



Manufacturer  
**TLV** CO., LTD.

Kakogawa, Japan  
is approved by LRQA LTD. to ISO 9001/14001



# Instruction Manual

## Vortex Flowmeter Counter **VFM-T2**

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## Introduction

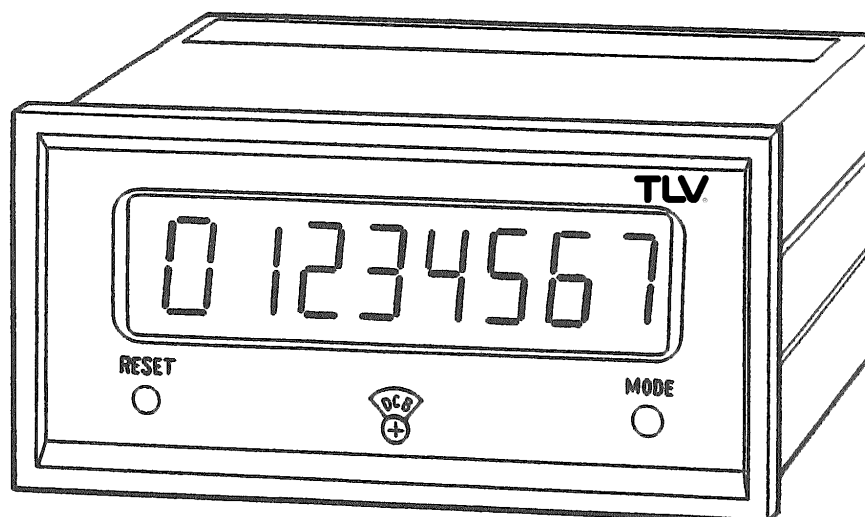
Thank you for purchasing the **TLV** vortex flowmeter counter.

This product has been thoroughly inspected before being shipped from the factory. When the product is delivered, before doing anything else, check the specifications and external appearance to make sure nothing is out of the ordinary. Also be sure to read this manual carefully before use and follow the instructions to be sure of using the product properly.

If detailed instructions for special order specifications or options not contained in this manual are required, please contact **TLV** for full details.

Please keep this manual in a safe place for future reference.

Please read this manual in conjunction with the VFM Vortex Flowmeter Transmitter "Instruction Manual".



## Safety Considerations

- Read this section carefully before use and be sure to follow the instructions.
- Installation, inspection, maintenance, repairs, disassembly, adjustment and valve opening/closing should be carried out only by trained maintenance personnel.
- The precautions listed in this manual are designed to ensure safety and prevent equipment damage and personal injury. For situations that may occur as a result of erroneous handling, three different types of cautionary items are used to indicate the degree of urgency and the scale of potential damage and danger: DANGER, WARNING and CAUTION.
- The three types of cautionary items above are very important for safety: be sure to observe all of them as they relate to installation, use, maintenance and repair. Furthermore, TLV accepts no responsibility for any accidents or damage occurring as a result of failure to observe these precautions.

### Symbols

	<b>Indicates a DANGER, WARNING or CAUTION item.</b>
	Indicates an urgent situation which poses a threat of death or serious injury
	Indicates that there is a potential threat of death or serious injury
	Indicates that there is a possibility of injury or equipment / product damage
	<p><b>Do not touch the terminals during transmission.</b> Failure to observe this precaution could result in such hazards as damage to the product, malfunctions, electric shock or fire.</p> <p><b>Make sure the power supply is OFF before carrying out work on the wiring or inspections involving disassembly.</b> If such work is carried out with the power on, there is a danger that equipment may malfunction or electric shock may occur, leading to injury or other accidents.</p> <p><b>Make sure that wiring work requiring a special license is carried out only by qualified personnel.</b> If carried out by unqualified personnel, overheating or short circuits leading to injury, fires, damage or other accidents may occur.</p>

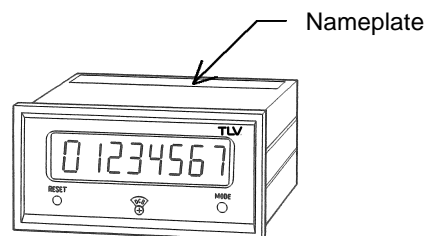
## Handling Precautions

This product has been thoroughly inspected before being shipped from the factory. When the product is delivered, check the exterior for any damage.

This section outlines precautions to be taken when handling the product.

### Verifying the Nameplate

This product is assembled and adjusted to meet each specification. The model and rated specifications are found on the product nameplate located on the outside of the case. Verify the number starting with "VT" on the sticker located on the display panel and the number starting with "VFM" engraved in the Tag. No. space on the nameplate of the VFM transmitter to which the counter is connected.



Location of Nameplate

- ◆ **When making inquiries concerning the product, please be prepared to provide details such as the product name, model, product number and rated specifications.**

### Precautions When Transporting the Product

- 1) To prevent damage from accidents during transport, where at all possible, transport the product to the installation site in the original packaging in which it was shipped from TLV.
- 2) During transport, avoid subjecting the product to strong impacts or shocks.

### Precautions When Storing the Product

If the period of time between the when the product is delivered and when it reaches the installation site is long, special consideration must be given to the possible occurrence of unexpected accidents. When it is known in advance that the storage period might be long, be sure to observe the following precautions.



