For your reference:

Please note that this product is no longer available and is provided as a reference technical document.

POWER AMPLIFIER

TA-120

INSTRUCTION MANUAL

NF Corporation

D: 54826-1

Model TA-120

Power Amplifier

Instruction Manual

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1. GENERAL DESCRIPTION

1.1 Introduction

The Model TA-120 Power Amplifier is an amplifier for industrial use which provides a rated output of 120VA over the frequency range of 40Hz to 10kHz. Incorporating a crystal oscillator with output frequencies of 50, 60 and 400Hz, it also serves readily as a required-frequency constant-voltage AC generator.

A selector on the rear panel enables the output voltage to be selected as 100, 120, 200 and 240V. The output is balanced and isolated from the cabinet.

When used as a power amplifier, the TA-120 gives a rated output of 120VA with a sinewave input of approximately 1V and an input impedance of approximately 10kΩ (unbalanced). Adjustment of the output impedance achieves virtually constant load regulation into a variety of loads. Line voltage fluctuations cause negligible output changes. An automatic resetting type protector is used which prevents instrument damage upon overloads and a front panel lamp indicates that the instrument is not operating normally.

A standard 480mm JIS (Japanese Industrial Standards) rack can house two of these benchtop amplifiers.

The amplifier operates on single-phase 100Vrms, 50/60Hz and consumes approximately 350VA of power.

1.2 Features

- Low-distortion output
- Excellent stability output. In combination with the internal crystal oscillator, the TA-120 achieves an output frequency stability of ±0.005%/8h and an output voltage stability of ±0.2%/8h.
- The effect of power line voltage fluctuations is negligible.

- o The instrument is completely free from the influence of line power frequency fluctuations.
- o By adjusting the output impedance, virtually perfect load regulation is achievable for a variety of loads.

1.3 Specifications

1.3.1 Electrical Specifications

Table 1-1 Crystal Oscillator

Item	Rated value
Output frequency	One of 50Hz, 60Hz, or 400Hz; selectable from the front panel
Frequency stability	±0.005% or less
Voltage stability	±0.2%/8h (central value of design) in power amplifier output
Output distortion	1% or less in terms of power amplifier output Typical value: 0.3%

Table 1-2 Power Amplifier

Item	Rated value	Typical value
Signal input	The selection of the external input/internal input (crystal oscillator) is possible from the rear panel. The external input is on the terminal strip (M3 screw).	
Input impedance	10kΩ ±20%, unbalanced	
Input voltage	Approx. 1Vrms for rated voltage using a sinewave. The maximum allowable input is 10Vrms.	
Input frequency	40Hz to 10kHz	
Output type	Floating (balanced) Single line available for grounding (unbalanced)	
Rated output voltage/current	100Vrms/1.2Arms (±1.7Apeak) rated load: 83.3Ω 120Vrms/1Arms (±1.42Apeak) rated load: 120Ω 200Vrms/0.6Arms (±0.85Apeak) rated load: 333Ω 240Vrms/0.5Arms (±10.71Apeak) rated load: 480Ω Power factor: 0.95 or greater. One of the above output voltage is selectable by a switch on the rear panel.	

Item	Rated value	Typical value
Maximum output power	130VA Rated resistive load, frequency: 45Hz to 1kHz, line power voltage: ±2% of rated value	140VA
Output impedance	Adjustable to zero in a range of 45Hz to 1kHz	
Line regulation	±0.2% or less At rated output, with respect to a change of ±10% in line power rated voltage	±0.1% or less
Harmonic distortion	1% or less (45Hz to 1kHz) 3% or less (40Hz to 10kHz) Into a rated resistive load. Rated output	0.1 to 0.5% 2.5%
Characteristic of output voltage vs. frequency	±1dB or less (45Hz to 1kHz) ±3dB or less (40Hz to 10kHz) Into a rated resistive load with 400Hz set as the reference.	±0.5dB or less ±2dB or less
S/N Ratio	60dB or more for the rated output voltage.	

Line power supply: Single-phase AC 100Vrms ±10%, 50/60Hz, approx. 350VA
For a frequency of 2 to 10kHz, the line voltage must be within ±5% of the rated voltage to achieve the rated output voltage.

Insulation resistance (between overall power input/output and cabinet; ambient humidity: 70% RH or less)

20MΩ or greater (measured with a 500VDC megohmmeter)

Dielectric strength (between overall power input/output and cabinet; ambient humidity: 70% RH or less)

AC 1.5kV, 50/60Hz for one minute

1.3.2 Mechanical Rating

Maximum outside dimensions	215(W) x 164(H) x 493(D)mm
Weight	Approx. 18kg

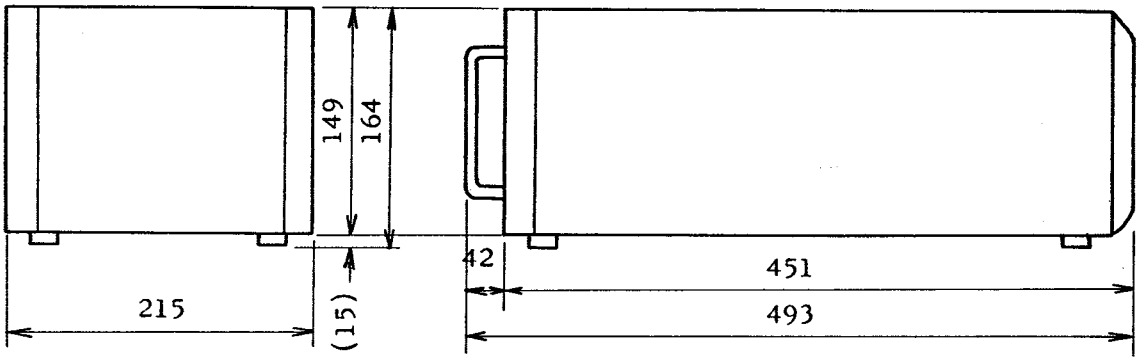


Fig. 1-1 External View

1.3.3 Environmental Conditions

Ambient temperature	0 to 40°C (operating), -20 to +70°C (storage)
Ambient humidity	10 to 90% RH (operating), 10 to 80% RH (storage)

2. PREPARATIONS

2.1 Unpacking and Repacking

2.1.1 Unpacking

Upon unpacking, check that the corrugated carton is free of holes, dents, splashed water or any other such condition.

2.1.2 Repacking

When transporting the amplifier by vehicle or other means, as a protective measure, pack the instrument into a corrugated carton with the space around the TA-120 packed with suitable protective material. Use packing materials that can protect the unit and sustain weights of approximately 18kg. Be sure to include the instruction manual and other accessories when repacking.

2.2 Initial Inspection

When unpacking, make sure to remove all the accessories from the carton. Perform an initial inspection, noting the following points in particular.

- Check for scratches or dents in the cabinet as well as for possible damage to meters, switches or protective covers that protrude from the panel surface.
- Check to see if your amplifier set is complete by referring to Table 2-1 (Configuration).

Table 2-1 Configuration

1.	TA-120 Power amplifier	1
2.	Accessories	
	Instruction manual	1
	Fuses (5A, tubular normal blow-out type)	2
	Hexagonal wrench (for knobs)	1

2.3 Installation

Observe the following when installing the instrument.

- An air space of at least 30cm must be provided at both sides, rear and top of the TA-120.
- No object should be placed on the top of the TA-120.
- Install the instrument in a location that is as free of vibration, dust and direct sunlight if possible.
- When installing the instrument under a bench or a staircase, provide suitable means to prevent objects from falling on the device.
- The installation location should meet the following conditions with respect to ambient temperatures and humidities.

