# Farnell

LF1, LFP1 and LFM4
sine-square oscillators

INSTRUCTION BOOK

# INSTRUCTION BOOK FOR

# LF1, LFP1 and LFM4
# sine-square oscillators

FARNELL INSTRUMENTS LIMITED · SANDBECK WAY WETHERBY WEST YORKSHIRE LS22 4DH TELEPHONE 0937 3541 TELEX 557294

# SCHEDULE OF EQUIPMENT

The instrument has been carefully packed to prevent damage in transit. When removing the unit from the box, be sure to remove all parts and accessories from the packing material.

The complete equipment comprises:-

a) 1 off LF1, LFP1 or LFM4 as ordered

b) 1 off Instruction book

c) 1 off Jack plug (LFP1 only)

Optional accessories

A setting-up screen to aid frequency calibration is available from The Service Department, Farnell Instruments Ltd.

Note:- In the event of damage in transit or shortage in delivery, separate notices in writing should be given to both the carriers and Farnell Instruments Ltd. within three days of receipt of the goods, followed by a complete claim within five days. All goods which are the subject of any claim for damage in transit or shortage in delivery should be preserved intact as delivered, for a period of seven days after making the claim, pending inspection or instructions from Farnell Instruments Ltd. or an agent of this Company.

## Model LF1

| | |
|---|---|
| TTL OUTPUT | Fixed amplitude TTL compatible output available when operating in square wave mode |
| FAN OUT | 10 standard TTL input loads |

## Model LFP1 only

This model has a power output/fixed gain amplifier in place of TTL output and is identical to the LF1 with the exception of the following:-

| | |
|---|---|
| POWER REQUIREMENTS | A.C. mains 190-260V, 50/60Hz |

*Low impedance output*

| | |
|---|---|
| POWER OUTPUT | 3 watts into 3Ω nominal at onset of limiting |
| POWER BANDWIDTH (3dB) | 25Hz to 25kHz typical at 2 watts into 3Ω |
| POWER OUTPUT DISTORTION | see graph page 6 |
| LOAD IMPEDANCE | 3Ω |
| VOLTAGE GAIN OF AMPLIFIER | X6.5 (16dB) typical |
| AMPLIFIER INPUT IMPEDANCE | 100kΩ approx. |
| OUTPUT PROTECTION | Short term short circuit proof |
| DIMENSIONS (LF1, LFP1) approx. overall | Height 90 mm<br>Depth 230 mm<br>Width 220 mm<br>Weight 2.0 kg (LF1) 2.42 kg (LFP1) |