**<Caution> After the product has been stored for a long period of no use, it is likely that an inspection of the internal components is necessary. Please consult with TLV.**

- 1) Where at all possible, store the product in the original packaging in which it was shipped from TLV.
- 2) Select a location for storage that meets the conditions set forth below.
  - A location in which it will not be exposed to rain or water.
  - A location in which it is subjected to minimal vibration or impacts.
  - A location in which it will experience only slight fluctuations in temperature and humidity (approximately 25°C and 65%).

## General Description



**CAUTION**

Make sure the power supply is OFF before carrying out work on the wiring or inspections involving disassembly. If such work is carried out with the power on, there is a danger that equipment may malfunction or electric shock may occur, leading to injury or other accidents.



**CAUTION**

Make sure that wiring work requiring a special license is carried out only by qualified personnel. If carried out by unqualified personnel, overheating or short circuits leading to injury, fires, damage or other accidents may occur.

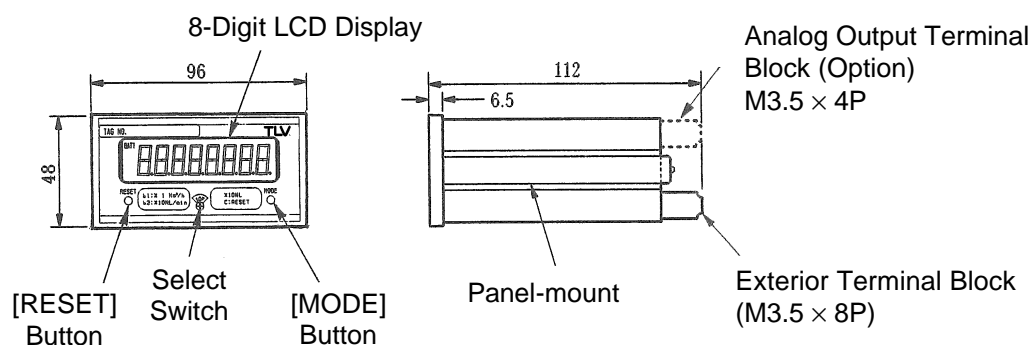


**CAUTION**

Do not touch the terminals during transmission. Failure to observe this precaution could result in such hazards as damage to the product, malfunctions, electric shock or fire.

This vortex flowmeter counter is built around a single-chip microprocessor and is lightweight and compact in design. It offers four independent functions (cumulative total flow, instantaneous flow rate, hourly and per-minute total flow and resettable total) in a single unit. Optional 4 – 20mA DC and 1 – 5V DC flow rate outputs are also available.

## Part Names and Exterior Dimensions



Units: mm

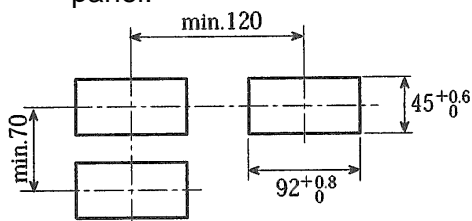
## Instructions for Installation

### Installation Location

- 1) Select a location that has no or extremely slight amounts of mechanical vibration or corrosive gas.
- 2) Select a location with low humidity, of typical room temperature and in which only slight fluctuations in temperature are experienced.  
NOTE: Though the acceptable operating temperature range is  $-10^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$ , whenever possible select a location that is of typical room temperature.
- 3) Secure sufficient space to the rear of the counter for ease of wiring and maintenance.

## Installation Method

- 1) The counter is designed for panel mounting.
- 2) To install the panel, follow the steps below.
  - After removing the panel-mount fitting from the body, insert the body into the front of the panel.
  - Using the panel-mount fitting, secure it to the panel from the interior of the panel.



Units: mm

Panel-cut Dimensions

## Instructions for Wiring Connections



**CAUTION**

Make sure the power supply is OFF before carrying out work on the wiring or inspections involving disassembly. If such work is carried out with the power on, there is a danger that equipment may malfunction or electric shock may occur, leading to injury or other accidents.



**CAUTION**

Make sure that wiring work requiring a special license is carried out only by qualified personnel. If carried out by unqualified personnel, overheating or short circuits leading to injury, fires, damage or other accidents may occur.

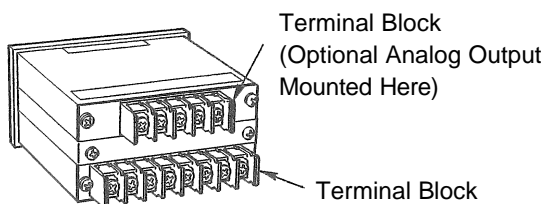


**CAUTION**

Do not touch the terminals during transmission. Failure to observe this precaution could result in such hazards as damage to the product, malfunctions, electric shock or fire.

## Wiring Cables

Be sure to use electrostatically-shielded, polyethylene-insulated, vinyl-sheathed control cables (CEVS 0.75 to 2 mm<sup>2</sup>, 2- or 3-conductor) or the equivalent as input and output signal lines.



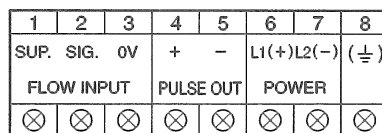
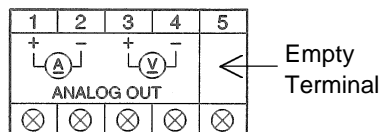
## Wiring Method

- 1) It is recommended that cables be routed through conduits.
 

