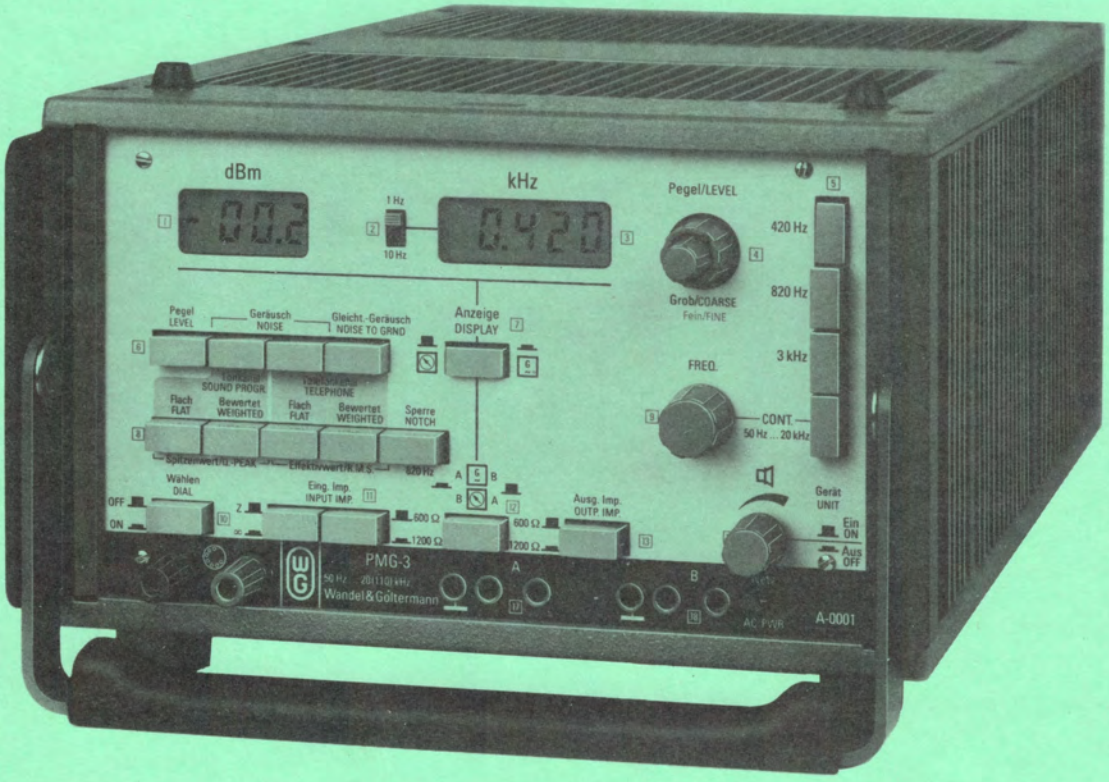
# Description and Operating Manual




## AF Level Measuring Set

## PMG-3

**for level and noise measurements in the frequency range of 50 Hz to 20 (110) kHz**

# AF LEVEL MEASURING SET PMG-3

for level and noise measurements in the frequency range of 50 Hz to 20 (110) kHz

Description and
Operating Manual 9202/03 A, B

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Wandel & Goltermann

PRECISION ELECTRONIC
MEASURING INSTRUMENTS

C O N T E N T S PMG-3

# I N T R O D U C T I O N

Accurate and repeatable measurements are easy and fast to make using the PMG-3 Transmission Measuring Set. The compact, portable instrument including both a level generator and receiver, permits measurement of all the standard transmission parameters in the field or in the central office. Applications for the PMG-3 include checking gain or loss on voice and data circuits, measuring frequency response, measuring noise through various weighting networks and measuring noise to ground. Compatibility with existing instruments and systems is assured to the pertinent CCITT or CCIR Recommendations.

An important feature of the PMG-3 is the synthesizer used in the Level Generator. The synthesizer's unique design allows continuous tuning, with 1 Hz resolution, over the whole frequency range of 50 Hz to 20 kHz yet gives very high stability once a frequency has been chosen. This excellent frequency stability, combined with a very stable output level, results in a highly accurate and repeatable test signal. In addition to the continuous tuning mode of operation there are 3 fixed frequencies available. These frequencies of 420, 820 and 3000 Hz are pushbutton selectable thus allowing quick frequency response tests to be done.

The generator output level ist settable over the range of +10 dBm to -50 dBm with a resolution of 0.1 dB. The switchable output impedances are 600 Ω and 1200 Ω balanced with the output connector being compatible with the standard 3 pole CF-plug. The level meter portion of the PMG-3 has many features and functions. The input impedances of 600 Ω and 1200 Ω plus a high impedance bridging mode allow matching to all voice and sound program circuits.

General level and noise measurements, using a RMS detector are possible over the frequency range of 50 Hz to 110 kHz. For measurements on sound program channels, weighted or unweighted, a quasi-peak detector according to CCIR Recommendation 468-2 has to be used. Selection of the weighting networks is made by a front panel switch. The PMG-3 is full autoranging so that range switching is not necessary.

The results of level and noise measurements are displayed in dBm on the digital display with a resolution of 1 Hz or 10 Hz respectively.

A 820 Hz notch filter is useable in tandem with all the noise weighting of flat networks. This allows notched noise measurements typically made on PCM systems.

Two-wire circuits may be dialed up for testing using a dial plugged into the dial jacks on the front of PMG-3. The transfer switch allows a fast and simple reversal of the direction of transmission so that the switching of cables is not necessary.

The built-in batteries allow the instrument to be used in locations without AC power. A built-in battery charger recharges the batteries overnight so that the instrument is available for field use again the next day.

# 1 TECHNICAL DATA

Unless otherwise stated, the specified values and error limits apply to any operating conditions and equipment settings within the rated operating ranges specified in Section 2.7.

