For your reference:

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WIDE RANGE DECADE FILTER

FV-628B

INSTRUCTION MANUAL

NF Corporation

D:59078-1

MODEL FV-628B

WIDE RANGE DECADE FILTER

INSTRUCTION MANUAL

TABLE OF CONTENTS

ATTACHED DRAWINGS

1. GENERAL

1-1 Introduction

This instrument is a very wide band cutoff frequency variable active filter that permits setting of maximum frequencies of 10 MHz (for low-pass filter) and 3 MHz (for high-pass filter).

The attenuation gradient is 24 dB/oct, and the filter can be used as a low-pass filter (LPF), high-pass filter (HPF) and bandpass filter (BPF).

The cutoff frequency can be set by a two-digit decade switch within the ranges from 1 Hz to 10 MHz for the low-pass filter and 1 Hz to 3 MHz for the high-pass filter.

The response characteristic of the low-pass filter can be changed over in two steps, maximum flatness and phase linear.

Considering the possibility of handling a high-frequency signal, the I/O terminal is designed to be compatible with a coaxial cable as well. With the filter section being set to THRU, the instrument can also be used as a buffer amplifier that operates within a range from DC to 20 MHz.

1-2 Features

o Very wide band : 1 Hz - 10 MHz for LPF, 1 Hz - 3 MHz for HPF, combination of LPF and HPF for BPF

- o Attenuation gradient: 24 dB/oct
- o Frequency response characteristic of LPF
  : Selection of MAX FLAT and PHASE LINEAR
- o Frequency setting : 2-digit decade
- o Can be used as a buffer amplifier in a wide bandwidth from DC to 20 MHz
- o Input impedance : Selection of 1 MΩ and 50Ω
- o Recorder output terminal
  : ±100 mA with 20Ω load
- o Output voltage and current
  : 10 Vp-p with 50Ω load
- o Option : Extension of inputs and outputs on the rear panel

1-3 Rating

1-3-1 Electrical rating

Number of channel	:	One
Mode	:	Through, low-pass filter (MAX FLAT, PHASE LINEAR), high-pass filter, bandpass filter
Cutoff frequency	:	1 Hz - 10 MHz for LPF (6 ranges for x1 - 100k) 1 Hz - 3 MHz for HPF (6 ranges for x1 - 30k) Combination of HPF and LPF for BPF, 2-digit decade setting

Accuracy of cutoff frequency

: Within ±5% for the x1 - x1k range
Within ±7% for the x10k range
Within ±10% for the x100k and the x30k ranges

Attenuation gradient

: 24 dB/oct

Accuracy of attenuation gradient

: ±2dB for the x1 - x1k range
±4dB for the x10k range
±6dB for the x30k range
±12dB for the x100k range

Pass gain : 0 dB

Pass gain deviation

HPF : ±0.7 dB for the x1 - 1k range
±1.5 dB for the x10k range
±1.8 dB for the x30k range

LPF : ±0.7 dB for the x1 - 10k range
±1.5 dB for the x100k range

Frequency characteristic

: Within -3 dB at 20 MHz

Input impedance : Selection of 1 MΩ and 50Ω,
unbalanced below 50 pF parallel

Maximum input voltage

: 10 Vp-p

Output impedance : 50Ω

Output voltage : 10 Vp-p max/50Ω load

Output current ±100 mA/20Ω load

I/O terminal : BNC receptacle

Distortion factor : Not more than 0.3% for 10 Hz to 100 kHz at rated output and in the flat portion

Output noise : Not more than 2 mVRMS (10 Hz - 20 MHz band)

Maximum attenuation : Not less than 60 dB (up to 100 MHz) with sinusoidal wave rated input (5.5 Vp-p to 10 Vp-p)

Power source : AC 100 V,120 V,220 V or 240 V $\pm$10% 48 to 62 Hz, approx. 20 VA

Ambient temperature and humidity : 0°C to +40°C, 10 to 90% RH when operating
-10°C to +50°C, 10 to 80% RH when stored

Note: The above rating applies when no option is provided. The rating may differ regarding the high frequency characteristics such as the frequency response, maximum attenuation and others when input/output terminals are provided on the rear panel as options.

1-3-2 Mechanical rating

Dimensions : 429(width) x 99(height) x 350(depth) (mm) excluding projections

Weight : Approx. 8.8 kg

2. PREPARATIONS BEFORE OPERATION

2-1 Unpacking

Upon unpacking the case, check to see if the instrument and components are damaged during transit. The instrument is carefully adjusted and inspected before shipment from the factory, but check knobs and controls for looseness and the quantity of components referring to the following list of components.

2-2 Components

The standard components of the instrument are shown below.

Basic unit	1 unit
Instruction manual	1 copy
Accessories	
Power cable	1 pc
Signal cable (BNC-BNC 50Ω, 1m long)	2 pcs
Fuse (0.5 A, glass-enclosed)	1 pc*

* Stored in a fuse holder as a spare.

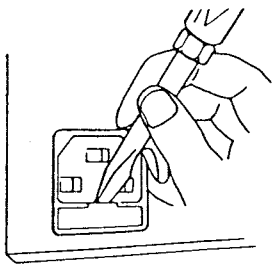


Fig. 2-1 Fuse holder

2-3 Outside Dimensions and Removal of Top Plate and Side Plate

A. Outside dimensions

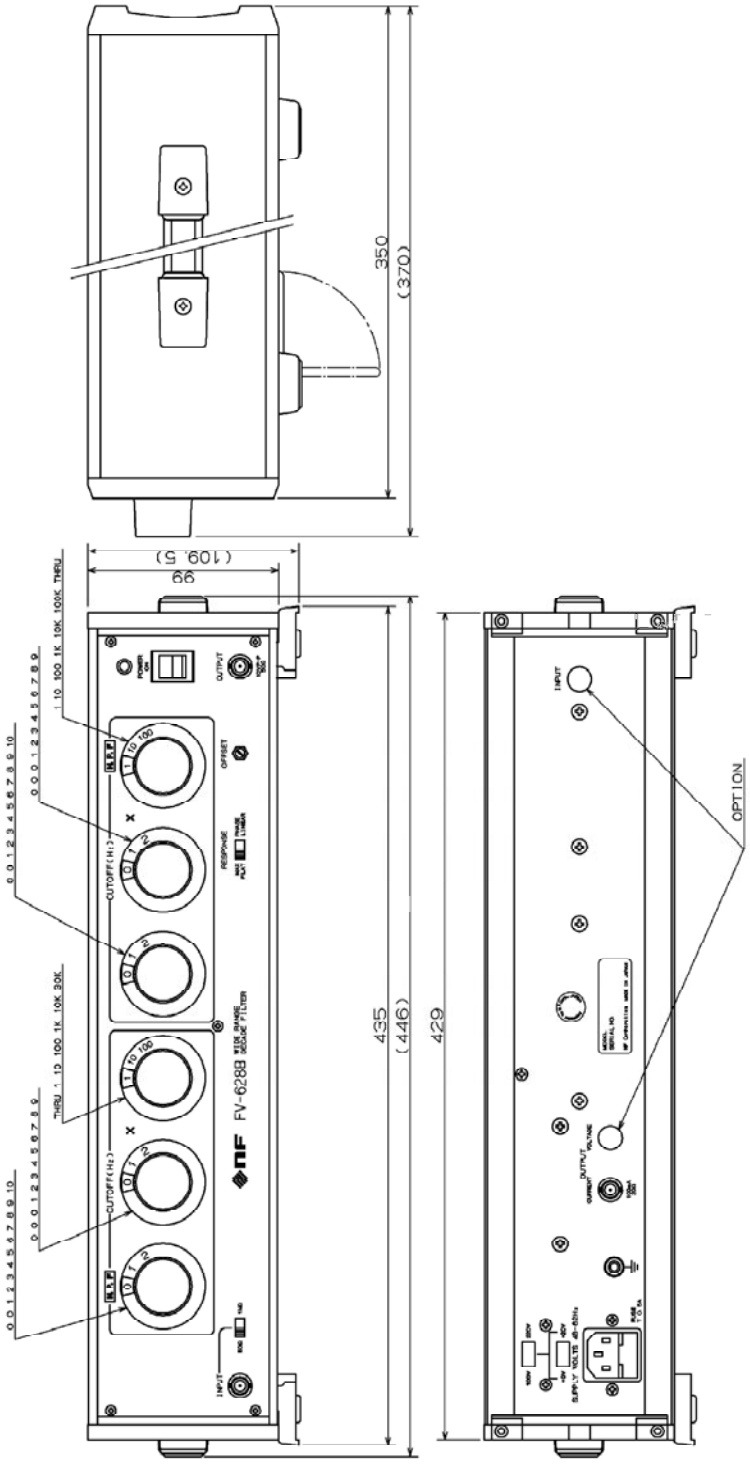
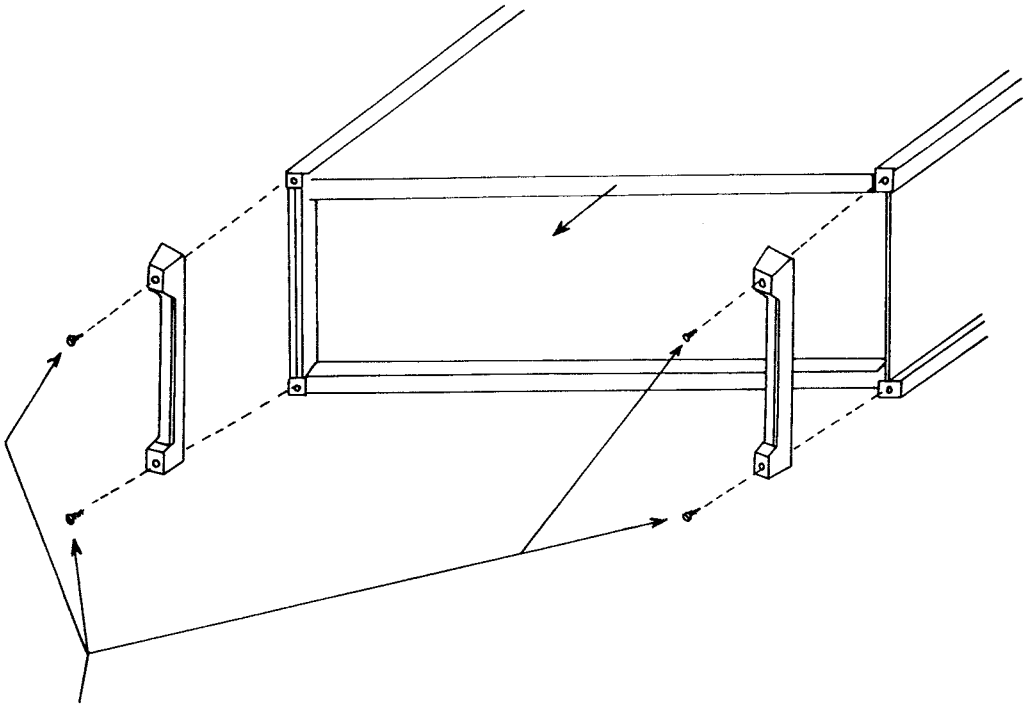


