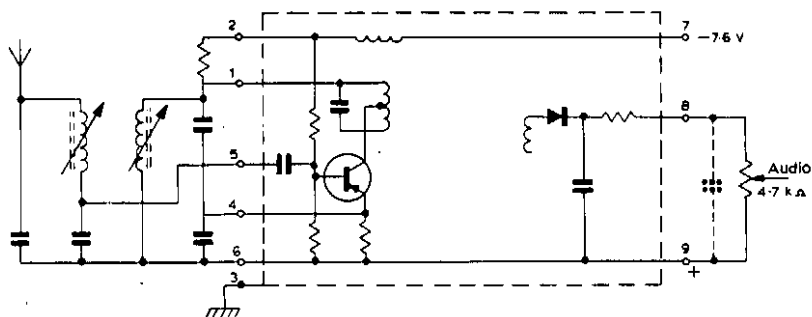
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## ASSOCIATED CIRCUITS



For use with inductively coupled oscillator circuits



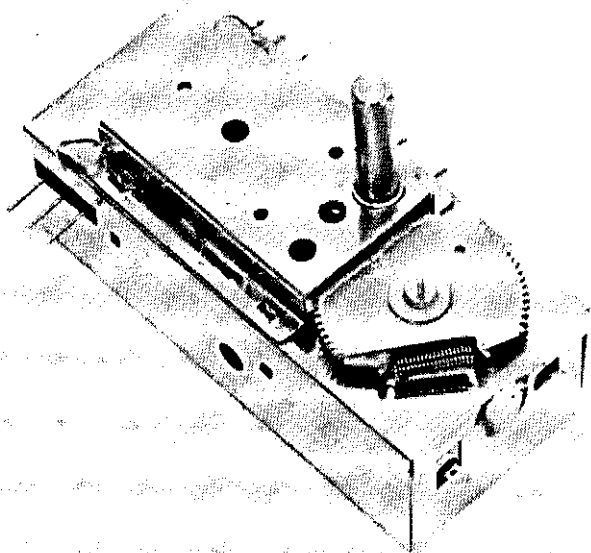
For use with Colpitts type oscillator circuits

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# F.M. TUNER MODULE

# LP1169

F. M. tuner module using silicon transistors, having a tuning capacitor incorporating a.m. sections, and intended for use with the LP1164, LP1165 and LP1171 a.m./f.m. modules.



## QUICK REFERENCE DATA

Supply voltage (nominal)	6.8	V
Frequency range	87.4 to 108	MHz
Power gain	30	dB

## DESIGN DATA

Negative supply voltage (nominal)	6.8	V
(maximum)	7.8	V
Supply current	3.5	mA
Aerial impedances	75 and 300	$\Omega$
I. F.	10.7	MHz
Output impedance	75	$\Omega$
A. F. C. at 100MHz	200	kHz/V
A. F. C. centre voltage	-6.8	V
A. F. C. polarity	positive going voltage change decreases oscillator frequency	
A.F.C. voltage range (maximum)	$\pm 2$	V

DESIGN DATA (cont'd)

A. M. capacitor (both sections are identical)

C min. (maximum)	9	pF
Capacitance swing	280	pF
Minimum trimmer swing	9	pF

PERFORMANCE

Measured with supply voltage of 6.8V and load impedance of 470Ω

Frequency range (see note 1)	87.4 to 108	MHz
I. F.	10.7MHz ± 50kHz	
Bandwidth to -3dB points	350	kHz
Power gain (measured at 100MHz) (typ.)	30	dB
(min.)	26	dB
Total gain variation over complete tuning range (max.)	8	dB
Noise factor at 100MHz (75Ω source) (max.)	8	dB
Image suppression (at 100MHz wanted signal) (nom.)	36	dB
I. F. rejection (at 100MHz wanted signal) (nom.)	54	dB
The oscillator will function at supply voltages	>4.5	V
Oscillator stability (worst case)		
with respect to supply voltage, a.f.c. disconnected	50	kHz/V
with respect to temperature, a.f.c. disconnected	20	kHz/degC

NOTE

- Setting accuracy ±0.2MHz at 87.4MHz, and ±0.5MHz at 108MHz.

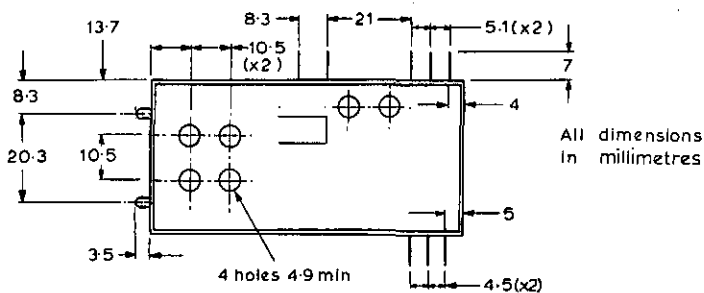
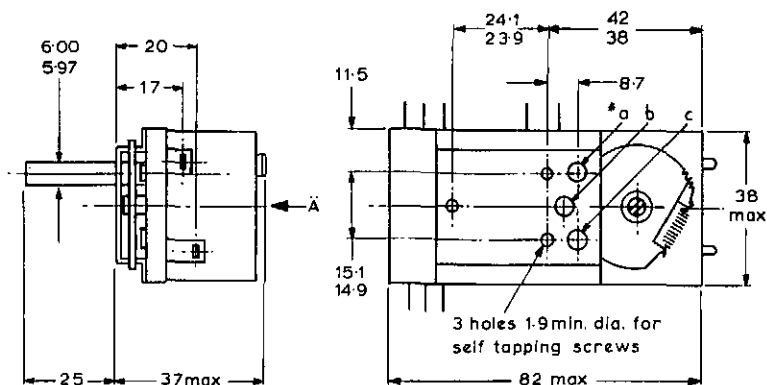
MECHANICAL DATA

Maximum torque on drive spindle	10	g m
Reduction gear (antibacklash type)	6.3:1	

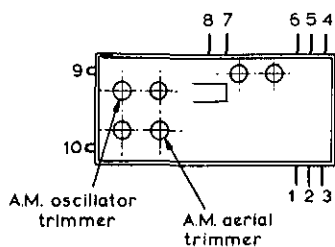
Drive shaft, 25mm long by 6mm diameter. Mounting is effected by means of three self-tapping screws, No. 2 type B to B.S. 4174.



## OUTLINE, DIMENSIONS AND CONNECTIONS



View in direction of arrow A



1. — 300  $\Omega$  Input
2. — 75  $\Omega$  Input
3. — 75 & 300  $\Omega$  Input
4. — -6.8 V Supply
5. — Output
6. — Output (earth)
7. — Positive supply & can
8. — A.F.C.
9. — A.M. oscillator capacitor
10. — A.M. aerial capacitor

\* LP1169/1 and LP1169/2 differ from LP1169 only in the position of the tuning shaft.

Type No	Position of spindle
LP1169	a
LP1169/1	b
LP1169/2	c

# A.M./F.M. I.F. AMPLIFIER MODULE

# LP1171

I.F. amplifier module including an a.m. oscillator coil. This unit is primarily intended for use in conjunction with the LP1169 f.m. tuner module.

## QUICK REFERENCE DATA

Supply voltage (nominal)	7	V
A.M. i.f.	470	kHz
F.M. i.f.	10.7	MHz

## DESIGN DATA

Positive supply voltage (nominal)	7	V
(maximum)	8	V
Supply current (no signal)	3.5	mA
I.F. (a.m.)	470 ± 2	kHz
(f.m.)	10.7MHz ± 50kHz	

## A.M. OPERATION

Optimum aerial source impedance		
200kHz	2	kΩ
1MHz	500	Ω
Oscillator coil inductance (nominal)	170	μH

When this module is used in conjunction with the tuner module LP1169, the medium wave tuning range is achieved with a padding capacitor of 270pF connected between the oscillator coil and the oscillator section of the tuning capacitor. Band-switching arrangements should include means of connecting a 100kΩ damping resistor across the oscillator coil on m.w. only.



## F.M. OPERATION

I. F. source impedance range	50 to 250	$\Omega$
Input impedance	470	$\Omega$
A. F. C. output polarity	input frequency rise produces positive going change in a. f. c. voltage	
A. F. C. centre voltage	0	V
A. F. C. sensitivity	600mV per 100kHz	
Audio load impedance (total)		
(a. m.) max.	10	k $\Omega$
min.	2.5	k $\Omega$
(f. m.) min.	2.5	k $\Omega$

## PERFORMANCE

Measured with supply voltage of 7V and load impedance of 4.7k $\Omega$ .

