



AUTORANGING AC VOLTMETER
NOISE METER

M2177

INSTRUCTION MANUAL

DA00010591-001

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NOISE METER

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INSTRUCTION MANUAL

----- WARRANTY -----

NF Corporation certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from our factory.

All **NF** products are warranted against defects in materials and workmanship for a period of one year from the date of shipment. During the warranty period of, **NF** will, at its option, either will repair the defective product without any charge for the parts and labor, or either repair or replace products which prove to be defective. For repair service under warranty, the product must be returned to a service center designated by **NF**. Purchaser shall prepay all shipping cost, duties, and taxes for the product to **NF** from another country, and **NF** shall pay shipping charge to returned the product to purchaser.

This warranty shall not apply to any defect, failure or damage caused by improper use, improper or inadequate maintenance and care or modified by purchaser or personnel other than **NF** representatives.

NF Corporation

After-sales service policy

In the unlikely event that a breakdown or unidentified problem has occurred, contact **NF Corporation** or an **NF Corporation** sales representative.

When contacting us, please indicate the model name (or product name), manufacturer's serial number, and a detailed description of the problem and the use conditions under which it occurred.

Although we do our best to repair products as promptly as possible, repair of products older than five years may be delayed by difficulties in obtaining replacement parts.

Note that, in cases where replacement parts are no longer being manufactured, repairs may be declined if the product in question has extensive damage or has been substantially modified.

---- Preface ----

Thank you for purchasing the M2177 Autoranging AC Voltmeter/Noise meter.

Be sure to read the section entitled "Safety Precautions" in advance to ensure safe use of this electrical product.

■ Caution Symbols Used in This Manual

The following caution symbols are used in this manual. Be sure to observe these caution symbols and their contents to ensure the safety of the user and avoid damage to the equipment.

WARNING

This mark indicates information for the avoidance of a hazard such as electric shock that may endanger human life or cause injury during handling of the equipment.

CAUTION

This mark indicates information for the avoidance of damage to the equipment during handling.

---- Safety Precautions ----

To ensure safe use, be sure to observe the following warnings and cautions.

NF Corporation shall not be held liable for damages that arise from a failure to observe these warnings and cautions.

- **Be sure to observe the contents of this user's manual.**

This user's manual contains information for the safe operation and use of this product.

Be sure to read this information first before using this product.

All the warnings in the user's manual must be heeded to prevent hazards that may cause major accidents.

- **Be sure to ground the product.**

To prevent accidental electrocution, always connect the M2177 to a grounding source rated as a Type 3 grounding source in the Technical Requirements for Electrical Appliances.

Use the supplied power cord (3-pin terminal) to connect the M2177 to a power outlet with a three-prong, grounded contact.

If only two-prong power outlets are available, use a conversion adapter.

In such cases, the conversion adapter's grounding wire should be attached to a nearby ground terminal before connecting the power cord to the outlet.

- **Check the power supply voltage.**

This product operates on the power supply voltage indicated in "2.4 Power Supply and Grounding" in this instruction manual.

Prior to connecting the power supply, check that the voltage of the power supply matches the rated power supply of the product.

- **Observe the fuse ratings.**

If not observed a fire may occur. Use fuses with the ratings specified in "2.4 Power Supply and Grounding".

Be sure to disconnect the power cord from the outlet when replacing the fuses.

- **In case of suspected anomaly**

If this product emits smoke, an abnormal smell, or abnormal noise, immediately power it off and stop using it.

If such an anomaly occurs, do not use this product until it has been repaired, and immediately report the problem to the location of purchase (either NF Corporation or your distributor).

- **Do not use this product when gas is present**

Do not use this product when gas is present, as this may cause an explosion.

- **Do not remove the cover.**

This product contains high-voltage parts. Absolutely never remove its cover.

Even when the inside of this product needs to be inspected, do not touch the inside. All such inspections are to be performed by service technicians designated by NF Corporation.

- **Do not modify this product.**

Use only parts designated by NF Corporation as replacement parts. Use of non-designated parts may result in new hazards or may interfere with repairs when breakdowns occur.

- **Safety-related symbols**

The general definitions of the safety-related symbols used on this product and in the instruction manual are provided below.



Instruction Manual Reference Symbol

This symbol is displayed to alert the user to potential danger and refer him/her to the instruction manual.



Warning Symbol

Together with this symbol, information is provided in order to prevent users from encountering hazards, such as electric shock, that could result in serious injury or death.



Caution Symbol

This symbol indicates information for preventing damage to the product when handling it.

Contents

	Page
1. General Description	
1.1 Outline.....	1-1
1.2 Features	1-1
1.3 Applications	1-1
1.4 Specifications	1-2
1.4.1 Electrical ratings	1-2
1.4.2 Mechanical ratings.....	1-4
1.4.3 Installation requirements.....	1-4
1.4.4 Options	1-5
2. Preparations before Operation	
2.1 Unpacking	2-1
2.2 Components	2-1
2.3 Installation	2-1
2.4 Power Supply and Grounding.....	2-2
3. Operations	
3.1 Part Names and Functions	3-1
3.2 I/O Connections	3-3
3.3 Startup.....	3-3
3.4 Cautions for Use	3-3
4. Principles of Operation	
4.1 Block Diagram	4-1
5. Maintenance	
5.1 Outline.....	5-1
5.2 Operation Checks.....	5-1
5.3 Adjustment and Calibration	5-3
6. Easy Checks on Faulty Parts	
7. Standard Data	
7.1 On Standard Data	7-1
7.2 Standard Data	7-1

Figures

	Page
Figure 1-1 External dimensions diagram.....	1-6
Figure 3-1 Diagrams of front and rear panels.....	3-6
Figure 4-1 Block diagram	4-1
Figure 5-1 Silk diagram of PCB (viewed from above, with top cover removed)	5-5
Figure 7-1 JIS C1502 (JIS A) characteristics diagram.....	7-2
Figure 7-2 JIS C1502 (JIS C) characteristics diagram.....	7-2
Figure 7-3 CCIR ARM characteristics diagram.....	7-3
Figure 7-4 DIN 45405 (AUDIO) characteristics diagram.....	7-3
Figure 7-5 DIN 45405 (NOISE) characteristics diagram.....	7-4
Figure 7-6 CCIR characteristics diagram	7-4
Figure 7-7 IHF BPF characteristics diagram.....	7-5

Tables

	Page
Table 2-1 Component list	2-1
Table 5-1 Reference levels of standard-equipped weighting filters.....	5-2

1. General Description

1.1	Outline	1-1
1.2	Features.....	1-1
1.3	Applications	1-1
1.4	Specifications.....	1-2
1.4.1	Electrical ratings	1-2
1.4.2	Mechanical ratings.....	1-4
1.4.3	Installation requirements.....	1-4
1.4.4	Options	1-5

1.1 Outline

The M2177 Autoranging AC Voltmeter/Noise Meter is a 30 μ V full scale AC voltmeter that features an autoranging function. Four types of weighting filters are standard equipped, and two additional filters can be added as options. The detection mode can be switched among root mean square detection (RMS), average value detection (AVE), and quasi-peak detection (Q.PEAK) modes, so the M2177 can also be used as a noise meter.

The M2177 includes an AC output terminal that enables it to be used as a signal conditioner. The M2177s' input impedance is typically 1 M Ω and it can be connected to the probe of various commercial oscilloscopes.

Since the M2177 also includes a DC output terminal, it can be used as an AC-DC converter, with measurement values saved to a recorder.

 Specification when ordering the M2177 Additional weighting filters can be specified.

 1.4.4 Options

 A "dB linear scale option" is available to make the decibel scale an evenly incremented scale.

1.2 Features

- High-speed auto range switching
Approximately 100 ms per range
- High sensitivity
30 μ V full scale
- Switchable display modes
Display modes are: root mean square detection, average detection, or quasi-peak detection.
- Weighting filters
Four types (JIS A, JIS C, DIN 45405 [AUDIO], and CCIR ARM) are included.
Up to two more types of weighting filters can be added as built-in options.
- Includes AC and DC output terminals
- Includes sensitivity adjustment function
0 to -10 dB
- Meter includes mirror for easier legibility
- dB linear scale is available as an option

1.3 Applications

- Large meters are used to facilitate in-line inspections.
- The sensitivity adjuster can be used to measure S-N ratios.
- This product can also be used as a signal conditioner (variable-gain preamplifier).
- This product can be used as an attenuator for input up to 250 V_{peak}. (For sine waves, it can be used as a sensitivity adjuster for up to 176 V_{rms}.)
- Voltage variation data can be recorded by connecting a recorder or A/D board to this product's DC output terminals.