Fig. 2-2 Outside dimensions

B. Removal of top plate and side plate



1. Unscrew these four screws on the right and left sides and remove the rear guard.
2. Pull out the top plate in the arrow direction.

Fig. 2-3 Removal of top plate

2-4 Power and Grounding

A. Power

The instrument should be operated within ±10% of the rated voltage. If there is no requirement regarding the power supply voltage, the voltage has been set to 100V when the instrument is delivered.

The capacitance of a fuse is 0.5A.

B. Grounding

As a safety measure and to prevent the effects of external noise, a ground terminal is provided on the rear panel. This terminal should be connected to an electrical ground. The FV-628B uses a line filter circuit such as shown in Fig. 2-4. The maximum leakage current at 250V/60Hz is 0.5mArms.

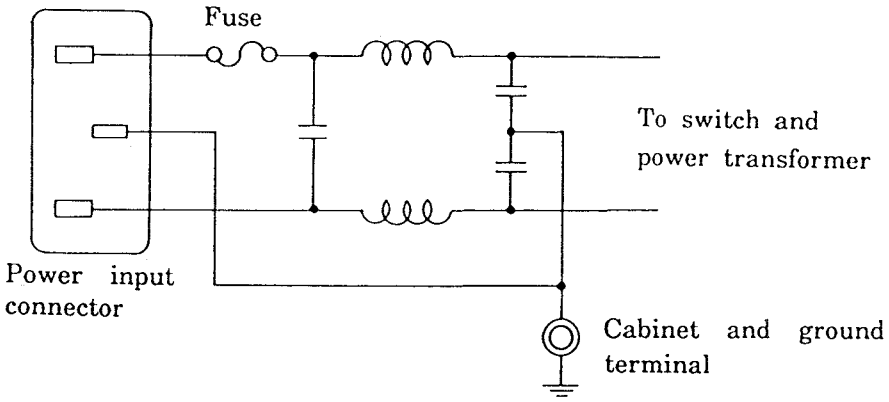


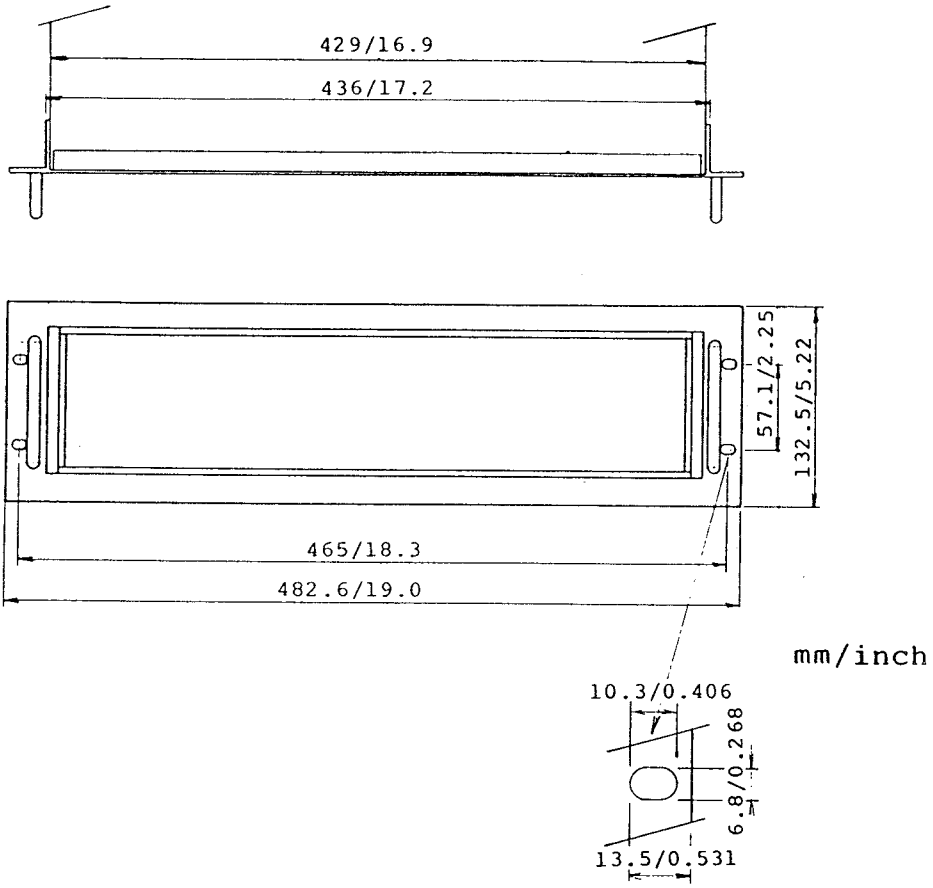
Fig. 2-4 Line Filter

2-5 Rack Mounting(Option)

The FV-628B may be mounted in a standard 19-inch IEC/EIA or a standard metric rack using the optional rack mount adaptors and rails.

The FV-628B is rack mounted by following the procedure below.