### A. M.

Bandwidth to -6dB points	6.5	kHz
Selectivity at $\pm 9$ kHz	30	dB
Sensitivity for 50mV output, 30% modulated		
m. w., 1MHz	1 $\mu$ V $\pm$ 6dB	
l. w., 200kHz	1.5 $\mu$ V $\pm$ 6dB	

### A. G. C.

Typically 6dB output change for 60dB input change

Signal to noise ratio (1MHz, 30% modulated, 1.5 $\mu$ V input)	10	dB
The oscillator will function at supply voltage	$\geq 4$	V

### F. M.

Bandwidth to -3dB points	300	kHz
Selectivity at $\pm 300$ kHz	35	dB
Sensitivity for 30mV output, 22.5kHz deviation	240 $\mu$ V $\pm$ 8dB	
Signal to noise ratio (240 $\mu$ V input, 22.5kHz deviation)	40	dB

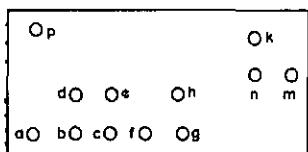
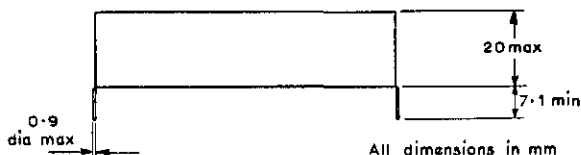
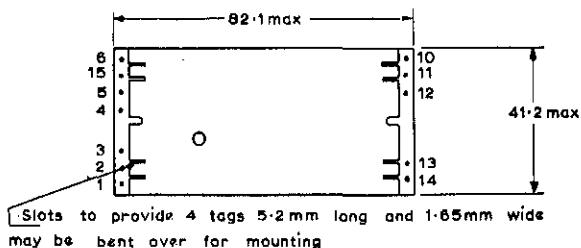
### A. M. rejection

Measured with a 10.7MHz carrier of 5mV amplitude, simultaneously modulated to 30% at 1kHz, and deviated to 22.5kHz at 400Hz. A. M. output typically 36dB below f. m. level.

Audio output at limiting (5mV input, 22.5kHz deviation at 400Hz)	75	mV
(with load of 100k $\Omega$ )	120	mV



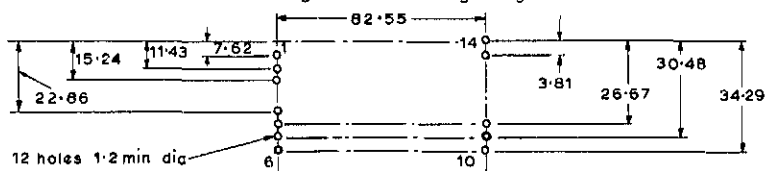
## OUTLINE AND DIMENSIONS



## Connections

- |                                |                            |
|--------------------------------|----------------------------|
| 1. Signal input                | a. A.M. oscillator coil    |
| 2. Tr1 collector               | b. A.M. 1st i.f. primary   |
| 3. F.M. coil, earthy end       | c. A.M. 1st i.f. secondary |
| 4. Earth                       | d. F.M. 2nd i.f. primary   |
| 5. Emitter Tr1, via capacitor  | e. F.M. 2nd i.f. secondary |
| 15. Oscillator coil primary    | f. F.M. 3rd i.f. primary   |
| 6. A.M. coil and damping diode | g. F.M. 3rd i.f. secondary |
| 10. Earth                      | h. A.M. 2nd i.f.           |
| 11. F.M. output                | k. A.M. 3rd i.f.           |
| 12. A.F.C. output              | m. Ratio detector          |
| 13. Positive supply            | n. Ratio detector          |
| 14. A.M. output                | p. -                       |

## Recommended Printed Wiring Board Piercing Diagram



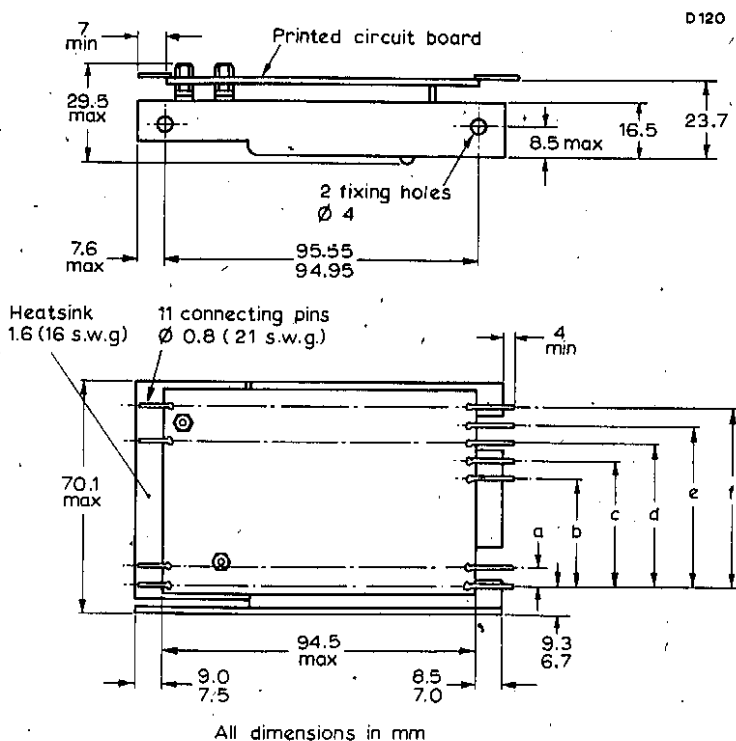


### QUICK REFERENCE DATA

Audio amplifier module intended for use in mains operated radio receivers and radiograms.

Output power, nominal	10	W
Supply voltage	+24	V
Load impedance (see note 1)	4	$\Omega$

### DIMENSIONS



Dimension	a	b	c	d	e	f
millimetres	5.08	35.56	40.64	45.72	50.8	55.88
inches	0.2	1.4	1.6	1.8	2	2.2

## MOUNTING

Vertically: there are two 4mm holes, 95.55mm (max.) apart, on the module flange for this purpose.

## ELECTRICAL DATA (typical values unless otherwise stated)

### Design

Supply voltage (absolute maximum)	+27	V
Supply voltage	+24	V
Supply current, 10W output	770	mA
no signal	68	mA
Load impedance (see note 1)	4	$\Omega$
Input impedance	40	k $\Omega$
Input voltage, 10W output, 4.7k $\Omega$ source impedance	130	mV
Temperature ratings		
storage	-40 to +70	$^{\circ}\text{C}$
maximum ambient	45	$^{\circ}\text{C}$

Note 1. The load impedance must be arranged to appear essentially resistive, by means of a Zobel network. This consists of a capacitor and resistor combination, the value of the resistor being equal to the loudspeaker resistance, and the capacitor value being determined by

$$C = \frac{L}{R^2}$$

where L is the loudspeaker inductance and R is its resistance. This network should be connected between pins 2 and 6.

### Performance

#### Frequency response

0.5W output, to -3dB points 50Hz to 16kHz

#### Total harmonic distortion

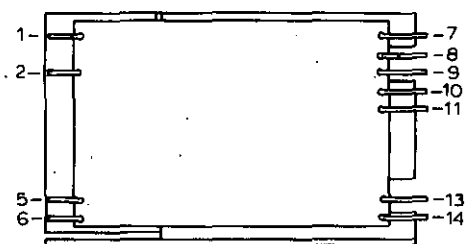
at 1kHz and 0.5W	0.2	%
at 1kHz and 10W	2	%

The voltage sensitivity of the module can be increased by connection of a resistor between pins 13 and 14, but this reduces the negative feedback; thus the frequency response will be reduced and the distortion increased.

## HANDLING NOTES

- The module may be soldered directly into circuit using a soldering iron, or solder bath, provided that the iron or solder temperature is below 245 $^{\circ}\text{C}$ , and the soldering time is less than 5 seconds.
- Care should be taken when bending pins that the printed circuit is not damaged.
- All soldering irons and signal supplies should be earthed to prevent breakdown of the transistors.
- Care must be taken to avoid a short circuit occurring across the output terminals, as this could cause permanent damage to the output transistors and associated resistors through excess dissipation.

