



Fig. 5. Performance characteristics of complete amplifier.

- Curve A 0dB feedback 0.16V r.m.s. input—U-L connection  
 Curve B 10dB feedback 0.11V r.m.s. input—pentode connection  
 Curve C 10dB feedback 0.38V r.m.s. input—U-L connection  
 Curve D 0dB feedback 0.25V r.m.s. input—pentode connection  
 Curve E 10dB feedback 0.80V r.m.s. input—triode connection  
 Curve F 10dB feedback 0.40V r.m.s. input—pentode connection

Maximum output watts with harmonic distortion less than 1%:

Transformer Connection	Replacement Triode		Transf. Pentode		LS-55 Transformer U-L		Pentode	
	0dB	10dB	0dB	10dB	0dB	10dB	0dB	10dB
30 c/s	0.1	0.5	0.1	0.5	12	18	10	15
100 c/s	1	6	1	8	12	18	12	15
1,000 c/s	3	6	3	8	12	18	12	15
10 kc/s	3	6	3	8	12	18	12	15

Note: Increase in feedback from 10 to 20dB with increase in input voltage of approx. x3 changes output characteristics less than 1dB with LS-55 transformer and less than 2dB with the replacement transformer.

is shown in the photographs. As may be surmised, neither construction, layout, nor wiring is critical in any sense. The —105volt supply required for the cathodes of the l.t.c.p. stage is an exceptional requirement, but it is easily met by a simple modification of a conventional power supply, as shown in the wiring diagram of Fig. 4. Since each d.c. connection to the amplifier is to a symmetrical and balanced load, isolation, hum and ripple filter can be quite simple.

The output stage cathode bias scheme shown is simple and effective for providing final stage balance, but it is not in any way a special feature—the Williamson-type network should be equally effective. The cathode bypass condenser in this stage is not necessary either, but the author prefers to use it since it tends to reduce distortion if and when the output tubes, by ageing or for other reasons, depart from perfect balance. No provision has been made for static balance of anode currents in this stage, since the author's experience and tests indicate that dynamic balance will produce lower distortion, and that dynamic and static balance frequently occur at different bias adjustment settings.

The "long-tailed cascode pair," by eliminating one inter-stage coupling without reducing gain or seriously complicating the power supply requirements of the conventional power amplifier system, makes the use of output transformers of non-critical

design consistent with high quality and exceptional stability. With a real "dog" for an output transformer, this "tail" will wag it so that it will perform like a thoroughbred!

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## COMMERCIAL LITERATURE

**A.M./F.M. Signal Generators**, an e.h.f. spectrum analyser, a v.h.f. alignment oscilloscope, s.h.f. and v.h.f. wavemeters, a counter-type frequency meter, and an f.m. station monitor are among the 25 new instruments described in the Marconi Instruments 1956 "Electronic Measurement" catalogue. From the company's address at Long-acres, St. Albans, Herts.

**Voltage Stabilizers**; a.c. for output currents of 0-9A and 0-30A at mains voltage; and d.c. with outputs of 0-7A, 1-30V and 0-2.5A, 1-15V. These and other electrical control instruments described in a 1956 general catalogue from Servomex Controls, Crowborough Hill, Jarvis Brook, Sussex. Also a data sheet on an i.f. waveform generator suitable for testing servo mechanisms, etc.

**Electronic Thermometer**, for industrial or medical use, with quick response. Uses germanium thermo-sensitive device and has accuracy of  $\pm 1^\circ\text{C}$ . Available in four types:  $25^\circ\text{--}45^\circ\text{C}$ ;  $-10^\circ\text{--}110^\circ\text{C}$ ;  $-50^\circ\text{--}160^\circ\text{C}$ ;  $0^\circ\text{--}210^\circ\text{C}$ ; manufactured by Ultrakust Geratebau of Germany. Leaflet from the distributors, Headland Engineering Developments, 164-168, Westminster Bridge Road, London, S.E.1.

**Decimal H.P. Electric Motors**, for sound recording and reproduction equipment. Shaded pole induction motors for 100/130V or 200/250V a.c. Type DHP1: speed 1,345 r.p.m. at 50 c/s; running torque 2 in.-oz. Type DHP2D: speed 2,800 r.p.m. at 50 c/s; running torque 3.5 in.-oz. Leaflet from The Garrard Engineering and Manufacturing Co., Newcastle Street, Swindon, Wilts.

**Silvered Mica Plates** for assembling capacitors with relatively simple equipment. Description, diagrams and tables of data in an engineering data sheet from Johnson Matthey and Co., 73-83, Hatton Garden, London, E.C.1. Also similar sheets on contact materials, their choice, properties and availability.

**Vibration Isolators**, air-damped, for mounting equipment to withstand mechanical shocks. A standard type is designed for protection against a series of 15g shocks and a ruggedized type for protection against 30g shocks. Technical data sheet from Cementation (Muffelite), 39, Victoria Street, London, S.W.1.

**Waveform Analysers**, signal generators, valve voltmeters, frequency monitors, counters, waveguide test equipment and other products of the Hewlett-Packard Company of California, U.S.A. Technical service in this country provided by Livingston Laboratories. A short-form illustrated catalogue from the British representatives, Lithgow Electronics, 1, Grange Court, Sudbury Hill, Harrow, Middlesex.