MITSUBISHI ELECTRIC

SPLIT-TYPE AIR CONDITIONERS

Changes for the Better

Revision G:
- MSZ-EF·VEW -E, MSZ-EF·VEB -E, MSZ-EF·VES -E and MXZ-C·VA -E have been added.

Please void OBT17 REVISED EDITION-F.

No. OBT17
REVISED EDITION-G

SERVICE TECHNICAL GUIDE

Models

MSC-GE•VB - E
MS-GD•VB - E
MS-GE•VB - E
MSH-GD•VB - E
MSH-GE•VB - E
MSZ-GC•VA - E
MSZ-HC•VA(B) - E
MSZ-CHC•VA - E
MSZ-FD•VA(S) - E
MSZ-GE•VA - E
MSZ-CGE•VA - E
MSZ-SF•VA - E
MSZ-EF•VEW - E
MSZ-EF•VEB - E
MSZ-EF•VES - E
MLZ-KA•VA - E

- **MU-GD•VB -** E
- **MU-GE•VB -** E
- **MUH-GD•VB -** E
- **MUH-GE•VB -** E
- **MUZ-GC•VA(H) -** E
- **MUZ-HC•VA(B) -** E
- **MUZ-FD•VA(H)(BH) -** E
- **MUZ-GE•VA(H) -** E
- **MUZ-EF•VE -** E
- **MUZ-EF•VEH -** E
- **MXZ-B•VA -** E
- **MXZ-C•VA -** E

CONTENTS

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Revision A:
• MSZ-FD·VA -[E] has been added.

Revision B:
• MS-GD·VB -[E] and MSH-GD·VB -[E] have been added.

Revision C:
• MSZ-FD50VA -[E], MSZ-GE·VA -[E], MSZ-CHC·VA -[E] and MSZ-CGE·VA -[E] have been added.

Revision D:
• MSC-GE·VB-[E], MS-GE·VB-[E], MSH-GE·VB-[E], MUZ-FD50VA -[E], MSZ-GE42/50VA -[E] and MSZ-CGE42/50VA -[E] have been added.

Revision E:
• MSZ-GE60/71VA-[E], MUZ-GE60/71VA -[E], MSZ-SF15/20VA -[E], MXZ-3B54VA -[E], MXZ-3B68VA -[E], MXZ-4B71VA -[E], MXZ-4B80VA -[E] and MXZ-5B100VA -[E] have been added.

Revision F:
• MXZ-2B30VA -[E], MXZ-2B40VA -[E] and MXZ-2B52VA -[E] have been added.

Revision G:
• MSZ-EF·VEW -[E], MSZ-EF·VEB -[E], MSZ-EF·VES -[E] and MXZ-C·VA -[E] have been added.

NOTE: As for the MXZ-A type models or MU/MUH-GA type models, refer to the appropriate service technical guide as well as this service technical guide.

1 MSC/MS/MSH MICROPROCESSOR CONTROL

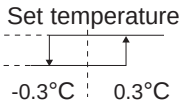
1-1. COOL (☼) OPERATION

1. Thermostat control (MSC-GE20/25/35VB)

Thermostat turns ON or OFF by the difference between room temperature and set temperature

Initial temperature difference	Thermostat
Room temperature minus set temperature : 0.3°C or more	ON
Room temperature minus set temperature : less than -0.3°C	OFF

Difference between room temperature and set temperature during operation

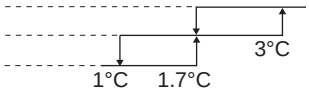


2. Indoor fan speed control

Indoor fan operates at the set speed by FAN SPEED CONTROL button.
In AUTO the fan speed is as follows.

Initial temperature difference	Fan Speed
Room temperature minus set temperature: 1.7°C or more	High
Room temperature minus set temperature: between 1 and 1.7°C	Med.
Room temperature minus set temperature: less than 1°C	Low

Difference between room temperature and set temperature during operation



3. Coil frost prevention

① Temperature control

The coil frost prevention mode in the temperature control is that the indoor fan operates at the set speed and the compressor stops for 5 minutes or more.

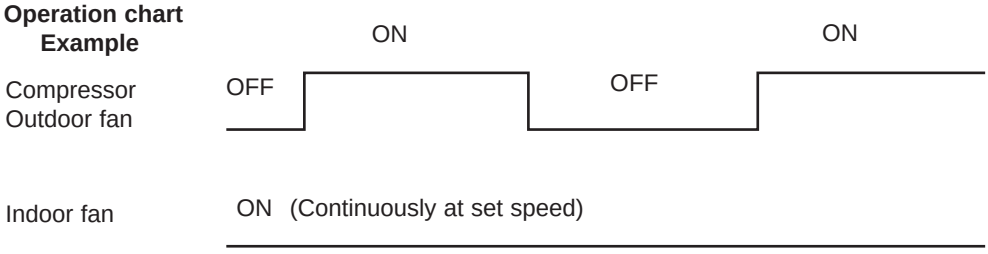
Model	Coil frost prevention	
	ON	OFF
	Indoor coil thermistor (°C)	Indoor coil thermistor (°C)
MSC-GE20VB MSC-GE25VB	4 °C or less	More than 4 °C
MSC-GE35VB	0 °C or less	More than 0 °C
MS-GD80VB	-1 °C or less	More than -1 °C
MS-GE50VB	3 °C or less	More than 3 °C
MSH-GD80VB MSH-GE50VB	1 °C or less	More than 1 °C

※ The coil frost prevention does not work for 5 minutes after the compressor started.

② Time control

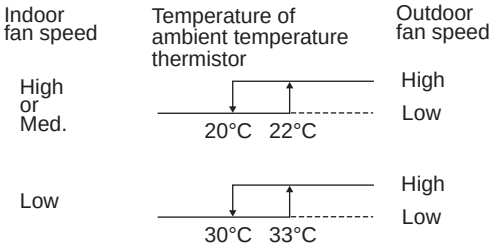
When the three conditions as follows have been satisfied for 1 hour and 45 minutes, compressor stops for 3 minutes.
a. Compressor has been continuously operating.
b. Indoor fan speed is Low or Med.
c. Room temperature is 26°C or less.
When compressor stops, the accumulated time is cancelled and when compressor restarts, time counting starts from the beginning.
Time counting also stops temporarily when the indoor fan speed becomes High or the room temperature exceeds 26°C. However, when two of the above conditions (b. and c.) are satisfied again, time accumulation is resumed.

Operation chart
Example



4. Outdoor fan speed control (MU-GD80VB, MUH-GD80VB)

Outdoor fan speed control is as follows.



5. Discharge temperature protection (MU-GD80VB, MUH-GD80VB)

The compressor is controlled by the temperature of discharge temperature thermistor for excess rise protection of compressor discharge pressure.

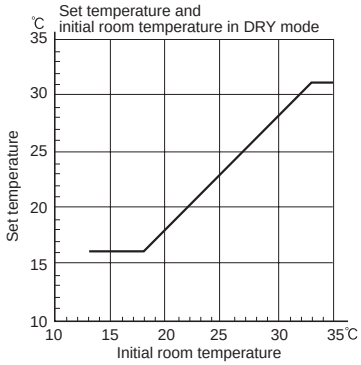
• Compressor

When the temperature of discharge temperature thermistor goes to 120°C or more, the compressor is turned OFF. After 3 minutes since the compressor has been turned OFF, if the temperature of discharge temperature thermistor becomes 100 °C or less, the compressor is turned ON.

1-2. DRY (△) OPERATION

Set temperature is as shown on the right chart.
The system for dry operation uses the same refrigerant circuit as the cooling circuit.
The compressor and the indoor fan are controlled by the room temperature.
By such controls, indoor flow amounts will be reduced in order to lower humidity without much room temperature decrease.

DRY operation will not work when the room temperature is 13°C or below.

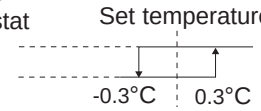


1. Thermostat control (MSC-GE20/25/35VB)

Thermostat turns ON or OFF by the difference between room temperature and set temperature.

Initial temperature difference	Thermostat
Room temperature minus set temperature : 0.3°C or more	ON
Room temperature minus set temperature : less than -0.3°C	OFF

Difference between room temperature and set temperature during operation



2. Indoor fan speed control

Indoor fan operates at the set speed by FAN SPEED CONTROL button.
In Auto fan speed becomes Low.