1.4 Specifications

1.4.1 Electrical ratings

- Measurement range

Voltage measurement range:

30 μ Vrms/full scale ^(*1) to 100 Vrms/full scale

1 or 3 series, 14 ranges

*1: Full scale is defined as level 10 on a meter with an 11 level scale.

Frequency range

True root mean square (RMS) detection	30 μ V range	5 Hz to 50 kHz
	100 μ V to 100 V range	5 Hz to 250 kHz
Average (AVE) detection	30 μ V range	5 Hz to 50 kHz
	100 μ V range	5 Hz to 250 kHz
	300 μ V to 100 V range	5 Hz to 500 kHz
Quasi-peak (Q.PEAK) detection	30 μ V range	5 Hz to 30 kHz
	100 μ V to 100 V range	5 Hz to 100 kHz

- Meter measurement accuracy

(23°C \pm 5°C, 1/5 full scale or above, CAL. Percentage vs. full scale is shown.)

True root mean square (RMS) detection	30 μ V range	\pm 5%, from 20 Hz to 30 kHz \pm 10%, from 5 Hz to 50 kHz
	100 μ V to 100 V range	\pm 3%, from 20 Hz to 100 kHz \pm 10%, from 5 Hz to 250 kHz
Average (AVE) detection	30 μ V range	\pm 5%, from 10 Hz to 30 kHz \pm 10%, from 5 Hz to 50 kHz
	100 μ V range	\pm 5%, from 10 Hz to 100 kHz \pm 10%, from 5 Hz to 250 kHz
	300 μ V to 100 V rang	\pm 3%, from 20 Hz to 100 kHz \pm 5%, from 7 Hz to 200 kHz \pm 10%, from 5 Hz to 500 kHz
Quasi-peak (Q.PEAK) detection	30 μ V range	\pm 5%, from 20 Hz to 10 kHz \pm 20%, from 5 Hz to 30 kHz
	100 μ V to 100 V range	\pm 5%, from 20 Hz to 10 kHz \pm 10%, from 10 Hz to 30 kHz \pm 20%, from 5 Hz to 100 kHz

- **Inputs**
 - Input connector: BNC-R
 - Input impedance: 1 M Ω Typ., 25 pF or less
 - Non-destructive maximum input voltage
 - 30 mV to 100 V range: Peak value of AC + DC \pm 250 V
 - 30 μ V to 10 mV range: AC \pm 5 V peak, peak value of AC + DC \pm 250 V
 - Overvoltage category(CAT): 1
- **Sensitivity adjustment range**
 - 0 to -10 dB or more
- **Weighting filters**
 - JIS A (JIS C1502), JIS C (JIS C1502), DIN 45405 (AUDIO), and CCIR ARM are included.
 - Two additional filters can be added (three can be added if CCIR ARM is removed).
 - The CCIR ARM can also be changed to CCIR.
- **Measurement methods**
 - True root mean square (RMS) detection
 - Average detection and root mean square indication (calibrated by sine wave)
 - Quasi-peak detection (calibrated by sine wave)

Switchable

The quasi-peak detection complies with the DIN and CCIR standards (except when 1/4 full scale or below).
- **Tolerable crest factor**
 - 5. (at full-scale input, RMS detection)
- **Meter**
 - Includes mirror and taut band
 - Voltmeter scales
 - 0 to 11, 0 to 3.5
 - Decibel scales
 - 20 to +1 dBV
 - 16 to +3 dBm (0 dBm = 1 mW @ 600 Ω)
 - Note: There is no scale for values less than 0.1 of full scale.
- **AC output**
 - Output connector: BNC-R
 - Output impedance: 50 Ω (Typ.) (recommended load impedance: at least 5 k Ω)
 - Output voltage: 1 V (with full-scale input and no load)
 - Output voltage accuracy: Same as accuracy meter's average detection mode.
 - Maximum output voltage: 10 Vpeak (1 kHz, no load, and linear operation)
 - Maximum output current: 10 mA (linear operation)

- DC output
 - Output connector: BNC-R
 - Output impedance: 50 Ω (Typ.) (recommended load impedance: at least 5 k Ω)
 - Output voltage: +1 V (with full-scale input, no load)
 - Output voltage accuracy: Same as accuracy meter's average detection mode.
 - Maximum output current: 10 mA (Typ.) (linear operation)
 - Ripple: 0.14 Vp-p (Typ.) (with no load, full-scale input, average detection, and 10 Hz)
- Autorange function (20 Hz to 500 kHz)
 - AUTO
 - Auto switching of ranges for input signals below approximately 2.4 or above 10.5 on the 11-level full scale.
 - HOLD
 - This stops the auto range switching function. When the range knob is turned, the range is switched upward or downward one range at a time.
- Power supply
 - 100 V / 120 V / 230 V AC \pm 10%
 - 50/60 Hz
 - 25 V Amax
 - Overvoltage category (CAT): II

1.4.2 Mechanical ratings

- Dimensions
 - 140 (W) \times 177 (H) \times 300 (D) mm (not including protruding parts)
- Weight
 - 3.5 kg (Typ.)

1.4.3 Installation requirements

- Ambient temperature and humidity
 - In operation: 0°C to 40°C, 10 to 95% RH (no condensation)
 - In storage: -10°C to 50°C, 10 to 85% RH (no condensation)
- Contamination
 - level: 2

1.4.4 Options

- Filters (options when ordering) used for weighting, etc.

Two filters can be added (three can be added if CCIR ARM is removed). The CCIR ARM can also be changed to CCIR.

DIN 45405 (Noise)

CCIR^(*2)

IHF BPF

*2: Either CCIR or CCIR ARM can be selected, but not both.

1/3 oct band pass filter: The following frequencies in the 10 Hz to 20 kHz range;

10, 12.5, 16, 20, 25, 31.5, 40, 50, 63, 80

(Example: fo; 100 Hz, 315 Hz, 800 Hz, 1 kHz)

- dB linear scale option (when ordering)

Voltage scales: 2.2 to 11, 0.7 to 3.5

Decibel scales: -13 to +1 dBV

-10 to +3 dBm (0 dBm = 1 mW, 600 Ω)

DC output voltage: +1 V (with full-scale input, no load)

