

**Space-saving Two-wire Signal Conditioners *B3-UNIT***

**FREQUENCY TRANSMITTER**  
(field-configurable)

MODEL **B3FP**

**MODEL & SUFFIX CODE SELECTION**

B3FP

MODEL \_\_\_\_\_

**INPUT SELECTION**

- Open collector
- Voltage pulse
- Two-wire current pulse

**OUTPUT**

4 – 20mA DC

**SUPPLY VOLTAGE**

12 – 45V DC

**OPTIONS**

/UL : UL approval

**ORDERING INFORMATION**

Specify code number. (e.g. B3FP)

Orders will be shipped with default factory settings as shown in the table below.

Factory default setting

PARAMETER	DEFAULT
Input type	Voltage pulse
Frequency range	0 – 1000 Hz
Pulse amplitude	5V p-p
DC offset	2.5V
Pulse sensing	DC coupled
Noise filter	None
Detecting level	High (2V)

**GENERAL SPECIFICATIONS**

**Connection:** Removable terminal block

**Housing material:** Flame-resistant resin (grey)

**Isolation:** Input to output

**Pulse sensing:** Capacitor or DC coupled selectable with DIP switches

**DIP/rotary switches:** For input calibration

**Noise filter:** Chattering protection filter selectable with DIP switches (time constant 1 msec.)

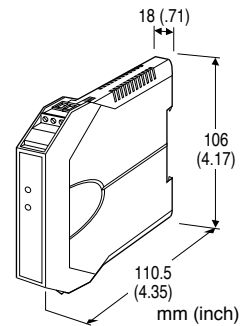
**INPUT & OUTPUT**

**INPUT**

**Measurable frequencies:** 0 – 0.01 Hz through 100 kHz;  
Sine waves with frequencies lower than 0.1 Hz cannot be detected with capacitor coupling.

**Pulse width time requirement:** Min. 4 µsec. for both H and L levels

**DC offset:** Selectable within the maximum voltage for respective pulse amplitude setting specified in Table 5.  
(e.g. For the amplitude 2V p-p with the maximum voltage 10V, DC offset can be as low as -9V and as high as +9V.)



**Functions & Features**

- Converts the output from a pulse-type transducer into a 4 – 20mA DC signal
- DIP switch configurable input range
- Monitor terminals
- High-density mounting
- CE marking
- UL approval

**Frequency offset:** Selectable up to 50% of the full-scale frequency.

**Open Collector**

**Sensing voltage/current:** Approx. 2.5V DC @1mA

**Detecting levels:** ≥3.0kΩ for OFF; ≤750Ω for ON

**Voltage Pulse**

**Waveform:** Square or sine

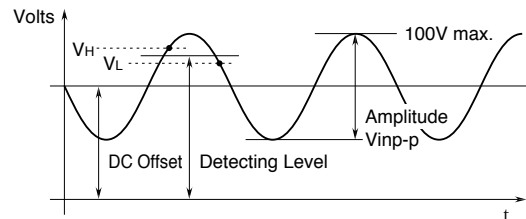
**Input impedance:** 10kΩ minimum

**Input amplitude:** Min. 0.1V p-p, max. 200V p-p

**Max. voltage between input terminals:** 100V

(Max. voltage across the input terminals:  
70V for CE conformity; 30V rms, 42.4V peak  
or 60V DC for UL approval)

**Detecting level:** See Table 6.



**Two-wire Current Pulse**

**Input resistance:** Receiving resistor 200Ω

**Input range:** 0 – 25mA

**Detecting level:** See Table 6.

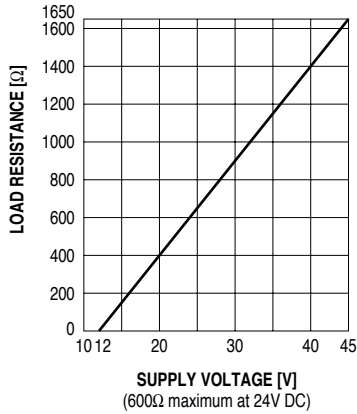
(Convert current into voltage using the receiving resistor value.)

■ **OUTPUT:** 4 – 20mA DC

**Load resistance vs. supply voltage:**

$$\text{Load Resistance } (\Omega) = \frac{\text{Supply Voltage (V)} - 12 \text{ (V)}}{0.02 \text{ (A)}}$$

(including leadwire resistance)



**INSTALLATION**

- Supply voltage:** 12 – 45V DC
- Operating temperature:** -40 to +85°C (-40 to +185°F)  
Max. 55°C (131°F) for UL approval
- Operating humidity:** 0 to 95% RH (non-condensing)
- Mounting:** DIN rail
- Dimensions:** W18×H106×D110.5 mm (0.71"×4.17"×4.35")  
See General Spec. Sheet Figure A-1.
- Weight:** 80 g (2.8 oz)
- Terminal assignment:** See General Spec. Sheet Figure B-1.

