

PCB 75024

#### 4.1 Introduction

This plug-in p.c.b. contains two active filters externally connected in cascade, capable of being separately switched in circuit under the control of the microcomputer.

##### 4.1.1 Band-pass filter

The band-pass filter effect is derived from two maximally flat pass-band sections: a third-order (18 dB/octave) high-pass filter and a sixth-order (36 dB/octave) low-pass filter.

Functionally, this filter measures unweighted noise across the audio band, according to CCIR 468 and DIN 45 405 unweighted requirements. It is specified for unweighted noise measurements by the I.B.A. and other broadcasting authorities. It can be used for 20 Hz to 20 kHz measurements with virtually immeasurable error.

NOTE: This filter must be switched out of circuit for T.H.D. measurements on signals having fundamental frequencies above 6 kHz, since it will reduce the amplitude of the higher harmonics.

##### 4.1.2 Low-pass filter

The low-pass filter has a maximally flat response and a roll-off of 36 dB/octave above 30 kHz. Having unity insertion loss, this filter maintains the instrument frequency response within  $\pm 0.15$  dB up to 20 kHz and can be usefully left in circuit for most audio measurements, particularly when there is the likelihood of out-of-band interference; e.g. tape bias oscillators, etc.

NOTE: This filter must be switched out of circuit for T.H.D. measurements on signals with fundamentals above 10 kHz, since it will reduce the amplitude of the higher harmonics.

The simplified block diagram is shown in Figure 4.1.1 below with all filters in the bypassed or disabled condition.

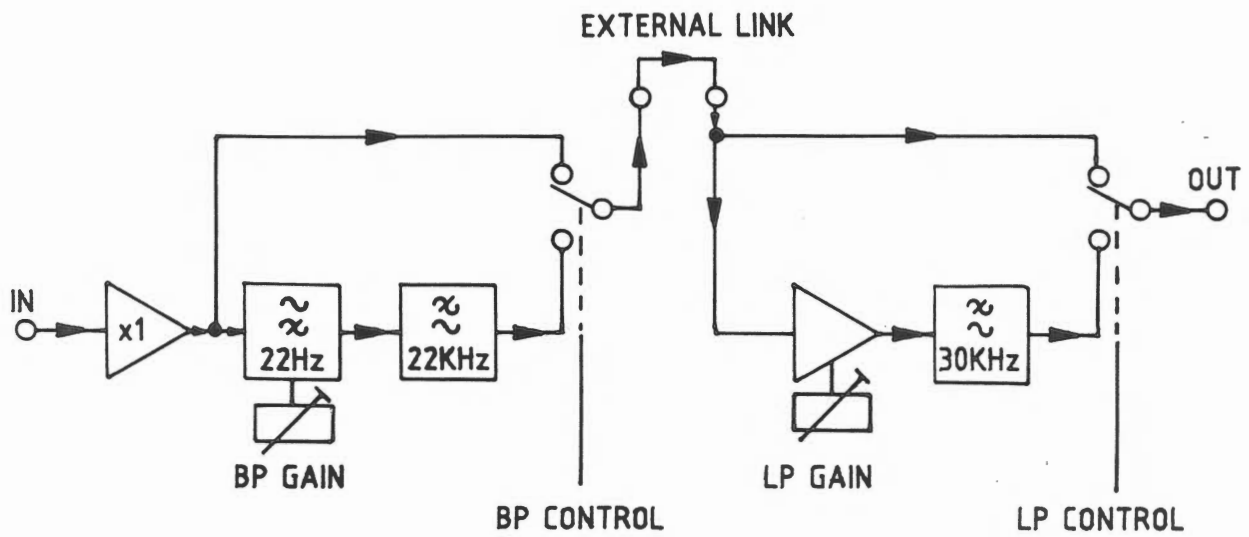


Figure 4.1.1 Band-pass/Low-pass Filter - Block Diagram

## 4.2 Circuit description

### 4.2.1 Band-pass Filter

The output from the CCIR/HP filter p.c.b. is applied to SKT2/8 (BAND-PASS FILTER IN).

In the inactive mode (logic 0 on SKT2/6), the signal is routed via voltage-follower IC4 and analogue switch IC3/3,4 directly to SKT1/1 (BAND-PASS FILTER OUT); i.e. the filter is bypassed.

In addition, the filter output is disconnected by the open switch IC3/1,16.

In the active mode (logic 1 on SKT2/6), with the switch driver input IC3/15 at logic 1, switch IC3/3,4 opens, and switch IC3/1,16 closes connecting the filter output to SKT1/1.

