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 or 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 capable of being used on production sites and dealing with sound or vibration that fluctuates periodically.

**FFT Comparator CF-4700**

**Features**

- **4 comparator functions**
  - The Block Comparator Function allows pass/fail judgment from the level of characteristic frequency signal using a preset judgment block area.
  - The Shape Comparator Function for pass/fail judgment by waveform shape.
  - The Tracking Function for pass/fail judgment by capturing level variation in specified order while rotational speed is varied.
  - The Amplitude Modulation Component Extraction Function (Band pass filter, Envelope and Monitor Function) that enables pass/fail judgment by extracting the amount of periodical fluctuations in sound or vibration caused by buzzing or chattering.

- **A variety of user-friendly functions**
  - The Assist Function for setting the judgment block area from the difference between frequency characteristics of good and defective products.
  - Accepts TEDS sensor for automatic unit calibration. (Accelerometer and microphone that conform to IEEE 1451.4 ver.0.9 and ver.1.0)
  - The Cable Disconnection Detecting Function for detecting cable disconnection or connector trouble automatically when using a constant current line drive (CCLD) type sensor.
  - Measurement conditions and data can be stored on a USB memory and SD/SDHC memory card.
  - Measurement conditions and data can be duplicated to a PC via USB cable.
  - The Monitor Function for auditory confirmation of specified characteristic frequency sound through headphones.
  - The Power Source Backup Function prevents loss of measurement data in case of a main power down.
  - The CF-4700 can be turned ON/OFF from an external main power supply such as a production line control panel.

**Related Functions**

- CF-0470 Amplitude Modulation Component Extraction Function
- CF-0471 Tracking Function
- CF-0472 Shape Comparator Function
- CF-0473 Power Source Backup Function
### 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, areal content rate) are available for each block. The judgment block can be determined by drag operation at a touch of a screen or by directly entering a numeric value on a list screen. In addition, the Assist Function reads differences in levels of sounds or vibrations from both passed and failed measurements data files respectively. This function makes it easier to set a judgment block, even for first-time users who are conducting a pass/fail judgment by frequency spectrum.

#### 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.

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

The Amplitude Modulation Component Extraction Function (CF-0473) is a preprocessing function to extract the amount of fluctuation of signal size 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.

#### 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, pre-setting 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.
Application Examples

Unusual noise evaluation of door mirror operation

Irregularity in the rotation of a door mirror drive motor while it is opened or closed may generate unusual fuzzy noises having periodic fluctuation components. These noises can be detected by the amount of periodic fluctuation extracted by the Amplitude Modulation Component Extraction Function from the door mirror motion sound measured with the MI-1235 1/2-inch Measurement Microphone and the MI-3111 Microphone Preamplifier. Using the Amplitude Modulation Component Extraction Function it may be possible to make judgments on sounds that cannot be judged simply by the sound level.

![Diagram of CF-4700 Amplitude Modulation Component Extraction Function](image1)

Abnormal vibration diagnosis of bearings

Damage of bearings causes abnormal vibrations. The CF-4700 performs diagnosis of bearings by inputted signal from an accelerometer attached on the rolling bearing. A basic frequency analysis according to a damaged part can be performed by optional band pass filter and envelope function (included in the CF-0473 Amplitude Modulation Component Extraction Function), which filters a frequency band in vibration caused from a damaged bearing. The amplitude in a frequency band tells the timing of bearing maintenance. Also the filter can be set while listening to the sounds from bearing through headphones.