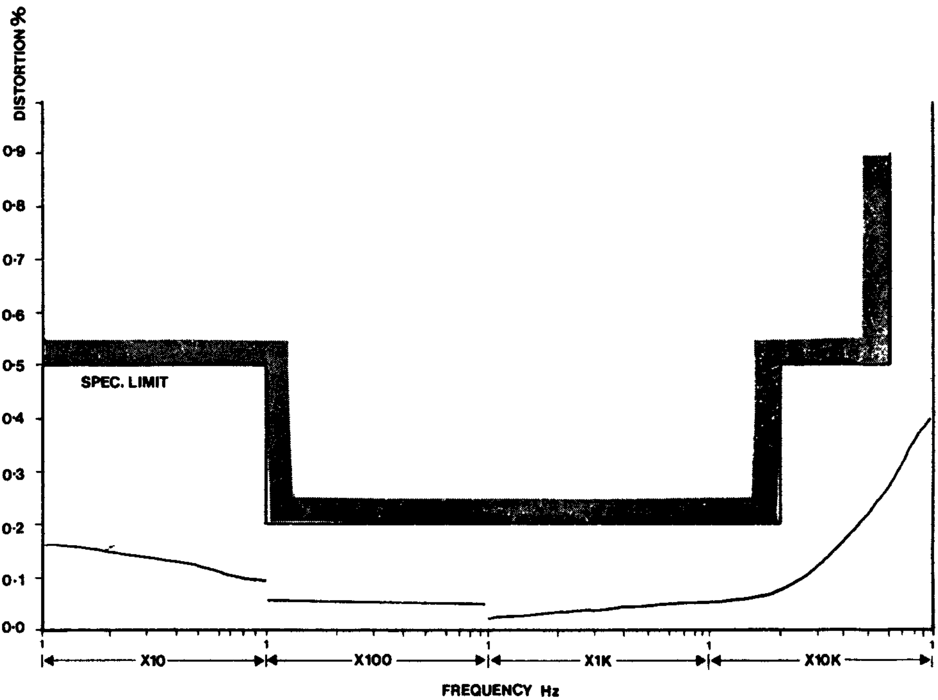
## Model LFM4 only

This model is similar to LF1 with the following additions:-

| | |
|---|---|
| POWER REQUIREMENTS | A.C. mains as LF1<br>Also BATTERY OPERATION using 3 x PP7 (not supplied). Rear panel switch selects mains or battery operation<br>20 hours battery life typical at 2 hours per day |
| OUTPUT METER | Scaled in V pk-pk into 600Ω and dBm (0dBm ref. 1mW into 600Ω). Facility to read battery voltage |
| METER ACCURACY | 4% f.s.d. to 100kHz |
| DIMENSIONS approx. overall | Height 132 mm<br>Depth 230 mm<br>Width 220 mm<br>Weight 2.50 kg |

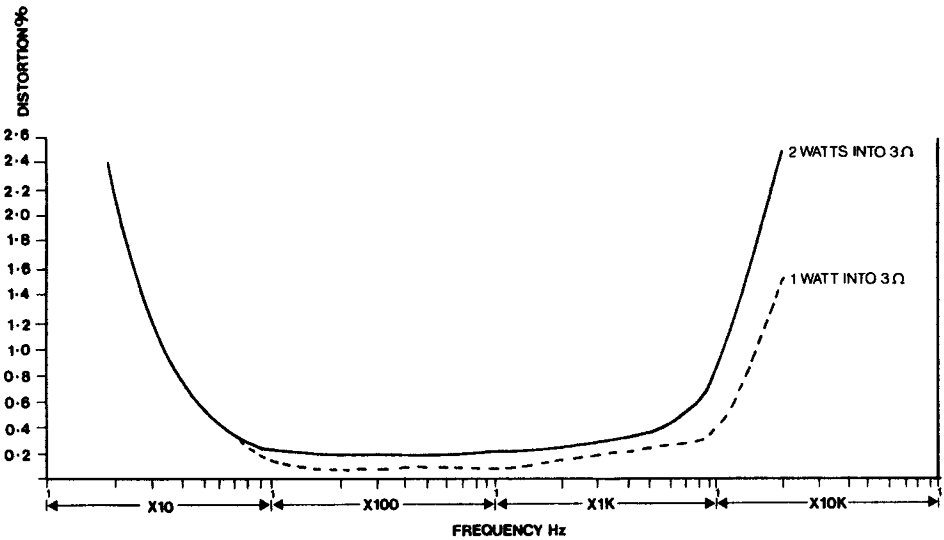
# GRAPH OF HARMONIC DISTORTION

Typical harmonic distortion of LF1, LFP1 and LFM4 when delivering 12V pk-pk into 600Ω over range 10Hz to 100kHz



# GRAPH OF POWER OUTPUT DISTORTION

This graph shows the typical distortion in the power output of the LFP1



# OPERATING INSTRUCTIONS

## Installation

Check that the voltage range of the instrument supplied is suitable for the local mains supply. The instrument is normally supplied set for 190-260V operation. On the LF1 and LFM4 it is possible to change the operating voltage to 95-130V by unsoldering the wire on the 240V tap of the transformer and transferring to the 110V tap.

The three core mains lead must be connected as follows:-

Brown - Mains live
Blue - Mains neutral
Green/yellow- Earth (Ground)

## Operating instructions

Switch the unit on by depressing the 'Power' ('Mains' for LF1, LFP1) button on the front panel. On model LFM4 first ensure that the rear panel 'Battery/Mains' switch is in 'Mains' position. Check that the neon indicator is illuminated.

The desired frequency is selected by turning the dial to the required setting and using the frequency multiplier push button.

Square waves are selected by depressing the 'square' wave button. When this button is out, sine waves are available. The LFM4 and LF1 also offer a TTL compatible output from the socket marked 'TTL' when operating in the 'square' mode.

