The CF-4700 FFT comparator is a pass/fail judgment machine used on production lines that is highly effective in accurate quality inspection by analyzing sound and vibration from products. Enables pass/fail judgment by extracting the amount of fluctuation of signal size focusing on a specific frequency band.
An FFT comparator that can measure periodically changing sounds and vibrations
Advantages in the manufacturing field

**FFT Comparator CF-4700**

**Features**

**4 comparator functions**

- **Block Comparator**
  - Pass / fail judgment is performed from the signal level with characteristic frequency by setting a judgment block area.

- **Shape Comparator by waveform shape**
  - Pass/fail judgment is performed by waveform shape.

- **Shape Comparator by tracking waveform**
  - Pass/fail judgment by capturing level variation in specified orders while rotation speed is varied.

- **Amplitude Modulation Component Extraction Function**
  - Pass/fail judgment is made by extracting fluctuation amount of vibration (chatter vibration etc.) and sounds caused by periodic fluctuations (roaring sound etc.).

**A variety of user-friendly functions**

- **Judgment Assist function** that sets the judgment block area based on the difference between frequency characteristics of good and defective products.

- **Accepts TEDS sensor** that automatically perform unit calibration. (Accelerometer and microphone that conform to IEEE 1451.4 ver.0.9 and ver.1.0)

- **Cable Disconnection Detecting function** that automatically detects cable disconnection and connector failure when using a constant current drive (CCLD) type sensor.

- **Stores measurement conditions and measurement data on an USB memory and SD/SDHC memory card.**

- **Monitor Function** that allows you to listen to and confirm characteristic frequency focused on.

- **Power Source Backup Function** prevents loss of measurement data in case of a main power down.

- **CF-4700 can be turned ON/OFF from an external main power supply such as a production line control panel.**
Functions

Judging by frequency level

The Block Comparator Function makes pass/fail judgments using a block area which is set in a certain frequency and level range. The judgment is made in terms of whether a peak value or level of a target signal coincides with the conditions which are set in advance or not.

- 6 kinds of judgment methods (level, peak level, peak max., inside max., partial overall, and areal content rate)
- Two methods for setting judgment block (drag operation at a touch of a screen or direct value entering on a list screen)
- Easy block setting by judgment assist function that reads differences in levels of sounds or vibrations from both passed and failed measurement data files respectively.

Related function
Block Comparator Function
Assist Function

Judging by shape of waveform

The Shape Comparator Function (CF-0472) makes pass/fail judgments by waveform shape. By setting a judgment line, this function enables pass/fail judgments on subtle variations in a time waveform or on differences in spectral shapes.

In order to avoid misjudgment due to instantaneous noises in a time waveform, if the number of data exceeding the judgment level is equal to or smaller than a set value, they are assumed to be noises and can be excluded from the target data for the judgment.

By using this function together with the Tracking Function (CF-0471), you can measure and analyze vibrations or noises caused by rotation and make pass/fail judgments on devices on the basis of the level or fluctuation of vibration or noise components that fluctuate according to the rotation speed.

Related function
CF-0472 Shape Comparator Function
CF-0471 Tracking Function

Judging by the signal amount of fluctuation in a specific frequency band

The Amplitude Modulation Component Extraction Function (CF-0473) is a preprocessing function to extract the signal amount of fluctuation in a specific frequency band. This function is effective for making judgments on abnormal sound or vibration stemming from fluctuations in signal size, and can be used as a preprocessing function for making pass/fail judgments on fuzzy creaks or chattering by a motor-driven device in operation.

This function (CF-0473) also enables measurements such as ‘monitoring of bearing vibrations’ using the band pass filter and envelope functions, as well as ‘auditory inspections of vibrations through headphones’ using the monitor function which amplifies inaudible vibrations to audible sounds.

Related function
CF-0473 Amplitude Modulation Component Extraction Function

Effective countermeasure against accidental power failure

At the production site, an instantaneous power failure or sudden large drop in the voltage of the production line’s main power could occur accidentally. The Power Source Backup Function (CF-0478) deactivates the CF-4700 in a normal manner in the event of a main power down of the production line. There is no need to prepare an uninterruptible power supply separately.

