## INSTRUCTION MANUAL

### FREQUENCY SCALER
#### (field-programmable; built-in excitation)

MODEL **JFR2**

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## BEFORE USE ....

Thank you for choosing M-System. Before use, please check contents of the package you received as outlined below.
If you have any problems or questions with the product, please contact M-System's Sales Office or representatives.

### ■ PACKAGE INCLUDES:

Signal conditioner (body + base socket).............................(1)

### ■ MODEL NO.

Confirm Model No. marking on the product to be exactly what you ordered.

### ■ INSTRUCTION MANUAL

This manual describes necessary points of caution when you use this product, including installation, connection, hardware setting, operation of the Programming Unit (model: PU-2x)* specific to this model and basic maintenance procedures.
This unit is factory adjusted and calibrated according to the Ordering Information included in the product package. If you don't need to change the pre-adjusted setting, you can skip the sections on hardware setting and calibration and Software Setting in this manual.
*When you need to change software settings, please refer to the Operation Manual for Model PU-2x (EM-9255), Section B: (B-1) Introduction, (B-2) General Operation Description, (B-3) Operation Flow chart for general information.

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## POINTS OF CAUTION

### ■ POWER INPUT RATING & OPERATIONAL RANGE

• Locate the power input rating marked on the product and confirm its operational range as indicated below:
  85 – 132V AC rating: 85 – 132V, 47 – 66 Hz, approx. 6VA
  12, 24 and 48V DC ratings: Rating ±10%, approx. 3.3W
  110V DC rating: 85 – 150V, approx. 3.3W

### ■ GENERAL PRECAUTIONS

• Before you remove the unit from its base socket or mount it, turn off the power supply and input signal for safety.

### ■ ENVIRONMENT

• Indoor use.
• When heavy dust or metal particles are present in the air, install the unit inside proper housing with sufficient ventilation.
• Do not install the unit where it is subjected to continuous vibration. Do not subject the unit to physical impact.
• Environmental temperature must be within -5 to +60°C (23 to 140°F) with relative humidity within 30 to 90% RH in order to ensure adequate life span and operation.

### ■ WIRING

• Do not install cables close to noise sources (relay drive cable, high frequency line, etc.).
• Do not bind these cables together with those in which noises are present. Do not install them in the same duct.
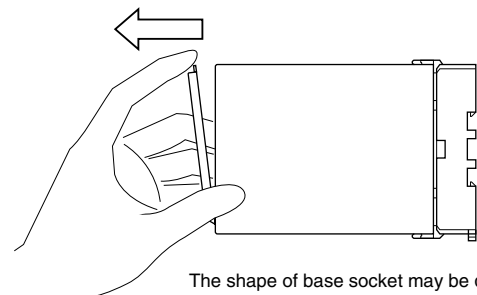
### ■ AND ....

• The unit is designed to function as soon as power is supplied, however, a warm up for 10 minutes is required for satisfying complete performance described in the data sheet.

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## COMPONENT IDENTIFICATION
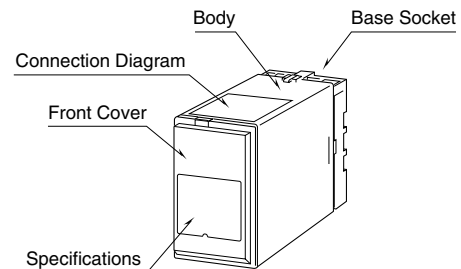


### ■ HOW TO OPEN THE FRONT COVER:

Hang your finger on the hook at the top of the front cover and pull.



The shape of base socket may be different for some models.

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## INSTALLATION

Detach the yellow clamps located at the top and bottom of the unit for separate the body from the base socket.