## CONNECTIONS



### Pin No.

- |  |                                      |
|--|--------------------------------------|
| 1. Power supply positive input               | 8. } Tone control feedback resistors |
| 2. Zobel network connection point            | 9. }                                 |
| 5. Audio output                              | 10. }                                |
| 6. Negative supply and audio output (earthy) | 11. Audio input                      |
| 7. Power supply positive output              | 13. Emitter end of feedback resistor |
|  | 14. Input earth and negative supply  |

### Remarks

The heatsink is isolated electrically and would usually be connected to the supply negative. However, in some applications, it may be advantageous to leave it 'floating', or to connect it to the supply positive.

# VOLTAGE MULTIPLYING MODULES

# LP1174 Series

AVAILABLE FOR CURRENT PRODUCTION; NOT INTENDED FOR NEW DESIGNS

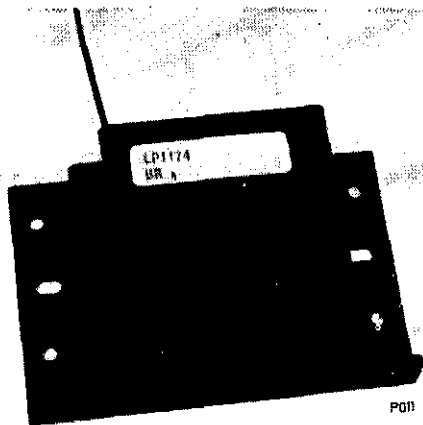
## QUICK REFERENCE DATA

The modules generate e.h.t. and focus voltage from line output pulses to supply colour picture tubes. To be used in conjunction with AT2055 or AT2056 line output transformers.

$V_{in}$ (peak-to-peak)	8.7	kV
$V_{out}$ (e.h.t. supply) (d.c.)	25	kV
$V_{out}$ (focus supply) (d.c.)	7.7	kV
$I_{out}$ (e.h.t. supply) (average)	1	mA
$I_{out}$ (focus supply) (average)	100	$\mu$ A

## MOUNTING PRECAUTIONS

A separation of at least 15mm between any part of the main module body or its leads and any metal parts of the receiver is essential to avoid any capacitive discharge current and detuning effects of the line output transformer. Mounting brackets must be confined to the module mounting flanges.



## TYPE NUMBER DESIGNATION

The LP1174/10, /20, /30 are based on five silicon rectifier diodes and four capacitors, in a cascade circuit to achieve 25kV output, and are suitable for tube applications. Types LP1174/20 and LP1174/30 are suitable for transistor applications. For circuit diagrams, see page 3.

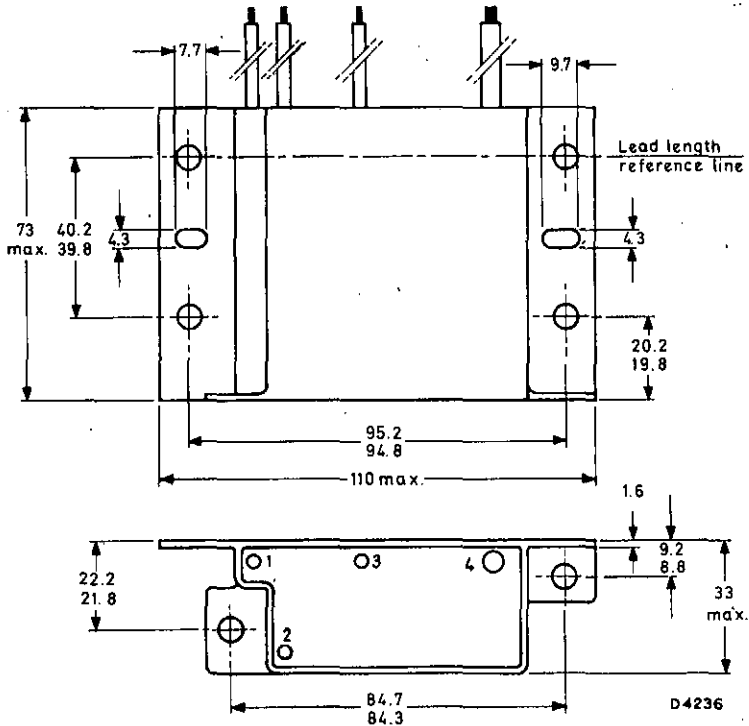
**Mullard**

## CASE AND TERMINATIONS

The modules are encapsulated in a flame retardant plastic case. Connections are by means of four flying leads, as shown below, and are flame retardant to IEC 197.

Lead No. 1	- input	15 cm
Lead No. 2	- earth	15 cm
Lead No. 3	- focus voltage	15 cm
Lead No. 4	- e.h.t. output	60 cm

## DIMENSIONS (millimetres)



## ELECTRICAL DATA

### Typical operation conditions

$v_{in}$	(peak-to-peak) (see note 1)	8.7	kV
$V_{out}$	(e.h.t. supply) (d.c.)	25	kV
$V_{out}$	(focus supply) (d.c.)	7.7	kV
$I_{out}$	(e.h.t. supply)	1	mA
$I_{out}$	(focus supply)	100	$\mu$ A
E.H.T. regulation (0 to 1.5mA)		1.3	M $\Omega$

# VOLTAGE MULTIPLYING MODULES

# LP1174 Series

## ELECTRICAL DATA (contd)

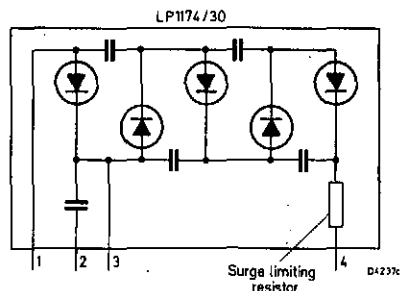
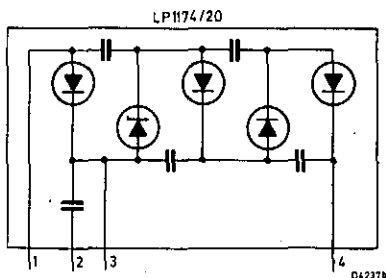
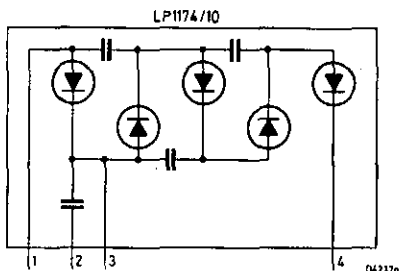
Limiting values - these are the absolute operating limits which must not be exceeded under any conditions.

$V_{in}$ (peak-to-peak)	10.5	kV
$V_{out}$ (e.h.t. supply) (d.c.) (see note 2)	31	kV
$I_{out}$ (e.h.t. + focus)	2	mA
$T_{amb}$	60	$^{\circ}C$

## NOTES

1. Maximum pulse duration 18% of one cycle.
2. This does not imply that the voltage rating for the final anode of the picture tube may be exceeded.