## 1.1 LEVEL GENERATOR

Send frequency

Frequency setting - continuously adjustable ..... 50 Hz to 20 kHz
Switch selectable fixed frequencies ..... 420, 820, 3000 Hz
Frequency accuracy and stability ..... 1 Hz
Frequency settability ..... 1 Hz

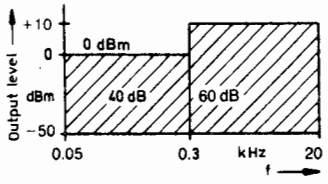
Send level

Setting range ..... -50 dBm to +10 dBm
Resolution of send level setting ..... 0.1 dB

Send level output

Output connector ..... compatible with standard CF plug
Output impedance, switchable ..... 600 Ω/1200 Ω balanced

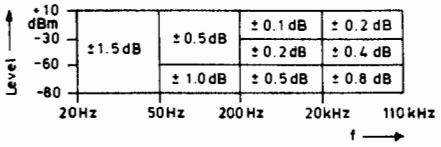
Harmonic ratio; $a_{k2}$, $a_{k3}$




## 1.2 LEVEL METER

Detector types ..... selectable between RMS and Quasi-Peak

Level measurements
for making wideband measurements of all types of signals
Level range ..... -80 dBm to +10 dBm
Level display resolution ..... 0.1 dB
Frequency range ..... 20 Hz to 110 kHz
Accuracy




Noise measurements
for the measurement of noise signals using weighting filters
Level range ..... -90 dBm to +10 dBm
Level display resolution ..... 0.1 dB
Frequency range ..... 20 Hz to 35 kHz

Noise weighting filters

Telephone channel ..... According to CCITT Rec. P.53

Sound program ..... According to CCIR Rec. 468-2

Selectable among ..... Telephone channel weighted
Telephone channel flat
Sound program weighted
Sound program flat

Noise to ground

Level range ..... -50 dBm to +30 dBm

Frequency range ..... 20 Hz to 20 kHz

Level display resolution ..... 0.1 dB

Noise measurement accuracy

Telephone weighted - RMS ..... +10 to -90 dBm ± 1 dB

Telephone flat - RMS ..... +10 to -80 dBm ± 1 dB
-80 to -90 dBm +3/-1 dB

Program weighted - quasi-peak ..... +10 to -70 dBm ± 1 dB
-70 to -85 dBm +3/-1 dB

Program flat - quasi-peak ..... +10 to -70 dBm ± 1 dB
-70 to -80 dBm +3/-1 dB

## 1.3 FREQUENCY COUNTER (Level Mode)

Frequency range ..... 20 Hz to 110 kHz

Resolution and accuracy ..... 1 Hz - below 20 kHz
10 Hz - above 20 kHz

Sensitivity ..... -69 dBm

Display refresh ..... 5/sec.

Display ..... 5 LCD digits

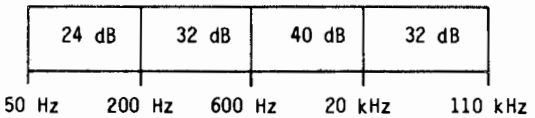
## 1.4 MEASURING INPUT

Input impedances, switchable ..... 600 Ω/1200 Ω; terminated or bridging

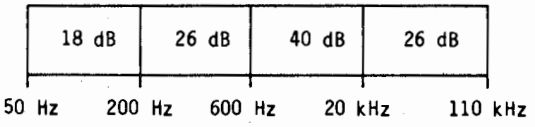
Input connector ..... compatible with the standard CF plug

Return loss:

600 Ω




1200 Ω




Longitudinal balance

(receiver balance ratio) ..... > 80 dB at 50 Hz

## 1.5 GENERAL SPECIFICATIONS

A.C. line voltage ..... 115 V or 220 V ± 10%
Frequency range ..... 45 - 66 Hz
Power consumption with A.C. line operation ..... 15 VA
Battery operation time ..... approx. 5 h at 25°C
Battery recharge time ..... approx. 16 h
Batterie live ..... in excess of 500 discharge/charge cycles
Dimensions (h x w x d) ..... 155 x 222 x 414 mm/6.1 x 8.75 x 16.3 in.
Weight ..... approx. 8 kg/18 lbs.

## 1.6 AMBIENT CONDITIONS

Permissible ambient temperature
Nominal range ..... 0° to +55°C
Storage and transport ..... -40° to +60°C
Relative humidity ..... 0 to 95 %
non-condensing

## 1.7 ORDERING INFORMATION

| | |
|---|---|
| Voice Frequency Transmission | |
| Test Set PMG-3 (without batteries) | BN 9202/03 |
| Rack Mount Kit | BN 9202/00.02 |
| AT-052S Carrying Case (soft pack) | BN 9000/01 |
| Rechargeable Battery Option | BN 9202/00.01 |

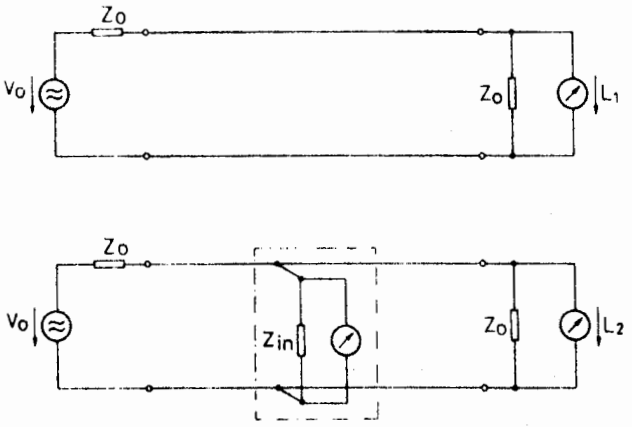
## Return Loss

The effect introduced by the return loss of the receiver input or the generator output is included in the error specified for the level reading of a receiver or the output level of a generator.

Moreover, the specified error takes into account that a level meter is operated as "terminated" (input impedance = source impedance = $Z_o$). This is also valid for a level generator (output impedance = load impedance = $Z_o$).

## Bridging Loss

A receiver operated in the "high impedance" (bridging) mode introduces a level error due to the finite input impedance. The error's maximum value when measured at a testpoint of source impedance Z/2 is expressed as $a_B$, the bridging loss.




The bridging loss is defined as follows:
Bridging loss $a_B = L_2 - L_1$

$$a_B = 20 \lg \left| 1 + \frac{1}{2} \frac{Z_o}{Z_{in}} \right|$$

Therefore, the bridging loss is the level difference caused by the high impedance level meter input bridging a system terminated with $Z_o$.

In every case, $Z_{in} \gg Z_o$, which results in:

$$a_B \leqq 4.3 \frac{Z_o}{Z_{in}} \quad [dB]$$

For that reason, the specified value of $a_{B,1}$ related to the value $Z_1$ (e.g. 600 Ohms) can be easily recalculated to yield the value of $a_{B,2}$ for the value $Z_2$ (e.g. 900 Ohms):

$$a_{B,2} = a_{B,1} \cdot \frac{Z_2}{Z_1}$$

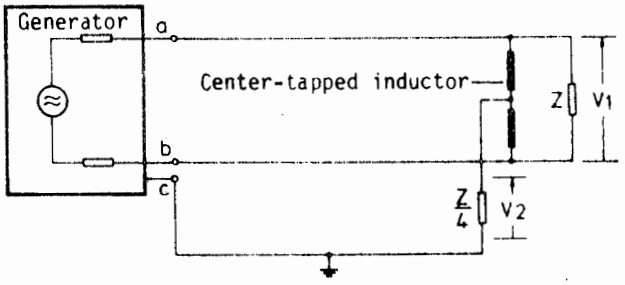
## Impedance balance ratio

The specifications given for the input or output balance are provided by the methods defined in CCITT Recommendation O. 121.