### ■ DIN RAIL MOUNTING

Set the base socket so that its DIN rail adaptor is at the bottom. Hang the upper hook at the rear side of base socket on the DIN rail and push in the lower. When removing the socket, push down the DIN rail adaptor utilizing a minus screwdriver and pull.
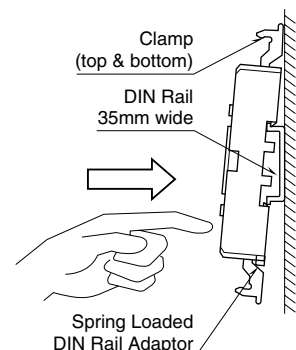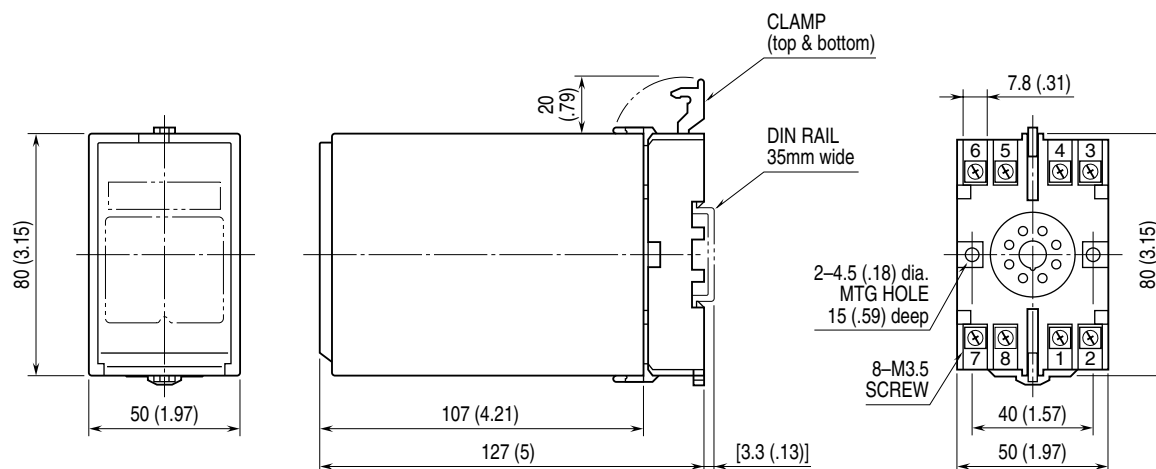


### ■ WALL MOUNTING

Refer to "EXTERNAL DIMENSIONS."

Shape and size of the base socket are slightly different with various socket types.

# TERMINAL CONNECTIONS

Connect the unit as in the diagram below or refer to the connection diagram on the top of the unit.
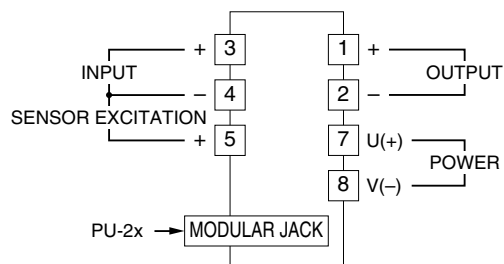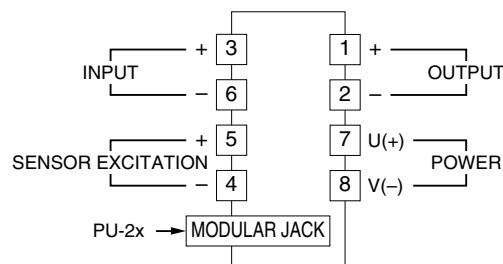
## ■ EXTERNAL DIMENSIONS  unit: mm (inch)

CLAMP
(top & bottom)

DIN RAIL
35mm wide

20 (.79)

80 (3.15)

50 (1.97)

107 (4.21)

127 (5)

[3.3 (.13)]

7.8 (.31)

6 5 4 3

7 8 1 2

2–4.5 (.18) dia. MTG HOLE
15 (.59) deep

8–M3.5 SCREW

80 (3.15)

40 (1.57)

50 (1.97)

• When mounting, no extra space is needed between units.