Standard 19-inch mount



Standard metric mount

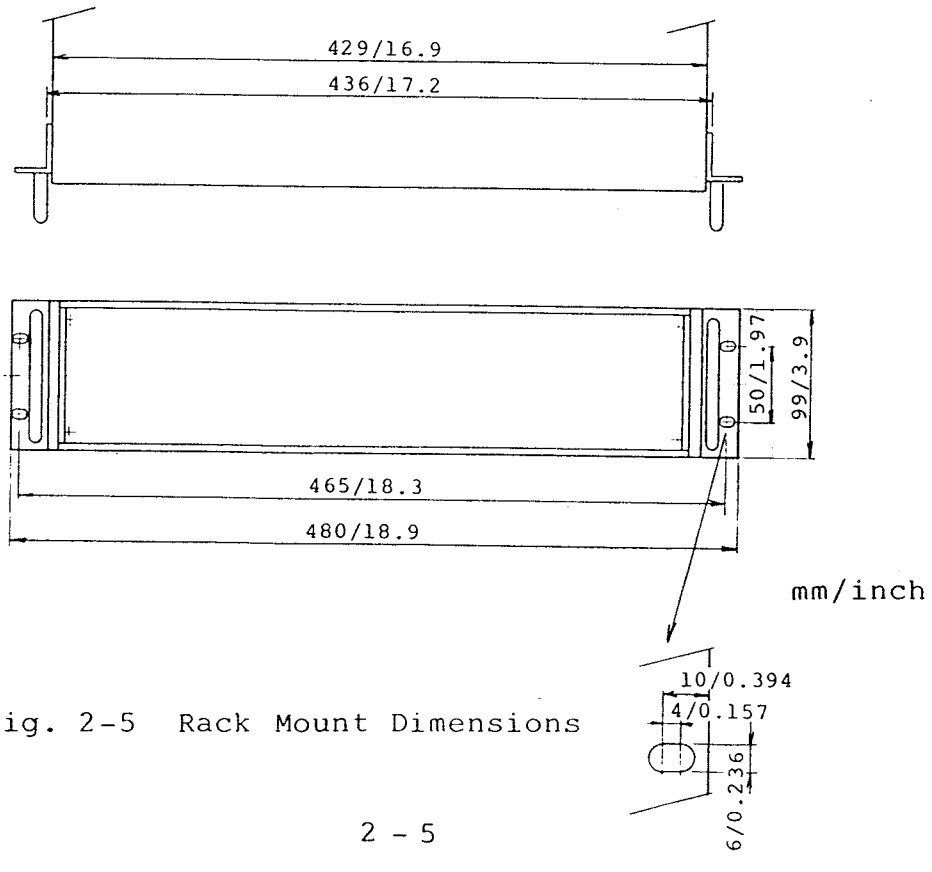


Fig. 2-5 Rack Mount Dimensions

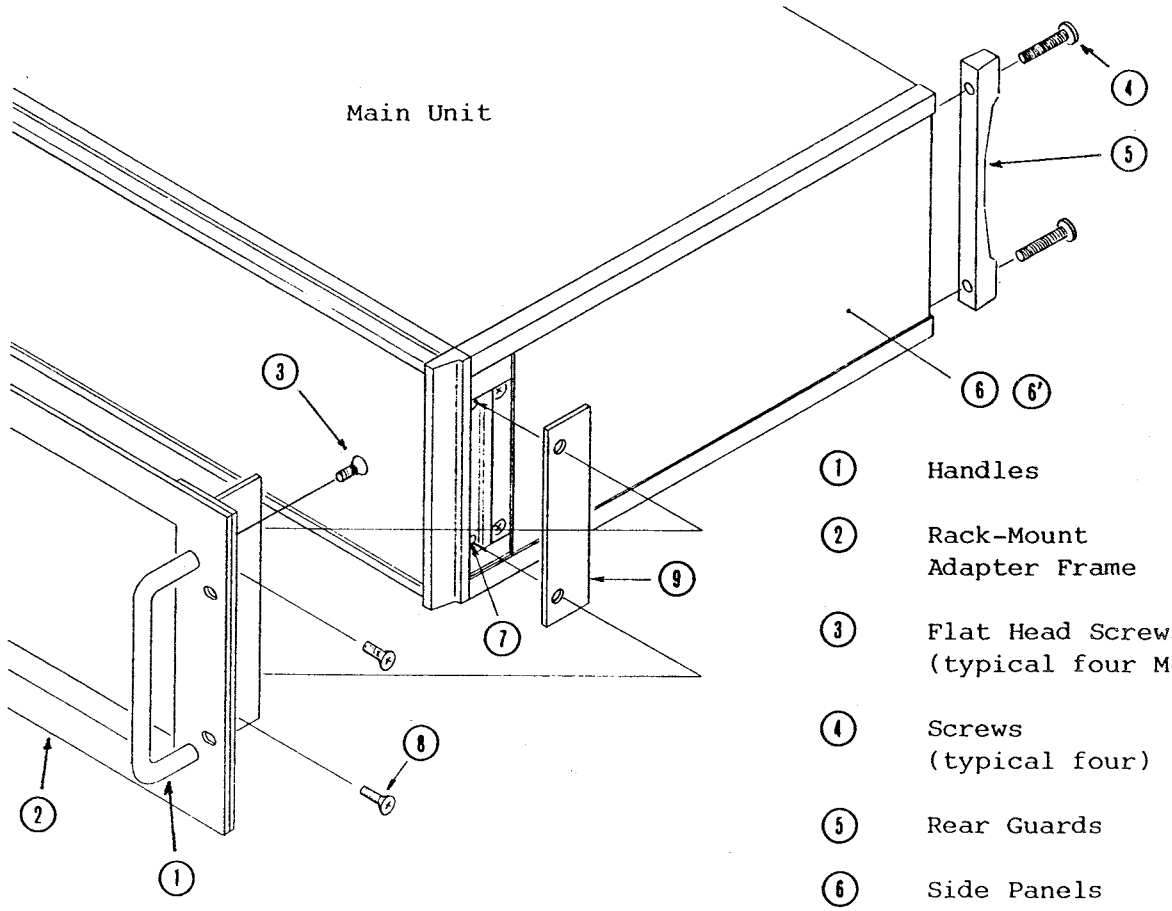
RACK-MOUNT ADAPTER FITTING PROCEDURE

(a) Fasten both handles (1) on the rack-mount adapter frame (2) by inserting the flat head screws (3) into the handle through the adapter frame.

(b) Remove the screws (4) and the rear guards (5). Pull the side panels (6) out from both sides.

(c) Remove the screws (7). Attach the rack-mount adapter frame (2) on the main unit using the flat head screws (8) after inserting spacers (9) between the main unit and the rack-mount adapter frame (2).

(d) Insert the optional side panels (6') into the slits of the main unit. Attach the rear guards (5) onto the side frame by using the screws (4).



Standard 19-inch mount

Fig. 2-6 Rack Mount Adaptor (1/2)

1 Handles

2 Rack-Mount Adapter Frame

3 Flat Head Screws (typical four M4x10)

4 Screws (typical four)

5 Rear Guards

6 Side Panels

6'

7 Screws (typical four)

8 Flat Head Screws (typical four M4x14)

9 Spacers

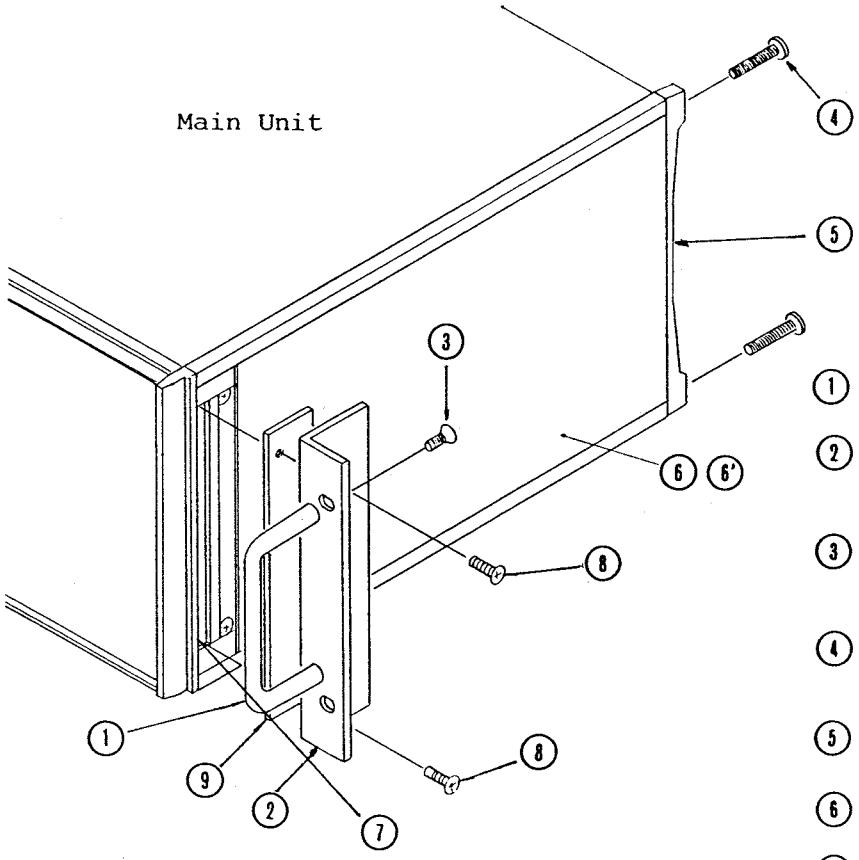
RACK-MOUNT ADAPTER FITTING PROCEDURE

(a) Fasten both handles (1) on the rack-mount adapters (2) by inserting the flat head screws (3) into the handle through the adapters.

(b) Remove the screws (4) and the rear guards (5). Pull the side panels (6) out from both sides.

(c) Remove the screws (7). Attach the rack-mount adapters (2) on the main unit using the flat head screws (8) after inserting spacers (9) between the main unit and the rack-mount adapters (2).

(d) Insert the optional side panels (6') into the slits of the main unit. Attach the rear guards (5) onto the side frame by using the screws (4).



Standard metric mount

① Handles

② Rack-Mount Adapter Frame

③ Flat Head Screws (typical four M4x10)

④ Screws (typical four)

⑤ Rear Guards

⑥ Side Panels

⑥'

⑦ Screws (typical four)

⑧ Flat Head Screws (typical four M4x14)

⑨ Spacers

Fig. 2-6 Rack Mount Adaptor (2/2)

3. OPERATION

3-1 Nomenclature and Operation

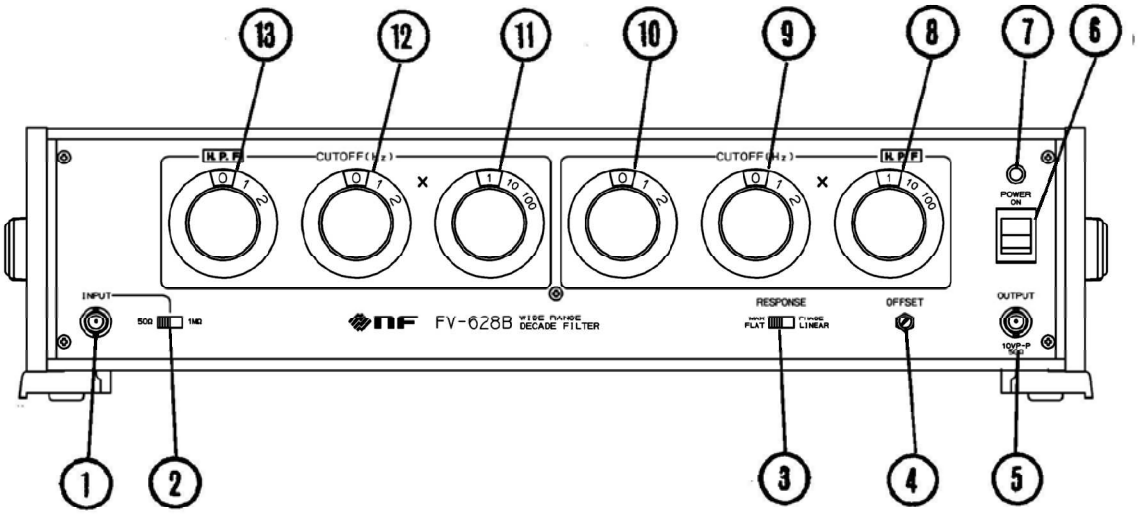


Fig. 3-1 Front panel

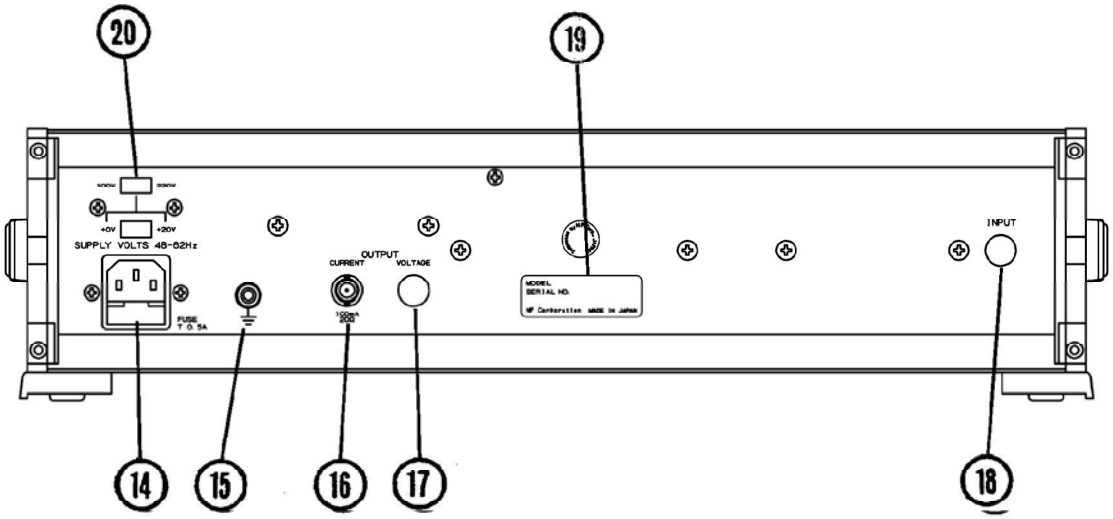


Fig. 3-2 Rear panel

① "INPUT" Input receptacle

This is a signal input receptacle. The earth side is connected to the housing.