3. The operation of the compressor and indoor/outdoor fan

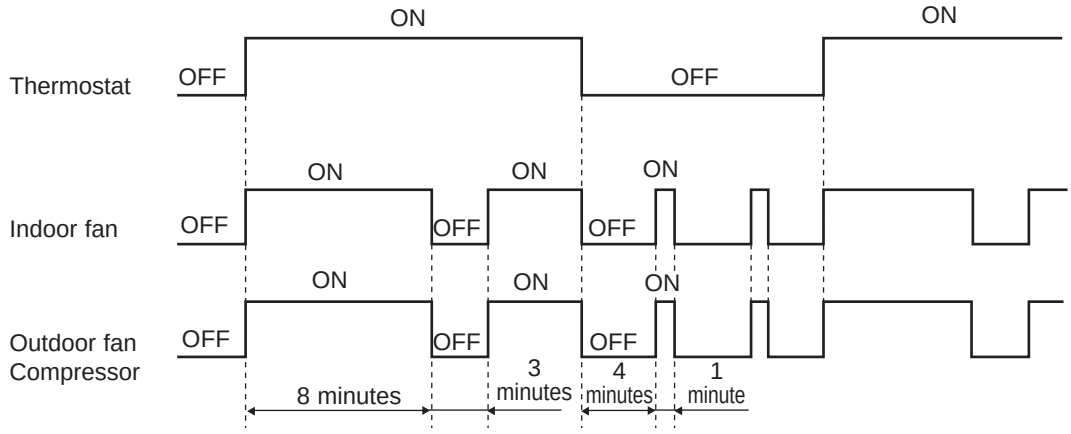
Compressor operates by room temperature control and time control.
Set temperature is controlled to fall 2°C from initial room temperature.
Indoor fan and outdoor fan operate in the same cycle as the compressor.

- When the room temperature is 23°C or over:
  When the thermostat is ON, the compressor repeats 8 minutes ON and 3 minutes OFF.
  When the thermostat is OFF, the compressor repeats 4 minutes OFF and 1 minute ON.
- When the room temperature is under 23°C.
  When the thermostat is ON, the compressor repeats 2 minutes ON and 3 minutes OFF.
  When the thermostat is OFF, the compressor repeats 4 minutes OFF and 1 minute ON.

Operation time chart

Example

When the room temperature is 23°C or over:



4. Coil frost prevention

- The operation is the same as coil frost prevention during COOL mode.
- The indoor fan operates at the set speed and the compressor does not operate for 5 minutes because the coil frost prevention has priority.

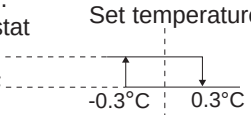
1-3. HEAT (☼) OPERATION (MSC-GE20/25/35VB, MSH-GD80VB, MSH-GE50VB)

1. Thermostat control (MSC-GE20/25/35VB)

Thermostat turns ON or OFF by the difference between room temperature and set temperature.

Initial temperature difference	Thermostat
Room temperature minus set temperature : less than -0.3°C	ON
Room temperature minus set temperature : 0.3°C or more	OFF

Difference between room temperature and set temperature during operation



2. Indoor fan speed control

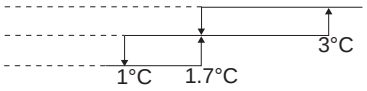
(1) In AUTO the fan speed

(MSC-GE20/25/35VB)

Indoor fan speed at set speed by FAN SPEED CONTROL button.

Initial temperature difference	Fan speed
Set temperature minus room temperature: 1.7°C or more	High
Set temperature minus room temperature: between 1 and 1.7°C	Med.
Set temperature minus room temperature: less than 1°C	Low

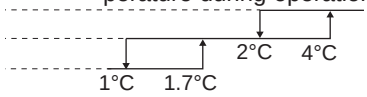
Difference between room temperature and set temperature during operation



(MSH-GD80VB, MSH-GE50VB)

Initial temperature difference	Fan speed
Set temperature minus room temperature: 2°C or more	High
Set temperature minus room temperature: between 1 and 2°C	Med.
Set temperature minus room temperature: less than 1°C	Low

Difference between room temperature and set temperature during operation



(2) Cold air prevention control

① When the compressor is not operating **(MSC-GE20/25/35VB)**:

(Ⅰ) If the temperature of indoor coil thermistor RT12 is 0°C or less, the fan stops.

(Ⅱ) If the temperature of indoor coil thermistor RT12 is more than 0°C, the fan operates at Very Low.

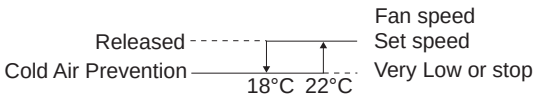
② When the compressor is operating:

(Ⅰ) If the temperature of RT12 is 22°C or more, the fan operates at set speed.

(Ⅱ) If the temperature of RT12 is less than 22°C and

(ⅰ) if the temperature of room temperature thermistor RT11 is 15°C or less, the fan stops.

(ⅱ) if the temperature of room temperature thermistor RT11 is more than 15°C, the fan operates at Very Low.



NOTE : If the temperature of RT12 reads from 18°C to 22°C at the air conditioner stating and also after defrosting, this control works.

(3) Warm air control

When compressor starts in heating operation or after defrosting, the fan changes the speed due to the indoor coil thermistor temperature to blow out warm air.

After releasing of cold air prevention, when the indoor coil thermistor temperature is 37°C or above, the fan speed shifts to the set speed, and when the fan speed is changed by the remote controller, the fan speed is the set speed.

When the indoor coil thermistor temperature is less than 37°C, the fan speed is controlled by time as below.

<Time condition>	<Indoor fan speed>
Less than 2 minutes	Low
2 minutes to 4 minutes	Med.
4 minutes or more	High

The upper limit of the fan speed in MANUAL is the set speed.

The upper limit of the fan speed in AUTO is the speed decided by the indoor fan speed control. (Refer to 1-3.2.(1).)

If the thermostat turns OFF, this operation changes to flow soft control. **(MSH-GD80VB, MSH-GE50VB)**

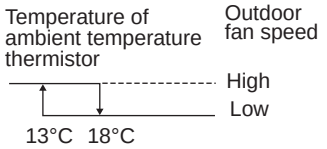
(4) Flow soft control **(MSH-GD80VB, MSH-GE50VB)**

After the thermostat turns OFF, the indoor fan operates at Very Low.

NOTE: When the thermostat turns ON, the fan operates at the set speed. Due to the cold air prevention control, the fan does not start at set speed until the indoor coil thermistor reads 22°C or more.

3. Outdoor fan speed control (MUH-GD80VB)

Outdoor fan speed control is as follows.



4. High pressure protection (MUH-GD80VB, MUH-GE50VB)

During heating operation, the outdoor fan and the compressor are controlled by the temperature of indoor coil thermistor for excess rise protection of compressor discharge pressure.

- Outdoor fan

  When the temperature of indoor coil thermistor goes to 55°C or more, the outdoor fan is turned OFF.

  When the temperature of indoor coil thermistor becomes 52°C or less, the outdoor fan is turned ON.

- Compressor

  When the temperature of indoor coil thermistor goes to 75°C or more, the compressor is turned OFF.

  3 minutes after the compressor is turned OFF and if the temperature of indoor coil thermistor becomes 75°C or less, the compressor is turned ON.

NOTE: During the high pressure protection and for 10 seconds after high pressure protection, defrosting of outdoor heat exchanger is not detected by the defrost thermistor.

5. Defrosting

Defrosting of outdoor heat exchanger is controlled by deicer P.C. board, with detection by the defrost thermistor.

(1) Starting conditions of defrost

When all conditions of a) ~ c) are satisfied, the defrosting operation starts.

a) Under the heat operation, the compressor cumulative operation time exceeds 40 minutes without the defrosting operation working.

b) The defrost thermistor reads -3°C or less.

c) After releasing the high pressure protection 4 minutes and 10 seconds have elapsed.