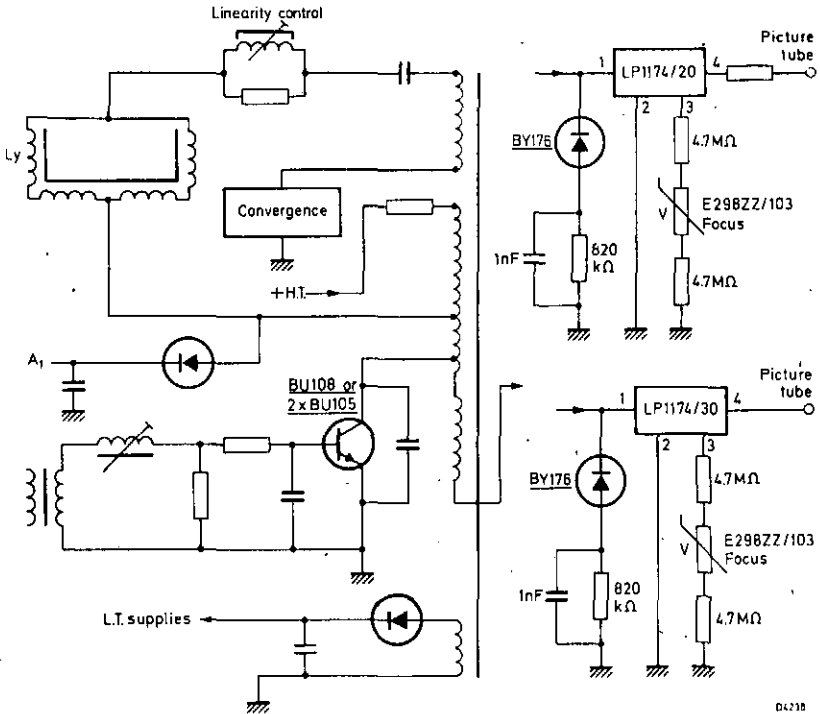
## CIRCUIT DIAGRAMS



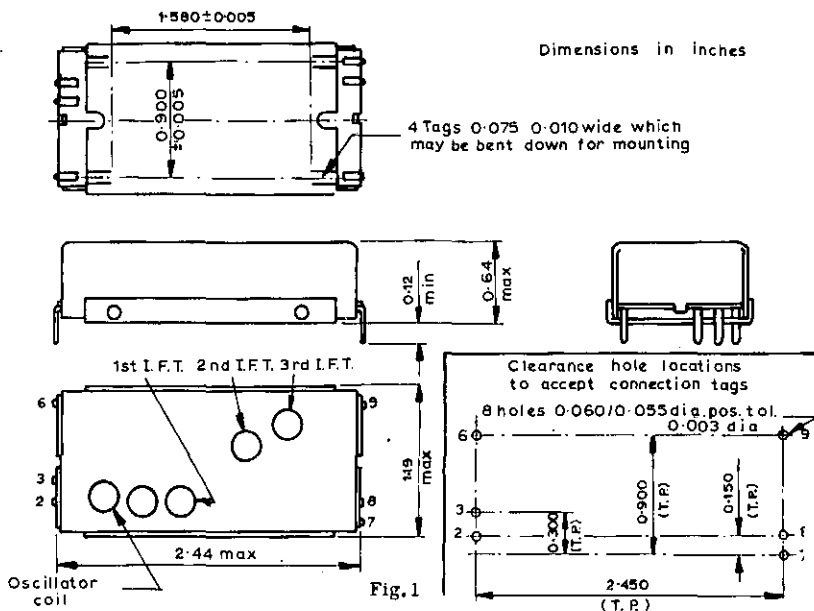
CIRCUIT DIAGRAMS (contd)

1. When using the LP1174/10 module, a 470Ω surge limiting resistor capable of withstanding high voltage must be connected in series with lead number 2.
2. When using the LP1174/20 module, a 47kΩ resistor capable of withstanding high voltage must be connected in series with the e. h. t. output lead 4.
3. LP1174/30 incorporates a surge limiting resistor.

APPLICATION CIRCUITS



04218



These three modules are similar to the i.f. Module LP1156 but include a long and medium wave oscillator coil matched to specific tuning capacitors.

The LP1155 covers the band 540kHz to 1640kHz when used with an oscillator tuning capacitance varying from 34 to 144pF. The LP1157 requires an oscillator tuning capacitance of 45 to 183pF and the LP1158 requires an oscillator tuning capacitance of 23 to 103pF, for example the Mullard capacitor AC1033. Two stages of i.f. amplification using AF117 transistors and single tuned coils are preceded by an AF115 mixer and followed by OA90 diode detector. Particular attention has been paid to r.f. filtering. The supply line is decoupled within the module adjacent to the supply tag with further decoupling between the oscillator and mixer stages. The audio output from the diode is filtered by a capacitor-resistor network.

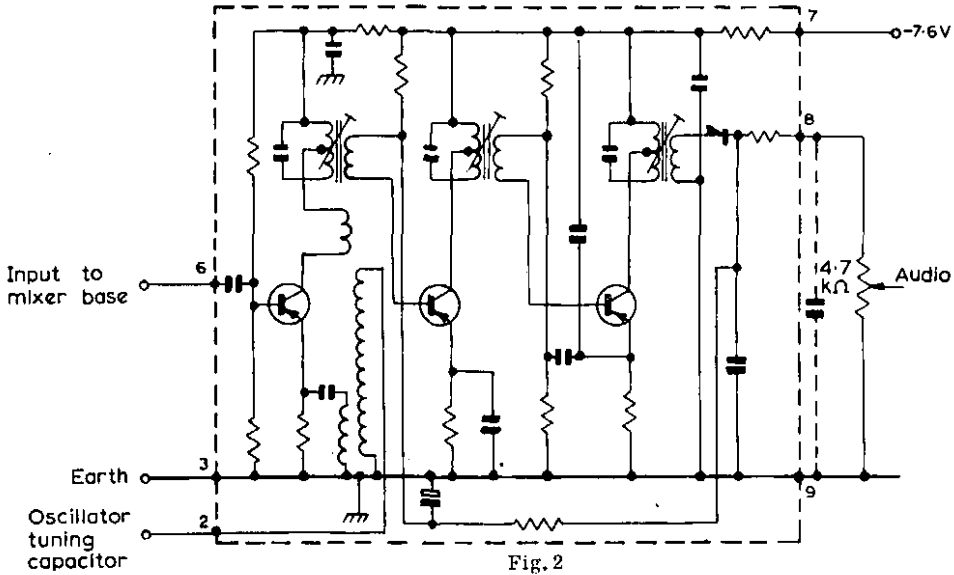
Connection to the module is by means of eight tinned brass tags which may also be used to mount the module to a printed board.

Four tags are also provided in the base of the can which may be bent down and used for additional mounting.



## CIRCUIT

The circuit diagram of the module is shown in Fig.2. The numbered connections in this diagram correspond to the tag numbers in Fig.1.



### CONNECTIONS

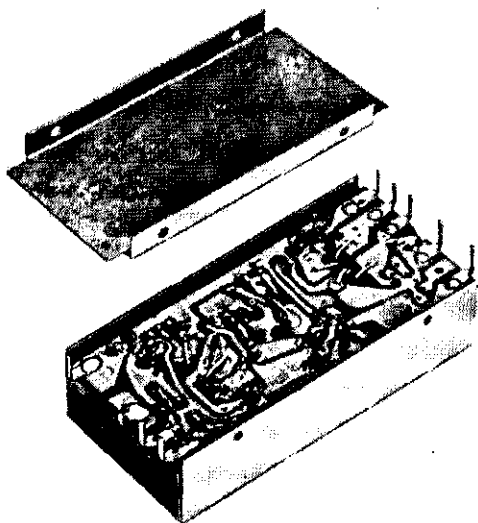
- |                                      |                        |
|--------------------------------------|------------------------|
| 1. -                                 | 6. Input to mixer base |
| 2. Oscillator section of tuning gang | 7. -7.6V supply        |
| 3. Earth                             | 8. Audio output        |
| 4. -                                 | 9. Earth               |
| 5. -                                 |                        |

### PERFORMANCE

These figures are based on initial production and may be amended. They are based on a supply voltage measured at the module of -7.6V.

- Sensitivity: Input =  $2.0\mu\text{V} \pm 6.0\text{dB}$  at 1.0MHz for 50mV audio output. The input is modulated 30% at 400Hz. The output is measured across a 4.7kΩ load.
- Bandwidth: 5.0kHz  $\pm$  1.0kHz at 6.0dB attenuation.
- Selectivity: Greater than 22dB at  $\pm 9.0\text{kHz}$  from centre frequency.
- Consumption: Approx. 3.3mA.





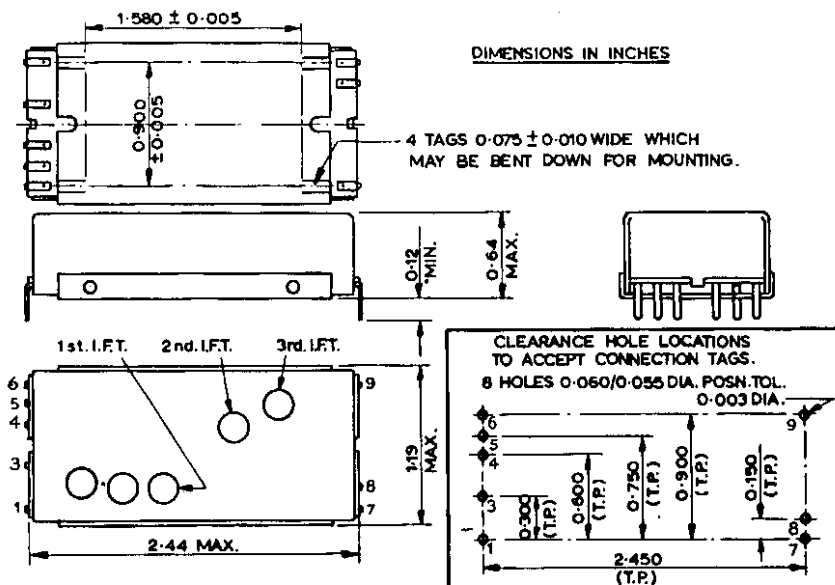
The Mullard LP 1156 i.f. module has been designed to have the widest possible application in a.m. radio receivers. It consists of a mixer stage followed by two i.f. stages and as the oscillator coil is not included in the module, the user may make his own choice of tuning components and frequency coverage.

