No rotational pulse signal is required for a measurement. The rotational speed is calculated from the frequency signal of light, magnetism, vibration, and sound.

The FT-2500 is an advanced tachometer which measures the rotational speed by the Fast Fourier Transform (FFT) calculation. Moreover, the FT-2500 can measure the rotational speed from frequency signal of sound, vibration or the like even though the rotating shaft is not accessible. The FT-2500 allows versatile rotational speed measurements such as the steady rotation of motor and acceleration/deceleration rotational speed of engine.

**Features**
- The reflective marks or special machining is not needed to attach the sensor.
- Because the rotational speed measurement can be performed easily from the frequency signal of sound or vibration, no special machining to rotating shaft is required.
- The measurement under the condition of the change or acceleration/deceleration in the rotational speed is available. (When the acceleration/deceleration rotation measurement mode is selected.)
- Provides rotating direction determination function. (When the FT-0501 DC Motor Rotation Detector is used.)
- Easy to read fluorescent display.
- Provides both the analog and pulse outputs.
- Ethernet communication function can be added as an option.
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- **Ethernet communication function can be added as an option.**

### Displaying section

It displays the measurement value. Displaying item can be selected from rotational speed (r/min) or frequency (Hz) in setup mode.

#### Previous or conventional model

- **Analog output waveform:**
  - When the amplitude of rotational signal is not stable and some of the pulse signals cannot be detected, the rotational speed is calculated lower than it should be.
  - When the electrical noise is contained in the rotational signal, the rotational speed is calculated higher than it should be owing to the malfunction by noise.

#### Comparator status display LEDs

LEDs for displaying comparator operation status of UPPER, LOWER or ROTATION.

- **Comparator status display LEDs**
  - **LED colors**
    - Green: Comparator OFF
    - Red: Comparator ON
    - Blue: Comparator disabled

#### Level monitor LED

This LED is used to monitor the sensor's input signal level.

- **LED colors**
  - Green: Appropriate signal level
  - Red: Signal level is too high
  - Blue: Signal level is too low

#### Comparator status display LEDs

LEDs for displaying comparator operation status of UPPER, LOWER or ROTATION.

- **Comparator status display LEDs**
  - **LED colors**
    - Green: Comparator OFF
    - Red: Comparator ON
    - Blue: Comparator disabled

#### Key function

**< COMP > key:**
- Key for starting/stopping the comparator function. When comparator function of automatic ON is set at ‘Normal’, the comparator function will be OFF at the time of restarting the main unit. If comparator function of automatic ON is set at ‘Auto’, the comparator function will be held its state at the time of restarting of main unit.

**< SENS > key:**
- Key for fine adjustment of the sensor sensitivity. Pressing this key displays the sensitivity level. Pressing the ‘↑’ or ‘↓’ key to make fine adjustment of the sensitivity.

**< MENU > key:**
- Key to select measurement mode or setup mode.

**< SET/NEXT > key:**
- In setup mode, you can go to the next setup item by pressing this key. Pressing and holding (for approximately 2 seconds) this key make the key protection function start or stop.
Advanced Tachometer FT-2500

Protection against the electrical noise

Parts list

<table>
<thead>
<tr>
<th>No.</th>
<th>Function</th>
<th>Manufacturer</th>
<th>Model name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Line filter</td>
<td>Schaffner Holding AG</td>
<td>FN9222R-3-06</td>
</tr>
<tr>
<td>2</td>
<td>Surge killer</td>
<td>Phoenix Contact GmbH &amp; Co.KG  (Germany)</td>
<td>F-MS 12ST</td>
</tr>
<tr>
<td>3</td>
<td>Surge killer</td>
<td></td>
<td>VAL-MS 230ST</td>
</tr>
<tr>
<td>4</td>
<td>Base for surge killer</td>
<td></td>
<td>VAL-MS-BE</td>
</tr>
</tbody>
</table>

When installing the FT-2500, the following precautions should be taken care of. Some installation conditions may give adverse influence against the noise tolerance.