② "_____" 50Ω, 1MΩ

Selector switch for input impedances of 50Ω and 1MΩ.

③ "RESPONSE" Switch to select the frequency response characteristic of LPF

The switch permits selection of MAX FLAT and PHASE LINEAR.

④ "OFFSET"

This is a trimmer to adjust offset.

⑤ "OUTPUT" Output receptacle

This is a signal output connector, and the output impedance is 50Ω. The voltage output is 10 Vp-p/50Ω.

⑥ "POWER" Power switch

Throwing this switch upward causes the ⑦ to light up.

⑦ "_____" Pilot lamp

Pilot lamp to indicate that the power is set to work.

⑧ "CUTOFF FREQ (Hz)" Frequency range selector switch for LPF

This switch covers six ranges from 1 Hz to 10 MHz in steps of x10. When the switch is set to THRU,

the LPF section is deprived of the filter functions and operates as a buffer amplifier.

⑨⑩ "CUTOFF FREQ (Hz)" Frequency setting knob for LPF

Two-digit decade setting. The higher digit is 0 to 10 and the lower digit is 0 to 9. The cutoff frequency can be set from 1 Hz to 10 MHz in conjunction with the multiplier ⑧.

⑪ "CUTOFF FREQ (Hz)" Frequency range selection switch for HPF

This switch covers six ranges from 1Hz to 3MHz. When the switch is set to THRU, the HPF section is deprived of the filter functions and operates as a buffer amplifier.

⑫⑬ "CUTOFF FREQ (Hz)" Frequency setting knob for HPF

Two-digit decade setting. The higher digit is 0 to 10 and the lower digit is 0 to 9. The frequency can be set from 1 Hz to 3 MHz in conjunction with the multiplier ⑪.

⑭ "SUPPLY VOLTS"

This is the connector which mates to the power cable and combines a fuse holder. Care should be taken that the power cable connector is securely mounted at this connector.

⑮ "⏚" Earth terminal

Earth terminal for the housing. Connect it to the ground.

⑯ "OUTPUT CURRENT" Current output receptacle

Current output terminal. The current output is 100 mAo-p/20Ω.

⑰ "OUTPUT VOLTAGE" Voltage output BNC receptacle on the rear panel for options

⑱ "INPUT" Input BNC receptacle on the rear panel for options

⑲ "_____" Nameplate

⑳ " 100V 220V +0V +20V "

This switch is used to select the line voltage of 100V, 120V, 220V or 240V, combining the two switches.
If there is no requirement regarding the power supply voltage, the voltage has been set to 100V when the instrument is delivered.
If changing the setting, be sure to check the supply voltage and disconnect the power cable from its outlet.

3-2 Input/Output Connection

A. When no options are provided

The input/output terminals of this instrument are BNC receptacles, which are located on the front panel. The current output terminal is located on the rear panel.

For connection to the signal input connector when the frequency is higher than 1 MHz or more, use a coaxial cable with an input impedance of 50Ω and a connecting cable of 50Ω and match the impedance between instruments. Operation at an impedance other than 50Ω will deteriorate the output waveform or may not meet the specifications. With a low frequency, the instrument can be operated at input impedances of 1 MΩ// 50 pF or

less, but high impedance of the signal source will decrease the passband gain or increase noise.

For connection to the output connector when the frequency is high, use a 50Ω coaxial cable for the connecting cable as with the input connector and match the load impedance at 50Ω.

Also at low frequencies, always connect a 50Ω output load so as to make the passband gain between the input and output the specified value (0 dB). The maximum output voltage is 10 Vp-p with 50Ω load.

Caution
Always connect a 50Ω output load.
Match the impedance if the frequency is high.

For the current output can be obtained a signal output for low input impedance such as for electromagnetic oscillograph and the like. The maximum output is ±100 mA. Do not use a voltage output and current output simultaneously.

B. When options are provided additionally

In this case, the input/output terminals on the front panel can be used for monitoring (terminal of 1 MΩ or more). Do not connect any device other than a monitor to the input/output terminals on the front panel. Connection to the input/output terminals for options

on the rear panel can be done in the manner described in par. A. The frequency response and maximum attenuation when the frequency is more than several tens of MHz may differ slightly from when no option is provided, or the specifications may not be met.

3-3 Operating Procedures

3-3-1 Switching on power

a. Verify that the line voltage selector is set to the line voltage to be used. The line voltage should be within ±10% of the selected voltage.

b. Insert the accessory power cable provided securely into the power input connector and the far end plug into a power outlet. When switched on, the FV-628B will become in operational status with a pilot lamp lit but it will take more than half an hour for the internal circuit to stabilize.

c. If highly precise measurement are required, perform measurements after allowing a one-hour warm up.

3-3-2 Low-pass filter operation

a. Set the 2-digit decade dials (13) and (12) of the "HPF CUTOFF FREQ (Hz)" to [10] and [0] and the multiplier (11) to THRU.

b. Set the cutoff frequency by means of the 2-digit decade dials (10) and (9) of "LPF CUTOFF FREQ (Hz)" and the multiplier (8).

c. Set the "RESPONSE" switch to "MAX FLAT" or "PHASE LINEAR", as necessary.

d. If necessary, adjust the output DC voltage to 0 V by means of the "OFFSET" trimmer.

3-3-3 High-pass filter operation

a. Set the 2-digit decade dials (10) and (9) of the "LPF CUTOFF FREQ (Hz)" to [10] and [0] and the multiplier (8) to THRU.

b. Set the cutoff frequency by means of the 2-digit decade dials (13) and (12) of the "HPF CUTOFF FREQ (Hz)" and multiplier (11).

c. If necessary, adjust the output DC voltage to 0 V by means of the "OFFSET" trimmer.

3-3-4 Bandpass filter

a. Set the low-pass side of the cutoff frequency by means of the 2-digit decade dials (13) and (12) of the "HPF CUTOFF FREQ (Hz)" and multiplier (11).

b. Set the high-pass side of the cutoff frequency by means of the 2-digit decade dials (10) and (9) of the "LPF CUTOFF FREQ (Hz)" and multiplier (8).

c. Set the "RESPONSE" switch to "MAX FLAT".

d. If necessary, set the output DC voltage to 0 V by means of the "OFFSET" trimmer.

3-3-5 Buffer amplifier operation

a. Set the 2-digit decade dials (13) and (12) of the "HPF CUTOFF FREQ (Hz)" to [10] and [0] and multiplier (11) to THRU.

b. Set the 2-digit decade dials (10) and (9) of the "LPF CUTOFF FREQ (Hz)" to [10] and [0] and multiplier (8) to THRU.

c. If necessary, set the output DC voltage to 0 V by means of the "OFFSET" trimmer.

3-3-6 Care to be taken in operation

a. With the multiplier switch set to THRU, the filter section corresponding to the switch is deprived of the filter functions irrespective of the setting of the 2-digit decade dial and operates merely as a buffer amplifier. Since the high frequency response of the buffer amplifier changes slightly according to the setting of the decade dials, however, it is most desirable to set the decade dials to [10] and [0] when the multiplier is set to THRU.

b. Adjustment of offset

If the instrument is operated in normal condition, adjustment of offset may not be necessary. However, the adjustment is necessary if it is used at a location where the ambient temperature changes considerably. The DC voltage change of this instrument is about 5 mV for 1°C.

c. Gain between input and output

With this instrument, the gain in the flat portion

of the HPF and LPF and the gain of the buffer amplifier are 0 dB only when the output load is 50Ω. So always connect a 50Ω load to the output.
The output signal has the same phase as that of the input signal in the flat region of the filter.

3-3-7 Selection of cutoff frequency

In a simple application for eliminating unnecessary signals when the instrument is used as an ordinary low-pass filter and high-pass filter, the cutoff frequency is set between a necessary signal component and unnecessary signal component.
When attenuating a single frequency and other frequency components superimposed on it, there can be two ways in selecting the cutoff frequency.
The first method is the case when the attenuation of the frequency to be passed can be a problem. The cutoff frequency is set in such a manner that the frequency comes in the flat portion of the frequency response so as to minimize the loss by the filter.
The second is the case when the attenuation of other superimposed frequency components is important.

In this case, the cutoff frequency is set so that necessary attenuation can be obtained in terms of the attenuation characteristics.
If the passband signal is not a single but a composite wave, loss of composite frequencies will be a problem, and the cutoff frequency is set by considering the frequency response so that it comes within the permissible deviation.
For setting, the 2-digit decade dials and multiplier are set in the following positions.
In the case of 5 Hz, the setting will be

[0] [5] x [1]

In the case of 250 Hz, the setting will be

[2] [5] x [10]

In the case of 980 kHz, the setting will be

[9] [8] x [10k]

In the case of 5.6 MHz, the setting will be

[5] [6] x [100k]

3-3-8 Operation of "RESPONSE" switch

The frequency response of a filter include many types. The instrument permits selection of two types that can be most widely used and are effective.
Generally, in a signal transmission system, it is necessary for distortionless waveform transmission that the amplitude response is flat in the frequency

components of the signal waveform to be transmitted and that the phase shift to which each frequency component is subjected is proportional to the frequency.

