

Quality. Uncompromised.

# ROTEL®

## PUBLIC ADDRESS AMPLIFIER WITH AM/FM TUNER

# QA-40B

# INSTRUCTION MANUAL

**WARNING**  
TO PREVENT FIRE OR SHOCK HAZARD,  
DO NOT EXPOSE THIS APPLIANCE TO  
RAIN OR MOISTURE

Write your SERIAL NUMBER here.  
The number is located near the name  
plate on the rear panel.

## PRECAUTIONS

To ensure maximum safety, please carefully follow the instructions below:

### 1. Check the power source

Plug the unit only into a power source whose voltage and frequency ratings match those given in the instruction manual.

### 2. Power cord

The unit is provided with a 3-core type a.c. line cord with a grounding wire. Insert the plug only into a 3 conductor outlet (containing grounding wire) of 120V/60Hz. Or if a 3-conductor outlet is not available, use an adaptor, connecting the grounding wire to a grounding screw on a wall, etc. Insert or unplug the a.c. line cord only after making certain the unit's power switch is turned off, to prevent shock noise from damaging the speakers.

### 3. Ventilation

To avoid heat generated by the unit, it is necessary to provide ample ventilation around the unit. Avoid blocking or impeding the ventilation holes on the unit. To prevent unnecessary problems, install the unit on a place free from any vibrations, direct sunlight, humidity or dust circulation.

### 4. Do not open the cabinet

The unit has been completely factory adjusted. To avoid electric shock or harm to the human body or to the unit, never open the cabinet.

### 5. If the unit gets wet or foreign matter enters

In case the unit gets wet or any water or foreign matter gets into the cabinet, immediately disconnect the a.c. line cord, and consult your dealer or qualified electrician.

### 6. Instruction manual

Keep the instruction manual near the unit, and record the serial number (found on the rear panel) on the cover.

## SWITCHES, CONTROLS AND OPERATION

### (1) Power Button

Depress this button to turn on power. Pressing it a second time will turn off power.

### (2) Power Indicator

Glowes when the power is turned on, indicating that the unit is in operation.

### (3) BASS/TREBLE Tone Controls

These are slider-type controls that regulate the balance of tone of input signals coming from AUX/TUNER. BASS regulates the low frequency range and TREBLE the high frequency range. Slide the respective knobs to the right to increase the response, and to the left to decrease it.

### (4) MIC 1, 2 Level Controls

These controls regulate the input levels from microphones connected to the respective MIC terminals. Rotate each knob clockwise to raise the input level, and counterclockwise to reduce it. Turning the knob fully counterclockwise (to position "0") cuts all input from microphone.

### (5) TEL PAGE Level Control

This knob regulates the level of input from a telephone paging unit connected to the TEL PAGE terminals. Rotate the knob clockwise to raise the level, and counterclockwise to reduce it. Turning the knob fully counterclockwise (to position "0") cuts input from a telephone paging unit.

### (6) AUX/TUNER Level Control

This knob regulates the level of input from the tuner section of the unit, or from any equipment connected to the PROGRAM/AUX input terminal on the rear panel, such as chimes, tape deck, rhythm box, synthesizer, etc. Rotate the knob clockwise to raise the level of input from the built-in tuner, and counterclockwise to raise the level of input from the auxiliary unit. At mid position ("0"), input from either source is cut.

**Note:** This control operates on either tuner or auxiliary unit, not both at once; signals cannot be mixed.

### (7) MASTER Volume Control

This knob controls at one time the combined signals coming from MICs 1, 2, TEL PAGE and AUX/TUNER. Rotate the knob clockwise to raise the overall level of those signals together, and rotate it counterclockwise to reduce it. Turning the knob fully counterclockwise (to "0" position) cuts all inputs.

### (8) Tuning Dial

This knob tunes in the desired AM or FM broadcast station. Use the lower half of the knob for AM band, and the upper half for FM band reception. Rotate the knob to bring the pointer on the knob to the desired position on the frequency scale around the knob.