0 V (with -10 dB of full-scale input, no load)

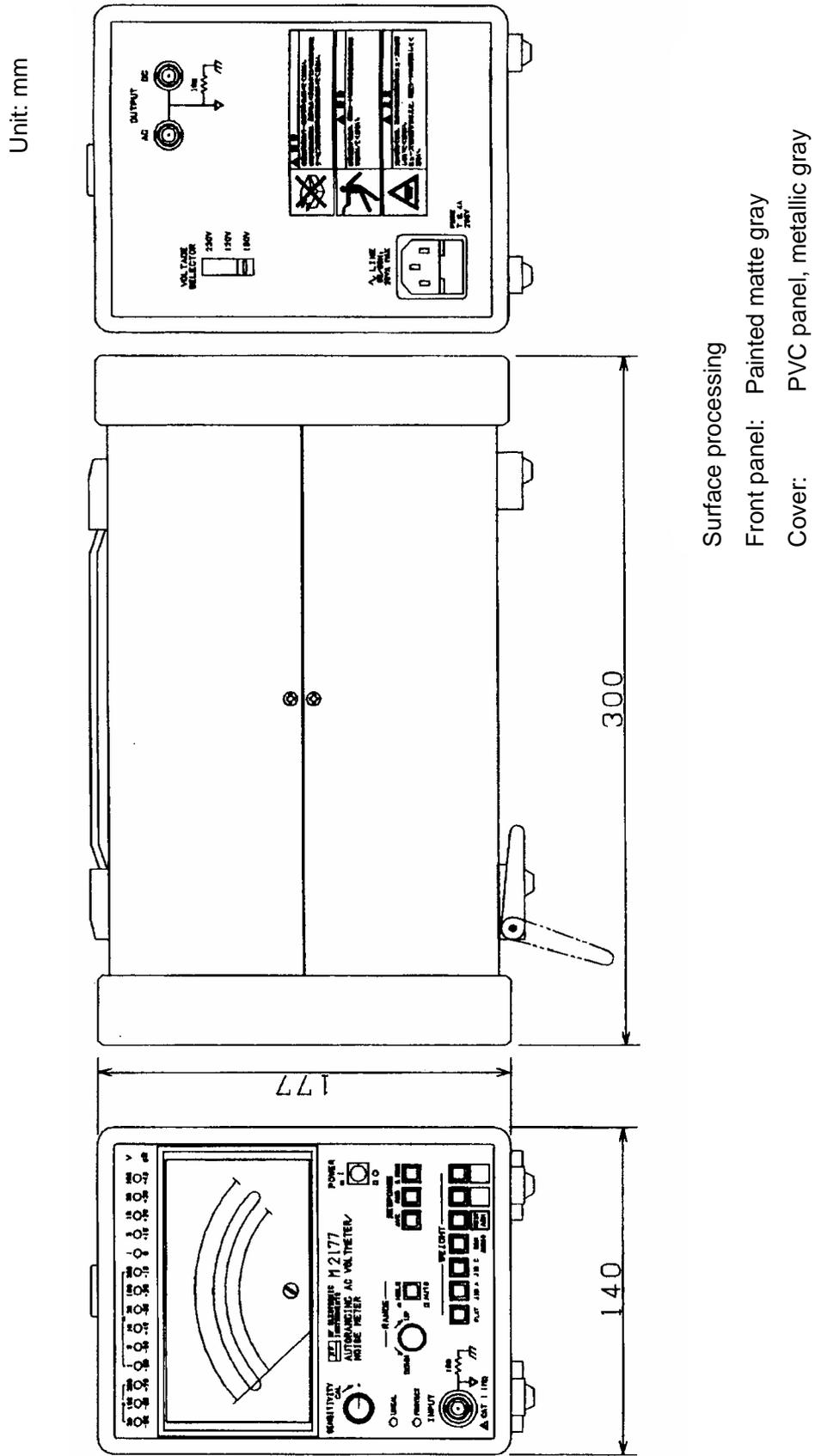


Figure 1-1 External dimensions diagram

2. Preparations before Operation

2.1	Unpacking.....	2-1
2.2	Components.....	2-1
2.3	Installation.....	2-1
2.4	Power Supply and Grounding	2-2

2.1 Unpacking

After unpacking, check for any damage that may have occurred during shipment. Although all parts are carefully checked before shipment, there may be loose components such as control knobs. Also, check the accessories against the component list shown in “Table 2-1 Component List” to make sure none are missing.

2.2 Components

The M2177’s standard components are listed in “Table 2-1 Component List” below.

Table 2-1 Component list

Item	Quantity
Main unit	1
Instruction Manual	1
Accessories	
Power cord (3 prong, 2 meter)	1
Plug conversion adapter	1
Fuses (0.4 A / 250 V time lag, $\phi 5.2 \times 20$ mm) [Fuses are provided in fuse holder.]	1

2.3 Installation

- Installation site
 - Set the main unit so that the rubber feet on the bottom and the stand are on a smooth flat surface such as a desk or table.
- Install this product in an environment that meets the following ambient temperature and humidity requirements.
 - In operation: 0°C to 40°C, 10 to 95% RH
 - In storage: -10°C to +50°C, 10 to 85% RH
 - This product should be used in a condensation-free environment.
- Do not install this product in any of the following types of environments.
 - An environment where flammable gas is present
 - To avoid risk of explosion, never install or use this product in an environment where flammable gas is present.
 - An outdoors site or other location that is exposed to direct sunlight or is close to a source of flame or heat
 - This product may suffer degraded performance or operation faults in such environments.

- An environment where corrosive gas or vapor, dust, or dirt is present or where the humidity is high
Such environments can cause this product to corrode or break down.
- A site close to a strong electromagnetic field source, high-voltage equipment, or power transmission lines
This product may suffer degraded performance or operation faults at such sites.
- A high-vibration environment
This product may suffer operation faults or breakdowns in such an environment.

Also note that in some environments, such as where pulsed noise is superimposed on signal lines, the M2177 may have degraded performance. Although the M2177 comes with a built-in line filter, an additional external line filter should be used in cases where not all noise is filtered out, so that the M2177 can have power supply input free of pulsed noise components.

Do not install the power cord near an input cable.

2.4 Power Supply and Grounding

(1) Power supply

The M2177 operates under the following power supply requirements.

- 100/120/230 Vrms \pm 10% AC power, controlled via power switch on rear panel
- 50/60 Hz, 25 VA or less
- Fuses: 0.4 A/250 V (time lag), ϕ 5.2 \times 20 mm
- Overvoltage category (CAT) II

The power cord bundled as a standard accessory, which has a voltage rating of 125 V AC and a dielectric withstand voltage of 1250 V for one minute, is intended for use in Japan only. The power cord must be changed to enable use outside of Japan or at a voltage higher than 125 V AC.

For information, please contact NF Corporation.

CAUTION

The power supply voltage setting is factory-set at 100 V AC. Please confirm this setting.

WARNING

- Always remove the power plug from the outlet before changing the power supply voltage setting or replacing a fuse.
 - Set the power supply voltage control switch correctly to one of the three possible voltage setting positions. Note that the 120 V setting position has about 2 mm of loose positioning above and below.
 - Check the power supply voltage control switch's setting before turning on the power.
 - Use only fuses that have the specified capacity.
-

(2) Grounding

 WARNING

Always ground this product using a grounding line connected to the power cord in order to prevent power problems and to ensure the safety of operators.

Ground the supplied power cord (3-pin terminal) by connecting it to a power outlet that has a three-prong, grounded contact.

If only two-prong power outlets are available, use the bundled conversion adapter. In such cases, the conversion adapter's (green) grounding wire should be attached to a nearby ground terminal before plugging the power cord into the outlet.

3. Operations

3.1	Part Names and Functions.....	3-1
3.2	I/O Connections	3-3
3.3	Startup	3-3
3.4	Cautions for Use	3-3

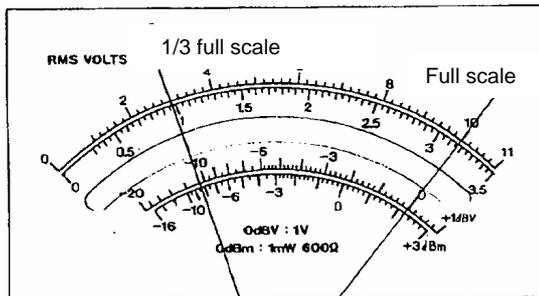
3.1 Part Names and Functions

Meters

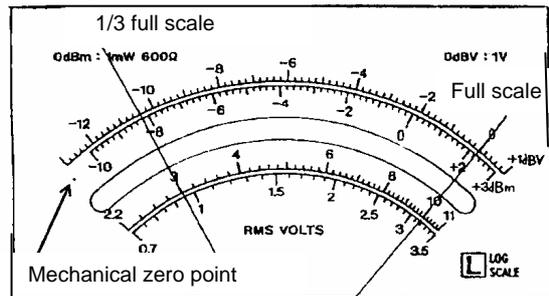
The voltage scale on the M2177 measurement meters are from 0 to 3.5 and 0 to 11, and the decibel scales are from -16 to +3 dBm and from -20 to +1 dBV.

When the dB linear scale option is attached, the decibel scale is a linear scale with ranges from -10 to 3 dBm and -13 to 1 dBV, and its voltage scales are from 0.7 to 3.5 and 2.2 to 11.

The lamp at the top of the meter indicates the current measuring range.



Normal scale



Scale using dB linear scale option

POWER ON : Power switch

This is the power control switch. When this switch is pressed, its lamp lights up to indicate that the M2177 is in operation-ready mode.

SENSITIVITY : Sensitivity adjuster

This adjuster is able to alter the meter's sensitivity in 10 dB increments. When the dial is turned completely clockwise, the value that was set with "RANGE" will become the meter sensitivity.

When the dial is turned counterclockwise until the UNCAL lamp lights up, the sensitivity is reduced and this may prevent direct readouts, in which case relative values must be read.

This sensitivity adjuster is used for S/N and/or decibel measurements.

INPUT : Input terminal

This is a BNC receptacle that is used to connect input signals. Its input impedance is 1 MΩ and its parallel capacity is 25 pF or less.

If the M2177's internal protection circuits are activated and the PROTECT lamp lights up, disconnect any excessive input and/or switch to a lower sensitivity range.