This same Recommendation states that:
"The signal balance ratio is an overall measurement of the symmetry of a device and includes the influence of the impedance balance ratio as well as the influence of unwanted longitudinal voltages produced by a generator or the influence of the common-mode rejection ratio of a receiver."

To describe the degree of balance of a device (generator or receiver) under operational conditions in most cases it is sufficient to measure and specify the signal balance ratio only. Thus, the specifications in this Operating Mannual are provided by measurement of signal balance ratio. This is done through emplomeent of an accurately center-tapped inductor with both of the tightly-coupled half windings being completely symmetrical. Each half represents Z/2.

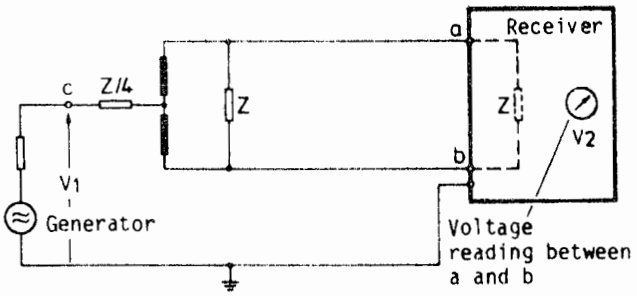
### Measurement of Generator Signal Balance Ratio




Generator signal balance ratio is defined as:

$$a_B = 20 \log \left| \frac{V_1}{V_2} \right| \quad [dB]$$

### Measurement of Receiver Signal Balance Ratio




Receiver signal balance ratio is defined as:

$$a_B = 20 \log \left| \frac{V_1}{V_2} \right| \quad [dB]$$

The dotted impedance, Z, is the input impedance of the device under test. If the input impedance is a high value, then this impedance must be externally connected in the parallel.

# Important Safety Instructions

## A.C. power line voltage

The operating voltage of the instrument should be the same as the a.c. line voltage, so check whether or not the two voltages are equal.

## Safety Class

This instrument is categorized as Safety Class I according to VDE 0411 or IEC Publ. 348. The power cord delivered with the equipment has a protective ground conductor. The a.c. power plug must be plugged into an a.c. power receptacle that has a third wire to ground, except in rooms that are particularly certified otherwise. Any disconnection of the protective ground conductor either inside or outside of the instrument is not permitted.

## Connection to measuring circuits presenting hazards to personnel

Before the connection is made to a hazardous circuit, a protective ground connection, for protection against the measurement circuit, ought to be connected to the enclosure. In case the protective ground conductor of the a.c. power line can also assume this protective function, the a.c. power connection should be established first of all. If the measuring circuit has an inherent protective ground conductor, then this conductor must be connected to the enclosure before a connection is made to the measuring circuit.

## Defects and Exceptional Conditions

When it can be assumed that safe operation is no longer possible, the equipment should be taken out of service and inadvertent operation should be prevented.
This occurs when

- the equipment shows external signs of damage
- the equipment no longer operates
- after being overstressed in any way (e.g. storage, transport) so that the tolerable limits are exceeded.

## Fuses

Only specified fuses are permitted for use.

## Opening the Instrument

After the covers have been removed or when components are removed with tools, certain components that operate with applied voltage could be exposed. And also connection points might be carrying a voltage.
Therefore, before the instrument is opened for inspection, all voltage sources should be disconnected.
But sometimes calibration, maintenance or repairs require that the instrument be open and operating with applied voltage. So only experienced craftspersons who understand the dangers associated with working on instruments that have exposed voltage points should undertake the job.
Capacitors can retain a voltage charge even after the instrument has been disconnected from voltage sources. Thus, the circuit diagrams should be observed.

## Repairs, Replacement of Components

Repairs must be done according to correct technical practice. With that, particular attention must be paid to the characteristics of construction. None of the safety precautions should be changed, especially for leakage paths and air gaps, and separation by insulation must not be reduced.
Only original replacement parts ought to be used. Other replacement parts are only permitted if the safety and protection against human injury are not degraded through the use of non-original components.

## Safety Testing after Repair and Maintenance

Testing of the protective ground conductor in the power cord for the instrument:

The resistance of the protective ground conductor shall be measured. It should be $<0.5\ \Omega$. The power cord should be bent and kinked during the measurement so as to reveal any intermittent connection. This gives evidence of a defective power cord.

Testing the insulation of the a.c. power circuit:

The insulation resistance is measured at 500 V between the a.c. power connection and the protective ground conductor connection. For this measurement, the instrument's power switch should be ON.
The insulation resistance ought to be $>2\ M\Omega$.

# 2 OPERATION

## 2.1 INTRODUCTION

This section contains information and instructions necessary for installing the Test Set. Included are initial inspection procedures, power and grounding requirements, environmental information, instructions for repackaging for shipment and first time operation.

## 2.2 INITIAL INSPECTION

This instrument was carefully inspected both mechanically and electrically before shipment. It should be free of mars or scratches and operating correctly upon receipt. To confirm this, the instrument should be inspected for physical damage in transit. If damage has occurred, file a claim with the carrier. Test the electrical performance of the instrument using the functional test found in Section 5 of this manual.

## 2.3 POWER REQUIREMENTS

The Test Set can be operated from the internal battery pack or from an external A.C. power source. Paragraph 2.4 explains the internal battery characteristics. Paragraph 2.5 explains the external A.C. power requirements.

### 2.3.1 BATTERY OPERATION

The internal battery pack consists of two rechargeable battery packs (+12 V and -12 V) which provide approximately 5 hours of continuous use without needing to be recharged. To recharge the batteries plug the Test Set into an external A.C. power source. Recharging takes place when the front panel power switch is in the OFF or ON position and takes 16 hours.

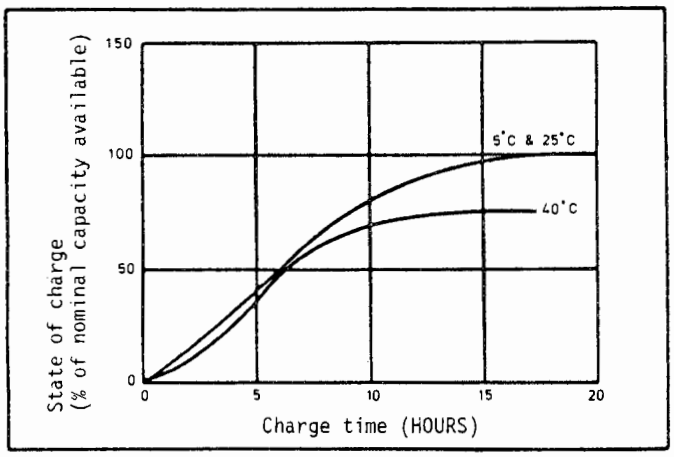



Fig. 2-1 Battery Charge Acceptance vs. Temperature

When operating on batteries, a flashing level display indicates that the batteries require recharging.