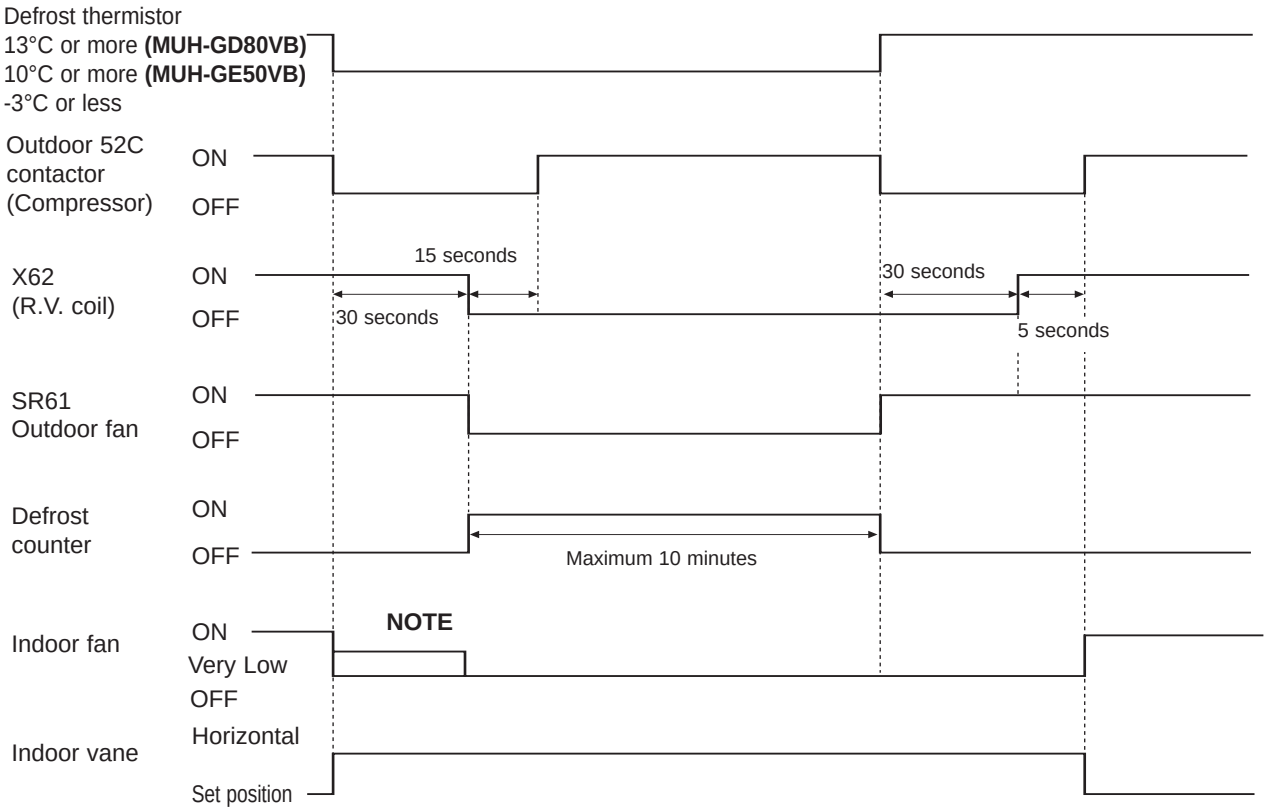
(2) Releasing conditions of defrost

When the condition d) or e) is satisfied, the defrosting operation stops.

d) The defrost thermistor reads 10°C **(MUH-GE50VB) /**13°C or more **(MUH-GD80VB)**.

e) The defrosting time exceeds 10 minutes.

(3) Defrosting time chart



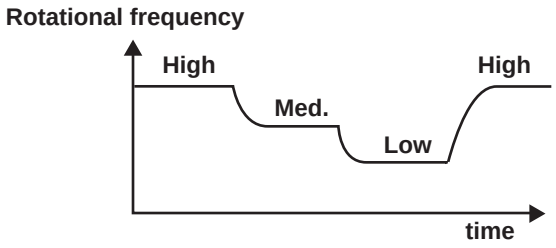
NOTE: • When the indoor coil thermistor reads above 18°C, indoor fan operates at Very Low for 30 seconds.

• When the indoor coil thermistor reads 18°C or less, the indoor fan stops.

1-4. INDOOR FAN MOTOR CONTROL

(1) Rotational frequency feedback control

The indoor fan motor is equipped with a rotational frequency sensor, and outputs signal to the microprocessor to feedback the rotational frequency. Comparing the current rotational frequency with the target rotational frequency (High, Med., Low), the microprocessor controls SR141 and adjusts fan motor electric current to make the current rotational frequency close to the target rotational frequency. With this control, when the fan speed is switched, the rotational frequency changes smoothly.



(2) Fan motor lock-up protection

When the rotational frequency feedback signal has not output for 12 seconds, (or when the microprocessor cannot detect the signal for 12 seconds) the fan motor is regarded locked-up. Then the electric current to the fan motor is shut-off. 3 minutes later, the electric current is applied to the fan motor again. During the fan motor lock-up, the OPERATION INDICATOR lamp flashes ON and OFF to show the fan motor abnormality.

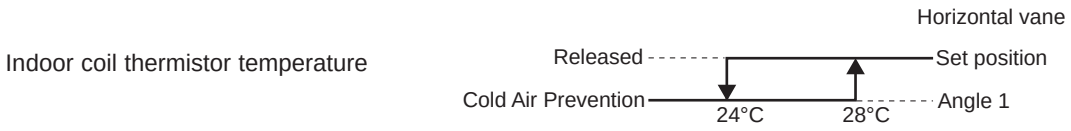
1-5. AUTO VANE OPERATION (MSC, MSH)

1. Horizontal vane

(1) Cold air prevention in HEAT operation

When any of the following conditions occur in HEAT operation, the vane angle changes to Angle 1 automatically to prevent cold air blowing on users.

① Compressor is not operating.
② Defrosting is performed.
③ Indoor coil thermistor reads 24°C or below.
④ Indoor coil thermistor temperature is rising from 24°C or below until it reaches 28°C.



NOTE1: If the temperature of the indoor coil thermistor reads from 24 to 28°C at the air conditioner starting, this control works.

NOTE2: When 2 or more indoor units are operated with multi outdoor unit, even if any indoor unit turns thermostat OFF, this control does not work in the indoor unit.

(2) ECONO COOL (🍃) operation (ECONOmical operation)

When ECONO COOL button is pressed in COOL mode, set temperature is automatically set 2°C higher.
Also the horizontal vane swings in various cycle according to the temperature of indoor heat exchanger.
SWING operation makes you feel cooler than set temperature. So, even though the set temperature is higher, the air conditioner can keep comfort. As a result, energy can be saved.
To cancel this operation, select a different mode or press one of the following buttons in ECONO COOL operation: ECONO COOL, VANE CONTROL or LONG button.

NOTE: ECONO COOL operation does not work in COOL mode of “I FEEL CONTROL”.

<SWING operation>

In swing operation of ECONO COOL operation mode, the initial airflow direction is adjusted to “Horizontal”.
According to the temperature of indoor coil thermistor at starting of this operation, next downward blow time is decided.
Then when the downward blow has been finished, next horizontal blow time is decided.
For initial 10 minutes the swing operation is performed in table G~H for quick cooling.
Also, after 10 minutes when the difference between set temperature and room temperature is more than 2°C, the swing operation is performed in table D ~ H for more cooling.
The air conditioner repeats the swing operation in various cycle as follows.

	Temperature of indoor coil thermistor(°C)	Downward blow time (second)	Horizontal blow time (second)
A	15 or less	2	23
B	15 to 17	5	20
C	17 to 18	8	17
D	18 to 20	11	14
E	20 to 21	14	11
F	21 to 22	17	8
G	22 to 24	20	5
H	More than 24	23	2

1-6. EXPANSION VALVE CONTROL (LEV CONTROL) (MU-GD80VB, MUH-GD80VB)

LEV (Expansion valve) is controlled by “Thermostat ON” commands given from the unit.

Standard specification	Control range	Minimum: 54 pulse, Maximum: 500 pulse
	Drive speed	30 ~ 90 pulse/second
	Opening set	The setting is always in opening direction. (To close LEV, it is closed to the pulse smaller than the one set finally. Then LEV is opened to the final setting pulse.)
General operation	Stop of indoor unit	Opening in stop: 150 pulse → LEV opening is set to become 500 pulse after 3 minutes.
	Remote controller ON	LEV positioning (LEV is closed completely at once)
	Power ON (Breaker ON)	LEV is positioned. However, afterwards, LEV is not positioned when the remote controller is turned ON for the first time after the power ON.
	Approximately for 2 minutes after compressor has started.	Opening is set by the initial opening. (Initial opening is set according to each operation mode and outer temperature conditions.)
	Approximately 2 to 13 minutes (for 11 minutes) after compressor has started.	Opening is set by standard opening. (Standard opening is set according to each operation mode and outer temperature conditions.)
	13 minutes after compressor has started.	LEV opening is corrected every 2 minutes so that discharge temperature becomes the target discharge temperature. (When the discharge temperature is lower than the target temperature: LEV is corrected in closed direction, when the discharge temperature is higher than the target temperature: LEV is corrected in opening direction.)
	Thermostat OFF	Opening in stop: 150 pulse → LEV is set to the initial opening after about 3 minutes.
	Thermostat ON	Same as the starting of compressor operation
	Remote controller OFF	Opening in stop: 150 pulse → LEV is set so that the opening is opened completely at the speed of 4 pulse every 5 seconds in opening after about 3 minutes.

