OMRON

Rotary Pulse Indicator
K3HB-R

Digital Rotary Pulse Meter Capable of 50 kHz Measurements

- Measures High-speed Pulses at 50 kHz.
  Provides high-speed pulse measurements up to 50 kHz of rotary encoder or ON/OFF pulse signals and can perform rotating measurement of high-speed rotating objects.

Note: No-voltage contacts of up to 30 Hz are supported.

- Six Measurement Operations Including Rotation (rpm)/ Circumferential Speed, Ratio, and Cumulative
  One Rotary Pulse Meter has 6 rotary pulse measurement functions to support a variety of pulse measurement applications. Select the best function for your application from the following: rotation (rpm)/ circumferential speed, absolute ratio, error ratio, error, flow rate ratio, and passing time.

NEW

⚠ Refer to *Common Precautions* on page 30.

Model Number Structure

■ Model Number Legend

Base Units and Optional Boards can be ordered individually or as sets.

Base Units

K3HB-R □ □□□
1 5

1. Input Sensor Codes
NB: NPN input/voltage pulse input
PB: PNP input

5. Supply Voltage
100-240 VAC:100 to 240 VAC
24 VAC/VDC: 24 VAC/VDC

Optional Board

Sensor Power Supply/Output Boards

K33-□
2

Relay/Transistor Output Boards

K34-□
3

Event Input Boards

K35-□
4

Base Units with Optional Boards

K3HB-R□-□□□ □□□
1 2 3 4 5

2. Sensor Power Supply/Output Type Codes
None: None
CPA: Relay output (PASS: SPDT) + Sensor power supply (12 VDC±10%, 80 mA) (See note 1.)
L1A: Linear current output (DC0(4)-20 mA) + Sensor power supply (12 VDC±10%, 80 mA) (See note 2.)
L2A: Linear voltage output (DC0(1)-5 V, 0 to 10 V) + Sensor power supply (12 VDC±10%, 80 mA) (See note 2.)
A: Sensor power supply (12 VDC ±10%, 80 mA)
FLK1A: Communications (RS-232C) + Sensor power supply (12 VDC±10%, 80 mA) (See note 2.)
FLK3A: Communications (RS-485) + Sensor power supply (12 VDC±10%, 80 mA) (See note 2.)

3. Relay/Transistor Output Type Codes
None: None
C1: Relay contact (H/L: SPDT each)
C2: Relay contact (HH/H/LL/L: SPST-NO each)
T1: Transistor (NPN open collector: HH/H/PASS/L/LL)
T2: Transistor (PNP open collector: HH/H/PASS/L/LL)
BCD: BCD output + transistor output (NPN open collector: HH/H/PASS/L/LL)
DRT: DeviceNet (See note 2.)

4. Event input Type Codes
None: None
1: 5 points (M3 terminal blocks) NPN open collector
2: 8 points (10-pin MIL connector) NPN open collector
3: 5 points (M3 terminal blocks) PNP open collector
4: 8 points (10-pin MIL connector) PNP open collector

Note: 1. CPA can be combined with relay outputs only.
2. Only one of the following can be used by each Digital Indicator: RS-232C/RS-485 communications, BCD communications, or DeviceNet communications.

Accessories (Sold Separately)

K32-DICN: Special Cable (for event inputs with 8-pin connector)
K32-BCD: Special BCD Output Cable

Specifications

■ Ratings

Supply voltage		100 to 240 VAC, 24 VAC/VDC, DeviceNet power supply: 24 VDC
Allowable power supply voltage range		85% to 110% of the rated power supply voltage, DeviceNet power supply: 11 to 25 VDC
Power consumption (See note 1.)		100 to 240 VAC: 18 VA max. (max. load) 24 VAC/DC: 11 VA/7 W max. (max. load)
Current consumption		DeviceNet power supply: 50 mA max. (24 VDC)
Input		No-voltage contact, voltage pulse, open collector
External power supply		12 VDC ±10%, 80 mA (models with external power supply only)
Event inputs (See note 2.)	**Startup compensation timer input**	NPN open collector or no-voltage contact signal ON residual voltage: 2 V max. ON current at 0 Ω: 4 mA max. Max. applied voltage: 30 VDC max. OFF leakage current: 0.1 mA max.
	Hold input	
	Reset input	
	Bank input	
Output ratings (depends on the model)	**Relay output**	250 VAC, 30 VDC, 5 A (resistive load) Mechanical life expectancy: 5,000,000 operations, Electrical life expectancy: 100,000 operations
	Transistor output	Maximum load voltage: 24 VDC, Maximum load current: 50 mA, Leakage current: 100 μA max.
	Linear output	Linear output 0 to 20 mA DC, 4 to 20 mA: Load: 500 Ω max, Resolution: Approx. 10,000, Output error: ±0.5% FS Linear output 0 to 5 VDC, 1 to 5 VDC, 0 to 10 VDC: Load: 5 kΩ max, Resolution: Approx. 10,000, Output error: ±0.5% FS (1 V or less: ±0.15 V; not output for 0 V or less)
Display method		Negative LCD (backlit LED) display 7-segment digital display (Character height: PV: 14.2 mm (green/red); SV: 4.9 mm (green))
Main functions		Scaling function, measurement operation selection, averaging, previous average value comparison, output hysteresis, output OFF delay, output test, teaching, display value selection, display color selection, key protection, bank selection, display refresh period, maximum/minimum hold, reset
Ambient operating temperature		−10 to 55°C (with no icing or condensation)
Ambient operating humidity		25% to 85%
Storage temperature		−25 to 65°C (with no icing or condensation)
Altitude		2,000 m max.
Accessories		Watertight packing, 2 fixtures, terminal cover, unit stickers, instruction manual. DeviceNet models also include a DeviceNet connector (Hirose HR31-5.08P-5SC(01)) and crimp terminals (Hirose HR31-SC-121) (See note 3.)