### (9) AFC Switch (FM)

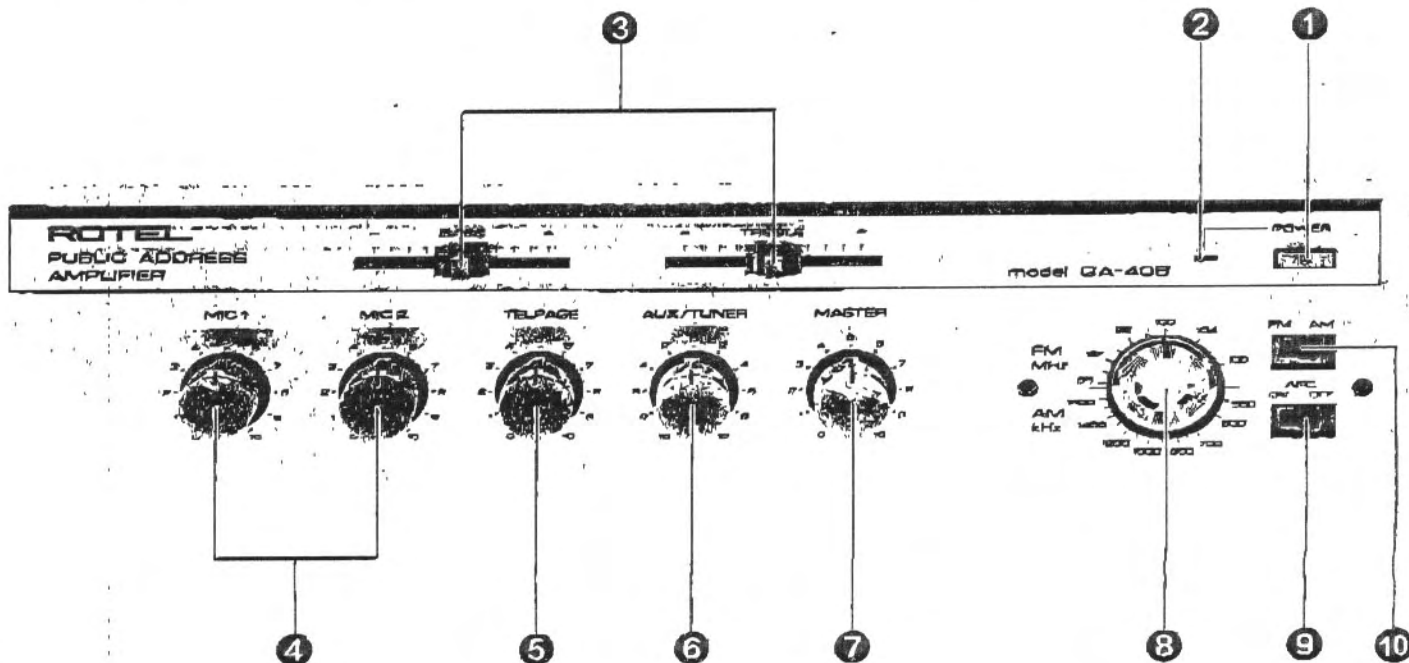
This switch is used to prevent tuning drift originating in frequency deviation of local oscillator. As a general rule, set the switch to OFF when you tune in to a station, and to ON after tuning is complete.

### (10) AM/FM Selector

This switch selects AM or FM reception.

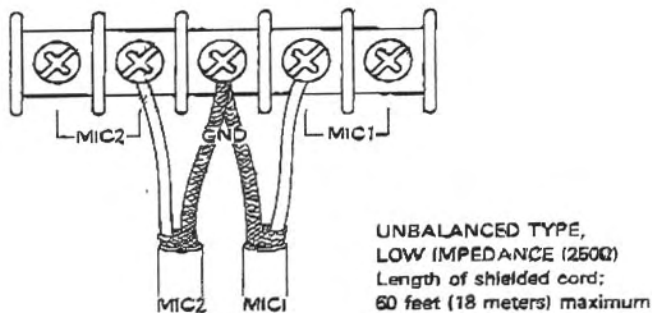
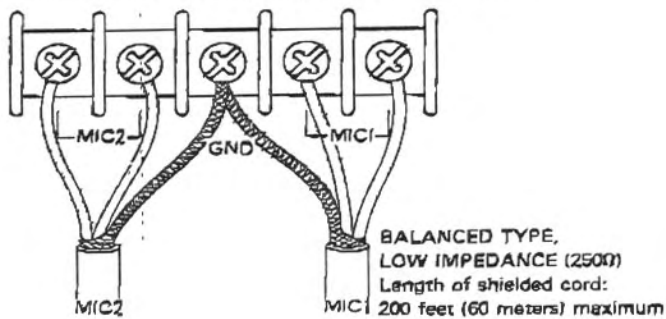
### (11) Microphone Input Terminals

These are screw-type microphone input terminals. The 2 right-hand terminals are for MIC 1 connections, and the 2 left-hand terminals are for MIC 2 connections. Both MIC 1 and MIC 2 connections can be made simultaneously. These terminals have been already adjusted to accept low impedance (250 ohms) balanced or unbalanced microphone.