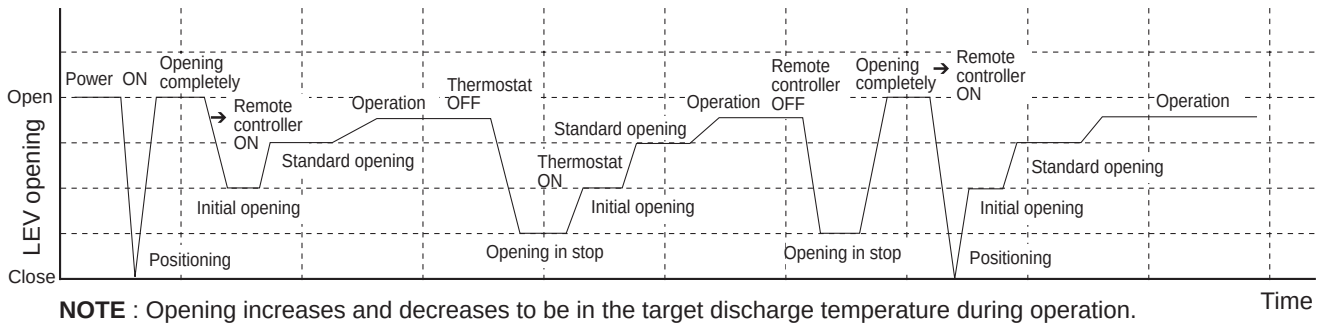
(1) Control data

Reference value of target discharge temperature

Operation mode	Target discharge temperature (°C)
HEAT (**MUH-GD80VB**)	85
COOL (Normal)	80
COOL (ΔRT is less than 2°C, or ΔRT is 2°C or more and less than 3°C.)	70
COOL (ΔRT is 3°C or more.)	65

NOTE: When the discharge temperature is 50°C or less on the cool operation, or is 49°C or less on heat operation (**MUH-GD80VB**), LEV opening is set in 54 pulse.
When this state continues for 20 minutes, the compressor is stopped and restarts in 3 minutes.
When the compressor is stopped, the indoor unit indicates the abnormality of refrigerant system and stops. (OPERATION INDICATOR lamp is 10-time flashing ON and OFF.)

(2) LEV time chart



NOTE : Opening increases and decreases to be in the target discharge temperature during operation.

2 MSZ/MLZ MICROPROCESSOR CONTROL

2-1. COOL (☼) OPERATION

1. Thermostat control (MSZ)

Thermostat turns ON or OFF by the difference between room temperature and set temperature.

Thermostat	Room temperature minus set temperature (Initial)	Room temperature minus set temperature (During operation)
ON	-1°C or more	-1°C
OFF	Less than -1°C	-0.75°C

2. Indoor fan speed control

Indoor fan operates continuously at the set speed by FAN SPEED CONTROL button regardless of the thermostat's OFF-ON. [When the thermostat turns OFF, the indoor fan stops running to reduce power consumption.
After that, the indoor fan stops for 60 seconds and then operates at Very Low for 10 seconds to sense accurate room temperature. The indoor fan alternates ON and OFF at this interval while the thermostat is OFF.
When the room temperature rises and the thermostat is ON, the indoor fan starts running according to the settings on the remote controller. (**MSZ-GE60/71VA**)]
[When the thermostat turns OFF, the indoor fan operates at very Low to reduce power consumption. When the room temperature rises and the thermostat turns ON, the indoor fan starts running according to the settings on the remote controller (**MSZ-EF**)]
In AUTO, the fan speed is as follows.

Fan speed	Room temperature minus set temperature (Initial)	Room temperature minus set temperature (During operation)
High	1.75°C or more	3°C
Med.	Between 1 and 1.75°C	1°C
Low	Less than 1°C	1.75°C

3. Coil frost prevention (MSZ)

The compressor operational frequency is controlled to prevent the temperature of indoor heat exchanger from falling excessively.
The compressor is turned OFF for 5 minutes when the temperature of indoor coil thermistor continues 3°C or less for 5 minutes or more.
The indoor fan maintains the actual speed at the time.

4. Low outside temperature operation (MUZ-GC/FD/GE/EF)

MUZ-GC25

If the outside temperature falls to 17°C or less during operation in COOL mode, the unit will switch to the low outside temperature operation mode.
Each outdoor actuator (compressor/fan/LEV) is operated in the exclusive control, which is different from one of normal cool operation.
Especially, fan motor does not operate continuously to maintain sufficient cooling capacity.
<Operation>

(1) Outdoor fan control
Basically, outdoor unit (compressor) operates with outdoor fan OFF.
But, when any of following conditions are satisfied, the outdoor fan turns ON for about 5 seconds.
a). The defrost thermistor reads 45°C or more.
b). The fin temperature thermistor reads 60°C or more.

(2) LEV (expansion valve) control
In normal cool operation, the opening degree of expansion valve is corrected according to the discharge temperature. But in this mode it is fixed to the value corresponding to the operation frequency of compressor.

(3) Dew drop prevention
When the ambient temperature thermistor reads -20°C or less, as coil frost or dew drop from indoor unit may occur, the compressor turns OFF with the outdoor fan ON for prevention of it.

(4) Outdoor temperature detecting control
To detect the exact outdoor temperature in this mode, the compressor turns OFF, but the outdoor fan stays ON for 3 minutes once every 1 hour. If the outdoor temperature rises over 19°C, the unit goes back to the normal COOL mode.
If the outside temperature stays below 19°C, the unit continues to run in the low outside temperature operation mode.

MUZ-GC35, FD, GE, EF

If the outside temperature falls to 18°C or less during operation in COOL mode, the unit will switch to the low outside temperature operation mode.
<Operation>

(1) Outdoor fan control
The outdoor fan rotation speed slows down to maintain sufficient cooling capacity.
NOTE: Even when the unit is in the "thermostat-off" status under the low outside temperature operation mode, the outdoor fan rotation does not stop.

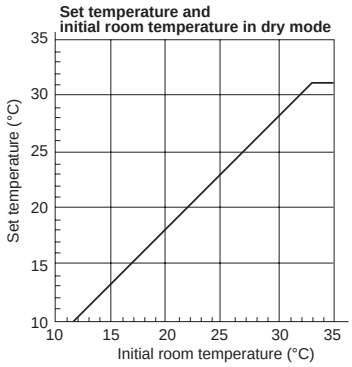
(2) Dew drop prevention
When the ambient temperature thermistor reads the following temperature, as coil frost or dew drop from indoor unit may occur, the compressor turns OFF with the outdoor fan OFF for prevention of dew drop.
- -20°C or less (**MUZ-GC35, FD25/35, GE25/35/42, EF25/35/42**)
- -15°C or less (**MUZ-FD50**)
- -12°C or less (**MUZ-GE50/60/71,EF50**)

(3) Outdoor temperature detecting control
To detect the exact outdoor temperature in this mode, the compressor turns OFF but the outdoor fan stays ON for 3 minutes once every 1 hour. If the outdoor temperature rises over about 18°C, the unit goes back to the normal COOL mode.
If the outside temperature stays below about 18°C, the unit continues to run in the low outside temperature operation mode.

※ Other protections work as well as in the normal COOL mode.

2-2. DRY (△) OPERATION

Set temperature is as shown on the right chart.
The system for dry operation uses the same refrigerant circuit as the cooling circuit.
The compressor and the indoor fan are controlled by the room temperature.
By such controls, indoor air flow amounts will be reduced in order to lower humidity without much room temperature decrease.



1. Thermostat control (MSZ)

Thermostat turns ON or OFF by the difference between room temperature and set temperature.