NOTE: Be sure to route the power cable independent of the input and output control cables.
- 2) Keep the cables away from other power cables or power circuits to prevent inductive interference. If inductive interference is suspected, use devices such as capacitors or surge suppressors where necessary.
- 3) Use spade terminals to ensure good electrical connections. The terminals for connections are located on the rear of the unit.

### Description of the Field Wiring Terminal Block

Before connecting the cables, make sure that the flowmeter transmitter is compatible with the counter. Acceptable combinations of these units can be determined by checking their model number and instrument number. Connect the wiring correctly.



Exterior Connection Terminal Block Diagram

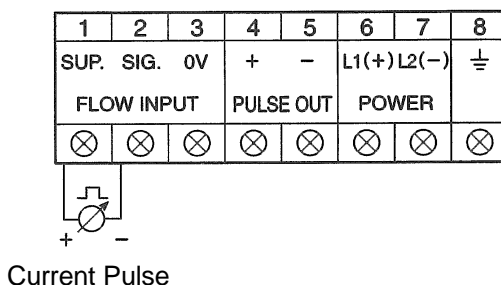
NOTE: The upper terminal on the rear of the counter is found only on models with analog output.

**⚠ <Caution> As incorrect combinations could lead to serious damage to these units, be sure to check again after connecting the cables.**

### Description of Field Wiring Terminals

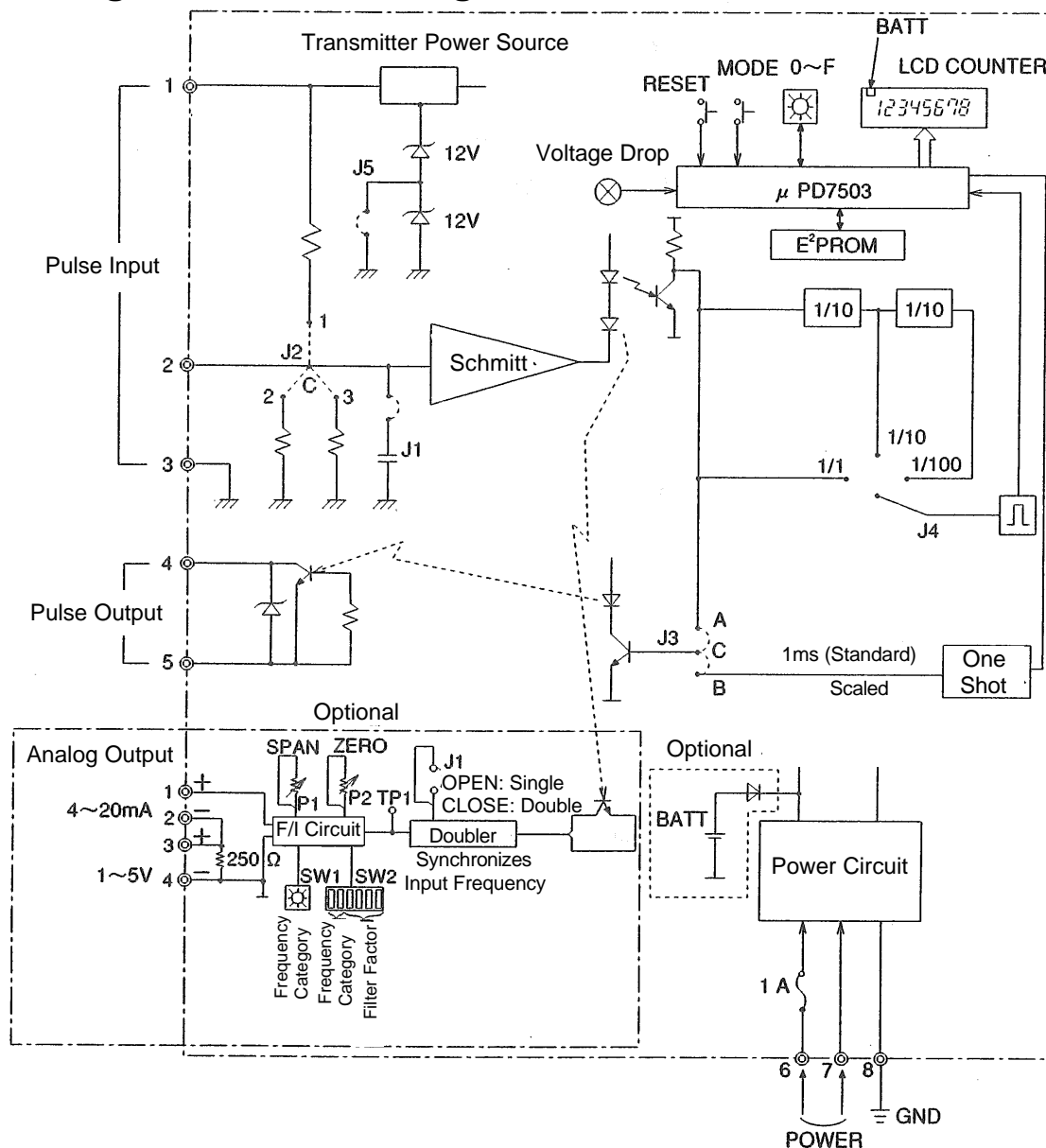
Name		Terminal No.		Connection and Specifications	
Power Supply		6 L1	7 L2	100V, 110/115V, 200V, 220/230V ± 10% 50/60Hz	
Ground		8		Must be grounded	
Pulse Input	Current Pulse	1, 2		1: + (+24 or 12V DC) 2: -	
Pulse Outputs	Open Collector	4, 5		4: + 5: -	
Analog Output	4 – 20mA DC	1, 2		1: + 2: -	Optional Feature <b>⚠ &lt;Caution&gt; If not using terminal 1 and 2, they MUST be connected using a wire link. If they are not linked, analog voltage does not reach terminals 3 and 4.</b>
	1 – 5V DC	3, 4		3: + 4: -	