Note: 1. DC power supply models require a control power supply capacity of approximately 1 A per Unit when power is turned ON. Particular attention is required when using two or more DC power supply models. The OMRON S8VS-series DC Power Supply Unit is recommended.

2. PNP input types are also available.

3. For K3HB-series DeviceNet models, use only the DeviceNet Connector included with the product. The crimp terminals provided are for Thin Cables.

■ Characteristics

Display range		−19,999 to 99,999
Measurement accuracy (at 23±5°C)		Functions F1, F6: ±0.006% rgd ±1 digit (for voltage pulse/open collector sensors) Functions F2 to F5: ±0.02% rgd ±1 digit (for voltage pulse/open collector sensors)
Measurement range		Functions F1 to F6: 0.5 mHz to 50 kHz (for voltage pulse/open collector sensors)
Input signals		No-voltage contact (30-Hz max. with ON/OFF pulse width of 15 ms min.) Voltage pulse (50-KHz max. with ON/OFF pulse width of 9 μs min.; ON voltage: 4.5 to 30 V; OFF voltage: −30 to 2 V; input impedance: 10 kΩ) Open collector (50-KHz max. with ON/OFF pulse width of 9 μs min.)
Connectable sensors		ON residual voltage: 3 V max. OFF leakage current: 1.5 mA max. Load current: Must have a switching capacity of 20 mA or higher. Must be able to properly switch load currents of 5 mA or less.
Comparative output response time (transistor output)		Functions F1 to F6: 100 ms max. (time until the comparative output is made when there is a forced sudden change in the input signal from 15% to 95% or 95% to 15%.)
Linear output response time		Functions F1 to F6: 110 ms max. (time until the final analog output value is reached when there is a forced sudden change in the input signal from 15% to 95% or 95% to 15%.)
Insulation resistance		20 MΩ min. (at 500 VDC)
Dielectric strength		2,300 VAC for 1 min between external terminals and case
Noise immunity		100 to 240 VAC models: ±1,500 V at power supply terminals in normal or common mode (waveform with 1-ns rising edge and pulse width of 1 μs/100 ns) 24 VAC/VDC models: ±1,500 V at power supply terminals in normal or common mode (waveform with 1-ns rising edge and pulse width of 1 μs/100 ns)
Vibration resistance		Frequency: 10 to 55 Hz; Acceleration: 50 m/s^2, 10 sweeps of 5 min each in X, Y, and Z directions
Shock resistance		150 m/s^2 (100 m/s^2 for relay outputs) 3 times each in 3 axes, 6 directions
Weight		Approx. 300 g (Base Unit only)
Degree of protection	**Front panel**	Conforms to NEMA 4X for indoor use (equivalent to IP66)
	Rear case	IP20
	Terminals	IP00 + finger protection (VDE0106/100)
Memory protection		EEPROM (non-volatile memory) Number of rewrites: 100,000
Applicable standards		UL61010C-1, CSA C22.2 No. 1010.1 (evaluated by UL) EN61010-1 (IEC61010-1): Pollution degree 2/Overvoltage category II EN61326: 1997, A1: 1998, A2: 2001
EMC		EMI: EN61326+A1 industrial applications Electromagnetic radiation interference CISPR 11 Group 1, Class A: CISPRL16-1/-2 Terminal interference voltage CISPR 11 Group 1, Class A: CISPRL16-1/-2 EMS: EN61326+A1 industrial applications Electrostatic Discharge Immunity EN61000-4-2: 4 kV (contact), 8 kV (in air) Radiated Electromagnetic Field Immunity EN61000-4-3: 10 V/m 1 kHz sine wave amplitude modulation (80 MHz to 1 GHz, 1.4 to 2 GHz) Electrical Fast Transient/Burst Immunity EN61000-4-4: 2 kV (power line), 1 kV (I/O signal line) Surge Immunity EN61000-4-5: 1 kV with line (power line), 2 kV with ground (power line) Conducted Disturbance Immunity EN61000-4-6: 3 V (0.15 to 80 MHz) Power Frequency Magnetic Immunity EN61000-4-8: 30 A/m (50 Hz) continuous time Voltage Dips and Interruptions Immunity EN61000-4-11: 0.5 cycle, 0°/180°, 100% (rated voltage)