The mixer stage uses an AF115 transistor and may be operated up to 13 Mc/s on oscillator fundamental or up to 26 Mc/s on second harmonic with suitable oscillator coils, tuning and coupling capacitors. Two stages of i.f. amplification using AF117 transistors and single tuned i.f. transformers are followed by an OA90 diode detector. Particular attention has been paid to r.f. filtering and screening. The supply line is decoupled within the module adjacent to the supply tag with further decoupling between the oscillator and mixer stages. The audio output from the diode is filtered by a capacitor resistor network and the whole unit is enclosed in a metal box.

Connection to the module is by means of eight tinned brass tags which may also be used to mount the module to a printed board.

Four tags are also provided in the base of the can which may be bent down and used for additional mounting.





## Performance

These figures are based on initial production and may be amended. For the purpose of these tests, the mixer collector is joined to the primary tap of the first I.F.T. (tag 4 joined to tag 1); the mixer emitter (tag 5) is decoupled to earth via a 0.022 $\mu$ F capacitor; the audio output is measured across a 4.7K $\Omega$  load; and the supply voltage is set to 7.6V.

- (a) Sensitivity 2.4 $\mu$ V  $\pm$  5dB at 470 Kc/s for 50mV output. The input is modulated 30% at 400~
- (b) Bandwidth 5.0 Kc/s  $\pm$  1.0 Kc/s at 6dB attenuation
- (c) Selectivity Greater than 22dB at  $\pm$  9 Kc/s from centre frequency
- (d) Consumption Approx. 3.3 mA. under no signal conditions

The Mullard LP1159 is a fully screened transistorised i.f. amplifier and mixer stage designed to cover the short, medium and long wave bands using external oscillator coils, which allows the user maximum flexibility in the choice of wave bands and frequency coverage.

The mixer stage uses an AF115 transistor which may be operated up to 13MHz on fundamental or 26MHz on second harmonic with suitable oscillator coils, tuning and coupling capacitors.

This stage is coupled to the first of two i.f. amplifiers by means of a double tuned i.f. transformer which achieves an adequate band width with extremely good skirt selectivity. In addition a damping diode is incorporated in this stage to extend the useful a.g.c. range.

The two stages of i.f. amplification using AF117 transistors are followed by an OA90 diode detector from which the filtered audio output is derived.

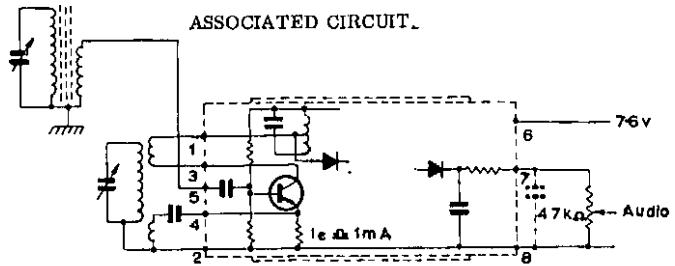
Particular attention has been paid to r.f. filtering within the module, the supply line being decoupled adjacent to the supply tag with further de-coupling for the mixer/oscillator stage. The audio output is filtered by a resistor capacitor network and the whole unit is enclosed in a metal screening box which is internally connected to the positive line.

Connection to the module is by means of eight tinned tags which may also be used to mount the module to a printed circuit board.

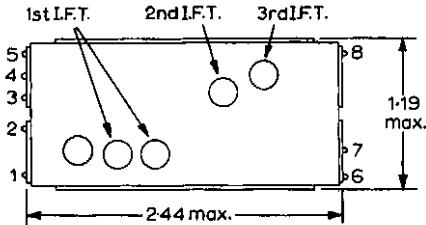
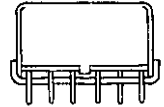
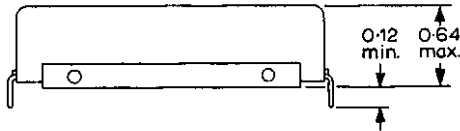
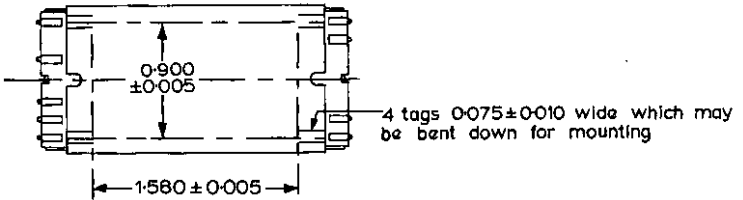
## PERFORMANCE

Sensitivity (at 470kHz for 50mV output. Input modulated 30% at 400Hz)	1.3 $\mu$ V $\pm$ 5dB
Bandwidth (at -6dB) typ.	6.0 kHz
Selectivity (at $\pm$ 9kHz from centre frequency) typ.	30 dB
A.G.C. range typ.	58 dB
Consumption approx.	3.3 mA

**NOTE** For the purpose of these tests, tags 1 and 4 are connected together and the mixer emitter is connected to earth via a 0.022 $\mu$ F capacitor. The audio output is measured across a 4.7k $\Omega$  load.

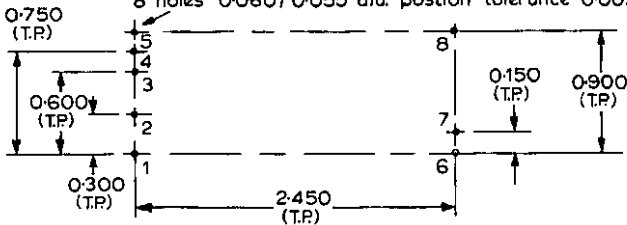


**OUTLINE AND DIMENSIONS**



Dimensions in inches

Clearance hole locations to accept connection tags  
8 holes 0.060/0.055 dia. position tolerance 0.003 dia.



**B7177**

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# I. F. MODULES

# LP1164 LP1165

Fully screened intermediate frequency modules for amplification and detection of f.m. signals at 10.7MHz and a.m. signals at 470kHz. The first stage is used as an i.f. amplifier for f.m. and a self-oscillating mixer for a.m. operation, in conjunction with an external oscillator coil.

	LP1164	LP1165	
Supply voltage	9.5	7.0	V
Supply current (approx.)	7.0	3.5	mA
A.M. operation			
Typical sensitivity for 50mV output	1.0	1.3	$\mu$ V
-6dB bandwidth	6.5	6.5	kHz
Attenuation at $\pm$ 9kHz	30	30	dB
F.M. operation			
Typical sensitivity for 30mV output	120	240	$\mu$ V
A.F. output at limiting	150	75	mV
-3dB bandwidth	300	300	kHz
Attenuation at $\pm$ 300kHz	35	35	dB

Further details may be obtained from the Consumer Electronics Division.



The Mullard LP1166 is a fully screened transistorised i.f. amplifier and mixer stage designed to cover the short, medium and long wave bands using external oscillator coils. The circuit connections have been arranged so that either inductively coupled or Colpitts oscillator circuits may be employed, thus allowing the user maximum flexibility in the choice of tuning components.

The mixer stage uses an AF115 transistor which may be operated up to 13MHz on fundamental or 26MHz on second harmonic with suitable oscillator coils, tuning and coupling capacitors. Two stages of i.f. amplification using AF117 transistors and single tuned i.f. transformers are followed by an OA90 diode detector.

Particular attention has been paid to r.f. filtering within the module, the supply line being decoupled adjacent to the supply tag with further decoupling for the mixer/oscillator stage. The audio output is filtered by a resistor capacitor network and the whole unit is enclosed in a metal box which may be connected to any suitable point of low r.f. potential.

Connection to the module is by means of eight tinned tags which may also be used to mount the module to a printed board.