![Diagram of CF-4700 Amplitude Modulation Component Extraction Function](image2)

Inspection of transmission noise by tracking analysis

The 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 rotational pulses from a rotation controller in a transmission tester. Rotational tracking analysis of meshing order is performed using measured vibration by the NP-3000 Series Accelerometer with Built-in Preamplifier. Inspection of transmission noise by tracking analysis

![Diagram of CF-4700 Tracking Function and CF-0472 Shape Comparator Function](image3)

Inspection of a metal part by hammering sound

The frequency spectrum of a hammering sound of a metal part (e.g. a casting part) is affected by its cracks or fractures. In this example, the metal part is suspended in free vibration for hammer exciting, and an inspection is made from the hammering sound. The hammering sound is measured by the LA-4441 Integrating Sound Level Meter. Then via AC output, inputted to the CF-4700 which performs a frequency analysis to find the difference in power spectrum shape between good and defective products. The CF-4700 makes judgments using the Shape Comparator Function with the difference.

![Diagram of CF-4700 Shape Comparator Function](image4)
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. In this example, abnormal sound coming from a power board is measured by the MI-1235 1/2-inch Measurement Microphone and the MI-3111 Microphone Preamplifier in an anechoic box to avoid influence of background noise. Then the signal is inputted to the CF-4700 for frequency analysis. The CF-4700 makes pass/fail judgment with areal content rate in power spectrum by setting up of a judgment block around the power frequency caused the abnormal sound.

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. The wire winding sound can be used for inspection. Drive a motor of wire harness device in a sound insulating box and the LA-1411 Integrating Sound Level Meter measures the sound from the device. Then the CF-4700 performs frequency analysis of the AC output signal from the Sound Level Meter to make pass/fail judgment of the partial overall level in a specific frequency band.

Imbalance inspection of a turbo fan

When a turbo fan has imbalance, the signal from a vibration sensor attached on it increases. Therefore, it is effective for imbalance inspection to measure vibrations of the rotating turbo fan. By using signals from the NP-3000 Series Accelerometer with Built-in Preamplifier, you can define the target frequency band and the judgment level, then set judgment blocks to the CF-4700 FFT comparator. In this case, the ‘peak max’ is selected as the judgment method. If the maximum value of the waveform exists in the specified block area, it means “good”. If not exists, it means “defective”.

* Programmable Logic Controller
Specifications

### Digital I/O

<table>
<thead>
<tr>
<th>Input Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input type</td>
<td>Driven by contact or open collector (common are isolated together)</td>
</tr>
<tr>
<td>Input current</td>
<td>Max. 5 mA</td>
</tr>
<tr>
<td>Logic</td>
<td>Negative logic (Low=1, High=0)</td>
</tr>
<tr>
<td>Power voltage</td>
<td>Isolation 5 V</td>
</tr>
<tr>
<td>Applicable connector</td>
<td>FK-MC 0.5/6-ST/2.5 (by Phoenix Contact. GmbH &amp; Co. KG) (provided as a standard accessory)</td>
</tr>
</tbody>
</table>

### 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.

### System Configurations

**Vibration**
- Laser Doppler Vibrometer LV Series
- Accelerometer With Built-in Preamplifier NP-3000 Series
- Charge Output Accelerometer NP-2000 Series
- Signal Cable
  - MX-100 Series

**Rotation**
- Optical Detector LG-9200
- Magnetoelectric Detector MP-961/9820

**Sound**
- 1/2-inch Measurement Microphone MI-1235/1271/1433
- Microphone Preamplifier MI-3111/3170
- Sound Level Meter LA Series

**System Configurations**

**Input**
- Signal input connector (isolated)
- TEDS available. Cable disconnection detecting function is also available when a constant current line drive (CCLD) type sensor is connected.

**Output**
- BUSY, OK, NG, ERROR

**Applicable connector**
- BNC cable
- AX-501
- Digital I/O
  - CF-0478 Power Source Backup

**Other Features**
- Remote controllable via LAN and RS-232C interfaces from a PC etc.

**Recommended Connection Circuit**

**CF-4700 side**
- 5 V (isolated)
- PHOENIX MC 0,5/10-G-2,5

**External device side (example)**
- 5 V
- PHOENIX MC 0,5/10-G-2,5

**Power Supply Backup**
- Charging time that the battery reaches maximum capacity:
  - 150 VA or less (When CF-0478 Power Source Backup)