## ■ CONNECTION DIAGRAM

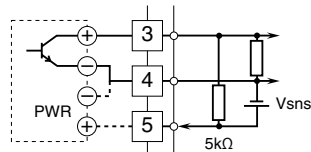### ■ OPEN COLLECTOR, MECHANICAL CONTACT, VOLTAGE PULSE or 2-WIRE CURRENT PULSE INPUT

INPUT  + 3
        − 4
SENSOR EXCITATION + 5

OUTPUT  1 +
         2 −
POWER   7 U(+)
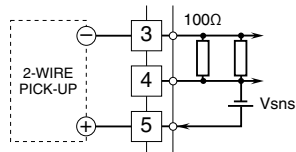        8 V(−)

PU-2x → MODULAR JACK

With 24V excitation and open collector/mechanical contact input,
the voltage across the terminals 3 – 4, divided in the waveform shaper,
is of approx. 16V.

### ■ RS-422 LINE DRIVER PULSE INPUT

INPUT  + 3
        − 6
SENSOR EXCITATION + 5
                  − 4

OUTPUT  1 +
         2 −
POWER   7 U(+)
        8 V(−)

PU-2x → MODULAR JACK

### Input Connection Examples

■ Open Collector or Mechanical Contact

3
4
PWR
5
5kΩ
Vsns

■ 2-Wire Current Pulse
• Built-in Excitation

2-WIRE PICK-UP
3  100Ω
4
5
Vsns

■ Voltage Pulse

3
4
PWR
5
Vsns

• External DC Supply

2-WIRE PICK-UP
DC SUPPLY
3  100Ω
4
5
Vsns

■ RS-422 Line Driver Pulse

3
6
PWR
4
5
Vsns
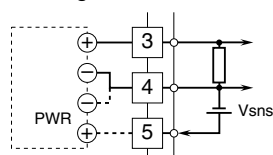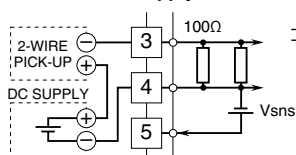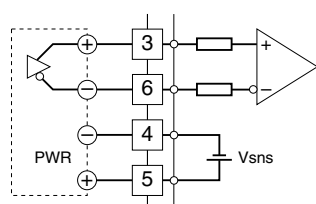
### Output Connection Examples

■ Open Collector

1 +
2 −

■ Voltage Pulse

1 +
2 −
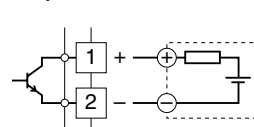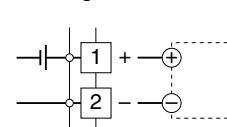
■ Noncontact AC/DC Switch
• AC Powered

1
2
LOAD
Relay or Counter Coil
Varistor or Spark Quenching Circuit

• DC Powered

1
2
LOAD
Relay or Counter Coil
Spark Quenching Diode

■ RS-422 Line Driver Pulse

1 +
2 −
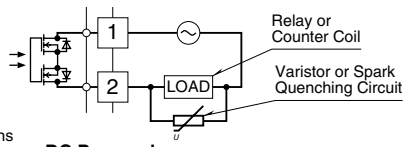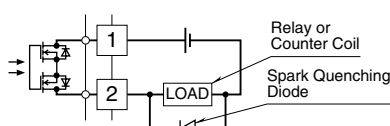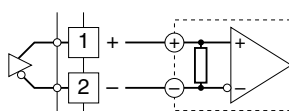
# EXPLANATIONS OF TERMS & FUNCTIONS

## ■ LOW-END CUTOUT

The output frequency is forcibly set to 0 Hz when the input frequency is below the low-end cutout setting by the PU-2x Programming Unit. It is selectable from 0.3 to 100% of the selected input frequency range (e.g. 30 Hz – 10 kHz for the input frequency range 0 – 10 kHz). Use the same unit as that for the input.

The low-end cutout is reset when the input frequency exceeds the cutout value by 1%. For example, with the input frequency range 0 – 100 kHz, the input span frequency 10 kHz and the low-end cutout set to 1 kHz; the output equals 0 Hz while the input is within 0 – 1 kHz. When it goes higher than 1.1 kHz, the output becomes proportional to the input.

When the input frequency range setting is changed, the low-end cutout value is automatically reset to the default value, 0.3% of the range.