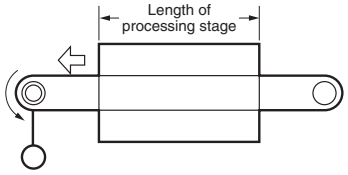
Operation

■ Functions (Operating Modes)

F1 to F6

Functions F1 to F6 provide rpm/circumferential speed and other calculation displays by measuring continuous pulses (frequencies).

Example



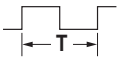
Function name	Function No.
Rpm/circumferential speed	F1
Absolute ratio	F2
Error ratio	F3
Rotational difference	F4
Flow rate ratio	F5
Passing time	F6

F1: Displays rotation (rpm) or circumferential speed for one input.

F2 to F5: Displays the calculation result for two rotation (rpm) speeds.

F6: Displays the passing time calculated from the circumferential speed and the length of the processing stage for one input.

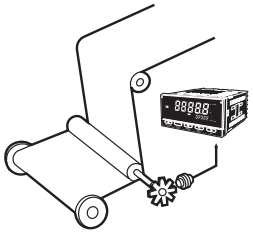
The basic principle used by the Digital Indicator to calculate the rotation speed (rpm) display is to count the ON/OFF time (T) for input sensor or other device inputs using the internal system clock, and then automatically calculate the frequency. This frequency (f) is multiplied by 60 and displayed as the rotation (rpm) speed.

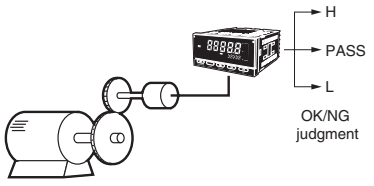
Input sensor or other input pulse ON/OFF time (T) = 

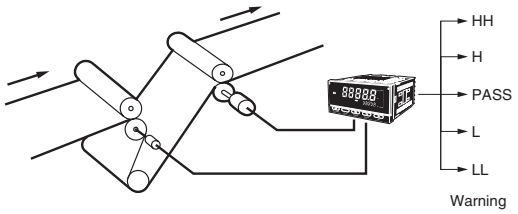
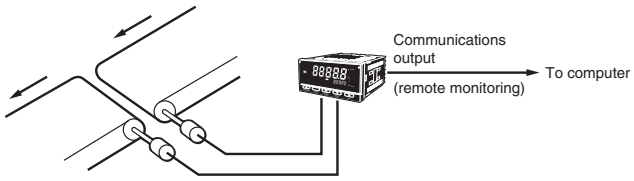
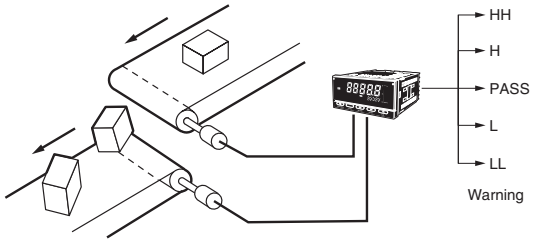
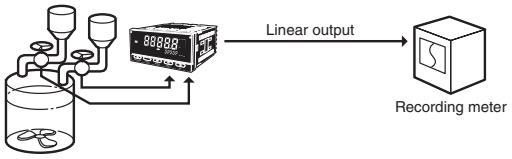
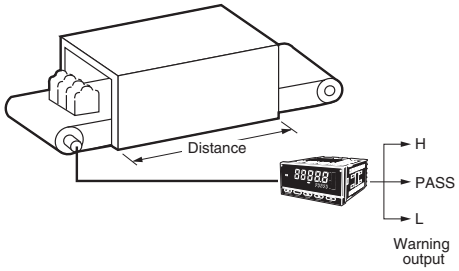
Frequency (f) = $\frac{1}{T}$

- Rotation speed (rpm) = f × 60
- Circumferential speed = Roll circumference × Rotation speed (rpm)
- Passing time= $\frac{\text{Length of processing stage}}{\text{Circumferential speed}}$

These calculations are automatically made internally and displayed whenever any input pulse is received.

