MITSUBISHI HEAVY INDUSTRIES

ENERGY CONSERVATION GRAND PRIZE
FY2013
Grand Prize for Excellence in Energy Efficiency and Conservation
(Product Category & Business Model Category)

Support : The Energy Conservation Center, Japan
Minister's Prize, The Ministry of Economy, Trade and Industry

Thermal Solution Engineering

Heat Source Control System

Ene-Conductor

Significant Energy Reduction

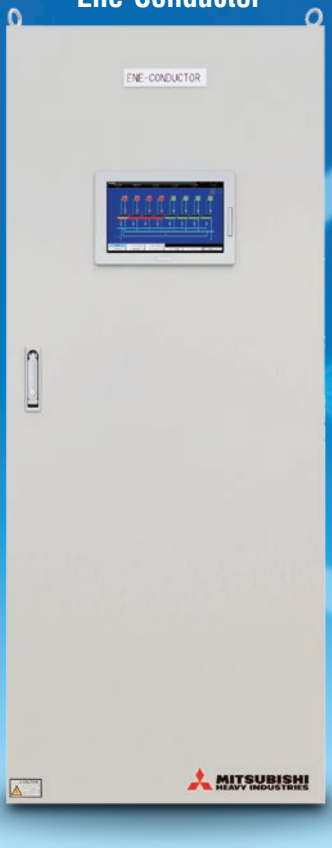
by total control of heat source system
It's a conductor of Energy

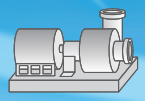
Significant Energy Reduction by total control of heat source system

~optimization from individual equipment to whole system~

Being required for contemporary office buildings, large shopping malls or factories, it is an environmental protection effort and saving energy. The key is the heat source system.
Energy-saving had to introduce high efficiency equipment some years ago. However it has to consider energy saving on heat source system levels rather than individual equipment.
Here is the “Ene-Conductor” which supports energy-savings for the whole system.