  Operating

Ambient temperature:	0 to 40°C
Ambient humidity:	10 to 90% RH

  Storage

Ambient temperature:	-20 to +70°C
Ambient humidity:	10 to 80% RH

3. OPERATING INSTRUCTIONS

3.1 Panel Descriptions

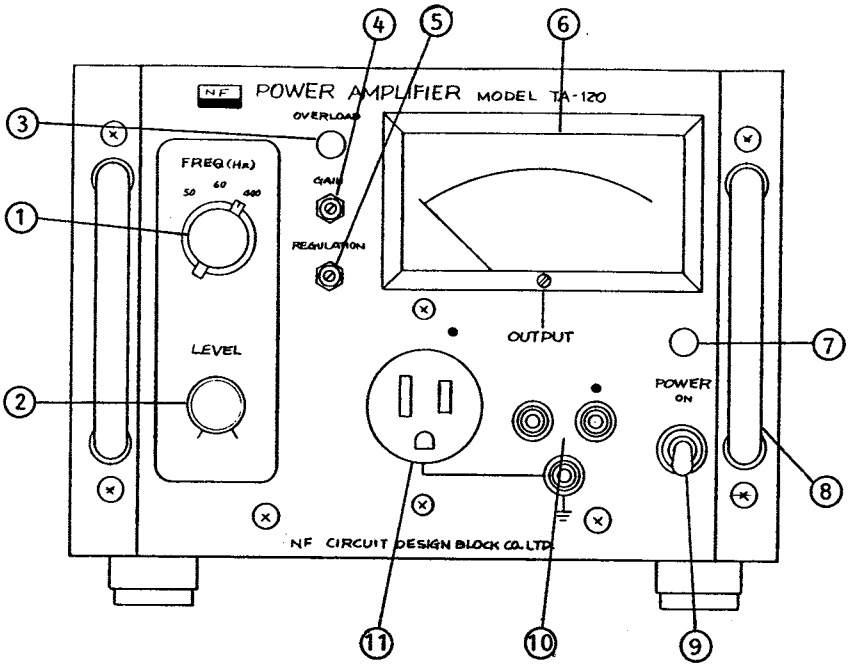


Fig. 3-1 Front View

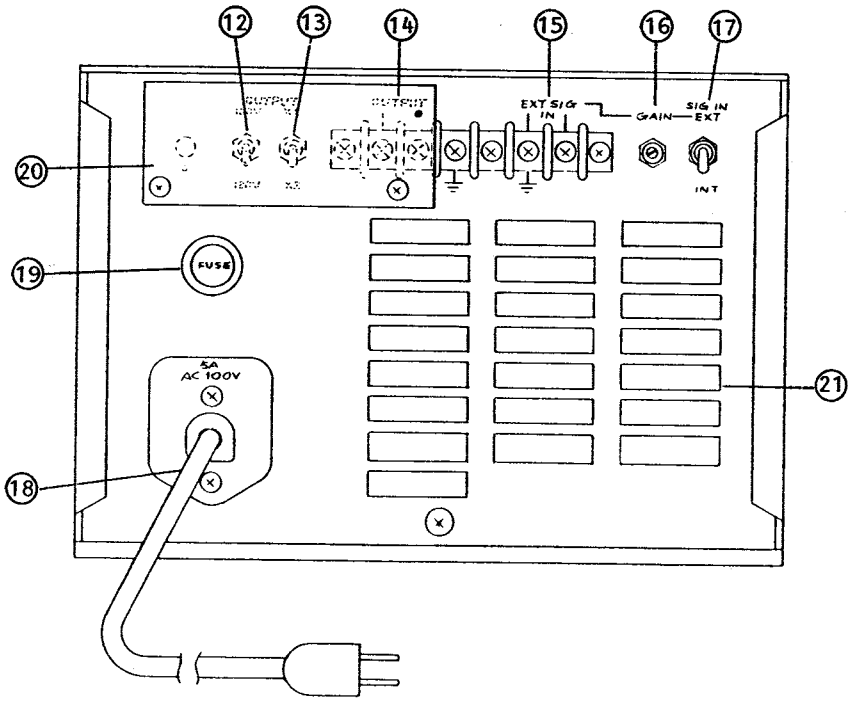


Fig. 3-2 Rear View

Table 3-1 Panel Controls, Switches, Etc. and Their Functions

Item		Name	Function
1	FREQ (Hz) 50, 60 400	Oscillation frequency switch	Serves to select one of 50, 60 and 400Hz as the oscillation frequency of the internal crystal oscillator.
2	LEVEL	Oscillator output control	Increases output amplitude when turned clockwise.
3	OVERLOAD	Protective circuit indicator lamp	Lights when the protective circuit operates upon output overload. It automatically goes off when the output drops below the rated value. The output waveform is distorted while the lamp is lighted.
4	GAIN	Output amplitude control	Increases output amplitude when turned clockwise using a flatblade screwdriver. A variation of approx. 6dB is available.
5	REGULATION	Output impedance regulator	Reduces output impedance when turned clockwise with a flatblade screwdriver. The frequency range over which the output impedance can be set to zero is 45Hz to 1kHz.
6		Output voltmeter	Indicates the output voltage and is of (250V fullscale, 2.5% accuracy meter)
7		Power lamp	Lights when Power Switch 9 is snapped upward, and the TA-120 is power ON.
8		Grip	
9	POWER ON	Power switch	When Power Switch 9 is snapped upward, the power is applied to the TA-120 and this lamp 7 lights.
10 11	OUTPUT	Output terminals	Connected in parallel with output terminals 14 on the rear panel. "." indicates equivalent potential. Black terminal 10 , rounded terminal of connector 11 and the terminal marked "⏚" of 14 are provided as grounding terminals.

Item		Name	Function
12 13	OUTPUT 100V, 120V x1, x2	Output voltage selecting switches	Select the required output voltage. The positions of the switches correspond to available output voltages as follows. Output voltage: 100V / 120V / 200V / 240V 12: 100V / 120V / 100V / 120V 13: x1 / x1 / x2 / x2
14	OUTPUT	Output terminals	Connected in parallel with the terminals 10 and 11 on the front panel.
15	EXT SIG IN	External signal input terminals	Used to apply external input signals. When using these terminals, set switch 17 to the EXT position.
16	GAIN	External input gain control	Adjusts the input level of external input signals. When turned clockwise with a flatblade driver, the amplifier output amplitude increases. This functions only when input switch 17 is set to the EXT position.
17	SIG IN EXT, INT	Input switch	Selects amplifier input signals. Set the switch to the INT and EXT positions when using the internal or an external crystal oscillator, respectively.
18	AC 100V	Power cable	Supplying the TA-120 with power; connected to an AC outlet of AC (100Vrms±10%, 50/60Hz, 350VA or greater).
19	5A	Fuse holder	Contains a 5A fuse for power supply protection.
20		Protection cover	Protects the output terminals and the output voltage switches.
21		Air vent (exhaust)	Allows heated internal air to be exhausted. Air intakes are provided on the top and side panels. The vent to blow out 70°C hot air must be at least 30cm away from the wall surface and no objects susceptible to heat should be placed near the vent.

3.2 Input/Output Connections

3.2.1 Power Cable and Ground Connections

Connect power cable 18 to an AC outlet of 100Vrms±10%, 50/60Hz and a current capacity of 3.5A or more. When the amplifier is used over the output frequency range of 2kHz to 10kHz, set the power supply voltage to within 100V±5V. Before inserting the plug into the outlet, be sure to snap power switch 9 to the OFF position. The instrument should be grounded for safety. Provide grounding connection by referring to Fig. 3-3. For grounding, use a green vinyl-covered stranded wire with one end terminated with a 1.25 to 3mm crimp-on terminal.

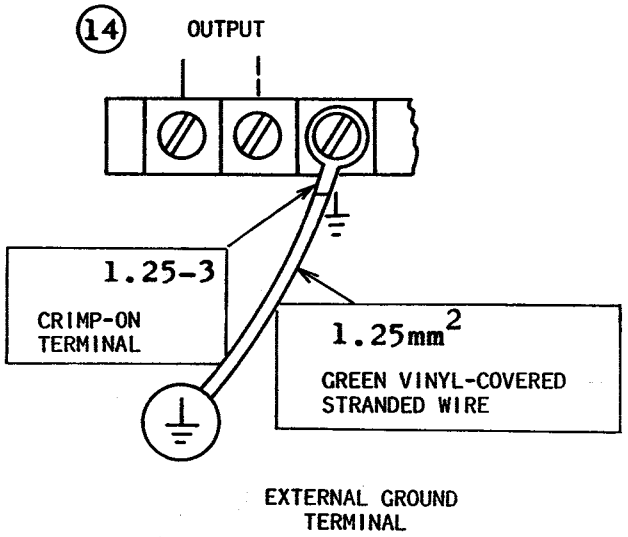


Fig. 3-3 Ground Connection

3.2.2 External Signal Input Connection

When using an external oscillator, set the input switch 17 to the EXT position and connect the oscillator output to the external signal input terminals 15 . Use a shielded wire for this connection and crimp a terminal onto one end.