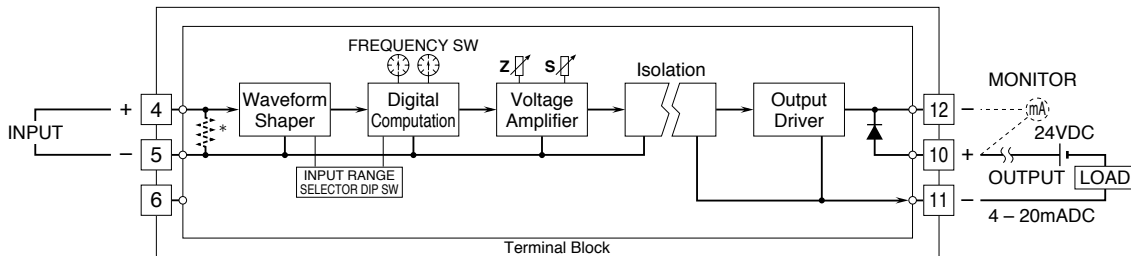
**PERFORMANCE in percentage of span**

- Accuracy:** ±0.1% (±0.3% for frequencies below 10 Hz for sine waves detected with capacitor coupling)
- Temp. coefficient:** ±0.02%/°C (±0.01%/°F)
- Response time:** ≤0.5 second + input pulse cycle (0 – 90%)
- Insulation resistance:** ≥100MΩ with 500V DC
- Dielectric strength:** 2000V AC @1 minute (input to output to ground)

**STANDARDS & APPROVALS**

- CE conformity:** EMC Directive (2004/108/EC)  
EN 61000-6-4 (EMI)  
EN 61000-6-2 (EMS)
- Approval:** UL/C-UL general safety requirements (UL 61010-1, CAN/CSA-C22.2 No.1010-1)

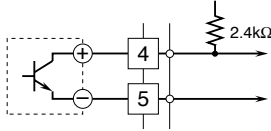
**SCHEMATIC CIRCUITRY & CONNECTION DIAGRAM**



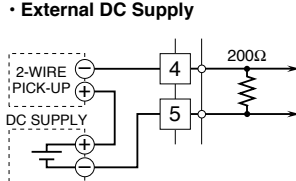
\*Input shunt resistor incorporated for current input.

**Input Connection Examples**

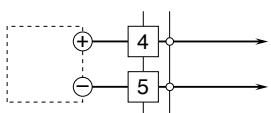
■ **Open Collector** +2.5V



■ **Two-wire Current Pulse**

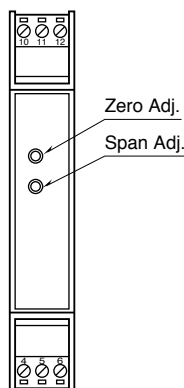


■ **Voltage Pulse**

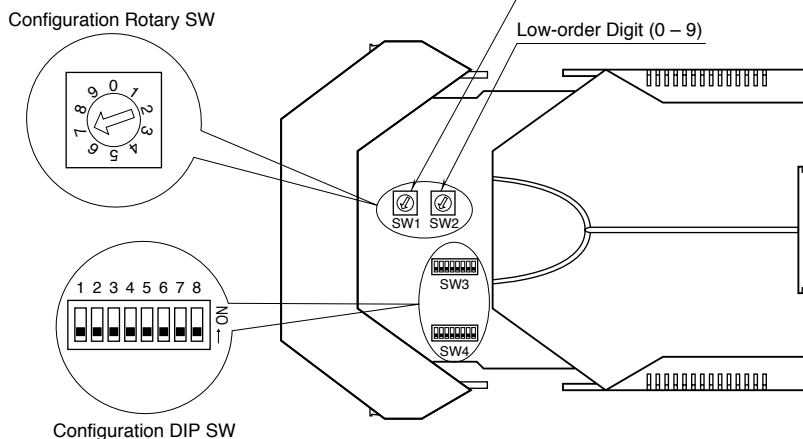


**EXTERNAL VIEWS**

■ **FRONT VIEW**



■ **SIDE VIEW**



**RANGE CONFIGURATION**

**CAUTION !**

- With the current pulse input configuration (SW3-1 ON), DO NOT apply voltage input.
- DO NOT apply voltage exceeding the maximum value of the selected range.
- Applying voltage pulse input greater than the maximum value of the selected range may cause failure of the unit. Check the setting before applying the input signal.

