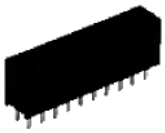
Heat capacity type **Moisture percentage adjustment module MC-1**
(Description of use)

The moisture percentage adjustment module (MC-1) is an indispensable tool for effective disposal processes using bacteria in garbage disposal, the control of moisture percentage of soil, portable toilets, movable sitting toilets, and domestic animal excreta processing, to name a few.
By maintaining the optimum conditions necessary for bacterial activity via the MC-1, the processing time for garbage disposal can be shortened to a fraction of the time it traditionally takes. If this process can be completed within a few hours, garbage will be dissolved by bacteria before rotting starts. As a result, there will be almost no foul odor.

Shape and configuration (Normally, the four items below are sold as a set.)

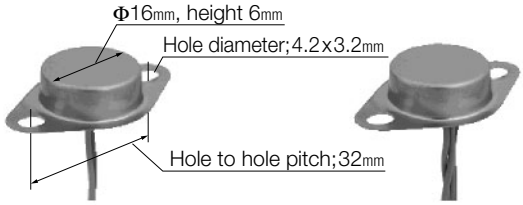
Main body
MC-1

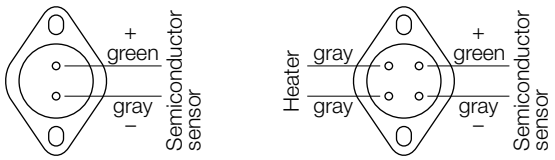
Receptacle



A sensor
(Temperature sensor)
MCS-A
(2 leads)

B sensor
(Moisture percentage sensor)
MCS-B
(4 leads)





(Note) • A diode is used as the standard temperature sensor.
• A thermister can be used as well, if so desired.

Connection instructions

Serial signal (computer reading)	P	○	○	1 Common	Output signal
	R	○	○	2 Moisture percentage, too little	
	T	○	○	3 Moisture percentage, too much	
	G	○	○	4 Temperature signal	
Spare terminals		○	○	5 + (green) Semiconductor sensor	MCS-A / Input sensor
		●	○	6 – (gray)	
Spare terminals		○	○	7 – (gray) Semiconductor sensor	
+12V		○	○	8 – (gray)	
G 0V		○	○	9 (gray) Heater	MCS-B / Input sensor
		●	○	10 (gray)	

No print side Printing side

(Sensor unit for measuring the moisture percentage of the soil)

A sensor and B sensor are housed in one case for moisture percentage measurements of the soil for gardening.

Rating · characteristics

Supplied power	:	DC12V (60mA)
Operational temperature range	:	Main body ···· –10˚C ~ 55˚C (MC-1) Sensor section ···· 0˚C ~ 80˚C (MCS-A / MCS-B)
Storage temperature range	:	–25˚C ~ 65˚C
Measurement sensor	:	Semiconductor sensor (standard type is a diode)
Input	:	A sensor (temperature sensor) (MCS-A) B sensor (moisture percentage sensor) (MCS-B)
Semiconductor contact-less output	:	Output of moisture percentage range (2 points, high and low) Temperature output (1 point at the preset temperature)

(Note)
Optimum conditions (parameters for upper limit and lower limit of moisture percentage, and temperature) can be set from a PC via a special adapter which we supply. Adapter and RS232C cable are sold separately. If desired, a designated parameter of moisture percentage and temperature can be preset at the time of shipment from Matsuo.

The concept of "moisture percentage" and preparation of the base material for the experiment

While the moisture percentage is indicated by a percentage, “%”, it is not a world standard value, and different from the case of “temperature”.
In the case of “temperature”, the transformation temperature when pure water freezes is defined as “0℃” and the transformation temperature when pure water boils is defined as “100℃”, and the range in between is equally divided into 100 to obtain the temperature in Celsius.
In the case of moisture percentage, it is not possible to establish a world standard. Why? It is because there is no standard base material as with “pure water”.

It is not possible to apply the same standard to all base materials. There are so many different types of base materials, and the physical properties of each material are different.
One extreme example is the case of a paper diaper. This material can absorb and retain water 1,000 times its own weight.

The base material commonly used for the decomposition of organic substances is sawdust.
The reasons are;

- Sawdust is an organic material, and can eventually be returned to a natural state.
- Sawdust is a porous material, and is a suitable place for moisture or for bacteria to live.
- In the disposition process of kitchen refuse or animal excrement, sawdust adapts itself due to a commonality in shape.
- It is easy to obtain and the price is not so expensive.

