

## 1.10 Options

There are 3 software options (named in the format CF-035X) and 4 hardware options (named in the format CF-038X) for the CF-350/360.

Model	Option Name	Description	CF-350				CF-360		
			N	A	B	C	A	B	C
CF-0354	Servo Analysis Software	4-decade analysis, autoranging analysis, signal sequencing			●	●			●
CF-0355	Curve Fitting Software	SDOF (single degree of freedom), MDOF (multiple degree of freedom) curve fitting, list display of resonant frequencies and damping factors.				●			●
CF-0356	Acceleration stimulus waveform compensation program	When the analyzer and signal output (CF-0383 or SG-450) are used in combination with an acceleration stimulus, this program compensates the acceleration waveform.							
CF-0381	CMOS Memory Card	1 Mbyte of RAM, battery backup, RAM disk/CRT block memory expansion/time record memory expansion.				●		●	●
CF-0382	Tracking & X-Y Output Card	Division and multiplication of rotational sync signal, rpm tracking analysis on the CRT, X-Y recorder output, search point analog output.		●	●	●			
CF-0383	Signal Output Card	Sine, sine sweep, random, periodic random, swept sine and impulse signal output.			●	●			●
CF-0384	Comparator Output Card	Spectrum comparator function and comparator output.							

● Indicates the option is provided as standard for that particular version

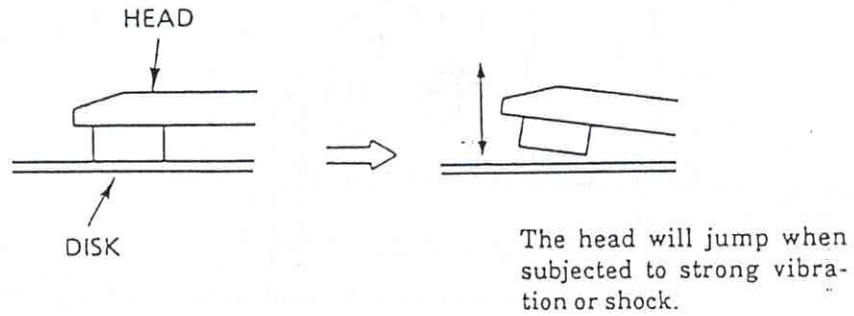
### Marking of Model Types

The model type of CF-350 N/A/B/C and CF-360 A/B/C is marked on a seal affixed to the rear panel.

Therefore, when grounding peripheral devices, connect the ground before inserting the power cord into the power outlet, then insert the plug and set the POWER switch to ON.

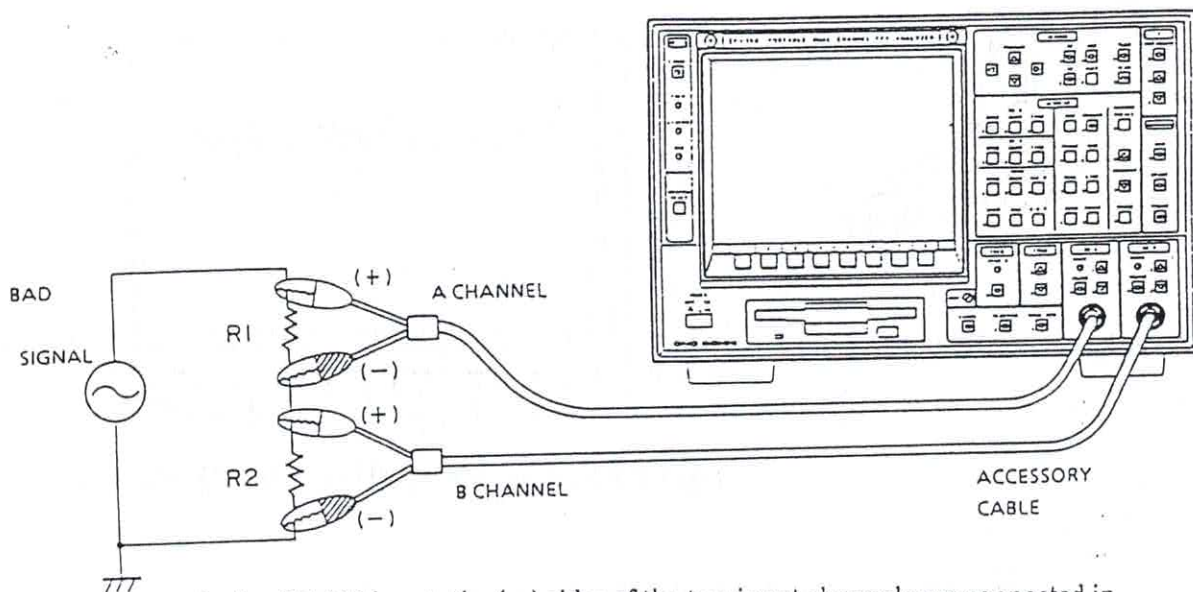
### 1.8 Floppy Disk Precautions

Do not move the analyzer or transport it with a disk remaining in the disk drive, as this can cause damage to the head and disk.

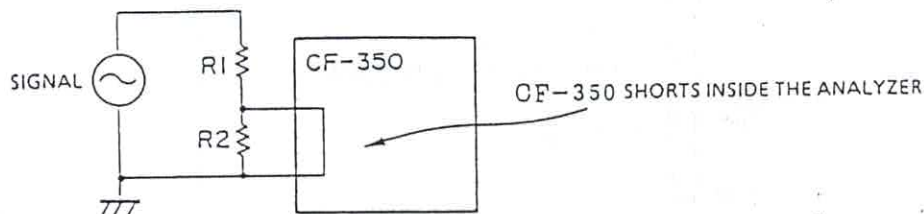


1.6 Measurement Precautions Using the CF-350

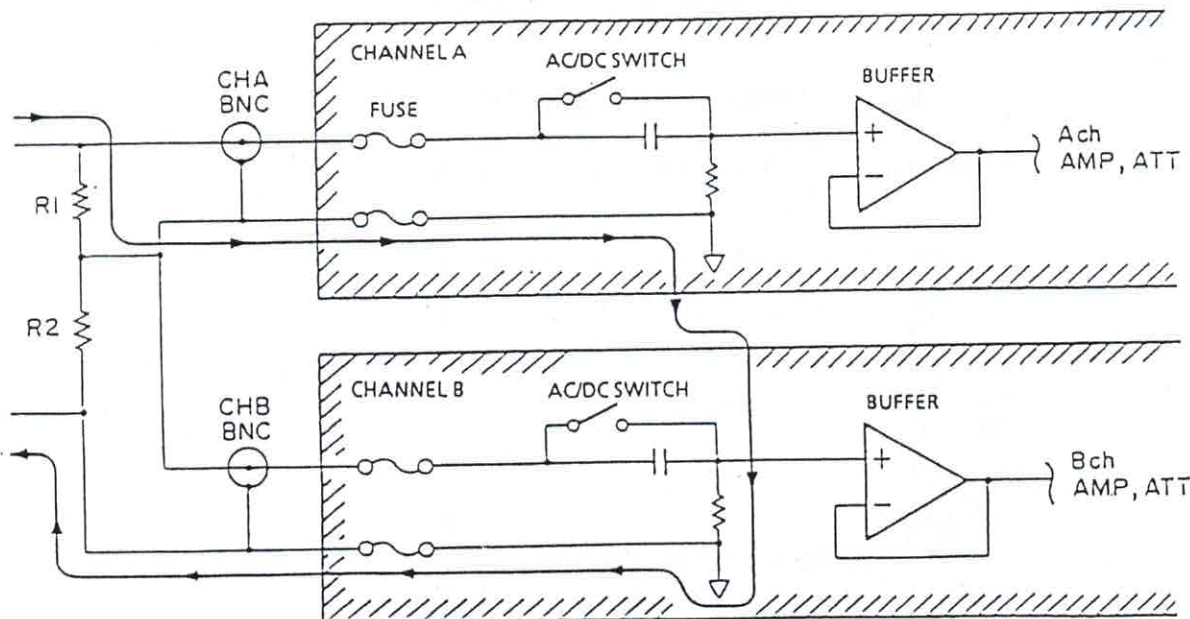
- Potential Difference Existing Between Channels A and B (-)



In the CF-350 input, the (-) sides of the two input channels are connected in common. Therefore, measurement connection method shown above cannot be used. That is, measurement is not possible if there is a potential difference between the (-) of channels A and B.