### Input Signal Connection





## Configuration Block Diagram



### ● Explanation of Various Circuits (By Block)

- **Power Circuit:** generates various internal voltages from the power supply voltage (POWER)
- **Doubler Circuit:** converts low frequencies\* into frequencies that can be processed by the F/I circuit in the next step  
\* When the full scale frequency is in the range of 2 – 4Hz and the waveform ratio of the input pulse is 1:1: J1 CLOSE.
- **F/I Circuit:** converts an input frequency of 4 – 20mA or 1 – 5V to an analog signal

## Functions and Operation



**CAUTION**

Make sure the power supply is OFF before carrying out work on the wiring or inspections involving disassembly. If such work is carried out with the power on, there is a danger that equipment may malfunction or electric shock may occur, leading to injury or other accidents.



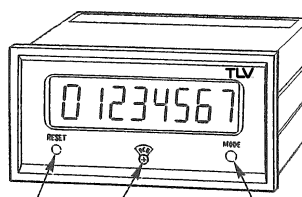
**CAUTION**

Make sure that wiring work requiring a special license is carried out only by qualified personnel. If carried out by unqualified personnel, overheating or short circuits leading to injury, fires, damage or other accidents may occur.

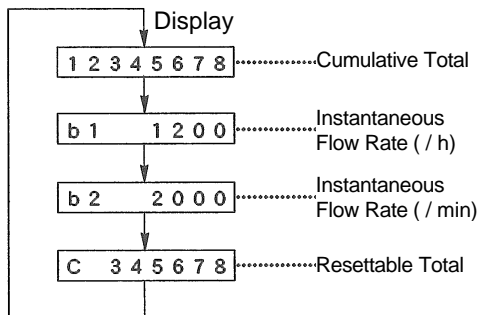
The counter is designed to show the following functions on the display by using the select switch or by pressing the [MODE] or [RESET] buttons.

### The LCD Counter Display

If the [MODE] button is pushed when the select switch is set to either "8" or "0", the LCD counter displays the following sequence:



[RESET] Button    Select Switch    [MODE] Button



NOTE: This is effective only when input pulses have very small periodic variation.

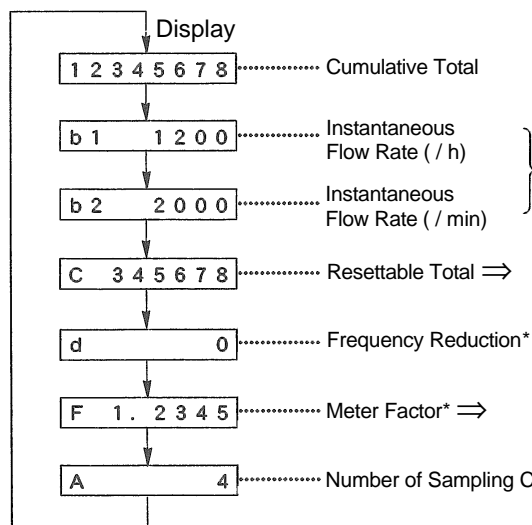
For details, see "Calculating Total and Instantaneous Flow Rates".

NOTE: The [RESET] button is activated only at this time, and pushing [RESET] changes the counter back to "0".



### Verifying the Meter Factors

If the [MODE] button is pushed when the select switch is set to either "C" or "4", the meter factors are displayed in the following sequence:



NOTE: This is effective only when input pulses have very small periodic variation.

For details, see "Calculating Total and Instantaneous Flow Rates".

The [RESET] button is not enabled. (Inoperable)

0: 1/1, 1: 1/10, 2: 1/100

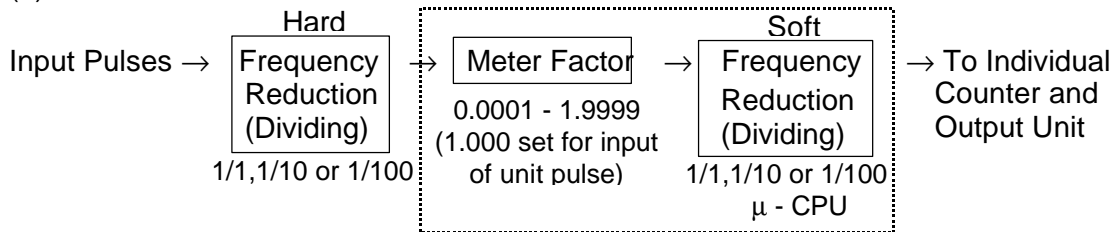
0.0001 - 1.9999

1 - 128

NOTE: For items marked with an asterisk\*, set points can be selected only within the ranges shown.