## ■ SCALING FACTOR, INPUT SPAN FREQUENCY & OUTPUT SPAN FREQUENCY

The scaling factor, rate of output frequency divided by input frequency, are determined by two parameters: input span frequency and output span frequency.

Although there are also input zero frequency and output zero frequency, they are fixed to zero (0) Hz.

The output frequency is limited up to 115% of the output span frequency.

## ■ INPUT/OUTPUT WAVEFORMS

The figure below shows an example of the output waveform when the input is changed from 100% to 0% (0 Hz), with no conversion to one-shot.

The output, as shown in the figure, does not drop to 0 Hz immediately after the input does, but rather decreases gradually down to 0 Hz.

The time required for the output reaches 0 Hz is longer when the input frequency range is lower.

In general, it becomes shorter when the low-end cutout value is greater.

INPUT

Input 100%          Input 0%

OUTPUT

Output 100%          Output frequency decreasing

Time
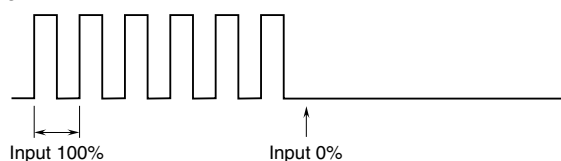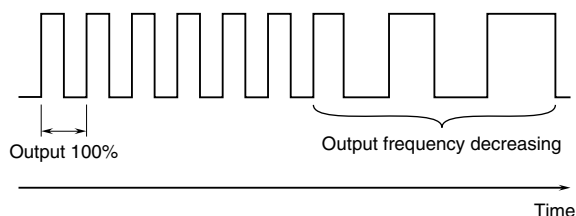
## ■ DETECTING PULSE EDGE

### • Open Collector & Mechanical Contact:

OFF (input monitor LED ON) to ON (input monitor LED OFF)

### • Voltage Pulse

A pulse rise detected when the input voltage goes above the detecting level (input monitor LED ON); a pulse sink detected when it goes below the level (input monitor LED OFF).

### • Two-wire Current Pulse

The input resistor (100 Ω) converts the current signal (0 – 25mA) into 0 – 2.5V. A pulse rise detected when the voltage goes above the detecting level (input monitor LED ON); a pulse sink detected when it goes below the level (input monitor LED OFF).

# HARDWARE SETTING & CALIBRATION

Modular Jack
Input Monitor LED
Unused
Unused
Detecting Level Adj.
Detecting Level Adj. Pin
Input Type Selectors
Pulse Amplitude Selector
Sensor Excitation Adj.

ON ←
1
2
3
4
5
6
7
8

■ **PULSE AMPLITUDE (rotary switch)** (*) Factory setting

For RS-422 line driver pulse, this setting is invalid.

For voltage pulse input, select the pulse amplitude (Vp-p) among the switch positions 0 through 6. For open collector, mechanical contact or two-wire current pulse input, set the switch to 7. DO NOT SET to 8 or 9. The power supply to the unit must be turned off when changing the setting.

| SW | PULSE AMPLITUDE | MAX. INPUT VOLTAGE |
|---|---|---|
| 0 | 50 – 100 Vp-p | 50V |
| 1 | 25 – 50 Vp-p | 50V |
| 2 | 10 – 25 Vp-p | 25V |
| 3 | 5 – 10 Vp-p | 10V |
| 4 | 1 – 5 Vp-p | 5V |
| 5 | 0.5 – 1 Vp-p | 1V |
| 6[*1] | 0.1 – 0.5 Vp-p | 0.5V |
| 7 (*) | Open collector, Mechanical contact or Two-wire current pulse | |

*1. Maximum frequency limited 50 kHz.