Ene-Conductor





Pump

Cooling tower

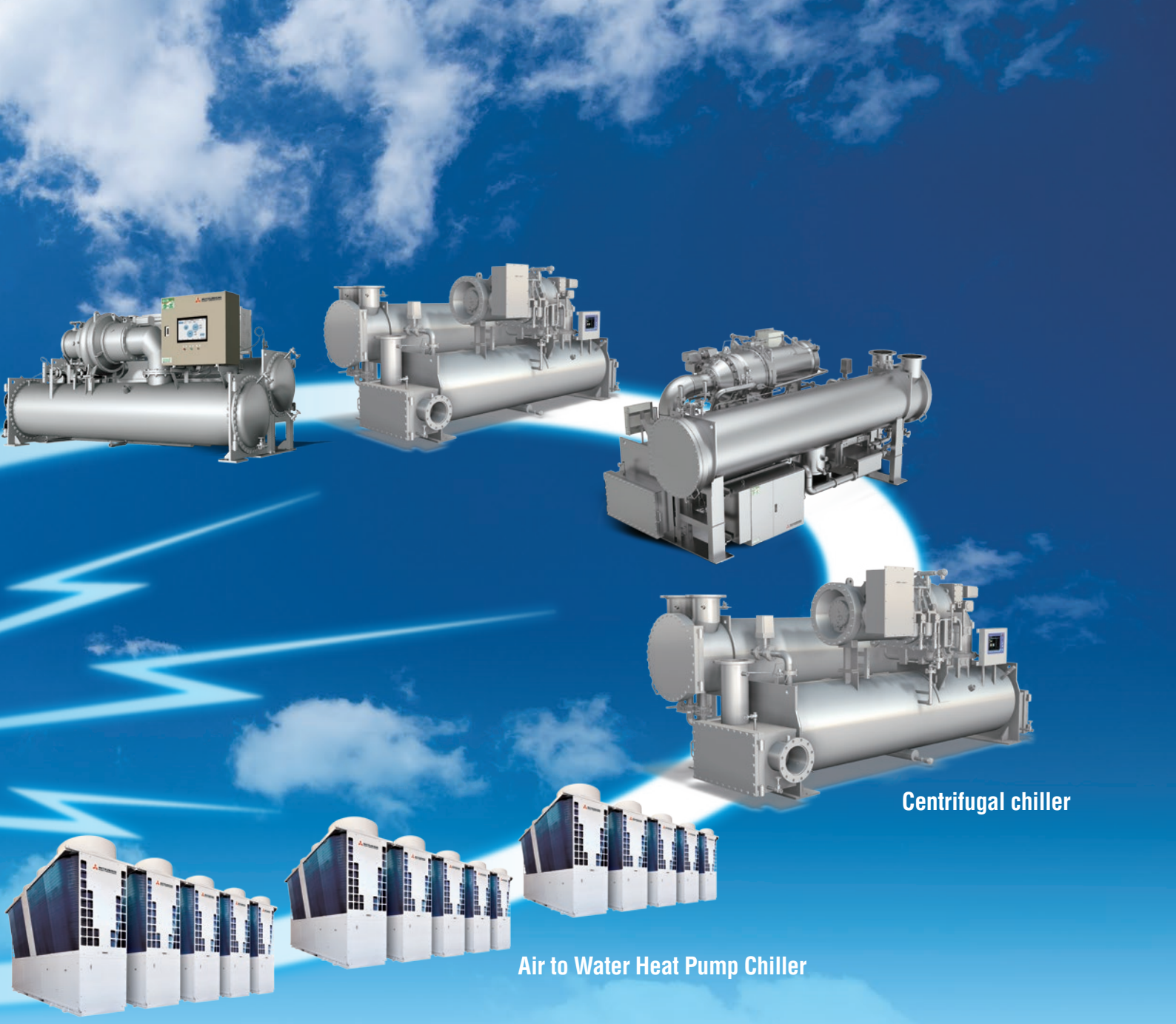
Heat Source Control System

Ene-Conductor

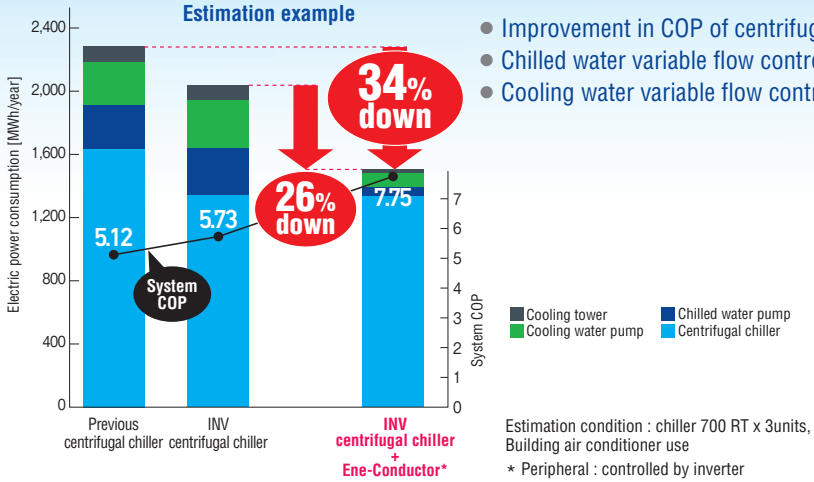
Improvement of system COP by optimal control which achieves the best performance out of centrifugal chiller

Various energy-saving control functions

Central monitoring



Electric power consumption in whole system 34% down



- Improvement in COP of centrifugal chiller
- Chilled water variable flow control
- Cooling water variable flow control

Estimation condition : chiller 700 RT x 3units, Building air conditioner use

* Peripheral : controlled by inverter

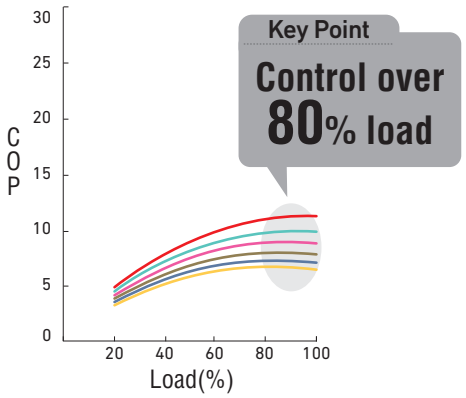
Easy to use for an automatic optimization of the whole system

Improvement of system COP

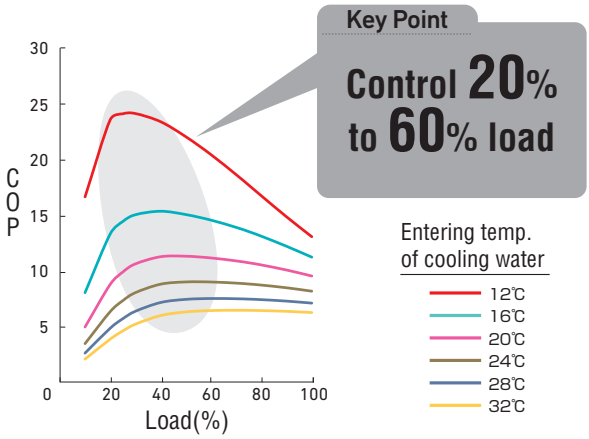
1 Improvement of system COP by optimal control which achieves the best performance out of centrifugal chiller

Optimize load distribution and operation number

In the case where the system combines multiple chillers with different performances, Ene-Conductor automatically calculates the best load for each chiller to obtain the highest COP of the complete system.



Constant speed chiller (JHT-Y)



Variable speed chiller (JHT-YI)

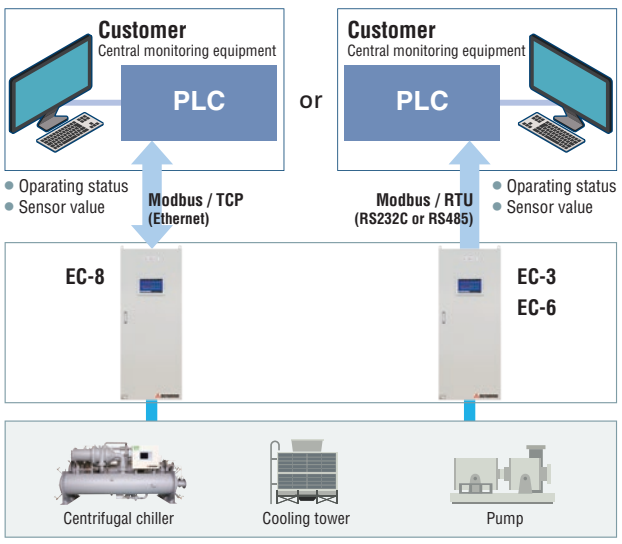
2 Various energy-saving control functions

Packaged control software of the heat source equipment. The system design work load is reduced for the customer.

- Multiple chiller and heat pump number control
- Chilled / Hot water variable flow rate control (primary pump)
- Cooling water variable flow rate control
- Cooling tower operation / fan control
- Cooling water bypass valve control
- Chilled water bypass valve control
- Chilled / Hot water secondary pump control

3 Central monitoring

(Option)