The stranded wire from the microphones should be hooked up to the common GND terminal.

### ● MICROPHONE INPUT TERMINAL CONNECTION



### (12) Mute Terminals

Connect wires from push-to-talk microphone or from telephone system, to mute music or signal from Program/Aux input when talking.

### (13) Program/Aux Input Terminals

Connect an auxiliary equipment such as tape player to the RCA type pin plug. Or, connect a 600-ohm input such as BGM source to the 600-ohm balanced terminals on connection of the rear panel.

Note: The RCA type pin jack and the 600-ohm balanced input terminals cannot be used simultaneously. Use either one or the other, and leave the other unconnected.

### (14) Ferrite-bar Antenna

This is a built-in antenna for use in AM broadcast reception. Erect the bar towards you, and position it where the reception is optimal.

### (15) Antenna Input Terminals

Use the terminals labeled 300Ω when parallel feeder is used, and the terminals labeled 75Ω for coaxial cable. The AM terminal is used to connect external antenna when sufficient electric field strength cannot be obtained with the built-in ferrite bar antenna.

### (16) Music On Hold Terminals

Signal from the tuner section of the unit is available through the terminal for connection to a telephone paging unit as music source while telephone is on hold. Adjust a level control underneath the unit (on bottom plate) by using screw driver for level setting.

### (17) Tel Page Terminals

Connect a telephone paging unit.

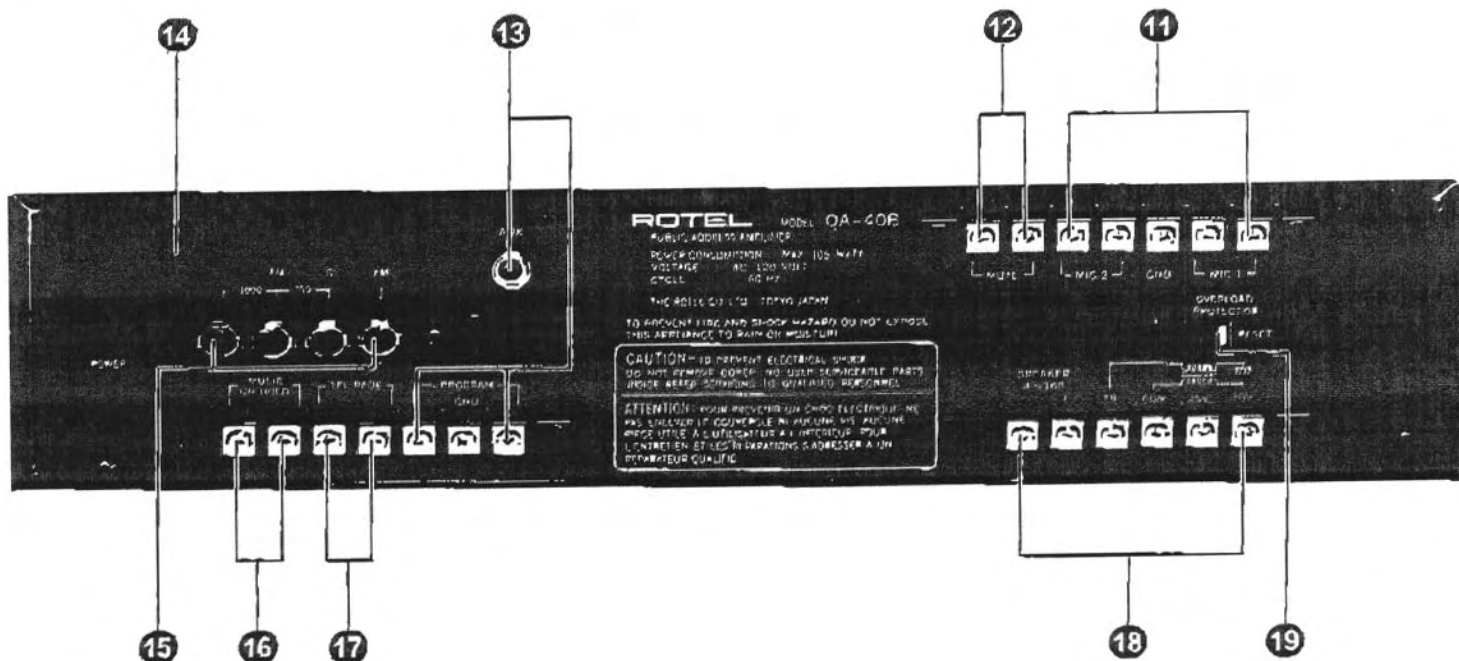
### (18) Speaker Terminals

Connect 4 to 16-ohm speakers to minus (-) and plus (+) terminals. Or, connect speakers with 25-volt line transformers to 25V and COM, and speakers with 70-volt line transformers to 70V and COM.