Thermostat	Room temperature minus set temperature (Initial)	Room temperature minus set temperature (During operation)
ON	-2 °C or more	
OFF	Less than -2 °C	-2°C -1.75°C (**MSZ-GE25/35/42,EF25/35/42/50**)
		-2°C -0.75°C (**Other models**)

2. Indoor fan speed control

Indoor fan operates continuously at the set speed by FAN SPEED CONTROL button regardless of the thermostat's OFF-ON. [When the thermostat turns OFF, the indoor fan stops running to reduce power consumption.
After that, the indoor fan stops for 60 seconds and then operates at Very Low for 10 seconds to sense accurate room temperature. The indoor fan alternates ON and OFF at this interval while the thermostat is OFF.
When the room temperature rises and the thermostat is ON, the indoor fan starts running according to the settings on the remote controller. (**MSZ-GE60/71VA**)]
[When the thermostat turns OFF, the indoor fan operates at very Low to reduce power consumption. When the room temperature rises and the thermostat turns ON, the indoor fan starts running according to the settings on the remote controller (**MSZ-EF**)]
In AUTO, the fan speed is as follows.

Fan speed	Room temperature minus set temperature (Initial)	Room temperature minus set temperature (During operation)
High	1.75°C or more	2.5°C
Med.	Between 1 and 1.75°C	1.75°C
Low	Less than 1°C	1°C

3. Coil frost prevention (MSZ)

Coil frost prevention is as same as COOL mode. (2-1.3.)
The indoor fan maintains the actual speed of the moment. However, when coil frost prevention works while the compressor is not operating, its speed becomes the set speed.

4. Low outside temperature operation (MUZ-GC/FD/GE/EF)

Low outside temperature operation is as same as COOL mode. (2-1.4.)

2-3. HEAT (☼) OPERATION

1. Thermostat control (MSZ)

Thermostat turns ON or OFF by the difference between room temperature and set temperature.

Thermostat	Room temperature minus set temperature (Initial)	Room temperature minus set temperature (During operation)
ON	Less than 1°C	
OFF	1°C or more	0.75°C 1°C (**MSZ-GE60/71,EF25/35/42/50**)
ON	Less than 2°C	
OFF	2°C or more	1.75°C 2°C (**Other models**)

NOTE: When 2 or more indoor units are operated with a multi type outdoor unit, the fan operates intermittently at Very Low or stops in the thermostat-OFF units while at least one unit is thermostat-ON.

2. Indoor fan speed control

(1) Indoor fan operates at the set speed by FAN SPEED CONTROL button.
In Auto, the fan speed is as follows.

Fan speed	Room temperature minus set temperature (Initial)	Room temperature minus set temperature (During operation)
High	Less than 0.25°C	0.25°C 1.75°C
Med.	Between 0.25 and 2°C	
Low	2°C or more	2°C 4°C

(2) Cold air prevention control

① When the compressor is not operating,

(Ⅰ) if the temperature of room temperature thermistor is less than 19°C, the fan stops.

(Ⅱ) if the temperature of room temperature thermistor is 19°C or more and

(ⅰ) if the temperature of indoor coil thermistor is less than 0°C, the fan stops.

(ⅱ) if the temperature of indoor coil thermistor is 0°C or more, the fan operates at Very Low.

② When the compressor is operating,

(Ⅰ) if the temperature of indoor coil thermistor is 40°C or more, the fan operates at set speed.

(Ⅱ) if the temperature of indoor coil thermistor is less than 40°C and

(ⅰ) if heating operation starts after defrosting, the fan stops.

(ⅱ) if the temperature of room temperature thermistor is 19°C or less, the fan stops.

(ⅲ) if the temperature of room temperature thermistor is more than 19°C, the fan operates at Very Low.

NOTE: When 3 minutes have passed since the compressor started operation, this control is released regardless of the temperature of room temperature thermistor and indoor coil thermistor.

(3) Warm air control **(MSZ-FD/GE/EF/GC/HC/CHC/CGE)**

When the following any condition of ① (a. ~ c.) and the condition of ② are satisfied at the same time, warm air control works.

① a.) Fan speed is used in MANUAL.

b.) When cold air prevention has been released.

c.) When defrosting has been finished.

② When the temperature of indoor coil thermistor is less than 40°C.

When warm air control works, the fan speed changes as follows to blow out warm air gradually.

Gradation of fan speed in initial

<Time condition>	<Indoor fan speed>
Less than 2 minutes	Low
2 to 4 minutes	Med.
More than 4 minutes	High or Super high

The upper limit of the fan speed in MANUAL is the set speed.

When the temperature of indoor coil thermistor has been 40°C or more, or when the set speed has been changed, this control is released and the fan speed is the set speed.

3. Overload starting

When the room temperature thermistor reads 18°C or more, the compressor runs with its regulated maximum frequency for a few minutes after the start-up.

4. Defrosting

(1) Starting conditions of defrosting

When the following conditions a) ~ c) are satisfied, the defrosting starts.

a) The defrost thermistor reads: -3°C or less (**MUZ-GC, HC, FD25/35, GE, EF**).
-0.6°C or less (**MUZ-FD50**).

b) The cumulative operation time of the compressor has reached any of the set values※ (defrost interval: 40-150 minutes).

c) More than 5 minutes have passed since the start-up of the compressor.

※ The defrost interval is decided by the previous defrosting time. The next defrost interval extends or shortens 0-20 minutes compared with the previous defrost interval.

(2) Releasing conditions of defrosting

Defrosting is released when any of the following conditions are satisfied:

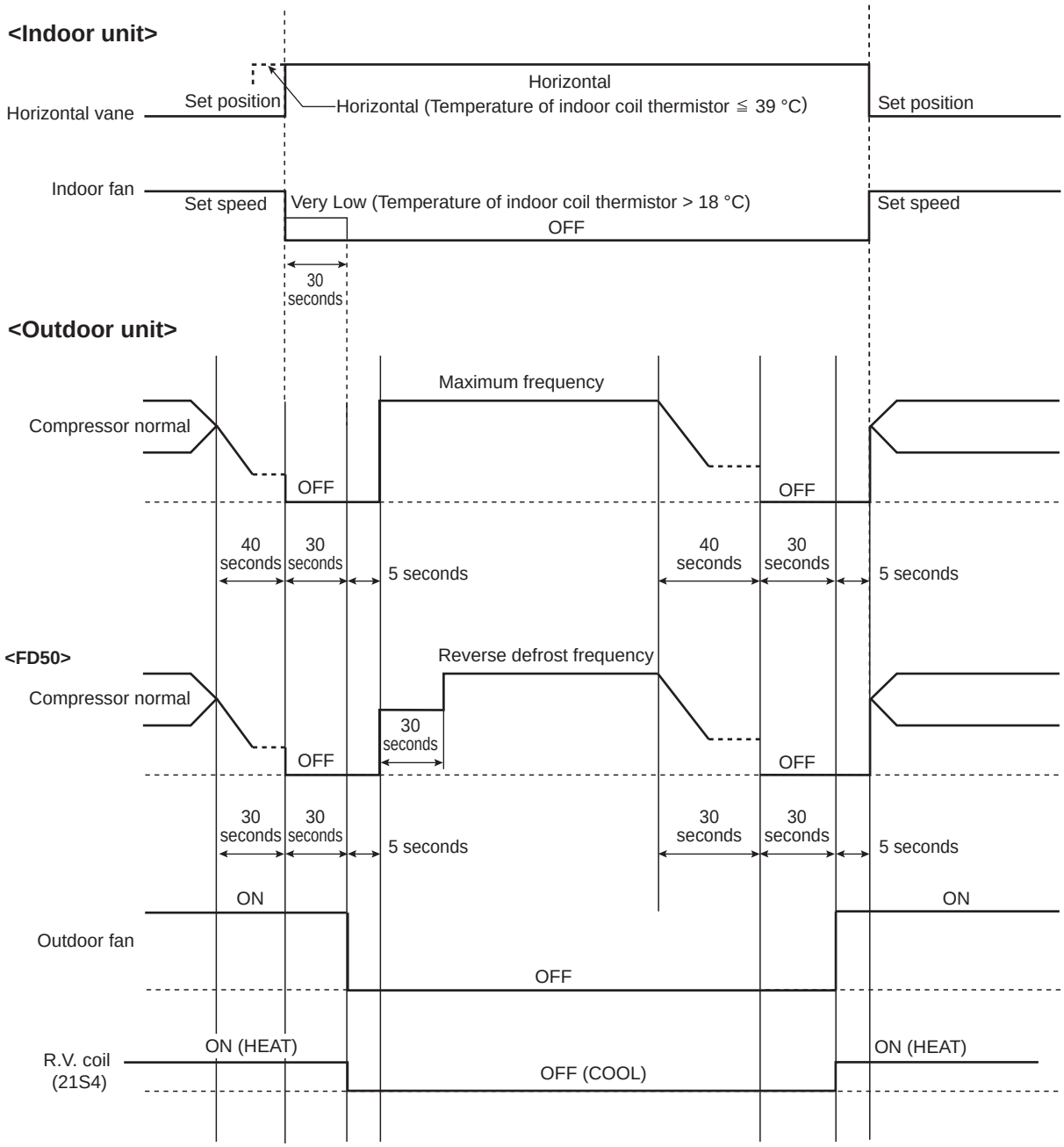
a) The defrost thermistor continues to read following temperature for 30 seconds:

- 5°C or more (**MUZ-GC•VA, HC, FD25/35, GE25/35/42, EF25/35/42**)
- 8°C or more (**MUZ-GC•VAH, FD50**)
- 15°C or more (**MUZ-GE50**)
- 10°C or more (**MUZ-GE60/71,EF50**)

b) Defrosting time exceeds 10 minutes.

c) Any other mode than HEAT mode is set during defrosting.