CF-350 Input Circuit



- Thick lines shown current flow direction.

In such cases, care is required as the protective input fuse might blow.

### CF-350/360 Grounding Method

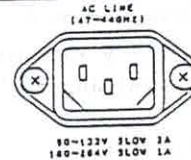
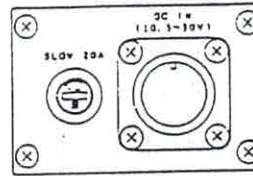
The cabinet of the CF-350/360 should be grounded, either at the ground terminal on the rear panel, or at the ground pin of the power plug. A three-pin power plug is provided on the power cord, the round center pin being the ground pin. When inserted into a 3-pin power outlet, the center pin is grounded. When using an adaptor on this plug to adapt it for 2-pin outlets, ground the terminal that protrudes from the side of the adaptor.

## 1.4 AC Line Power

The CF-350/360 line voltage must be kept within specified limits. The line voltage is indicated on the rear panel. If the power is applied when the CF-350/360 is connected to a line of the incorrect voltage, damage can result to the instrument. Always take extreme care to avoid this danger.

If the optional DC power supply unit has been installed, it is possible to power the CF-350/360 from an external DC power supply. The power supply is selected automatically, so that when an AC power line is connected, AC is used, and when a DC power supply is connected, DC will be used.

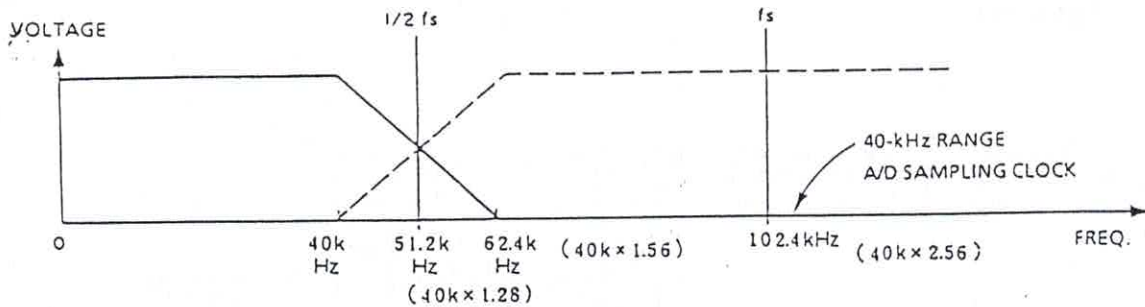
Whether powering the analyzer from AC or DC, be sure to switch the CF-350/360 power switch to OFF before removing the power plug. Also, be sure to switch the analyzer off before changing from AC to DC power supply or vice versa.



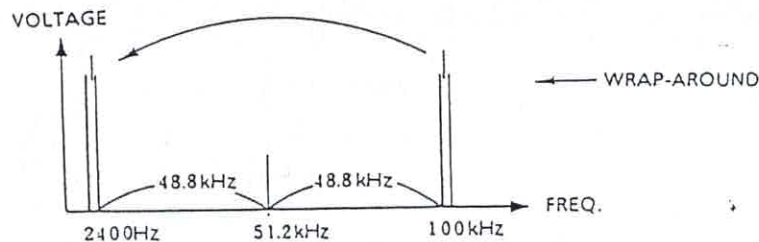
### WARNING !!

Although the CF-350/360 can be powered from an AC line in the voltage range 100 to 240 V by merely changing the fuse rating, the ratings of the power cord limit operation to the line voltage range of 100 to 125 V.

To power the unit from a line voltage greater than 125 V, it is necessary to change the plug and power cord. If this becomes necessary, consult your sales representative.



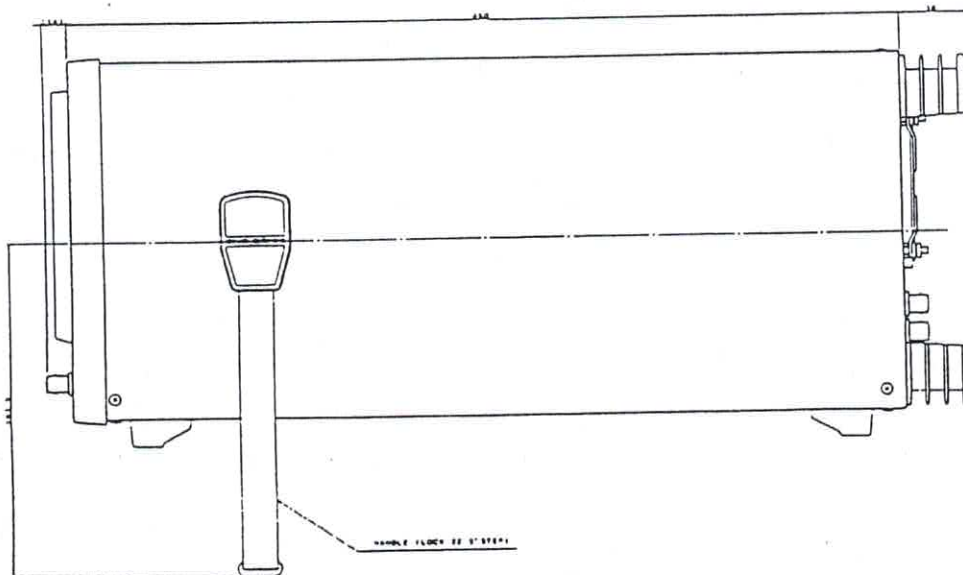
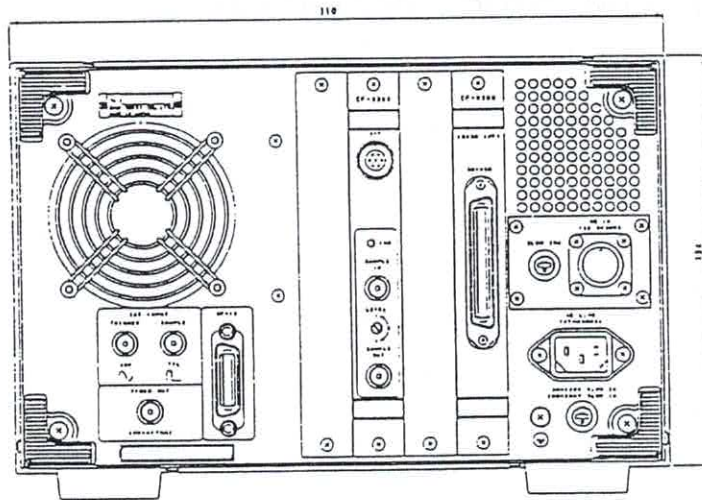
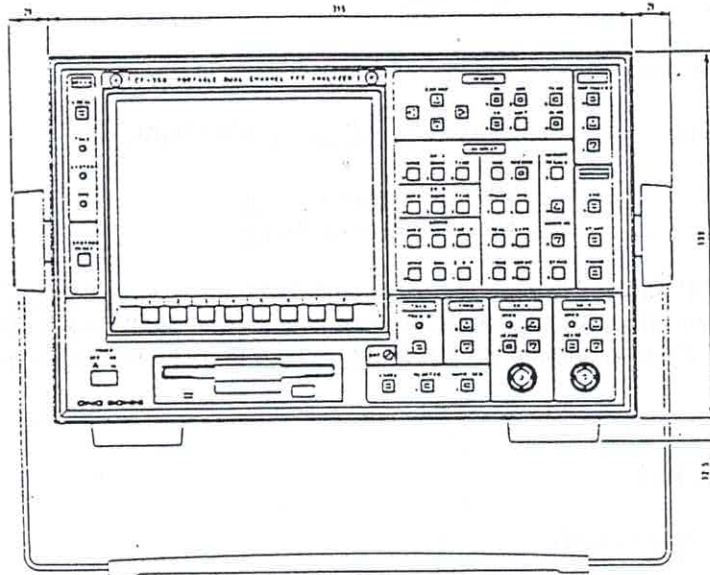
In the case of the 40-kHz range, the signal would exhibit wraparound a center frequency of 51.2 kHz ( $40 \text{ kHz} \times 2.56 / 2$ ). With the filter off, a 100-kHz signal would, therefore, be A/D converted as a 2400-Hz signal. (Signal components above 62.4 kHz would be wrapped around and appear on the CRT at "false" or alias positions.)