RANGE : Sensitivity switching

When the HOLD/AUTO button on the right is pressed, the range becomes fixed in HOLD mode. When the pressed button is released to its previous position, AUTO mode is set and the optimum range is set automatically.

When the range is fixed in HOLD mode, turning the UP/DOWN knob (on the left side) clockwise sets a higher sensitivity range and turning it counterclockwise sets a lower sensitivity range. Even when in AUTO mode, if the measured value is near the edge of the meter's scale, this UP/DOWN knob can be turned to set the optimum range.

When measuring an unknown voltage, start in the 100 V range and then gradually increase the sensitivity.

3.1 Part Names and Functions

WEIGHT : Weighting filter

This switch is used to set the weighting filter.

Up to six weighting filters can be included, which provides seven settings (including FLAT). No filter name is shown on any switch that does not have a corresponding filter.

When the FLAT button is pressed, this device becomes an ordinary wide frequency range AC voltmeter.

RESPONSE : Detection method switches

Press "AVE" to set average detection.

Press "RMS" to set true root mean square detection.

Press "Q.PEAK" to set quasi-peak detection.

These detection methods comply with the DIN and CCIR standards except when at or below 1/4 full scale.

VOLTAGE SELECTOR

2.4 Power Supply and Grounding

AC OUTPUT : AC output terminal

The AC output terminal is used whenever this voltmeter is used as a waveform monitor or amplifier. The output voltage is 1 V during full scale mode and the output impedance is 50ΩTyp. (recommended load impedance: at least 5 kΩ).

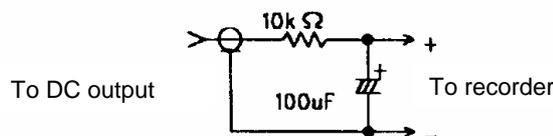
DC OUTPUT : DC output terminal

The DC output terminal is used to record measured values via a recorder. The output voltage is +1 V at the meter's full scale.

Ripple increases as the measuring frequency is reduced. If problems occur, connect a resistor and electrolytic capacitor as in the example shown in the figure. However, this will slow the DC output response speed. When the dB linear scale option is attached, the output may become negative, in which case a nonpolarized electrolytic capacitor should be used.

Also, when the dB linear scale option is attached, the DC output becomes logarithmic output.

The meter scale becomes +1 V when at 0 dBV or 0 V when at -10 dBV, i.e., 0.1 V/dB.



~LINE : 50/60 Hz

Use this connector to connect the power cord. Make sure the power cord plug is fully inserted so it will not come loose easily.

A fuse holder is located below this connector. The cap on the fuse holder can be removed with a flat-head screwdriver after the power cable has been removed.

2.4 Power Supply and Grounding

3.2 I/O Connections

Connect the signal cable to the input terminal. If a reduced input capacity is desired, use a shorter line to connect the M2177 to the object to be measured via the shortest possible distance.

When using this voltmeter as a waveform monitor or amplifier, connect an oscilloscope (or similar device) to the AC output terminal.

When using a recorder to record data, connect it to the DC output terminal.

3.3 Startup

The M2177 operates via the following sequence.

1. Make sure the power switch is correctly set for the power supply voltage to be used.
2. Plug in the power cord.
3. Check the meter's mechanical zero point (when using the dB linear scale, the black mark at the left edge of the meter scale is the mechanical zero point).
4. Set "RANGE" to a low sensitivity level (100 V range).
5. Turn on the power via the power switch.
6. Let device unit warm up for at least 30 minutes.
7. Apply a signal and set the meter to a range between 1/3 full scale and 1.1 full scale.

3.4 Cautions for Use

- (1) The M2177 is highly sensitive and its high input impedance is 1 M Ω . Consequently, using a solid wire for the input cable or a wire with inadequate shielding will enable increased noise and may result in abnormal oscillation.

Although an oscilloscope probe can be used as an input cable, noise will increase if the range is at or below 100 μ V.

- (2) When a cable is connected to the AC output terminal, induction occurs between the input cable and the AC output cable during high-sensitivity mode, which may increase the margin of error or cause oscillation. In such cases, increase the distance between the input cable and the AC output cable or add more extensive shielding.
- (3) When used as an amplifier
When the meter's indicator goes off scale, the output waveform may become distorted and abnormal oscillation may occur. Also, if the input is not sine wave input, the meter output may be distorted even when the meter's indicator is not off scale.
- (4) When AC output or DC output is connected to another device
When the M2177's AC output or DC output is connected to an A/D board, differential input (or a similar means) should be used so that common mode noise is not affected.

3.4 Cautions for Use

- (5) Applying an excessive input will damage the M2177. The maximum non-destructive input voltage is as follows.

30 mV to 100 V range: AC + DC peak value \pm 250 V

10 μ V to 10 mV range: AC \pm 5 V peak, AC + DC peak value \pm 250 V

In the 10 μ V to 10 mV range, application of an excessive input may reduce the input impedance to about 100 Ω . When the DC component's voltage is at least 5 V, set the range to at least 30 mV before connecting an input and wait at least one second before setting the optimum range.

If the M2177's built-in protection circuit is activated and the PROTECT lamp lights up, either disconnect the excessive input or switch it to a lower sensitivity range.

- (6) The input terminal's overvoltage category is category I.

WARNING

Do not directly measure the voltage from a commercial power source such as a distribution panel or power outlet. Electric shock may occur or the M2177 may be damaged by fire.

- (7) After signals that include a DC component are measured, a DC charge is applied to the input terminal. This charge is retained even after the M2177's power is turned off, which poses a risk of electric shock when discharge occurs.

WARNING

Input should be shorted for at least one second after measuring a signal with a large DC component.

- (8) The I/O terminal GND side is connected to the frame via a 10 Ω connection. This is to prevent inaccurate measurements when the device has been installed in a rack or is otherwise in contact with another device's frame.

CAUTION

Never apply voltage of 1 V or more between the I/O terminal's GND side and the frame.

(9) Cautions for use of weighting filter

An amplifier is connected in front of the weighting filter (see Figure 4-1 Diagrams of front and rear panels). Although there is no problem for the dynamic range as far as the filter's input when measuring noise in a part such as the audio amplifier, if (for example) a signal comprised of frequencies exceeding 100 kHz is read in the vicinity of the full scale of the meter, the signal may be saturated inside the device.

To determine this, set the WEIGHT switch to the FLAT setting and use an oscilloscope to observe the AC output. If the waveform becomes saturated, it may cause measurement errors to occur when using a weighting filter. However, when measuring white noise in either average value detection mode or RMS detection mode, slight saturation is of very short duration and thus has almost no effect on measured values.

Although the M2177's dynamic range is approximately 26 dB, when the SENSITIVITY control is used to lower the sensitivity, note with caution that the dynamic range will be narrowed proportionately.

Since the weighting filter has a wide dynamic range of several dozen decibels, the filter's amplitude characteristics cannot be measured via the M2177's meter or DC output.

- (10) When measuring a frequency at or below 20 Hz, the range may not be stable if the signal line has high impedance (50 k Ω or above) or quasi-peak detection mode (Q.PEAK) has been selected. In such cases, use HOLD mode instead.
- (11) The M2177's RMS detection method measures only the RMS voltage values of AC components. Consequently, when measuring signals that have superposed DC components, use the following formula to calculate the RMS voltage that includes DC components.