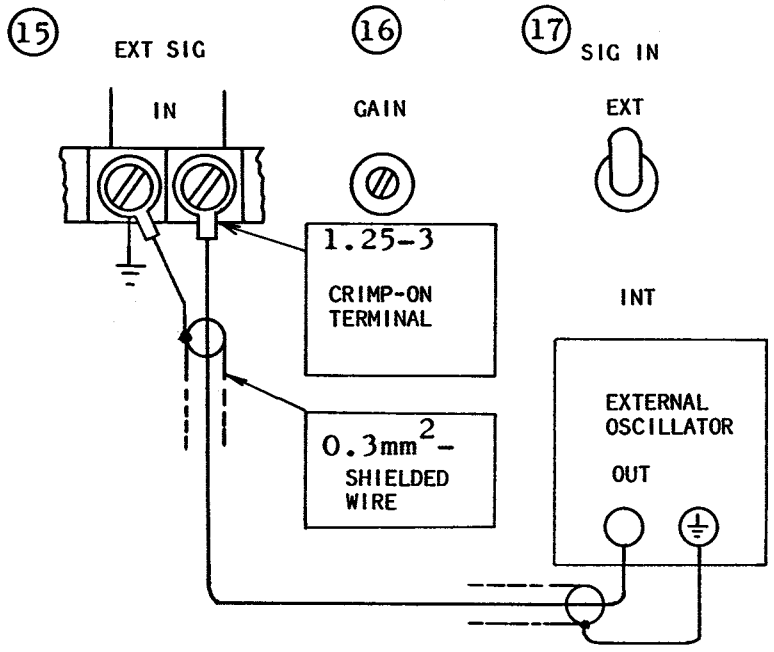


Fig. 3-4 External Oscillator Connection

CAUTION

The input signal should be in the range of 40Hz to 10kHz. Inputting a signal with a frequency outside this range will damage the TA-120. The input voltage should be in the range of 0 to 10Vrms, with the external input gain control 16 set fully counterclockwise for a voltage of 10Vrms. A voltage exceeding this range will damage the TA-120.

Set the input voltage to 0V before applying power and increase it gradually after applying power. If the power is turned on with an excessive voltage applied, the TA-120 will fail.

3.2.3 Internal Signal Input Connection

When using the internal crystal oscillator, turn the input switch 17 on the rear panel to the INT position. If the TA-120 is to be used at a constant output voltage, set the voltage using the output amplitude control 4 after setting the oscillator output control fully clockwise. This is to prevent misoperation.

3.2.4 Output Connection

The output terminals 10 and 11 on the front panel and 14 on the rear panel are available for applying the TA-120 output to loads. All these terminals are connected in parallel with the output transformer of the TA-120. When making connection to the terminal 14 at the rear, use a cable with one end terminated with a 1.25 to 3mm crimp-on terminal.

Cables with a nominal cross-sectional area of 0.75sq.mm to 1.25sq.mm should be used for applying the TA-120 output to loads. Longer cables should be greater in diameter. The voltage drop in the cable may deteriorate load regulation.

3.3 Starting

3.3.1 Using the Internal Crystal Oscillator

After making the connections described in Section 3.2.3, set the oscillator output control 2 fully counterclockwise and select the output voltage using the output voltage switches 12 and 13 . With the power switch 9 placed in the ON position, the equipment is powered and the power lamp 7 lights. The OVERLOAD lamp 3 may momentarily flash at this time, but this does not indicate trouble. About 20 seconds after turning on the power, set the oscillator output control 2 clockwise to set the output voltage. Since the internal output voltmeter is only a 2.5% accuracy meter, connect a precision voltmeter to the output terminals 10 for precise setting.

CAUTION

1. No output is available unless the input switch 17 is set to the INT position.

2. The crystal oscillator gives no output until approx. 20 seconds elapse after the power is applied. The output rises gradually afterwards.

3. Do not touch the output voltage switches 12 and 13 after turning on the power. Be sure to mount the protection cover over them after use.

3.3.2 Using an External Oscillator

After making the connections described in Section 3.2.2, the output voltage of the external oscillator set to a minimum, turn the external input regulator 16 fully counterclockwise and set the output voltage using the output voltage switches 12 and 13 . Place the power switch 9 to the ON position to turn on the power. With the output voltage of the external oscillator set to 1V to 2Vrms, turn the external input control 16 clockwise to set the output voltage.

3.4 Adjusting the Output Impedance

The TA-120 shows a slight fluctuation in output impedance depending on output frequencies. To make a precise measurement of the constantly fluctuating output current of the TA-120, follow the steps given below to set the output impedance control 5 .

- With no load connected to the TA-120, set the output voltage to the rated output voltage.
- Connect the desired load to the TA-120 and adjust the output impedance control 5 to set the output voltage to the above rated output voltage.

3.5 Maximum Allowable Output

Since the TA-120 is an amplifier, its maximum allowable output depends on the output voltage and power factor. The relation of output voltage Vo (Vrms) and power factor cosϕ to the maximum allowable output power Po (VA) is given by the following.

$$Io \geqq \frac{120Vo \cdot \cos\phi}{Vs^2} \quad (Arms),\ Po = Vo \cdot Io\ :\ Vo \leqq Vs$$

Vs (Vrms): Rated output voltage

Io (Arms): Maximum allowable output current

This relationship applies if the voltage and current waveforms are sinewaves. A strict relationship cannot be made when the voltage and current waveforms are distorted. However, when the voltage waveform is a sinewave and the load is a full-wave rectifier, peak current values are allowable up to the rated value. With reactor or a half-wave rectifier loads, approximately 30% of the rated value is available as the peak excitation current value.

Fig 3-5 shows the allowable output current and voltage with power factor varied as a parameter. This figure applies if the voltage and current waveforms are of sinewaves. With the voltage and current waveforms consisting of a sinewave and distorted waveform, respectively, as shown in Fig. 3-6, a peak value up to $\sqrt{2}$ times the rms current values obtained from Fig. 3-5 are allowable. To obtain ϕ to calculate the power factor, refer to Fig. 3-6.

(Example)

For a rated output voltage of 100Vrms, output voltage of 80Vrms (80%) and a power factor of 0.8, the allowable current is 80% or 0.96Arms as indicated at point A in Fig. 3-5.

Line power 50Hz, 100Vrms

Output 60Hz

Values given are those occurring just before the protector operates.