The CF-350/360 uses an 8th order filter to reduce aliasing error by attenuating signals greater than 1.56 times the analysis frequency range by at least 80 dB.

- ④ After passing through the filter, the signals are sampled and held and then A/D converted by a 16-bit successive approximation type A/D converter.
- ⑤ The A/D converted data is temporarily stored in memory. The memory always contains the latest captured data (without regard to the START or PAUSE conditions). The trigger condition and channel-to-channel delay and other settings control the transfer of CPU data into the storage memory.
- ⑥ CPU Time data is sent to a DSP (digital signal processor), at which it undergoes a fast Fourier transform. This processor performs such processing tasks as window application, FFT, IFFT and calculations such as the power and cross spectrum. The FFT calculation is normally performed with a fixed-point precision of 16 bits. However, a soft key selection of 32-bit precision can be made as well. The DSP also serves as a digital filter. Down to the 200 Hz range, the cutoff frequency of an analog lowpass filter is switched. However, in the 100-Hz range and below, the filtering is performed by the DSP. The A/D converted data is input to the DSP, passed through the filter, resampled and finally sent to the memory.

1.2 Outer Views



Output modes	
Continue:	Continuous output
Single:	One cycle of the selected waveform (except for random signals)
Burst:	Set number of cycles of the selected waveform output every set time interval

#### Built-in summation amplifier

#### Waveform characteristics

##### (1) Sine

###### Harmonic distortion:

- 70 dB or lower at below 1 kHz
  - 58 dB or lower at 1 kHz to 10 kHz
  - 53 dB or lower at 10 kHz to 40 kHz
- (at an amplitude of 1 V<sub>0-p</sub>)

###### Accuracy:

- 40 kHz  $\geq f > 2$  kHz:  
± 12.5 mHz ± 50 ppm
- 2 kHz  $\geq f > 200$  Hz:  
± 5 mHz ± 50 ppm
- 200 Hz  $\geq f > 20$  Hz:  
± 8 mHz ± 50 ppm
- 20 Hz  $\geq f > 2$  Hz:  
± 3.5 mHz ± 50 ppm
- 2 Hz  $\geq f$ : ± 650  $\mu$ Hz ± 50 ppm

##### (2) Impulse

- Flatness: ± 2 dB
- Crest factor: 30 max.

##### (3) Swept sine

- Flatness: + 4 dB, - 9 dB
- Crest factor: 2 max.

##### (4) Periodic random

- Flatness: ± 1 dB
- Crest factor: 4 max.

##### (5) Random

- 0.5 Hz - 3 dB AC Coupling
- Flatness: ± 2 dB (with 512 averages)

#### Other interfaces

##### SG-450 interface

(Used to make to connection to the SG-450 Signal Source Unit.)

#### 1.1.11 General Specifications

##### Power requirements

90 to 264 VAC, 47 to 440 Hz (see note)  
10.5 to 30 VDC\*

##### Power consumption

Approx. 100 VA

## Time Record Memory Time Lengths

	7 6 8 K (1ch)	3 8 4 K (2ch)	2 5 5 K (1ch)	1 2 7 K (2ch)	3 1 K
100kHz☆	3.07s	1.53s	1.02s	0.50s	0.12s
50kHz☆	6.14s	3.07s	2.04s	1.01s	0.24s
40kHz★	7.68s	3.84s	2.55s	1.27s	0.31s
20kHz	15.36s	7.68s	5.10s	2.54s	0.62s
10kHz	30.72s	15.36s	10.20s	5.08s	1.24s
5kHz	61.44s(1m01s)	30.72s	20.40s	10.16s	2.48s
2kHz	153.6s (2m33s)	76.8s (1m16s)	51s	25.4s	6.2s
1kHz	307.2s (5m07s)	153.6s (2m33s)	102s (1m42s)	50.8s	12.4s
500Hz	614.4s (10m14s)	307.2s (5m07s)	204s (3m24s)	101.6s (1m41s)	24.8s
200Hz	1,536s (25m36s)	768s (12m48s)	510s (8m30s)	254s (4m14s)	62s (1m02s)
100Hz	3,072s (51m12s)	1,536s (25m36s)	1,020s (17m)	508s (8m28s)	124s (2m04s)
50Hz	6,144s (1h42m)	3,072s (51m12s)	2,040s (34m)	1,016s (16m56s)	248s (4m08s)
20Hz	15,360s (4h16m)	7,680s (2h08m)	5,100s (1h25m)	2,540s (42m20s)	620s (10m20s)
10Hz	30,720s (8h32m)	15,360s (4h16m)	10,200s (2h50m)	5,080s (1h24m)	1,240s (20m40s)
5Hz	61,440s (17h04m)	30,720s (8h32m)	20,400s (5h40m)	10,160s (2h49m)	2,480s (41m20s)
2Hz	153,600s (42h40m)	76,800s (21h20m)	51,000s (14h10m)	25,400s (7h03m)	6,200s (1h43m20s)
1Hz	307,200s (85h20m)	153,600s (42h40m)	102,000s (28h20m)	50,800s (14h06m)	12,400s (3h26m40s)

☆: CF-360 only, ★: CF-350 only  
(Places beyond decimal point discarded,)

### Panel condition memory

Panel condition settings can be stored (four sets of conditions) in battery backed up (5 years min.) memory.

Auto-recall function: When power is switched on, contents of panel condition memory address No. 1 are automatically set.

### 1.1.9 Operating Functions

#### Autosequence function

Manual operating procedures are programmed for automatic execution of analysis.

Auto mode: Continuous automatic analysis

Stepped mode: Stepped operation by means of repeated pauses and starts

Memory capacity: Two 63-step programs (Of which one can be used as a subroutine.)

#### Signal sequence\*

When the analyzer is used in combination with the optional signal output (CF-0383 for the CF-350 or CF-0386 for the CF-360) or the SG-450, it is possible to sequentially switch the output signal for each specified frequency range when determining the transfer function.

#### Misoperation display

When a misoperation is sensed, a long beeper sounds as a warning, as a message indicating the type of error or the corrective action required appears on the display.

## Search functions

- Peak
- Next peak
- Harmonics
- Arbitrary (search point movable in 1-point or 13-point units)
- Automatic search for point of an arbitrary value
- Automatic search for a point having  $-180$ -deg phase on the transfer function
- Search for the maximum point in a specified range and automatic search for the point  $-3$  dB with respect to this point
- Automatic search for the maximum and minimum points within a specified range
- Automatic search for the 10% and 90% points with respect to the full scale over a specified range of a time-axis waveform
- Maximum-value search of time record memory data

## Maximum value display function

With the search function OFF, the maximum value and corresponding frequencies (X-axis values) are displayed.

For time-axis waveforms, the maximum and minimum values in the single-frame mode are displayed.

## $\Delta$ cursor function

Display of or range specification of the difference from the search point

## Display inhibit function

Inhibit of display update to shorten processing time.

Display is possible either every other average or only after completion of averaging.

