CF-4500

FFT Comparator CF-4500

The CF-4500 FFT comparator can be used as an OK/NG judgment machine on production lines for accurate quality inspection by sound or vibration from products. As featuring our accumulated FFT technology over the years, the CF-4500 enables OK/NG judgment by Block Comparator Function, Shape Comparator Function, Tracking Function and Band-pass Filter & Monitor Function. The combinations of these judgment functions greatly help to improve product quality and working efficiency on production sites.

Discontinued
(Reference only)

ONO SOKKI

The CF-4500 FFT Comparator is widely used in various fields from production line to R & D!
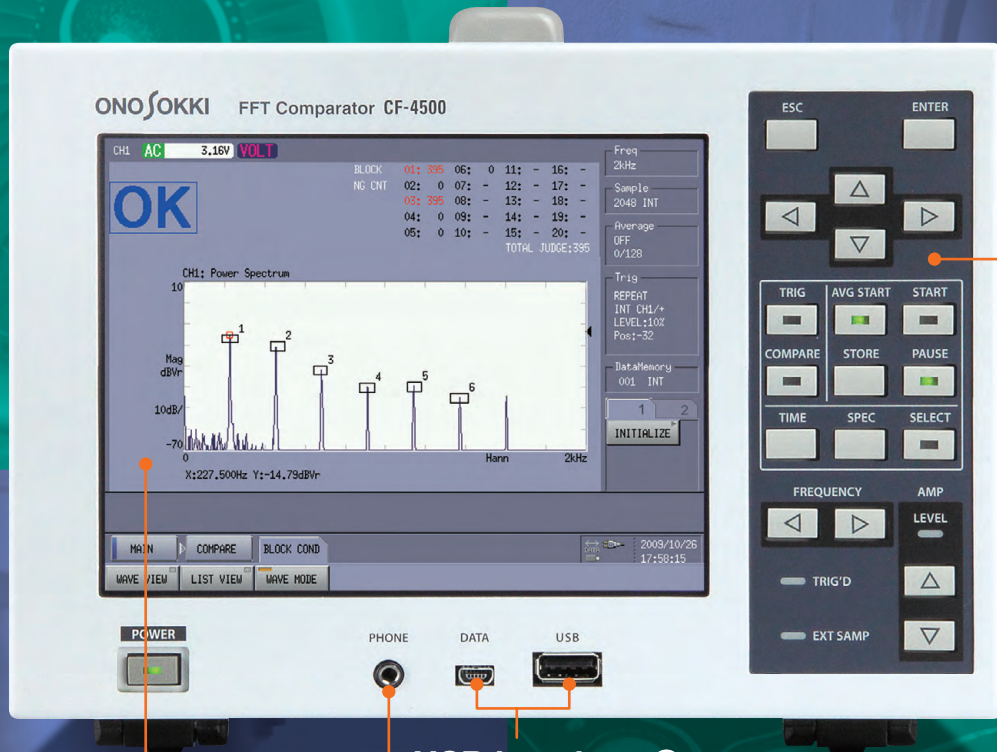
Direct key operation: Commonly-used functions.

USB interface ❻

Headphone output ❹

6.5-inch touch-panel color LCD ❺

Panel protection cover
(CF-0459: option)
- Prevention of miss operation caused by human errors (e.g. when an operator accidentally strikes keys).
- Protection of LCD.
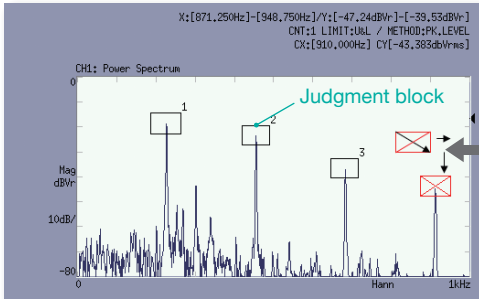* It is not dust-proof or splash-proof structure.

Features

❶ Max. 20 judgment blocks for OK/NG judgment from the level of characteristic frequency signal. 5 kinds of judgment methods for each judgment block.

❷ The Shape Comparator Function for OK/NG judgment by waveform shape (option).

❸ The Tracking Function for OK/NG judgment by capturing level variation in specified order (option).

❹ The Band-pass Filter & Monitor Function for allowing characteristic abnormal sound to be monitored auditorily through headphones (option).

❺ A touch-panel color LCD enables easy setup of judgment block or judgment shape by drag & drop operations at a touch of a screen.

❻ Measurement data and conditions can be stored on an USB memory. It enables management or backup copy of them on a PC.

❼ An open collector output for total and individual judgment results to PLC* (controllable by 9 kinds of commands)

❽ The Power Supply Backup Function prevents loss of measurement data in case of a main power down (option).

*PLC: Programmable Logic Controller

Functions

Judging frequency level
Block Comparator Function

X:[871.250Hz]-[948.750Hz]/Y:[-47.24dBVr]-[-39.53dBVr]
CNT:1 LIMIT:U&L / METHOD:PK.LEVEL
CX:[910.000Hz] CY[-43.383dbVrms]

CH1: Power Spectrum

Judgment block

Judgment block can be moved using the cursor.