Important: Ensure plus (+) and TR terminals are strapped with jumper wire when using 25V and 70V terminals.

### (19) Overload Protector Button

If overload occurs due to mismatched speaker impedance, etc., remove the cause of the overload and push this button to reset power to the unit.



# CONSIDERATIONS FOR PA SPEAKER LAYOUT

## SPEAKER CONNECTIONS

In connecting speakers to a public address amplifier it is important to present the amplifier with the load impedance it is designed to handle. Failure to do this can cause overheating and component failure. In many cases problems can take months to appear in the form of reduced reliability and unnecessary service calls. A load impedance that is too low is especially bad. You should strive to have a load impedance of not less than 70% of the chosen amplifier output impedance. For example, do not connect a 4 Ohm speaker to the 8 Ohm output. Driving a load of higher impedance than rated amplifier output is not as serious, but results in a power loss proportional to the mismatch and should be avoided. For example, driving a 16 Ohm load through the 8 Ohm output will result in a 50% loss in power. The high impedance mismatch should be kept to less than 200%, especially if it is anticipated that more than 50% of the rated amplifier power will be required.

There are two methods of connecting groups of speakers to the amplifier. Firstly, using the low impedance (i.e. 4, 8, 16 Ohm) outputs. This is preferable where: -

- (a) Runs are short (less than 200 ft. [70 m]).
- (b) Few horns or speakers are to be used (i.e. typically 4-8)
- (c) Same sound levels are required at each speaker.
- (d) Low impedance also provides slightly better fidelity and frequency response.

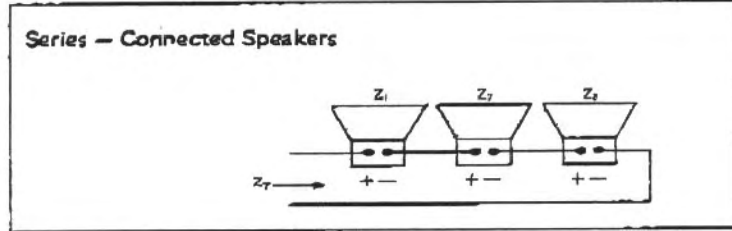
High impedance or constant voltage is the second method and is preferable where: -

- (a) The runs are long and line losses are to be avoided.
- (b) Many speakers are to be used.
- (c) Different sound levels are required at different locations, for example indoor speakers and outdoor horns.
- (d) Future expansion possibilities require flexibility in wiring layout.

The following is a more detailed discussion of these two methods.

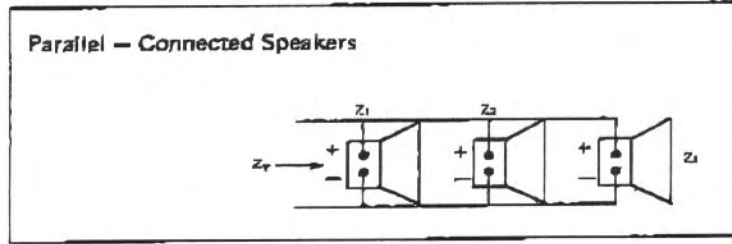
### LOW IMPEDANCE CONNECTION

The speakers must be connected so as to present a combined impedance equal to the selected amplifier output impedance, i.e. 4, 8, 16 Ohms. The connections should be arranged in a series/parallel combination to achieve this according to the following formulae. The impedance should be between 70% and 200% of the output impedance selected. If the amplifier is to be driven anywhere near its full rated output the impedance should be well within these tolerances.



$$Z_T = Z_1 + Z_2 + Z_3 + \dots + Z_N$$

where  $Z_T$  = total combined load impedance  
and  $Z_N$  = individual speaker impedance