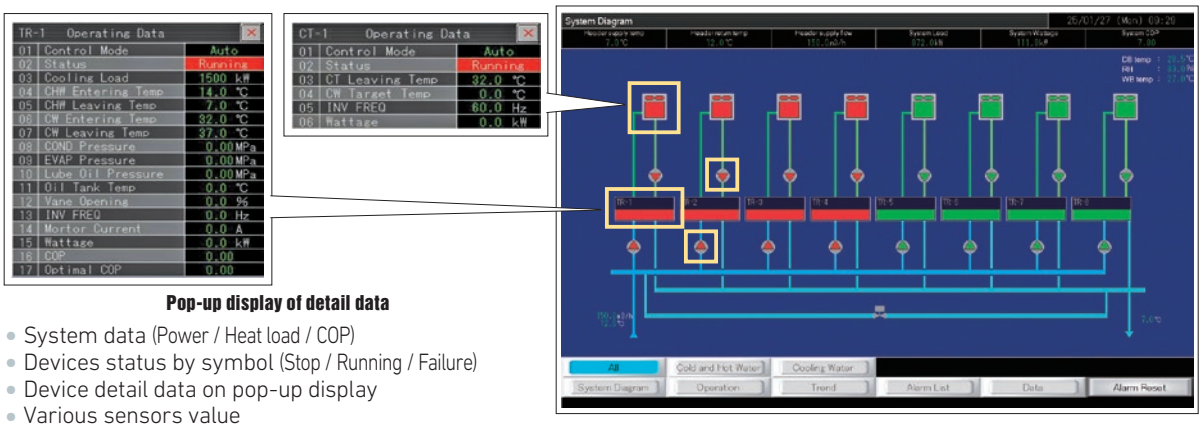


* PLC: MODBUS Communication module

Easy Operation

System diagram

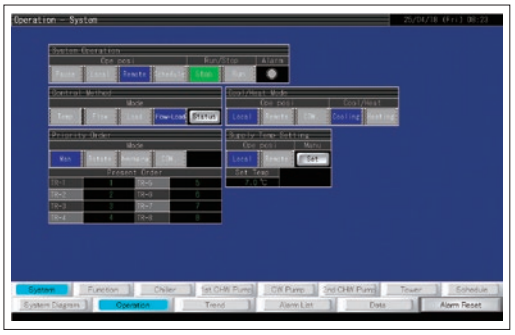
Various information is displayed on the system diagram of the main screen.



Pop-up display of detail data

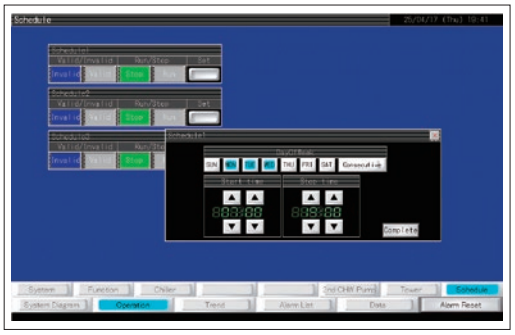
- System data (Power / Heat load / COP)
- Devices status by symbol (Stop / Running / Failure)
- Device detail data on pop-up display
- Various sensors value

Operation screen



- Switching of system operation mode (Pause / Local / Remote / Schedule)
- Setting for chiller operation order (Manual / Rotation / Averaging)
- Setting for control method (Temperature / Flow / Load / Flow + Load)
- Setting for supply water temperature
- Start-stop individually order for chiller, cooling tower etc.

Schedule screen



- Setting for weekly schedule pattern, max. 3 patterns
  Example :- Daily pattern : from 8:00 to 19:00 of Mondays, Wednesdays and Fridays
  - Continuance pattern : from Mondays 8 :00 to Fridays 19:00