“Tentative plan to obtain a % by weight comparison” by using sawdust is explained below.

· Dry some amount of sawdust, and prepare 400g of this sawdust, which is (or considered to be) dried to a 0% moisture percentage, and divide it into two plastic bags of 200g each. (The weight of the plastic bag should be measured in advance.)
· Add 200g of water to one of the two bags and crumple it well so that the sawdust and the water mix thoroughly together. Now you have two types of base material, one with a 0% moisture percentage and the other with a 50% moisture percentage.
· If 400g of water is added to 200g of sawdust, the moisture percentage will be 66.7%.
· If 600g of water is added to 200g of sawdust, the moisture percentage will be 75%.

As you already understand, it is not possible to make a 100% moisture percentage base material under this method. It is said that approximately a 60% moisture percentage is the optimum environment for bacteria.

Operational principle of the moisture percentage adjustment module

Under the heat-capacity method, the moisture percentage is obtained by the temperature difference between the following two sensors;

MCS-A (temperature sensor with two leads) (A sensor)
MCS-B (moisture percentage sensor with 4 leads) (B sensor)

· The MCS-A is an ordinary semiconductor temperature sensor. The base temperature of the sawdust base material is constantly measured by this sensor.
· The MCS-B consists of the same temperature sensor as the A sensor and a miniature heater which maintains the temperature of the sensor at a temperature 30℃ higher than the external temperature.

- If there is no moisture in the sawdust base material, the temperature difference between the A sensor and B sensor will be 30℃. But as the moisture in the sawdust increases, most of the temperature raised by the miniature heater is taken away by the moisture.

In other words, if the temperature difference between the A sensor and B sensor is 30℃, it means that the heat generated by the miniature heater is not taken away by the moisture at all, meaning the moisture percentage is 0%.

As the moisture percentage goes up, more of the temperature from the B sensor is taken away by the moisture. As a result, the temperature difference between A and B will be smaller.

When you do an experiment, start by placing the A and B sensors in several plastic bags containing different known levels of moisture percentages and verifying what the temperature difference is for each moisture percentage level.

The table below (Fig.1) shows the data for cases of 40℃ and 60℃ base material temperatures using cedar sawdust, which can be easily obtained.

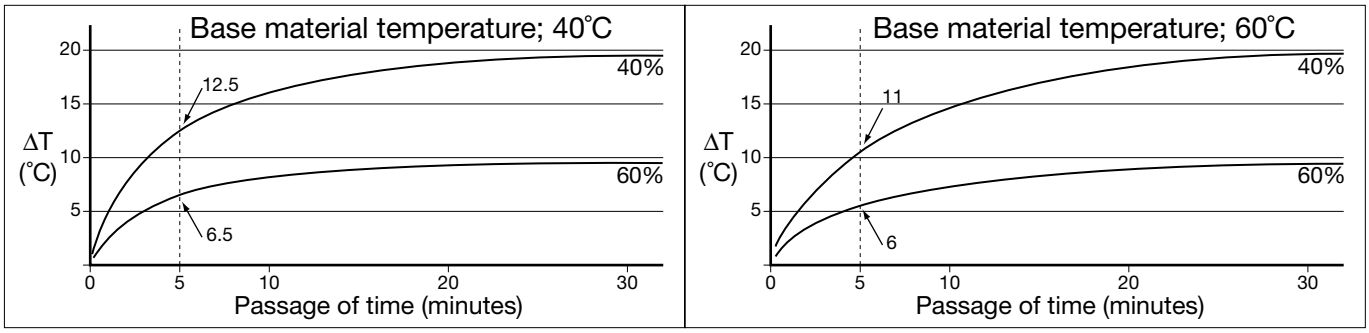
Measurements are taken at moisture percentages of 40% and 60%, respectively.

The measurement point is set at five minutes after power on, and the measurement at the 40℃ base material temperature resulted in the following:
If the moisture percentage is 40%, the A/B temperature difference is 12.5℃.
If the moisture percentage is 60%, the A/B temperature difference is 6.5℃.

Fig.2 is an operational model of T1 and T2 operated by settings on the actual device.

Fig.3 is an operational model of T3 operated by settings on the actual device.

(Fig.1) (ΔT is the temperature difference between the A and B sensors.)



(Fig.2) (ΔT is the temperature difference between the A and B sensors.)