$$E(AC+DC)_{rms} = \sqrt{E^2_{AC(rms)} + E^2_{DC}}$$

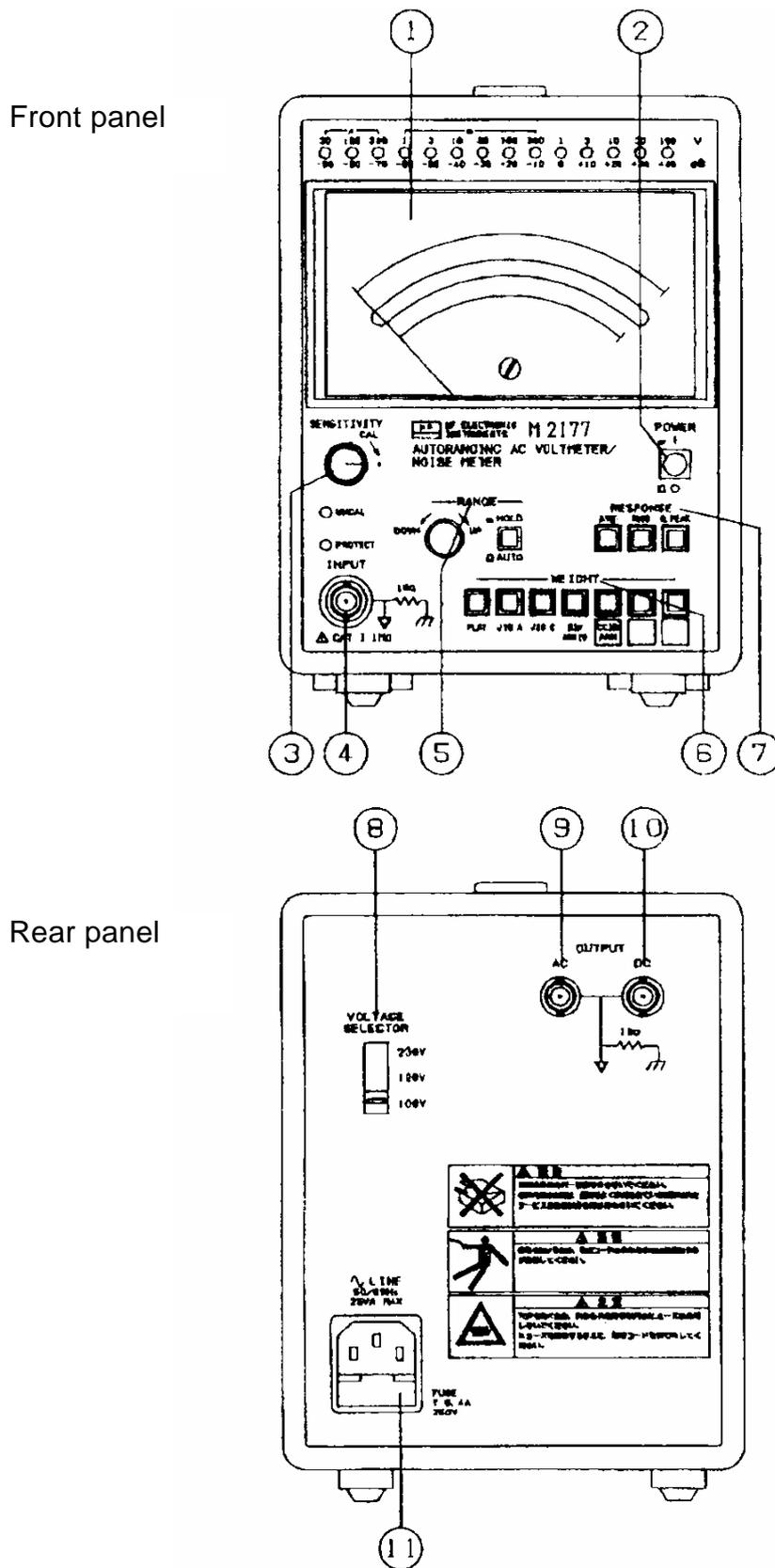


Figure 3-1 Diagrams of front and rear panels

4. Principles of Operation

4.1	Block Diagram.....	4-1
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4.1 Block Diagram

Input is applied to ATT1, and its DC component is blocked by capacitor C.

When using a high-sensitivity range of 100 μV or less, insert a low pass filter for ATT2 to limit the bandwidth according to the range.

SENSITIVITY is a variable resistor which can be used to vary the meter's sensitivity in a range from 0 to -10 dB.

Two weighting filters (WEIGHT) can be added (see option 1 and option 2 in "Figure 4-1 Block diagram").

CCIR ARM can be changed to another filter if specified when ordering. The DETECTOR block uses a full-wave rectifier circuit that includes an operational amplifier. The RMS detector uses a squaring circuit in a semiconductor.

The AUTORANGING LOGIC block is used to adjust ATT1 and ATT2 according to the DC signal output of the DETECTOR, in order to set the optimum range.

When using the dB linear scale option, LOG AMP is inserted between DETECTOR and the meter. In such cases, the DC output is logarithmic.

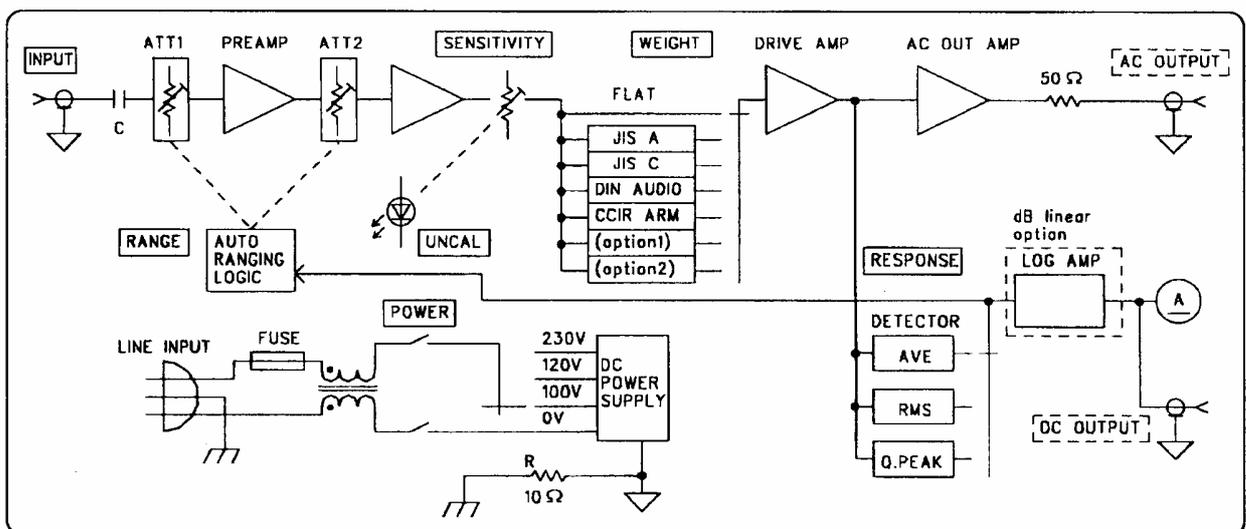


Figure 4-1 Block diagram

5. Maintenance

5.1	Outline	5-1
5.2	Operation Checks	5-1
5.3	Adjustment and Calibration	5-3

5.1 Outline

Proper maintenance is required to keep this device in optimum condition. Normally, such maintenance includes the following four steps.

(1) Operational check

Make sure the device operates correctly, according to the rated values.

(2) Adjustment and calibration

If the device is not operating correctly, adjust or calibrate the specified parts.

(3) Detecting fault locations

If there are failures, check for sources of the problem, and investigate fault locations.

(4) Troubleshooting

This instruction manual describes only relatively simple methods for checking operations, adjusting and calibrating this device, and performing aging checks on faulty parts.

For more complicated checks, calibrations, or repairs, contact an NF Corporation sales office or your local NF Corporation sales representative.

5.2 Operation Checks

First, make sure the power is OFF, then check the meter's zero point. When the dB linear scale option is attached, the black point on the left of the meter scale is the mechanical zero point. The screw at the bottom center of the meter frame can be used to adjust the mechanical zero point.

Keep the "SENSITIVITY" knob set to the CAL position.

(1) Indication accuracy check

The following measuring instruments are needed to check the accuracy of the meter's indicated values.

AC standard voltage generator	Frequency:	400 Hz or 1 kHz
	Output voltage:	1 mV to 100 Vrms \pm 0.1%

Connect the generator to the M2177 and read the indicated values for each range while the meter is at full scale. Indicated values are normal if their error margin is within \pm 2%.

If this kind of generator is not available, use an oscillator in combination with another calibrated AC voltmeter, an accurate differential voltmeter, or a digital voltmeter to check operations.

A calibrated resistance attenuator is used to check the range from 0.01 mV to 0.3 mV.

(2) Frequency characteristics check (check the average value detection "AVE")

Measuring instrument: Sine wave oscillator 5 Hz to 500 kHz

Connect the oscillator with a terminating resistor and resistance attenuator conforming with the oscillator's output impedance. Adjust the oscillator's voltage so that the meter is at full scale when at 1 kHz.

The meter is normal if it displays the following ranges. Select an oscillator that keeps about 1/3 of the following frequency characteristics.