The +5 V supply on IC3/12 is derived by potential divider R42, R36 from the +18 V rail and decoupled by C18.

The filter path is as follows:

The output from voltage follower IC4/6 is passed to the third-order high-pass filter comprising C7-C9, R15-R17, op amp IC2a and its feedback network. Any insertion loss is trimmed out by feedback resistor VR2.

The IC2a/8 output is fed to the network R18//R19, R20//R21, which attenuates the input to the three stage low-pass filter by a factor of 4 to compensate for the stage gain. The network resistance is effectively 15 k.

The three sections of the sixth-order low-pass filter, IC2b, IC2c, IC2d, are equal-value Sallen and Key configurations. The op amps have a certain amount of gain (determined by gain setting resistor pairs R23,R24; R27,R28; and R31,R32) to define the Q of the individual filter sections. The filter output is connected via C16 and switch IC3/1,16 to SKT1/1 (BAND-PASS FILTER OUT).

### 4.2.2 Low-pass Filter

The output from the band-pass filter (SKT1/1) is connected via the motherboard to the low-pass filter input on SKT1/2. This input is directly connected to the non-inverting input of IC1a/10 and also to the filter bypass switch IC3/6,5.

In the inactive state (logic 0 on SKT1/4), switch IC3/6,5 bypasses the signal to output SKT1/3 and with switch IC3-8,9 open, the low-pass filter output is disconnected.

In the active state (logic 1 on SKT1/4), a logic 1 on driver input IC3/10 opens the bypass switch IC3/6,5 and connects the low-pass filter output via IC3/8,9 to SKT1/3.

The filter path is as follows:

The feedback resistor VR1 of op amp IC1a is adjusted to give no change in level when the low-pass filter is switched in circuit; i.e. 0 dB insertion loss.

The output on IC1a/8 feeds a three-stage, low-pass, Sallen and Key active

filter comprising operational amplifiers IC1b, IC1c, IC1d and their associated RC components. The resultant output via C17 gives a maximally flat characteristic with a roll-off of 36 dB/octave above 30 kHz.

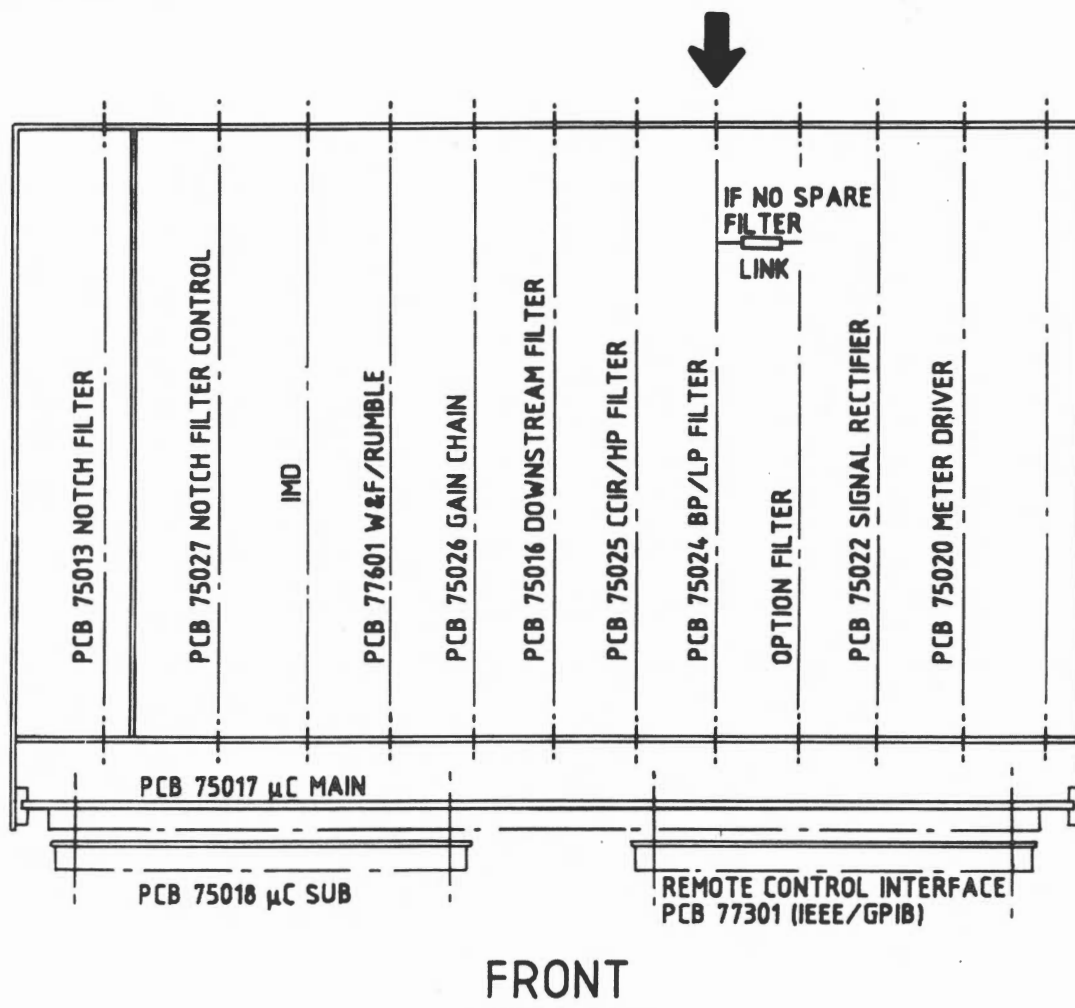
The output is fed via IC3/8,9 to SKT1/3 (LOWPASS FILTER OUT).