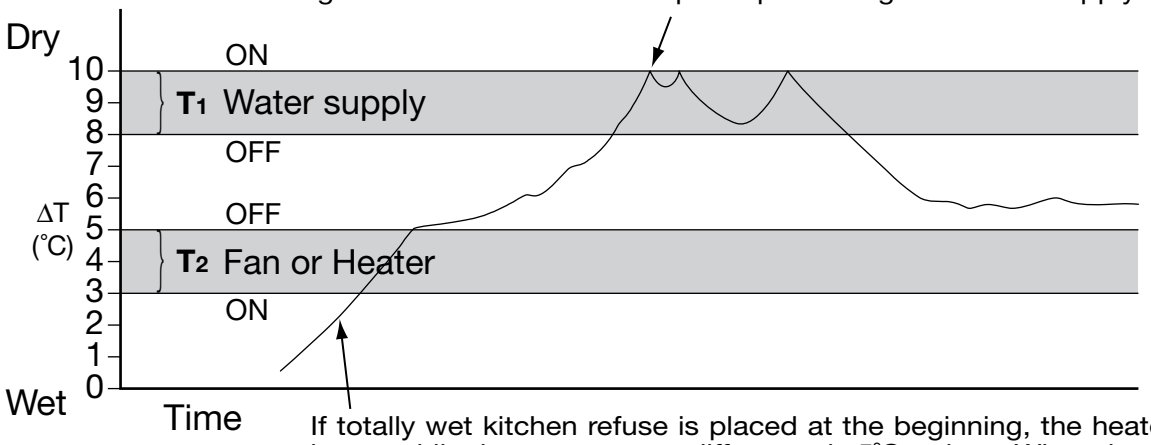
T1: This is instructions on adding water when it is too dry.

Under the temporary setting, the water supply valve is opened at a 10℃ temperature difference, and the valve is closed when the temperature difference has come down to 8℃. Because it will take some time for the supplied water to penetrate the sawdust, it is recommended that the amount of water supplied each time is made small and that the water is supplied several times.

T2: This is instructions on drying by a fan or a heater when there is too much moisture.

Under the temporary setting, the heater (or fan) will stay on as long as the temperature difference is 5℃ or less. When the temperature difference exceeds 5℃, the fan will be turned off, but the temperature difference will continue to increase for a while due to the remaining heat. If the bacteria continue to increase, there may be cases where the temperature difference is automatically maintained between a range of 10~3 due to the fermentation heat.

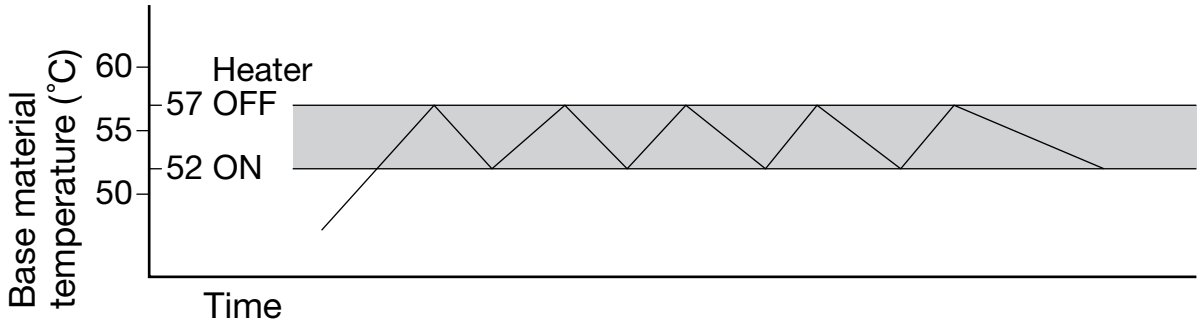
If ΔT reaches 8℃ as a result of water supply, the water supply will stop. However, it will take some time for the sawdust to get totally wet. Therefore, it is a good idea to lessen each amount of supplied water to prevent over watering and causing too much moisture.
The figure below shows an example of preventing over water supply.



If totally wet kitchen refuse is placed at the beginning, the heater will be on while the temperature difference is 5℃ or less. When the difference exceeds 5℃, that level is maintained for a while due to the remaining heat. After that, it starts to get dry due to the fermentation heat of the bacteria, and a supply of water will be required when the temperature difference reaches 10℃.

(Fig.3) T3: This is instructions on maintaining the base material temperature.

Under the temporary setting, the heater is turned off at 57℃ and turned on at 52℃.
Set the temperatures to your required level.



How to communicate between the module and the PC (Compatible to Windows 98 or higher.)