Moreover, presetting of startup conditions helps a smooth restart at the time of power restoration.

This function also allows for centralized power control of the production line. In other words, the CF-4700 can be turned on or off by mere operation of the control panel of the production line’s main power.

Related function
CF-0478 Power Source Backup Function
**Unusual noise evaluation of door mirror operation**

Unusual fuzzy noises having periodic fluctuation components may be generated while door opening and closing if a drive motor of door mirror has irregularity in the rotation. Amplitude Modulation Component Extraction function (CF-0473) of the CF-4700 is helpful for the evaluation of those sounds. The fluctuation amount of periodic fluctuation detected by microphones is the judgment index whether it contains abnormal sound or not. Using CF-0473 may be possible to evaluate on sounds that cannot be judged simply by the sound level. 

**Function used**

<table>
<thead>
<tr>
<th>CF-0473 Amplitude Modulation Component Extraction Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>MI-3111 Measurement Microphone + MI-3111 Microphone Preamp</td>
</tr>
<tr>
<td>SC-3120 Sound Calibrator (precise type)</td>
</tr>
</tbody>
</table>

**Inspection of transmission noise by tracking analysis**

CF-4700 can perform quality control of transmission by tracking analysis of vibration signal from a transmission. In this example, the CF-4700 performs tracking analysis with rotation pulses from a rotation controller in a transmission tester. Rotation tracking analysis of meshing order is performed using vibration generated when its rotation speed is varied from idling to maximum. Pass/fail judgment of the transmission is made by setting a judgment line along the tracking data.

**Function used**

| CF-0471 Tracking Function + CF-0472 Shape Comparator Function |

**Abnormal vibration diagnosis of bearings**

If the bearings are damaged, abnormal vibrations will occur. Amplitude Modulation Component Extraction function (CF-0473) of the CF-4700 is useful for judging the maintenance timing of bearings. Apply a filter (band pass filter) to the frequency band of vibration caused by bearing damage using CF-0473, and the basic frequency corresponding to the damaged part is analyzed by the envelope function. Monitor the condition of the bearing focusing on the amplitude of the frequency, and then the maintenance timing is judged. You can also set the filter while listening to the sound using the headphone output.

**Function used**

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<tr>
<td>CF-4700 CF-4700</td>
</tr>
<tr>
<td>NP-3000 Series Accelerometer with Built-in Preamp</td>
</tr>
<tr>
<td>HT-5500 Handheld Digital Tachometer</td>
</tr>
</tbody>
</table>

**Inspection of a metal part by hammering sound**

CF-0472 is helpful to make pass/fail judgment of metal parts. Frequency spectrum of a hammering sound of a metal part (a casting part) which will change with cracks or fractures is used for the inspection. In this example, the metal part suspended in free vibration is hit with a hammer, and its distribution sound is recorded with a sound level meter. FFT analysis is performed on CF-4700 to be able to see the difference in power spectrum shape between good and defective products. By reference to the shape, set the Shape Comparator to make pass/fail judgment.

**Function used**

| CF-0472 Shape Comparator Function |

**Inspection of a wire harness device for automobile**

To check the harness sound, block comparator function is effective. A wire harness device inside a sliding door of automobile is used. Inspection of a wire harness device inside a sliding door of automobile

**Function used**

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<td>HT-5500 Handheld Digital Tachometer</td>
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<tr>
<td>LA-4441A Integrating Sound Level Meter</td>
</tr>
</tbody>
</table>

**Application Examples**

- **Unusual noise evaluation of door mirror operation**
- **Abnormal vibration diagnosis of bearings**
- **Inspection of transmission noise by tracking analysis**
- **Inspection of a metal part by hammering sound**
- **Inspection of a wire harness device for automobile**
**Inspection of abnormal sound generated from a power supply board**

Sometimes power frequency sound and high frequency sound are generated from electronic parts on a power supply board. Block comparator of CF-4700 can be used for the pass/fail judgment of those electronic parts using the block comparator function.