### 4.3 Removal/Replacement

Switch off the MJS401D and remove the mains lead.

Remove the four screws retaining the top cover. Pull the top cover straight up.

With the instrument facing you, the BP/LP filter card is installed in the 8th slot from the left in the main card frame. Verify by noting the printing on the motherboard.



MJS401D PCB Location Guide

Remove the card by grasping the top corners and gently pulling up.

Replacement is the opposite of removal. Carefully line up the connectors before pushing down and ensure the card is properly held within the guides.

Extender card PCB 75032 may be used to facilitate repair and calibration.

#### 4.4 Fault Finding

Use extender card PCB 75032.

##### 4.4.1 Band-pass Filter Activation

Select "22-22k" filter on the instrument front panel. The red LED above the switch should illuminate. Failure to illuminate indicates a fault in the switch itself, LED, encoders or micro-processor system. See section 12 to repair the switch, LED or encoders, and section 3 for the processor system.

The LED labelled Filter 1 on the extender should illuminate indicating that the switch, encoder and processor control output are functional.

If this does not illuminate, remove the BP/LP card from the extender. If the Filter 1 LED now illuminates then a fault is likely in the logic circuit input IC3, R38. If Filter 1 still remains off, check for +5 V on PL2/6. If this is missing the fault is in the processor, motherboard or interconnections.

If the logic circuits appear correct, check for signal continuity through IC4/3 to IC4/6 and through IC3/1 to IC3/16.

Failure of the signal to appear at IC4/3 indicates a failure elsewhere in the system, probably on the CCIR/HP filter board, motherboard or connectors between the two.

If the signal appears on SKT1/1, but not SKT1/2, then the fault is definitely on the motherboard PL1 or contact failure between SKT1 and PL1.

##### 4.4.2 Low-pass Filter Activation

Select "30k" filter on the instrument front panel. The red LED should illuminate. Failure to illuminate indicates a fault in the switch itself, LED, encoders or micro-processor system. See section 12 to repair the switch, LED or encoders, and section 3 for the processor system.

The LED labelled Filter 2 on the extender should illuminate indicating that the switch, encoder and processor control output are functional.

If this does not illuminate, remove the BP/LP card from the extender. Illumination of the Filter 2 LED now indicates a fault in the logic circuit input IC3, R40. If Filter 2 still remains off, check for +5 V on PL1/4. If this is missing the fault is in the processor, motherboard or interconnections.

If the logic circuits appear correct, check for signal continuity through IC1a/10 to IC1a/8 and through IC3/8 to IC3/9.

Failure of the signal to appear at IC1a/10 indicates a failure elsewhere in the system, probably on the BP filter section of this PCB, or between connector SKT1 and the motherboard.

#### 4.5 Calibration

First assure that basic functionality is correct. Extender card PCB 75032 is useful but not essential.

##### 4.5.1 Band-pass Filter

###### MJS401D Front Panel Setup

| Input | Load | Function | Filters | Rectifier | Scale  | Dist'n | Coarse | Fine |
|-------|------|----------|---------|-----------|--------|--------|--------|------|
| A     | Off  | Level    | Off     | RMS       | dB Exp | ---    | 0      | 0    |

###### Set Mid-Band Calibration

- 1) Apply 0 dB (0.775 V) at 1 kHz to the test set input A. Adjust the source to give exactly "0" on the meter.
- 2) Select "22-22k" filter. Adjust VR2 (nearest rear of Test Set) to read exactly "0" on the meter.
- 3) Switch the "22-22k" switch in and out several times and ensure that there is no steady-state level change.

