

## Chapter 4

### LF UNIT TYPE 4

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#### LEADING PARTICULARS

Purpose of unit ... ..	AF mixer and output stages, also flight indicator signal output
Power supply:—	
LT ... ..	19V at approx. 0.5A
HT ... ..	200V at approx. 40 mA
Minimum input signals:—	
Audio ... ..	0.3V at 1 kc/s for 225 mW
Indicator ... ..	1V ± 2 dB at 90 c/s + 1V ± 2 dB at 150 c/s to give 270 μA pointer current and 0.45 mA flag current
Stores Ref. No. ... ..	10D/7822
Weight ... ..	6lb. 10oz.

*This unit also serves as the mounting frame for the localizer and marker receivers.*

#### Introduction

1. The LF unit Type 4 contains the audio stages of the localizer and marker receivers, and the interconnecting leads for these units. The output from the LF unit consists of an audio channel for conveying information over the localizer and marker channels to the aircrew by telephones and two DC outputs which operate the flight indicator.

2. The two DC outputs are derived from the 90 c/s and 150 c/s tones radiated as carrier modulation by the localizer transmitter. The difference in magnitude between the tones provides the signal

for the localizer pointer of the flight indicator, while the sum of the tone amplitudes provides the current to actuate the localizer flag.

3. The flag is a small indicator which normally covers the end of the pointer when no current is flowing. When the output current from the LF unit is of correct amplitude, the flag moves out of sight. This indicates that the output from the LF unit is normal and hence both transmitter and receiver are operating correctly. If fault conditions occur at either transmitter or receiver, the combined tone amplitudes will not be great enough to move the flag and the aircraft pilot will know that an approach is unsafe.

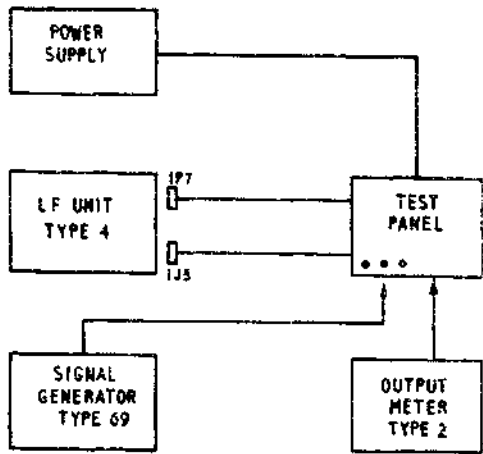


Fig. 1. Test equipment layout

4. The DC outputs are derived by separation of the two tones, rectification and recombination. The sum output is to be adjusted so that failure of either tone reduces the output current and de-energizes the flag. The differential output is to be adjusted so that a given tone ratio causes a predetermined deflection of the pointer in the correct direction.

#### Test equipment

5. As with other units of ILS, there are two possible test methods (*Chap. 1, para. 5*) which may be employed and the one selected will depend upon available space and test equipment and quantity of work. The test sequences and setting-up procedure may be carried out with the unit mounted in a test rig Type 5, with the signal generator Type 69. A multimeter and an output meter are the only other essential items. Fig. 1 shows the arrangement of the test equipment in block form. Fig. 2 gives the circuit diagram for a separate test panel which may be locally manufactured.

6. Certain of the tests call for an output meter (wattmeter) with an input impedance variable between 30 and 100 ohms. These values are available on the output meter Type 2 but not on other instruments in service. The wattmeter CT44 is unsuitable for these tests. The multimeter electronic CT38 may be used with slight modification in the method of use. The modification consists of adding suitable external series resistors which will

double the input resistance on two ranges. For an input impedance of 30 ohms a 15-ohm resistor in series with the 15-ohm input range will give the required value. The 100-ohm condition may be met with a 50-ohm series resistor on the 50-ohm range. If the method outlined here is employed, all the readings taken must be doubled as the meter then reads only half the power applied to the circuit.

#### Signal generator Type 69

7. The output voltage from the signal generator Type 69 is adjustable over the range 0-10V when switched to the GENERAL PURPOSE position. In the following series of tests the output required from the signal generator is 1V plus 1V at 90 c/s and 150 c/s. This condition is met by the following sequence of operations:—

- (1) Switch to GENERAL PURPOSE, 90 c/s and 0 dB.
- (2) Set the output voltage to 1V measured by a valve-voltmeter or a multimeter Type 1 set to 10V AC, using the OUTPUT LEVEL GENERAL PURPOSE control.
- (3) Switch to 90 plus 150 c s.