## List display

- Listing of harmonics up to the 20th order
- Listing of up to 10 peak points (positive-side 10 points and negative-side 10 points for a time-axis waveform)
- List display of up to 20 set points
- List display of octave analysis results
- Display of sideband modulation indexes, levels, and total sideband power

## Setup display

Display of soft key setting conditions

## Annotation display

Basic conditions

Input voltage ranges, input coupling (AC/DC), frequency ranges, averaging mode, number of set averages, number of averages executed, X/Y-axis scaling and units, analysis data length, label, window type, displayed data type, date, time

View display

Automatic display and manual selection of averaging type, mass memory address, and eight types of analysis conditions corresponding to displayed data.

## Soft key display

Menu and setting items

Channel-to-channel phase matching	$\pm 3$ deg (phase adjustment OFF, in the same sensitivity range) $\pm 0.5$ deg (phase adjustment ON, in the same sensitivity range)
Input attenuator phase error	$\pm 0.7$ deg (at 40 kHz) $\pm 0.4$ deg (at 10 kHz)
DC offset	AC coupling: $\pm 0.6\%$ of voltage range ( $-44$ dB) max. DC coupling: $\pm 0.8\%$ of voltage range ( $-42$ dB) max. With auto-zero function on: $\pm 0.1\%$ of voltage range ( $-60$ dB) max.
1.1.7 Display Functions	
Display type	7-inch raster-scan CRT
Graphic display modes	Single-frame display mode Function graphics and list  Dual-frame display mode Function graphics and list (with the exception of Nyquist plot and lissajous displays)  Overlaid display mode Overlaid display of of of the same domain (but not including Nyquist plots and lissajous displays)  3-Dimensional display mode* 20-line mode <ul style="list-style-type: none"> <li>• 20 lines of any data (except for Nyquist plots and lissajous displays) plotted in 3 dimensions</li> <li>• Specification of 3-dimensional display angle and amplitude (3 values)</li> <li>• Scrolled display and specification of scrolling direction (up or down)</li> </ul> 60- and 90-line modes <ul style="list-style-type: none"> <li>• 60- or 90-line 3-dimensional display of the power spectrum</li> </ul> Lissajous display mode Lissajous display between channels A and B  Nyquist plot mode Nyquist display of Fourier spectrum, cross spectrum and transfer function  Perspective display mode Perspective display of Nyquist plot and orbit pattern. The displayed region can be limited.  Nichols plot mode Nichols plot of transfer function

Related functions

A/D overflow cancel: When an excessive input to the A/D converter is detected, the resulting data is canceled.

Cancel function: When performing averaging and using a trigger, a cancel function can be used to cancel waveforms to prevent addition of such effects as double hammering.

Display inhibit function: To shorten the averaging time, it is possible to display every other average or inhibit display until the averaging is completed.

1.1.6 Input Section

No. of input channels

2

Input configuration

Single-ended (CF-350)  
Isolated single-ended (CF-360)

Cross talk

- 120 dB or more

Input impedance

1 M $\Omega$   $\pm$  1%

Input capacitance

Between signal and ground:  
Approx. 110 pF (1kHz)  
(accessory cable: approx. 190 pF, 1 kHz)

Input coupling

DC and AC (0.5 Hz, -3 dB  $\pm$  4%)  
(AC only for  $\pm$  1 mV to 5 mV ranges)

DC cancel

After A/D conversion, the DC component is calculated from the average value of the time data and this value is canceled out.

Auto-zero function

The analog input section is automatically calibrated to the zero potential.

Voltage ranges

$\pm$  1 mV,  $\pm$  2 mV,  $\pm$  5 mV  
 $\pm$  10 mV,  $\pm$  20 mV,  $\pm$  50 mV  
 $\pm$  100 mV,  $\pm$  200 mV,  $\pm$  500 mV  
 $\pm$  1 V,  $\pm$  2 V,  $\pm$  5 V  
 $\pm$  10 V,  $\pm$  20 V,  $\pm$  50 V  
and autoranging, for a total of 16 ranges

Maximum allowed input voltage

100 VAC rms for 1 minute (50 Hz)

Input level monitor

LED indicates excessive input (CF-350)  
LEDs indicate -12-dB and excessive input (CF-360)

### Noise Floor and Spurious Components

Range	1 to 200 Hz	500 Hz to 10 kHz	20 and 40 kHz
50 V 20 V 10 V 5 V 2 V 1 V 500 mV 200 mV 100 mV	-80 dB min. with respect to fs	-80 dB min. with respect to fs	-80 dB min. with respect to fs
50 mV	-80 dB min. with respect to fs	-78 dB min. with respect to fs	-76 dB min. with respect to fs
20 mV	-76 dB min. with respect to fs	-73 dB min. with respect to fs	-70 dB min. with respect to fs
10 mV	-72 dB min. with respect to fs	-68 dB min. with respect to fs	-64 dB min. with respect to fs
5 mV	-68 dB min. with respect to fs	-63 dB min. with respect to fs	-58 dB min. with respect to fs
2 mV	-60 dB min. with respect to fs	-55 dB min. with respect to fs	-50 dB min. with respect to fs
1mV	-55 dB min. with respect to fs	-50 dB min. with respect to fs	-45 dB min. with respect to fs

(Above applied for 16 averages, Hanning window, 50% or less overlap in the high-precision mode.)

Calculation precision	Normal mode: 16-bit FFT High-precision mode: 32-bit FFT
Amplitude flatness	±0.3 dB
Frequency accuracy	±0.01% of full scale
No. of sampled points, frequency resolution and no. of spectral lines	See table.

No. of sampled points	1024-point mode	2048-point mode
Frequency resolution	1/400	1/800
No. of spectral lines	400	800

(Does not apply to 4-decade analysis.)

Power spectrum processing	Power spectrum density, energy spectrum density Partial overall Search enhanced function (using a Hanning window, the line spectrum reading resolution is improved to $\pm 0.1$ dB for the Y axis and improved 32 times for the X axis) A weighting
Function data processing	Arithmetic calculations Time-axis differentiation/integration, frequency-axis differentiation/integration
Transfer function/power spectrum processing	Equalization function
Transfer function processing	$H_2 (= G_{bb}/G_{ab}^*)$ Reciprocal (1/H) Open-to-close-loop transformation Multiple degree of freedom/single degree of freedom curve fitting
Octave analysis processing	1/3 octave analysis: 30 bands conforming to ANSI CLASS III specifications 1/1 octave analysis: 10 bands and the corresponding a weighted function
Amplitude-domain processing	Average value, standard deviation, skewness, kurtosis

# 1. INTRODUCTION TO THE CF-350/360

## 1.1 Specifications

(Items marked \* are options)

### 1.1.1 Signal-Processing Functions

Time-domain functions Time-axis waveform, absolute-value waveform, auto-correlation function, cross-correlation function, impulse response, time-envelope waveform, Hilbert transform, cepstrum, inverse Fourier transform

Frequency-domain functions Fourier spectrum, power spectrum, cross spectrum, phase spectrum, transfer function  $H_1, H_2$ , coherence function, coherence output power, octave analysis (1/1, 1/3 octave), power spectrum envelope, group delay, rpm order ratio analysis, rpm tracking analysis\*

Amplitude-domain functions Probability density function, probability distribution function

### 1.1.2 Signal-Analysis Modes

Analog signal analysis/processing modes

Current data analysis: Current analysis and processing of the signals applied to the inputs

Disk-data analysis: Analysis of time record data stored on floppy disk, and CRT block data (time-axis waveforms)

CRT block data analysis: FFT analysis of time-axis waveform data stored in CRT block memory

Time-record data analysis: Processing of time record memory data.