- Separate the power supply cable of the FT-2500 from the power line which is connected to high-power load.
- Be sure to use the power supply cable which is provided as standard accessory.
- Do not arrange the wiring of the FT-2500 cables in parallel or together with the power line.
- Do not extend the sensor signal cable longer than necessary.
- Use cables of 5m or less in length for DIGITAL-I/O and V-OUT.
- Use a shielded cable as the signal cable. In addition, be sure to ground the shielding wire.
- Keep the FT-2500 as far away as possible from devices, which are generating the strong high-frequency signal or surge.
- Keep the FT-2500 and its cables away from devices, which are generating the strong electric and magnetic fields.
- Be sure to connect the FT-2500 to protective ground.
- When installing the FT-2500 inside a control or measurement panel, ground the instrument shielding wire to the panel and also ground the control or measurement panel.
- If it is subject to influences by electrical strong noise or surge, use a surge killer and noise filter inside the control or measurement panel.
- It is requested to wire the signal cable as short as possible. Keep the minus side of the surge killer within 50 cm. Ground both ends of the shielding wires of all input/output signal cables to the ground terminal of the panel.

Digital IO

Connector for remote input, comparator output and pulse output

Pin NO. | Functions
--------|----------------|
1-4     | Comparator
5-7     | Comparator
8       | Comparator
9-11    | Not connected
12      | Pulse output
13      | Pulse output
14      | Remote input
15      | Remote input

(Note) Pulse output signal (the above No. 12/13) is equivalent to that of the displaying of the frequency.

Remote input

MODE | Remote input terminal
-----|-----------------------|
NORMAL | Open  | Measure  | Close
REVERSE | Hold  | Measure

Pulse output

The frequency of measured power spectrum is output after being converted to the pulse signal. Therefore, the displayed value may differ from the frequency of pulse output when the rotational speed is selected as a display.

Comparator output

Photo-MOS relay enables the FT-2500 to connect directly to PLC etc.

RS-232C communication

RS-232C communication can be used with the AX-5022 signal cable.

LAN (Ethernet option) FT-0251

The FT-2500 can be connected to LAN by using Ethernet.

Network I/F: 100BASE-TX/10BASE-T (automatic switching)
Protocol: TCP/IP
Connector: RJ-45

(Note) LAN and RS-232C communication cannot be used at the same time.

V-OUT connector

Connector for analog voltage output.
It can output the analog voltage signal for input signal monitoring depending on the setting.

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Function</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>SIG</td>
<td>SIG</td>
</tr>
<tr>
<td>B</td>
<td>COM</td>
<td>COM</td>
</tr>
<tr>
<td>C</td>
<td>Not connected</td>
<td>Not connected</td>
</tr>
</tbody>
</table>

(Note) The signal after envelope-processed and sensitivity adjusted is output from SIG.

Connector for sensor input

Select appropriate input connector from SIG-1 or SIG-2 depending on the sensor.
SIG1 : FT-0501

*PLC : Programmable Logic Controller
### FT-2500 application examples

#### Rotational speed measurement of a DC motor with the micro rotating shaft

The rotational speed of a DC motor can be measured without attaching the reflective mark on the surface of the shaft. This example allows the rotational speed measurement of the fan, which shaft is too thin that reflective mark can not be attached or optical light can not be reflected straight when optical sensor is used.

- Easy operation - just input the number of fan blades.
- Non-contact measurement - ideal for inspection line measurement.

#### Rotational speed measurement of a compressor using an accelerometer

With a combination of the FT-2500 and suitable accelerometer, the rotational speed of a compressor in the refrigerator, vending machine, air conditioner etc., which shaft is not directly accessible, can be measured easily. Put an accelerometer (NP-3000 series) on an optional magnet base (NP-0100 or NP-0101) and check the signal at various locations. And then place it at an optimum position on the compressor.

- Permits easy measurement of compressor shaft’s rotational speed even though a rotating shaft is not accessible.
- Permits measurement of the rotational speed of a compressor itself and also which is already built in a final product.

#### Rotational speed measurement of a pump using sound pressure

A pump’s rotational speed is easily measured by monitoring exhaust sound. The rotating shaft in a pump is generally not exposed externally, making it difficult to perform measurement of the rotational speed by the ordinary and conventional pulse detection method. In this example, the sound pressure of the exhaust sound is detected for the rotational speed measurement with a microphone.

- Easy operation - just input the number of blades.
- Permits measurement of pump rotations when the rotating shaft is not directly accessible.

#### Determining of rotating direction and rotational speed measurement of a general DC motor

It is an example to determine the rotating direction and measure the rotational speed of a DC motor by using the FT-0501 DC Motor Rotation Detector. The FT-0501 detects the magnetic flux leakage of a DC motor and extracts a frequency signal in proportion to the rotational speed. Since the FT-0501 has two internal coils, a phase shift occurs between the two detected signals. The rotating direction is then determined by the relationship of these two phases. This function is very convenient for quality control of small DC motors, whose rotating directions may be difficult to be determined visually. Of course, it can measure the rotational speed.