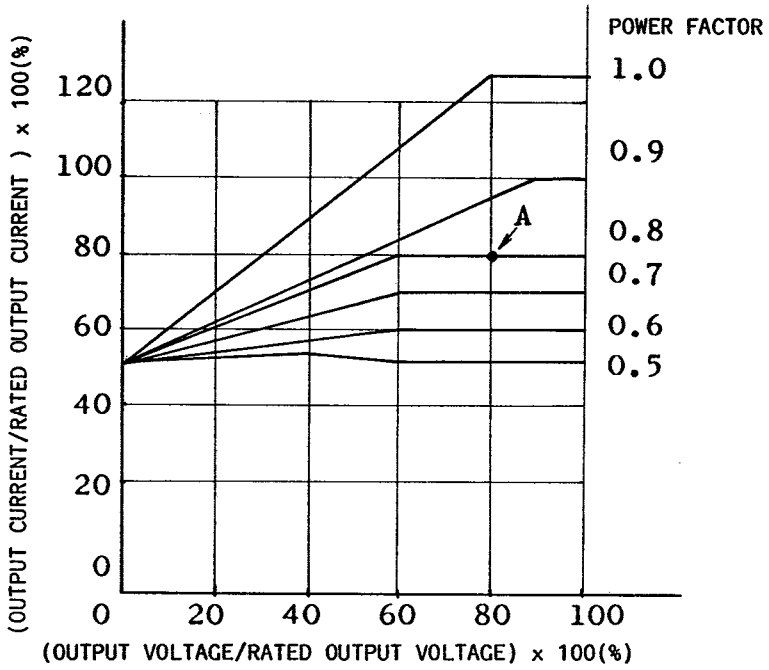


Fig. 3-5 Maximum Allowable Output

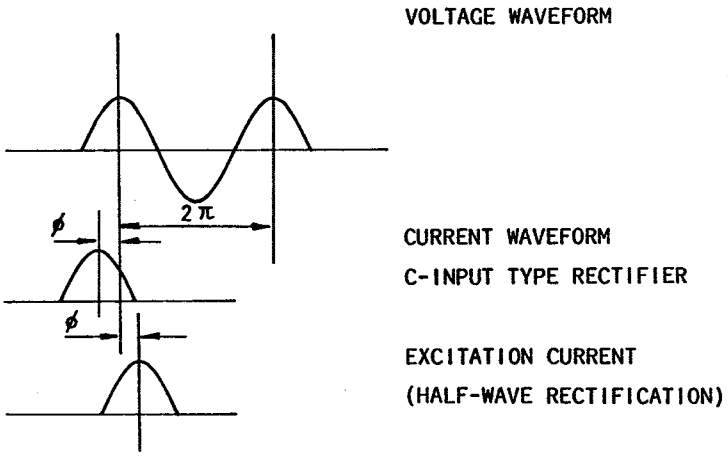


Fig. 3-6 Voltage/Current Waveforms

3.6 Polyphase AC Power Supply

3.6.1 Two-Phase AC Power Supply

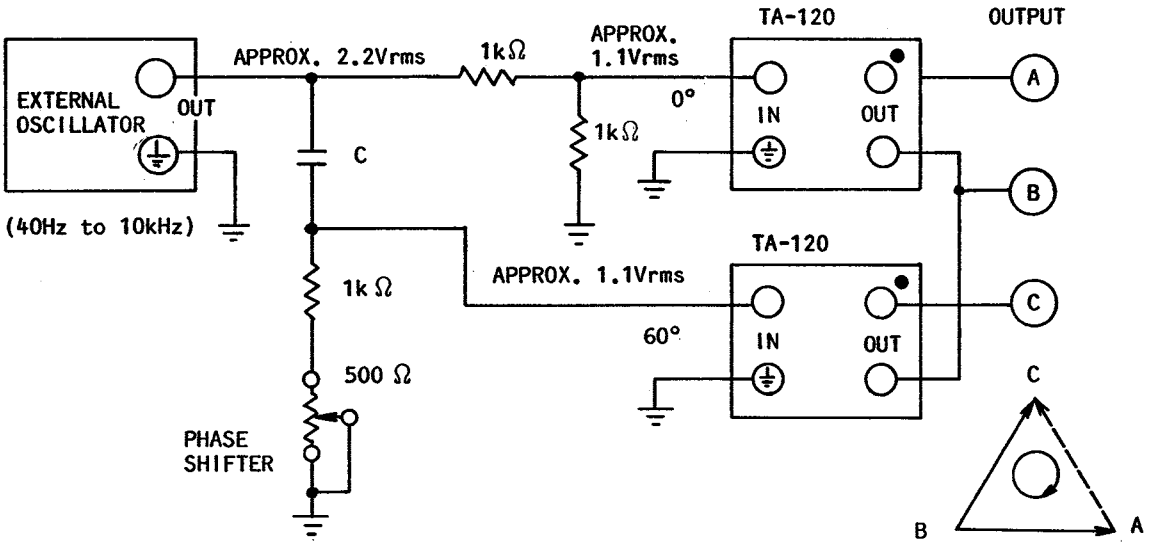
A combination of two TA-120 amplifiers and the PH-20 two-phase shifter can be used to configure a two-phase AC power supply unit, but additionally requires a DC power supply for the two-phase shifter and an external oscillator. NF supplies as standard the Model 2TA-240 equipped with a control panel incorporating a rack mount, power/output simultaneous actuating switch, output terminals and phase shifter. Contact NF for more information. An internal crystal oscillator is used with this setup.

3.6.2 Three-Phase AC Power Supply

NF supplies the Model 3TA-360 as standard. For more information, contact NF.

3.6.3 Improvised Three-Phase AC Power Supply

Two units of this amplifier and an external oscillator can be used for configure an improvised three-phase AC power supply unit. In the setup of Fig. 3-7, this combination serves as a delta-type three-phase power supply with a rated output of 170VA. The drop in rated output is attributable to the V connection and the phase relationship between the voltage and current. Since the TA-120 output has no neutral point, output voltages are line-to-line. For loads with Y connection, the phase voltage is $1/\sqrt{3}$ times the line-to-line voltage.



The value of C is determined by the frequency f, using the following formula.

$$C = \frac{84}{f}(\mu F) \quad : f(Hz)$$

(Examples) 50Hz, C = 1.7μF
60Hz, C = 1.4μF
400Hz, C = 0.2μF

Fig. 3-7 Improvised Three-Phase AC Power Supply

4. PRINCIPLE OF OPERATION

4.1 General

Figure 4-1 shows the block diagram of the TA-120, which consists of the following.

- o Crystal oscillator
- o Amplifier
- o Protective circuit
- o DC Power supply

4.2 Circuit Descriptions

4.2.1 Crystal Oscillator

This circuit includes a waveform shaper and provides accurate signals (at 50, 60 or 400Hz as selected) with minimal distortion.

4.2.2 Amplifier

Amplifies the input signal to a specified level for output. Uses in the input-stage an internal/ external switch that selects input signals, a level control, and voltage switch in the output stage.

4.2.3 Protective Circuit

Detects the output voltage and current of the amplifier to protect the power transistor from being operated beyond the safety limit.

4.2.4 DC Power Supply

Provides the DC power ($\pm$35V, $\pm$40V and regulated $\pm$15V) required for the operation of the TA-120.

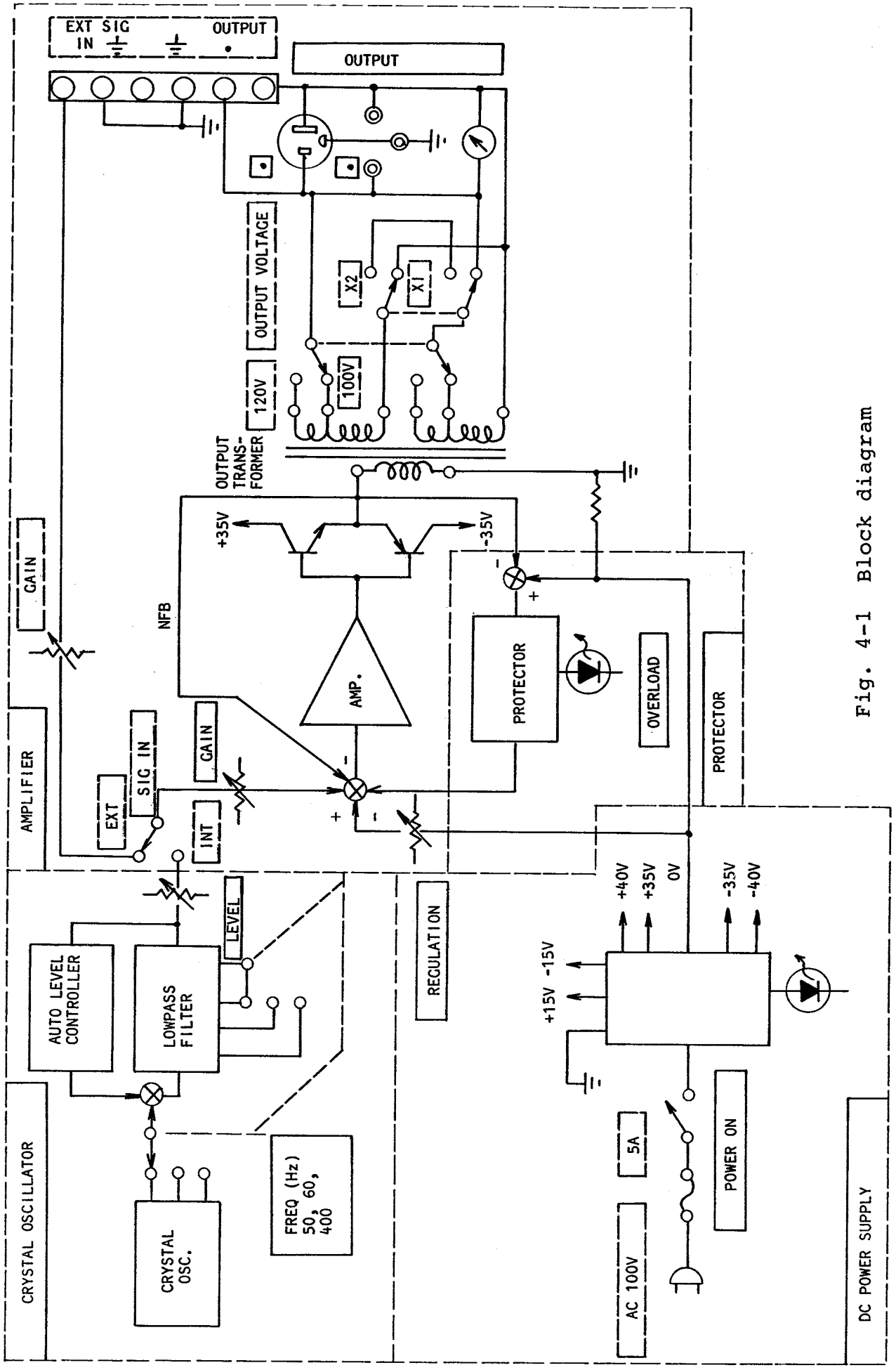


Fig. 4-1 Block diagram

5. MAINTENANCE

5.1 General

For the instrument to operate under an optimum condition, the following maintenance work is required to be done.