Trend graph screen

- Display max.24hours of trend graphs

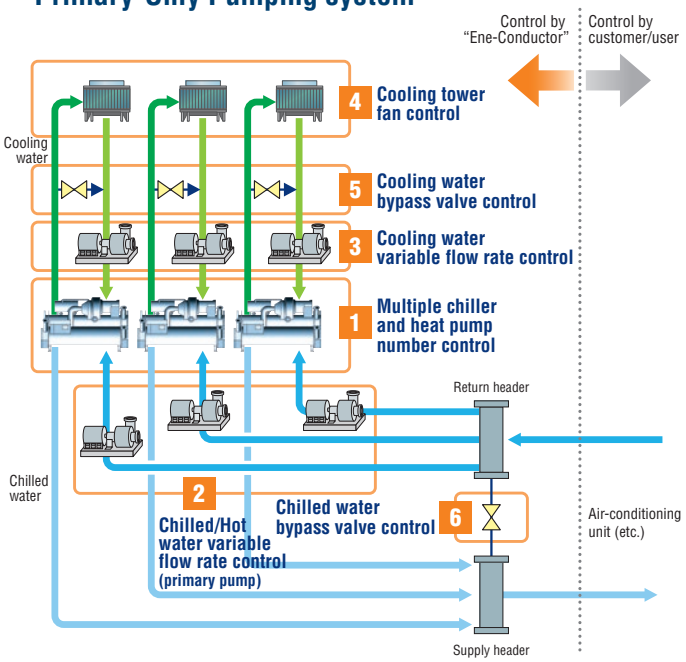
Alarm history screen

- Display max.128 of alarm history

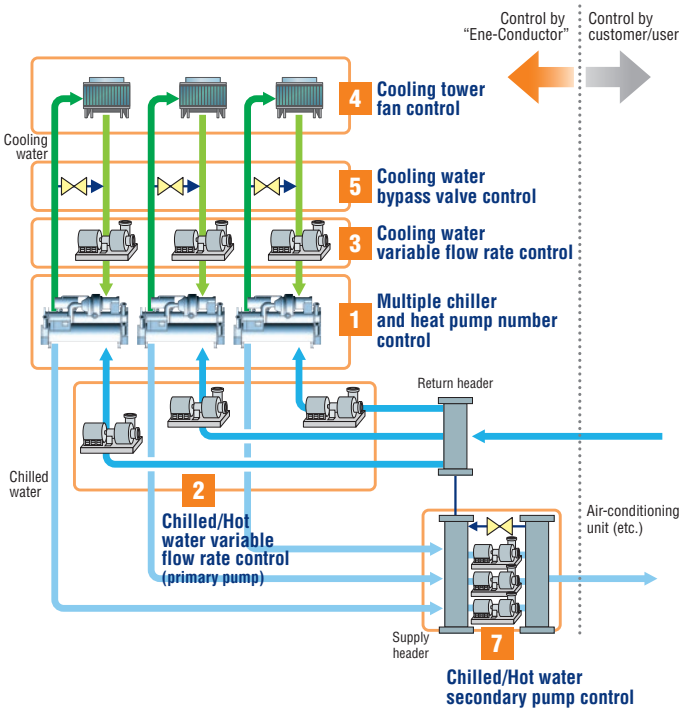
Various energy-saving control functions

Individual pump system

Primary-Only Pumping system

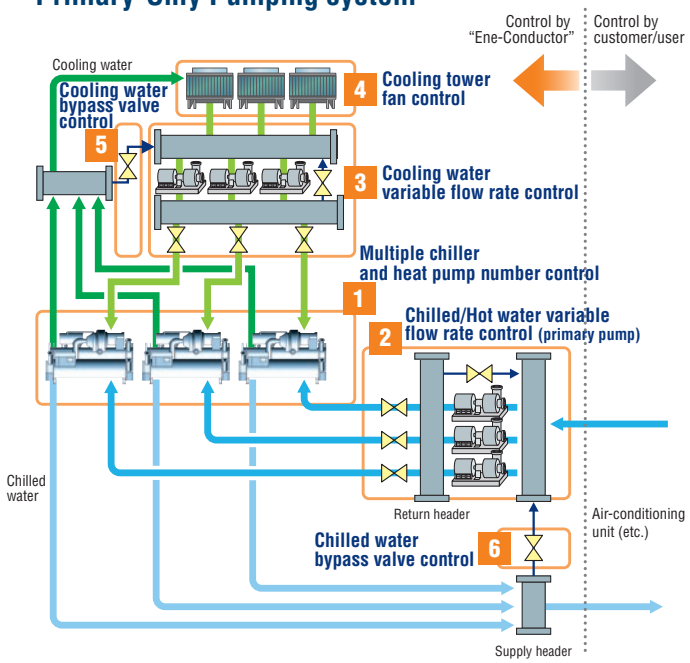


Primary-Secondary Pumping system

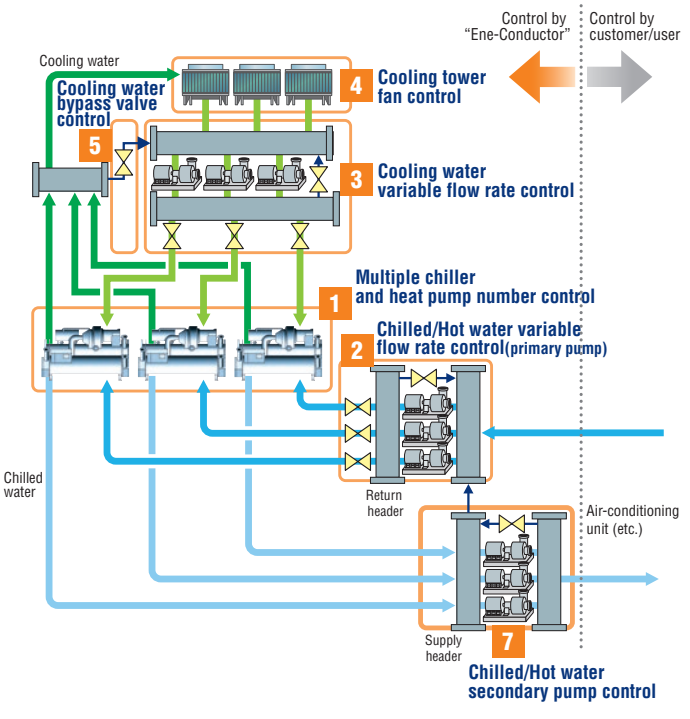


Multiple pump system (EC-8 only)

Primary-Only Pumping system



Primary-Secondary Pumping system



: Control by "Ene-Conductor" : "Ene-Conductor" refers to operation status

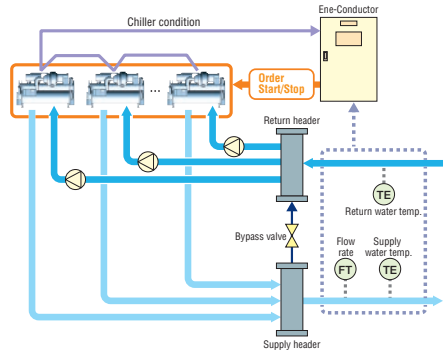
1 Multiple chiller and heat pump number control

MTH* original (Patent approval)

Energy Saving Level ★★

"Ene-Conductor" will decide on the number of chillers to start/stop and the load conditions of each chiller for optimizing performances:

- Energy savings by the amount of chillers to start/stop automatically
- Automatic determination of operation order (manual settings are also available)



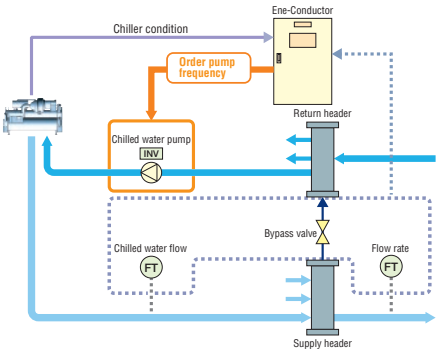
2 Chilled/Hot water variable flow rate control(Primary pump)

MTH* original (Patent approval)

Energy Saving Level ★★★

"Ene-Conductor" will control the chilled water supply flow rate for closing the bypass valve (bypass flow rate is zero) by the pump frequency.

- Reduction of the pump energy consumption depending on the load
- Flexibility to maximize the cooling capacity by increasing the flow rate of the chilled water and, consequently, taking advantage to operate the right number of chillers.



