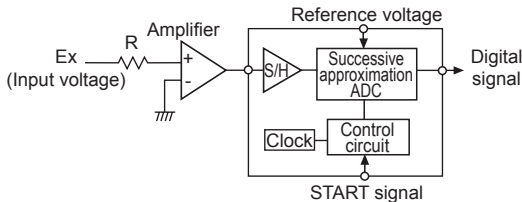


# Technical Description

## ■ Analog to Digital Converter Method

### ◎ ADC (Analog to Digital Converter) method



(Figure 1) ACD basic configuration

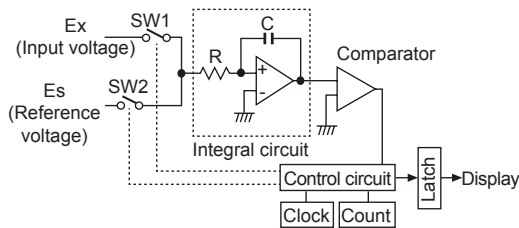
The measuring speed is fast, and the resolution is high because of sampling the input signal on ADC and then measuring the changes by successive approximation ADC like figure 1. Successive approximation ADC which converts from the highest order bit toward the lower order bit has fast convert time and simple circuit.

### ◎ Dual slope integration method

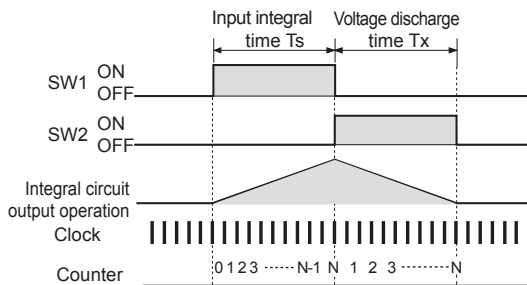
Like (Figure 2-1) if SW1 is ON, input voltage  $E_x$  is integrated by a certain time  $T_s$ . After finish integral of input voltage  $E_x$ , SW2 is ON, then when connect to reference voltage  $E_s$ , it will be integral in the direction of zero voltage. (Based on  $E_s$ ,  $E_x$  becomes reverse polarity.) When integral operating becomes zero, comparator stops integral, and this integral time is  $T_x$ .

$$\text{The formula is } EX = \frac{T_x}{T_s} Es .$$

The integral times of Successive approximation  $E_s$  and input voltage  $E_x$  are fixed. So, if  $T_x$  value is measured with the counter, the digital value proportional to the input can be obtained.



(Figure 2-1) Dual slope integration method basic configuration



(Figure 2-2) Integral waveform

### ◎ Compare ADC and Dual slope integration method

	ADC	Dual slope integration method
Property	<ul style="list-style-type: none"> <li>● Fast measurement</li> <li>● Improved noise characteristics</li> <li>● High resolution</li> <li>● Expensive price</li> </ul>	<ul style="list-style-type: none"> <li>● Stable AD convert</li> <li>● Good linearity</li> <li>● Reasonable price</li> </ul>

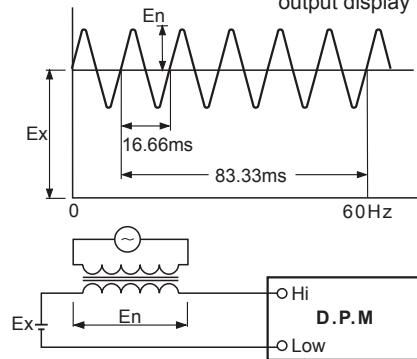
## ■ Normal Mode Rejection Ratio (NMR)

NMR is the rate of ripple error caused by AC voltage when AC voltage of commercial power frequency is mixed at the measuring input terminal during measuring DC voltage. To remove this error, the rate of remove is changed depending on the method of the A/D change.