## Calculating Total and Instantaneous Flow Rates

(1) Total: both cumulative and resettable total



(2) Instantaneous: used only when input pulses have very small periodic variation. The period of sample cycles is measured down to the unit of 1 ms, calculated using the following equation and the result shown on the display.

$$\text{Flow rate per hour} = b1 = \frac{3600 \times A \times F}{T \text{ (ms)}} \times 100$$

NOTE: A: number of sampling cycles  
F: meter factor  
T: interval of input pulse

$$\text{Flow rate per minute} = b2 = \frac{b1}{60} \times 100$$

NOTE: The number of sampling cycles is determined such that the accuracy of the instantaneous flow rate in full scale is held within  $\pm 1\%$  ( $100 \leq T \leq 200\text{ms}$ ).

NOTE: It is designed so that when  $T \geq 5000 \text{ (ms)}$ , the instantaneous flow rate on the display will show "0".

NOTE: Set it so that sampling cycles  $\times$  input period  $\leq 5000 \text{ (ms)}$ .

NOTE: Note that when "hard" dividing, the units for instantaneous flow rate are modified.

## Setting and Adjusting Jumpers, Switches and Volumes

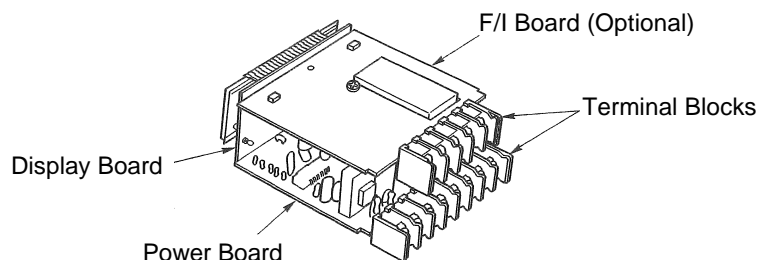
- The multifunction counter is preset to the customer specifications at the factory before shipment. Unless it is necessary to change the preset settings in the field, further adjustment should not be required.

NOTE: It is necessary to remove the internal components (motherboard) of the unit when setting, modifying or adjusting jumpers, switches or volumes.

## Internal Construction

For pulse type, the motherboard is of 2-board construction, containing a “display board” and a “power board”. Analog type (optional) is of 3-board construction, containing the addition of an “F/I board”. The power board and F/I board are connected by individual connectors to the display board.

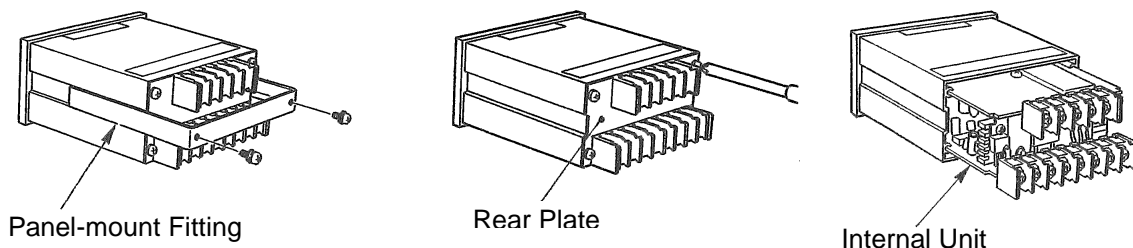
The external connection terminals are found on the rear of the counter.



## Removing the Internal Components

**⚠ <Caution> Be sure to perform this operation with the power supply turned OFF.**

NOTE: Disconnect all wiring from the counter unit.



- 1) Remove the panel-mount fitting, and then pull the unit out from the front of the panel.
- 2) Remove the screws from the rear plate, and then take the rear plate off.
- 3) Pull the internal unit out to the rear.

## Waveform Shaping Function

Specifications for Type of Pulse Input and Input Settings

Type of Pulse Input	Jumper Set Points					Power to Transmitter	Input Impedance
	J2	J5	J1	J3	J4		
Current Pulse	3 – C	Uncoupled	*1	*2	*3	24V DC	510Ω

NOTE: \*1: Couple to increase the waveform shaping filter approximately 10 times.

\*2: This jumper is used to select the pulse output specifications.

Synchronized input (1/1) : A – C

Scaled (display units) : B – C (STD.)

→→ See the next section.

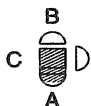
\*3: A microprocessor input speed with a maximum of 200Hz is required. It may be necessary to set “hard” dividing prior to the processor input. Divide by one of the following: 1/1, 1/10 or 1/100.

→→ See the next section.

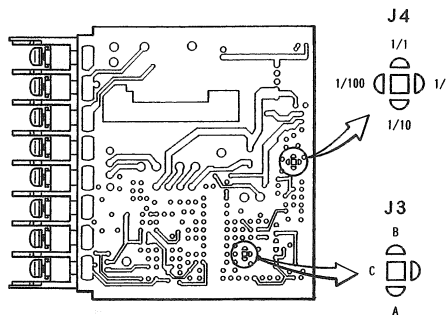
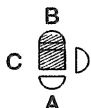
◆ Solder jumpers to the locations on the power board indicated by the shaded areas below in accordance with the individual specifications.

