

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 (Δf) for the Each Frequency Range

| Frequency range | 800 Lines (2048 points) | | 400 Lines (1024 points) | |
|-----------------|-------------------------|---------------------------|-------------------------|---------------------------|
| | Data length (t) | Resolution (Δf) | Data length (t) | Resolution (Δf) |
| 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

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| 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

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|-----------------|-------------------|---|
| 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) |

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| 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 $\pm 1/128$ of the full-scale voltage range (minimum: -95.5%, maximum: +95.3%)</p> <p>External trigger full scale: $\pm 5V$</p> |
| Trigger slope | (+) and (-) (rising edge and falling edge) |
| External trigger input | <p>Maximum sensitivity: 0.5 V_{p-p}</p> <p>Input impedance: 100 kΩ \pm 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 | ± 0.3 dB |

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| | 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 | ± 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 _{rms} , V ² , V _{rms} ² , dBV, dBV _{rms} , EU, dBEU, dB, %, deg, s, V ² /Hz, V/ $\sqrt{\text{Hz}}$, dBV/Hz, EU ² /Hz, EU/ $\sqrt{\text{Hz}}$, dBVs/Hz, EU ² 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). |

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| 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_{0-p} (open circuit)

Setting resolution: 1 mV_{0-p}

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.

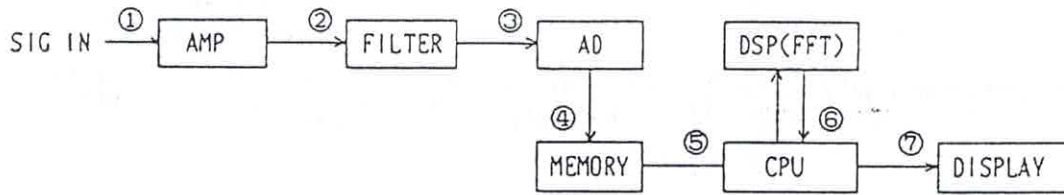
1.1.12 Accessories

Power cord (AX-203)

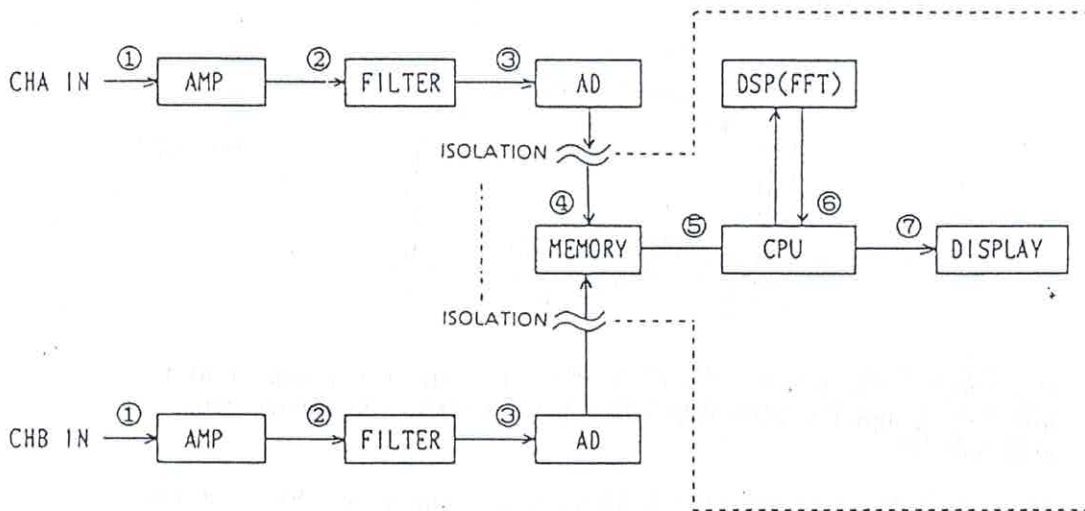
BNC-alligator clip cables (2)

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

1.3 Signal Flow



CF-350 Block Diagram



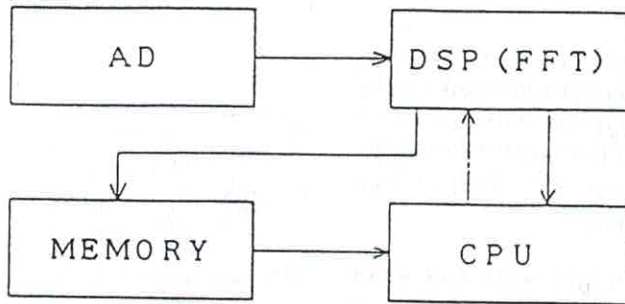
CF-360 Block Diagram

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.