Digital signal analysis/processing mode

Analysis and processing of data input from a computer via the GPIB interface

### 1.1.3 Function Calculation and Processing Functions

Time-axis waveform processing

Trend elimination

Smoothing (moving average method)

Average value, absolute-value average, rms, standard deviation, skewness, kurtosis, maximum value, minimum value, crest factor list display, surface area calculation

Frequency-domain function processing

Zooming

### 1.1.4 FFT Analysis Section

Frequency analysis ranges 1, 2, 5, 10, 20, 50, 100, 200, 500, 1 k, 2 k, 5 k, 10 k, 20 k, 40 kHz ★, 50 kHz ☆, 100 kHz ☆  
 (★: CF-350 only, ☆: CF-360 only)

Data Capture Times and Frequency Resolution ( $\Delta f$ ) for the Each Frequency Range

Frequency range	800 Lines (2048 points)		400 Lines (1024 points)	
	Data length (t)	Resolution ( $\Delta f$ )	Data length (t)	Resolution ( $\Delta f$ )
100 kHz ☆	8 ms	125 Hz	4 ms	250 Hz
50 kHz ☆	16 ms	62.5 Hz	8 ms	125 Hz
40 kHz ★	20 ms	50 Hz	10 ms	100 Hz
20 kHz	40 ms	25 Hz	20 ms	50 Hz
10 kHz	80 ms	12.5 Hz	40 ms	25 Hz
5 kHz	160 ms	6.25 Hz	80 ms	12.5 Hz
2 kHz	0.4 s	2.5 Hz	0.2 s	5 Hz
1 kHz	0.8 s	1.25 Hz	0.4 s	2.5 Hz
500 Hz	1.6 s	0.625 Hz	0.8 s	1.25 Hz
200 Hz	4 s	0.25 Hz	2 s	0.5 Hz
100 Hz	8 s	0.125 Hz	4 s	0.25 Hz
50 Hz	16 s	62.5 mHz	8 s	0.125 Hz
20 Hz	40 s	25 mHz	20 s	50 mHz
10 Hz	80 s	12.5 mHz	40 s	25 mHz
5 Hz	160 s	6.25 mHz	80 s	12.5 mHz
2 Hz	400 s	2.5 mHz	200 s	5 mHz
1 Hz	800 s	1.25 mHz	400 s	2.5 mHz

A/D converter 16 bits

Sampling frequency 2.56 times the analysis range, and external sampling clock

Anti-aliasing filter	All automatically set according to the analysis frequency range. 8th order cascade Chebyshev type Cutoff frequency: Maximum frequency in analysis range Rolloff: - 140 dB/oct min. Digital filtering below 100 Hz Filter usable at 200-Hz range and above when using an external sampling signal.
Overlap processing	Sampling overlap is settable. Setting values: 0%, 50% and max.
Window functions	Rectangular, Hanning, flattop, force, exponential and user-defined windows
Delay function	A delay can be introduced in the Ch B window with respect to Ch A window before sampling (up to 65,536 points in 1-point steps).
Real-time analysis	Up to 2 kHz range
Digital zooming function	Real-time zoom and record zoom ×2 to ×64, settable in binary sets
4-decade analysis *	1117-line/4-decade analysis
Autoranging analysis *	For servo analysis
Log-sweep analysis *	Using a logarithmic frequency scale analysis is possible using a sine wave for each frequency line set at even intervals on the scale. Sweep range: 1 to 4 decades Number of sampling lines: 10, 20, 40 or 80 lines per decade

### 1.1.5 Averaging Function

Averaging modes	Time domain:      Summation averaging, exponential averaging, absolute-value averaging
	Frequency domain: Summation averaging, exponential averaging, peak hold, differential averaging, Fourier averaging, sweep averaging
	Amplitude domain: Summation averaging
No. of averages	1 to 8,192 (set in binary steps)  1 to 32,767 (set as any value)  (Does not apply to peak hold and sweep averaging)

Internally generated test signals	<p>Sinewave: 0 to 0.7 V (Ch A and Ch B same phase)</p> <p>Frequency is linked to the frequency range at ranges of 200 Hz and above (fundamental is 1/25 of the analysis frequency range).</p> <p>In the 100 Hz and lower ranges, the frequency is fixed at the 200-Hz frequency (i.e., fundamental of 8 Hz).</p>
Harmonic distortion	- 74 dB with respect to full scale
Trigger modes	Free, repeating, single, and one-shot
Trigger source	Internal (Ch A or Ch B) and external trigger signal
Trigger view function	Display of an external trigger signal
Trigger point	<p>Pre-triggering and post-triggering</p> <p>Pre-triggering: Settable up to 65,536 points before the trigger, in 1-point steps.</p> <p>Post-triggering: Settable up to 65,536 points after the trigger, in 1-point steps.</p>
Trigger level	<p>Settable with a resolution equal to <math>\pm 1/128</math> of the full-scale voltage range (minimum: -95.5%, maximum: +95.3%)</p> <p>External trigger full scale: <math>\pm 5V</math></p>
Trigger slope	(+) and (-) (rising edge and falling edge)
External trigger input	<p>Maximum sensitivity: 0.5 V<sub>p-p</sub></p> <p>Input impedance: 100 k<math>\Omega</math> <math>\pm</math> 2%</p> <p>Frequency response: 100 kHz or greater</p> <p>Absolute maximum input: 100 VAC rms for 1 minute (50 Hz)</p>
External sampling input	<p>Configuration: TTL, rising edge</p> <p>Fan-in: 1 TTL load</p> <p>Maximum input frequency: 102.4 kHz (CF-350) 256 kHz (CF-360)</p> <p>Absolute maximum input: 100 VAC rms for 1 minute (50 Hz)</p>
Channel-to-channel amplitude matching	$\pm 0.3$ dB

	Co-quad plot Couplex functions (dual-frame display)
	Bode plot Transfer function
	Cole-Cole plot mode Cole-Cole plot of transfer function
	Coherence blanking Transfer function
	S/N ratio calculation Transfer function
Graphic data display modes using a plotter	130-line, 3-dimensional plot of disk data Campbell plot*
Graphic data display	Grid display
Vertical-axis scaling	Linear and logarithmic Linear: 1/10, 1/5, 1/2, $\times 1$ , $\times 2$ , $\times 5$ , $\times 10$ , $\times 20$ , $\times 50$ , $\times 100$ , $\times 200$ , $\times 500$ , $\times 1000$ and $\times 2000$ Log: 20, 30, 40, 50, 60, 70, 80, 90, 100, 120, 140, 160, 180 and 200 dB
Autoscaling	Automatic setting of the power spectrum and transfer function vertical-axis scaling
Phase display	$\pm 10$ to $\pm 20\,000^\circ$ full scale Reference can be changed. (For unwrapped display, it is possible to display only negative or positive values.) Phase sign reversal function.
Vertical-axis units	V, V <sub>rms</sub> , V <sup>2</sup> , V <sub>rms</sub> <sup>2</sup> , dBV, dBV <sub>rms</sub> , EU, dBEU, dB, %, deg, s, V <sup>2</sup> /Hz, V/ $\sqrt{\text{Hz}}$ , dBV/Hz, EU <sup>2</sup> /Hz, EU/ $\sqrt{\text{Hz}}$ , dBVs/Hz, EU <sup>2</sup> s/Hz, EU $\sqrt{\text{s}}$ / $\sqrt{\text{Hz}}$ , dBEUs/Hz
Horizontal-axis scaling	Linear and logarithmic (baseband frequency axis) For linear scaling, expanded display is possible along the <i>f</i> , <i>t</i> and amplitude axes, over a specified region.
Horizontal-axis units	Hz, CPM (cycles per minute), ORD (order), V, s, and EXT (when an external clock is used)
Direct displacement reading	When executing time-axis/frequency-axis integration, if the EU units are calibrated in terms of acceleration, it is possible to read velocity (mm/s, mil/s, inch/s) and acceleration (mm, mil, inch).

Label function Two lines of up to 55 characters each, including alphanumeric characters and symbols can be displayed.  
The uppermost line can be stored.