3 Cooling water variable flow rate control

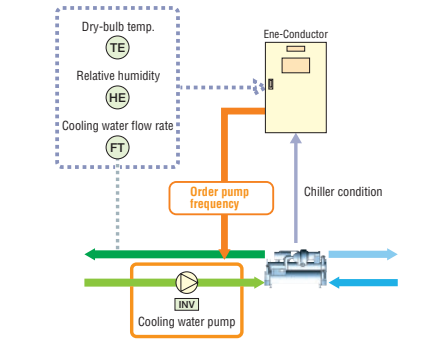
MTH* original (Patent approval)

Energy Saving Level ★★★

Depending on the chillers' load conditions and the outside air conditions,
"Ene-Conductor" will control the cooling water flow rate by the pump frequency.

- Reduction of cooling water pump energy consumption

Note: The chiller energy consumption is slightly increased due to a higher cooling water outlet temperature



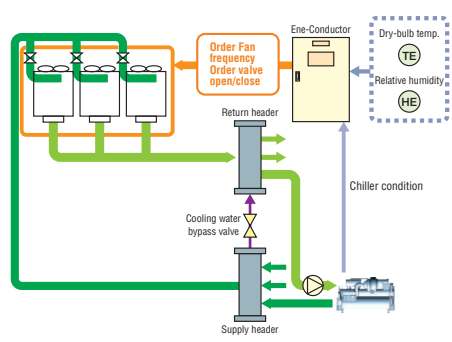
4 Cooling tower fan control

MTH* original (Patent approval)

Energy Saving Level ★★

"Ene-Conductor" will select the number of cooling towers in operation depending on the chillers' load conditions and the outside air conditions. It controls the start/stop of the cooling tower fans depending on outside air conditions and the minimal cooling water temperature.

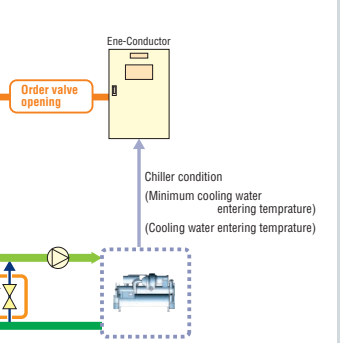
- Lowering the cooling water temperature → higher efficiency operation of the chillers
- Optimizing the number of cooling towers in operation → reducing the energy consumption of the fans



5 Cooling water bypass valve control

"Ene-Conductor" is going to open/close the bypass valve depending on the minimal temperature selected from the chillers.

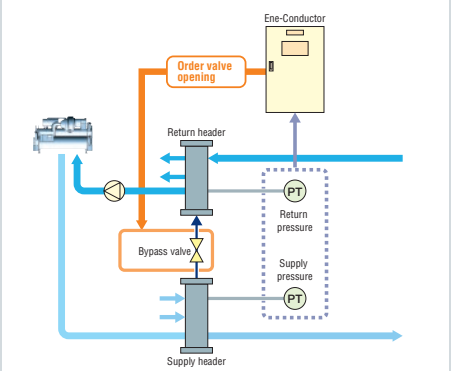
- Stable operation of chillers at low outside temperature
- The chiller operates by a constant acquisition of the minimal cooling water temperature which depends on the chiller operating conditions (supply water temperature/chiller load conditions).



6 Chilled water bypass valve control

Maintain pressure in the chilled water system constant by continuous differential pressure control.

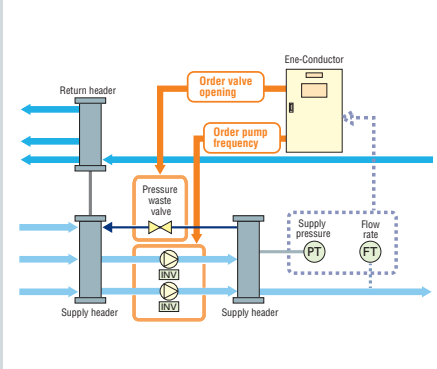
- Control style:select from 3styles;
  Fixing supply pressure
  Fixing estimated terminal differential pressure
  Fixing terminal differential pressure
- Stable supply pressure of chilled water



7 Chilled/Hot water secondary pump control

"Ene-Conductor" will decide on the number of secondary pumps to start / stop for enough supply flow rate of chilled water.
"Ene-Conductor" will control pump frequency and the pressure relief valve opening for supply designed pressure.

- Control style:select from 3styles;
  Fixing supply pressure
  Fixing estimated terminal differential pressure
  Fixing terminal differential pressure
- Suppress hunching by cooperating with multiple chiller control



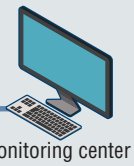
Air to Water Heat Pump Chiller MSV2 optimum control (only for Japan)

Package control max.160units (20units x 8sets)

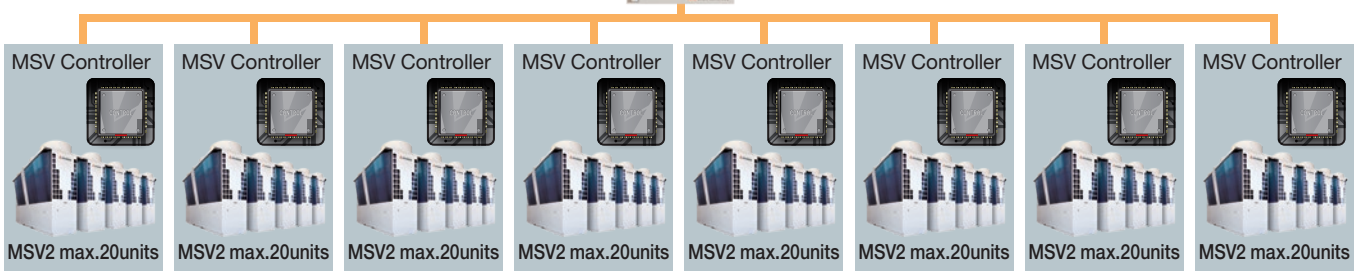
Operate max.11220HP as well as 1unit

Heat Source Control System "Ene-Conductor"