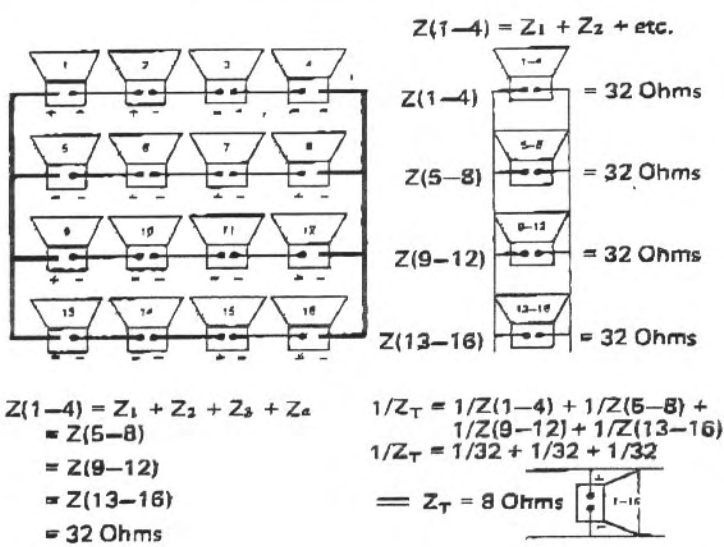


$$Z_T = \frac{1}{1/Z_1 + 1/Z_2 + 1/Z_3 + \dots + 1/Z_N}$$

## SERIES/PARALLEL COMBINATIONS

In larger systems it will be necessary to combine series and parallel connections to obtain the necessary impedance. The rules for calculating the total effective impedance is to divide the entire circuit into individual small series of parallel sub-circuits and apply the foregoing rules to them.

The following is an example using 16 x 8 Ohm speakers. Each schematic is an impedance equivalent to its predecessor but has been simplified.



As can be seen, a problem arises if one more speaker must be added at some future date, as all the connections must be changed. This is not much of a problem if only a few speakers are involved, but if the network is extensive, the problem is significant. In addition, failure of one speaker can take out a number of associated units.

### HIGH IMPEDANCE OR CONSTANT VOLTAGE (25V & 70V) SYSTEMS

The high impedance or constant voltage method of impedance matching uses a high impedance amplifier output which is transformed down to 8 Ohms by an impedance matching transformer at each individual speaker. The big advantages of this approach as compared to low impedance are: -

- (1) Reduced line losses and ability to use smaller wire gauges. This is due to the higher voltage and reduced current in the speaker lines.
- (2) Much simpler impedance matching procedures and connections.

Constant voltage is a misnomer in that the amplifier does not always produce 70V. Rather, the amplifier output impedance is set at such a level that, irrespective of its rated power, it will produce 70.7 volts output at full power. Thus a 10 Watt amplifier optimum load would have an impedance of 500 Ohms ( $V^2/P = 70.7^2/10$ ), a 40 Watt amp would be 126 Ohms and 100 Watt amp, 50 Ohms:

Multiple transformer taps allow the impedance at each speaker to be adjusted individually to give a total matched load. Because of the high impedance arrangement, the system is easier to impedance match and is also inherently less susceptible to problems caused by mismatching.

The transformer taps are marked in Watts instead of Ohms (usually 4, 2, 1, 1/2). Again, it should be borne in mind that these levels of power output are only achieved when the transformer is working at 70.7 volts. The transformers are connected in parallel. A good match is obtained by ensuring that the total of all tap settings fits into the range of 40-80% of rated amplifier output. 80% is chosen to allow for transformer insertion loss. It is also good practice not to drive the amplifier to 100% of its capacity.

Examples are shown below. For simplicity it is assumed that all tap settings are the same at each speaker.

For a 40 Watt amplifier the range 40-80% is equivalent to 16-32 Watts. Therefore:

- 6 speakers x 4 Watt taps each = 24W . . . . . Good match
- 4 speakers x 1 Watt taps each = 4W . . . . . Poor match
- 20 speakers x 1 Watt taps each = 20W . . . . . Good match
- 20 speakers x 4 Watt taps each = 80W . . . . . Very poor match—overload
- 30 speakers x 1 Watt taps each = 30W . . . . . Good match

#### NOTE:

None of the above tap settings guarantee the actual sound levels through each speaker. This is as much a function of the master volume control as the tap setting. The setting simply defines the maximum power consumed by an 8 Ohm speaker if presented with 70.7 volt input. In the case of a small number of speakers, it is always preferable to use a higher tap setting and reduced the sound level by turning down the master volume control. In calculating the amplifier rating needed for a typical music/paging system using speakers distributed in an office environment, a good rule of thumb is to allow about 1W per speaker and space speakers at 1% X ceiling height. For noisy areas, or where the volume level required is higher, more power is required.