### 1.1.8 Memory Function

Data memory capacity RAM mass memory: 640 Kbytes  
3.5-inch micro-floppy disk: 300 frames  
CMOS memory\*: 1 Mbyte

Memory type and capacities Time record memory  
Time axis waveform  
CRT block memory  
CRT screen data  
Floppy disk memory  
Time record data  
CRT block memory data  
Panel conditions  
Autosequence programs  
Signal sequence programs  
CMOS memory\*  
Floppy disk mode  
Time record mode  
CRT block memory mode

RAM memory Time record memory data length  
255 Kwords (1 ch) 1 data  
127 Kwords (2 ch) 1 data  
31 Kwords (1 ch) 8 data  
31 Kwords (2 ch) 4 data  
CRT block memory  
60 frames of CRT data

Floppy disk Disk drive: 3.5-inch double-sided, double-density floppy disk (2DD), 1 drive  
Total number of files: 300 files/disk  
Number of files used  
Time record data: 1 file/1 Kwords  
CRT block memory data  
Single mode data: 1 file/frame  
Cross mode: 2 files/frame  
Panel condition sequence programs: 1 file/1 P.COND + 1 OS.S.PROG  
Autosequence program: 1 file/2 A.S.PROG

CMOS memory\* Three types of memory and the memory capacities below can be selected.  
Time record memory (the following data lengths can be selected, including RAM memory.)  
768 Kwords (1 ch) 1 data  
384 Kwords (2 ch) 1 data  
255 Kwords (1 ch) 3 data  
127 Kwords (2 ch) 3 data  
31 Kwords (1 ch) 24 data  
31 Kwords (2 ch) 12 data  
CRT block memory (including RAM memory)  
540 frames  
Floppy disk  
Same as floppy disk (300 files)

Timer function

Clock and scheduler functions

Time display: Date, hour and minute are displayed.  
Scheduler function: Analysis is performed at an interval set in the range 1 to 9999 s.

1.1.10 Output Section

Data bus

GPIB interface (conforms to IEEE-488 1978 standards)

Plotter output\*

Output for HP-GL type plotters or Graphtec plotters (Personal mode) (HP-GL is the HP plotter command set.)

Output modes: Hardcopy, annotationless, frameless and dataless output or specification of output of only annotation, data or frame.

Autoplotting from mass memory or disk

3-Dimensional plotting (130 lines) of data from disk

Plotter tracing

Video signal output

Hardcopy of the display screen using a VP-035 Video Printer

X-Y recorder output\*

Plotting of waveform only is possible. Tracking analysis is possible using the search point analog output.

Signal output\*

Output waveforms:

Sine, sine sweep, random, periodic random, swept sine, impulse, pip

Pink filtering can be selected for the above waveforms.

Time-axis waveform display analog output:

Analog output of the waveform displayed on the CRT screen

Time record analog output:

Analog output of 4 or 8 Kwords of data from the time record memory

Sync pulse signal for above signals (except for random signals):

Output level: TTL

Output characteristics

Frequency range: 0.0001 Hz to 40 kHz (CF-350)  
0.0001 Hz to 100 kHz (CF-360)

Maximum output: 5 V<sub>0-p</sub> (open circuit)

Setting resolution: 1 mV<sub>0-p</sub>

Impedance: Approx. 50 Ω

Output connector type: BNC

Operating temperature range 0 to +40°C (+5 to +35°C when using the floppy disk drive)

Humidity range 20 to 80%

Storage temperature range -10 to +60°C

Outer dimensions 315 (W) × 199 (H) × 450 (D) mm

Weight CF-350: Approx. 13 kg  
CF-360: Approx. 16 kg

Note: The CF-350/360 is supplied with a 2-A line fuse. When powering the analyzer from a 180 to 264 V line, this must be changed to a EAWK 1-A fuse. Refer to Section 1.4 for further information on the power line.

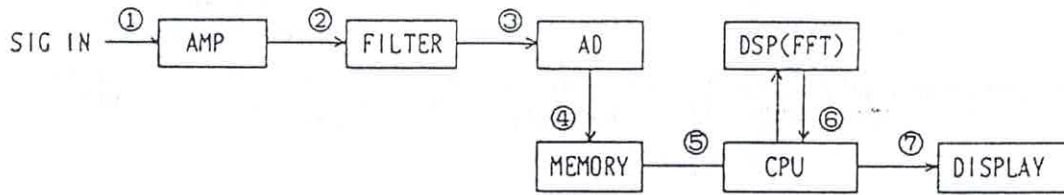
#### 1.1.12 Accessories

Power cord (AX-203)

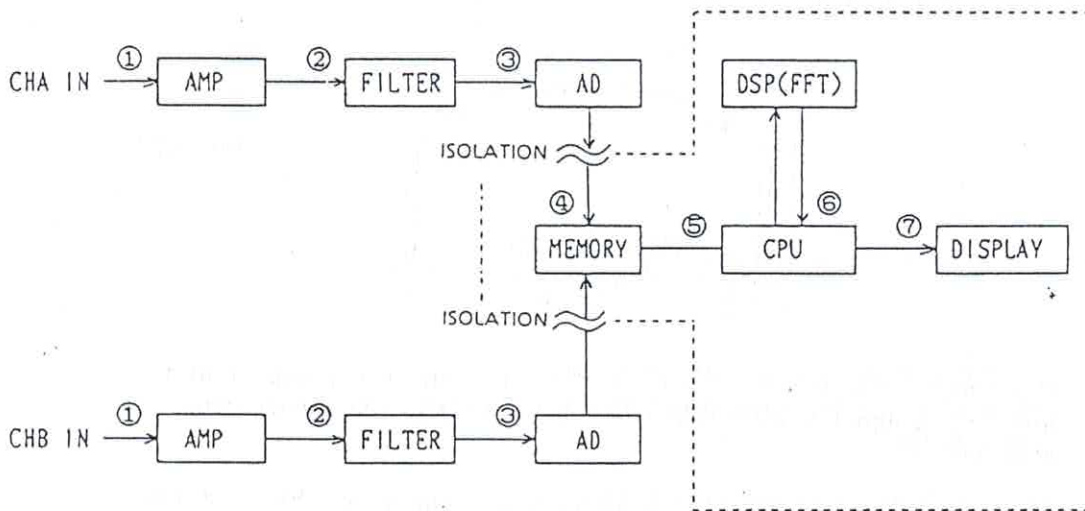
BNC-alligator clip cables (2)

BNC cable (supplied with CF-350A, B, and C types only.)

### 1.3 Signal Flow



CF-350 Block Diagram



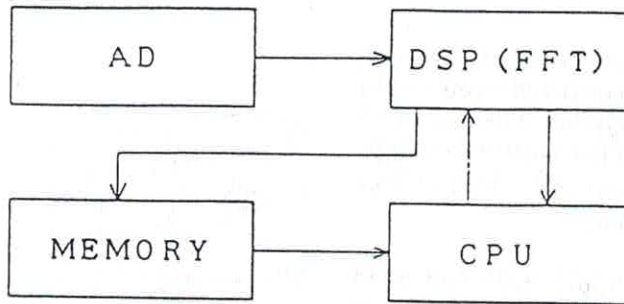
CF-360 Block Diagram

In the CF-360, the commons for channel A and channel B are independent from one another and isolated from the case. This enables floating measurements which do not use the ground level as a reference. (Note, however, that the commons for the external trigger and external sampling inputs are connected to the case.)

In the CF-350, the input and output connectors all have a common ground. For this reason it is necessary to observe the measurement precautions described in Section 1.6.