Setting the Pulse Output Specifications Selection Jumper: J3

- (1) Synchronized input 1/1 (A – C)



- (2) Scaled (display units): standard (B – C)



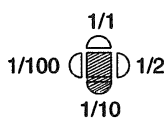
Power Board (underside)

Setting "Hard" Dividing: J4

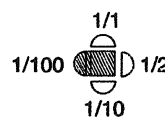
- (1) Dividing 1/1



- (2) Dividing 1/10

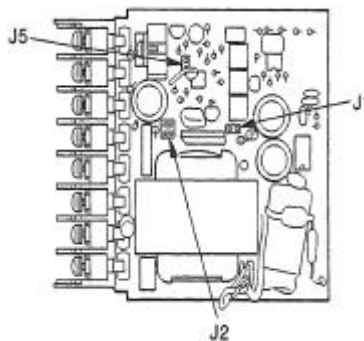
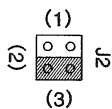


- (3) Dividing 1/100



Setting the Pulse Input Specifications Selection Jumper: J2

- (1) 3 – C



Power Board (topside)

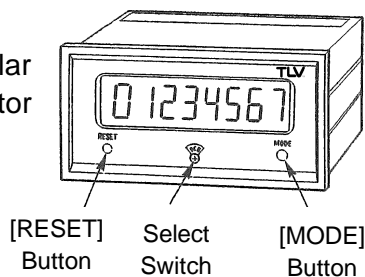
## Functions to Establish Factors

It is possible to establish the following 4 factors:

- 1) Initial set point for the cumulative total  
When replacing the battery or performing maintenance, it may be necessary to establish previous readings before resuming cumulative totaling.
- 2) Frequency reduction: 1/1, 1/10 or 1000  
When wanting to change the display units used in totalizing (pulse output unit).
- 3) Meter factor: 0.0001 - 1.9999  
Where readjustment of the meter factor is necessary to accommodate official meter verification.
- 4) Number of sampling cycles: 1 – 128  
The counter shows the instantaneous flow rate at the particular point specified. For example, in applications where observing readings at increased accuracy is desired.

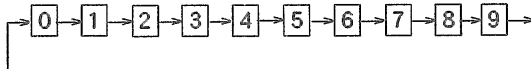
### ● Operation to Set and Modify the Factors

Since the four factors above are set in a similar manner, only the procedure for the meter factor is explained here to avoid duplication.



(Ex.) Changing the meter factor from 1.2345 to 0.9876.

1. Change the position of the select switch from the default position of “8” to “C”.
2. Push the [MODE] button to display the meter factor. In this case F1.2345 .
3. Change the select switch from “C” to “D” and press the [MODE] button. The LCD display changes from F1.2345 to F . 0 and begins blinking (at 0.5 second intervals).
4. Change the select switch from “D” to “E”.  
In this position, press the [RESET] button to increment the number from “0” in the order shown below.



Note that, as seen from the sequence above, the largest number possible is “9”. To remedy this, with the display reading “0”, press the [MODE] button one time to move the “0” one place to the left.

The LCD display changes to F . 00 .

5. Press the [RESET] button 9 times to change the second digit to “9”.  
The LCD display reads F . 09 .
6. Push the [MODE] button one time to move the “09” one place to the left.  
The LCD display now reads F . 090 .

7. Press the [RESET] button 8 times to change the third digit to "8".  
The LCD display now reads F . 098 .
8. Press the [MODE] button one time.  
The LCD display now reads F .0980 .
9. Press the [RESET] button 7 times.  
The LCD display now reads F .0987 .
10. Press the [MODE] button one time.  
The LCD display now reads F0.9870 .
11. Press the [RESET] button 6 times to change the smallest digit to "6", which is displayed at the far right-hand side of the LCD display of numerals.  
The LCD display now reads F0.9876 .

All the numerals for the desired meter factor setting are now displayed.  
Note that the number is still blinking at this point.

NOTE: The [RESET] button functions as the number-setting button, and the [MODE] button functions as the place-shifting button.

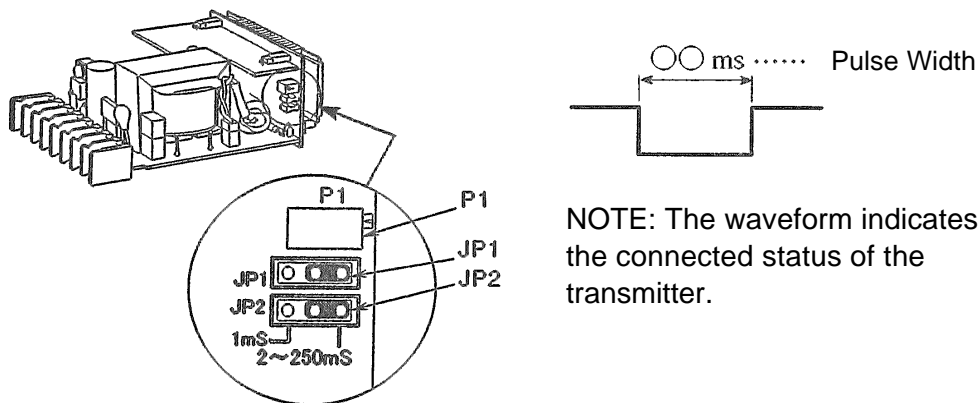
12. After making sure that the blinking number is as desired, change the select switch from "E" to "F" and press the [MODE] button. The LCD display stops blinking and shows the newly set meter factor.
13. Verifying the New Meter Factor Setting  
Change the select switch from "F" to "C" and press the [MODE] button to confirm each individual digit. The new meter factor (Ex.) F0.9876 is displayed.
14. Change the select switch from "C" back to "8".