- Rotating direction is also determined by the output of the two-phase signal.
- The output function (semiconductor relay) that determines the rotating direction is useful for CW/CCW judgment on inspection lines.

#### Rotational speed measurement of a DC motor in a fuel pump using a current probe sensor

Many DC motors are mounted in automobile electrical equipment. The consumption current of the DC motor pulses in proportion to the number of poles in the motor. The rotational speed of the DC motor can be accurately measured by inputting the current signal which is detected by the current probe sensor to the FT-2500. This example is ideal for measuring the rotational speed of a stand-alone DC motor or products (parts) that incorporate motors whose lead wires are accessible, such as those found in automobile electrical equipment.

#### Rotational speed measurement of a DC motor which is built in a home appliance

A popular electric toothbrush is operated by converting the rotation of the DC motor into the vibration. The FT-2500 with FT-0501 detector can measure the rotational speed by detecting the magnetic flux leaking from the DC motor which is built in such product.

- The FT-2500 detects the pulsation of the magnetic flux leakage in proportional to the number of poles of the DC motor which is built in the finished product.
- Provides two steps, upper-/lower-limit comparator output which is ideal for OK, LOWER, or UPPER determination on inspection lines.
- Permits data management through RS-232C interface.
- Measurement system can be configured at affordable cost.
The FT-2500 can measure the rotational speed of an engine by the sound and vibration related to the movement of the pistons. It is effective when the rotational sensor cannot be attached because the engine compartment is covered.

- Set the number of pulses to match the number of ignition firings per one crankshaft rotation.
- (e.g.) Set at 2 P/R in the case of a four-cylinder engine with four-cycle

Connect the sensor to a power outlet in a car or construction machine. With the FT-2500, you can determine rotational speed of the engine by measuring the ignition noise from the power outlet. Can be used with both 12 and 24 VDC batteries.

By detecting magnetic flux change, you can perform the rotational speed measurement of a motor in a hybrid/electric car or the motor in its air conditioner. Using the OM-1200, which detects magnetic flux leakage from an object, you can measure the rotational speed of the motor even if the rotating shaft is not directly accessible.

By the rotational vibration, the FT-2500 can measure the rotational speed of a motor which is built into the dryer, electric drilling machine or the similar equipment even though the motor is not accessible.
**System configurations**

The model with * has been already discontinued.

NP-0120 series:
- NP-0121 (1.5m)
- NP-0122 (3.0m)
- NP-0123 (5.0m)
- NP-0124 (10m)

NP-0130 series:
- NP-0131 (1.5m)
- NP-0132 (3.0m)
- NP-0133 (5.0m)
- NP-0134 (10m)

NP-0150 series:
- NP-0151 (1.5m)
- NP-0152 (3.0m)
- NP-0153 (5.0m)
- NP-0154 (10m)

**MX-100 series**:
- MX-101 (1.5m)
- MX-105 (5.0m)
- MX-110 (10.0m)
- MX-120 (20.0m)

**NP-0120 series**:
- NP-0121 (1.5m)
- NP-0122 (3.0m)
- NP-0123 (5.0m)
- NP-0124 (10m)

**NP-0130 series**:
- NP-0131 (1.5m)
- NP-0132 (3.0m)
- NP-0133 (5.0m)
- NP-0134 (10m)

**NP-0150 series**:
- NP-0151 (1.5m)
- NP-0152 (3.0m)
- NP-0153 (5.0m)
- NP-0154 (10m)

*Please refer to the exclusive brochures for details about MI series and NP series.

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**Microphone Preamplifier**
- NP-0021

**Accelerometers**
- NP-2000/3000/500** series

**Charge Converter**
- CH-6130/CH-6140

**Ignition Pulse Detectors**
- IP-292/296/3000A/3100

**Cigarette Lighter Socket Sensor**
- FT-0801

**DC Motor Rotation Detector**
- FT-0501

**Miniature/BNC Conversion Adapter**
- NP-0021

**Input side**

**Output side**

**Advanced Tachometer**
- FT-2500

**FFT analyzer**

**Recorder**

**PLC**

**CPU**

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*PLC : Programmable Logic Controller

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- Direct connection
- Directly-attached cable (4.9m)
- Directly-attached cable (2m)
- Directly-attached cable (3.0m)

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*Please refer to the exclusive brochures for details about MI series and NP series.