■ **GENERAL PROCEDURE**

First select a coarse range using the internal rotary switches (SW1 and SW2) and DIP switches (SW3 and SW4) according to Tables 1 through 9 below. Then apply simulated 0% and 100% inputs and fine-tune the output range to 4mA and 20mA using the front zero and span adjustments.

■ **SELECTING DIP SW (coarse adjustment)**

**INPUT TYPE**

Choose from Table 1.

Table 1 ■ = ON

INPUT TYPE	SW3-1	SW3-2
Open collector		■
Voltage pulse		
Two-wire current pulse	■	

**FREQUENCY RANGE**

Selectable frequency range: 10 mHz to 100 kHz  
 Set the two most significant digits of the required full-scale frequency with SW1 (high order digit) and SW2 (low order digit) according to Table 2, and then choose the multiplication factor and the frequency unit with SW3 according to Table 3.

Frequency range = [SW1][SW2] × [Factor/Unit (SW3)]

Table 2

■ = ON

FULL-SCALE FREQUENCY (two most significant digits)	SW1 (high)	SW2 (low)
01 to 99	0 to 9	0 to 9

Table 3

■ = ON

MULTIPL. FACTOR / FREQ. UNIT	SW3-4	SW3-5	SW3-6
10 kHz	■	■	■
1 kHz	■	■	
100 Hz	■		■
10 Hz	■		
1 Hz		■	■
100 mHz		■	
10 mHz			■
1 mHz			

[Example] 100% frequency = 32.1 kHz

- 1) Full-scale frequency  
 Values of the two significant digits: 32  
 ⇒ Set SW1 to 3, SW2 to 2.
- 2) Multiplication factor / Frequency unit: According to Table 3, choose '1 kHz.'  
 ⇒ Set SW3-4 and 3-5 to ON.

Coarse frequency range selected with the above switch settings equals: 32 × 1 kHz = 32 kHz.  
 Fine range is adjusted with the front Zero/Span adjustments after all switch settings are complete.

**FREQUENCY OFFSET**

See Table 4.  
 The offset is defined by the following equation:

$$\text{Offset} = \frac{0\% \text{ Input}}{100\% \text{ Input}} \times 100 (\%)$$

Table 4

■ = ON

FREQUENCY OFFSET	SW3-7	SW3-8
0 – 20%		
20 – 50%	■	■

**PULSE AMPLITUDE**

See Table 5.

Choose '0.1 – 2V p-p' for open collector input (SW3-2 ON).  
For a current pulse input (SW3-1 ON), convert the range to a voltage using the receiving resistor value 200Ω.

Table 5 ■ = ON

AMPLITUDE	MAX. VOLT	SW4-1	SW4-2
0.1 – 2V p-p	2V	■	
2 – 10V p-p	10V	■	■
10 – 200V p-p	100V*1		■

\*1. Max. input voltage across the terminals conforming CE is limited to 70V.

Max. input voltage across the terminals approved for UL is limited to 30Vrms and 42.4Vpeak or 60V DC.

**DETECTING LEVEL**

Four levels are selectable according to Table 6.

Detecting level and deadband values depend upon the pulse amplitude. Refer to Table 7.

Choose 'High level' for open collector input (SW3-2 ON).  
For a current pulse input (SW3-1 ON), convert the range to a voltage using the receiving resistor value 200Ω.

Choose 'Zero-cross' with the capacitor coupling (SW3-3 OFF).

Table 6 ■ = ON

DETECTING LEVEL	SW4-5	SW4-6	SW4-7	SW4-8
Zero-cross			■	
Low level	■			
Middle level		■		■
High level				■

Table 7

DETECTING LEVEL	PULSE AMPLITUDE		
	0.1 – 2V p-p	2 – 10V p-p	10 – 200V p-p
Zero-cross	0V	0V	0V
Low level	45mV	60mV	300mV
Middle level	200mV	400mV	2V
High level	1V	2V	10V
DETECTING LEVEL	DEADBAND		
Zero-cross	±15% of Amplitude, ≥±45mV*2		
Low level	±15% of Amplitude, ≥±40mV*2		
Middle level	±15% of Amplitude, ≥±80mV*2		
High level	±40% of Detecting Level		

\*2. Minimum deadband required for the amplitude 0.1 – 2 Vp-p.

**PULSE SENSING**

See Table 8.