Block setup List display

Frequency range, upper/lower-limit level values, and judgment method can be set on the list screen.

The Block Comparator Function makes OK/NG judgment depending on whether a peak value or level of a target signal coincides with a block area set in a certain frequency range and level range. 5 kinds of judgment methods (level, peak level, peak max, section overall, areal rate of content) are available for each block. The judgment block can be determined by drag operation at a touch of a screen or directly entering a numeric value on a list screen.

(Block Comparator Function: standard)

Judging rotational speed variation
Tracking waveform Shape Comparator

Judgment line

Measurement value
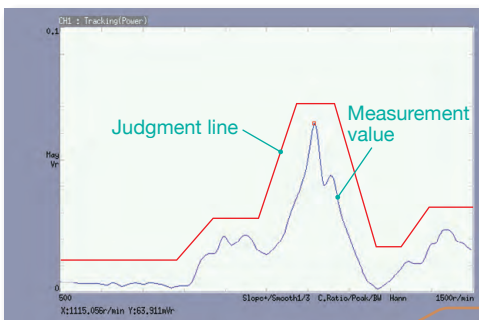
MP-981/9820   LG-916   CF-4500

In sound and vibration countermeasures for rotational machines, it is important to measure or analyze which rotational speed increases sound or vibration. The CF-4500 is capable of tracking speed variation to extract sound and vibration components caused by rotational speed variation, and making OK/NG judgment of the rotating machine under measurement from level value variation. The LG series or the MP series rotational detectors by ONO SOKKI can be connected directly to input signal of rotational speed.

(CF-0451 Tracking Function + CF-0452 Shape Comparator Function: options)

Judging shape of waveform
### Shape Comparator Function

CH1: Time

Judgment line
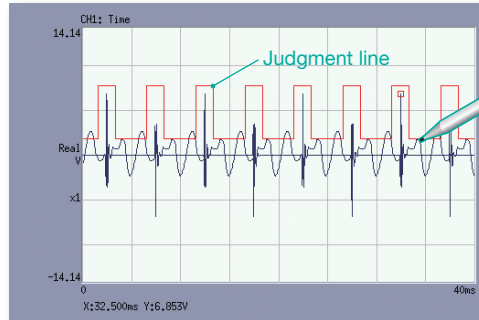
Judgment shape can be set by touching on a screen.

The Shape Comparator Function is effective for judgment by waveform shape. Sometimes it is not easy to judge subtle variation in signal waveform of sound or vibration by frequency analysis. This function allows judgment of subtle variation in signal waveform by setting a judgment line along the shape of signal waveform. The judgment line connects any points to form judgment area.
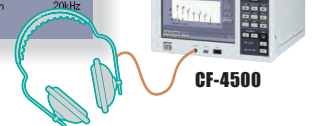
(CF-0452 Shape Comparator Function: option)

Auditory checking of sound and vibration
Band-pass Filter & Monitor Function

CH1: Time
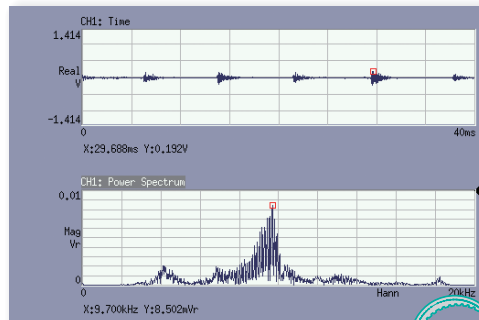
CH1: Power Spectrum

In this example, a 4-10 kHz Band-pass Filter is set to bearing vibration waveform.
(Top: Time waveform, Bottom: Power spectrum)

CF-4500

Abnormal sound from products has been inspected based on auditory check by using stethoscopic probes. The CF-4500 can extract and check a frequency band which may cause abnormal sound with Band-pass Filter while monitoring through headphones.

(CF-0453 Band-pass Filter & Monitor Function: option)

No worry about accidental power failure
Power Supply Backup Function

At production site, it could be occurred an instantaneous power failure or a main power down of production line accidentally. This optional function deactivates the CF-4500 in normal manner in case of a main power down of production line. There is no need to prepare an uninterruptible power supply separately. Moreover, presetting of startup conditions helps smooth restart and also allows centralized power control of production line. The main power of production line and the CF-4500 can be powered on or off just by an ON/OFF operation.
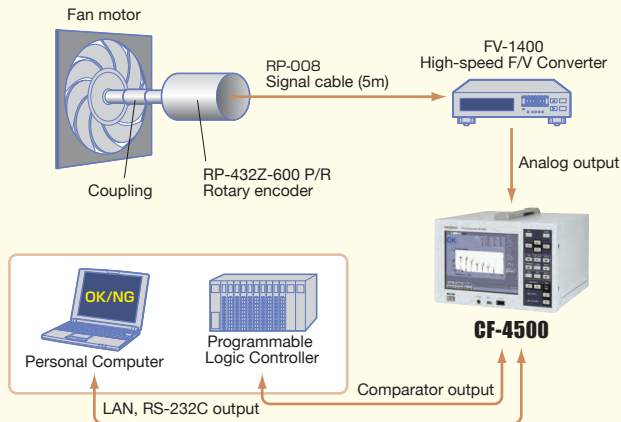
(CF-0458 Power Supply Backup Function: option)