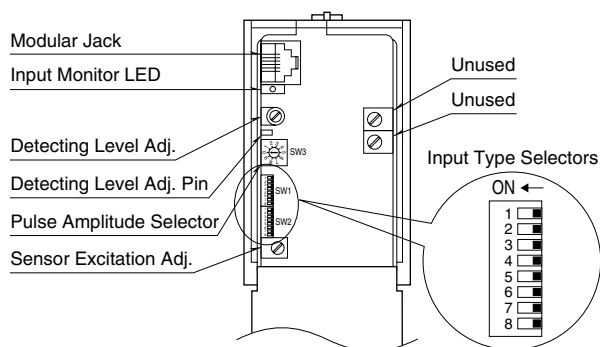■ **DIP SWITCH SETTING** (*) Factory setting

For RS-422 line driver pulse, the noise filter setting is invalid.

SW2 is not used. Turn all switches to OFF.

The power supply to the unit must be turned off when changing the setting.

• **Input Type**

| INPUT TYPE | SW1 | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Open collector (*) Mechanical contact | ON | OFF | ON | OFF | OFF | ON |
| Voltage pulse | OFF | OFF | ON | OFF | OFF | ON |
| Two-wire current pulse | OFF | ON | ON | OFF | OFF | ON |
| RS-422 line driver pulse | OFF | OFF | OFF | ON | ON | OFF |

• **Noise Filter**

Choose an appropriate noise filter setting according to input frequency. (The unit may not function within the described accuracy level if no filter is used.)

'High' setting is used for input ranges ≤ 1 Hz.

'Low' setting is used for input ranges ≤ 1 kHz.

| NOISE FILTER | SW1-7 | SW1-8 |
|---|---|---|
| High | ON | OFF |
| Low (*) | OFF | ON |
| None | OFF | OFF |

■ **CAUTION FOR RS-422 LINE DRIVER PULSE**

For RS-422 line driver pulse, the input amplitude, detecting level and noise filter settings are all invalid. However, in order to prevent errors in setting, set these switches as follows:

Input amplitude = 50 – 100 Vp-p (SW=0)
Detecting level = 0V
Noise filter = None

■ **EXAMPLE 1: VOLTAGE PULSE with Amplitude 5 Vp-p, DC Offset 2.5V, Input Frequency 1 kHz**

Input type: Voltage Pulse
Input frequency: 1 kHz (range and span frequency selected with the PU-2x)
Input amplitude: 1 – 5 Vp-p
Detecting level:
 2.5V (DC Offset × Sensitivity Scale = 2.5 × 1/1 = 2.5 V)
 (Set to the offset value after it is scaled by the sensitivity scale.)
Noise filter: Low

The rotary switch and DIP switch are configured as shown to the right.

SW3     SW1     SW2
ON      ON
1 2 3 4 5 6 7 8    1 2 3 4 5 6 7 8
Not Used (All OFF)

■ **EXAMPLE 2: VOLTAGE PULSE with Amplitude 30 Vp-p, DC Offset 15V, Input Frequency 50 Hz**

Input type: Voltage Pulse
Input frequency: 100 Hz (range and span frequency selected with the PU-2x)
Input amplitude: 25 – 50 Vp-p
Detecting level:
 1.5V (DC Offset × Sensitivity Scale = 15 × 1/10 = 1.5 V)
 (Set to the offset value after it is scaled by the sensitivity scale.)
Noise filter: High

The rotary switch and DIP switch are configured as shown to the right.

SW3     SW1     SW2
ON      ON
1 2 3 4 5 6 7 8    1 2 3 4 5 6 7 8
Not Used (All OFF)

## ■ DETECTING LEVEL

Determine the appropriate detecting level referring to the flow chart below.



```
                    ┌─────────────┐
                    │    START    │
                    └──────┬──────┘
                           │
                ┌──────────▼──────────┐
                │  Voltage pulse input or    No
                │  Two-wire current pulse input? ├────────┐
                └──────────┬──────────┘                    │
                           │ Yes                            │
```

Confirm the Sensitivity Scale in Table 1 below.
Assign the value in the following equation.

Detecting Level (V)[*1] = DC Offset (V)[*2] × Sensitivity Scale

Adjust the detecting level to the value calculated above following the procedure explained below.

Open collector input or Mechanical contact input?  No

Yes

Adjust the detecting level appropriate for the sensor excitation voltage.

| Excitation | Detect. Level |
|---|---|
| ≥ 10V DC | 2V |
| 7 – 10V DC | 1.5V |
| 5 – 7V DC | 1V |

Adjust the detecting level to 0V appropriate for RS-422 line driver pulse input.