###### Check LF Response

- 4) Ensure all filters are off. Set source frequency to 22 Hz. Adjust the source to set the level to read exactly "0" on the meter.
- 5) Turn "22-22k" filter on. Set "dB FINE" to "-3".
- 6) Adjust source frequency to read "0" on the meter. The frequency should be between 20 Hz and 24 Hz.

###### Check HF Response

- 7) Turn all filters off. Set "dB FINE" to "0". Set source frequency to 22 kHz. Adjust source level to read "0" on the meter.
- 8) Set "dB FINE" to "-3". Turn "22-22k" filter ON.
- 9) Adjust source frequency to read "0" on the meter. Frequency should be between 20.9 kHz and 23.1 kHz.

###### Check Mid-Band Response

- 10) Set "dB FINE" to "0". Ensure "22-22k" filter is on, all other filters off.
- 11) Set source to read exactly "0" on the meter.
- 12) From 100 Hz to 10 kHz the response should be within  $\pm 0.1$  dB on the meter. If it deviates from this switch the "22-22k" filter out to confirm the source reference is "0" on the meter. If not, adjust the source to this reference and then turn the filter on to confirm no change in level.

#### 4.5.2 Low-pass Filter

##### MJS401D Front Panel Setup

| Input | Load | Function | Filters | Rectifier | Scale  | Dist'n | Coarse | Fine |
|-------|------|----------|---------|-----------|--------|--------|--------|------|
| A     | Off  | Level    | Off     | RMS       | dB Exp | ---    | 0      | 0    |

##### Set Mid-Band Gain Calibration

- 1) Apply 0 dBu (0.775 V) to input A of the test set at 1 kHz.
- 2) Adjust the source level to read exactly "0" on the meter.
- 3) Select "30k" filter on.
- 4) Set VR1 (the preset nearest the front of the test set) to adjust the meter to read exactly "0".
- 5) Switch "30k" filter on and off several times to confirm no level change.