In this example, abnormal sound coming from a power board is measured by microphone in an anechoic box to avoid influence of background noise. Perform the frequency analysis with the CF-4700, and then pass/fail judgment is made to that sound by block comparator with areal content rate by setting the judgment block including the frequency caused the abnormal noise.

**Function used**

- **Block Comparator Function**
- **SC-3120 Sound Calibrator (precise type)**
- **MI-1235 1/2-inch Measurement Microphone**
- **MI-3111 Microphone Preamplifier**
- **Anechoic box**
- **Power supply board**
- **External power supply**

**Inspection of a wire harness device for automobile**

A wire harness device inside a sliding door of automobile sometimes makes abnormal sound while the door is in motion. To check the harness sound, block comparator function is effective. Measure and output the winding sound of wire harness while driving a motor at a sound insulating box with a sound level meter. CF-4700 performs frequency analysis of that sound and makes pass/fail judgment using the partial overall level in a specific frequency band.

**Function used**

- **Block Comparator Function**
- **SC-2120A Sound Calibrator (simple type)**
- **LA-1411 Integrating Sound Level Meter (Microphone)**
- **Wire harness**
- **Motor**
- **External power supply**

**Imbalance inspection of a turbo fan**

To inspect the imbalance of turbo fan, block comparator function is helpful. Using the vibration of turbo fan which increases when it has imbalance, find the frequency band and judgment block to be set.

CF-4700 can make pass/fail judgment by setting the "peak max" judgment block. When there is MAX value of waveform inside the block area, it means "Pass". If not, it means "Fail".

**Function used**

- **Block Comparator Function**
- **NP-3000 Series Accelerometer with Built-in Preamplifier**
- **OK/NG**
- **PC**
- **PLC*”**
- **Comparator output**
- **LAN, RS-232C output**

* Programmable Logic Controller
Remotely controllable from a PC etc via LAN and RS-232C interfaces.

**DIGITAL INPUT**
The following functions are assigned to the connector.
- Control by command assignment (max. 9 terminals)
- Panel condition selection (4 terminals)
- Judgment block changeover (4 terminals)

**STATUS OUTPUT**
Contact terminal to output 4 kinds of statuses. (Comp-BUSY, OK, NG, ERROR)

**COMP OUTPUT**
Contact terminal that selects 5 judgment setups from 20 setups, and outputs the results.

### Digital I/O Specifications

<table>
<thead>
<tr>
<th>Input type</th>
<th>Output type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driven by contact or open collector (common are isolated together)</td>
<td>Open collector (4 outputs are separated, each signal is isolated.)</td>
</tr>
<tr>
<td>Max. 5 mA</td>
<td>Max. 25 mA (sink)</td>
</tr>
<tr>
<td>Negative logic (Low=-1, High=0)</td>
<td>1.0 V or less</td>
</tr>
<tr>
<td>Isolation 5 V</td>
<td>Negative logic (Low=-1, High=0)</td>
</tr>
<tr>
<td>FK-MC 0.5/8-ST-2.5 (by Phoenix Contact, Gmbh &amp; Co. KG)</td>
<td>FK-MC 0.5/8-ST-2.5</td>
</tr>
<tr>
<td>(provided as a standard accessory)</td>
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</tr>
</tbody>
</table>

### Recommended Connection Circuit

**CF-4700 side**
- FK-MC 0.5/10-ST-2.5
- FK-MC 0.5/6-ST-2.5
- FK-MC 0.5/5-ST-2.5

**External device side (example)**
- PHOENIX FK-MC 0.5/10-ST-2.5
- PHOENIX FK-MC 0.5/6-ST-2.5
- PHOENIX FK-MC 0.5/5-ST-2.5