The output amplitude is set by the 'Fine Amplitude' rotary control and the four position attenuator. On the LF1 and LFP1 an approximate indication of output voltage is given by the scaling around the 'Fine Amplitude' control. On the LFM4 the output level is indicated by the meter. The calibration of the meter is volts peak to peak into a 600Ω load. A dBm scale is also provided (0dB being 1mV into 600Ω load) and the meter may be used to check battery voltage.

In addition to the normal output, the LFP1 offers a low impedance (Lo Z) high power output.

The output of the Lo Z terminals is controlled by:- i) The'sine/square' function switch, ii) the 'Fine Amplitude' control and iii) the push button attenuator. The input to this amplifier is connected through normally closed contacts on the front panel jack socket ('Amplifier input') from the Hi Z output terminals.

The power amplifier may be used independently of the oscillator by connecting the input signal to a 3.5 mm jack plug and inserting into the 'Amplifier input' front panel socket.

A sync. socket is provided on each instrument and gives a sine wave output of about 4V pk-pk irrespective of the wave shape or amplitude present at the output terminals. For greater frequency accuracy and stability a reference signal may be coupled to this socket to 'lock' the instrument to the reference.

# CIRCUIT DESCRIPTION

For the purpose of this description the sections that are common to the LF1, LFP1 and LFM4 are outlined with the additional parts of the LFM4 and LFP1 described separately.

## Oscillator

The oscillator is based on the Wien bridge circuit and uses a thermistor in the negative feedback loop to stabilise the output amplitude. Amplitude 'bounce' whilst tuning is minimised by using a variable gauged capacitor and by ensuring that both 'arms' of the bridge are balanced. Range change is accomplished by selecting difference resistor value.

Negative feedback is applied to the high open loop gain of IC1 to give exceptionally low distortion figures. The loading on high value frequency determining resistors is minimised by the very high input impedance of IC1. The emitter follower VT1 improves the current drive abilities of IC1.

The whole of the oscillator circuitry including the variable capacitor is housed in a metal enclosure to shield it from stray fields.

## Square wave circuit

When a square wave output is required, the output of the oscillator circuit is fed into a conventional Schmitt trigger formed by VT101 and VT102. The mark/space ratio of the square waveform can be set by adjustment of P101.

## Mains output amplifier

Sine or square waves are switched into the 'Fine Amplitude' potentiometer P103 which then feeds the output amplifier. The gain of the amplifier is set by potentiometer P102.

The output amplifier comprises a differential pair (VT103/104) feeding a class A driver (VT106) with a constant current load VT105, which in turn drives the complementary pair of emitter followers (VT107, VT108).

The d.c. output voltage is set to 0V by P104 (Amplifier Balance).

Attenuation is accomplished by switching in '$\pi$' section networks for each of the lower outputs. A nominal output impedance of 60Ω is maintained by using this method.

## Power supply

The full wave rectified output of the transformer is regulated by IC100 to give a single line of 20V. This line is electronically centre tapped by VT100 to give a positive and a negative line of 10V each.

The square wave circuit, output amplifier and power supply, with the exception of the mains transformer, is mounted on the main circuit board.

## Meter, Battery (LFM4 only)

The above are in addition to the circuits described previously and all bear prefix 200 component designations.

The meter circuit comprises a full wave rectifier feeding the output meter. Sine wave calibration is by P201 and square wave by P200. The meter indicates the peak to peak voltage into a 600Ω load by monitoring the output of the emitter followers. The meter is also used to indicate battery condition by depressing SW201 (Battery Test).

SW200 (Mains/Battery) is used to interrupt the output of D100 and D101 and supply the IC regulator from the batteries (3 x PP7).

## TTL circuit (LFM4 and LF1 only)

The TTL output comes from the collector of VT200, a saturated switch driven from the square wave circuit. Note that this output is only available when operating in the square wave mode.

## Power amplifier (LFP1 only)

The power amplifier along with its power supply bear prefix 300 component designations and are mounted on a separate board.

VT302 and VT301 form a compound emitter follower regulator to feed the IC audio amplifier IC301. The output of the amplifier, which incorporates short circuit protection, is capacitively coupled to the output terminals.

The facility for feeding an external signal into the power amplifier is provided by a front panel jack socket.

# MAINTENANCE

## Guarantee

The equipment supplied by Farnell Instruments Ltd. is guaranteed against defective material and faulty manufacture for a period of twelve months from the date of despatch. In the case of material or components employed in the equipment but not manufactured by us, we allow the customer the period of any guarantee extended to us.