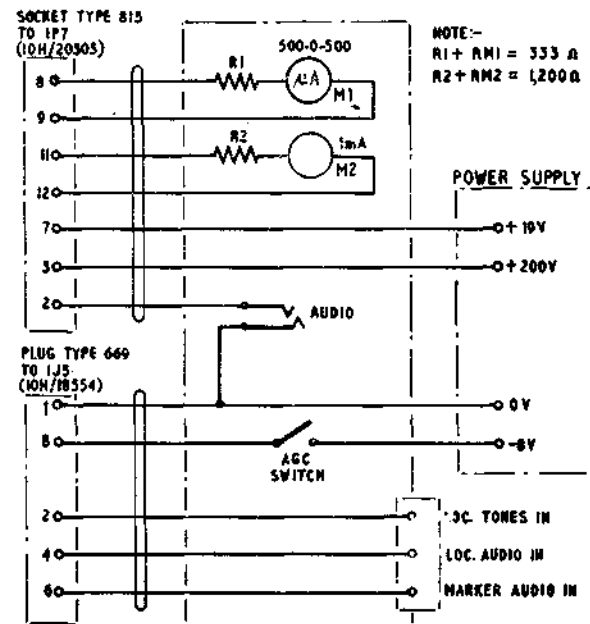


Fig. 2. Test panel circuit

TABLE I  
List of test equipment

Item	Scores Ref.	Description	Remarks
1	10S/16377	Signal generator Type 69	AF voltage source
2	10S/11934	Output meter Type 2	Power measurements
3	10S/16411	Multimeter Type 1	DC voltage tests
4	10S/16373	Valve voltmeter CT54	AF voltage measurement
5	10S/16478	Test rig installation Type 5	
or		Test panel	Refer to fig. 2.
6	10S/831	Oscilloscope Type 13A	LF unit tests

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**TABLE 2**  
List of additional test items

Item	Stores Ref.	Description	Remarks
1	10H/20305	Socket Type 813	Connects to 1J3
2	10H/18806	Plug	Connects to 1P
3	5Q/12284	Meter 0-2 mA	Flag current meter
4		Meter 500-0-500 $\mu$ A	Pointer current meter
5		Headset jack	
6		Single pole on-off switch	AGC switch

8. Before commencing the electrical tests on the LF unit Type 4, a visual examination should be made to check the mechanical security of all parts. The Volkes air filter should be removed by releasing the four Oddie fasteners, lifting out the container and removing the filter from its container. The manufacturer's instructions for cleaning the filter should be followed and the unit reassembled.

9. Tests for insulation and continuity should be made on the three inter-unit connectors 1P2-1J4, 1P3-1P4 and 1P1-1P5 and the plugs should be examined for security, frayed wires, etc.

10. The seal on the cover plate of the SET-ZERO and DEFLECTION SENSITIVITY control should be broken to allow access to the two controls.

11. Some units may be found to have a rubber ring fitted to the air filter outlet while others have not. This is due to the fact that the rotary transformer Type 261 as originally fitted was provided with a ring on its cover. The newer transformer (Type 264) does not have a groove to carry the ring, which must therefore be fitted to the LF unit filter aperture.

#### Test procedure

12. The tests described in this Chapter are to ensure that the gain, AGC action, regulation and response of the various sections of the unit are as laid down in the manufacturer's test specification. Final adjustments of the speech volume, marker volume and marker gain are made at second line but the operation of all controls must be investigated at third line. The circuit references (*fig. 3 and 4*) contained in the following paragraphs are marked on the chassis at the LF unit Type 4.

13. The order in which tests and adjustments are to be made is as follows:—

- (1) Setting of 1R7 (SET ZERO)
- (2) Measurement of sensitivity
- (3) Setting of 1R17 (DEFLECTION SENSITIVITY)
- (4) AGC action
- (5) Speech channel gain and regulation
- (6) Speech channel response
- (7) Marker audio characteristics

14. The instructions given relate to the use of the test rig Type 5 but, apart from the slight differences in switching, etc., they also apply to a locally manufactured test rig.

15. To undertake the series of tests on the LF unit it is first necessary to assemble the unit on the test rig as shown in *fig. 1* and to switch on the power supplies and signal generator Type 69. Ensure that the power supplies to the unit under test are at the correct levels, that is, LT, 19V and HT, 200V.

16. The signal generator is to be set to give an output of one volt at 90 c/s and one volt at 150 c/s (*para. 7*) with a dB ratio of 0.

#### Set zero

17. Set the FLAG CURRENT control (1R17) on the LF unit Type 4 to its maximum clockwise position and inject the output voltage from the signal generator to pin 2 of socket 1J2 and chassis. (Provision is made on the locally manufactured test rig to plug directly into this point, i.e. loc. in.)

18. Ensure that the SET ZERO control (1R7) will provide a deflection on the 500-0-500  $\mu$ A meter of 80  $\mu$ A in either direction and set the control to give zero deflection.

19. Adjust the output from the signal generator to give a reading of 0.45 mA on the flag-current meter (situated on the test rig) and ensure that the signal generator output is not greater than 0.9V, this measurement being made with a valve voltmeter CT54, at the output terminals of the signal generator.

#### Deflection sensitivity

20. Set the signal generator DECIBEL control to +4 dB and adjust the output of the signal generator to give a reading of 0.45 mA on the flag current meter. Check the operation of the deflection of the localizer meter (of the test rig) with the left-hand meter (of the test rig) set to X5.

21. With the equipment still set as in *para. 20*, set the signal generator DECIBEL switch to -4 dB and note that the direction of deflection of localizer meter is reversed and that the deflection is within 10  $\mu$ A of that obtained in *para. 20*.



output required to give this result. The reading on the valve voltmeter connected to the signal generator output terminals should not exceed 0.6V.