5.1.1 Operation Check

Check to see if the instrument properly works and complies with the rated values.

5.1.2 Adjustment and Calibration

If a rated value is not met, the specified control should be adjusted.

5.1.3 Troubleshooting

If troubles too serious to be adjusted by controls come up, check for the cause and defective parts.

5.1.4 Repairs

Repair defective parts. This manual describes the procedure of adjustment, calibration and troubleshooting readily employed by the untrained. For more sophisticated calibration and troubleshooting, contact NF.

(Periodic Inspection Service Contract)

NF offers a service contract under which NF personnel periodically conduct inspection, calibration and repairs for the maintenance of your NF product. For more information, contact the representative from whom you purchased your unit.

5.2 Measuring Instrument Required for Maintenance Work

AC voltmeter	Moving-core type or rectifier-type 150V fullscale
AC Ammeter	Moving-core type 5A, and 1.5A fullscale ranges
High-sensitivity AC voltmeter	M-177 or M-170 (from NF) with 10mV range
Distortion meter	E-2001A or DM-153B (from NF)
Oscilloscope	AC/DC, 5mV/DIV; capable of measuring up to 15MHz
Load	Resistive load: 83.3Ω, 200W
Oscillator	E-1205 or E-1011A (from NF)

5.3 Operational Check

Described in this paragraph is the checkup procedure covering the controls on the front and rear panels only.

5.3.1 Rated Output Check

Connecting a 83.3Ω resistive load to the output terminal of the TA-120, check to ensure that the rated output (100Vrms) and the rated output current (1.2Arms) are obtained and that the protective circuit lamp does not light. Set the power input to within ±10% of the rated value and adjust the output frequency to 60Hz.

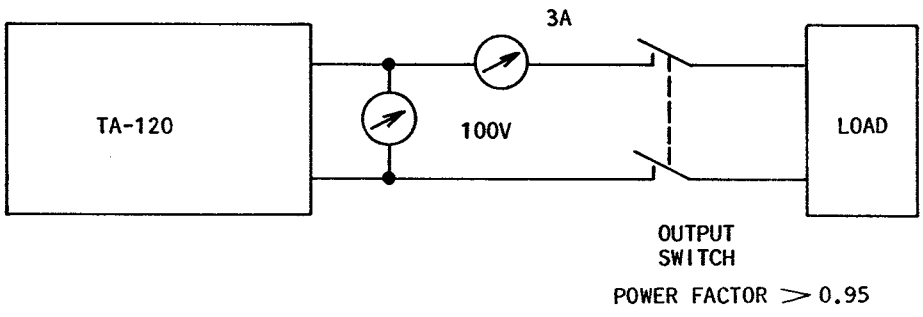


Fig. 5-1 Rated Output Check

5.3.2 Output Impedance Check

By setting the line power voltage to 100Vrms with the same connection as mentioned in Section 5.3.1 and varying the load from 0 to 100%, check that the output voltage shows no fluctuation. (The output impedance will vary slightly, depending upon the load characteristic and frequency.)

5.3.3 Harmonic Distortion Check

With the line power voltage set to 100Vrms and under the rated output condition, check to see if output distortion factor is within the following ranges.

Output frequency	45Hz to 1kHz	1% or less
	40Hz to 10kHz	3% or less

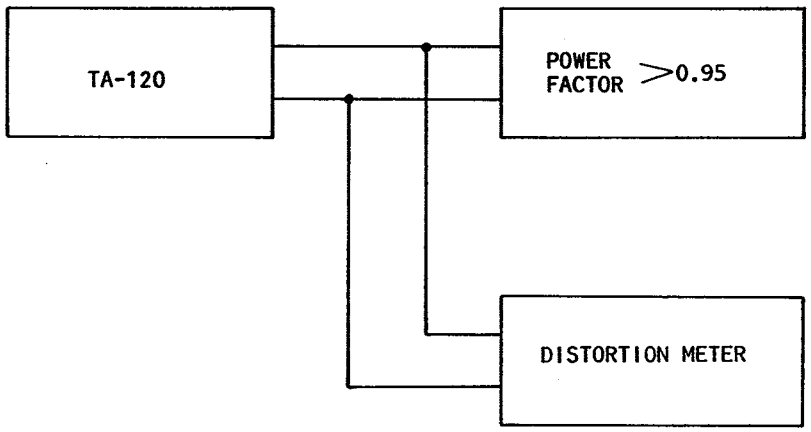


Fig. 5-2 Harmonic Distortion Check

5.3.4 S/N Ratio Check

At the rated output voltage (100Vrms), the output voltage for the no-signal condition should be 100mVrms or less.

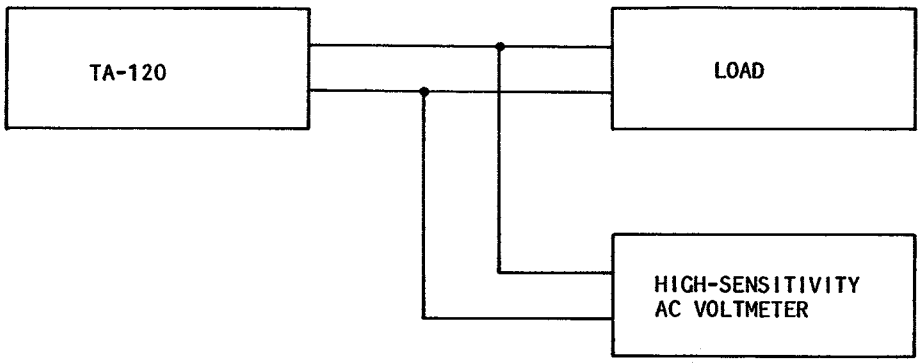


Fig. 5-3 S/N Ratio Check

5.3.5 Output Voltage vs. Frequency Characteristic Check

With the line power voltage at 100Vrms, set the rated output to 0dB (reference) at 400Hz and check that output voltage response complies with the following.

Output frequency	45Hz to 1kHz	Within ±1dB
	40Hz to 10kHz	Within ±3dB

Establish the same connection as given in Fig. 5-3 for this check.

5.3.6 Protective Circuit Performance Check

Set the line power voltage, output frequency and output voltage to 100Vrms, 60Hz and 100Vrms, respectively. With the TA-120 output shorted, check that the output current is approximately 0.6Arms.

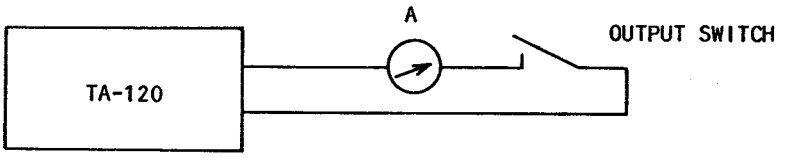


Fig. 5-4 Protective Circuit Performance Check

5.3.7 Output Voltage Check

Using the output voltage switches to set the output voltage to 100, 120, 200 and 240V progressively with no load, check that the output voltage deviation stays within ±1%.

5.4 Adjustment and Calibration

This section relates the measure to adjustment and calibration of items which are found not to comply with the requirements in Section 5-3, these being possible even without the use of a soldering iron.

Remove the eight screws holding the cover to dismount it. Make adjustments and calibration by referring to Fig. 5-5 (Troubleshooting).

5.5 Troubleshooting

This section describes simple repair procedures for the cases where the action taken as described in Section 5.4 fails to make the instrument comply with specifications.

5.5.1 Verification of Failures

Determine whether the trouble is attributable to the instrument itself or to abnormal input signals or loads.