**Specifications**

- Dimensions: 220 (W) × 185 (H) × 220 (D) mm (Excluding handle, stand, and protruded section)
- Weight: 8.4-inch ON/OFF 2 levels
- TFT Color LCD with resistive film type touch panel
- LCD resolution: 800 × 600 pixels
- Operating temperature range: 0 to 40 ˚C (Humidity 20 to 80 %RH, with no condensation)
- Power supply current for sensor (CCLD): 70 Vrms AC 1 minute (50 Hz)
- Power consumption: 65 VA or less
- Power requirement: 100 to 240 VAC, 50/60 Hz
- Number of measurement channels: 10 (5 analog, 5 digital)
- Number of input signals: 12
- Number of output signals: 8
- Number of output signals: 5
- Number of input signals: 5
- Operating memory: 512 MB (PS-P20023A, VM1072-VM1700 (2 m))
- Internal memory: 512 MB (PS-P20023A, VM1072-VM1700 (2 m))
- Number of setup blocks: Maximum 5000
- Target waveform: Band pass filter, Envelope and Monitor Function
- Resolution: Digital I/O: 32-bit floating point (IEEE single-precision format)
- Input coupling: DC or AC (-3 dB±0.3 dB at 0.5 Hz)
- Dynamic range: ±0.1 dB or less (At 1 kHz)
- Input range: ±90 dB or less (Standard, when optional filter is off)
- Input range: ±60 dB full scale or less (When auto zero is on and DC coupling)
- Maximum input voltage: ±70 Vrms AC 1 minute (50 Hz)
- Input connector type: BNC (Type C02)
- Cut-off frequency (Selectable) 1k, 10 kHz (-18 dB/oct)
- Low-pass filter (LPF) (3 order Butterworth, ISO 2954)
- Individual judgment output (any 5 outputs)
- 5 outputs and common (Insulation withstand voltage 42.4 Vpeak)
- BUSY, OK, NG, ERR (Each signal is isolated, insulation withstand voltage 42.4 Vpeak)
- Digital I/O: BUSY, OK, NG, ERR (Available when the CF-0471 Tracking Function is installed)
- Ext Trig: External trigger input
- Ext SAMP: External sample input

**Appendix**

* Programming Logic Controller
4. Comparator Function

Judgment mode
- Continuous mode, single mode

Judgment result output
- Total judgment result, individual judgment result of up to 5 specified blocks or shapes

Automatic data storage
- Using for all measurement results

Trier function
- Start delay time setting, judgment execution time setting
  - 0 to 255 seconds (Interval: 1 second)

Block mode
- Target waveform
  - Power spectrum, 1/2 octave (bundled), 1/3 octave (bundled), order spectrum

Maximum number of setup blocks
- 40 blocks

Judgment method
- Peak level, peak max (maximum), inside max, partial overlap, area content rate

Judgment criterion
- Judgment method can be specified for each block.

Shape mode (CF-0472 option)
- Target waveform
  - Power spectrum, power spectrum, 1/2 octave (bundled), 1/3 octave (bundled), order spectrum, tracking diagram

Maximum number of setup channel
- 20 blocks

Judgment criterion
- Specified area, specified level

5. Memory Function

Recording device
- Selectable from internal storage of main unit, USB memory or SD/SDHC card

Data file
- Number of storage data: 9999

Data transfer
- Dak, DAT, BMP, TRC

(TDC data can be saved simultaneously in four formats. (Data storage in TXT, TXT, BMP, and TRC formats can be selected optionally.)