The equipment has been carefully inspected and submitted to comprehensive tests at the factory prior to despatch. If, within the guarantee period, any defect is discovered in the equipment in respect of material or workmanship and reasonably within our control, we undertake to make good the defect at our own expense subject to our standard conditions of sale. In exceptional circumstances and at the discretion of the Service Manager, a charge for labour and carriage costs incurred may be made.

Our responsibility is in all cases limited to the cost of making good the defect in the equipment itself. The guarantee does not extend to third parties, nor does it apply to defects caused by abnormal conditions of working, accident, misuse, neglect or wear and tear.

## Maintenance

In the event of difficulty, or apparent circuit malfunction, it is advisable to telephone (or telex) the Service Department or your local Sales Engineer or Agent (if overseas) for advice before attempting repairs.

For repairs and re-calibration it is recommended that the complete instrument be returned to:-

The Service Department,
Farnell Instruments Ltd.,
Sandbeck Way, Wetherby,
Yorkshire LS22 4DH.
Tel:(0937) 61961
Telex: 557294

Regional Office (South)
Davenport House, Bowers Way,
Harpenden, Herts. AL5 4HX
Tel:(05827) 69071
Telex: 826307

Please ensure adequate care is taken with packing and arrange insurance cover against transit damage or loss.

For those who operate their own comprehensive repair and calibration facilities a section on 'RE-CALIBRATION' follows.

# RE-CALIBRATION

It may be that after effecting repairs to active circuitry it becomes necessary to recalibrate the instrument. The following procedure should be followed:-

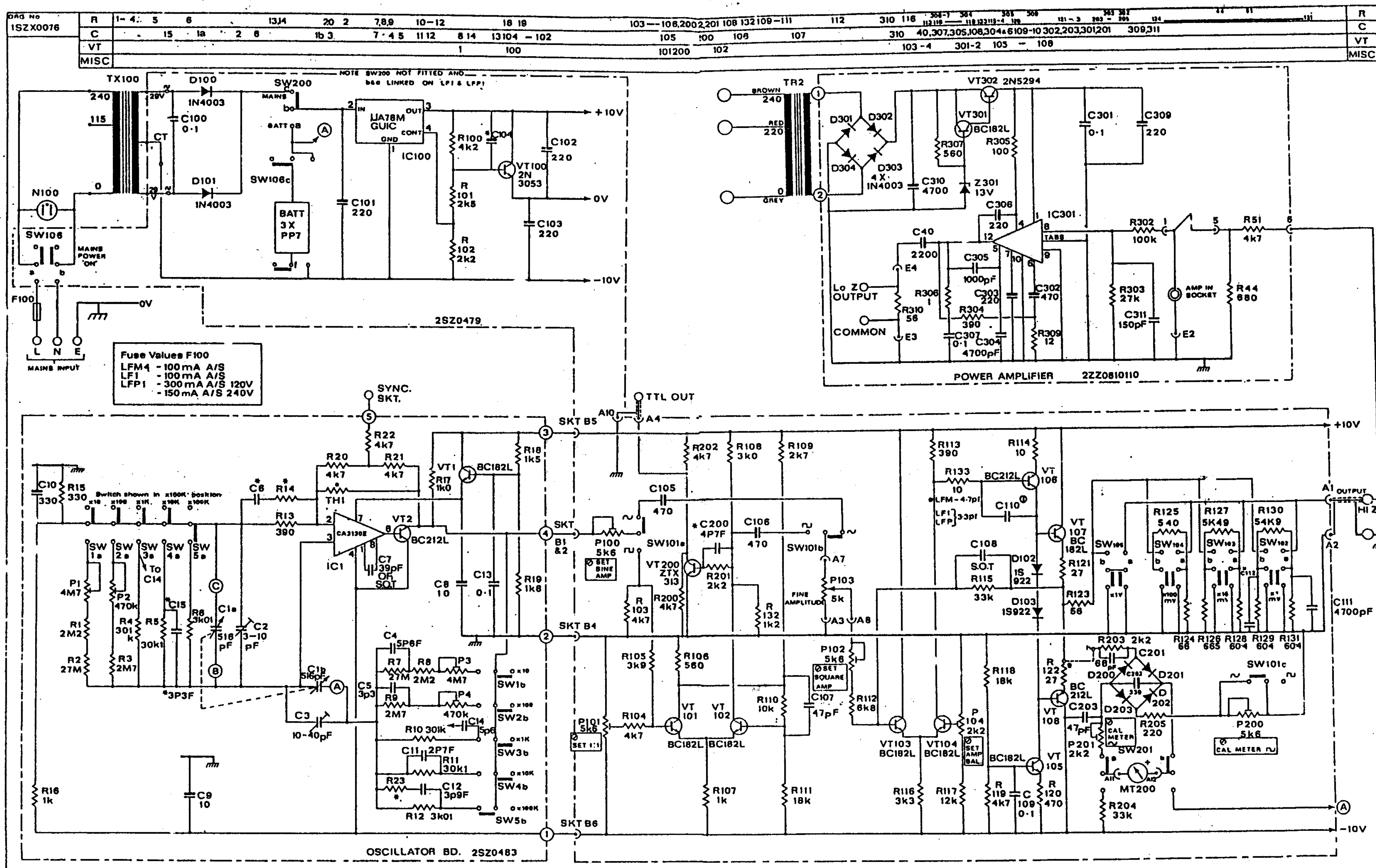
1) Connect instrument to suitable mains supply and switch on (Select mains operation on LFM4)
2) Confirm that voltage across C102 is about +10V
3) Confirm that voltage across C103 is about -10V
4) Set push button attenuator to X1V, turn 'Fine Amplitude' control fully anti-clockwise. Monitor d.c. voltage at the Hi Z terminals and set to 0V (±250mV) by adjusting P104.
5) Select square wave operation at 1kHz, monitor the output with a scope and increase the 'Fine Amplitude' to maximum by turning fully clockwise. Set the mark/space ratio of the square wave to unity by adjusting P101
6) With a 600Ω load on the Hi Z terminals adjust P102 to give 14V pk-pk
7) Reduce this amplitude to 12V pk-pk and select sine wave. Adjust P100 to give an output of 12V pk-pk
8) On LFM4 adjust P201 to give a meter reading of 12V pk-pk
9) Select square wave and adjust P200 to give the same reading