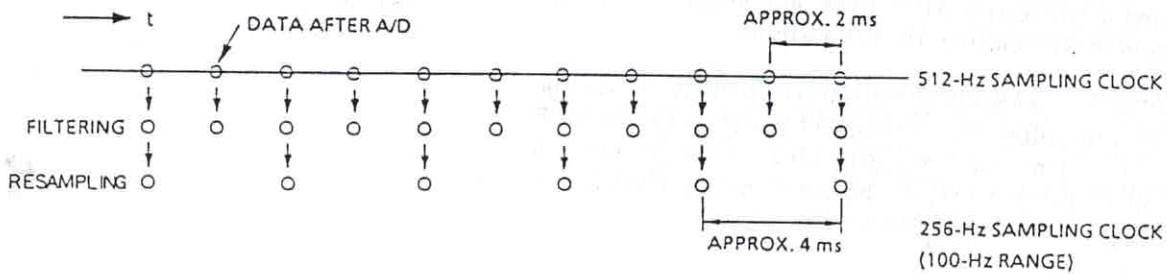
In the CF-360, A/D-converted data is sent to memory through a photocoupler.

- ① The input signal is either AC or DC coupled and applied to a high-impedance (1 M $\Omega$ ) input circuit. In the case of the CF-350, one side of both the Ch A and Ch B signals is grounded in common. For this reason, input signals having grounds with potential differences should be avoided.
- ② The signals are amplified or attenuated, according to the setting of the front panel voltage range.
- ③ To reduce errors caused by the wraparound phenomenon (aliasing) that can occur when A/D conversion is performed, the input signals are passed through a lowpass filter.



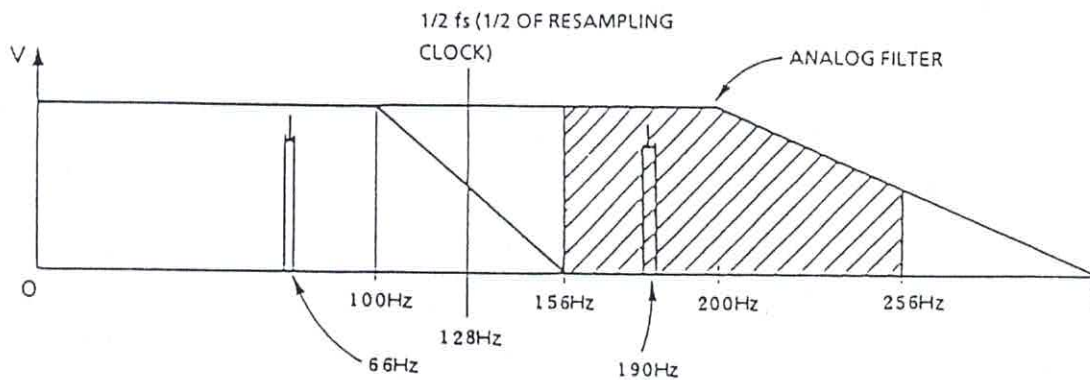
SIGNAL FLOW AT  
BELOW 100 Hz

For frequency zooming, the DSP performs processing tasks related to frequency shifting, digital filtering and resampling.



As shown above, data sampled at 512 kHz is filtered and sent to memory (1 time out of 2). This data is then the time data for the 100-Hz range. Below 100 Hz, combinations of 1/5 and 1/2 resampling are applied.

When data sampled by a 512-Hz clock and filtered with a cutoff frequency of 200 Hz are resampled by a sampling clock of 256 Hz and then FFT processed, signal components in the 156 to 256 Hz range are wrapped around. Digital filtering is used to prevent this wraparound.



When digital filtering is not applied, the shaded section is wrapped around

- ⑦ After processing by the DSP, data is transferred to the CPU memory and displayed on the CRT.

## 1.5 Grounding

In the CF-350, when the signal source ground and the cabinet are connected as shown in Fig. 1-1, a ground loop will be formed, causing susceptibility to noise. For this reason, the signal source ground should be isolated from the cabinet as shown in Fig. 1-2.

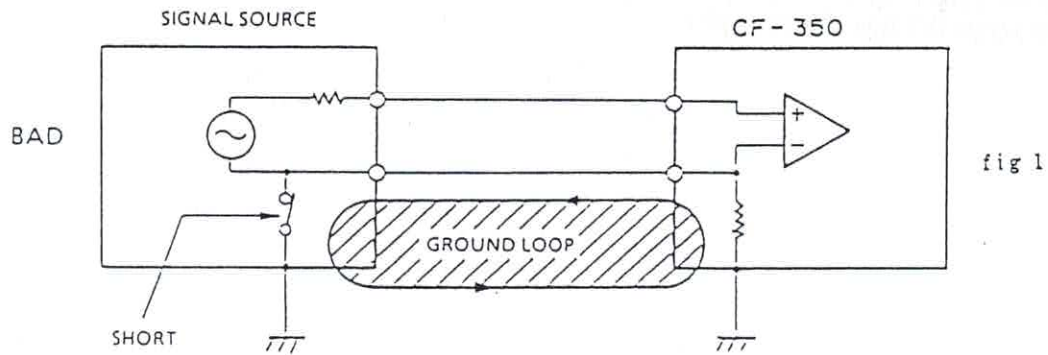


Fig. 1-1

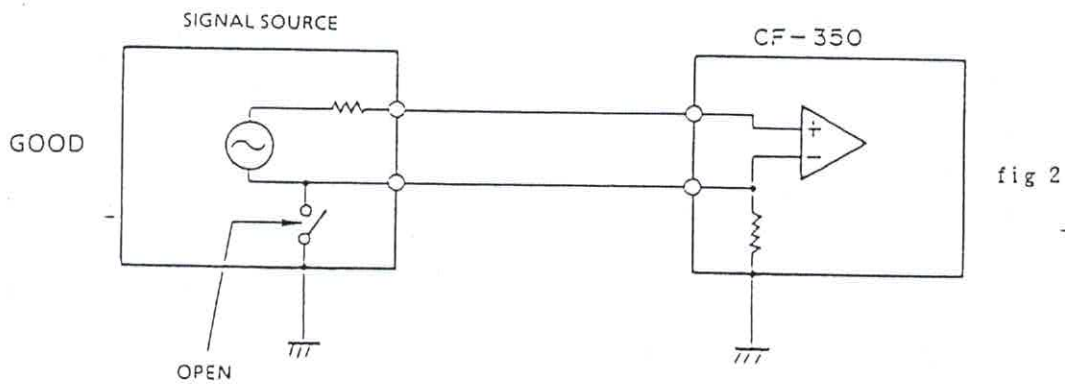
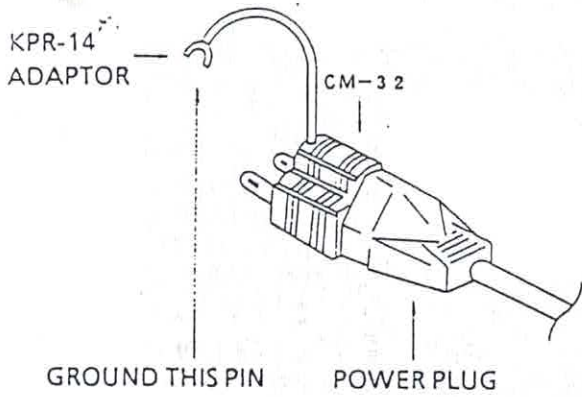