30 μ V range:	from 10 Hz to 30 kHz \pm 5%	from 5 Hz to 50 kHz \pm 10%
100 μ V range:	from 10 Hz to 100 kHz \pm 5%	from 5 Hz to 250 kHz \pm 10%
300 μ V to 100 V range:	from 20 Hz to 100 kHz \pm 3%	from 5 Hz to 500 kHz \pm 10%

(3) Residual noise check

Use a wire to short the M2177's input connector, then read the measured value.

The value is normal if it is within the following range (the measured value may be to the left of the meter's zero point, depending on the ambient temperature).

30 μ V range: input equivalent noise is 5 μ V or less, average (AVE) detection mode is set

When the dB linear scale option is attached, the AC output measured by the AC voltmeter is 150 mV or less and the meter's measured value is to the left of the zero point when in the 30 μ V range.

(4) Characteristics check of weighting filter

Due to the filter's wide dynamic range, it is not possible to check all frequency characteristics. Connect a resistance attenuator between the oscillator and M2177, then check in the reference level \pm 10 dB range. The oscillator's frequency should be set to \pm 0.1% accuracy. For description of the characteristic curve, see "7. Standard Data".

If the measured value at 0 dB point frequency on the characteristic curve is the same (\pm 0.5 dB) as when the "⑥ WEIGHT" switch is set to FLAT, the reference level is normal.

Table 5-1 Reference levels of standard-equipped weighting filters

JIS A	500Hz, -3.2dB
JIS C	500Hz, 0dB
DIN AUDIO	1kHz, 0dB
CCIR ARM	6.3kHz, +6.6dB

(5) Auto ranging function

Input a 1kHz, 1V sine wave and set the 1 V range and average detection (AVE) mode. Next, gradually increase the input voltage. The range is normal if it goes up to between 1.02 full scale and 1.08 full scale.

Next, gradually decrease the input voltage. The range is normal if it goes down to between 0.22 full scale and 0.26 full scale. When the input is shorted, the range is lowered and it is normal if it stops at 30 μ V range.

5.3 Adjustment and Calibration

“5.2 Operation Checks” described adjustment and calibration that can be performed only with semi-fixed resistors when rated values are not met. Never touch any parts other than the specified adjustment sites.

WARNING

All maintenance and adjustment of this product should be performed only by service technicians who are thoroughly acquainted with electrical safety principles and this product's structure. Work where assistance is immediately available in case an accident occurs.

High voltage components in the internal power supply and on the circuit board pose a risk of electrocution if touched.

The following measuring instruments are required for adjustments and calibration.

AC standard voltage generator	Frequency:	400 Hz or 1 kHz
	Output voltage:	1 Vrms \pm 0.1%
Digital voltmeter	DC voltage measurement precision:	0.1% (when 1 V)
	AC voltage measurement precision:	0.2% (400 Hz to 1 kHz, 1 V)

Before starting operations, close the M2177's cover and let the M2177 warm up for at least one hour, then quickly adjust and calibrate.

Once the warm-up period has ended, remove the protectors for the front and rear panels. Remove the screws from the top and both sides, then remove the top cover.

“Figure 5-1 Marking drawing of PCB (viewed from above, with top cover removed)” shows the PCB as it appears from above after the top cover has been removed. Make the following adjustments in the following order.

1. AC OUT GAIN

Set the M2177 to the 1 V range. Set the AC standard voltage generator to 1 Vrms, then connect it to the M2177. Connect a digital voltmeter to the AC output connector, then measure the AC voltage. Now adjust the “1.AC OUT GAIN” so that the digital voltmeter's measured value is 1 V \pm 0.2%.

2. DC OUT GAIN

Set the M2177 to average value detection (AVE) mode. Connect a digital voltmeter to the DC output connector, then measure the DC voltage. Now adjust the “2.DC OUT GAIN” so that the digital voltmeter's measured value is 1 V \pm 0.1%.

3. RMS GAIN

Set the M2177 to root mean square detection (RMS) mode. Adjust the “3.RMS GAIN” so that the digital voltmeter's measured value is 1 V \pm 0.1%.

4. Q. PEAK GAIN

Set the M2177 to quasi-peak detection (Q.PEAK) mode. Adjust the “4.Q. PEAK GAIN” so that the digital voltmeter's measured value is 1 V \pm 0.1%.

5.3 Adjustment and Calibration

5. METER GAIN (when dB linear option is not attached)

Set the M2177 to average detection (AVE) mode. Adjust the "5.METER GAIN" so that the digital voltmeter's measured value is $1\text{ V} \pm 0.2\%$.

6. METER OFFSET (when dB linear option is not attached)

Set the AC standard voltage generator to 300 mV, then adjust the "6.METER OFFSET" so that the meter's measured value is $300\text{ mV} \pm 0.4\%$.

Steps 5 and 6 above can be repeated numerous times.

6. Easy Checks on Faulty Parts

Note: In the event that a breakdown or other abnormality has occurred in the M2177, check the following things first.

If you are still not able to clearly judge the source of the problem, please submit a report of the symptoms and your check results. This will help us provide the right kind of service and will make it easier for us to resolve the problem, so your cooperation is kindly requested.

(1) The devices do not operate at all.

- Is the power cord's input connector correctly plugged into an AC outlet?
- Is there a blown fuse?
- Is the voltage setting correct?

(2) The meter's indicator goes off scale.

- Is excessive input being applied?
- Is the input connected correctly? (Check for disconnection of signal cable on GND side, etc.)
- Is oscillation occurring due to monitoring of the M2177's AC output?
- Does the meter's indicator go off scale even when the input is shorted?

(3) Indicated values are abnormal.

- Is the sensitivity adjuster being used? (Is the UNCAL lamp ON?)
- Is a weighting filter being used?
- Is either the RESPONSE switch or the WEIGHT switch pressed (but not both)?
- Has WEIGHT switch been pressed even though no optional parts have been attached?
- Is the input frequency within the specified range?
- Is oscillation occurring due to monitoring of the M2177's output?
- Are other ranges also abnormal?
- Is the signal source's impedance too high?

(4) Range is not stable.

- Is it stable during HOLD mode?
- Does the measured signal include any low-frequency components?
- Is the signal source's impedance too high?

7. Standard Data

- 7.1 On Standard Data 7-1
- 7.2 Standard Data 7-1

7.1 On Standard Data

The standard data described below has been recorded for the M2177's weighting filter characteristics. At NF Corporation, this standard data is used as a reference when attempting to minimize variation in performance, as one of the company's quality control techniques.

When this data is measured for a product's various performance features, the average measured value should be this standard value. In some cases, the M2177's characteristics fall short of the standard data, but users can rest assured that the results of strict testing are used to check for full compliance with rated values before products are shipped.

7.2 Standard Data

Figure 7-1 JIS C1502 (JIS A) characteristics diagram	7-2
Figure 7-2 JIS C1502 (JIS C) characteristics diagram.....	7-2
Figure 7-3 CCIR ARM characteristics diagram	7-3
Figure 7-4 DIN 45405 (AUDIO) characteristics diagram	7-3
Figure 7-5 DIN 45405 (NOISE) characteristics diagram	7-4
Figure 7-6 CCIR characteristics diagram	7-4
Figure 7-7 IHF BPF characteristics diagram	7-5