CF-4500

Applications

Motor inspection by rotational speed fluctuation

Rotational speed fluctuation is one of the items for motor quality inspection. An F/V converter is used to detect rotational fluctuation. The signal from a rotary encoder coupled with a rotating shaft is input to the High-speed F/V Converter (FV-1400) and then the F/V Converter outputs voltage signal proportional to rotational speed into the CF-4500. Voltage signal is maintained when rotational speed is kept constant. Otherwise, rotational fluctuation appears as subtle variation in voltage. The CF-4500 can perform frequency analysis of voltage fluctuation and quality inspection in amplitude level by the Block Comparator Function.
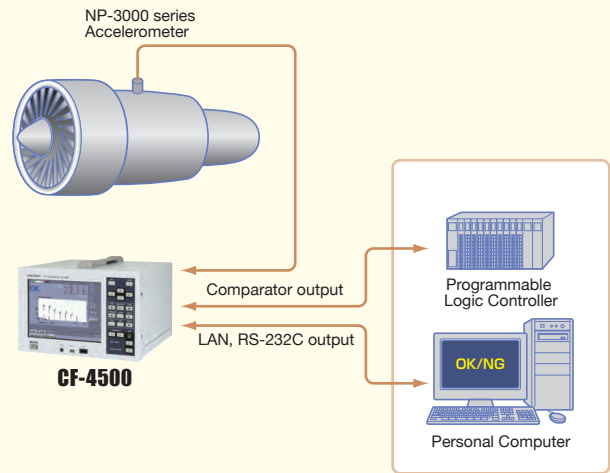
(Block Comparator Function: standard)

Fan motor

RP-008 Signal cable (5m)

FV-1400 High-speed F/V Converter

RP-432Z-600 P/R Rotary encoder

Coupling

Analog output

CF-4500

OK/NG

Personal Computer

Programmable Logic Controller

LAN, RS-232C output

Comparator output

Imbalance inspection of turbofan

An imbalanced turbofan increases larger power spectrum level in rotational frequency. The CF-4500 can make OK/NG judgment whether the max value of waveform is within a specified block area or not by using Peak Max as a judgment method. OK when the max value of the waveform exists in a specified block and does not exceed the upper limit, or NG otherwise.

(Block Comparator Function: standard)

NP-3000 series Accelerometer

Comparator output

Programmable Logic Controller

LAN, RS-232C output

OK/NG
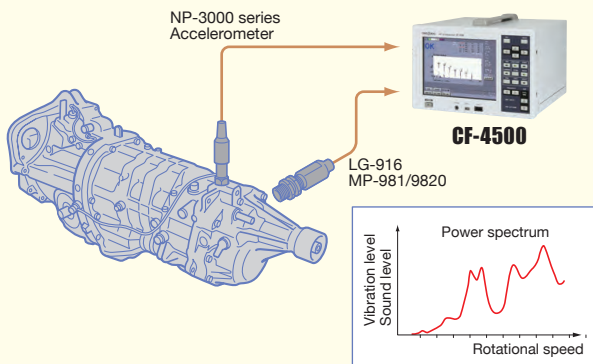
CF-4500

Personal Computer

Inspection of transmission noise by tracking analysis

The CF-4500 can perform quality control of transmission by tracking analysis of vibration signal from a transmission.
In this example, the CF-4500 performs tracking analysis with rotational pulses from a rotation controller in a transmission tester. Rotational tracking analysis of meshing order is performed by varying rotational speed from idling to the maximum. OK/NG judgment of the transmission is made by setting a judgment line along the tracking data.

(CF-0451 Tracking Function + CF-0452 Shape Comparator Function: options)

NP-3000 series Accelerometer

CF-4500

LG-916 MP-981/9820

Power spectrum

Vibration level Sound level

Rotational speed

Diagnosis of bearing

The CF-4500 performs frequency analysis of abnormal vibration to monitor any damage of bearings. A basic frequency analysis according to a damaged part can be performed by optional Envelope & Band-pass Filter 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 hearing vibration through headphones.

(CF-0454 Envelope & Band-pass Filter Function: option)

NP-3000 series Accelerometer

Acceleration signal

CF-4500

Headphone output

HT-5500 Digital Handheld Tachometer
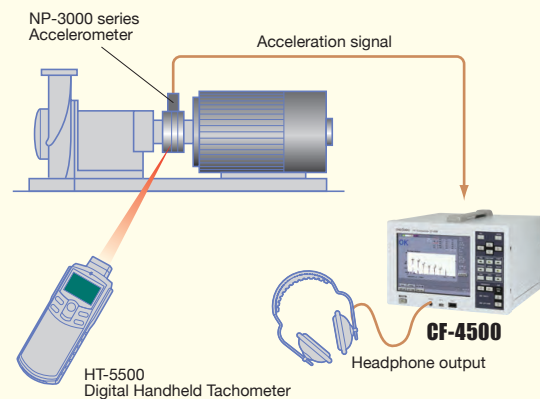
Quality control of power supply board in home appliances

This example shows how to control quality of a power supply board in home appliances. Sound coming from a power board is measured by the MI-1234 Microphone and the MI-3111 Preamplifier in a sound insulating box to avoid influence of background noise, and then input to the CF-4500 for frequency analysis. It can make OK/NG judgment with areal rate of content in power spectrum by setting up of a judgment block around the power frequency caused the noise.