31. Adjust the signal generator for an output frequency of 400 c/s and record the wattmeter reading, repeat the observation with the frequency adjusted to 3 kc/s. The readings should not differ from the reading obtained at 1,000 c/s by more than 2 dB.

32. The unit should be assembled as part of a receiver R.1964 in the test rig Type 5 and the overall tests of Chapter 5 made. The lower preset control cover may be sealed at third line but it should be noted that final assembly adjustments must be made at second line.

#### Electrode voltage tests

33. Table 3 gives the electrode voltages to be expected in a serviceable LF unit Type 4 with the power supplies at the correct levels and no signal inputs.

34. The readings may be taken with a testmeter Type F or a multimeter Type 1. A variation of up to 20 per cent may be expected between individual units.

**TABLE 3**  
Valve electrode voltages

Valve	Electrode	Pin No.	Voltage
1V1	Anode	5	200V
	Screen	7	200V
	Cathode	2	2V
	Heater	3	12.6V
	Heater	4	6.3V
1V2	Anode (1)	6	50V
	Anode (2)	1	50V
	Cathode (1)	8	1.6V
	Cathode (2)	3	1.6V
	Heater	5	19V
	Heater tap	9	12.6V
	Heater	4	6.3V
1V3	Anode	5	200V
	Screen	7	200V
	Cathode	2	1.5V
	Heater	3	12.6V
	Heater	4	19V
1V4	Anode	5	130V
	Screen	7	130V
	Cathode	2	6.5V
	Heater	3	0V
	Heater	4	6.3V

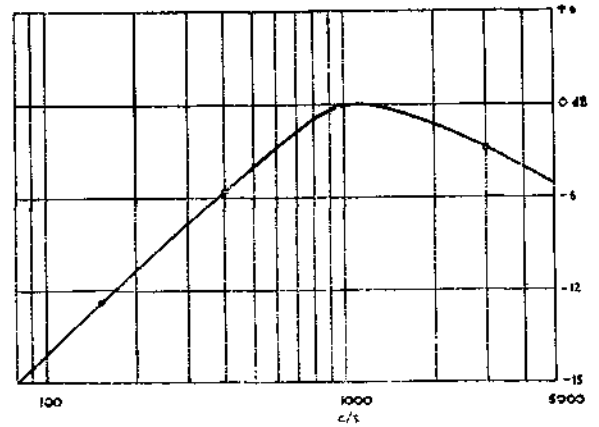


Fig. 4. Audio response curve

#### Fault diagnosis

35. The LF unit Type 4 contains two separate amplifier channels and this simplifies fault tracing procedure as each channel may be examined individually. The following tests will assist in the location of faults in the audio channels:—

- (1) *Gain.* With the valve voltmeter CT54 and the oscilloscope Type 13A connected to the anodes (pins 1 and 6) of 1V2, it should be possible to obtain a reading of 5V RMS on the valve voltmeter CT54 with no overload distortion indicated on the CRT. The output valve should be capable of supplying 300 mW to a 30-ohm load (output meter Type 2).
- (2) *Regulation.* An input at 1 kc/s which supplies 225 mW into a 30-ohm load should supply less than 110 mW into a 100-ohm load.

36. The following Table will be of assistance in correcting faults which appear in the tests described in para. 15 to 32.

**TABLE 4**  
Audio channel faults

Indication	Probable cause
Low gain	1V, 1V3 low emission, 1T1 unserviceable
Distortion	Leak in 1C9
One audio channel unserviceable	1V2 (fault in one section)
Poor regulation	Fault in 1C10
Oscillation	1C11 open-circuit

37. Tests on the indicator channel should be made with the unit assembled in a receiver R.1964 using a two-tone modulated RF input. The waveform of the signal may be checked on an oscilloscope Type 13A at the following points:—

- (1) Grid 1V4
- (2) Cathode 1V4
- (3) Grid 1V1
- (4) Cathode 1V1

Distortion may be caused by valve faults or a leaking coupling capacitor 1C3, but may not be apparent at the anode circuit of 1V1 due to the high Q of the anode load.

38. The output windings of the two tone filters are isolated from chassis and a comparison of these outputs with equal tone modulations must be made directly across the terminals of the filters.

39. The gain of IV4 is controlled by the AGC line of the receiver unit Type 117. The alteration in gain between minimum and maximum signal inputs is approximately 5 dB.

**Renewal of components**

40. Owing to the small size of the chassis and many components, when removing a resistor or capacitor from a valveholder, the wire from the component should be cut rather than unsoldered, as the latter process may result in damage to the valveholder or associated wiring.

41. Certain sub-units of the LF unit Type 4 are intended to be renewed as complete items and are held as spares under the stores reference numbers quoted in Table 4.

**TABLE 5**  
**Sub-units held as spares**

Circuit Ref.	Description	Stores Nomenclature	Stores Ref.
1 filter 1	Tone filter	Filter units Type 391	10P/13187
1 rectifier 1	Tone rectifier	Rectifier units Type 18	10D/17821

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