The battery packs may be charged at temperatures between 0°C and 40°C (32°F to 104°F), but will accept a greater charge if the temperature is between 0°C and 25°C. Figure 2-1 shows the decrease in charge acceptance at temperatures up to 40°C. Charging at temperatures outside the specified range may cause the batteries to vent, with a resulting decrease in capacity.
The batteries can be stored in the charged or discharged state. If the batteries are stored in the charged state they should be recharged for a period of 14 to 15 hours every 3 months. If this is not done, significant loss of battery capacity will occur. To minimize self-discharge during storage the batteries should be stored at a temperature of 20°C or lower. Although a nickel-cadmium battery will eventually lose all of its charge through self discharge it can be returned to full capacity with several charge/discharge cycles.

Caution: Permanent battery damage may result if the batteries are stored at high temperatures for a prolonged period.

Battery Life

The battery packs have a life in excess of 500 discharge-recharge cycles.

### 2.3.2 A.C. POWER OPERATION

The Test Set can be operated from any power source supplying 120 V or 220 V A.C. ± 10% with a frequency of 45 Hz to 60 Hz. The Test Set requires 15 VA maximum. Upon receipt of the Test Set the line voltage setting should be checked. If the AC line voltage available is in the range of 198 to 242 the power supply should be set to 220. If the voltage is in the range of 108 to 132 the supply should be set to 120. The 100 and 240 settings can be ignored.

If it is necessary to change the line voltage setting the following steps should be followed:

1. Remove the AC line cord.
2. Slide the plastic shield so that the fuse is accessible.
3. Remove the fuse.
4. Pull out the small PC card that is visible alongside the fuse holder with a pair of pliers. Orient the PC board so that the proper voltage marking (120 or 220) is visible when reinserted into the holder.
5. Replace the fuse with one of the proper value. For the 120 VAC setting a T 0.25A slow blow fuse is required. For 220 VCA operation, a T 0.125A slow blow fuse is required.

Caution: If the instrument is not set for the proper primary voltage and not properly fused, it may be seriously damaged.

## 2.4 GROUNDING REQUIREMENTS

To protect operating personnel, the Test Set complies with protection class I of VDE 0411.

The Test Set is equipped with a three conductor power cable which, when plugged into an appropriate receptacle, grounds the instrument. The offset pin on the power plug is the ground connection.

Warning: For operator protection connect the rear panel ground terminal to earth ground when operating in the battery mode.

## 2.5 ENVIRONMENTAL INFORMATION

Operating Temperatures

In order for the Test Set to operate within the specifications listed in Section 1, the operating temperature must be within the range of 0°C to +55°C (32°F to +131°F). Refer to Paragraph 2.4 for storage information.

Relative Humidity

The allowable humidity for proper operation of the Test Set is 0% to 95% for temperatures below 40°C (+105°C). As temperatures increase above 40°C the allowable relative humidity for proper operation will decrease.

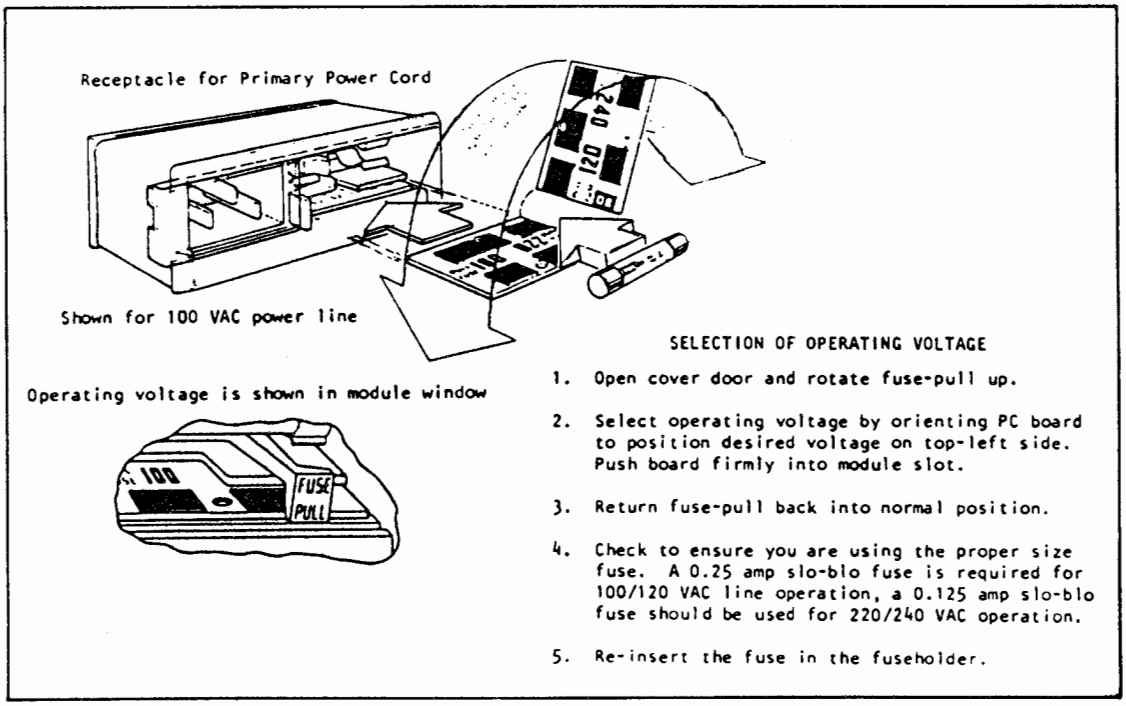



Fig. 2-2 Voltage Selection

## 2.6 TEST SET FEATURES

The model PMG-3 Transmission Test Set measures noise level, tone level and tone frequency while simultaneously sending tone. Both input and output circuits have independently selectable impedances of 600 and 1200 Ω. An additional high input impedance is available for bridging applications. The frequency of send and receive tone signals, are measured with a five digit frequency counter that has a range of 20 Hz to 110 kHz and a resolution of either 1 or 10 Hz. The level of send and receive tones, as well as noise are measured with a three digit auto ranging level meter that has a dynamic range of 90 dB with a resolution of 0.1 dB.