(Block Comparator Function: standard)

SC-3120
Sound Calibrator

MI-1234
Microphone
+
MI-3111
Preamplifier

Power supply
board

CF-4500

Sound insulating box

External power supply
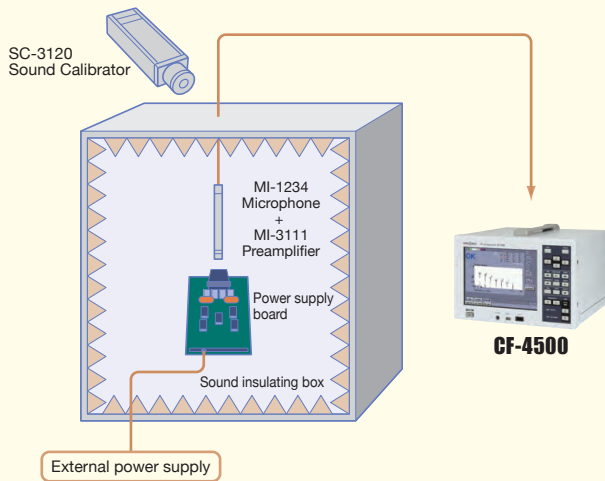
Inspection of metal part by hammering sound

In this example, a metal part (e.g. a casting part) is suspended in free vibration for hammer exciting, and then the hammering sound is measured by the LA -5560 Integrating Sound Level Meter. The CF-4500 performs frequency analysis of the AC output from the Sound Level Meter to find difference of power spectrum shape between OK and NG products by using the Shape Comparator Function.
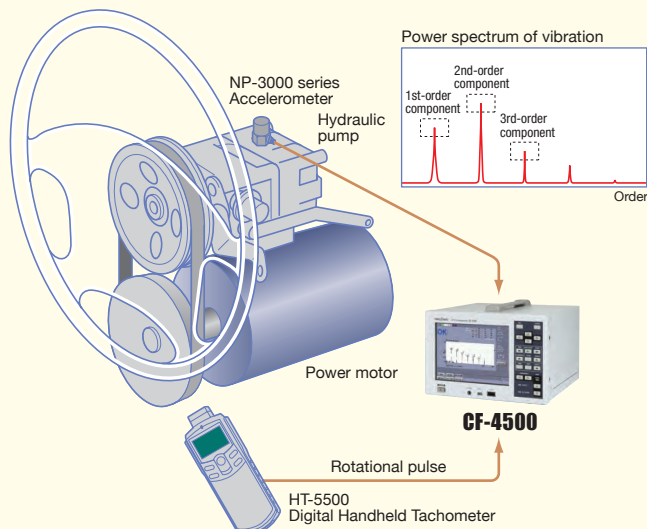
(CF-0452 Shape Comparator Function: option)

Hammer exciting

LA-5560
Integrating Sound Level Meter

Hammer

Metal part
(casting part)

CF-4500
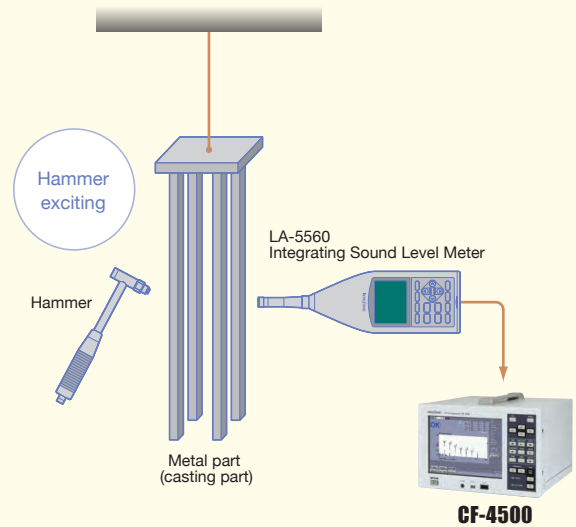
Quality control of power steering pump

Pulsatile vibration is generated when a hydraulic pump for power steering is performed by applying oil pressure. You can input vibration detected by an accelerometer and rotational pulse detected by a rotational detector to the CF-4500. The CF-4500 can make OK/NG judgment of vibration amplitude from rotational the 1st-order to the Nth-order of pulsatile vibration by Peak Hold Function.

(CF-0451 Tracking Function: option)

NP-3000 series
Accelerometer

Hydraulic
pump

Power spectrum of vibration

2nd-order
component

1st-order
component

3rd-order
component

Order

Power motor

CF-4500

Rotational pulse

HT-5500
Digital Handheld Tachometer

Quality control of wire harness

Vehicle's wire harness inside a sliding door makes sound while the door is in motion. The sound can be used for quality control of the wire harness system. Drive a motor of wire harness system in a sound insulating box and the LA-1410 Sound Level Meter measures the sound from wire harness system. Then the CF-4500 performs frequency analysis of the AC output signal from the Sound Level Meter to make OK/NG judgment of the partial overall level in a specific frequency band.