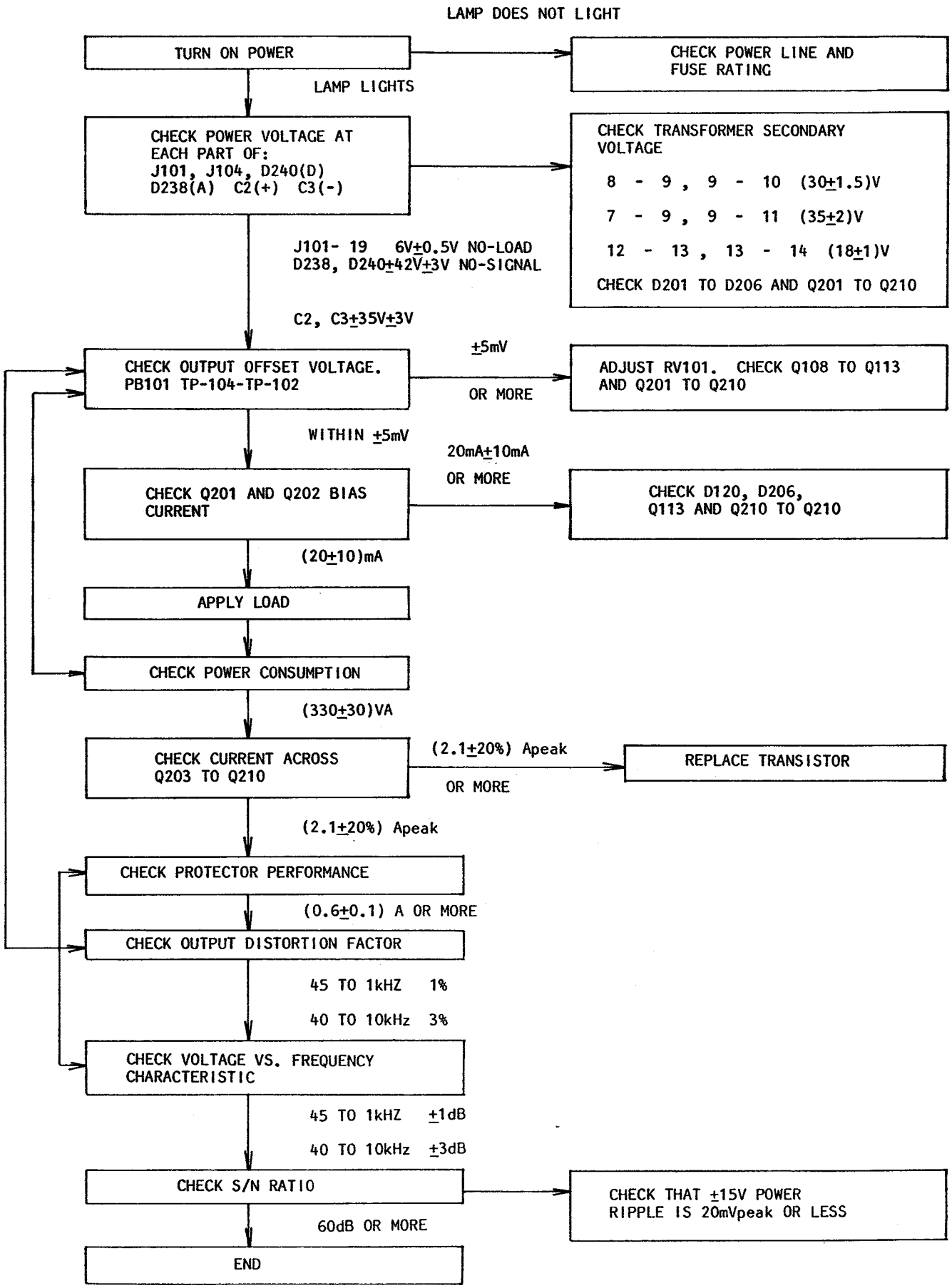
Refer to Fig. 5-5 for the troubleshooting flow. The following are examples of frequently occurring misoperations.

- Input switch (improper position)
- External input level control (improper position)
- Improper line power voltage range
- Power protection fuse has blown
- Improper power factor
- Output voltage switches (improper position)

5.5.2 Detecting the Trouble Visually

In most cases, troubles can be detected by visual inspection. Check to see if any of the resistor or other parts on the printed circuit board has burnt. If a defective part is detected, before replacement, be sure to check the circuit around it to determine whether the defect is restricted to that part only or the failure is attributable to another part associated with it.

Fig. 5-5 Troubleshooting



6. REFERENCE DATA

6.1 General

Provided here are the reference data for the major items of performance of the TA-120. As a means to promote quality control, NF is striving to minimize deviations in performance with its instruments. These data are obtained by averaging the performance of individual products, and may not coincide precisely with those of your unit. Rest assured however, that each product was shipped from the factory after being thoroughly tested and found to meet published specifications.

6.2 Reference Data

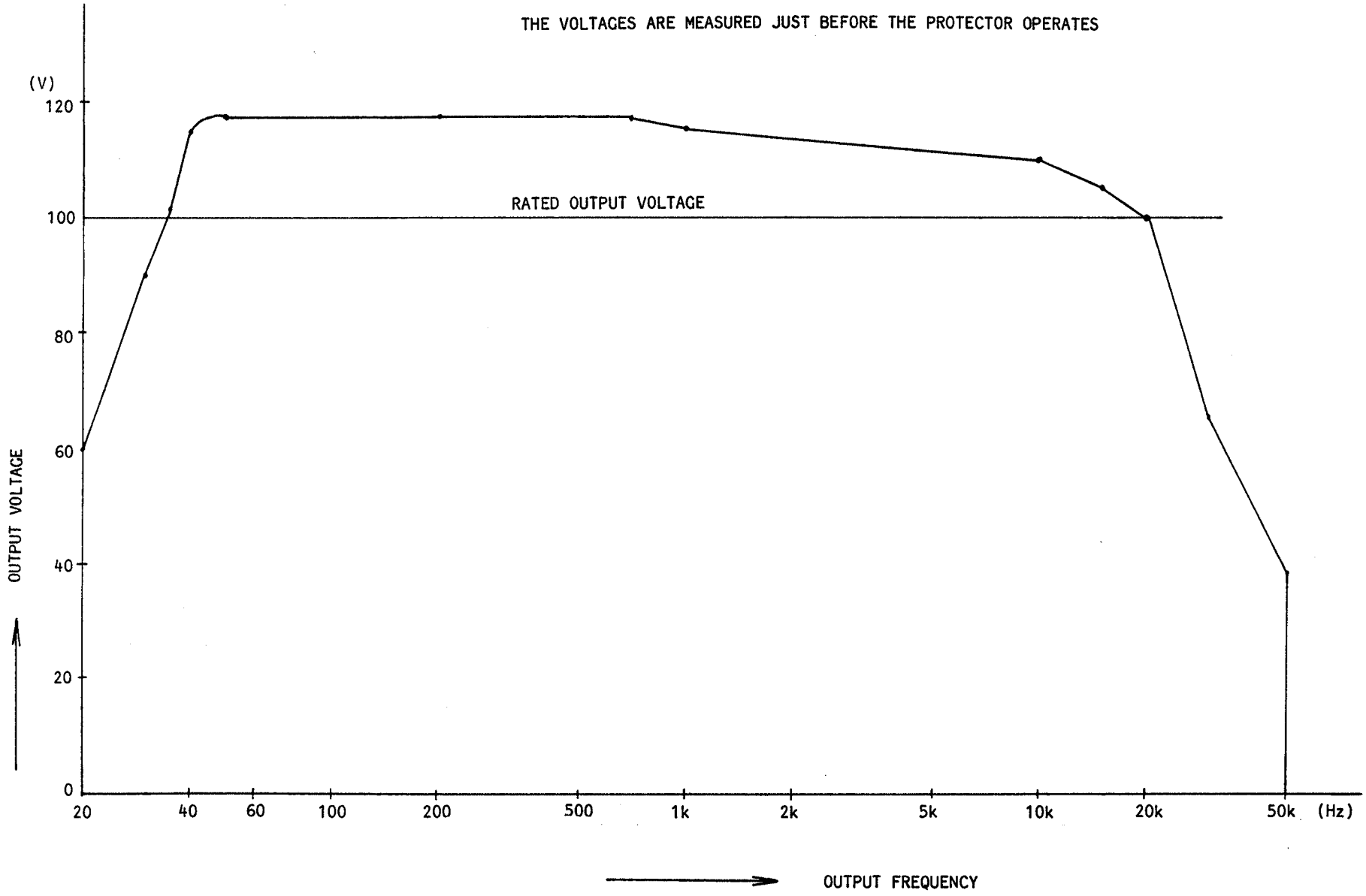
- o Maximum output voltage vs. frequency
- o Harmonic distortion factor vs. frequency
- o Gain/phase contrast vs. frequency
- o Maximum output vs. power factor
- o Maximum output vs. power voltage