1. Connect the module, the adapter (sold separately), your control PCB or evaluation PCB (sold separately) and the PC as shown in figure ① on the right. Set the sensor A and B into the base material. (Make the connections without the power for all devices.)
2. Turn the PC and other devices ON, open the "MC communication" folder contained in the attached CD-ROM, and start "MC-COM1".
3. On the communication screen, make sure that [OK>] is displayed when the ENTER key is pressed. If it does appear, it means that the connection is complete.
4. Start the "Settings manual" file in the CD-ROM and refer to the instructions therein for details of the settings for different moisture percentage and temperatures or when the connections cannot be completed successfully.

   If the lower limit and the upper limit of the moisture percentage are set as parameters of T1 and T2, the moisture percentage within that range can always be maintained.
   Furthermore, the temperature of the base material to be maintained can also be set.

5. When the settings are complete, turn OFF the PC and other devices, remove the module from the adapter and insert the module into your control PCB. The procedure is now complete.(Fig.②)

⚠ CAUTION !

Turn the power off when you insert the module into the receptacle.
Direction of the module and pin numbers should correspond to the receptacle.
Turn the power on after the correct insertion has been confirmed.

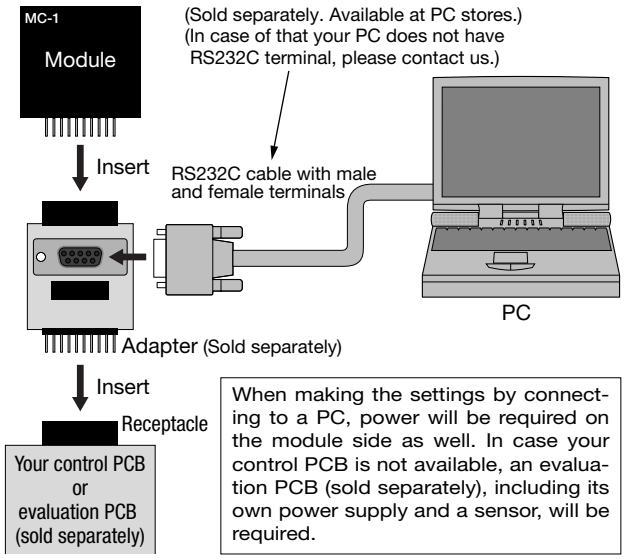


Fig.① How to connect the module, the adapter and the PC

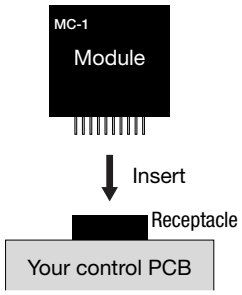
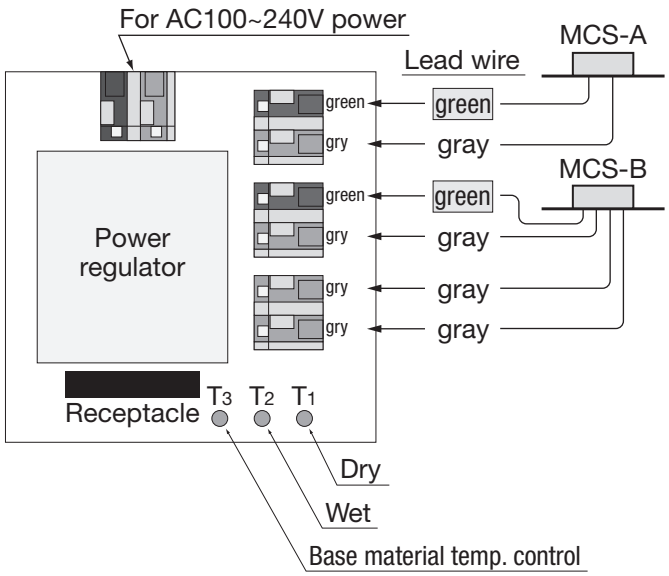


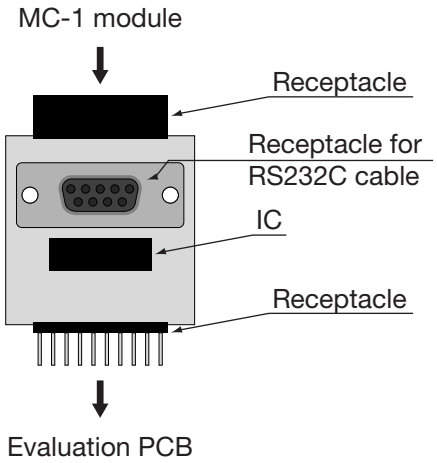
Fig.② Connection to your control PCB

Evaluation PCB and adapter (Sold separately)

Evaluation PCB



Adapter



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