Time chart of defrosting in HEAT mode (reverse type)



5. Defrost heater (MUZ-GC·VAH, FD·VAH/VABH, GE·VAH, EF·VEH)

(1) Starting conditions

When all of the following conditions a) ~ d) are satisfied, defrost heater turns ON to prevent ice from foaming on the base of outdoor unit.

a) HEAT mode is selected.

b) The ambient temperature thermistor reads 5°C or less for 5 minutes continuously. (**NOTE 1**).

c) The defrost thermistor reads -1°C or less for 5 minutes continuously.

d) Outdoor fan motor is turned ON.

(2) Releasing conditions

When any of the following conditions are satisfied, defrost heater turns OFF.

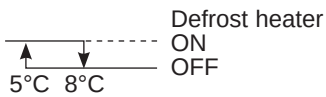
a) Any other mode than HEAT mode is selected. (**NOTE 2**).

b) The ambient temperature thermistor reads 8°C or more for 5 minutes continuously. (**NOTE 1**).

c) The defrost thermistor reads more than 15°C for 5 minutes continuously.

d) Outdoor fan motor is turned OFF.

NOTE 1: Ambient temperature thermistor



NOTE 2: During defrosting operation, defrost heater continues to be ON.

2-4. AUTO CHANGE OVER ··· AUTO MODE OPERATION (MSZ-GC/FD/GE/CGE/SF/EF, MLZ-KA)

Once desired temperature is set, unit operation is switched automatically between COOL and HEAT operation.

1. Mode selection

(1) Initial mode

At first, indoor unit operates only indoor fan with outdoor unit OFF for 3 minutes to detect present room temperature. Following the conditions below, operation mode is selected.

① If the room temperature thermistor reads higher than set temperature, COOL mode is selected.

② If the room temperature thermistor reads set temperature or lower, HEAT mode is selected.

(2) Mode change

In case of the following conditions, the operation mode is changed.

① COOL mode changes to HEAT mode when 15 minutes have passed with the room temperature 1 - 2°C below the set temperature.

② HEAT mode changes to COOL mode when 15 minutes have passed with the room temperature 1 - 2°C above the set temperature.

In the other cases than the above conditions, the present operation mode is continued.

NOTE1: Mode selection is performed when multi standby (refer to **NOTE2**) is released and the unit starts operation with ON timer.

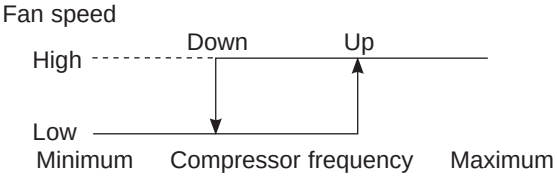
NOTE2: If 2 or more indoor units are operating in multi system, there might be a case that the indoor unit, which is operating in AUTO (▭), cannot change over the other operating mode (COOL ↔ HEAT) and becomes a state of standby.

(3) Indoor fan control/Vane control

As the indoor fan speed and the horizontal vane position depend on the selected operation mode, when the operation mode changes over, they change to the exclusive ones.

2-5. OUTDOOR FAN MOTOR CONTROL

Fan speed is switched according to the compressor frequency.



	Compressor frequency (Hz)	
	Down	Up
MUZ-HC/GC	41	54
MUZ-FD25/35 **MUZ-GE35/42** **MUZ-EF35/42**	33	43
MUZ-FD50	25	33
MUZ-GE25, EF25	41	54
MUZ-GE50, EF50	33	44
MUZ-GE60	33	44
MUZ-GE71	33	43

2-6. AUTO VANE OPERATION

1. Horizontal vane

(1) Cold air prevention in HEAT operation

When any of the following conditions occur in HEAT operation, the vane angle changes to horizontal position automatically to prevent cold air blowing directly onto users.

① Compressor is not operating.

② Defrosting is performed.

③ Temperature of indoor coil thermistor does not exceed following temperature within about 3 minutes after compressor starts.

- 24°C (**MSZ**)
- 18°C (**MLZ**)

NOTE: When 2 or more indoor units are operated with multi outdoor unit, even if any indoor unit turns thermostat OFF, this control does not work in the indoor unit.

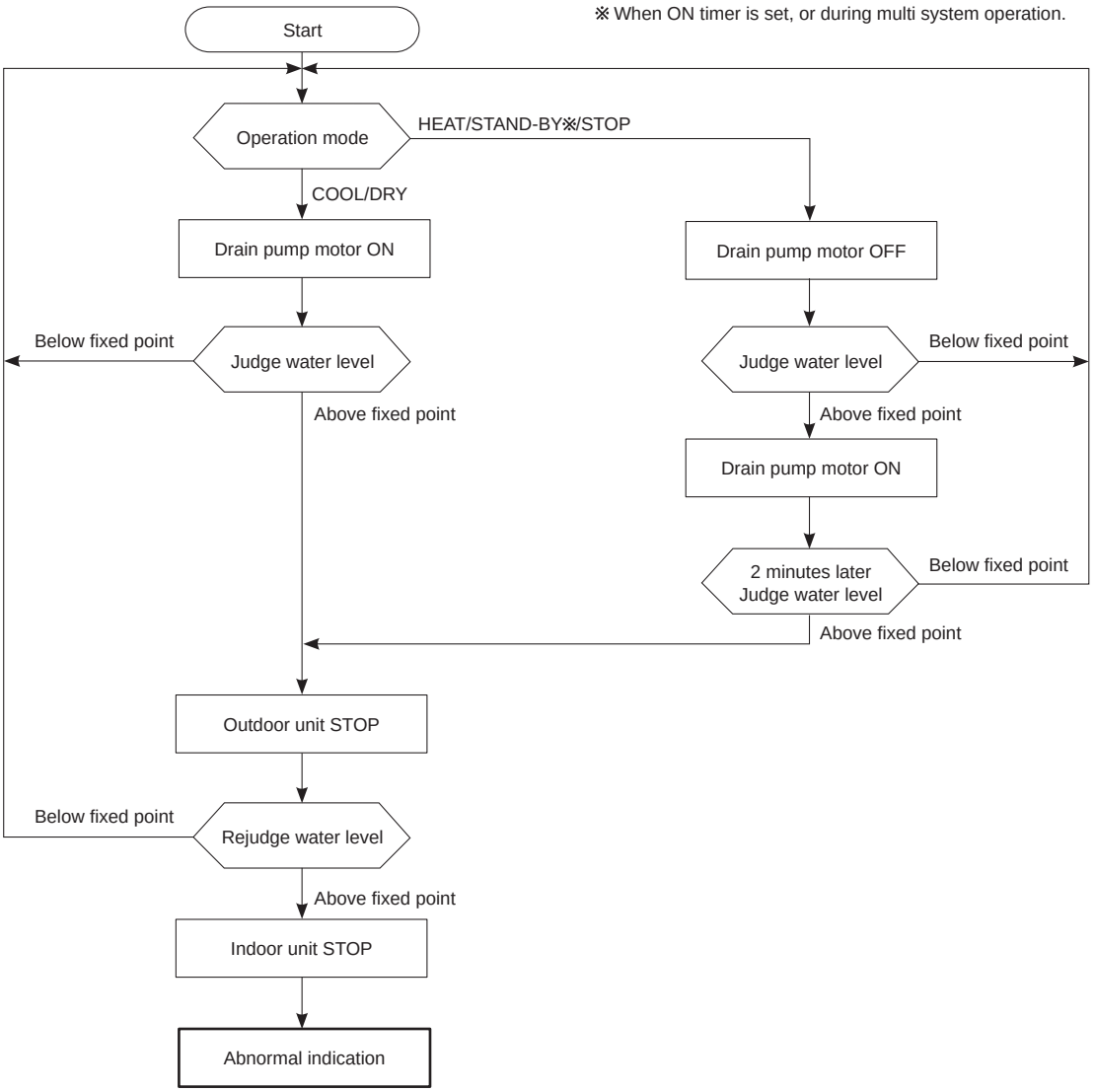
(2) ECONO COOL (🍃) operation (ECONOmical operation)

When ECONO COOL button is pressed in COOL mode, set temperature is automatically set 2°C higher.
Also the horizontal vane swings in various cycle according to the temperature of indoor coil thermistor.
SWING operation makes you feel cooler than set temperature. So, even though the set temperature is higher, the air conditioner can keep comfort. As a result, energy can be saved.
To cancel this operation, select a different mode or press one of the following buttons in ECONO COOL operation: ECONO COOL, VANE CONTROL, LONG or POWERFUL button.