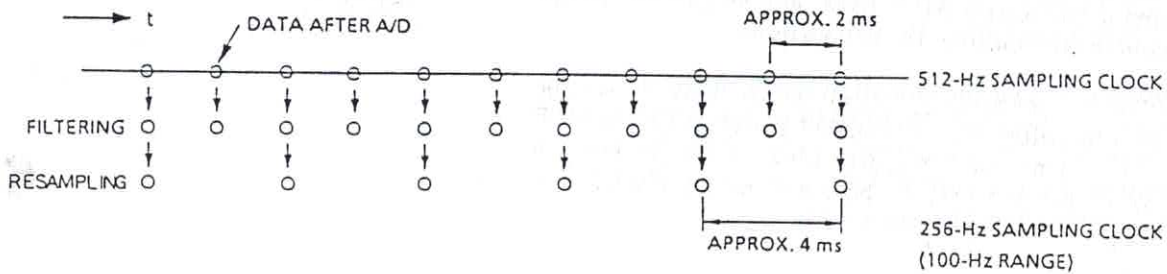
In the CF-360, A/D-converted data is sent to memory through a photocoupler.

- ① The input signal is either AC or DC coupled and applied to a high-impedance (1 M Ω) 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.



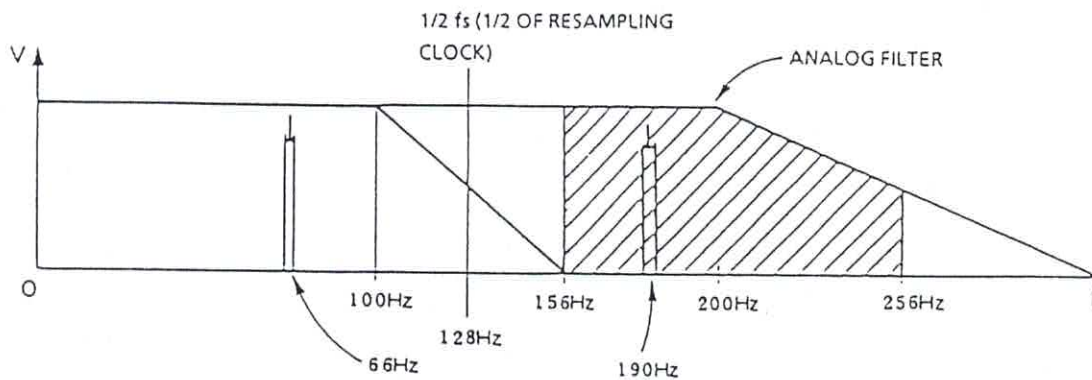
SIGNAL FLOW AT BELOW 100 Hz

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.