#### PHASING

When using multiple speakers in a sound system installation, it is advisable to phase the speakers in order to reduce the cancellation effect caused by improper phasing. Speakers out of phase will lose up to one-half of their normal volume and will operate with poor tonal characteristics.

For speakers facing in the same general direction, the speakers are in phase when all speaker cones move in the same direction when an equal signal is applied. With two speakers facing each other, proper phasing is achieved when the cone of one speaker moves inward while the cone of the other speaker moves outward.

If speakers are unmarked, or not the same model, the following procedure will allow fast and simple phasing.

- (1) Connect one side of a flashlight battery to one of the speaker terminals.
- (2) Momentarily contact the other speaker terminal to the other side of the battery.
- (3) Note direction of cone movement (inward or outward).
- (4) Mark the speaker terminal that corresponds to the positive side of the battery.
- (5) Repeat the same procedure for each successive speaker, making sure that the direction of cone movement is the same for each case.
- (6) If the speaker cones are all to move in the same direction, connect the marked terminals to each other and the unmarked terminals to each other. If the cones are to move in opposite directions, as is the case when two speakers are facing each other, connect the marked terminal of each speaker to the unmarked terminal of each speaker.

#### POWER LOSS IN LONG LINES

For long lines the power loss in the lines ( $I^2R$ ) becomes a significant factor. The power supplied by the amplifier is effectively reduced by the line loss. For a 0.5 db loss in sound pressure the total wire resistance must be limited to 6% of speaker impedance. The following table shows the calculated two wire cable lengths permissible for a number of wire sizes in feet. For a 1 db loss, the lengths may be doubled. For 2 db loss, multiply by 4.4.

AWG Size	Resistance (Ohms/1000 Feet)	Low-Impedance			High-Impedance Systems		
		4Ω	8Ω	16Ω	100W/70.7V 12½W/25V (50Ω)	50W/70.7V 6¼W/25V (100Ω)	25W/70.7V 3¼W/25V (200Ω)
14	2.50	48	98	190	600	1,200	2,400
16	4.02	30	60	90	370	740	1,500
18	6.39	19	38	76	230	460	920
20	10.1	12	24	48	150	300	600
22	16.2	7	14	28	93	190	380

## TECHNICAL SPECIFICATIONS

### AMPLIFIER SECTION

Power Output .....	40 watts RMS (8 ohms)
Frequency Response .....	50Hz—18kHz, +1dB, -3dB (8 ohms)
Hum and Noise	
MIC 1, 2 Input .....	55dB below rated output
AUX Input .....	70dB below rated output
TEL PAGE Input .....	65dB below rated output
PROGRAM Input .....	70dB below rated output
Sensitivity	
MIC 1, 2 Input .....	0.8mV/250 ohms
AUX Input .....	150mV/38 kohms
TEL PAGE Input .....	100mV/680 ohms
PROGRAM Input .....	115mV/600 ohms
Outputs .....	4—16 ohms, 25V (16 ohms) Use with output trans., 70V (122.5 ohms) Use with output trans.
Inputs .....	2 MICs (low-impedance), 1 AUX (high-impedance)/ PROGRAM (low-impedance), 1 TEL PAGE (high-impedance)
Controls .....	2 MIC VOLUMES, 1 TEL PAGE VOLUME, 1 AUX/TUNER VOLUME, MASTER VOLUME, BASS and TREBLE
Tone Control Action	
BASS .....	+6.0dB, -8dB (100Hz)
TREBLE .....	+6.0dB, -8dB (10kHz)
Muting Level .....	-60dB

● Specifications and features subject to possible modification without notice.

### TUNER SECTION (at MUSIC ON HOLD)

Frequency Range .....	AM: 535—1,605kHz FM: 88—108MHz
Sensitivity .....	AM: 500 $\mu$ V for 20dB quieting FM: 4 $\mu$ V for 30dB quieting
Distortion .....	AM: 1.5%, MOD 30% 400Hz FM: 0.8%, MOD 100% 400Hz
Hum and Noise .....	AM: 40dB FM: 55dB
Output .....	AM: 950mV, MOD 30% 400Hz (at MUSIC ON HOLD) FM: 2.3V, MOD 100% 400Hz
<b>MISCELLANEOUS</b>	
Power Requirement .....	120V AC/60Hz
Power Consumption .....	105 watts
Dimensions .....	370(W) x 94(H) x 210(D)mm 14-19/32" x 3-73/32" x 8-9/32"
Weight .....	5.5kg/12.1 lbs.