This completes the setting of the factors.

### **Modifying the Pulse Width of the Output Signal (Optional)**

When shipped from the factory, the pulse width is set to 1ms (standard specification). However, if it is necessary, the product can be modified after it arrives. It is possible to adjust the pulse width from 2 to 250ms by following the steps below.

1. Turn the power OFF and pull the internal components out of the unit casing. (See "Removing the Internal Components".)
2. Set jumpers JP1 and JP2 on the display board to "2 – 250ms".
3. Turn ON the power.
4. Produce an output pulse from the flowmeter transmitter connected to the input or connect a pulse generator and produce an input pulse.
5. Connect an instrument capable of measuring pulse width, such as an oscilloscope, between terminal blocks 4 and 5 (PULSE OUT).
6. The pulse width is adjusted by turning the P1 volume.



NOTE: The waveform indicates the connected status of the transmitter.



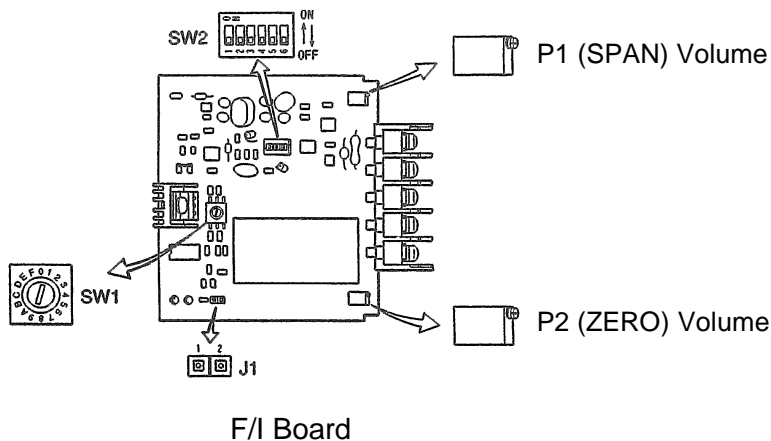
**<Caution>**

- Avoid turning P1 with excessive force as it could result in damage.
- When JP1 and JP2 are set to "1ms", the pulse width becomes 1ms (fixed).
- Set the pulse width to a suitable flow rate range to ensure that the pulse does not become too heavy.

### Operation and Adjustment for Setting and Modifying the Analog Output Circuit (Optional)

The items in the following section can be set and modified by switching the jumper J1, SW1 and SW2 on the F/I board.

The analog output signal is adjusted by controlling the P1 (SPAN) and P2 (ZERO) volume.





- F/I Frequency Categories and Filter Constant Settings

Set the frequency category and filter constant that correspond to the input frequency.

SW1	SW2						Full Scale Frequency Category [Hz]
	1	2	3	4	5	6	
0	ON	OFF	ON	ON	ON	ON	2.00 – 3.99
0	ON	OFF	ON	ON	ON	ON	4.00 – 9.99
1	↓	OFF	↓	↓	ON	ON	10.00 – 19.99
2	↓	ON	↓	↓	OFF	OFF	20.00 – 29.99
3	↓	↓	↓	↓	↓	↓	30.00 – 39.99
4	↓	↓	↓	↓	↓	↓	40.00 – 49.99
5	↓	↓	↓	↓	↓	↓	50.0 – 59.9
6	↓	↓	↓	↓	↓	↓	60.0 – 69.9
7	↓	↓	↓	↓	↓	↓	70.0 – 79.9
8	↓	↓	↓	↓	↓	↓	80.0 – 89.9
9	↓	↓	↓	↓	↓	↓	90.0 – 99.9
A	↓	↓	↓	↓	↓	↓	100.0 – 109.9
B	↓	↓	↓	↓	↓	↓	110.0 – 119.9
C	↓	↓	↓	↓	↓	↓	120.0 – 129.9
D	↓	↓	↓	↓	↓	↓	130.0 – 139.9
E	↓	↓	↓	↓	↓	↓	140.0 – 149.9
F	ON	ON	ON	ON	↓	↓	150.0 – 199.9
2	OFF	OFF	OFF	OFF	↓	↓	200.0 – 299.9
3	↓	OFF	↓	↓	↓	↓	300.0 – 399.9
4	↓	ON	↓	↓	↓	↓	400.0 – 499.9
5	↓	↓	↓	↓	↓	↓	500 – 599
6	↓	↓	↓	↓	↓	↓	600 – 699
7	↓	↓	↓	↓	↓	↓	700 – 799
8	↓	↓	↓	↓	↓	↓	800 – 899
9	↓	↓	↓	↓	↓	↓	900 – 999
A	↓	↓	↓	↓	↓	↓	1000 – 1099
B	↓	↓	↓	↓	↓	↓	1100 – 1199
C	↓	↓	↓	↓	↓	↓	1200 – 1299
D	↓	↓	↓	↓	↓	↓	1300 – 1399
E	↓	↓	↓	↓	↓	↓	1400 – 1499
F	OFF	ON	OFF	OFF	OFF	OFF	1500 – 2000

- Adjusting the Analog Output Signal

Adjusting the ZERO and SPAN of the Analog Signal

Volume	Adjustment Method
P1 (SPAN)	Adjust the analog signal to the maximum value (20mA or 5V) corresponding to the input frequency maximum value.
P2 (ZERO)	Adjust the analog signal to the minimum value (4mA or 1V) corresponding to the input frequency minimum value.