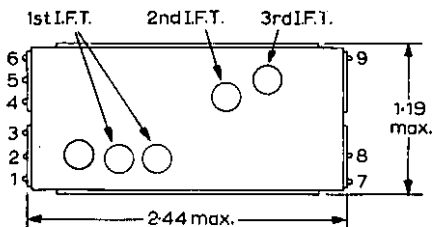
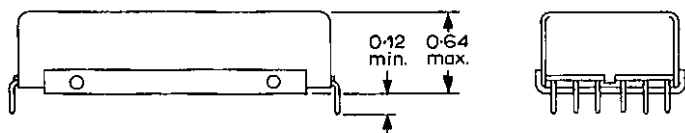
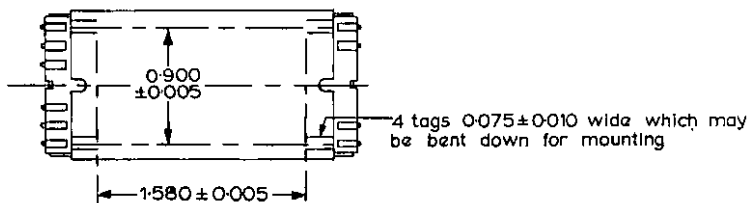
### PERFORMANCE

Sensitivity (at 470kHz for 50mV output. Input modulated 30% at 400Hz)	2.0 $\mu$ V $\pm$ 5dB
Bandwidth (at -6dB)	5.0 $\pm$ 1.0 kHz
Selectivity (at $\pm$ 9kHz from centre frequency)	> 22 dB
Consumption, approx.	3.3 mA

**NOTE** For the purpose of these tests the top end of the first i.f. transformer primary is connected to decoupled supply line and the mixer emitter is decoupled to tag 6 via a 0.022 $\mu$ F capacitor. The audio output is measured across a 4.7k $\Omega$  load.

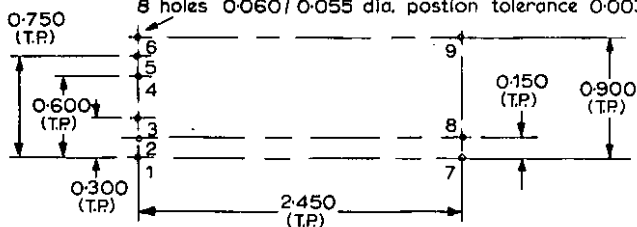


OUTLINE AND DIMENSIONS



Dimensions in Inches

Clearance hole locations to accept connection tags  
8 holes 0.060 / 0.055 dia. position tolerance 0.003 dia.

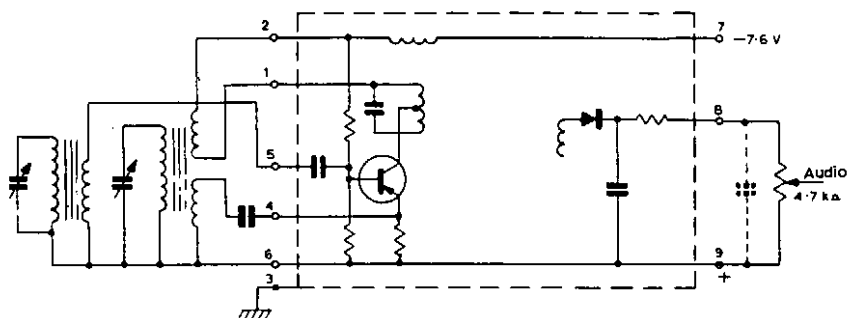


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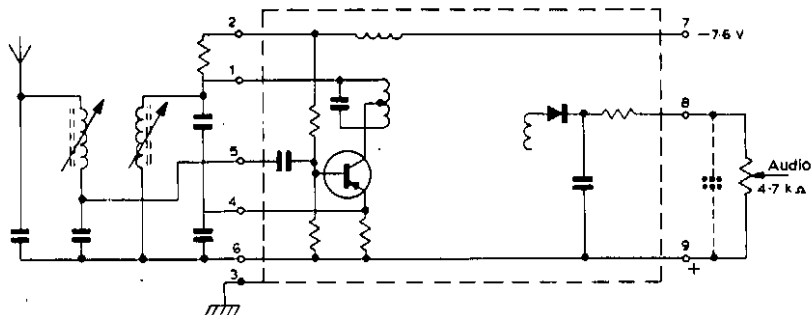




## ASSOCIATED CIRCUITS



For use with inductively coupled oscillator circuits



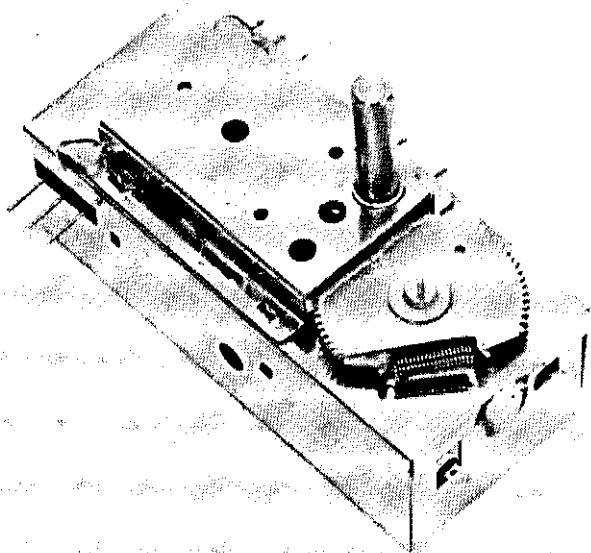
For use with Colpitts type oscillator circuits

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# F.M. TUNER MODULE

# LP1169

F. M. tuner module using silicon transistors, having a tuning capacitor incorporating a.m. sections, and intended for use with the LP1164, LP1165 and LP1171 a.m./f.m. modules.



## QUICK REFERENCE DATA

Supply voltage (nominal)	6.8	V
Frequency range	87.4 to 108	MHz
Power gain	30	dB

## DESIGN DATA

Negative supply voltage (nominal)	6.8	V
(maximum)	7.8	V
Supply current	3.5	mA
Aerial impedances	75 and 300	$\Omega$
I. F.	10.7	MHz
Output impedance	75	$\Omega$
A. F. C. at 100MHz	200	kHz/V
A. F. C. centre voltage	-6.8	V
A. F. C. polarity	positive going voltage change decreases oscillator frequency	
A.F.C. voltage range (maximum)	$\pm 2$	V

DESIGN DATA (cont'd)

A. M. capacitor (both sections are identical)

C min. (maximum)	9	pF
Capacitance swing	280	pF
Minimum trimmer swing	9	pF

PERFORMANCE

Measured with supply voltage of 6.8V and load impedance of 470Ω

Frequency range (see note 1)	87.4 to 108	MHz
I. F.	10.7MHz ± 50kHz	
Bandwidth to -3dB points	350	kHz
Power gain (measured at 100MHz) (typ.)	30	dB
(min.)	26	dB
Total gain variation over complete tuning range (max.)	8	dB
Noise factor at 100MHz (75Ω source) (max.)	8	dB
Image suppression (at 100MHz wanted signal) (nom.)	36	dB
I. F. rejection (at 100MHz wanted signal) (nom.)	54	dB
The oscillator will function at supply voltages	>4.5	V
Oscillator stability (worst case)		
with respect to supply voltage, a.f.c. disconnected	50	kHz/V
with respect to temperature, a.f.c. disconnected	20	kHz/degC

NOTE

- Setting accuracy ±0.2MHz at 87.4MHz, and ±0.5MHz at 108MHz.

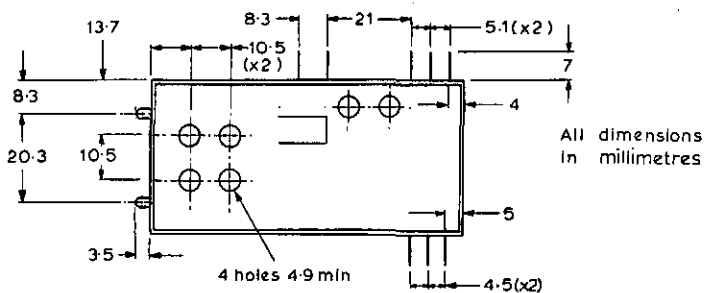
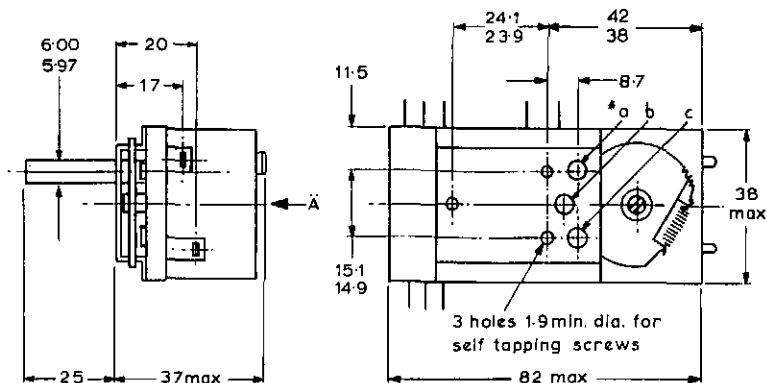
MECHANICAL DATA

Maximum torque on drive spindle	10	g m
Reduction gear (antibacklash type)	6.3:1	

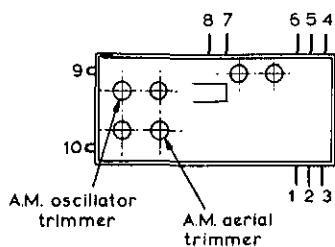
Drive shaft, 25mm long by 6mm diameter. Mounting is effected by means of three self-tapping screws, No. 2 type B to B.S. 4174.