(Block Comparator Function: standard)

LA-1410
Sound Level Meter

AG-2000 series
Microphone extension cable

SC-2120A
Sound Calibrator

Sound
insulating
box

Wire
harness

Wire
harness

Motor

CF-4500

External power supply
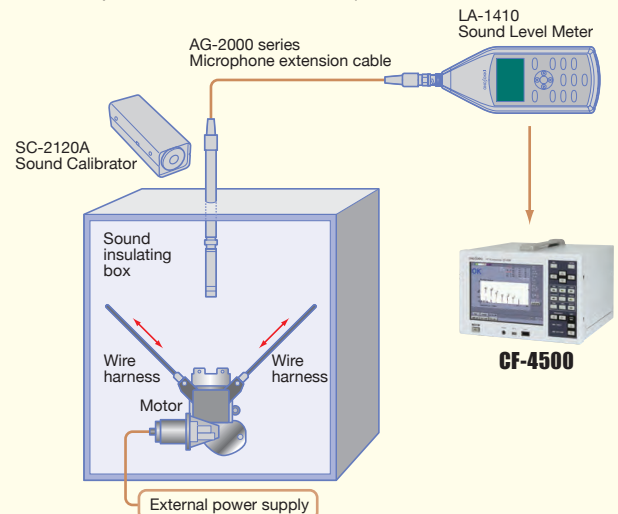
Rear panel
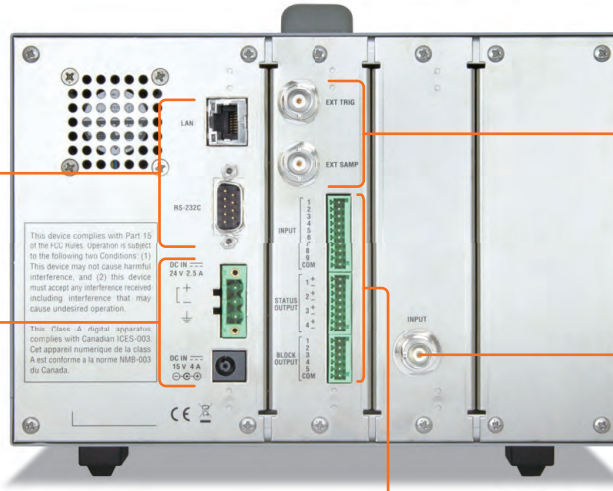
Remotely controllable via LAN and RS232C interfaces from a PC etc.

DC power supply connector (+24VDC) is provided as a standard for a usage on production line. AC adapter can be also used. (sold separately)

EXT TRIG : External trigger input
EXT SAMP: External sample input* (optionally equipped)

Input impedance : 100kΩ ±0.5%
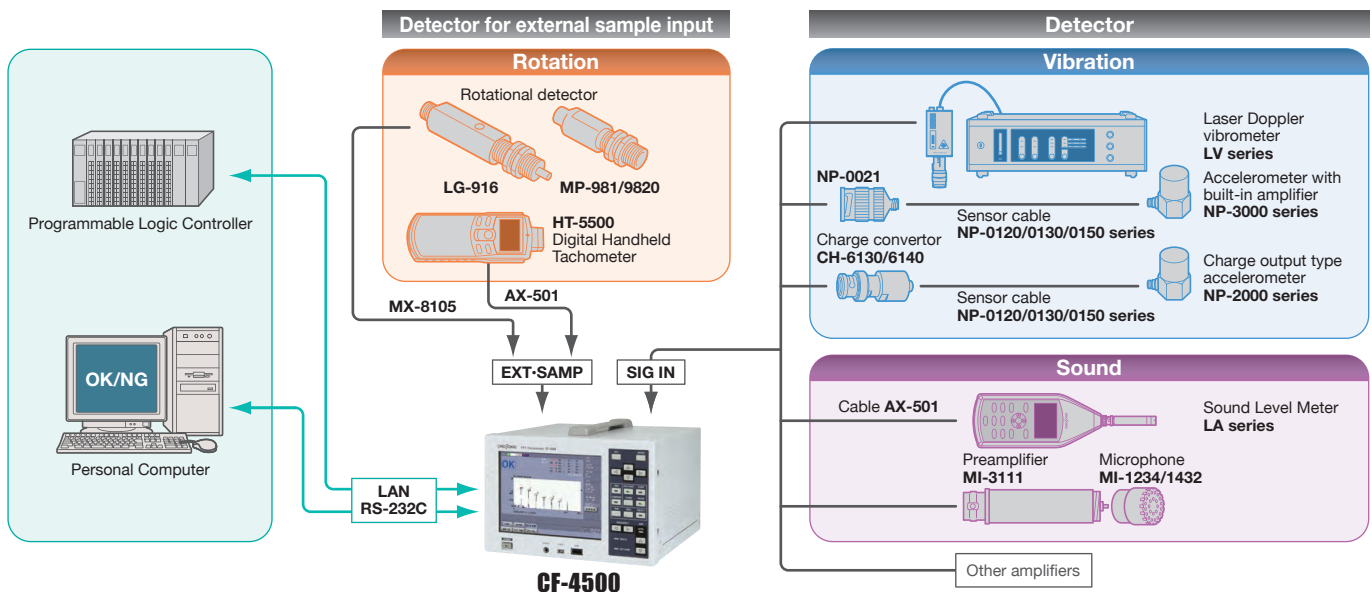*Selectable from BNC or R03-R6F connector for rotational sensor (with power supply for sensor)