Optimizing the number of heat source equipment, max.8sets



24hrs and 365days Remote Monitoring Program (Option)



■Control function list

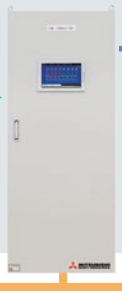
No	Item	"Ene-Conductor"	Control by "Ene-Conductor" + MSV Controller	Unit Control	Control by MSV Controller
1	Multiple heat pump control	• In the case of direct connection with the Ene-Conductor without the MSV controller ✓ max.8units Optimizing the load balance between the operation of the units	• In the case of a connection with the Ene-Conductor through the MSV controller ✓ max.160units (8sets of heat source equipment) Optimizing the load balance between the operation of the units	—	✓ max.20 units Optimizing the load balance between the operation of the units
2	Rotating operation time	✓ Operate by rotation in the operation ime and set priority order	✓ Operate by rotation in the operation time and set priority order	✓ Operate modules by rotation in the operation time	✓ Operate by rotation in the operation time
3	Chilled/Hot water variable flow rate control (Primary pump)	✓	✓	✓	✓
4	Chilled/Hot water secondary pump control	✓	✓	No	✓
5	Chilled water bypass valve control	✓	✓	✓	✓
6	Connection with centrifugal chiller Centrifugal chiller auxiliary control	✓	✓	—	—

Mitsubishi Heavy Industries
Thermal Systems's Strengeth

Control mixed with centrifugal chiller

Heat Source Control System
"Ene-Conductor"

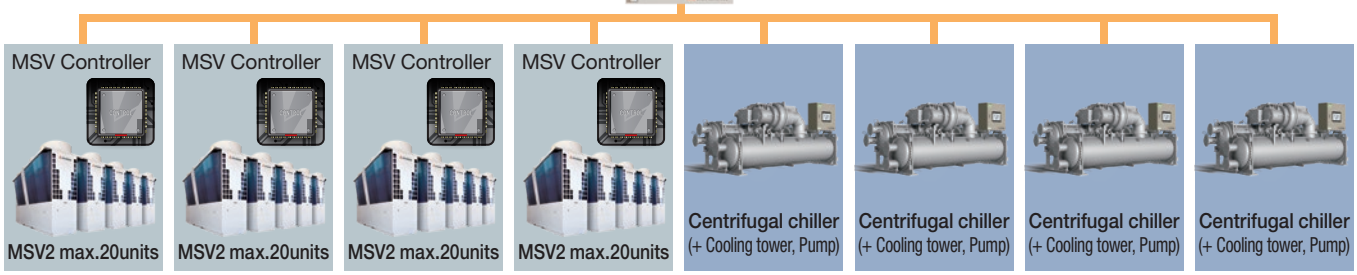
Optimizing the number of
heat source equipment, max.**8**sets

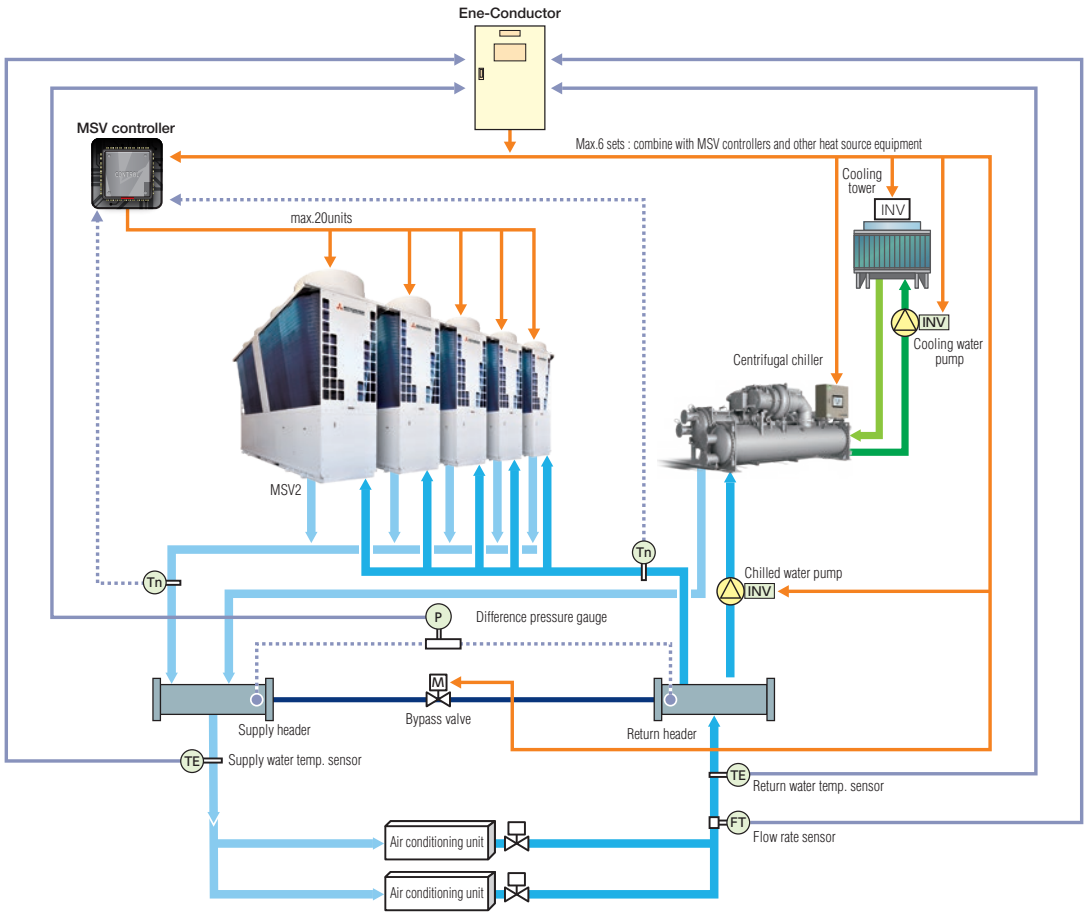



Internet


Monitoring center

24hrs and 365days Remote Monitoring Program
(Option)





Specification

*MTH : Mitsubishi Heavy Industries Thermal Systems, Ltd.