In the "MAX FLAT" position, the flatness characteristic is maximum, and the amplitude response is the flatest in the passband. Here, since the phase shift is not proportional to the frequency, waveform distortion like overshoot will be caused if the signal waveform such as a square wave or other has a steep wavefront.

In the "PHASE LINEAR" position, phase linear characteristic is obtained so that the phase characteristic is proportional to the frequency in the passband. Since the delay time is the flatest in the passband and there occurs almost no phase distortion, the waveform distortion is reduced considerably for a signal input having a steep wavefront such as a square wave or others, so that it can be effectively used when the waveform is of special importance. However, the amplitude response becomes dull in the neighborhood of the cutoff frequency, and thus special care should be taken in setting the cutoff frequency in an application where the amplitude response can be a problem.

3-3-9 Operation with increased S/N ratio

The maximum signal level of this instrument is ±5 V (3.5 VRMS with a sinusoidal wave), and the noise level is not more than 2 mVRMS. Thus the S/N ratio is 3.5 V/2 mV=65 dB.

If the signal level is constant, maximum S/N ratio can be obtained by setting the input signal level in the neighborhood of the maximum signal level.

If the signal level of the passband changes, the average level is selected in such a way that the peak value of the change becomes less than the maximum signal level.

Basically, determine the input signal level by considering the S/N ratio, keeping the noise level in mind at all times. The noise level is also important when considering the S/N ratio in the passband and attenuation band. The attenuation gradient is constant in rate (24 dB/oct), but it becomes flat because of the noise level.

When an unnecessary signal is to be eliminated with a small signal input, the attenuation cannot be made smaller than the noise level.

4. PRINCIPLE OF OPERATION

4-1 General

The block diagram in Fig. 4-1 shows the circuit construction of this instrument. Major components include the following.

a) Input circuit

b) Filter section (CR element, amplifier)

c) Output amplifier section

d) Power supply section

4-2 Block Diagram

a) Input circuit

The input circuit is buffer amplifier A_1 comprising an attenuator, and isolates the signal source from the filter section.

b) Filter section

The filter section is made up of two stages of second order high-pass filter A_2 and A_3 and two stages of low-pass filter A_4 and A_5. The input signal, after passing through the buffer amplifier, is led to the two-stage cascade connection HPF section.

The output of the HPF section is applied to the two-stage cascade connection LPF section. The output of the LPF section is the output of this instrument through a negative phase amplifier.

When each filter section is operated to function as

a filter, the instrument functions as a bandpass filter. If the HPF section or LPF section is set in the THRU mode, the instrument operates either as an LPF or as HPF. If both filter sections are set in the THRU mode, the instrument operates as an wide band amplifier (gain +1).

The cutoff frequency is determined by the value of the CR element of the filter section. The R element undertakes division of each range and the C element undertakes multiplication. One range of multiplier is divided by 100 in steps of 2-digit decade. The multiplier covers six ranges (HPF) and six ranges (LPF) from x1 to x30,000 (HPF) and 100,000 (LPF).

The fundamental circuit of the second order LPF is shown on the next page.

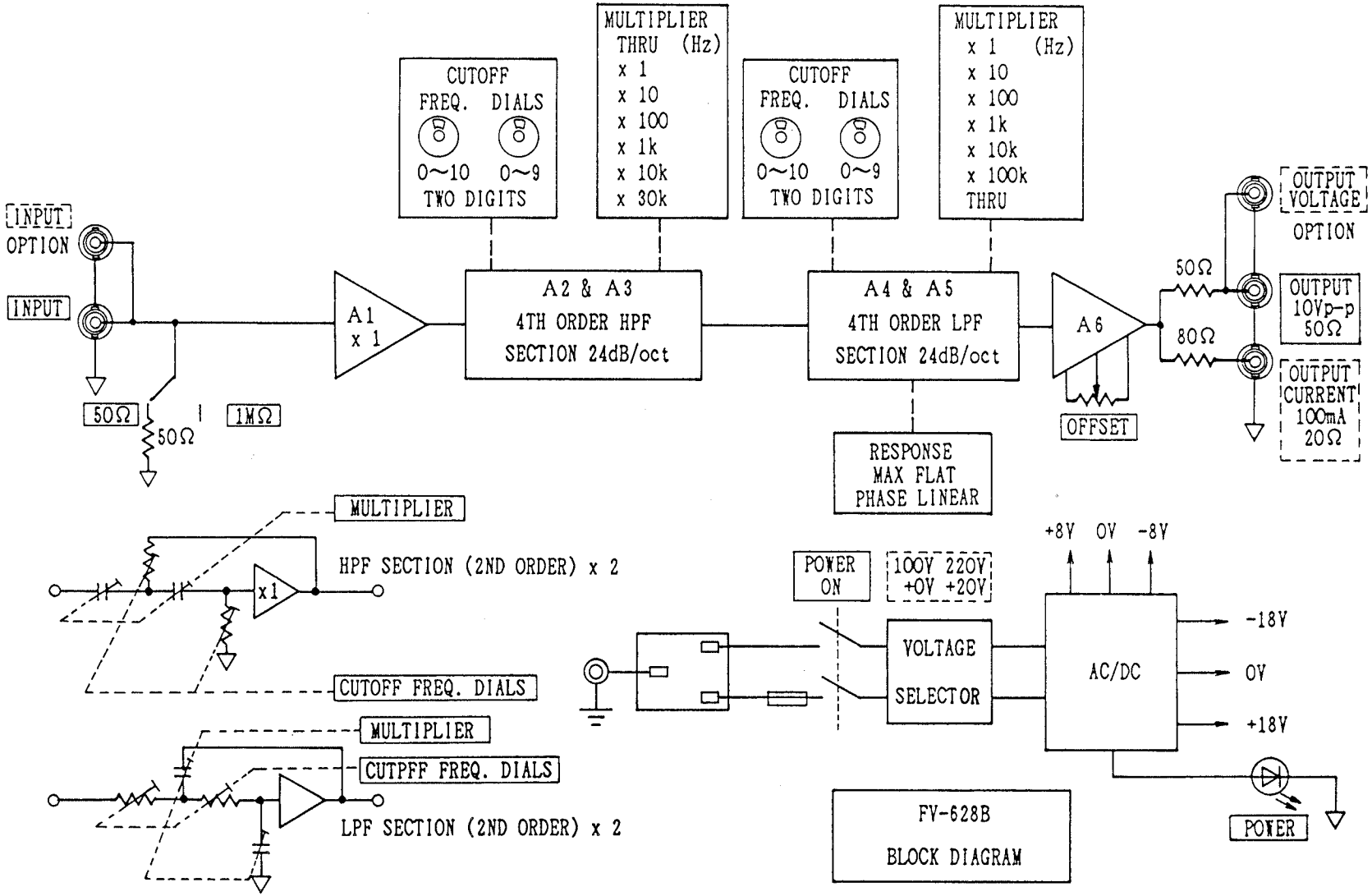


Fig. 4 - 1 FV-628B BLOCK DIAGRAM

The overall response of the fourth order (24 dB/oct) when K=1 at MAX FLAT can be expressed by the following formula.

$$|A(j\omega)| = \frac{1}{\sqrt{1 + X^8}} \quad \text{-------- (4-1)}$$

where, $X = \frac{\text{signal frequency (f)}}{\text{cutoff frequency (fc)}}$

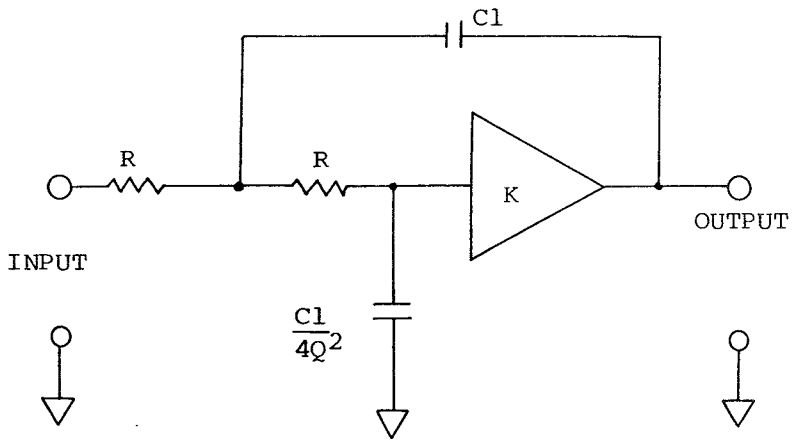


Fig. 4-2 Fundamental circuit

Fig. 4-3 shows the amplitude response.
The frequency response is changed over by changing the gain K of each filter amplifier.
At MAX FLAT, the amplitude response becomes the flatest in the passband, and most of the commonly used filters are of this type.
The phase linear characteristic (PHASE LINEAR) is so designed that the phase shift between the input and output becomes nearly proportional to the frequency

in the passband so as to hold the waveform transmission distortion to a minimum. If the phase shift is proportional to the frequency, phase ϕ differentiated by the angular frequency becomes constant.

$$\tau = -\frac{d\phi}{d\omega} \quad \text{---------- (4-2)}$$

This τ is termed group delay time and is equal to the delay time when a waveform passes. Thus such a phase linear filter is also called a constant delay type filter. Fig. 4-3 and Fig. 4-4 show its amplitude and phase characteristic.

Fig. 4-6 shows the step response. The abscissa shows the value of the product of fc·t (without dimension). For example, if the value of fc·t is 1, time t is 1 sec when fc is 1 Hz, and 1 msec when fc is 1 kHz. As is obvious from the figure, the overshoot is about 11% at MAX FLAT, while it is only 1% at PHASE LINEAR.