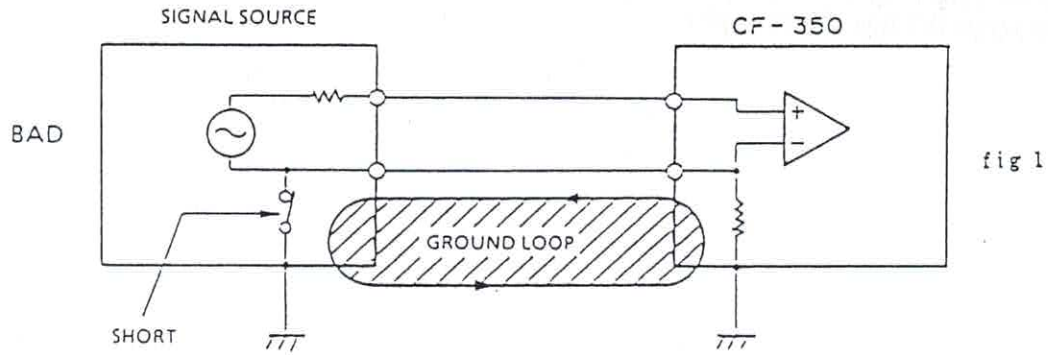


Fig. 1-1

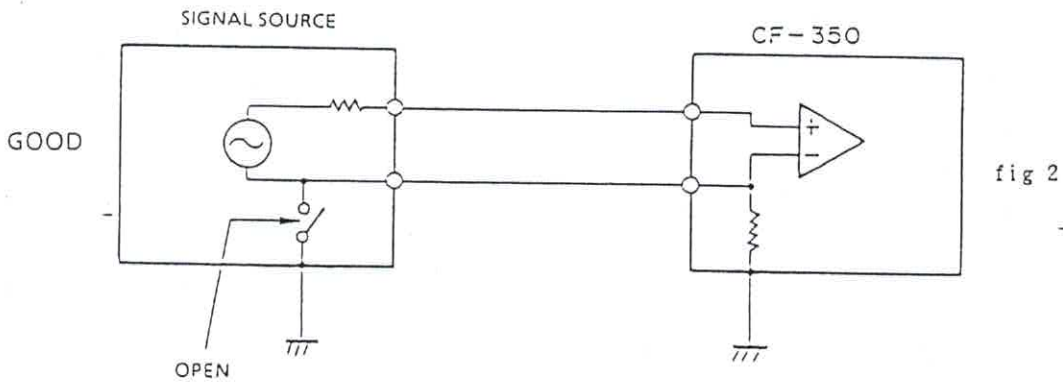
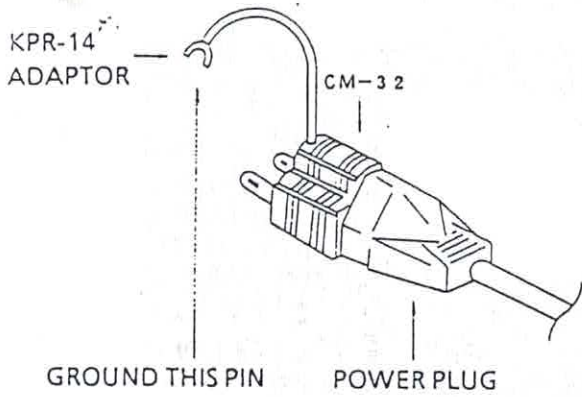