Item	Standard specification			Option specification
Model	EC-3	EC-6	EC-8	
No. of control chiller	1~3 units	1~6 units	1~8 units	
No. of cooling tower	1~3 units	1~6 units	1~8 units	EC-3:1~6 units (Add IO board)
Dimensions (mm)	L700 × D350 × H1300	L800 × D500 × H1800	L800 × D500 × H1800	
Weight (kg)	Approx. 130	Approx. 240	Approx. 240	
Installation Site condition	Indoor installation (Install at a place not exposed to rain, wind, direct sunlight, salt and steam. The adverse environment such as suspending oil-mist, dust or dirt, corrosive gas or flammable gas should be avoided. Use within the range of 0~40°C for ambient temperature and 5~95% for ambient humidity.)			
Installation method	Wall hung	Standing	Standing	EC-3:Provide the mounting for self-support by MTH.
Power specification	Control power: 100~125V		Control power: 100~240V,	200~220V EC-3 and EC-6: Supported with transformer addition
Target model	Centrifugal chiller (JHT-Y, JHT-YI, GART-ZE, GART, GART-I, AART, AART-I, NART, NART-I, ETI-Z, ETI *2) Centrifugal heat pump (ETW*3) ATW heat pump chiller (MSV2, MSV, VOXCEL)			Consult with MTH* for centrifugal chillers not listed in the left column or other companies centrifugal chillers, Absorption chiller, ATW heat pump chiller (add IO board)*1
Auxiliaries to be controlled	Primary chilled/hot water pump, secondary chilled/hot water pump, cooling water pump, cooling tower			Standard specification only The load side equipment such as air conditioning unit should be separately controlled by customer's equipment.*4
Control function *5	Multiple chiller and heat pump, Chilled/Hot water variable flow rate control (primary pump, excess flow control), Cooling water variable flow rate control, Cooling tower operation/fan control (variable air volume control or ON/OFF control), Cooling water bypass valve control, Chilled water bypass valve control, Chilled/Hot water secondary pump control (variable flow control and bypass valve control)			•Instantaneous power failure restart •Demand restriction •Stabilization of supply water temperature •Increase correction of supply water temperature
Screen display	System diagram, operation setting, schedule setting, trend graph, alarm list, control parameter setting screen with password			
display	Stop: Green Operation: Red Fault condition: Orange			① Stop: Red, Operation: Green, Fault condition: Orange ② Stop: Green, Operation: Red, Fault condition: Yellow ③ Stop: Red, Operation: Green, Fault condition: Yellow
Individual failure display	Failure names are displayed on the liquid crystal touch panel.			Individual output is possible by external communication.
Remote start/stop signal	Dry contact pulse signal (Start-up a contact, stop a contact)			Dry contact continuous signal
External signal output (Digital)	Input signal of start, stop, emergency stop Output signal of operation (stop), failure, minor failure, cooling (heating)			Individual output is possible by external communication.
External signal output (Analog)	Input signal of supply water temperature setting			Individual output is possible by external communication.
External communication function	——			"Web communication", "PLC Communication", "Modbus communication", "BACnet communication" are available.*6
Painting	Munsell 5Y7/1 (Half gloss)			
Power wire leading direction	Lead-in from lower part	Lead-in from upper part	Lead-in from upper part	
Signal isolating	Analog signals are all non-isolated. Please perform the insulating work on analog signals at customer's equipment.			

1: Please consult with MTH *2: Exclusion model: heat recovery model *3: Connect equipment consisting of only ETW.
*4: Please control boiler and thermal storage tank by customer *5: Apply to 2 pipes system *6: Please contact us regarding communication devices

Scope of supply

*MTH : Mitsubishi Heavy Industries Thermal Systems, Ltd.

Item	Content	MTH* scope	Out of MTH* scope	Comments
Equipment design	Equipment design		○	
Main body	Control panel (Ene-Conductor)	○		
	Parameter adjustment	○		Set before shipment and at site commissioning
Peripheral devices	Chiller		○	MTH*'s scope of work if the chiller is also purchased.
	Auxiliary		○	Primary chilled/hot water pump, cooling water pump, cooling tower, secondary chilled/hot water pump
	Auxiliary power panel (including inverter and isolator)		○	For Primary chilled/hot water pump, cooling water pump, cooling tower, secondary chilled/hot water pump
	Control valve		○	Main pipe bypass valve, pressure relief valre cooling water bypass valve, cooling tower passing water valve
	Equipment sensor		○	Pressure sensor, temperature sensor, flow sensor
Accessories	Instruction manual	○		
Shop test / inspection	Appearance inspection	○		
	Test to approve the parameter setting	○		
Delivery & Installation	From factory FOB KOBE port in Japan	○		Please consult with MTH* about CIF, specified warehouse in Japan etc.
	Foundation		○	Unloading, hanging, lifting, horizontal pull, delivery to site, etc. are out of MTH*'s scope.
	"Ene-Conductor" installation		○	Installation to foundation or wall surface and installation of foundation bolts are out of MTH*'s scope.
	Storage		○	Maintenance management after delivery is out of MTH*'s scope.
	Entire delivery and installation of peripheral devices		○	
Electric works	From power source to automatic control panel		○	
	From automatic control panel to chiller control panel		○	Chiller is out of MTH*'s scope of supply. If a chiller is purchased from MTH*, it will be the MTH*'s scope of supply.
	From automatic control panel to auxiliary power panel		○	Auxiliary power panel is out of MTH*'s scope of supply.
	From automatic control panel to control valve		○	Control valve is out of MTH*'s scope of supply.
	From automatic control panel to equipment sensor		○	Equipment sensor is out of MTH*'s scope of supply.
	From automatic control panel to remote monitoring panel		○	
	From power source to chiller		○	
	From power source to auxiliary power panel		○	Auxiliary power panel is out of MTH*'s scope of supply.
	From auxiliary power panel to auxiliary equipment		○	Auxiliary equipment is out of MTH*'s scope of supply.
	Grounding work		○	
	Electric wiring counter check		○	Please perform it before trial operation adjustment in principle.
Operation	Existing chiller program change	○		If the existing chiller is MTH'*s chiller, program change will be conducted for communication.
	Site trial operation adjustment		○	Please perform the trial operation according to MTH* operating instruction manual.
Paint works	Control panel (Ene-Conductor) painting	○		Painting color is munsell 5Y-7/1 (Half gloss)
Appurtenant works	Foundation work		○	
	Foundation bolt		○	1 set
	Piping work		○	Include the installation of control valves and equipment sensors.
Others	Cooling water quality control		○	Please be aware that the water quality needs to meet the standards (JRA-GL-02-1994) of the Japan Refrigeration and Air Conditioning Industry Association. Water treatment is out of scope of "heat source control system Ene-Conductor" control.
	Electric, water, etc. for site assembly		○	Please supply free of charge.
	Electric, water, etc. for site trial operation		○	Please supply free of charge.
	Entire load side equipment, control and adjustment		○	Load side equipment such as air conditioning unit is out of MTH*'s scope.
	Post handling of packing material for shipment		○	