(Note)

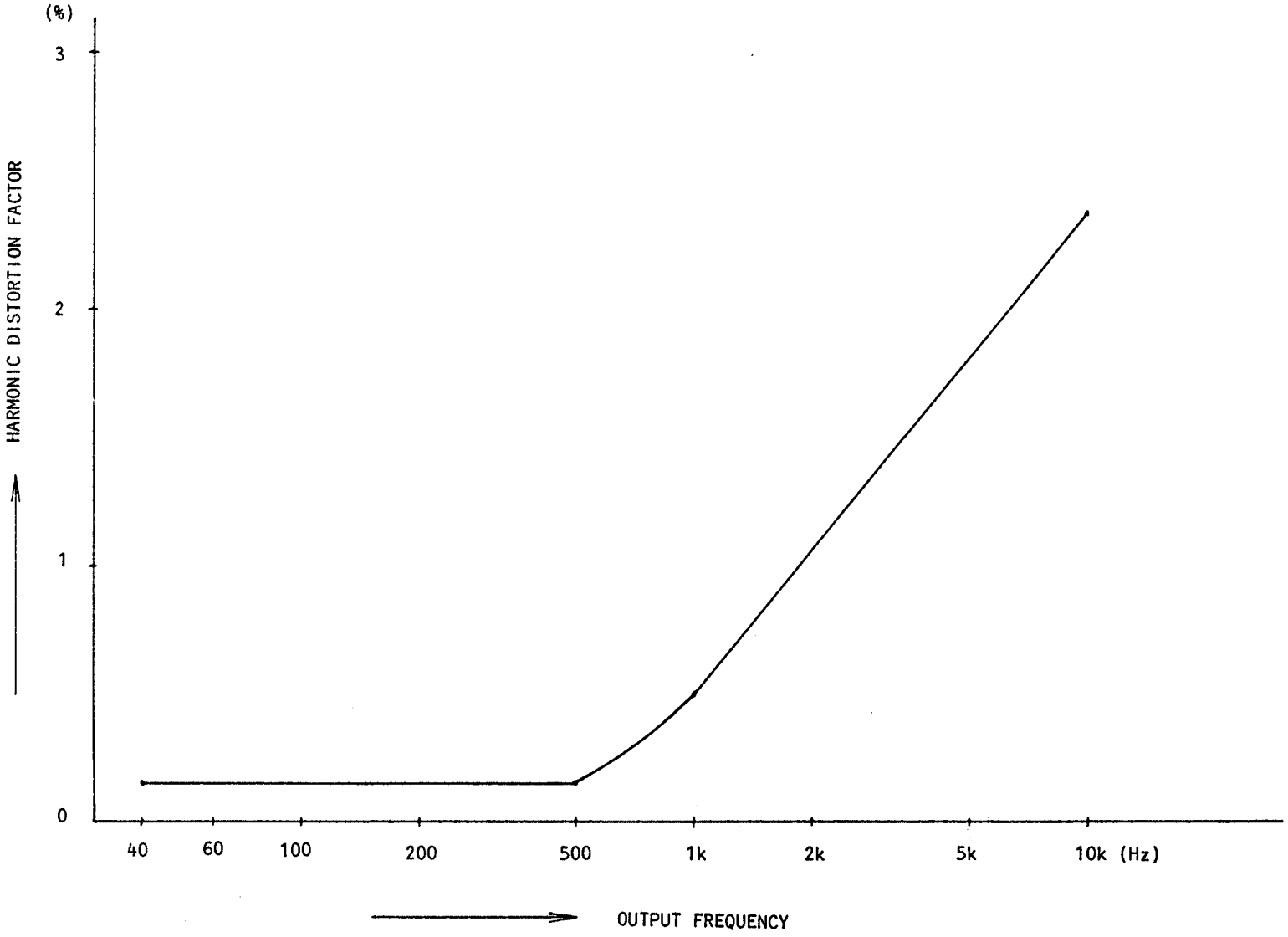
Unless otherwise specified, the above data were obtained under the following conditions.

Line power voltage	100Vrms (50Hz)
Output voltage	100Vrms
Load	83.3Ω (rated resistive load)