<SWING operation>
In swing operation of ECONO COOL operation mode, the initial air flow direction is adjusted to “Horizontal”.
According to the temperature of indoor coil thermistor at starting of this operation, next downward blow time is decided.
After the downward blow has been finished, next horizontal blow time is decided.
For initial 10 minutes, the swing operation is performed in table G ~ H for quick cooling.
Also, after 10 minutes when the difference between set temperature and room temperature is more than 2°C, the swing operation is performed in table D ~ H for more cooling.
The air conditioner repeats the swing operation in various cycle as follows.

	Temperature of indoor coil thermistor (°C)	Downward blow time (second)	Horizontal blow time (second)
A	15 or less	2	23
B	15 to 17	5	20
C	17 to 18	8	17
D	18 to 20	11	14
E	20 to 21	14	11
F	21 to 22	17	8
G	22 to 24	20	5
H	More than 24	23	2

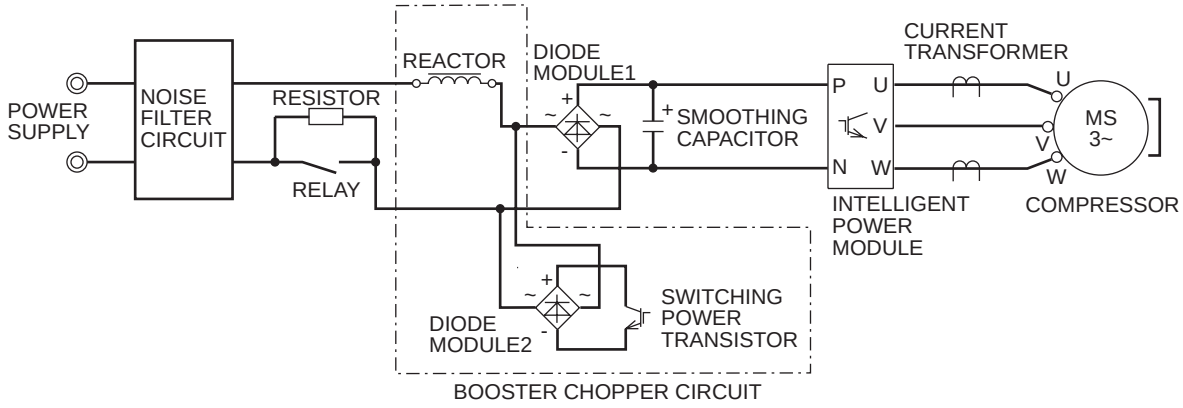
2-7. DRAIN PUMP/FLOAT SENSOR CONTROL (MLZ)



2-8. INVERTER SYSTEM CONTROL

2-8-1. Inverter main power supply circuit

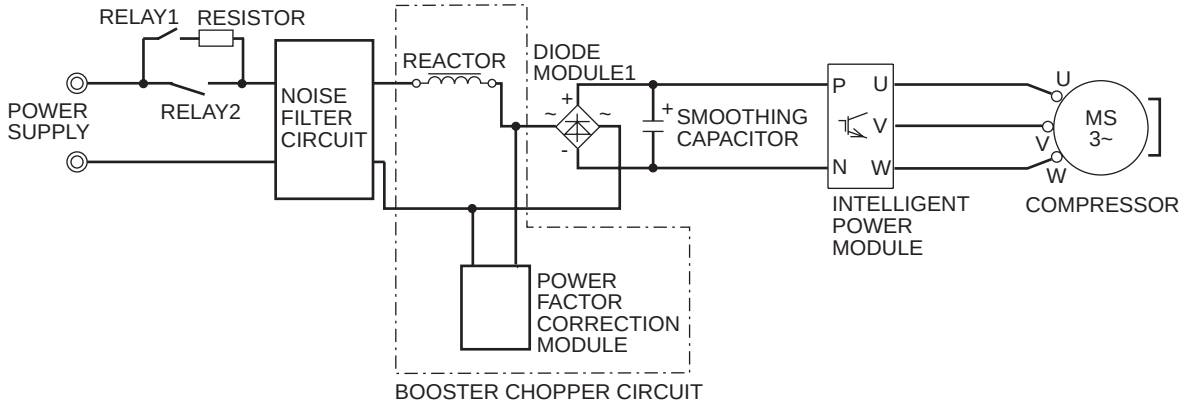
MUZ-GC, HC, FD25/35, GE25/35/42/50



Function of main parts

NAME		FUNCTION
INTELLIGENT POWER MODULE		It supplies 3-phase AC power to compressor.
SMOOTHING CAPACITOR		It stabilizes the DC voltage and supply it to INTELLIGENT POWER MODULE.
CURRENT TRANSFORMER		It measures the current of the compressor motor.
DIODE MODULE 1		It converts the AC voltage to DC voltage.
RESISTOR		It absorbs the rush current not to run into the main power supply circuit when the power is turned ON.
RELAY		It keeps the RESISTOR, which restricts rush current, short-circuit while the compressor is operating.
BOOSTER CHOPPER CIRCUIT	DIODE MODULE 2	It improves power factor. It controls the bus-bar voltage.
	SWITCHING POWER TRANSISTOR	
	REACTOR	

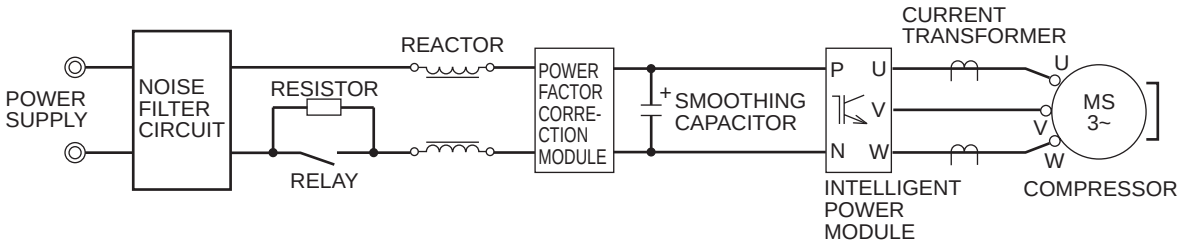
MUZ- EF



Function of main parts

NAME		FUNCTION
INTELLIGENT POWER MODULE		It supplies 3-phase AC power to compressor.
SMOOTHING CAPACITOR		It stabilizes the DC voltage and supply it to INTELLIGENT POWER MODULE.
DIODE MODULE 1		It converts the AC voltage to DC voltage.
RESISTOR		It absorbs the rush current not to run into the main power supply circuit when the power is turned ON.
RELAY1		It passes the rush current to RESISTOR when the power is turned ON.
RELAY2		It keeps the RESISTOR, which restricts rush current, short-circuit while the compressor is operating.
BOOSTER CHOPPER CIRCUIT	POWER FACTOR CORRECTION MODULE	It improves power factor. It controls the bus-bar voltage.
	REACTOR	

MUZ-FD50, GE60/71



Function of main parts

NAME	FUNCTION
INTELLIGENT POWER MODULE	It supplies 3-phase AC power to compressor.
SMOOTHING CAPACITOR	It stabilizes the DC voltage and supplies it to INTELLIGENT POWER MOD-ULE.
CURRENT TRANSFORMER	It measures the current of the compressor motor.
REACTOR	It rectifies AC, controls its voltage and improves the power factor of power supply.
POWER FACTOR CORRECTION MODULE	
RESISTOR	It absorbs the rush current not to run into the main power supply circuit when the power is turned ON.
RELAY	It keeps the RESISTOR, which restricts rush current, short-circuit while the compressor is operating.

2-8-2. Outline of main power supply circuit
MUZ-GC, HC, FD25/35, GE25/35/42/50, EF
1. At the start of operation

Main power supply circuit is formed when RELAY is turned ON at COMPRESSOR startup.
To prevent rush current from running into the circuit when power supply is turned ON, RESISTOR is placed in sub circuit.