At the integral method like (Figure 3), the half cycle of + and the half cycle of - are cancelling each other, so mixed noise can be removed effectively, and if integral time of input is integral multiples of power frequency, it is able to get infinite noise remove ratio theoretically. And if filter method is inserted in the input circuit, NMR can be big, but it does not need to do because the response to reply to the change of signal voltage is worse.

$$\text{NMR (dB)} = 20 \log \frac{E_n}{\Delta E}$$

$E_n$ : Input mixed AC voltage noise peak value  
 $\Delta E$ : Rate of change of output display



(Figure 3)

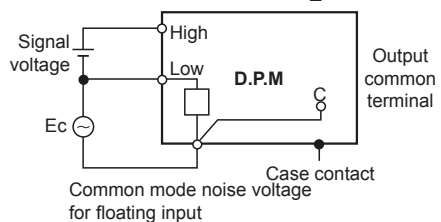
## ■ Common Mode Rejection Ratio (CMR)

CMR is the rate of error occurred when receiving noise voltage of same phase (Common Mode) during the measuring input 2 terminals is same size as in common (ground). The measured degree under the real operating condition can be declined often by same phase noise.

This noise is that when the potential difference at the earth terminal is caused between earth terminal of panel meter and the ground, the terrestrial current enters into the meter. It is represented between high and low of measurement input terminal. Same phase noise can be neglected several V, dozens of V of the noise voltage when earthing point is long, or the earthing points of substation or the device using high power broadcasting is nearby.

The definition of CMR is that using the circuit on the (Figure 4) when applied  $E_c$  (Common Mode Current: AC Peak voltage), if output is changed as much as  $\Delta E$ , the formula is below.

$$\text{CMR (dB)} = 20 \log \frac{E_c}{\Delta E}$$



(Figure 4)

## ■ Glossary

### ◎ Measurement of AVG/RMS

- There are two ways to measure voltage or current of AC waveforms.

They are read AVG or RMS to get AC wave. User can select any kinds of measuring method.

#### • AVG

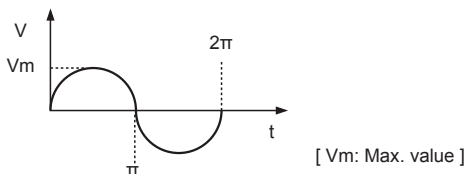
The average value of each half cycle at AC waveforms.

#### • RMS

AC is that voltage and current are changed every time not like DC. So, it can show same effectiveness which is the value of voltage and current like DC.

Generally RMS of AC is the value of DC which is spent same quantity of electrical energy during same time at the same resistance. Generally use Root mean square (RMS) to get the real RMS value because AC has lots of electrostriction.

(For sine wave)



$$\text{AVG} = \frac{2V_m}{\pi} = 0.637V_m$$

$$\text{RMS} = \frac{V_m}{\sqrt{2}} = 0.707V_m$$

- The result of measuring electrostriction waveform Measuring the average value:

There can be big display deviation by the rate of electrostriction of waveform.

Measuring the RMS value:

There is no display deviation when measuring RMS value because sine wave or no sinusoidal wave is measured by its quantity of heat.

- In conclusion, the waveform close to sine wave does not have any big difference using AVG or RMS, but RMS is better to measure electrostriction of waveform.
- We produce both models for measuring AVG and RMS. For RMS model, indicate "R" on the name of the model, but no "R" for AVG model.

But, there is only RMS measuring model for M5W Series, and "R" is not on the name of the model.

And the method of AVG and RMS can be selected on the parameter for multi panel meter.

### ◎ Display accuracy

Display accuracy means the maximum error guaranteed by maker. It is displayed by % on the full scale of meter. (Full scale: the maximum display range. For 3½ line is 1999, 4 line is 9999, 4½ line is 19999.)

E.g.) The display accuracy of M4Y Series is ±0.2 rdg, ±1 digit for full scale. So, 1999 × ±0.2% = ±4digit, after include reading error ±1digit, the display accuracy is ±5 digit. rdg is the code address of reading.

### ◎ AUTO ZERO

When input is zero, corrects the offset value in the inner circuit, and displays "0000" or "00000"

### ◎ HOLD

The function holds the display value by shorting and hold terminal when it is difficult to read the display value by changing input frequently.

### ◎ Display decimal point

All models adopt fixed decimal point function. Please do not change the decimal point arbitrarily. (Except multi-meter and scale function embedded types) Please contact main office or branches if there is any change.