## Frequency calibration

Before this can be done it is necessary to remove the side plate and replace by a setting up screen (available from the Service Department, Farnell Instruments) with component adjust holes in. Alternatively a suitable screen may be fabricated to enclose the oscillator section.

Set instrument to 'sine' and monitor the output with a suitable counter.

1) Confirm that the fully anti-clockwise position on the dial is about 0.92. If not slacken grubscrews on flexible coupling and adjust.
2) Select x1k range and turn dial to '10' mark and whilst monitoring the output with a scope, 'rock' the dial back and forth. Adjust C3 for minimum amplitude bounce
3) Return dial to 10 and note frequency. Adjust C2 and C3 to give equal frequency increments or decrements to reach 10KHz
4) Confirm that at the dial mark of 1 a frequency of 1kHz ±1% is obtained. If not adjust dial position slightly and repeat 2, 3 and 4.
5) Confirm that the frequency is within specification at the 1 and 10 marks on the x10k and x100K ranges
6) With dial at 10 select x100 range and adjust P2 and P4 for maximum frequency. Adjust P2 and P4 to give equal frequency decrements to reach 1.000kHz
7) Similarly on x10 range adjust P1 and P3 to give a frequency of 100.0Hz
8) With dial at 1 confirm that frequency is within specification on x10 and x100 range.




**NOTE**
RESISTOR VALUES IN Ω UNLESS STATED OTHERWISE
CAPACITOR " " µF
○— DENOTES CCT. BOARD PIN CONNECTIONS
⊖— " AMP PLUG & SOCKET

* COMPONENT NOT ALWAYS FITTED
COMPONENTS NUMBERED FROM 200 ON LFM4 ONLY
" " 300 ON LFP1 ONLY
— COMMON LINE

CAUTION STATIC SENSITIVE DEVICES

FARNELL INSTRUMENTS LTD. WETHERBY, YORKS.

TITLE LFM4, LF1 LFP1 CCT DIAGRAM CONNECTION DIAGRAM

DRG No. 1SZX0076

SHT 1 OF 1 SHTS