*1. Divide a two-wire current pulse input (mA) by 10 and convert it into voltage (V).
*2. Rounded off to one decimal place.

**Table 1**

| SW | PULSE AMPLITUDE | SENSITIVITY SCALE |
|---|---|---|
| 0 | 50 – 100 Vp-p | 1/20 |
| 1 | 25 – 50 Vp-p | 1/10 |
| 2 | 10 – 25 Vp-p | 1/5 |
| 3 | 5 – 10 Vp-p | 1/2 |
| 4 | 1 – 5 Vp-p | 1 |
| 5 | 0.5 – 1 Vp-p | 5 |
| 6 | 0.1 – 0.5 Vp-p | 10 |
| 7 | Open collector<br>Mechanical contact<br>Two-wire current pulse | 1 |

A specific sensitivity scale is applied according to the pulse amplitude setting. The scaled input voltage is then compared to the detecting voltage level (0 – 5 V).

The scaled H level voltage must be equal to or higher than the detecting level so that the pulse state is accurately detected (Refer to the instruction manual for detailed information about adjusting the detecting level).

**• Setting Examples**
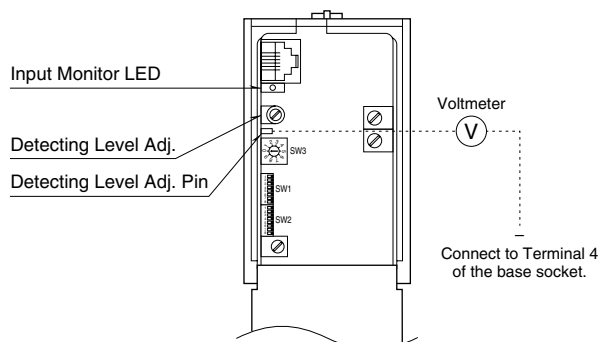**Voltage pulse (DC Offset = Pulse Amplitude / 2)**

| PULSE AMPLITUDE (Vp-p) | AMPLITUDE RANGE (Vp-p) | DETECTING LEVEL (V) |
|---|---|---|
| 50 | 50 – 100 | 1.3 |
| 50 | 25 – 50 | 2.5 |
| 30 | 25 – 50 | 1.5 |
| 25 | 10 – 25 | 2.5 |
| 15 | 10 – 25 | 1.5 |
| 10 | 5 – 10 | 2.5 |
| 7.5 | 5 – 10 | 1.9 |
| 5 | 1 – 5 | 2.5 |
| 3.5 | 1 – 5 | 1.8 |
| 2 | 1 – 5 | 1 |
| 1 | 0.5 – 1 | 2.5 |
| 0.5 | 0.1 – 0.5 | 2.5 |

**Two-wire current pulse (DC Offset = Pulse Amplitude / 2)**

| PULSE AMPLITUDE (mAp-p) | AMPLITUDE RANGE | DETECTING LEVEL (V) |
|---|---|---|
| 15 (1.5 Vp-p) | Set to open collector, mechanical contact or two-wire current pulse | 0.8 |
| 25 (2.5 Vp-p) | | 1.3 |

Set DC offset to 0 V for 100 Vp-p pulse input.

**• How to Change the Detecting Level**

Input Monitor LED

Detecting Level Adj.

Detecting Level Adj. Pin

SW3

SW1

SW2

Voltmeter

V

Connect to Terminal 4
of the base socket.

A voltmeter of class 0.5 or better accuracy with pointed probes is required.

1) Connect the negative probe of voltmeter to the terminal 4 of base socket.

2) If you need a noise filter, set the SW1-7 and SW1-8 in advance.

3) Connect the positive probe to the test pin and turn the Detecting Level Adjustment until the meter shows desired value.

4) Apply input signals and check that input monitor LED (PL1) blinks according to the input signal.

If the LED does not blink, the detecting level may be out of pulse amplitude range. Check the pulse amplitude and the DC offset again and readjust the detecting level.