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(FI-2500)

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(FI-2500)
Specifications

Signal input section

- **SIG 1 (FT-0501)**
  - Input voltage range: ±12V, ±6.5V
  - Input coupling: AC
  - Input connector: R03-RBF (main unit side)
  - Power supply for sensor: 12V±1.8V (150mA MAX)

  - Input voltage range: ±5V, ±0.6V, ±0.5V
  - Input coupling: AC
  - Input connector: BNC/34 (BNC) (main unit side, female)
  - Power supply for constant current line drive: 2.2 to 3.2mA (25°C)

*Power supply for constant current line drive is output only when MI or NP series is connected with the FT-2500.

Measurement section

- **Measurement mode: Steady rotation measurement mode**
  - Arithmetic calculation: 1024-point FFT calculated processing
  - Measurement frequency range: 50Hz, 250Hz, 1kHz
  - Rotational speed range: 250, 500Hz, 2kHz, 1kHz
  - Rotational speed: Frequency range [Hz] = 1200 x 60 / set pulse count [PPR]
  - Measurement accuracy: ±2 x rotational speed resolution [r/min] ±1 count
  - Rotational speed resolution: Frequency range [Hz] = 1200 x 60 / set pulse count [PPR]
  - Display range: 0 to 999,999 r/min (0 to 10,000Hz)

- **Measurement mode: Acceleration/deceleration rotation measurement mode**
  - Arithmetic calculation: 512-point FFT calculated processing
  - Frequency range: 50Hz, 250Hz, 1kHz, 2kHz
  - Rotational speed range: 250Hz, 500Hz, 2kHz, 1kHz
  - Rotational speed: Frequency range [Hz] = 600 x 60 / set pulse count [PPR]
  - Measurement accuracy: ±2 x rotational speed resolution [r/min] ±1 count
  - Rotational speed resolution: Frequency range [Hz] = 600 x 60 / set pulse count [PPR]
  - Display range: 0 to 999,999 r/min (0 to 10,000Hz)

Display section

- **Main display device**
  - Displaying device: Fluorescent display tube (blue-green)
  - Display update time: 0.5±0.2s
  - Display resolution: 1min, 1Hz
  - Measurement display range: 0 to 999,999 (min to 0 to 10,000Hz)

- **Level monitor LED**
  - Displaying device: 2-color LED
  - LED status:
    - Unit: Sensor signal amplitude is small and steady measurement is disabled.
    - Lit in green: Sensor signal amplitude is appropriate.
    - Lit in red: Sensor signal amplitude exceeds the set limit.

- **Comparator monitor LED (common to UPPER, LOWER, and ROTATION)**
  - Displaying device: 2-color LED
  - LED status:
    - Unit: Comparator function is disabled or disabled by pressing and holding the accelerator/decelerator button.
    - Lit in green: Comparator function is active and measurement values meet the setting conditions.
    - Lit in red: Comparator function is active and measurement values do not meet the setting conditions.

Rotational pulse count setting

- Setting range: 0.5 to 199.5
- Minimum number of steps: 0.5 (PRP)

Averaging processing

- Averaging type: Moving average
- Allowable count: OFF, 2, 4, 8, 16 (times)

Filter function

- Filtering type: Specifying the desired measurement rotational speed range (within the selected frequency range)
- Setting: Specifying the upper/lower limit rotational speeds (frequency)

Rotating direction determination

- Applicable sensor: FT-0501
- Determination: ON/OFF
- Determination output: Semiconductor relay, status display

Key protection function

- Setting/unlocking: Key protection function is enabled or disabled by pressing and holding the SET/NEXT key for approximately 3 seconds in measurement mode.
- Keys to be protected: All keys except (SAMPLE) key when returning to measurement ready state at the acceleration/deceleration rotation measurement mode.

REVO output

- Output content: Output in proportion to the displayed value
- Voltage range: 0 to 10V to F.S.
- Conversion type: 8-bit conversion
- Linearity: ±0.5% of F.S.
- Output update time: Steady rotation measurement mode (CONSTANT): 500ms or less
  - Acceleration/deceleration rotation measurement mode (ACTIVE): 250ms or less
- Temperature stability: ±0.05% of F.S./°C (common to ZERO and SPAN)
- Setting error: ±0.5% of F.S. (Fault error at the time of factory shipment, common to ZERO and SPAN)
- Load resistance: 100k or more
- Output connector: R03-RBF
- Calibration function: Outputting ZERO/FULL calibration signal