<table>
<tr><th>Function</th><th>Operation</th><th>Operation image (application)</th></tr>
<tr><td>F1
Rpm/circumferential speed/
Instantaneous flowrate</td><td>Measures frequency for input A and displays the rotation (rpm) or circumferential speed proportional to the input frequency.
<table>
<tr><th>Calculation</th><th>Display unit</th><th>Prescale value (α)</th></tr>
<tr><td rowspan="2">Rotation speed</td><td>rpm</td><td>1/N</td></tr>
<tr><td>rps</td><td>1/60 N</td></tr>
<tr><td rowspan="2">Frequency (of input pulse)</td><td>Hz</td><td>1/60</td></tr>
<tr><td>kHz</td><td>1/60000</td></tr>
<tr><td rowspan="5">Circumferential speed</td><td>mm/s</td><td>1000 πd/60 N</td></tr>
<tr><td>cm/s</td><td>100 πd/60 N</td></tr>
<tr><td>m/s</td><td>πd/60 N</td></tr>
<tr><td>m/min</td><td>πd/N</td></tr>
<tr><td>km/h</td><td>0.06 πd/N</td></tr>
<tr><td rowspan="2">Instantaneous flowrate</td><td>ℓ/min</td><td rowspan="2">Check the output specifications of the input device and calculate the prescale value from the following equation:
Display value D = fa × 60 × α</td></tr>
<tr><td>ℓ/h</td></tr>
</table>
N = Pulses per rotation
πd = Circumferential length per rotation</td><td>Measuring roller winding speed
 

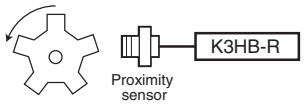
Measuring motor speed (for product testing)
 
</td></tr>
</table>

Function	Operation	Operation image (application)
F2 Absolute ratio	Multiples input B divided by input A ($\frac{B}{A}$) by 100 and displays the ratio as a percentage (%). Display unit: %	Measuring the speed ratio between two rollers 
F3 Error ratio	Multiplies the error between input A and input B ($\frac{B}{A}-1$) by 100 and displays the ratio as a percentage (%). Display unit: %	Measuring the line speed error ratio between two conveyors 
F4 Rotational difference	Displays the difference between input A and input B (B - A) as the rotation (rpm) speed error or circumferential speed error. (Display unit: rpm, rps, rph, Hz, kHz, mm/s, m/s m/min, km/h l/min, l/h, etc.)	Measuring the rotation (rpm)/circumferential speed error (absolute error) between two conveyors 
F5 Flow rate ratio	Displays the flow rate ratio of B from inputs A and B ($\frac{B}{A+B}$) as a ratio (%). Display unit: %	Monitoring liquid mixture flow rate ratio 
F6 Passing time	Passing time (s) = $1/fa \times \alpha$ fa: Input frequency (Hz) Set the prescale value for the desired display unit using the following table for reference. N = Pulses per rotation πd = Circumferential length per rotation (m) L = Length of process (m)	Displaying the passing time for a conveyor line 

Calculation	Display unit	Prescale value (α)
Passing time	s	L/(πd/N)

■ What Is Prescaling?

To make calculations using the input pulse to display rotation (rpm) or circumferential speed, the number of pulses per rotation or the length of the circumference must be multiplied by a certain coefficient. This coefficient is called the prescale value.



Rotation speed (rpm) = f × 60 × a

f: Input pulse frequency (No. of pulses per second)

a: Prescale value

If there are 5 pulses per rotation, then

a = 1/5 (= 0.2 = 2×10^{-1})

and an accurate rotation speed (rpm) can be calculated.

The actual setting is X = 2.0000 (mantissa) and Y = 10^{-1} (exponent).

■ What Is the Auto-zero Function?

(Set this function before using the Digital Indicator.)

If a function F1 to F6 is set, the frequency can be force-set to zero if there is no input pulse for a set period. This period is called the auto-zero time. Set the auto-zero time to slightly longer than the longest input pulse interval. (The display will not easily return to zero if the auto-zero time is too long or left at the default setting.)

Time Unit Settings

Setting	Meaning
SCAL	Prescale value menu setting
0.00	Minute display
0.00.00	h.mm.ss display
00.00.0	mm.ss.d display (d = tenths of a second)

Note: Time unit can be set only when passing time (F6) is selected.

Input Type Setting

	NO: Voltage pulse high	NC: Voltage pulse low
No-contact or voltage pulse input	00	01
Contact	10	11

Note: Set to 10 or 11 when there is a large variation in the display. The largest measurement range is 30 Hz.