In the case of adding an "Ene-Conductor" system to existing equipment, please contact MTH* as the scope is different from above.

HEAT SOURCE CONTROL SYSTEM “Ene-Conductor” CHECK LIST

Workflow == from inquiry to submitting specification/quotation ==

Confirmation1

Control function

Confirm customer’s requests

Equipment

Confirm about the following items
-Specification of heat source equipment
connected with “Ene-conductor”.
-System diagram of existing equipment.

→

Determination of suitable control function

Determine applicable and suitable control functions on the basis of equipment specification.

→

Confirmation2

Specification

Submit the following documents
-specification of sensors selected by MTH*
- procedure of power distribution work

Determine control functions after consultation the following items with customer.
- Adaption or rejection of sensors selected by MTH*
In case of adaption sensors: confirm signal range

Option

Confirm customer’s requests

Submit specification and signal list,
in case of applying of external communication functions.

→

Submit final specification and quotation.

*MTH : Mitsubishi Heavy Industries Thermal Systems, Ltd.

1.Installation

☐ Install with chiller ☐ Add “Heat source control system Ene-Conductor” to existing chiller

2.Application

☐ Air-conditioning for building ☐ Air-conditioning for factory
☐ Production/manufacturing process in factory ☐ D.H.C. ☐ Other

If other, please fill in this space

3.Heat source equipment

Centrifugal chiller

☐ JHT-Y/JHT-YI (Unit) ☐ NART/NART- I (Unit)
☐ GART/GART- I (Unit) ☐ ETI (Unit)
☐ GART-ZE/ZEI (Unit) ☐ ETI-Z (Unit)
☐ AART/AART- I (Unit) ☐ Other (Unit)

Heat pump

☐ ATW Heat pump chiller (Unit)
☐ WTW Centrifugal heat pump ETW (Unit)
☐ Absorption chiller (Unit)
☐ Otherr (Unit)

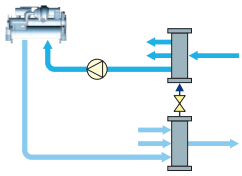
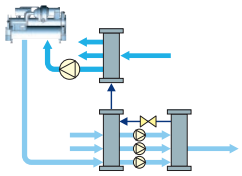
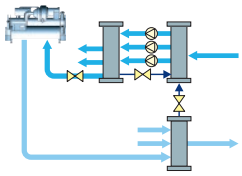
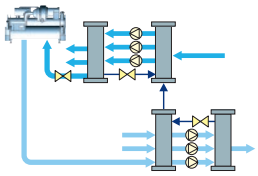
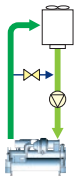
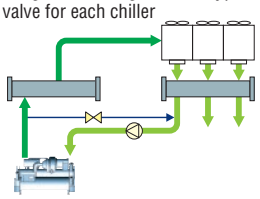
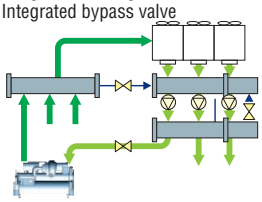
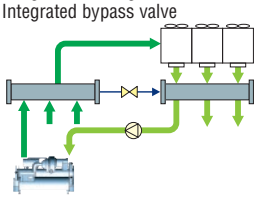
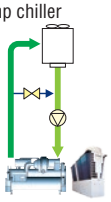
Not MTH product

☐ Centrifugal chiller (Unit)
☐ Absorption chiller (Unit)
☐ ATW Heat pump chiller (Unit)

4.Control function

☐ Multiple chiller and heat pump control
☐ Cooling water variable flow rate control
☐ Cooling water bypass valve control
☐ Chilled water bypass valve control
☐ Cooling tower/fan control (☐ Constant speed ☐ Variable/INV)
☐ Chilled/Hot water variable flow rate control (Primarypump)l
☐ Chilled/Hot water secondary pump control

5.Equipment configuration

	Indivisual pump system		Multiple pump system	
Chilled water/Hot water system	☐ Primary-Only Pumping system 	☐ Primary-Secondary Pumping system 	☐ Primary-Only Pumping system 	☐ Primary-Secondary Pumping system 
Cooling water system	☐ 1 cooling tower and 1 bypass valve for each chiller 	☐ Integrated cooling tower, 1 bypass valve for each chiller 	☐ Integrated cooling tower, Integrated bypass valve 	
	☐ Integrated cooling tower, Integrated bypass valve 	☐ Centrifugal chiller with ATW heat pump chiller 		

☐ Other (If other, please fill in this space)

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