## OUTLINE, DIMENSIONS AND CONNECTIONS



View in direction of arrow A



1. — 300  $\Omega$  Input
2. — 75  $\Omega$  Input
3. — 75 & 300  $\Omega$  Input
4. — -6.8 V Supply
5. — Output
6. — Output (earth)
7. — Positive supply & can
8. — A.F.C.
9. — A.M. oscillator capacitor
10. — A.M. aerial capacitor

\* LP1169/1 and LP1169/2 differ from LP1169 only in the position of the tuning shaft.

Type No	Position of spindle
LP1169	a
LP1169/1	b
LP1169/2	c

# A.M./F.M. I.F. AMPLIFIER MODULE

# LP1171

I.F. amplifier module including an a.m. oscillator coil. This unit is primarily intended for use in conjunction with the LP1169 f.m. tuner module.

## QUICK REFERENCE DATA

Supply voltage (nominal)	7	V
A.M. i.f.	470	kHz
F.M. i.f.	10.7	MHz

## DESIGN DATA

Positive supply voltage (nominal)	7	V
(maximum)	8	V
Supply current (no signal)	3.5	mA
I.F. (a.m.)	470 ± 2	kHz
(f.m.)	10.7MHz ± 50kHz	

## A.M. OPERATION

Optimum aerial source impedance		
200kHz	2	kΩ
1MHz	500	Ω
Oscillator coil inductance (nominal)	170	μH

When this module is used in conjunction with the tuner module LP1169, the medium wave tuning range is achieved with a padding capacitor of 270pF connected between the oscillator coil and the oscillator section of the tuning capacitor. Band-switching arrangements should include means of connecting a 100kΩ damping resistor across the oscillator coil on m.w. only.



## F.M. OPERATION

I. F. source impedance range	50 to 250	$\Omega$
Input impedance	470	$\Omega$
A. F. C. output polarity	input frequency rise produces positive going change in a. f. c. voltage	
A. F. C. centre voltage	0	V
A. F. C. sensitivity	600mV per 100kHz	
Audio load impedance (total)		
(a. m.) max.	10	k $\Omega$
min.	2.5	k $\Omega$
(f. m.) min.	2.5	k $\Omega$

## PERFORMANCE

Measured with supply voltage of 7V and load impedance of 4.7k $\Omega$ .

### A. M.

Bandwidth to -6dB points	6.5	kHz
Selectivity at $\pm 9$ kHz	30	dB
Sensitivity for 50mV output, 30% modulated		
m. w., 1MHz	1 $\mu$ V $\pm$ 6dB	
l. w., 200kHz	1.5 $\mu$ V $\pm$ 6dB	

### A. G. C.

Typically 6dB output change for 60dB input change

Signal to noise ratio (1MHz, 30% modulated, 1.5 $\mu$ V input)	10	dB
The oscillator will function at supply voltage	$\geq 4$	V

### F. M.

Bandwidth to -3dB points	300	kHz
Selectivity at $\pm 300$ kHz	35	dB
Sensitivity for 30mV output, 22.5kHz deviation	240 $\mu$ V $\pm$ 8dB	
Signal to noise ratio (240 $\mu$ V input, 22.5kHz deviation)	40	dB

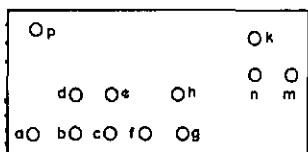
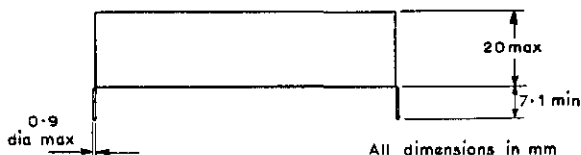
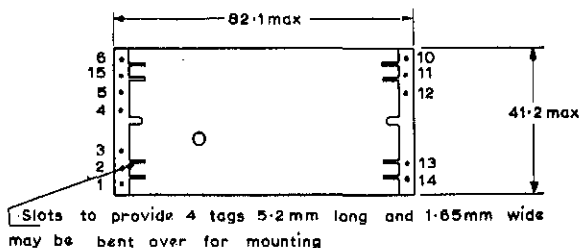
### A. M. rejection

Measured with a 10.7MHz carrier of 5mV amplitude, simultaneously modulated to 30% at 1kHz, and deviated to 22.5kHz at 400Hz. A. M. output typically 36dB below f. m. level.

Audio output at limiting (5mV input, 22.5kHz deviation at 400Hz)	75	mV
(with load of 100k $\Omega$ )	120	mV



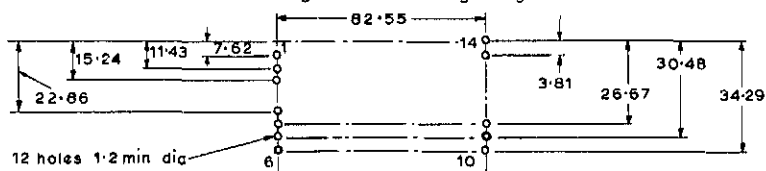
## OUTLINE AND DIMENSIONS



## Connections

- |                                |                            |
|--------------------------------|----------------------------|
| 1. Signal input                | a. A.M. oscillator coil    |
| 2. Tr1 collector               | b. A.M. 1st i.f. primary   |
| 3. F.M. coil, earthy end       | c. A.M. 1st i.f. secondary |
| 4. Earth                       | d. F.M. 2nd i.f. primary   |
| 5. Emitter Tr1, via capacitor  | e. F.M. 2nd i.f. secondary |
| 15. Oscillator coil primary    | f. F.M. 3rd i.f. primary   |
| 6. A.M. coil and damping diode | g. F.M. 3rd i.f. secondary |
| 10. Earth                      | h. A.M. 2nd i.f.           |
| 11. F.M. output                | k. A.M. 3rd i.f.           |
| 12. A.F.C. output              | m. Ratio detector          |
| 13. Positive supply            | n. Ratio detector          |
| 14. A.M. output                | p. -                       |

## Recommended Printed Wiring Board Piercing Diagram

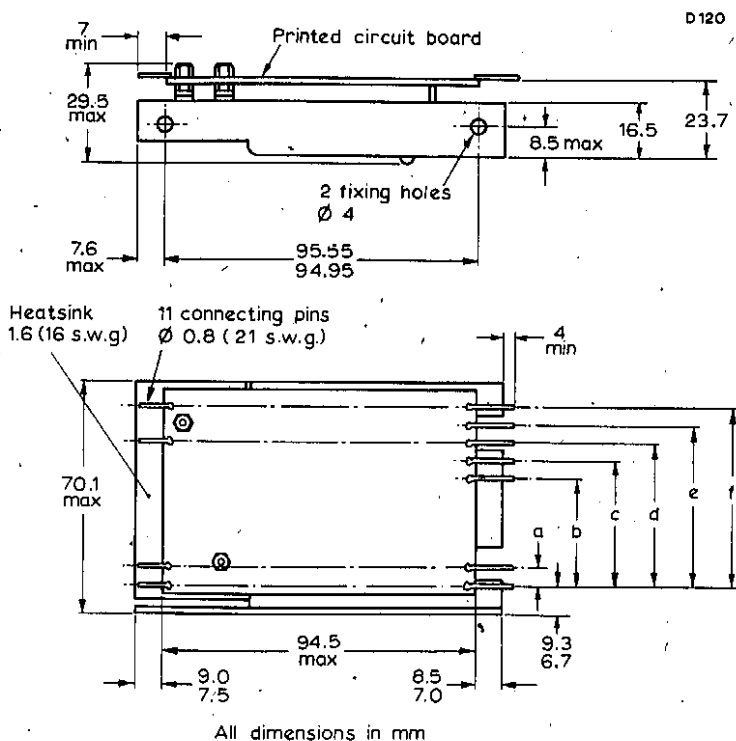


### QUICK REFERENCE DATA

Audio amplifier module intended for use in mains operated radio receivers and radiograms.