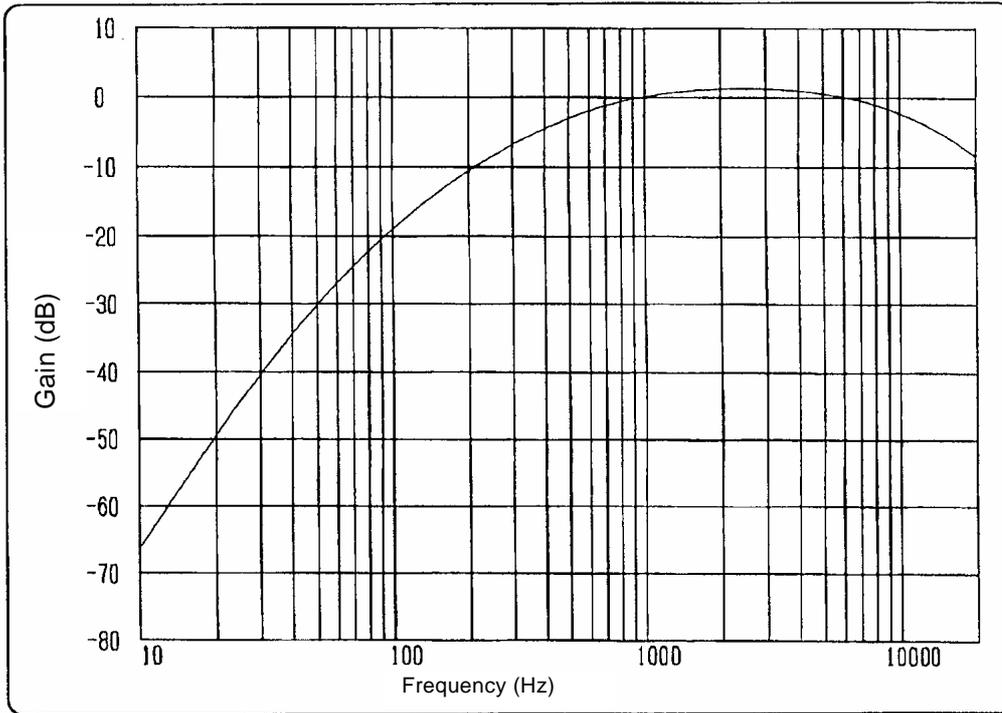


Figure 7-1 JIS C1502 (JIS A) characteristics diagram

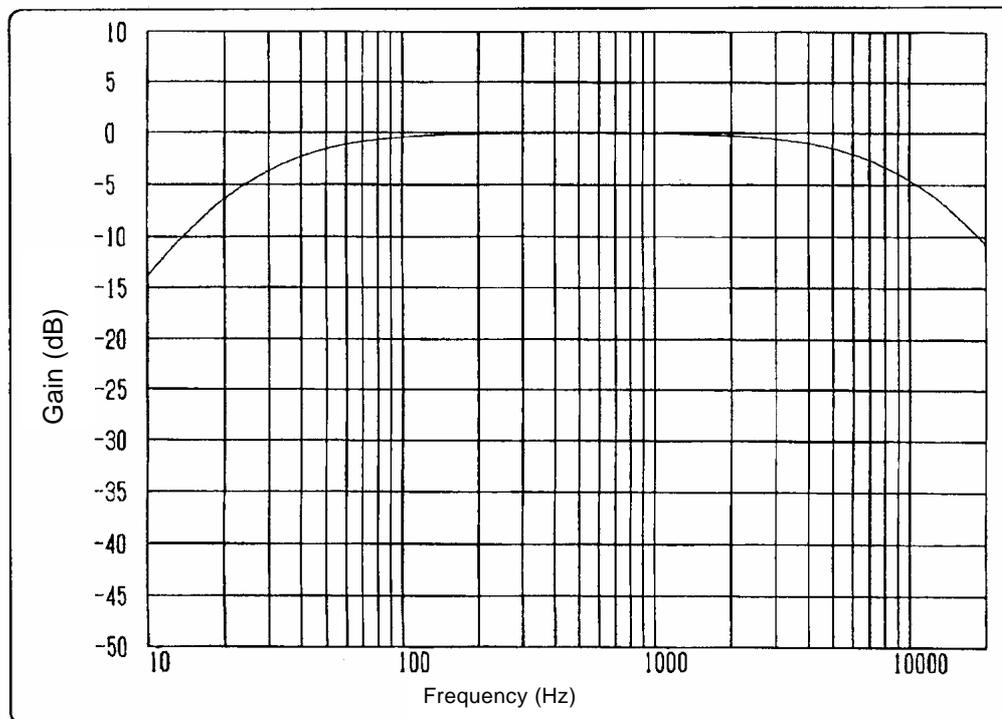


Figure 7-2 JIS C1502 (JIS C) characteristics diagram

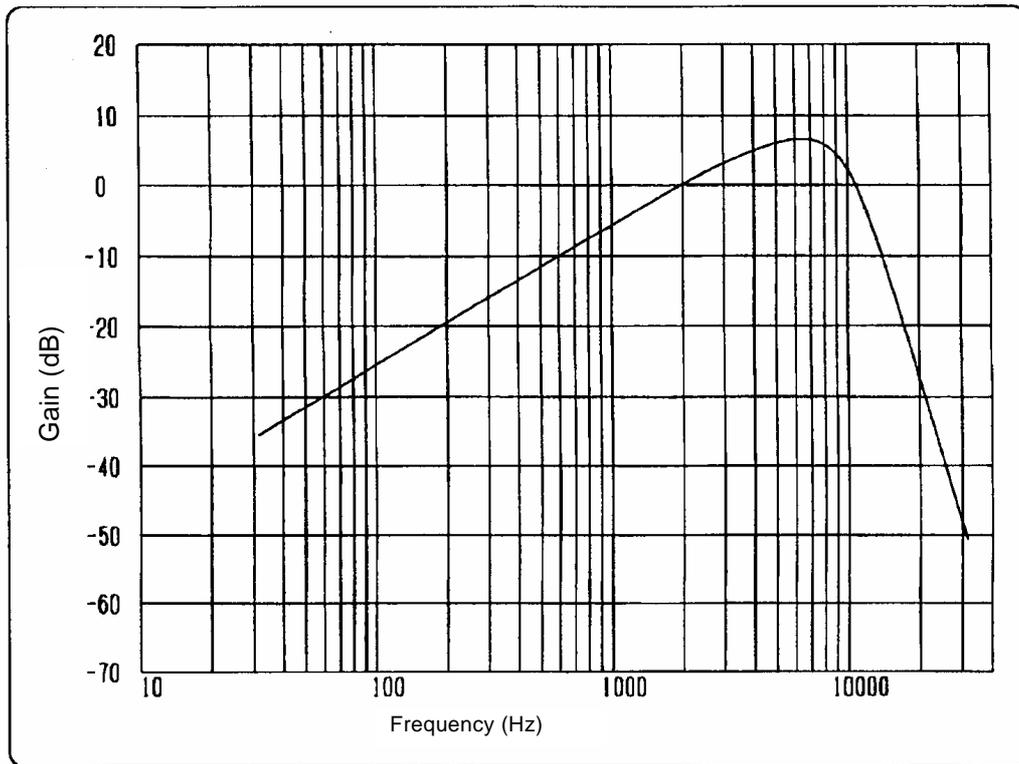


Figure 7-3 CCIR ARM characteristics diagram

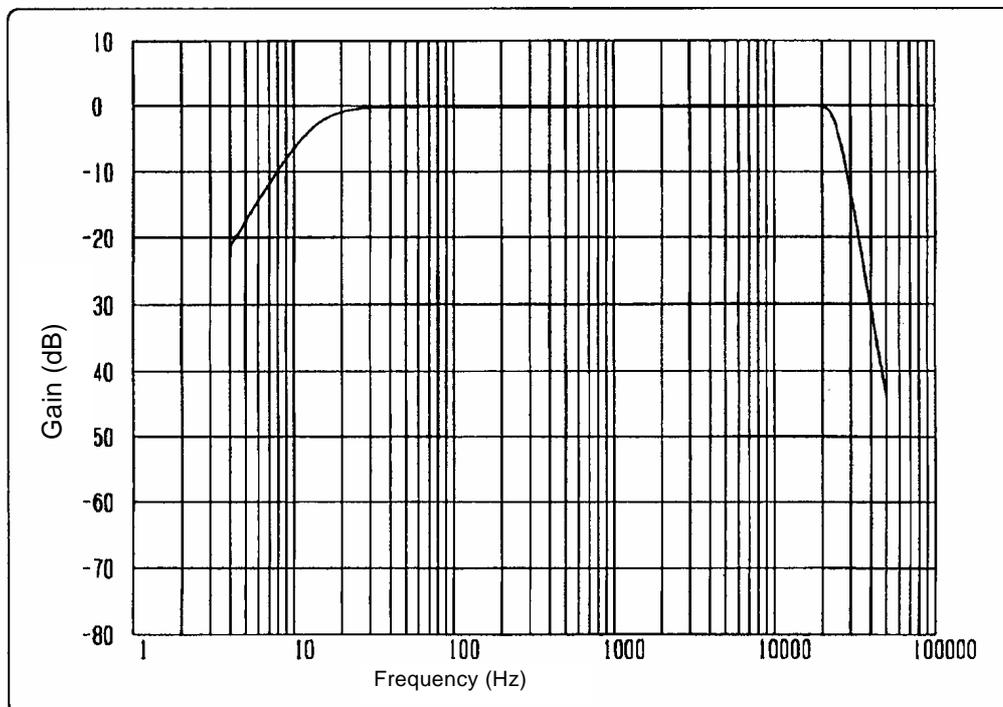


Figure 7-4 DIN 45405 (AUDIO) characteristics diagram

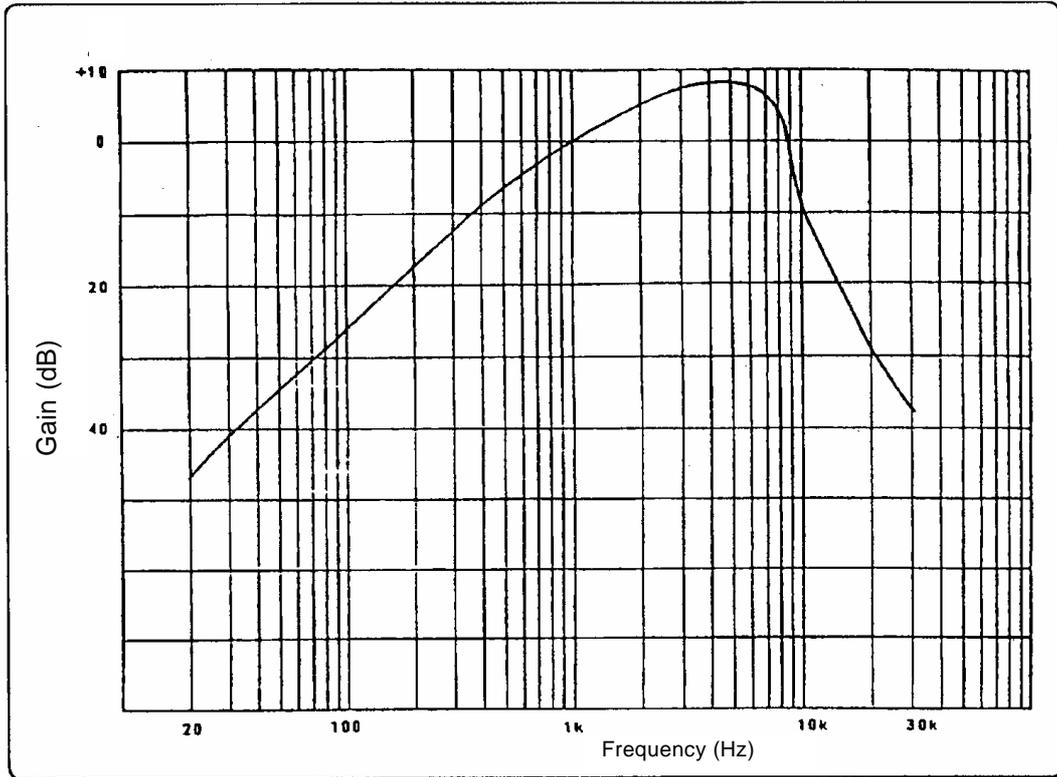