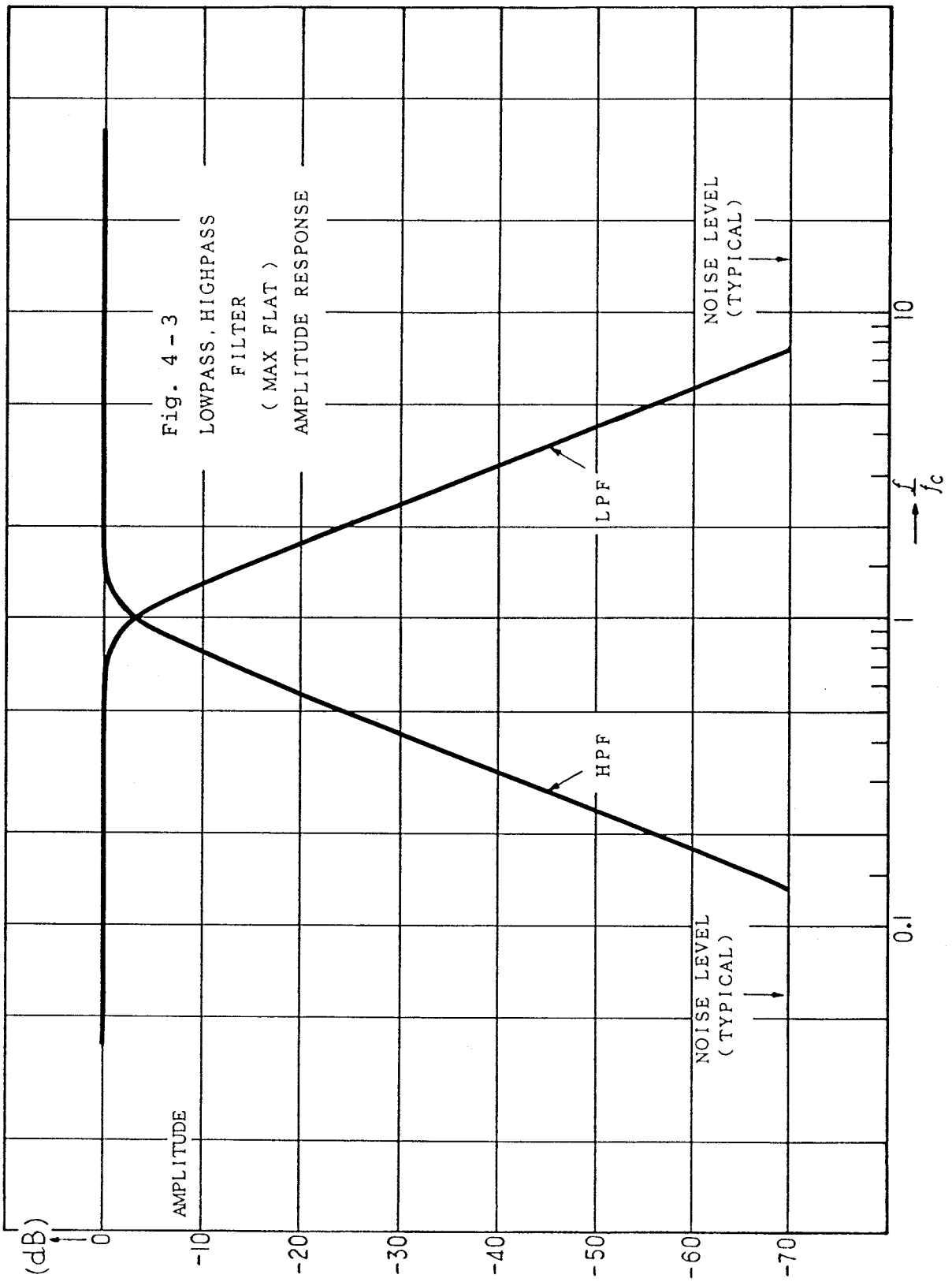


Fig. 4 - 3
LOWPASS, HIGHPASS
FILTER
(MAX FLAT)
AMPLITUDE RESPONSE
(dB)
AMPLITUDE
0
-10
-20
-30
-40
-50
-60
-70
LPF
HPF
NOISE LEVEL
(TYPICAL)
NOISE LEVEL
(TYPICAL)
0.1
1
10
f
fc

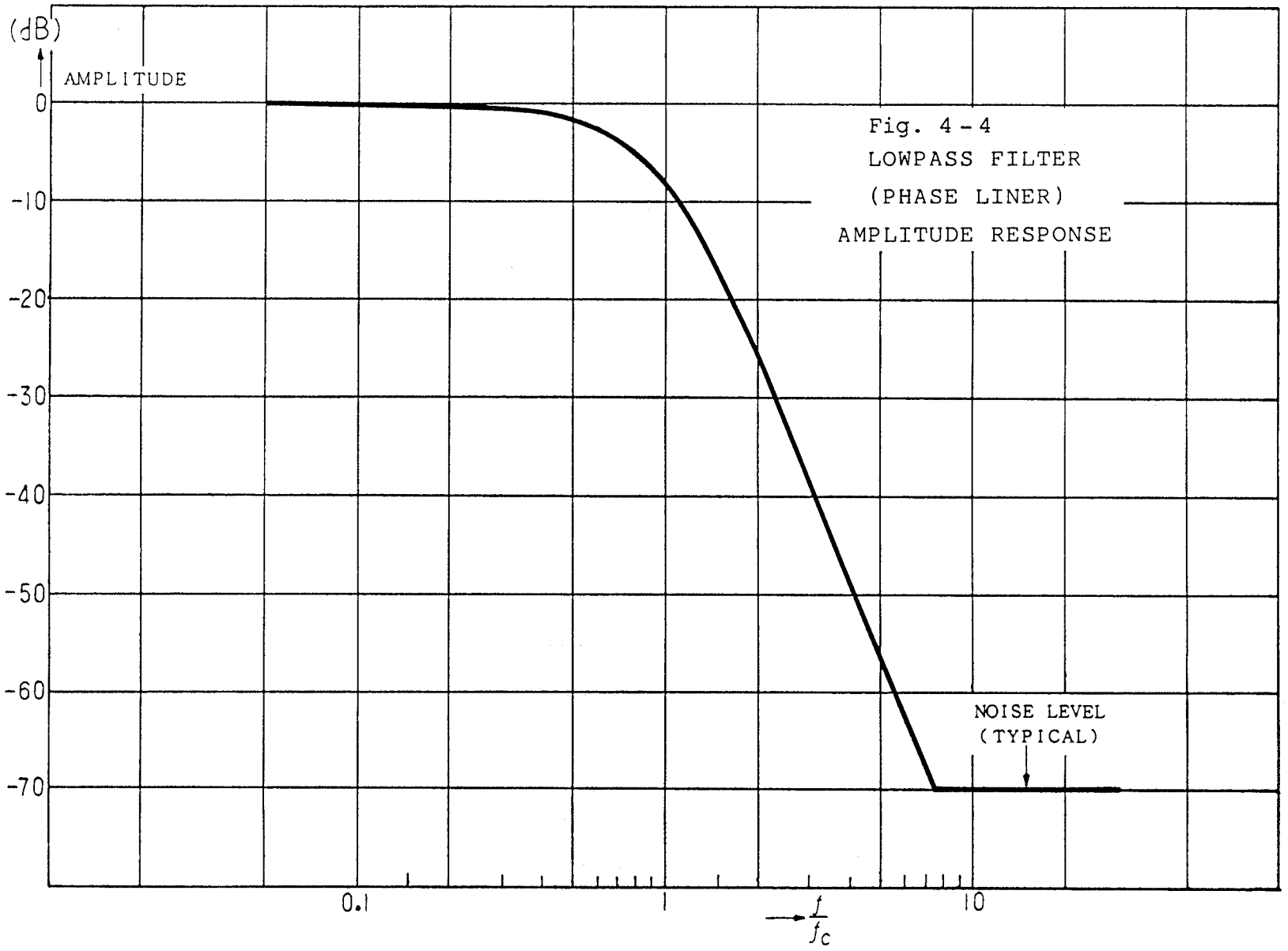
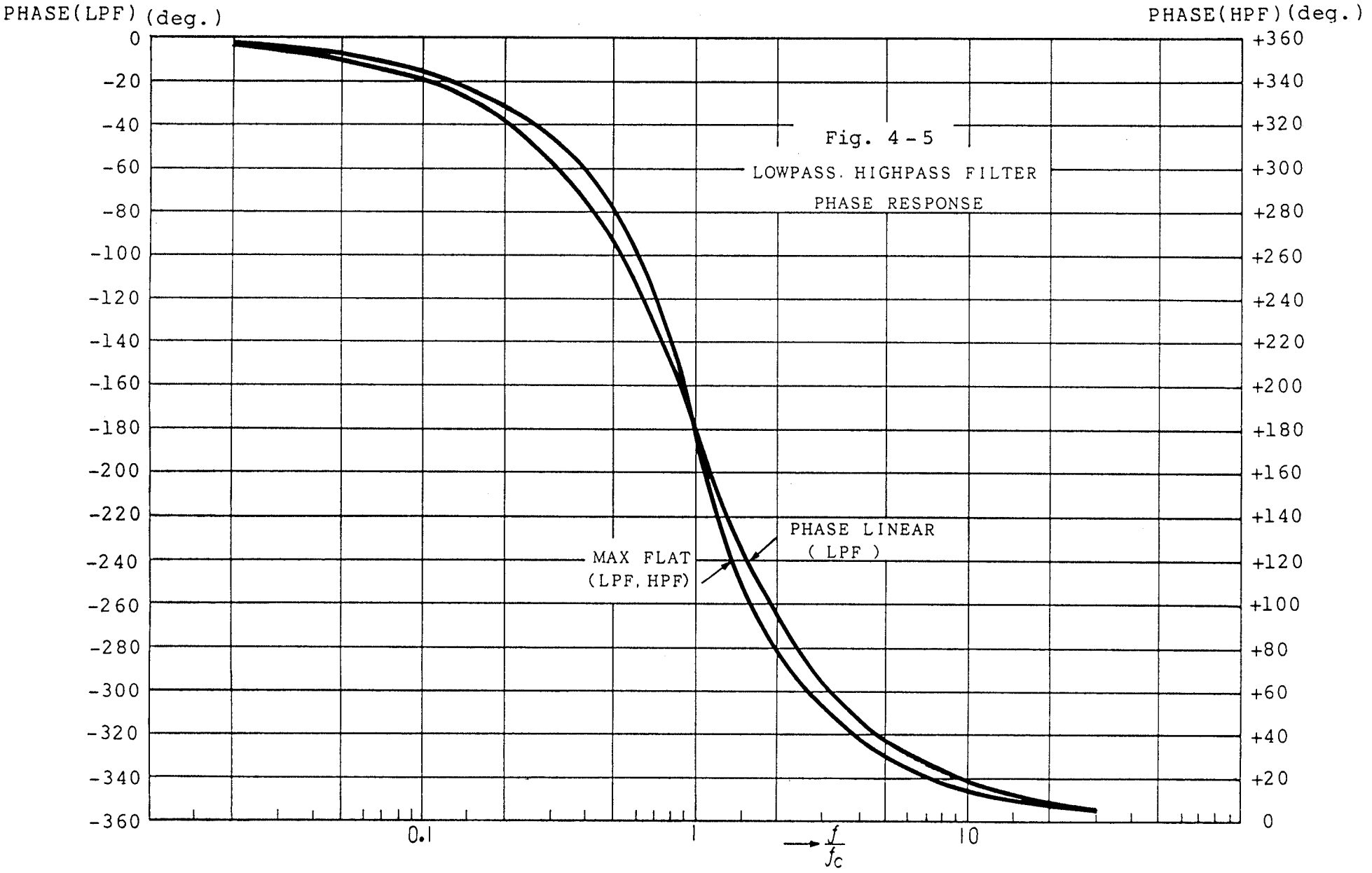