SIG output

- Output content: The external sensor signal which was reshaped to a waveform (analog output signal for monitoring purpose)
- Load resistance: 100Ω or more
- Output connector: Switching to/from REVO output connector

Comparator output

- Items:
  - LOWER, UPPER, ROTATION, and OK
- LOWER operation: ON when the LOWER threshold value is displayed value
- UPPER operation: ON when the UPPER threshold value is displayed value
- ROTATION operation: ON when the comparator ROTATION operation direction setting value (CW/CCW)
- OK operation: ON when the lower comparators above are all OFF
- Output type: Semiconductor relay (Photo-MOS)
- Output connector: D-SUB (15-pin connector)
- Maximum contact capacity: 30VDC, 0.1A
- Contact ON resistance: 5Ω or less

Pulse output

- Signal content: Pulse of power spectral frequency extracted by FFT calculation
- Output voltage: LD-IV or less, ±4.5V or more (when no load)
- Load resistance: 10Ω or more
- Output connector: D-SUB (15-pin connector)

External command signal

- Input logic switching: Enabled by RS-232C communication in setup mode.
- Input connector: D-SUB (15-pin connector)
- Input signal type:
  - Non-voltage contact input
  - Open voltage: 9V(±0.25V), Short-circuit current: ±1mA or less.
  - Contact resistance: ±50Ω or less

Condition memory function

- Function content: Saving parameter setting values to non-volatile memory
- Number of conditions: 3 kinds (selectable in setup mode)
- Content of memory:
  - Setting parameters

Communication function

- **RS-232C**
  - I/F function:
    - Reading measurement data, setting parameters, reading parameters
  - Connector:
    - RJ-45
  - Communication protocol:
    - TCP/IP

Ethernet (option)

- Network I/F:
  - 10BASE-T, 100BASE-T (automatic switching)
- Connector:
  - RJ-45

General specifications

- Power requirement: 110 to 240VAC, 50/60Hz
- Power consumption: 2.2 to 3.2W
- Operating temperature range: 0 to +40°C
- Storage temperature range: -10 to +55°C
- Outer dimensions: 144 x 75 x 110 (mm) (Not including protruded sections)
- Weight:
  - Approx. 1.3kg

Conformity standard:

- CE marking: EN61010-1: 2001 (2nd), EN61326-1: 2006
- This mark represents a declaration that the product is conforming to EC directives.

Accessories

- Power cable: Rated voltage 100V to 240VAC 1 pc.
- Instruction manual:
  - 1 copy
- Power recording fixture:
  - 1 set
- Stand foot:
  - 1 set
- Connector:
  - D-SUB (15-pin plug)
Applicable sensors / options (sold separately)

- **Cigarette Lighter Socket Sensor**
  - FT-0801
- **Ignition Pulse Detector**
  - (Primary Side) IP-292
  - (Secondary Side) IP-296
- **Motor/Gasoline Engine RPM Detector**
  - OM-1200
  - OM-1500
- **DC Motor Rotation Detector**
  - FT-0501
- **Engine Vibration Detector**
  - VP-202/1220 (High-sensitivity Type)
- **1/2-inch Measurement Microphone**
  - MI-1235/1433
- **High Function Sound Level Meter**
  - LA-3000 series

**Main unit**
- **FT-2500** Advanced Tachometer

**Detectors**
- **FT-0801** Cigarette Lighter Socket Sensor
- **IP-292** Ignition Pulse Detector (Primary Side)
- **IP-296** Ignition Pulse Detector (Secondary Side)
- **IP-3000A** Ignition Pulse Detector
- **IP-3100** Ignition Pulse Detector
- **OM-1200** Motor/Gasoline Engine RPM Detector
- **OM-1500** Motor/Gasoline Engine RPM Detector
- **FT-0501** DC Motor Rotation Detector
- **VP-202** Engine Vibration Detector
- **VP-1220** Engine Vibration Detector (High-sensitivity Type)

**Options**
- **NP-2000/3000 series** Piezoelectric Type Accelerometer
- **MI-1235/1433** 1/2-inch Measurement Microphone
- **MI-3111** Microphone Preamplifier
- **LA-3000 series** High Function Sound Level Meter
- **FT-0100** Analog Output Cable 1.5 m R03PB3M - BNC245
- **FT-0110** Pulse Output Cable 1.5 m D-Sub 15-pin - BNC245
- **AX-5022** RS-232C Cable 2 m
- **FT-0251** Ethernet Communication Function (A LAN cable is not included.)

**Outer dimensions**

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