Figure 7-5 DIN 45405 (NOISE) characteristics diagram

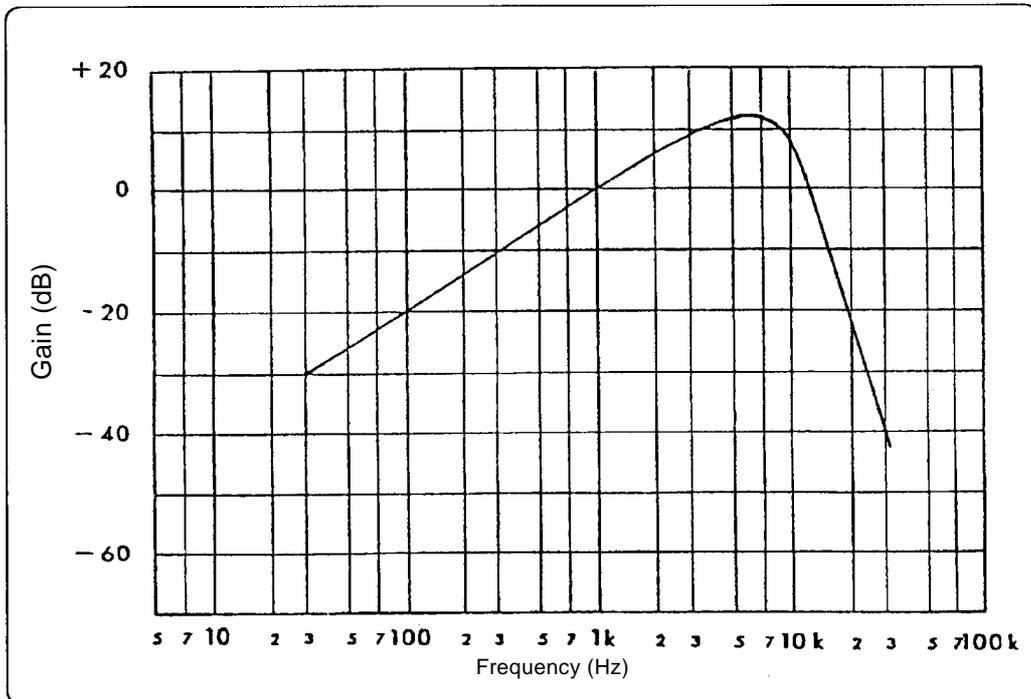


Figure 7-6 CCIR characteristics diagram

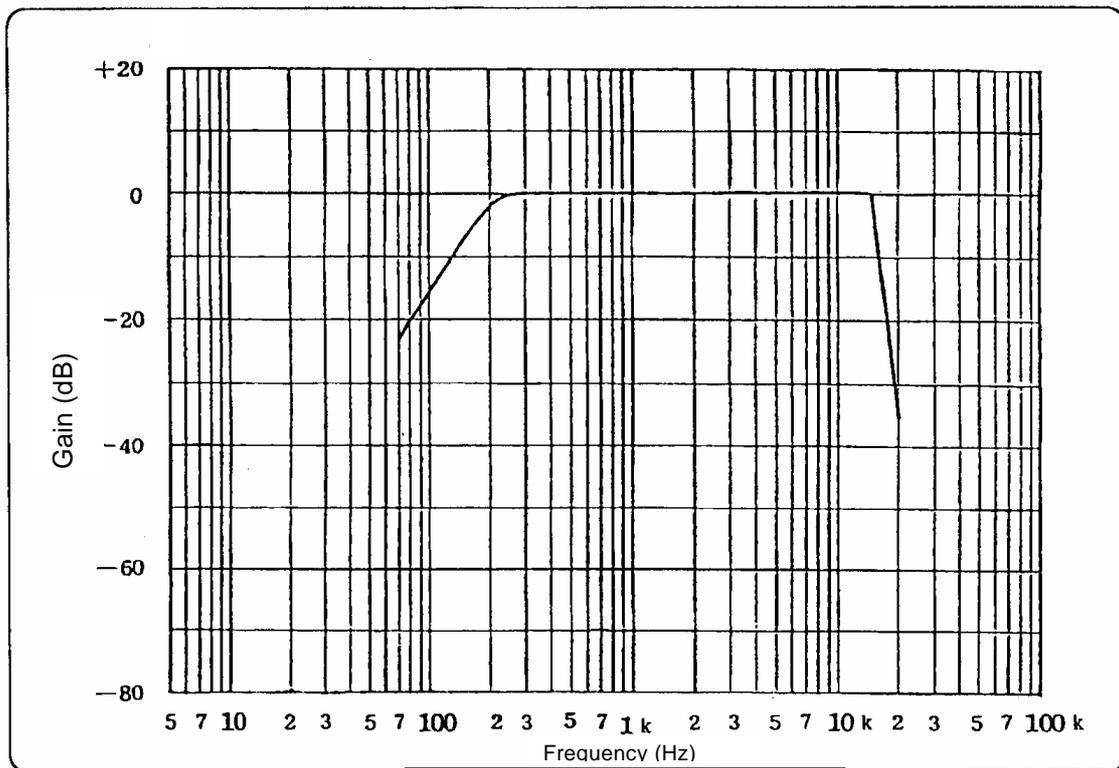


Figure 7-7 IHF BPF characteristics diagram

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If there are any misplaced or missing pages, we will replace the manual. Contact the sales representative.

NOTES

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