■ **SENSOR EXCITATION ADJUSTMENT**

You can change the sensor excitation voltage with the sensor excitation adj. located behind the front cover. If you need to change it, check that the required current is within the specification.

**• How to Change the Excitation**

A voltmeter and ammeter of class 0.5 or better accuracy are required.

SENSOR EXC.  V  Voltmeter

A  Ammeter

4  −
5  +

1  +  OUTPUT
2  −
7  U(+)  POWER
8  V(−)

PU-2x → MODULAR JACK
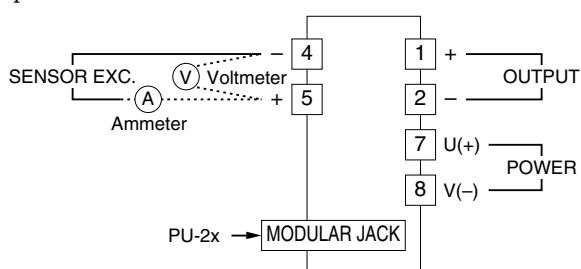
1) Connect the voltmeter across the terminal 5 – 4.

2) Connect the ammeter to terminal 5.

3) Turn the potentiometer until the meter shows the desired value.

Check that the current value indicated on the ammeter is within the allowable limit. If the value is greater than the limit, lower the voltage value or connect a separate power source. Otherwise, the transmitter may fail.

Voltage (V) × Current (A) ≤ 600mW

VOLTAGE (V): 24, 12, 5
CURRENT (mA): 25, 60, 120
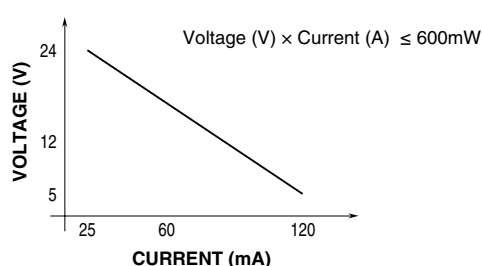
# SOFTWARE SETTING

Please refer to the Operation Manual for Model PU-2x (EM-9255), Section B: (B-1) Introduction, (B-2) General Operation Description, (B-3) Operation Flowchart for general information.

[GROUP 01]