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**System Configurations**

### Vibration

- Laser Doppler Vibrometer LV Series
- Accelerometer With Built-in Preamplifier NP-3000 Series
- Charge Output Accelerometer NP-2000 Series
- Signal Cable NP-0120/0130/0150 Series

### Sound

- 1/2-inch Measurement Microphone MI-1235/1433
- Sound Level Meter LA Series
- Microphone Preamp MI-3111

### Rotation

- Optical Detector LG-9200
- Magnetoelastic Detector MP-981/9820
- Handheld Digital Tachometer HT-5500
- Digital Tachometer TM-3100 Series

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**Digital I/O**

- AX-501
- CH-6130/6140
- MX-603+MX-100 Series
- LG-9200
- MX-7100 Series
- Signal Cable MX-100 Series
- Sound Level Meter AX-501

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**Specifications**

- **Input current**
  - AX-501: 1.0 V or less
  - CH-6130/6140: ±0.1 dB or less (At 1 kHz)
  - LG-9200: ±0.1 dB

- **Output current**
  - AX-501: ±90 dB or less
  - CH-6130/6140: ±0.1 dB

- **Input coupling**
  - AX-501: Single-ended, isolated
  - CH-6130/6140: 70 Vrms AC 1 minute (50 Hz)

- **Input connector type**
  - AX-501: Stereo mini-jack
  - CH-6130/6140: 3.5 mm (L and R same signal output)

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**Digital I/O**

- BUSY, OK, NG, ERROR
- DIGITAL INPUT
- STATUS OUTPUT
- COMP OUTPUT
- 1/3 octave (bundled), order spectrum, tracking diagram
- 0 to 99 (Unit: %) Default value: 2 %

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**Battery replacing intervals**

- Approx. 2 years

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**TEDS function**

- TEDS ver.0.9 (0: accelerometer, 12: microphone)

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**Input voltage range**

- 10 kV (Isolation)
1. Input Section

General input
- Number of input channels: 1 channel
- Input connector type: BNC (Type C12)
- Input type: Single-ended, isolated
- Input impedance: 2 M\(\Omega\) or 10\% of full scale
- Input coupling: DC or AC

Input signals (typical values) 5 V to 4 mA

- Maximum input voltage: 15 V rms
- Absolute maximum input voltage: 30 V
- Input range: 1 V to 1 mV

Sampling rate: 1,200,000 (SD/SDHC card)


data file
- Number of data files: 9999 max.
- DAT, TIFF, BMP, TRC (Data can be saved simultaneously in four formats. (Data storage in TXT, TRC, and BMP formats can be selected optionally.)
- Panel condition memory: Memories and recall measurements conditions (500 max)

5. Memory Function

Recording device: Selectable from internal storage of main unit, USB memory or SD/SDHC card
- Data file: Number of data files: 9999 max.
- DAT, TIFF, BMP, TRC (Data can be saved simultaneously in four formats. (Data storage in TXT, TRC, and BMP formats can be selected optionally.)
- Panel condition memory: Memories and recall measurements conditions (500 max)

6. Interface

USB Type: USB
- Number of ports: 1
- Data USB 2.0 for USB mass storage class function (CF-0477 option)
- Data transfer in one unit is read by connecting to a PC (file transfer)

LAN
- Number of ports: 1
- Supports 10/100/1000 capacity 4 GB, 32 USB

7. General Specifications

Power requirement: 16 VDC, 3.4 A
- Ac adapter: Power requirement 100 to 240 VAC, 50/60 Hz
- Power consumption: 150 VA or less

Operating temperature range: 0 to 50 \(^\circ\)C

Storage temperature range: -10 to 60 \(^\circ\)C

Dimensions: 290 (W) x 125 (H) x 85 (D) mm

Weight: 1.5 kg (Provided as a standard accessory)

- LCD: 150 VA or less (When CF-0478 Power Source Backup Function is installed and charging battery)

CF-0478 Power Source Backup Function

Battery life: Lithium ion secondary battery mounted in main unit (detachable)
- Battery: Li-ion 10.8 V, 1.9 Ah (8 s)

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