## ■ Proper Usage

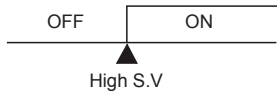
- Please read this catalog before buy or use the Panel Meter. The shipped product which is produced by order error cannot be exchanged.
- After install this product, even though the input signal is zero if arbitrary number is shown, cut measurement input terminal and check 0000 is displayed after remove input signal. (Check auto zero function)  
If 0000 is not displayed, please contact us, but MT4Y, MT4W Series are able to revise this error using error correction function.  
Note) M5W Series does not have Auto Zero function.
- After install this product, when input signal is applied if 1999 or +999 is displayed, it means that input signal is bigger than input specification or measurement input is not correct. In this case, shut down the power and check wires.  
Note) M5W Series displays 19999 or +99999.  
but Error display function embedded displays own error code.
- For ordering digital panel meter with option power supply, must write the specify the power supply specifications. Please refer to the desired Series' specifications.

(A)	Photoelectric Sensors
(B)	Fiber Optic Sensors
(C)	Door/Area Sensors
(D)	Proximity Sensors
(E)	Pressure Sensors
(F)	Rotary Encoders
(G)	Connectors/ Connector Cables/ Sensor Distribution Boxes/ Sockets
(H)	Temperature Controllers
(I)	SSRs / Power Controllers
(J)	Counters
(K)	Timers
(L)	Panel Meters
(M)	Tacho / Speed / Pulse Meters
(N)	Display Units
(O)	Sensor Controllers
(P)	Switching Mode Power Supplies
(Q)	Stepper Motors & Drivers & Controllers
(R)	Graphic/ Logic Panels
(S)	Field Network Devices
(T)	Software

# Technical Description

- The output of D.P.M for single setting works as the upper limit alarm output. If the measured value is higher than high setting value, the output works, and if the measured value is lower than high set value, the output does not work.

Applied Series: M4W1P, M4M1P Series



- The output of D.P.M for dual setting works as the upper, lowest limited alarm output. The output works if the measured value is higher than high setting value or lower than low setting value. And if the measured value is lower than high setting value, and higher than low setting value, the output does not work. (The upper, lowest limits work separately.)

Note) The setting value displays Error when Low  $\geq$  High. Please set Low < High.

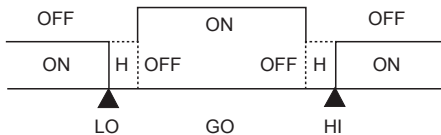
Applied Series: M4W2P, M4M2P Series



- Multi panel meter (MT4Y/MT4W) works as triple output (LO, GO, HI), and provides 5 types of output except the upper limit output.

(OFF, L5t, H5t, LH5t, LL5t, HH5t, Ld5t Mode)

E.g.) The upper/lowest limit alarm output (LH5t Mode)



※Please refer to L-45 page for more detail information.

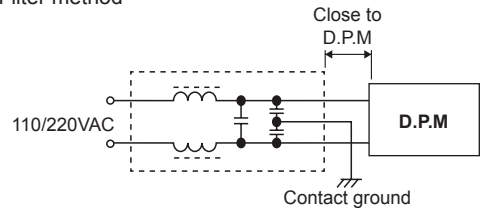
- Use environment
  - Operate at temperature -10 to 50°C, humidity 85%. Please use at the room temperature because temperature will affect the accuracy of the measurement.
  - Please avoid the condition of condensation caused by the rapid change of temperature.
  - Please be careful not to cause vibration or shock. Please do not use in the surrounding of gases, dust, chemicals which is harmful to electric devices.
- Storage
 

When store items for long term, avoid direct sunlight, keep in -20 to 60°C temperature range and under 30 to 85% relative humidity. Keep the packaged products like factory condition.

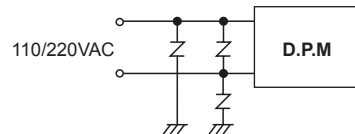
- Noise

The biggest problem is the noise which is mixed into power line at the AC power panel meter. Anti-noise condenser is available between wires at the 1st part of power Trans. But, it is difficult to put in the perfect anti-noise circuit in the small product like panel meter. Please use noise absorbing circuit like filter or varistor at the outside line when abnormal voltage is caused by power relay, magnet S/W, using high frequency device, high voltage spark, and thunderbolt at the same line.

- Line Filter method

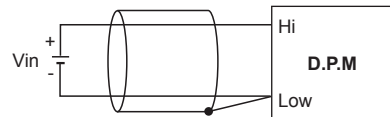


- Varistor method



- Input line If the measuring input wire is long, please must use the shield wire at the place where noise can occur often.

- Use 2 core Shield wire



- Use 1 core Shield wire