Panel condition memory
- Memories and recalls measurement conditions. (500 max)

6. Interface

DSUB 9 pin
- Number of ports: 2

USB-A mini
- Number of ports: 1

USB-C
- Number of ports: 1

LAN
- Supports 10/100/1000BASE-T, 1000BASE-LX

7. General Specifications

Power
- 16 WDC, 9-4 A

Input power
- 100 to 240 VAC, 50/60 Hz

Power consumption
- 65 W or less (When CF-0480 Power switch is on)

Operating temperature
- 0 to 40 °C (Humidity: 20 to 80 % RH, with no condensation)

Storage temperature
- -10 to 50 °C (Humidity: 20 to 80 % RH, with no condensation)

Dimensions
- 240 × 140 × 80 mm (W × H × D, excluding controls and test sections)

Weight
- Without optional: Approx. 3.5 kg

Operational environment
- CE marking

Vibration resistance
- 9.9 m/s² (Frequency: 10 to 1000 Hz in each axis: X, Y, and Z direction)

Shock resistance
- 49.1 m/s² (11 g, 11 ms x-axis)

Accessory
- Optical adapter × 1

Analog filter
- X (PS-PS03X5), VM1072, VM1070 (2 each)

Input signal
- 3 signal

DC HUM
- X (Reference guide, utility, DLL for external control, etc.)

SD card
- X (Optional for upgrades: 512 MB)

Connectors for terminal
- FK-MC 0,5/8-G-2,5 ×1, FK-MC 0,5/8-ST-2,5 ×1

Ferrite core 
- X (LOSM001005, made by Molec, ELECO MG, CO., LTD.)

Option Functions

CF-0478 Power Source Backup Function
- Battery
  - Lithium-Ion secondary battery mounted in main unit (detachable)

Battery charging time
- 4 hours at battery level 0%, ensuring temperature range +10°C to +30°C

Function becomes available
- The battery can be charged only when the main unit is on.

Battery charging interval
- Approx. 2 years"
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 or vibration from products. Enables pass/fail judgment by extracting the amount of fluctuation of signal size focusing on a specific frequency band.

**Product Lineup**

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<td>CF-0471</td>
<td>Tracking Function</td>
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<tr>
<td>CF-0472</td>
<td>Shape Comparator Function</td>
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<tr>
<td>CF-0473</td>
<td>Amplitude Modulation Component Extraction Function (Band pass filter, Envelope and Monitor Function)</td>
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<tr>
<td>CF-0477</td>
<td>USB Mass Storage Function</td>
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*CF-0703 USB connection cable is included.

**Recommended Product**

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</tr>
<tr>
<td>PSDC004GSTCC3AG</td>
<td>SDHC memory card (4 GB)</td>
</tr>
<tr>
<td>PSDC032GMTNC3AG</td>
<td>SDHC memory card (32 GB)</td>
</tr>
<tr>
<td>MDR-7506</td>
<td>Stereo headphone</td>
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**Power Source Backup Function**

- Stylus pen
- USB connection cable (1.5 m TYPE-A mini-B)
- Reference guide (Japanese)
- Reference guide (English)

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**ONOSOKKI**

**U.S.A.**
Ono Sokki Technology Inc.
2171 Executive Drive, Suite 400
Addison, IL, 60101, U.S.A.
Phone: +1-630-627-9700
Fax: +1-630-627-0004
E-mail: info@onosokki.net
http://www.onosokki.net

**THAILAND**
Ono Sokki (Thailand) Co., Ltd.
1/293-4 Moo.9 T.Bangphud A.Pakred
Nonthaburi 11120, Thailand
Phone: +66-2-584-6735
Fax: +66-2-584-6740
E-mail: sales@onosokki.co.th

**INDIA**
Ono Sokki India Private Limited
Plot No.20, Ground Floor, Sector-3, IMT Manesar Gurgaon-122050, Haryana, INDIA
Phone: +91-124-421-1807
Fax: +91-124-421-1809
E-mail: office@onosokki.co.in

**P.R.CHINA**
Ono Sokki Shanghai Technology Co., Ltd.
Room 506, No.47 Zhenyi Road, Yangpu District, Shanghai, 200433, P.R.C.
Phone: +86-21-6503-2656
Fax: +86-21-6506-0327
E-mail: admin@onosokki.com

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