The level generator in the PMG-3 is a frequency synthesizer that is phase locked to a 1 MHz crystal controlled frequency standard. The generator has a continuously variable frequency range of 50 Hz to 20 kHz with a 1 Hz resolution and crystal stability.

The generator also has three fixed frequencies of 420, 820 and 3000 Hz. The output level is continuously adjustable from +10 dBm to -50 dBm with a resolution of 0.1 dBm for both fixed and variable frequencies.

Four noise weighting filters as per CCITT P.53 and CCIR 468.2 specifications are provided: Telephone weighted and flat and sound program weighted and unweighted. Also provided is a narrowband notch filter with a center frequency of 820 Hz. This filter can be inserted in series with the signal path to eliminate test or holding tones that are necessary for some measurements.

## 2.7 FRONT AND REAR PANEL LAYOUT

The following table shows the relationship between the operating control and connector numbers the associated abbreviations in the circuit diagram and their functions. Refer to figures 2-3 and 2-4. Note that the numbers in the squares agree with the numbers printed on the front and rear of the instrument.

| Control or Connector No. | Abbreviation in Circuit Diagram | Function |
|---|---|---|
| [1] | DS 1 | Measured level display |
| [2] | S 1601 | Resolution selector for frequency display |
| [3] | DS 4 | Frequency display |
| [4] | R 1601 | Generator output level adjustment, coarse and fine |
| [5] | S 1801, S 1802, S 1803, S 1804 | Generator frequency selector switch; 3 fixed frequencies or continuous tuning |
| [6] | S 1301, S 1302, S 1303, S 1304 | Measuring mode selection switches |
| [7] | S 1305 | Display selection switch; select display of generator or receiver level and frequency |
| [8] | S 1201, S 1202, S 1203, S 1204, S 1205 | Noise weighting selection switches |
| [9] | G 1601 | Generator frequency tuning control |
| [10] | S 1101 | Switch for connection of external dial |
| [11] | S 1102, S 1103 | Input impedance selection switches |
| [12] | S 1104 | Input/output jack selector |
| [13] | S 1105 | Output impedance selection switch |
| [14] | R 1602 | On/Off and monitoring volume control |
| [15] [16] | J 1102 | Dial connection posts |
| [17] | J 1101 | Input/output port A |
| [18] | J 1103 | Input/output port B |
| | Rear Panel | |
| - | LS 1701 | Monitor speaker |
| - | FL 1 | Power supply line voltage selection card with fuse and AC power socket |
| - | - | Screw removal tool |
| - | - | Ground connection jack |

## 2.8 FRONT PANEL CONTROLS, CONNECTORS AND DISPLAYS

The use of the front panel controls and connectors depends on the measurement task. A general description of the function of the controls follows:

### 2.8.1 POWER

Power to the test set is controlled by a push-pull power switch. When connected to an external power source the pilot lamp will remain lit in both the ON and OFF position of the power switch. This indicates that the internal battery pack is being charged.

Warning: For operator protection connect the rear panel ground terminal to earth ground when operating in the battery mode.

Speaker volume is controlled by rotating the power switch knob clockwise or counter-clockwise.

### 2.8.2 DIAL AND HOLD

This feature allows a lineman's handset to be connected to the PMG-3 and a line dialed up for testing. The line to be tested is connected to the A connector and a lineman's handset is connected to the DIAL connector. Depressing the DIAL switch connects the DIAL and A connector together. After a line has been seized and dialed up, release the DIAL switch and remove the handset. Testing of the telephone line can now proceed without the additional loading of the handset.

### 2.8.3 INPUT/OUTPUT SELECTION

This section selects the A and B connectors for sending or receiving as well as the proper terminations for the telephone line under test. The test set has two input/output connectors and an input/output selection switch. Either the A or B connector can be used for sending or receiving. If one connector is selected for sending - the other connector is automatically connected for receiving.

Three pushbutton switches independently select either 600 or 1200 Ω input/output impedances. An additional high input impedance is available for bridging applications.

### 2.8.4 MEASUREMENT MODES

#### 2.8.4.1 Level and Noise

Four pushbutton switches are used to select different receive modes of operation. When the level switch is depressed, the test set is capable of wideband level measurements in the frequency range of 50 Hz to 110 kHz. The detector used for level measurements is a true R.M.S. responding detector.

In the LEVEL mode of operation, the frequency of the measured signal is also displayed. For LEVEL measurements under 20 kHz the frequency counter has a resolution of 1 Hz. For frequency measurements over 20 kHz the resolution is 10 Hz.

Depressing either of the NOISE switches allows one of four weighting filters to be inserted into the signal path for noise measurements. Note that a RMS or quasi-peak detector can be selected for noise measurements. If no weighting filter is selected, the noise measurement is band limited at approximately 35 kHz.

#### 2.8.4.2 Noise to Ground

When the NOISE TO GROUND switch is depressed the test set will measure the common mode noise signal that is present on the balanced telephone line under test.

### 2.8.5 SEND FREQUENCY

Send frequencies generated by the test set can be selected in one of two ways. By depressing the CONTINUOUS switch and rotating the continuous FREQUENCY knob, any frequency in the range of 50 Hz to 20 kHz can be selected. By depressing either the 420, 820 or 3000 switch, one of three fixed frequencies can be selected.

### 2.8.6 SEND LEVEL

The level of the send frequency can be adjusted to the required value by rotating either the COARSE or FINE LEVEL controls. Any level in the range of -50 dBm to +10 dBm can be selected.

By depressing the DISPLAY switch the two readouts will simultaneously monitor the output frequency and level.

### 2.8.7 FREQUENCY MEASUREMENT

Frequency measurements may be made by releasing the display switch and depressing the LEVEL switch. The frequency to be measured is connected to the "A" or "B" input and read on the right hand display in kHz. If the frequency is below 20 kHz and a measurement with a 1 Hz resolution is required set the RESOLUTION switch to 1 Hz.

## 2.9 O P E R A T I N G  I N S T R U C T I O N S

The operation of the test set is quite simple. The following step-by-step instructions can be used to make basic transmission tests. Note that knowledge of the transmission system under test is necessary so that meaningful measurements can be made. Attention should be paid to match circuit impedances and to select the proper weighting networks. Finally, subscriber circuits may be carrying DC or ringing voltage, therefore, care should be taken to avoid shock.

### 2.9.1 LEVEL MEASUREMENTS

| Step | Description |
|---|---|
| 1 | Turn power on. |
| 2 | Set the RESOLUTION switch to 10 Hz. |
| 3 | Release the DISPLAY switch. |
| 4 | Depress the LEVEL switch. |
| 5 | Select the required INPUT IMPEDANCE. |
| 6 | Select the "A" or "B" RECEIVE, and connect the signal to be measured to this input. |

NOTE: The signal frequency will be displayed on the right hand readout in kHz with a 10 Hz resolution. If the measured frequency is below 20 kHz and 1 Hz resolution is required set the RESOLUTION switch to 1 Hz.