Output power, nominal	10	W
Supply voltage	+24	V
Load impedance (see note 1)	4	$\Omega$

### DIMENSIONS



All dimensions in mm

Dimension	a	b	c	d	e	f
millimetres	5.08	35.56	40.64	45.72	50.8	55.88
inches	0.2	1.4	1.6	1.8	2	2.2



## MOUNTING

Vertically: there are two 4mm holes, 95.55mm (max.) apart, on the module flange for this purpose.

## ELECTRICAL DATA (typical values unless otherwise stated)

### Design

Supply voltage (absolute maximum)	+27	V
Supply voltage	+24	V
Supply current, 10W output	770	mA
no signal	68	mA
Load impedance (see note 1)	4	$\Omega$
Input impedance	40	k $\Omega$
Input voltage, 10W output, 4.7k $\Omega$ source impedance	130	mV
Temperature ratings		
storage	-40 to +70	$^{\circ}\text{C}$
maximum ambient	45	$^{\circ}\text{C}$

Note 1. The load impedance must be arranged to appear essentially resistive, by means of a Zobel network. This consists of a capacitor and resistor combination, the value of the resistor being equal to the loudspeaker resistance, and the capacitor value being determined by

$$C = \frac{L}{R^2}$$

where L is the loudspeaker inductance and R is its resistance. This network should be connected between pins 2 and 6.

### Performance

#### Frequency response

0.5W output, to -3dB points 50Hz to 16kHz

#### Total harmonic distortion

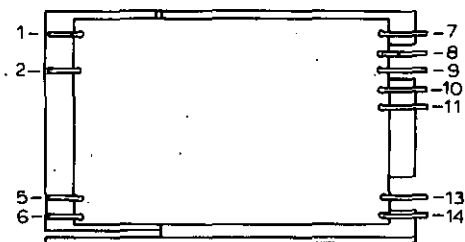
at 1kHz and 0.5W	0.2	%
at 1kHz and 10W	2	%

The voltage sensitivity of the module can be increased by connection of a resistor between pins 13 and 14, but this reduces the negative feedback; thus the frequency response will be reduced and the distortion increased.

## HANDLING NOTES

- The module may be soldered directly into circuit using a soldering iron, or solder bath, provided that the iron or solder temperature is below 245 $^{\circ}\text{C}$ , and the soldering time is less than 5 seconds.
- Care should be taken when bending pins that the printed circuit is not damaged.
- All soldering irons and signal supplies should be earthed to prevent breakdown of the transistors.
- Care must be taken to avoid a short circuit occurring across the output terminals, as this could cause permanent damage to the output transistors and associated resistors through excess dissipation.

## CONNECTIONS



### Pin No.

- |  |                                      |
|--|--------------------------------------|
| 1. Power supply positive input               | 8. } Tone control feedback resistors |
| 2. Zobel network connection point            | 9. }                                 |
| 5. Audio output                              | 10. }                                |
| 6. Negative supply and audio output (earthy) | 11. Audio input                      |
| 7. Power supply positive output              | 13. Emitter end of feedback resistor |
|  | 14. Input earth and negative supply  |

### Remarks

The heatsink is isolated electrically and would usually be connected to the supply negative. However, in some applications, it may be advantageous to leave it 'floating', or to connect it to the supply positive.

# VOLTAGE MULTIPLYING MODULES

# LP1174 Series

AVAILABLE FOR CURRENT PRODUCTION; NOT INTENDED FOR NEW DESIGNS

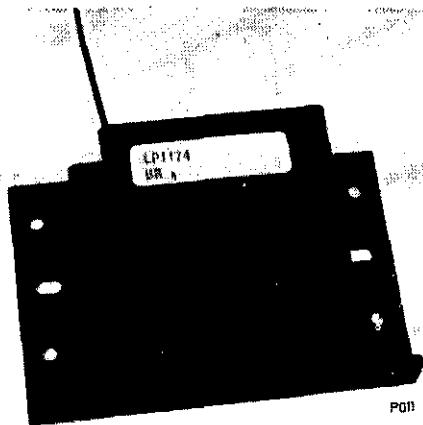
## QUICK REFERENCE DATA

The modules generate e.h.t. and focus voltage from line output pulses to supply colour picture tubes. To be used in conjunction with AT2055 or AT2056 line output transformers.

$v_{in}$ (peak-to-peak)	8.7	kV
$V_{out}$ (e.h.t. supply) (d.c.)	25	kV
$V_{out}$ (focus supply) (d.c.)	7.7	kV
$I_{out}$ (e.h.t. supply) (average)	1	mA
$I_{out}$ (focus supply) (average)	100	$\mu$ A

## MOUNTING PRECAUTIONS

A separation of at least 15mm between any part of the main module body or its leads and any metal parts of the receiver is essential to avoid any capacitive discharge current and detuning effects of the line output transformer. Mounting brackets must be confined to the module mounting flanges.



## TYPE NUMBER DESIGNATION

The LP1174/10, /20, /30 are based on five silicon rectifier diodes and four capacitors, in a cascade circuit to achieve 25kV output, and are suitable for tube applications. Types LP1174/20 and LP1174/30 are suitable for transistor applications. For circuit diagrams, see page 3.

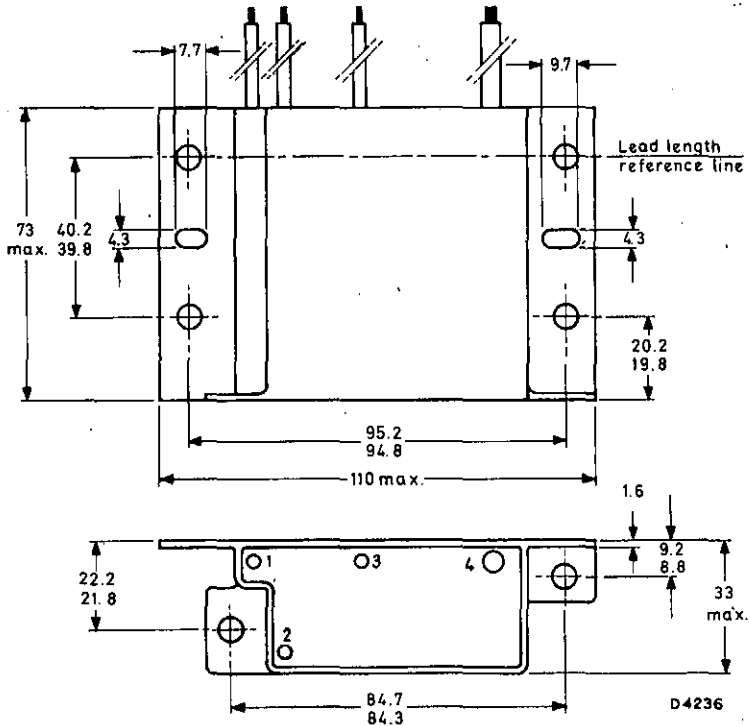
**Mullard**

## CASE AND TERMINATIONS

The modules are encapsulated in a flame retardant plastic case. Connections are by means of four flying leads, as shown below, and are flame retardant to IEC 197.

Lead No. 1	- input	15 cm
Lead No. 2	- earth	15 cm
Lead No. 3	- focus voltage	15 cm
Lead No. 4	- e.h.t. output	60 cm

## DIMENSIONS (millimetres)



## ELECTRICAL DATA

### Typical operation conditions

$v_{in}$	(peak-to-peak) (see note 1)	8.7	kV
$V_{out}$	(e.h.t. supply) (d.c.)	25	kV
$V_{out}$	(focus supply) (d.c.)	7.7	kV
$I_{out}$	(e.h.t. supply)	1	mA
$I_{out}$	(focus supply)	100	$\mu$ A
E.H.T. regulation (0 to 1.5mA)		1.3	M $\Omega$

# VOLTAGE MULTIPLYING MODULES

# LP1174 Series

## ELECTRICAL DATA (contd)

Limiting values - these are the absolute operating limits which must not be exceeded under any conditions.

$V_{in}$ (peak-to-peak)	10.5	kV
$V_{out}$ (e.h.t. supply) (d.c.) (see note 2)	31	kV
$I_{out}$ (e.h.t. + focus)	2	mA
$T_{amb}$	60	$^{\circ}C$

## NOTES

1. Maximum pulse duration 18% of one cycle.
2. This does not imply that the voltage rating for the final anode of the picture tube may be exceeded.

## CIRCUIT DIAGRAMS