Fig. 1-2



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

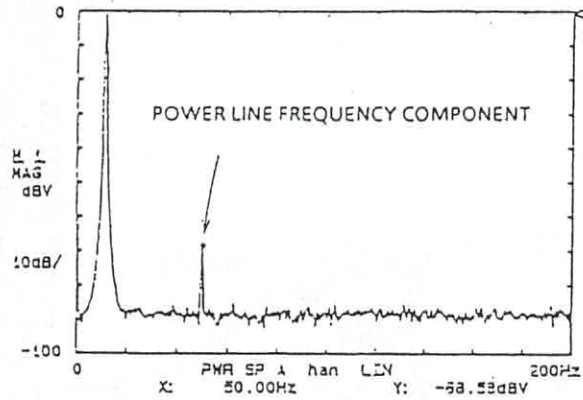


Fig. 1-3 Data when the signal source is not grounded

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

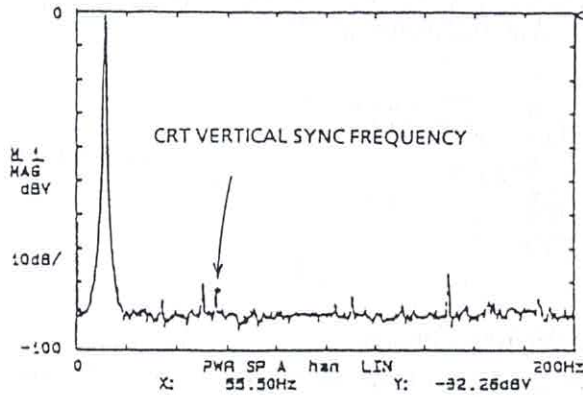


Fig. 1-4 Data with an improper ground

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

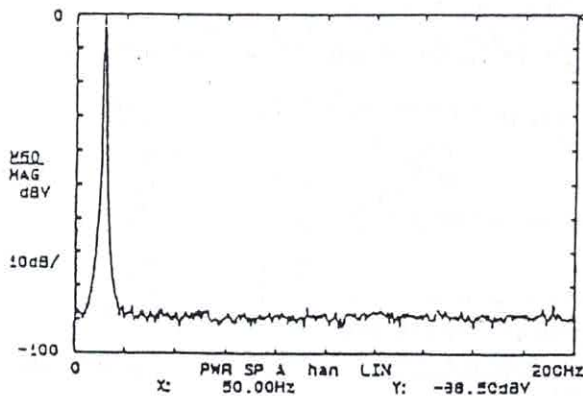


Fig. 1-5 Data with a proper ground

1.7 Connections to Peripheral Devices

① Potentials Developing Between Cabinets

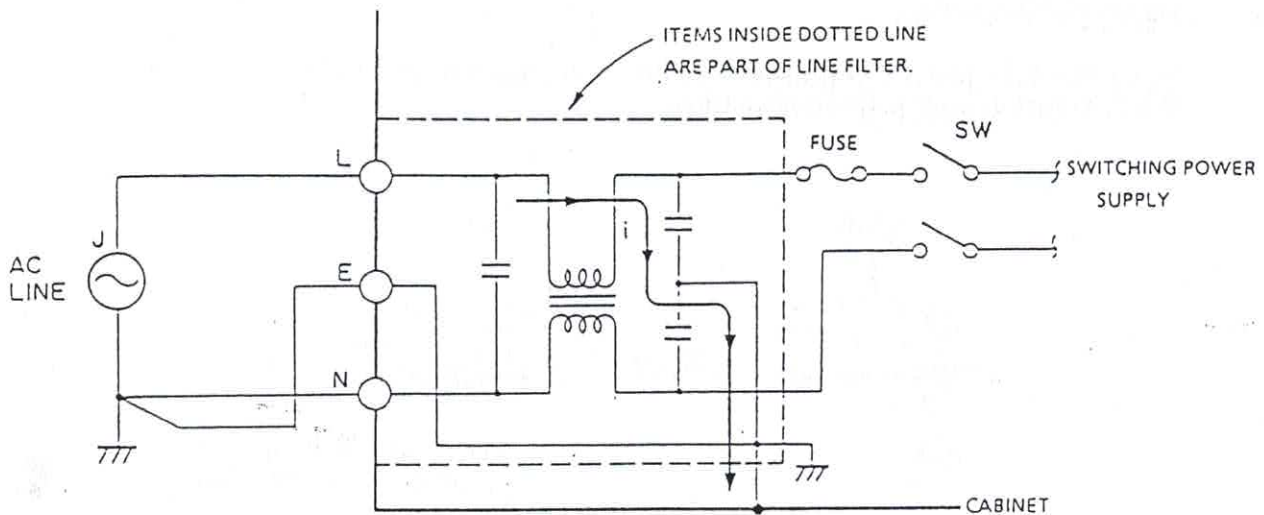


Fig. 1-6 CF-350/360 Power Supply Input Circuit

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.

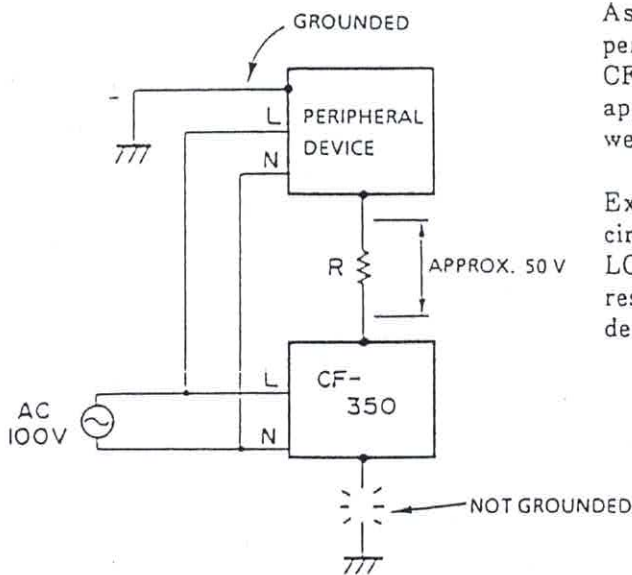
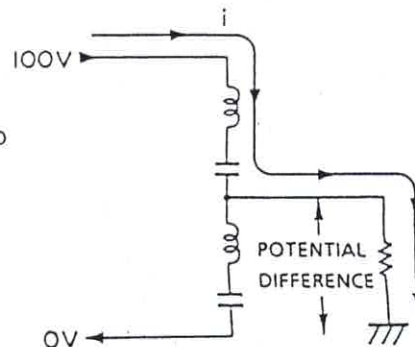


Fig. 1-7

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.