### 2.9.2 NOISE MEASUREMENTS

| Step | Description |
|---|---|
| 1 | Turn power on. |
| 2 | Select the required input impedance. |
| 3 | Select either "A" receive or "B" receive and connect the telephone line under test to this input. |
| 4 | Select the required noise weighting filter by depressing the appropriate pushbutton. |
| 5 | Depress the appropriate NOISE pushbutton and release the DISPLAY pushbutton. |
| 6 | Noise testing of the telephone line can now proceed. |

NOTE: If test or holding tones are present they can be eliminated from the noise measurements by depressing the notch pushbutton.

### 2.9.3 NOISE TO GROUND MEASUREMENTS

| Step | Description |
|---|---|
| 1 | Turn power on. |
| 2 | Select the required input impedance. |
| 3 | Select either "A" receive or "B" receive and connect the telephone line under test to this input. |
| 4 | Select the required noise weighting filter by depressing the appropriate pushbutton. |
| 5 | Depress the NTG pushbutton and release the DISPLAY pushbutton. |
| 6 | Connect a ground lead from the rear panel ground terminal to earth or system ground. |
| 7 | Noise testing of the telephone line can now proceed. |

NOTE: If test or holding tones are present they can be eliminated from the noise measurements by depressing the notch pushbutton.

## 2.9.4 GENERATOR LEVEL AND FREQUENCY ADJUSTMENT

| Step | Description |
|---|---|
| 1 | Turn power on. |
| 2 | Depress the DISPLAY switch. The send frequency and level will now be monitored on the two displays. |
| 3 | Select the required output impedance. |
| 4 | Select either "B" receive or "A" output and connect the telephone line under test to this output. |
| 5 | Select one of the three fixed frequencies or the continuously tuned frequency mode and adjust to the required output. |
| 6 | Using the COARSE and FINE LEVEL controls adjust the send frequency to required level. |
| 7 | Testing of the telephone line or circuit can now proceed. |

## 2.9.5 FREQUENCY MEASUREMENTS

| Step | Description |
|---|---|
| 1 | Turn power on. |
| 2 | Set the RESOLUTION switch to 10 Hz. |
| 3 | Release the DISPLAY switch. |
| 4 | Depress the LEVEL switch. |
| 5 | Select the required INPUT IMPEDANCE. |
| 6 | Select either "A" receive or "B" RECEIVE, and connect the frequency to be measured to this input. |
| | NOTE: The frequency will be displayed on the right hand readout in kHz with a 10 Hz resolution. If the measured frequency is below 20 kHz and 1 Hz resolution is required set the RESOLUTION switch to 1 Hz. |

## 2.9.6 LINE BALANCE MEASUREMENT

| Step | Description |
|---|---|
| 1 | Measure the telephone line noise using Table 3-4 as a guide. |
| 2 | Measure the noise to ground using Table 3-5 as a guide. |
| 3 | Figure the telephone line balance using the following formula: |

Balance (dB) = Noise (dBm) - NTG (dBm)

# 3 MEASUREMENT NOTES

## 3.1 LEVEL MEASUREMENTS

When measuring the level of test tones or complex signals, the Test Set should be in the level mode. In this mode the test set measures the total power on the circuit under test using a RMS detector. The measuring bandwidth is approximately 10 Hz to 240 kHz.

## 3.2 NOISE MEASUREMENTS

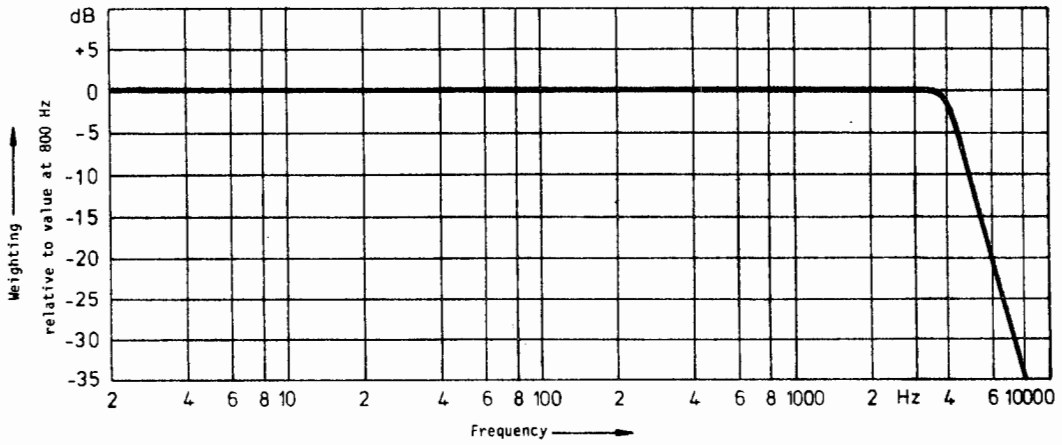
The measurement of noise on telephone circuits generally involves the use of noise weighting filters. These filters weight the response of the test set so that there is a more direct relationship between the measured result and the true circuit quality degradation as perceived by a listener.

When measuring noise on telephone channels a RMS detector is used. Measurement of noise on sound program channels is usually done using a quasi peak detector.

The four noise weighting filters included in the PMG-3 meet the relevant CCITT and CCIR specifications. In addition, a notch filter can be placed in series with the noise weighting filters to allow notched noise measurements.

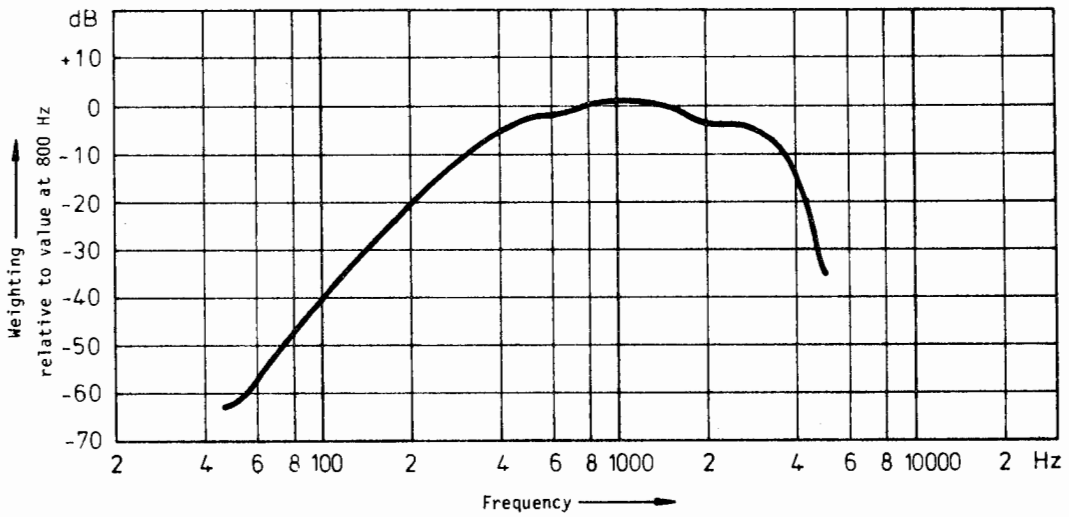
### 3.2.1 TELEPHONE FLAT

This filter is used to analyze low frequency noise such as power line hum on telephone message circuits.