INPUT : Signal input connector TEDS available

Digital I/O

	Specifications	Recommended Connection Circuit	
		CF-4500 side	**External device side (example)**
● INPUT The following functions are assigned to the connectors. • Control by command assignment (max. 9 connectors) • Panel condition selection (4 connectors) • Judgment block changeover (2 connectors)	Input type : Driven by contact or open collector Input current : Sink current 5mA or more Logic : Negative logic (Lo=1, Hi=0) Power voltage : Isolation 5V Applicable plug : FK-MC 0,5/10-ST-2,5 (by Phoenix Contact. GmbH & Co. KG) (provided as a standard accessory)	PS2801 or equivalent 5V (Isolation) PHOENIX MC 0,5/10-G-2,5 750Ω COM (Isolation)	or PHOENIX FK-MC 0,5/10-ST-2,5
● STATUS OUTPUT Outputs 4 kinds of statuses. (Comp-BUSY, OK, NG, ERROR)	Output type : Open collector (4-circuit isolation) Output withstand voltage : 30V Output current : 25mA or more (sink) Collector saturation voltage : 1.0 V or less Logic : Negative logic (Lo=1, Hi=0) Applicable plug : FK-MC 0,5/8-ST-2,5 (by Phoenix Contact. GmbH & Co. KG) (provided as a standard accessory)	PS2502 or equivalent PHOENIX MC 0,5/8-G-2,5	5V 10 kΩ 24Vmax CMOS/TTL GND or Photo-Coupler GND-2 PHOENIX FK-MC 0,5/8-ST-2,5
● BLOCK OUTPUT Any 5 judgment setups can be selected from 20 and the results can be output.	Output type : Open collector (shared common) Output withstand voltage : 30V Output current : 25mA or more (sink) Collector saturation voltage: 1.0V or less Logic : Negative logic (Lo=1, Hi=0) Applicable plug : FK-MC 0,5/6-ST-2,5 (by Phoenix Contact. GmbH & Co. KG) (provided as a standard accessory)	PS2502 or equivalent PHOENIX MC 0,5/6-G-2,5 PS2502 or equivalent	5V 5V 10 kΩ CMOS/TTL or Photo-Coupler GND PHOENIX FK-MC 0,5/6-ST-2,5

System Configuration

Detector for external sample input

Rotation

Rotational detector

LG-916   **MP-981/9820**

HT-5500 Digital Handheld Tachometer

MX-8105   AX-501

EXT·SAMP   SIG IN

Detector

Vibration

NP-0021

Charge convertor **CH-6130/6140**

Sensor cable **NP-0120/0130/0150 series**

Laser Doppler vibrometer **LV series**

Accelerometer with built-in amplifier **NP-3000 series**

Charge output type accelerometer **NP-2000 series**

Sound

Cable **AX-501**

Sound Level Meter **LA series**

Preamplifier **MI-3111**

Microphone **MI-1234/1432**

Other amplifiers

Programmable Logic Controller

OK/NG

Personal Computer

LAN RS-232C

CF-4500

Specifications

Input Section

General input
Number of input channels, type	: 1 channel, single-ended
Connector, signal type	: BNC, voltage/CCLD (4mA,+24V:TEDS Ver1.0 or later)
Input coupling	: AC/DC
Input impedance	: 100kΩ
Voltage range	: 10mVrms-31.6Vrms, 8 ranges
Dynamic range	: 90dB (in 1Vrms range)

External trigger input
Connector, signal type	: BNC, voltage
Input voltage range	: ±10V
Trigger source, mode	: Internal/external, Free/Repeat/Single/One-shot
HPF, LPF	: HPF ; 1Hz, 10Hz / LPF ; 1kHz, 10kHz (-18dB/oct)
	*HPF 10Hz and LPF 1kHz conform to vibration severity standards.
Frequency weighting filter	: A/C JIS C1509-1 Class1, IEC61672-1 Class1

Analysis Section

Frequency range	: 1Hz to 40kHz 21ranges
Number of sampling points	: 256/512/1024/2048/4096
Real-time frequency range	: 20kHz
Window function	: Hanning / Rectangular / Flat-top

Averaging processing
Type	: Number of times (1 to 8192 times) or time duration (0.1 to 100 seconds)
Time domain	: Summation average
Frequency domain	: Summation average, exponential average, PeakHold, MaxOverAll (excluding phase spectrum)
Phase spectrum	: Summation average
Amplitude domain	: Summation average
Time-axis waveform processing	: DC cancel, trend elimination, absolute value, polarity inversion, first/second order derivative, single/double integration
Frequency-axis waveform processing	: $1/j\omega$, $1/j\omega^2$, $xj\omega$, $xj\omega^2$, PSD, ESD, POA