## Operation

### Preparations Before Operation

Inspect the counter and associated instruments to ensure that they are correctly installed and wired and that nothing has been overlooked.



**<Warning> Use of a power source of an incorrect voltage may result in burnout of the counter. Make certain to use a power source of the rated voltage.**

(Pre-operational Check)

Supply power to the counter. Press the [MODE] button to test function and check for irregularities.



**<Caution> Avoid repeatedly turning the power ON and OFF, as this may cause the counter to begin counting.**

Next, supply a simulated pulse train of the appropriate type to confirm that the counter counts and displays a correct totalized flow and instantaneous flow rate in response.

### Operation

After pre-operational preparations are completed, turn on the power.

## Troubleshooting

### ◆ IMPORTANT ◆

**When internal trouble is suspected, contact TLV after inspecting the counter by following the steps below.**

Symptom	Check Item	Possible Causes
The display indicates neither total flow nor instantaneous flow rate	Is power being supplied? (1) Check the voltage (2) Inspect the fuse	(1) The supply voltage is incorrect (2) The fuse is blown (internal) (3) The power supply unit is faulty
	Is a pulse input train being supplied? (1) Is the wiring correct? (2) Is the pulse input train reaching the counter?	(1) The input lines are wired incorrectly (2) The transmitter is faulty (3) The waveform shaping circuit is faulty (4) The custom ( $\mu$ CPU) is defective

### ◆ IMPORTANT ◆

**If the problem is suspected to be other than one listed above, contact the TLV service network. When contacting TLV, be prepared to provide details such as the product name, model and symptoms of the problem.**

## Standard Specifications

Item		Description	
Display	Display Type	LCD Character height: 12.7 mm	
	Items Displayed	Sequential display by pressing [MODE] Button 8-digit nonresettable Total flow readout 4-digit hourly Flow rate readout 4-digit per minute Flow rate readout 7-digit nonresettable Total flow readout	
	Program	Scaler	0.0001 to 1.9999 (adjustable in steps of 0.0001)
		Frequency Reduction	Select the display units: 1/1 (standard), 1/10, 1/100
Backup Function		The counter display values and settings are saved by an internal E <sup>2</sup> PROM.	
Input Signal	Transmitter Power Source	24V DC 50mA with overcurrent protection	
	Trigger Level	3V DC hysteresis 0.8V DC	
	Pulse Response	200Hz (contact input 50Hz): standard Note: Can follow up to 2kHz when input frequencies are reduced to 1/10 or 1/100. When scaler value exceeds 1 150Hz maximum	
Output Signal	Pulse Output	Selection	Scaled (same unit as displayed) = standard or synchronized input (unscaled)
		Output Signal	Open collector after optical isolation.
		Capacity	30V DC 50mA max.
		Voltage When Power ON	1.5V DC max.
		Pulse Width	1ms: standard
	Analog Output	Output Signal	4 – 20mA DC and 1 – 5V DC
		Load Resistance	Current Output: 350Ω max.
			Voltage Output Cutoff: 600Ω max.
			Voltage Output: 1MΩ min.
		Accuracy	± 0.1% of full scale (temp. factor 0.015%/°C)
Ripple	1% of full scale (at 10% of full scale flow rate)		
Time Constant	4(2) – 19.99Hz: 6.5 seconds 20 – 199.99Hz: 2.1 seconds 200 – 2000Hz: 1.5 seconds Figures in brackets ( ) with frequency doubler		
Ambient Temperature		-10° to +50°C	
Insulation Resistance		Between power terminals and ground 10MΩ or greater at 500V DC	
Withstand Voltage		Between power terminals and ground 1500V AC for 1 minute	
Power Consumption		7VA max.	
Weight		Approximately 0.6 kg	
Case		Molded resin and aluminum	
Frame Color		Munsell N1.5 or equivalent	

## Product Warranty

1. Warranty Period  
One year following product delivery.
2. Warranty Coverage  
TLV CO., LTD. warrants this product to the original purchaser to be free from defective materials and workmanship. Under this warranty, the product will be repaired or replaced at our option, without charge for parts or labor.
3. This product warranty will not apply to cosmetic defects, nor to any product whose exterior has been damaged or defaced; nor does it apply in the following cases:
  - Malfunctions due to improper installation, use, handling, etc., by other than TLV CO., LTD. authorized service representatives.
  - Malfunctions due to dirt, scale, rust, etc.
  - Malfunctions due to improper disassembly and reassembly, or inadequate inspection and maintenance by other TLV CO., LTD. authorized service representatives.
  - Malfunctions due to disasters or forces of nature.
  - Accidents or malfunctions due to any other cause beyond the control of TLV CO., LTD.

Under no circumstances will TLV CO., LTD. be liable for consequential economic loss damage or consequential damage to property.

\* \* \* \* \*

For Service or Technical Assistance:

Contact your **TLV** representative or your regional **TLV** office.

### Manufacturer

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