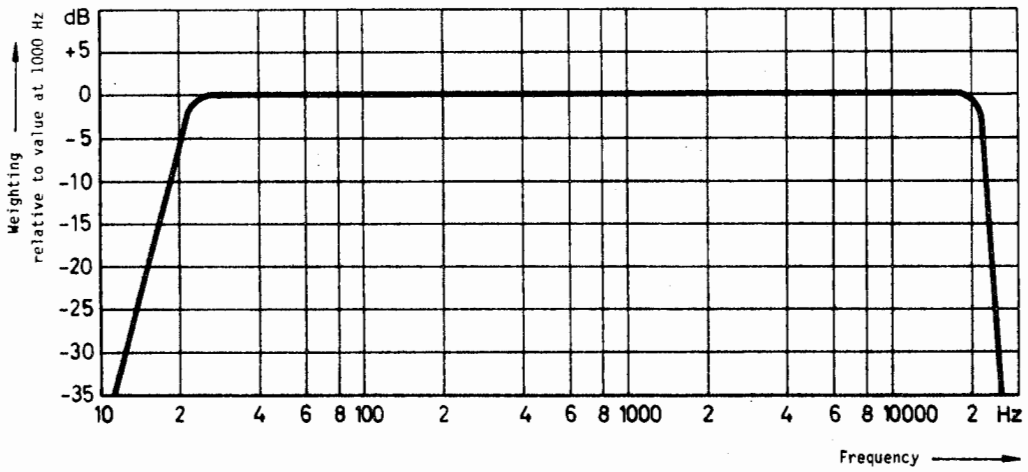

### 3.2.2 TELEPHONE WEIGHTED (PSOPHOMETRIC)

The psophometric weighting filter provides the frequency response weighting characteristic specified by the CCITT for telephone message circuit noise measurements. The psophometric characteristic simulates the perceived response of the human ear to telephone noise.



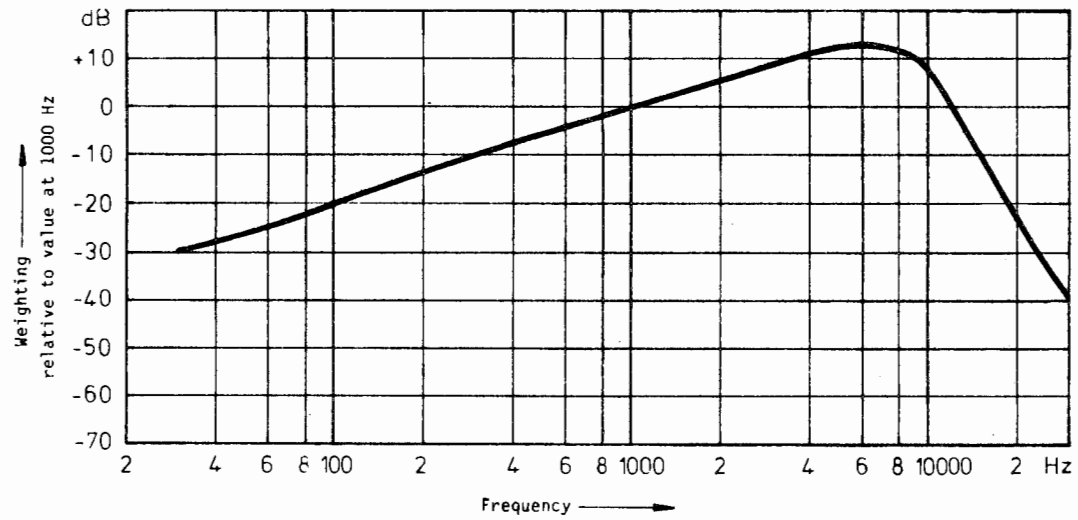

### 3.2.3 SOUND PROGRAM FLAT

This filter is used for unweighted noise measurements on telephone lines carrying radio broadcast material.




### 3.2.4 SOUND PROGRAM WEIGHTED

This filter is used for weighted noise measurements on telephone lines carrying radio broadcast material.



### 3.2.5 NOTCH FILTER

This narrowband filter has a center frequency of 820 Hz and can be inserted into the test signal path in series with any one of the four other filters. The purpose of this filter is to eliminate test or holding tones that are necessary for some transmission tests. The filters -0.5 dB, -3 dB and -50 dB bandwidth points conform to CCITT 0.132 specification.

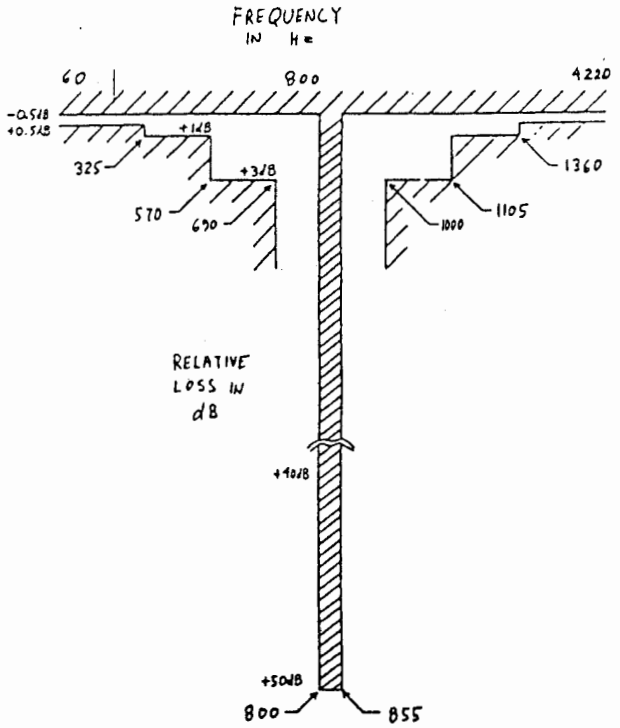



Fig. 3-4 Notch Filter-Frequency Response, CCITT 0.132.