Processing function
Time domain	: Time-axis waveform
Frequency domain	: Power spectrum, Fourier spectrum, octave (1/1, 1/3)
Amplitude domain	: Probability density function, probability distribution function

Comparator

Block comparator
Target waveform	: Power spectrum, octave (1/1, 1/3), order spectrum
Maximum number of setup blocks	: 20 blocks
Judgment method	: PeakLevel, PeakMax, POA, areal rate of content, level (Judgment method can be specified for each block.)
Judgment criterion	: AND or OR of all specified blocks
Judgment mode	: Continuous mode, single mode
Automatic data storage function	: Only for NG or all measurement results
Timer function	: Comparator start delay time and judgment execution time can be specified.
Specified time	: 0 to 255 seconds in one-second steps

Judgment output
Judgment contents	: Total judgment result and individual judgment result of up to 5 specified blocks or shapes
Connectors	: Rear panel digital I/O, open-collector output *Common isolation (Common for individual judgment output connector is shared.)

Display

Display	: 6.5-inch TFT color LCD (640 x 480) with touch panel
Waveform display mode	: Single, double, and overlay

Waveform display function
Y-axis scale	: rms, 0-p, p-p
Y-axis unit	: m/s^2, m/s, mm, µm, Pa, dB, V, Vrms (automatic unit conversion by derivative/integration)
X-axis scale	: Default / expanded display function
X-axis unit	: Hz, ORD, r/min, s (sec)
Search function	: Peak cursor, search cursor, search enhance

List display
Number of points	: 40 points (peak value or user-defined)
Harmonics	: Up to 40th-order harmonics (with fit function)
Comparator judgment display	: Total judgment, and list display for individual judgment

Memory Function

Screen data format	: DAT, TXT, BMP, TRC (number of data: 300)

Panel condition
Number of memory devices	: 50
Contents of storage	: Measurement conditions, comparator conditions (block and shape comparator setup, judgment conditions etc.)
Other functions	: Deactivation-time auto store function, activation-time auto recall function

Interface

Digital I/O
Number of input signals	: 9 inputs, open collector (shared common)
Input function	: The following functions are assigned to the connectors.
	• Control by command assignment (up to 9 kinds)
	• Panel condition selection (15 kinds)
	• Judgment block changeover (4 blocks)
Number of output signals	: 9 outputs, open collector
	• Common isolation (Common for individual judgment output is shared.)
Output signal	: Comp-BUSY, OK, NG, ERROR
	• Individual judgment output (any 5 outputs)

RS-232C	: Control of the CF-4500
Baud rate	: 1,200, 2,400, 4,800, 9,600, 19,200, 38,400bps
USB	: USB 2.0 high speed
USB (A connector)	: For USB memory
DATA (mini AB connector)	: For USB mass storage class (connection to a PC)
LAN	: Control of the CF-4500
Standards	: 10BASE-T/100BASE-TX/1000BASE-T

General Specifications

Power requirement	: 24VDC or exclusive AC adapter (100 to 240 VAC, sold separately)
Power consumption	: 40VA (24VDC), 60VA (with AC adapter)
Operating temperature /humidity range	: 0 to 40ºC (with no condensation)
Outer dimensions	: 149 (H) x 220 (W) x 250 (D) mm (not including protruded section)
Weight	: Approx. 3.3kg
Accessories	: Instruction manual (User Guide x 1, Reference guide CD-ROM x 1), terminal board socket (for DC power supply x 1, for I/O 10-pin x 1, 8-pin x 1, 6-pin x 1) *AC adapter is sold separately.

Optional Functions

• **CF-0451 Tracking Function**
Tracking analysis type	: Constant width or constant ratio
Schedule	: Rotational speed or time
Maximum analysis order	: 6.25, 12.5, 25, 50, 100, 200, 400, 800
Rotational speed range (1P/R input)	:

Maximum analysis order	Measurable rotational speed (r/min)
6.25	300 to 190,000
12.5	200 to 96,000
25	150 to 48,000
50	150 to 24,000
100	150 to 12,000
200	100 to 6,000
400	100 to 3,000
800	100 to 1,250

Processing function	: Maximum amplitude order, POA, OrderPeak, OrderBand
Smoothing processing	: Exponential averaging processing, smoothing processing (Type 1, Type 2)
Rotational slope	: Rising (+), falling (-), rising(+)/falling (-)
Trace data	: Line 1/2/3/4, MaxOrder, OA, POA
External sample / rotational sensor input section	: BNC or R03-R6F (specified at the time of order) BNC ; Voltage / TTL R03-R6F; For rotational sensor input (Used for LG-916, MP-981, power supply 12V, 0.1A)

• **CF-0452 Shape Comparator Function**
Target waveform	: Time-axis waveform, power spectrum, octave (1/1,1/3), order spectrum, tracking diagram
Maximum number of standard lines	: 20 lines
Judgment criterion	: Range specification between two standard lines Level specification by one standard line