Fig. 4 - 4
LOWPASS FILTER
(PHASE LINER)
AMPLITUDE RESPONSE


PHASE(LPF) (deg.)
PHASE(HPF)(deg.)
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
-220
-240
-260
-280
-300
-320
-340
-360
+360
+340
+320
+300
+280
+260
+240
+220
+200
+180
+160
+140
+120
+100
+80
+60
+40
+20
0
0.1
1
10
$\frac{f}{f_c}$
Fig. 4-5
LOWPASS. HIGHPASS FILTER
PHASE RESPONSE
PHASE LINEAR
(LPF)
MAX FLAT
(LPF, HPF)

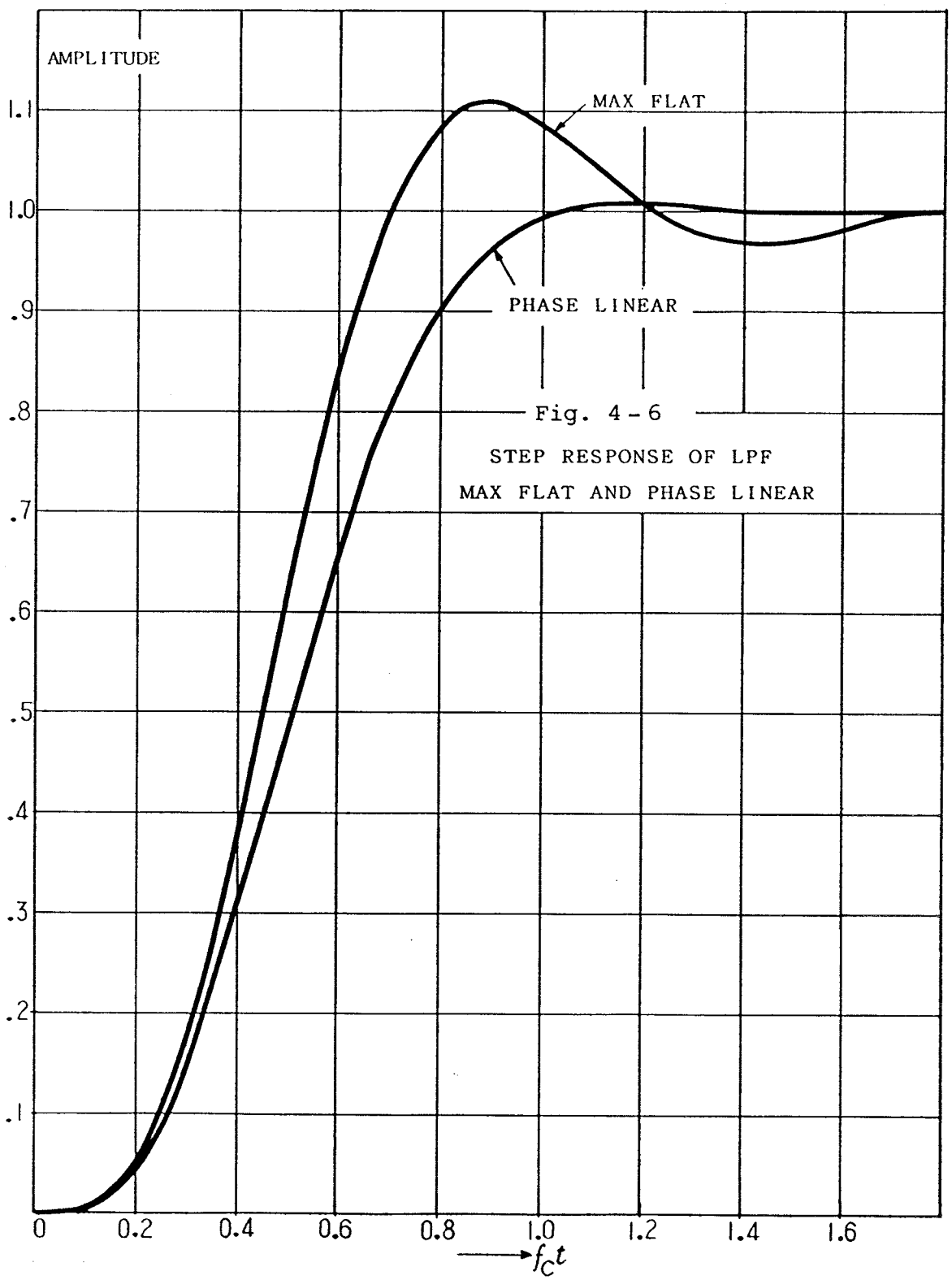
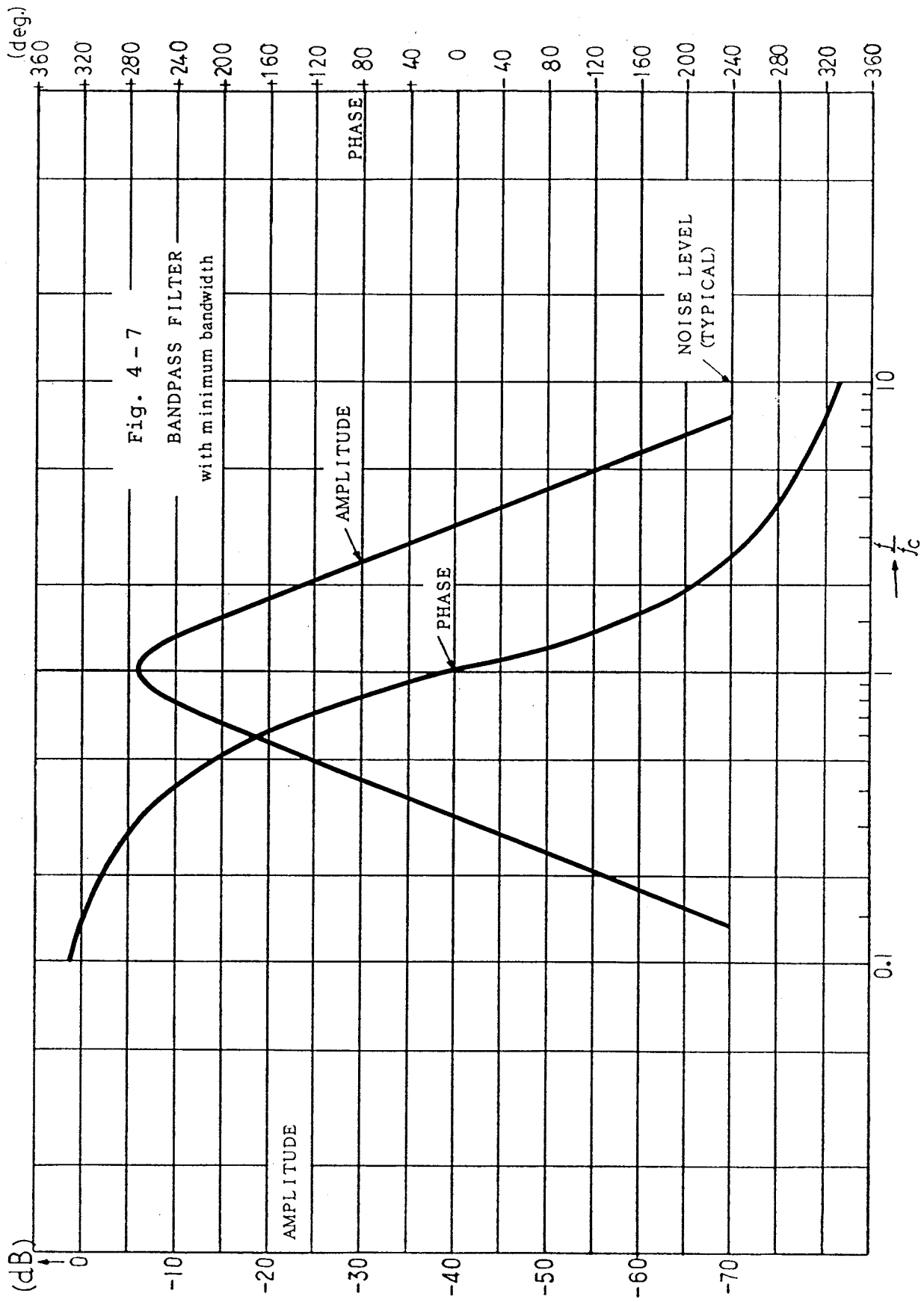