Duty ratio of the input waveform with the capacitor coupling must be lower than 70% with the amplitude 2 – 200 Vp-p, less than 55% with 0.1 – 2 Vp-p. If the pulse cannot be detected with 'Zero-cross' setting due to a low duty ratio, set the detecting level to 'Low level' according to Table 6.

Table 8 ■ = ON

PULSE SENSING	SW3-3
Capacitor (AC) coupled	
DC coupled	■

**NOISE FILTER**

See Table 9.

The filter may be activated for frequencies lower than 100 Hz.

Table 9 ■ = ON

FILTER	SW4-3	SW4-4
OFF		
ON; Amplitude 2 – 10V p-p	■	
ON; Other amplitude		■

**EXAMPLE 1**

Voltage with amplitude 5V, DC offset 2.5V, Frequency range 0 – 1 kHz, Duty ratio 50%

1) Input type: According to Table 1, choose 'Voltage pulse.'  
⇒ Set SW3-1 and SW3-2 remain OFF.

2) Frequency range  
Choose 10 as the two most significant digits. Choose a greater value selectable with SW1 and SW2, i.e. 10 × 100 Hz range rather than 01 × 1 kHz range for better performance.

⇒ According to Table 2, set SW1 to '1' and SW2 to '0.'

According to Table 3, choose 100 Hz as the frequency unit.

⇒ Set SW3-4 and SW3-6 to ON.

3) Offset

$$\frac{0 \text{ kHz}}{1 \text{ kHz}} \times 100 = 0 (\%)$$

⇒ According to Table 4, SW3-7 and SW3-8 remain OFF.

4) Pulse amplitude: According to Table 5, choose '2 – 10V p-p.'

⇒ Set SW4-1 and SW4-2 to ON.

The following settings may be added depending on the actual input signal characteristics.

5) Detecting level: According to Table 6, choose 'High level.'

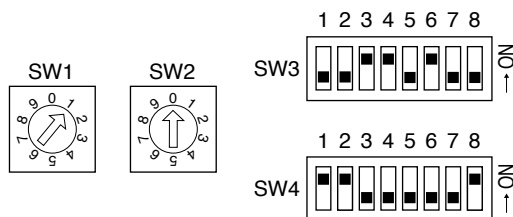
⇒ Set SW4-8 remains ON.

6) Pulse sensing: According to Table 8, choose 'DC coupled.'

⇒ Set SW3-3 remains ON.

7) Filter: According to Table 9, choose 'OFF.' Filter cannot be used for frequency ranges (100% input) wider than 100 Hz.

⇒ Set SW4-3 and SW4-4 remain OFF.



## ■ EXAMPLE 2

Voltage with amplitude 20V, DC offset 90V, Frequency range 25 – 85 Hz, Duty ratio 1%

- 1) Input type: According to Table 1, choose 'Voltage pulse.'  
 ➔ Set SW3-1 and SW3-2 remain OFF.
- 2) Frequency range  
 Choose 85 as the two most significant digits.  
 ➔ According to Table 2, set SW1 to '8' and SW2 to '5.'  
 According to Table 3, choose 1 Hz as the frequency unit.  
 ➔ Set SW3-5 and SW3-6 to ON.
- 3) Offset

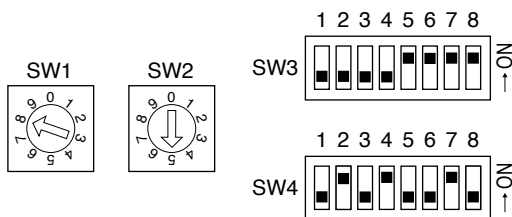
$$\frac{25 \text{ Hz}}{85 \text{ Hz}} \times 100 = 29.4 (\%)$$

➔ According to Table 4, SW3-7 and SW3-8 to ON.

- 4) Pulse amplitude: According to Table 5, choose '10 – 200V p-p.'  
 ➔ Set SW4-2 to ON.

The following settings may be added depending on the actual input signal characteristics.

- 5) Detecting level: According to Table 6, choose 'Zero-cross.'  
 ➔ Set SW4-7 to ON.  
 If the input pulse cannot be detected with the above setting, choose 'Low level.'  
 ➔ Set SW4-5 to ON.
- 6) Pulse sensing: According to Table 8, choose 'capacitor coupled.' DC coupled type is not suitable with the selected detecting level.  
 ➔ Set SW3-3 to OFF.
- 7) Filter: According to Table 9, choose 'ON, other amplitude.'  
 ➔ Set SW4-4 to ON.



## ■ ZERO & SPAN ADJUSTMENTS (fine adjustments)

Referring to the instruction manual, apply 0% and 100% input signals and adjust the Zero to have 4mA output and Span to have 20mA output respectively.