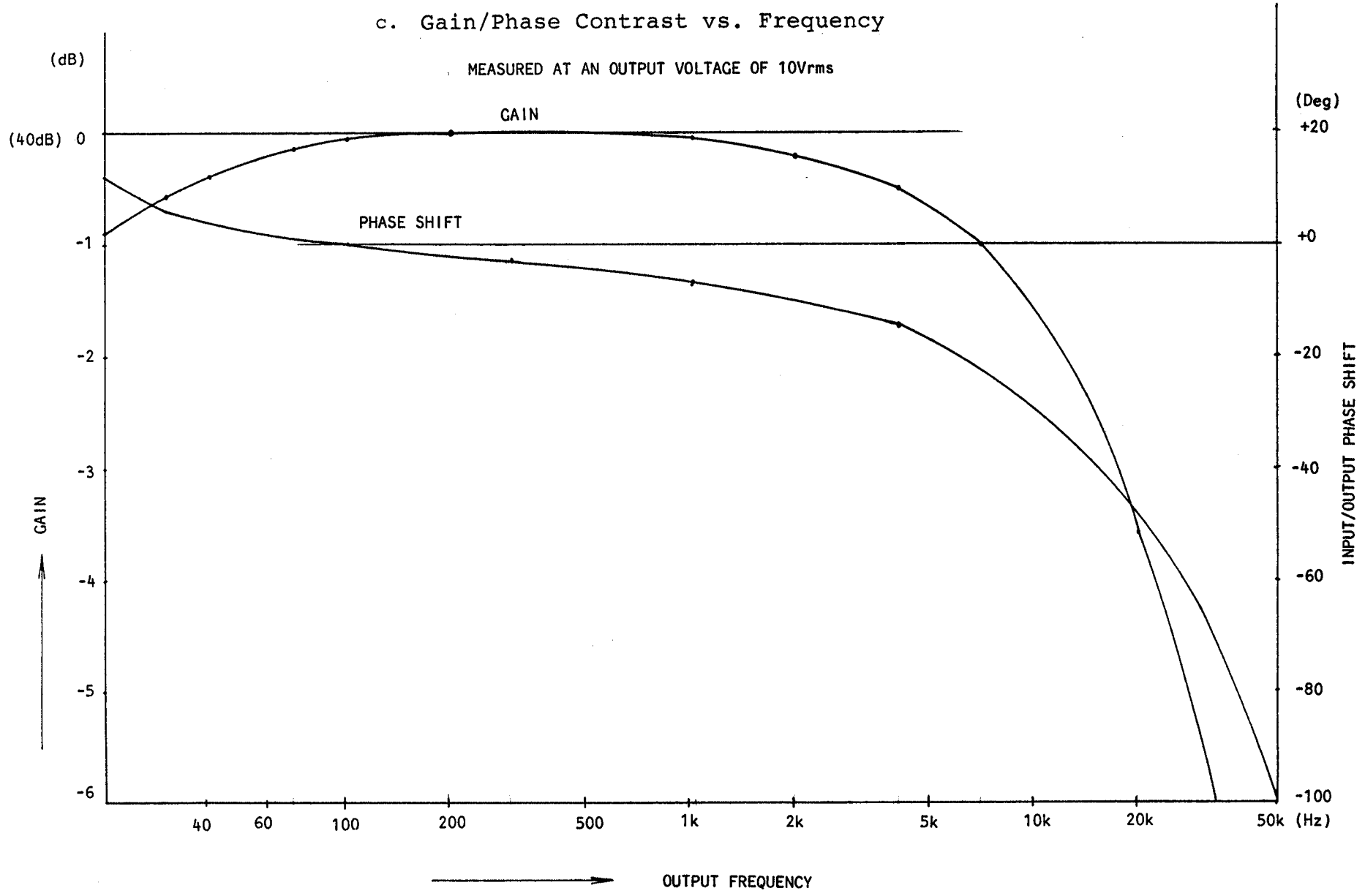
a. Maximum Output Voltage vs. Frequency



b. Harmonic Distortion Factor vs. Frequency

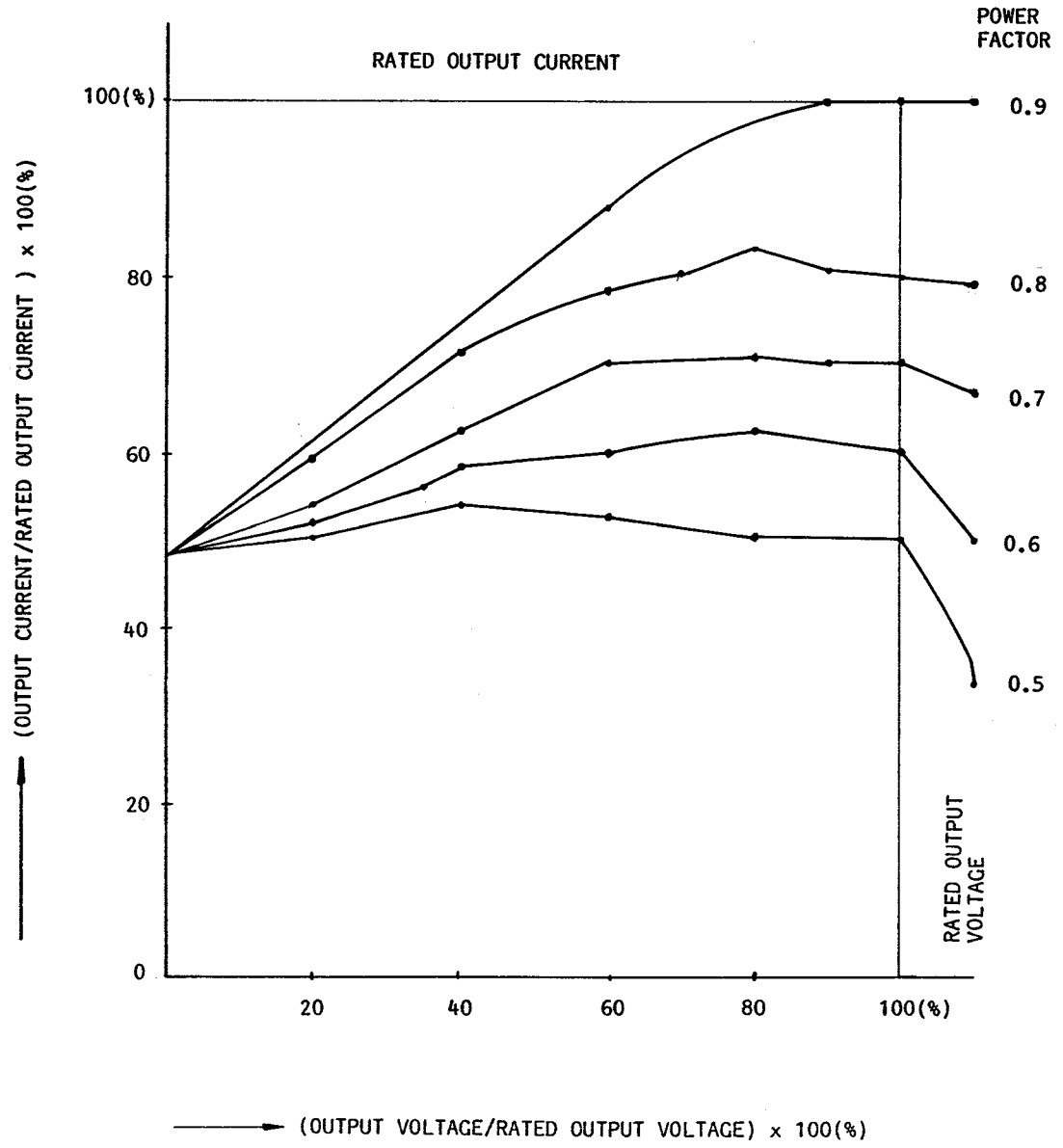


c. Gain/Phase Contrast vs. Frequency



d. Maximum Output vs. Load Factor

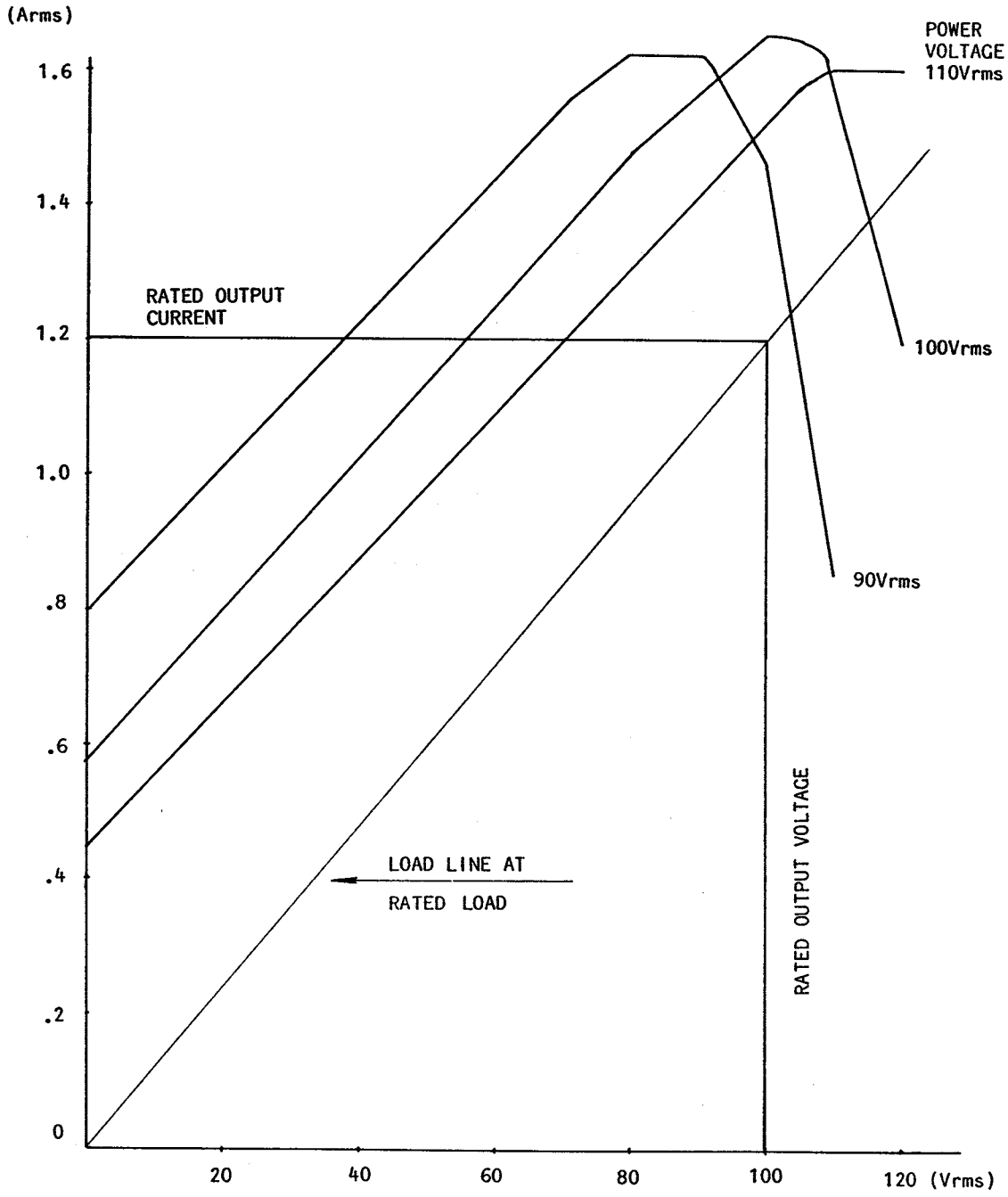
MEASURED JUST BEFORE THE PROTECTOR OPERATES,
WITH AN OUTPUT FREQUENCY OF 60Hz



e. Maximum Output vs. Power Voltage

MEASURED AT THE LOAD RESISTANCE JUST BEFORE THE PROTECTOR OPERATES.

THE VALUES ARE MEASURED JUST BEFORE OUTPUT WAVEFORM IS CLIPPED.



WARRANTY

NF CIRCUIT DESIGN BLOCK CO., LTD. certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory.

All NF products are warranted against defects in materials and workmanship. Obligations under this warranty are limited to replacing, or repairing of any instrument returned to our factory for that purpose within one year of delivery to the original purchaser. No other warranty is expressed or implied. NF does not assume liability for installation or for incidental or consequential damages.

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