Fig. 4-6

STEP RESPONSE OF LPF

MAX FLAT AND PHASE LINEAR


(deg.)
360
320
280
240
200
160
120
80
40
0
40
80
120
160
200
240
280
320
360
PHASE
Fig. 4 - 7
BANDPASS FILTER
with minimum bandwidth
AMPLITUDE
PHASE
NOISE LEVEL
(TYPICAL)
(dB)
0
-10
-20
-30
-40
-50
-60
-70
AMPLITUDE
0.1
1
10
f/fc

c) Output amplifier

The instrument uses a inverted amplifier as an output amplifier after the LPF section to obtain enough power to supply maximum votage and current.

d) Power supply section

The power supply section supplies positive and negative DC power necessary for operation of the instrument. After passing through a line filter, an AC voltage obtained from a commercial power line is converted to an appropriate low voltage by a power transformer and rectified. The rectified voltage, passing through an IC regulator, is fed to the amplifier.

The DC voltages of this instrument include two kinds, $\pm$8 V and $\pm$18 V. The $\pm$8 V power is for operating each filter section and the $\pm$18 V power is for operating the output amplifier.

e) Phase relationship between input and output

The input and output of this instrument are of the same phase. This is as viewed at a point at least 10 times away from the cutoff frequency toward the flat portion. Phase shift occurs in the vicinity of the cutoff frequency.

5. MAINTENANCE

5-1 General

Maintenance is necessary for keeping the instrument in the best operating condition. The maintenance normally includes four steps.

A. Check of operation

This checks whether the instrument operates correctly and satisfies the rating.

B. Adjustment and correction

If anything is wrong, the specified portion is adjusted or corrected.

C. Troubleshooting

If the instrument is still not normal, locate the cause of failure and identify defective part.

D. Repair

This manual contains only the operational check and easy check of defective parts that can be easily done by the user.

For more complex check, correction and servicing, contact our local distributor or NF head office, Yokohama.

5-2 Check of Operation

A. Check of cutoff frequency

Connect an oscillator to the input of the instrument, and an AC voltmeter, oscilloscope and frequency

counter to the output (do not forget the 50Ω termination).

The cutoff frequency is defined as a frequency at a point attenuated by 3 dB from the point where the attenuation is 0 dB in the flat portion of the passband at MAX FLAT. With this instrument, the measuring point of the flat portion is half the cutoff frequency for LPF and two times the cutoff frequency for the HPF. The accuracy of the cutoff frequency is normal if it is within the following ranges.

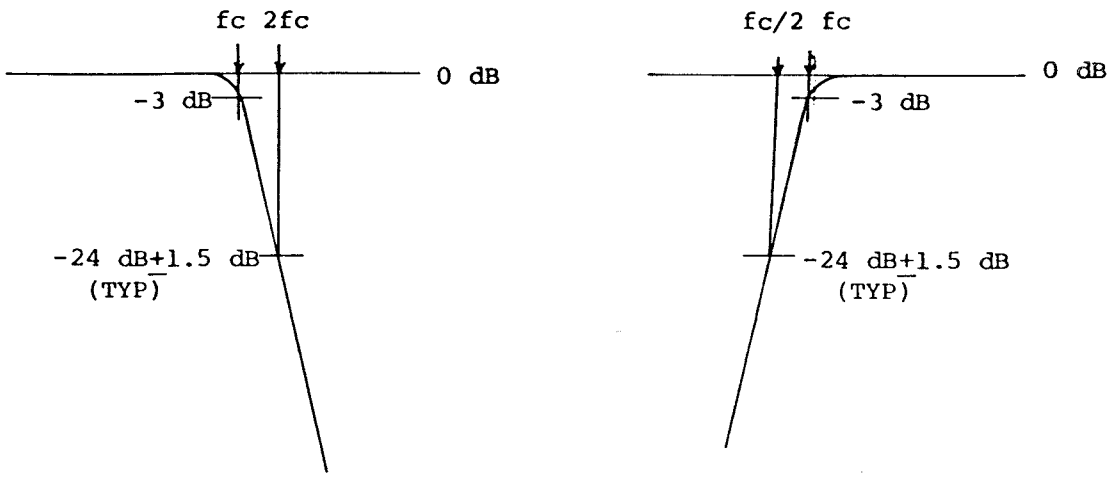
±5% for the X1-1K range

±7% for the X10K range

±10% for the X100K and the ×30k ranges

B. Check of frequency response and attenuation characteristic

The frequency response is normal, if it is ±1.5 dB between 1 Hz and 20 MHz when the HPF and LPF sections are set in the THRU mode to measure the frequency response.



Low-pass filter (MF) High-pass filter

Fig. 5-1 Amplitude response of LPF and HPF

The attenuation gradient is measured at a point detuned two times from the actually measured cutoff frequency (LPF) or at a point detuned by half (HPF). It is normal if it comes within the following ranges.

-24 dB±2 dB for the X1-1K range
−24 dB±4 dB for the ×10k range
−24 dB±6 dB for the ×30k range
-24 dB±12 dB for the x100k range

C. Check of frequency response

The accurate method is to measure the frequency characteristics and phase characteristics for both MAX FLAT and PHASE LINEAR. Here, an easy method is used for the check.

Connect a function generator to the input of this instrument. Set the input signal to a square wave and the repetitive frequency to about one-tenth of the

cutoff frequency. The output waveform will be seen, accompanied by overshoot, on an oscilloscope. (See Fig. 4-6.) Here, measure the amount of the overshoot and calculate its ratio to the waveform amplitude. The operation is normal if the value is 12% at MAX FLAT and not more than 1.5% at PHASE LINEAR.

D. Check of noise

The operation is normal if the noise is not more than 2 mVRMS at any setting when the input is shorted.

E. Check of distortion factor

Use an oscillator of small waveform distortion, which should be less than 0.02% over a range from 10 Hz to 100 kHz. Measurement should be made under the most unfavorable condition because of the filter characteristic.

Set the signal frequency to half of the cutoff frequency for LPF and twice the cutoff frequency for HPF. The operation is normal if the distortion factor is not more than 0.3% over a range from 10 Hz to 100 kHz when the input signal level is 3 VRMS at THRU, HPF, and LPF.

6. EASY TROUBLESHOOTING

Should the instrument fail or appear to have failed, be sure to check it in accordance with the following procedure.
If the instrument is found evidently defective, inform our local distributor or NF head office, Yokohama, of its symptom and the result of check. The information will help us locate the cause of trouble and take prompt appropriate action.

A. No operation at all

- o Is the power supply voltage appropriately set?
- o Is the fuse blown?

B. No output

- o Is the frequency setting correct?
- o Is the mode setting (THRU, HPF, LPF, BPF) correct?

WARRANTY

NF Corporation certifies that this product was thoroughly tested and inspected and found to meet its published specifications when it was shipped from our factory. In the unlikely event that you experience an issue during use, please contact our company or agency of our company from which you purchased the product.
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, NF will repair the defective product without any charge for the parts and labor.
For repair service under warranty, the product must be returned to either NF or an agent designated by NF. The Purchaser shall prepay all shipping cost, duties and taxes for the product to NF from another country, and NF shall pay shipping charges to return the product to the purchaser.

This warranty shall not apply when corresponding to following particulars.

A) Failure caused by improper handling or use of the product in a manner that does not conform with the provisions of the Instruction Manual.
B) Failure or damage caused by transport, dropping, or other handling of the product after purchase.
C) Failure caused by repair, adjustment, or modification of the product by a company, organization, or individual not approved by NF.
D) Failure caused by abnormal voltage or the influence of equipment connected to this product.
E) Failure caused by the influence of supply parts from the customer.
F) Failure caused by such as corrosion that originate in the use of causticity gas, organic solvent, and chemical.
G) Failure caused by the insect or small animal that invaded from the outside.
H) Failure or damage caused by fire, earthquakes, flood damage, lightning, war, or other uncontrollable accident.
I) Failure caused by the reason that was not able to be foreseen by the science and technology level when shipped from our company.
J) Replacement and replenishment of consumables such as batteries.

NF Corporation

Request for Repair

When a failure occurred and the product was found to be defective or you have any uncertainty, please get in touch with NF Corporation or its authorized agent.
In such a case, let us know the model name (or product name), serial number (SERIAL No. given on the nomenclature plate), and symptom and operating conditions as detail as possible.
Though we will make efforts to reduce the repair period, when five or more years have passed since you purchased the product, it may take time due to, for instance, the out of stock of repair parts.
Also, if the production of repair parts is discontinued, the product is extremely damaged, or the product is modified, we may decline the repair.

WABUN: (DB58466-4)

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

NOTES

- Reproduction of the contents of this manual is forbidden by applicable laws.
- The contents of this manual may be revised without notice.
- Information provided in this manual is intended to be accurate and reliable. However, we assume no responsibility for any damage regarding the contents of this manual.
- We assume no responsibility for influences resulting from the operations in this manual.

FV-628B INSTRUCTION MANUAL

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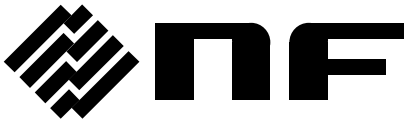

http://www.nfcorp.co.jp/

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