Fig. 1-2



200Hz A: AC/ 1V B: AC/ 50V S.SUM 15/16 DUAL 1k

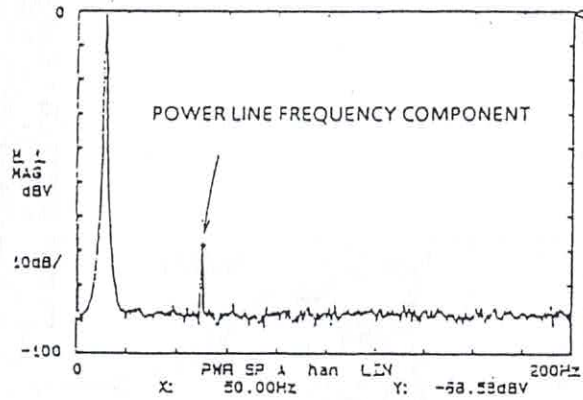


Fig. 1-3 Data when the signal source is not grounded

200Hz A: AC/ 1V B: AC/ 50V S.SUM 15/16 DUAL 1k

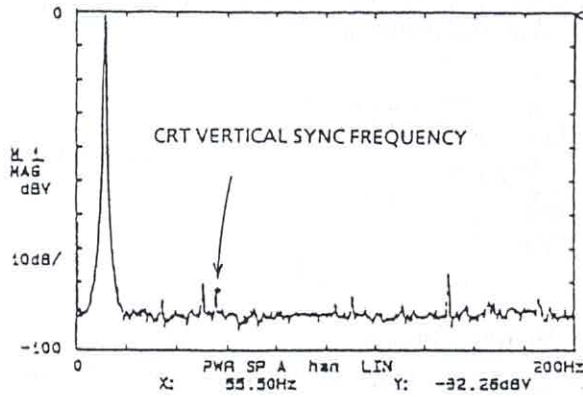


Fig. 1-4 Data with an improper ground

200Hz A: AC/ 1V B: AC/ 50V S.SUM 15/16 DUAL 1k

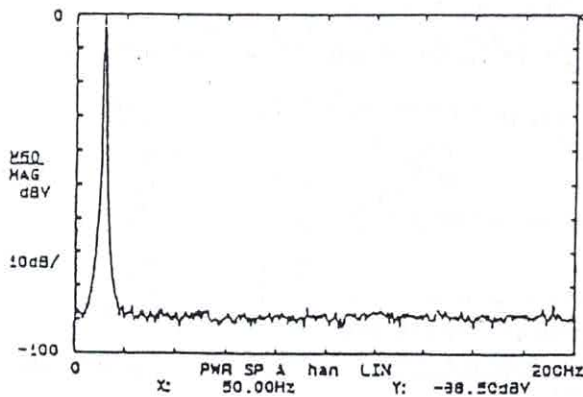


Fig. 1-5 Data with a proper ground

1.7 Connections to Peripheral Devices

① Potentials Developing Between Cabinets

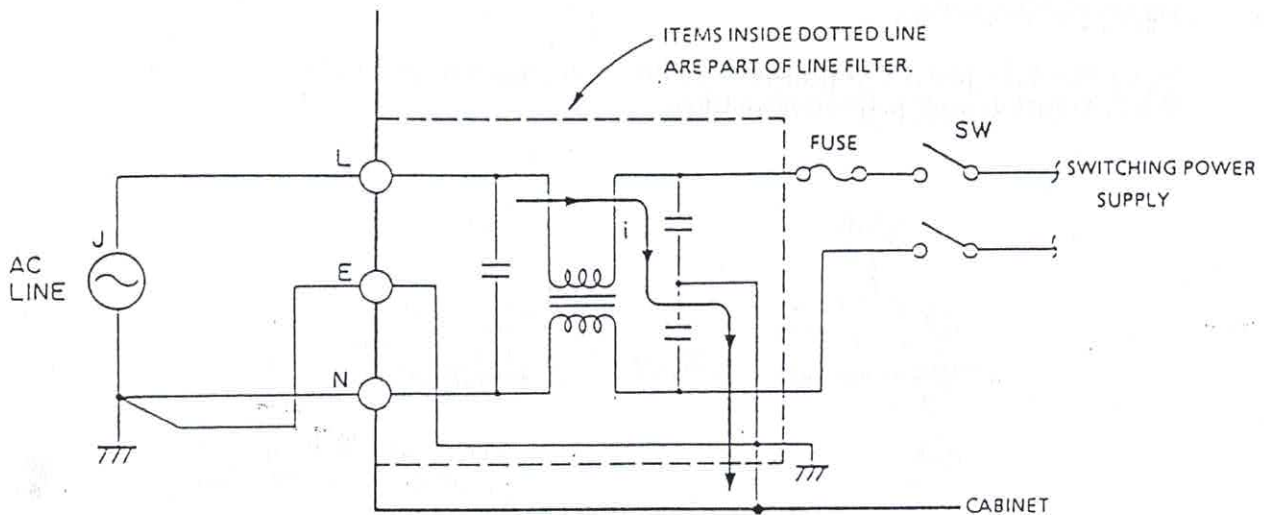


Fig. 1-6 CF-350/360 Power Supply Input Circuit

The CF-350/360 power supply has a line filter to eliminate noise and, as shown by the thick arrows in Fig. 1-6, a minute current flows in this filter, although not enough current to cause bodily harm. When using a 2-pin power cord, connections to other devices should be made as shown below.

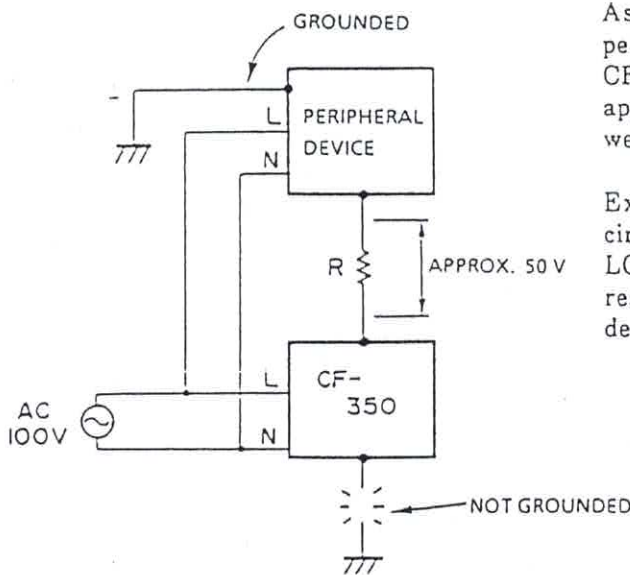
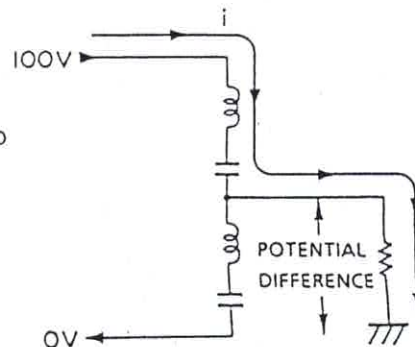


Fig. 1-7

As shown in Fig. 1-7, with the peripheral device grounded and the CF-350/360 left floating, a potential of approximately 50 V will develop between the cabinets.

Expressing this as an equivalent circuit, the current flows through the LC circuit of the filter and into a resistance, across which the potential develops.



In the configuration shown in Fig. 1-7, grounding the equipment will result in damage to internal circuitry.

## 1.9

### Cleaning

- Cleaning the CRT Filter and Screen

Wet a soft cloth with methyl alcohol and use it to wipe the surface of filter.

- Cleaning Panel Surfaces of Dirt and Dust

Polish panel surfaces with silicone-treated cloth. If the panel surface is extremely dirty, wipe with a soft cloth wetted with methyl alcohol, taking care not to apply too much alcohol.

- Cleaning the Cooling Fan Filter

(1) Remove the filter frame and remove dust from the metallic mesh and filter using a stiff brush. Remount by pushing in the frame, taking care to observe the proper attitude of the filter element.

(2) Remove the four screws from the protective cover, remove the finger guards and remove the air filter. Remove dust from the metallic mesh and filter using a stiff brush.

(3) Cleaning with a stiff brush will cause dust to be raised, even if there is not much dust in the filter. Choose the location for this cleaning task carefully.

- When cleaning the CF-350/360, always be sure to shut the power OFF first.
- Check with a screwdriver that no screws on the outside of the analyzer have been loosened.
- Because the CF-350/360 uses high-speed processing circuits, they generate some heat. While the cooling fan used has sufficient capacity to cool the unit, if the fan filter at the rear panel becomes clogged, cooling will not be sufficient, leading not only to a reduced lifetime for the analyzer, but to possible failures as well. Care should always be taken to make sure that the fan filter does not become clogged. Clean it periodically. Also, ensure that the air outlets are not blocked, as this will have the same effect.