* The specifications of judgment mode, automatic data storage function and judgment output are equivalent to the block comparator function.
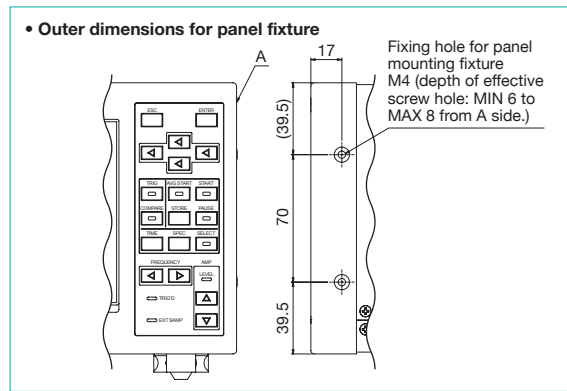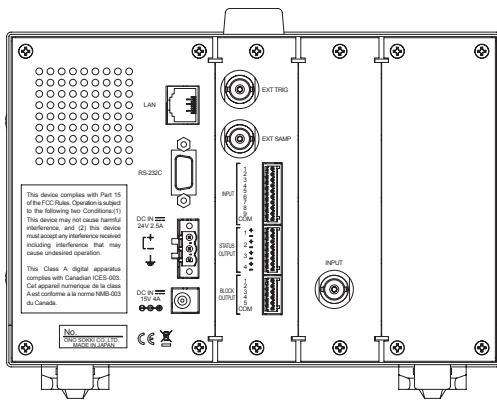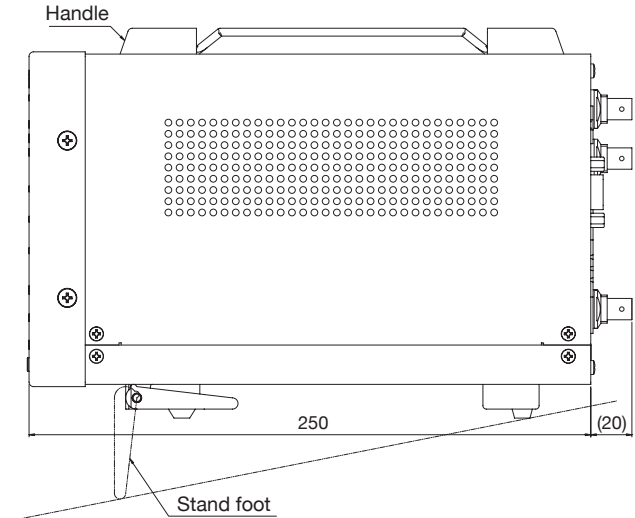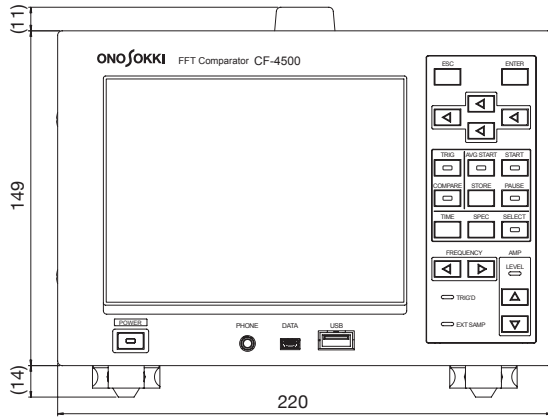
• **CF-0453 Band-pass Filter & Monitor Function**
Frequency setup range	: HPF, LPF: 50Hz to 10kHz (-24dB/OCT)
Output connector	: ø3.5 mini jack

• **CF-0454 Envelope & Band-pass Filter Function**
Method	: 1kHz low-pass filter method

*The CF-0453 Band-pass Filter & Monitor Function included.

• **CF-0458 Power Supply Backup Function**
Power failure countermeasure function	: If instantaneous power failure or power line disconnection occurs, the CF-4500 is deactivated in normal manner.
Automatic activation function	: When the power is supplied, the CF-4500 is automatically activated with setup conditions.

Handle

Stand foot

• **Outer dimensions for panel fixture**

A

17

Fixing hole for panel mounting fixture M4 (depth of effective screw hole: MIN 6 to MAX 8 from A side.)

Model Name	Product name
CF-4500	FFT Comparator
CF-0451	Tracking Function
CF-0452	Shape Comparator Function
CF-0453	Band-pass Filter & Monitor Function
CF-0454	Envelope & Band-pass Filter Function
CF-0458	Power Supply Backup Function
CF-0459	Protection panel
CF-0702	Stylus pen
CF-0703	USB cable

Model Name		Product Name
SQ60W15P		AC adapter
Power cable	VM1048-VM1099 (2m)	100V for Japan
	VM0238-VM0225 (2m)	120V for USA
	VM0718-VM0719 (1.5m)	240V for China (A plug)
	VM0311-VM0322 (2m)	240V for Europe (C plug)
PE3532788 (20cm)		R03=BNC conversion cable

* The CF-0454 includes the CF-0453 Band-pass Filter & Monitor Function.
* The input connector for the CF-0451 Tracking Function can be selected from BNC (standard) or R03-R6F (specified at the time of order).

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ONO SOKKI

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URL: http://www.onosokki.co.jp/English/english.htm