| ITEM | MDFY. | INPUT DATA | DISPLAY | DEFAULT | CONTENTS |
|---|---|---|---|---|---|
| 01 | S | | | N/A | MAINTENANCE SWITCH |
| | | 0 | MTSW: MON.MODE | | 0: Data indication only. |
| | | 1 | MTSW: PRG.MODE | | 1: All 'P' marked parameters are modifiable. |
| 02 | P | Alphabets & No | TG: XXXXXXXXXX | N/A | Tag name entry (10 characters max.) |
| 03 | P | Numeric (%) | OUTPER XXX.XX | N/A | Output in % and simulated output |
| 05 | D | No input | INPPER XXX.XX | N/A | Input in % |
| 06 | D | No input | INPFRQ XXX.XX | N/A | Input frequency (unit as in ITEM 11) |
| 07 | D | No input | | N/A | Input specification selected with the front rotary switch |
| | | | SW: IN_V 1/20 | | SW = 0, Voltage pulse input, Sensitivity scale = 1/20 |
| | | | SW: IN_V 1/10 | | SW = 1, Voltage pulse input, Sensitivity scale = 1/10 |
| | | | SW: IN_V 1/5 | | SW = 2, Voltage pulse input, Sensitivity scale = 1/5 |
| | | | SW: IN_V 1/2 | | SW = 3, Voltage pulse input, Sensitivity scale = 1/2 |
| | | | SW: IN_V 1/1 | | SW = 4, Voltage pulse input, Sensitivity scale = 1/1 |
| | | | SW: IN_V 5/1 | | SW = 5, Voltage pulse input, Sensitivity scale = 5/1 |
| | | | SW: IN_V 10/1 | | SW = 6, Voltage pulse input, Sensitivity scale = 10/1 |
| | | | SW: IN_OC, mA | | SW = 7, Open collector, mechanical contact or two-wire current pulse input |
| | | | SW: no use | | SW = 8, (not used) |
| | | | SW: no use | | SW = 9, (not used) |
| | | | SW: IN_RS-422 | | DIP switch set to RS-422 line driver pulse |
| 11 | P | | | 5 | Input frequency range |
| | | 0 | INRNG: 10 mHz | | 0 – 10 mHz |
| | | 1 | INRNG: 100 mHz | | 0 – 100 mHz |
| | | 2 | INRNG: 1.0 Hz | | 0 – 1.0 Hz |
| | | 3 | INRNG: 10 Hz | | 0 – 10 Hz |
| | | 4 | INRNG: 100 Hz | | 0 – 100 Hz |
| | | 5 | INRNG: 1.0 kHz | | 0 – 1.0 kHz |
| | | 6 | INRNG: 10 kHz | | 0 – 10 kHz |
| | | 7 | INRNG: 100 kHz | | 0 – 100 kHz |
| 12 | P | Numeric | INSPN XXXXXX | 1.0000 | Input span frequency (unit as in ITEM 11) |
| 13 | P | | | 6 (5)* | Output frequency range |
| | | 0 | OUTRNG: 1 mHz | | 0 – 1 mHz |
| | | 1 | OUTRNG: 10 mHz | | 0 – 10 mHz |
| | | 2 | OUTRNG: 100 Hz | | 0 – 100 mHz |
| | | 3 | OUTRNG: 1.0 Hz | | 0 – 1.0 Hz |
| | | 4 | OUTRNG: 10 Hz | | 0 – 10 Hz |
| | | 5 | OUTRNG: 100 Hz | | 0 – 100 Hz |
| | | 6 | OUTRNG: 1.0 kHz | | 0 – 1.0 kHz |
| | | 7 | OUTRNG: 10 kHz | | 0 – 10 kHz |
| 14 | P | Numeric | OUTSPN XXXXXX | 1.0000 (20.00)* | Output span frequency (unit as in ITEM 13) |
| 15 | P | Numeric | DRPOUT XXX.XX | 0.30 | Low-end cutout frequency (unit as in ITEM 11) Deadband fixed at 1% (Low-end cutout is reset when the input exceeds the setting by 1%) |
| 18 | P | Numeric | SMPL RATE XXX | 1 | Averaging non-uniform pulses Input pulses are divided and then multiplied by the ratio so that the output waveform is uniform (stable). Range ≤ 0 – 100 Hz : Ratio 1 – 255; 0 – 1 kHz : 1 – 25; 0 – 10 Hz : 1 – 2; 0 – 100 Hz : Not selectable (fixed at 1) |

| ITEM | MDFY. | INPUT DATA | DISPLAY | DEFAULT | CONTENTS |
|---|---|---|---|---|---|
| 19 | P | Numeric (%) | FINZER XXX.XX<br>OUTPER XXX.XX | 0.00 | Fine zero adjustment<br>Indicates the output in % when data is input. |
| 20 | P | Numeric (%) | FINSPN XXX.XX<br>OUTPER XXX.XX | 100.00 | Fine span adjustment<br>Indicates the output in % when data is input. |

*(　) Output code R: Noncontact AC/DC switch

**Modification Code**
D: No modification (writing) possible.  Used only for monitoring (reading).
S: Modifiable at any time.
P: Modifiable only when the MAINTENANCE SWITCH is in the 'PRG' mode.

**ROM Version Indication**
[GROUP 00] [ITEM 99]

# CHECKING

1) Terminal wiring:  Check that all cables are correctly connected according to the connection diagram.
2) Power input voltage:  Check voltage across the terminal 7 – 8 with a multimeter.
3) Check input signal.
4) Sensor excitation:  Check that the load for the sensor excitation is within the permissible limit.
5) Output:  Check that the load resistance meets the described specifications.

# LIGHTNING SURGE PROTECTION

M-System offers a series of lightning surge protectors for protection against induced lightning surges.  Please contact M-System to choose appropriate models.