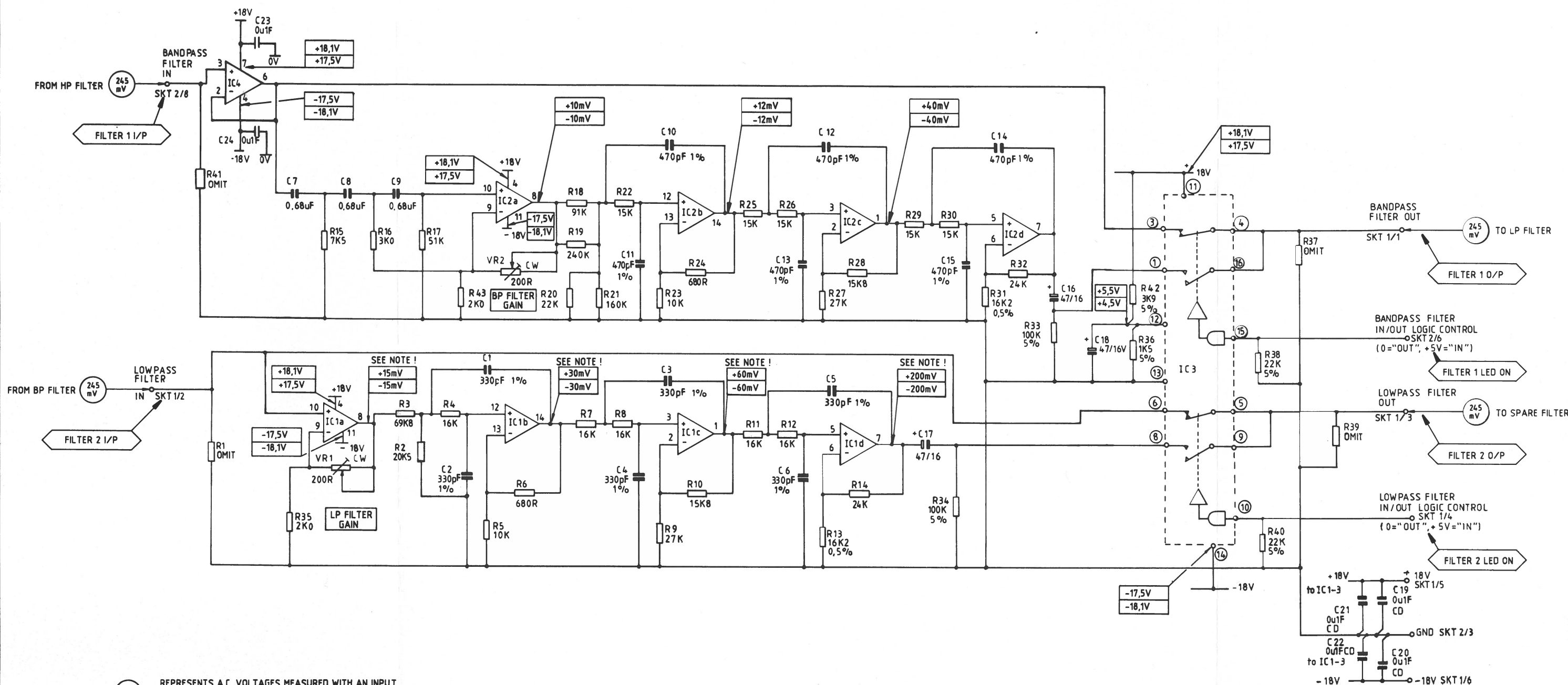
##### Check HF response

- 6) Set the source frequency to 30 kHz.
- 7) Select all filters off. Set source level to read exactly "0" on the meter.
- 8) Select "30k" filter on. Set "dB FINE" to "-3".
- 9) Adjust the source frequency to read exactly "0" on the meter. The frequency should be between 28.5 kHz and 31.5 kHz.

##### Check Mid-Band and LF Response

- 10) From 20 Hz to 18 kHz the change in meter reading on selecting or deselecting the filter should be within  $\pm 0.1$  dB.

| REVISION |         |                                                |          |
|----------|---------|------------------------------------------------|----------|
| NO       | DATE    | CHANGE                                         | APPROVED |
| 1        | 5-7-83  | IC4 ADDED, R41 WAS 100K, R1 REMOVED R3 WAS 16K |          |
| 2        | 21-12-8 | SOCKET No CHANGED                              |          |
| 3        | 12.1.84 | R2 WAS 19K6 R3 WAS 84K5                        |          |



REPRESENTS A.C. VOLTAGES MEASURED WITH AN INPUT IMPEDANCE OF 10K OHMS OR GREATER. UNLESS OTHERWISE SPECIFIED THESE LEVELS CORRESPOND TO A 1KHz TONE AT A REFERENCE LEVEL OF 0dBu (0.775V) INTO A FULLY CALIBRATED TEST SET, 'LEVEL' FUNCTION, 0dB RANGE

REPRESENTS D.C. VOLTAGES MEASURED WITH A VOLTMETER OF 20,000Ω/V OR GREATER. MAXIMUM IS DEFINED AS THE MOST POSITIVE VOLTAGE WHEN MEASURING VOLTAGES AT IC1 PINS 8, 14, 1 OR 7, SUBTRACT ANY VOLTAGE APPEARING AT IC1 PIN 10 BEFORE COMPARING WITH THESE LIMITS.

EXTENDER TEST POINT OR INDICATOR REFERENCE

USE EXTENDER CARD PCB 75032

HIGHEST R 43  
C 24  
IC 4  
VR 2

IC1 & IC2 = LF347 OR uAF774

IC3=DG243, IC4=LF356

ALL UNMARKED RESISTORS 1% 1/4 W

+5V SKT 2/4  
LOGIC 0V SKT 2/5

|                                                                                                                                                         |                |                                                      |  |             |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|------------------------------------------------------|--|-------------|--|
| <br>Unit 2,<br>Samuel Whites Industrial Estate,<br>Medina Road, Cove,<br>Isle of Wight, PO31 7LP,<br>GB<br>Tel: (0883) 299959<br>Telefax: (0883) 290142 |                | TITLE PCB 75024                                      |  |             |  |
|                                                                                                                                                         |                | BANDPASS / LOWPASS<br>FILTER CARD<br>CIRCUIT DIAGRAM |  |             |  |
| TOLERANCES - UNLESS OTHERWISE STATED<br>Linear Millimetres ±0.4mm Angular Degrees ±0.25°                                                                |                | USE MJS 401D TEST SET                                |  |             |  |
| MATERIAL                                                                                                                                                | ORIGINAL SCALE | DRAWN D. CHEN                                        |  | DATE 9/2/83 |  |
| FRISH                                                                                                                                                   | CHECKED M.J.S. | PROJECT NO 750                                       |  | TYPE C      |  |
|                                                                                                                                                         | DATE           | SHEET NO 132                                         |  | SIZE 1      |  |
|                                                                                                                                                         |                |                                                      |  | REV 3       |  |