# 5 FUNCTION CHECKING, MAINTENANCE AND GENERAL INFORMATION

## 5.1 FUNCTIONAL TESTS

1. Turn the PMG-3 on using the ON/OFF control.

2. Set up the PMG-3 by depressing the following switches:

   LEVEL
   DISPLAY
   820 Hz
   TELEPHONE FLAT

   Set the RESOLUTION switch to 1 Hz. The right hand readout should indicate 820 Hz.

   Rotate the LEVEL controls untill 0 dBm is indicated in the left hand readout.

   Rotate the SPEAKER control. An audible tone should be heard.

3. Depress the continuous switch. Rotate the continuous knob clockwise. The right hand display will increase up to a 20 kHz reading. The reading will then change to 10 kHz with a flashing (-) sign. Rotate the continuous knob counter-clockwise. The reading will decrease to under 20 Hz. Set the frequency to 1000 Hz.

4. Select an output and input impedance of 600 Ω.

5. Connect a cable between the "A" and "B" connectors. Release the DISPLAY switch.

   The left hand display should read 0 dBm and the right hand display should read 1000 Hz.

6. Depress the NOISE TELEPHONE switch. The right hand display should indicate all 0's.

7. One at a time depress the NOISE WEIGHTING FILTER switches. The level display readings should be:

| | | | |
|---|---|---|---|
| TEL WTD | - | +1.0 ± 0.2 dB | |
| TEL FLAT | - | 0 | ± 0.2 dB |
| PROGRAM WTD | - | 0 | ± 0.5 dB |
| PROGRAM FLAT | - | 0 | ± 0.2 dB |

   Set frequency to 820 Hz. Depress TELEPHONE FLAT.

8. Depress the NOTCH switch. The left hand display should indicate a changing reading of less than -54 dBm and an audible rushing noise should be heard. Release the NOTCH switch.

9. Depress the DISPLAY switch and set the level to -40 dBm. Release the DISPLAY SWITCH.

10. Depress the NTG switch, the left hand display should read less than -49.5 dBm.

11. With the DIAL switch in the released position, connect a lineman's handset to the DIAL connector.

12. Select the desired input impedance.

13. Connect the telephone line to connector "A".

14. Depress the DIAL switch and dial TEST NUMBER with the handset.

15. When a line has been seized, release the DIAL switch. The line should remain connected to the selected output connector.

16. Remove the line and handset from the PMG-3 connectors. This completes the first time operational checkout of the PMG-3 Test Set.

## 5.2 INSTALLATION IN 19" RACKS

Mounting brackets plus a 1/2 rack width blank panel must be attached to the PMG-3 in order to rack mount the PMG-3. The complete set of mounting hardware can be obtained by ordering the rack mounting kit 9202/00.02. The feet on the bottom of the PMG-3 and the guide studs on top of the instrument should be removed before installation.

## 5.3 REPLACEMENT OF FUSE

The fuse is located behind a clear plastic shield located on the rear panel. In order to change the fuse, the AC power cord must be removed. When the power cable is removed the plastic shield can be slid up to allow access to the fuse. The fuse is easily removed by using the knob contained in the fuse holder. The fuse must be replaced with the correct type and size. Spare fuses can be found inside the instrument and can be accessed by removing the top of the instrument. The top cover of the instrument can be removed by unfastening the six hexagon screws using the tool mounted on the back of the test set.

## 5.4 REPACKAGING FOR SHIPMENT

NOTE: If the instrument is to shipped to W&G for service or repair, attach a tag to the instrument identifying the owner and indicating the service or repair to be accomplished. Include the model number and full serial number of the instrument. In any correspondence, identify the instrument by model number and full serial number. Please contact the nearest W&G service center before shipping the unit. This will allow for proper repair scheduling and will minimize repair turn-around time.

The following is a general guide for repackaging the instrument for shipment. If the original container is available, place the instrument in the container with appropriate packing material and seal well with strong tape or metal bands. If the original container is not available, proceed as folllows:

a. Wrap the instrument in heavy paper or plastic before placing in an inner container.

b. Place packing material around all sides of the instrument and protect panel face with cardboard strips or plastic foam. See Fig. 5-1.

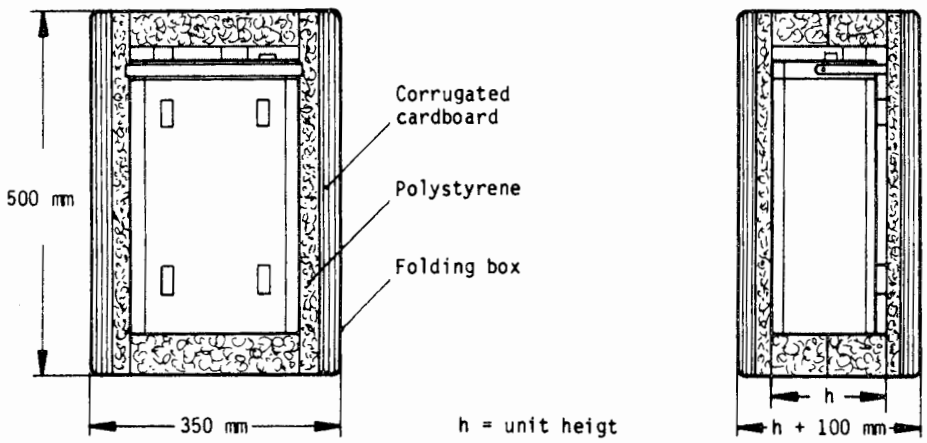



Fig. 5-1 Packing Instructions

c. Place instrument and inner container in a heavy carton and seal with strong tape or metal bands.

d. Mark shipping container "DELICATE INSTRUMENT", "FRAGILE", etc.

## 5.5 REPLACEMENT OF THE BATTERY PACK

In the event the battery pack has to be replaced, the following steps should be followed:

1. Disconnect the AC line cord and turn the test set OFF.
2. Remove the top of the test set by removing the 6 hexagon screws using the tool located on the back of the test set.
3. Remove the instrument from its housing by lifting it up and out of the housing.
4. Remove the metal clamp that is holding the battery pack in place.
5. Carefully disconnect the battery pack connector from the circuit board at the rear of the test set. Note the orientation of the connector!
6 Slide the battery pack out of the side of the instrument.
7. The battery pack can now be serviced or replaced entirely.

   CAUTION: When placing a serviced or a new battery pack into the test set pay special attention to the orientation of the connector. The wider locking lip should face the bottom of the instrument.

8. Before replacing the top cover of the instrument check that the battery clamp has been properly installed and that the front panel of the instrument is at the front of the housing.