2. At normal operation

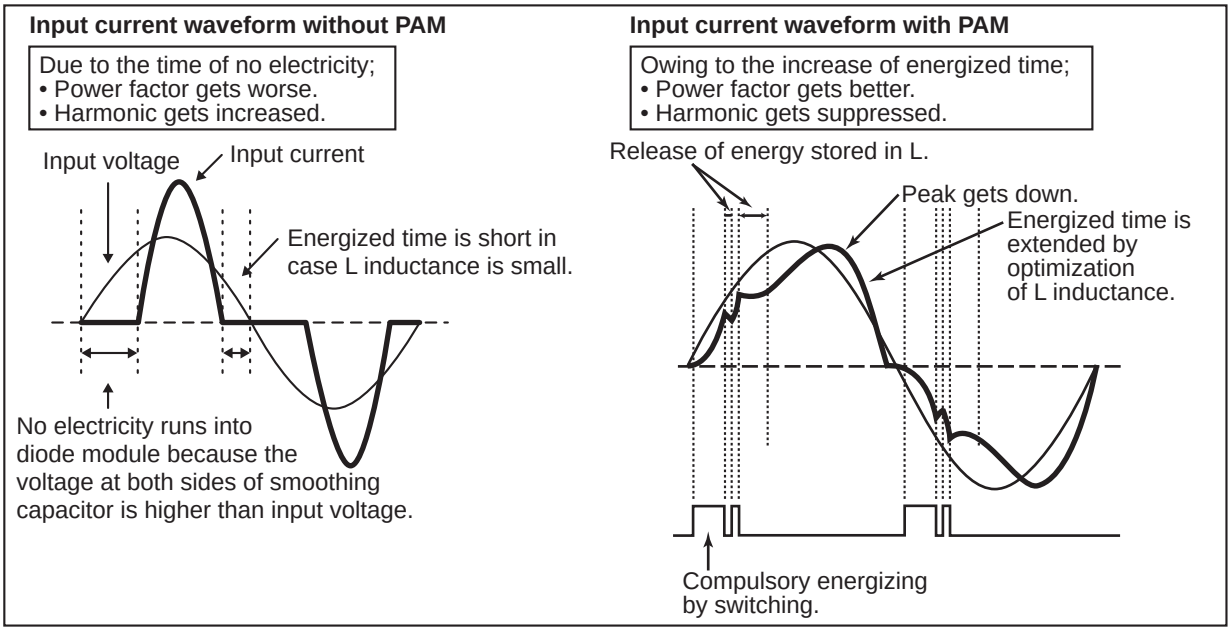
① When AC runs into P.C. board, its external noise is eliminated in the NOISE FILTER CIRCUIT.
② After noise is eliminated from AC, it is rectified to DC by DIODE MODULE 1.
③ DC voltage, to which AC has been rectified by process ②, is stabilized by SMOOTHING CAPACITOR and supplied to IN-TELLIGENT POWER MODULE.
④ DC voltage, which has been stabilized in process ③, is converted to 3-phase AC by INTELLIGENT POWER MODULE and supplied to COMPRESSOR.

3. Purpose of PAM adoption

PAM: Pulse Amplitude Modulation
PAM has been adopted for the efficiency improvement and the adaptation to IEC harmonic current emission standard.

Outline of simple partial switching method

In conventional inverter models, DIODE MODULE rectifies AC voltage to DC voltage, SMOOTHING CAPACITOR makes its DC waveform smooth, and INTELLIGENT POWER MODULE converts its DC voltage to imitate AC voltage again in order to drive the compressor motor.
However, it has been difficult to meet IEC harmonic current emission standard by above circuit because harmonic gets gener-ated in the input current waveform and power factor gets down. The simple partial switching method with PAM, which has been adopted this time, places and utilizes BOOSTER CHOPPER CIRCUIT before rectifying AC voltage in the general passive-meth-od converter circuit. As harmonic gets suppressed and the peak of waveform gets lower by adding BOOSTER CHOPPER CIR-CUIT as mentioned above and by synchronizing the timing of switching with the zero-cross point of waveform, the input current waveform can be improved and the requirement of IEC harmonic current emission standard can be satisfied. Since the switching is synchronized with the zero cross point, this simple partial switching method has the feature of lower energy loss compared to active filter method. In addition, output and efficiency is enhanced by combining with vector-controlled inverter in order to boost the voltage of power supplied to INTELLIGENT POWER MODULE.



4. Intelligent power module

INTELLIGENT POWER MODULE consists of the following components

- IGBT (x6) : Converts DC waveform to 3-phase AC waveform and outputs it.
- Drive Circuit : Drives transistors.
- Protection circuit : Protects transistors from overcurrent.

Since the above components are all integrated in INTELLIGENT POWER MODULE, INTELLIGENT POWER MODULE has a merit to make the control circuit simplify and miniaturize.

5. Elimination of electrical noise

NOISE FILTER CIRCUIT, which is formed by *CMC COILS capacitors placed on P.C. board, eliminates electrical noise of AC power that is supplied to main power supply circuit. And this circuit prevents the electrical noise generated in the inverter circuit from leaking out.

*CMC COILS: Common mode choke coils

MUZ-FD50,GE60/71

1. At the start of operation

Main power supply circuit is formed when RELAY is turned ON at COMPRESSOR startup.

To prevent rush current from running into the circuit when power supply is turned ON, RESISTOR are placed in sub circuit.

2. At normal operation

① When AC runs into noise filter P.C. board, its external noise is eliminated in NOISE FILTER CIRCUIT.

② After noise being eliminated from AC, it is rectified to DC by REACTOR and POWER FACTOR CORRECTION MODULE. If the operating frequency becomes 25 Hz or more, DC voltage rises to 370 V.

③ DC voltage, to which has AC been rectified by process ②, is stabilized by SMOOTHING CAPACITOR and supplied to INTELLIGENT POWER MODULE.

④ The DC (Bus voltage), which has been stabilized in process ③, is converted to 3-phase AC by INTELLIGENT POWER MODULE and supplied to COMPRESSOR.

⑤ CURRENT TRANSFORMER which is placed in the power supply circuit to COMPRESSOR, is used to measure the value of phase current and locates the polar direction of rotor with algorithm. PWM (Pulse width modulation) controls impressed voltage and frequency with those pieces of information.

3. Power factor improvement

Booster coil reactor and POWER FACTOR CORRECTION MODULE rectify AC to DC and control its voltage.

In the motor drive system of sine wave control, power factor can be improved by reducing harmonics. POWER FACTOR CORRECTION MODULE and reactor stabilize the voltage of DC supplied to inverter circuit and make its waveform smooth.

4. Intelligent power module

INTELLIGENT POWER MODULE consists of the following components.

- Power Transistors (x6) : Converts DC waveform to 3-phase AC waveform and outputs it.
- Drive Circuit : Drives transistors.
- Protection circuit : Protects transistors from over current.

Since the above components are all integrated in INTELLIGENT POWER MODULE, INTELLIGENT POWER MODULE has a merit that can get the control circuit simplified and miniaturized.

5. Elimination of electrical noise

NOISE FILTER CIRCUIT, which is formed by *CMC COILS and capacitors placed on the noise filter P.C. board, eliminates electrical noise of AC power that is supplied to main power supply circuit. In short, common mode noise is absorbed in this circuit. Moreover, normal mode noise is absorbed in another NOISE FILTER CIRCUIT which is formed by *NMC COILS and capacitors. Both NOISE FILTER CIRCUITS exist for preventing the electrical noise generated in the inverter circuit from leaking out.

*CMC COILS: Common mode choke coils

*NMC COILS: Normal mode choke coils

2-8-3. Sine wave control

In these air conditioners, compressor equips brushless DC motor which does not have hall element.
In short, the motor is sensorless. However, it is necessary to locate the polar direction of rotor in order to drive brushless DC motor efficiently. The general detection method of the polar direction for such a DC motor is to locate it from the voltage induced by deenergized stator.
Therefore, it is necessary to have a certain period of time in which the stator is being unenergized for the rotor position detection when the voltage of supplied power is impressed.
So the motor has been driven by square wave control (the conventional motor drive system) which energizes the motor only when the range of electrical angle is within 120° because it is forced to be unenergized within 30° at start and end of one heap in one waveform cycle (180°) when the voltage is impressed.
However, torque pulsation occurs at rotation in this method when the current-carrying phases are switched over to other phases in sequence. Therefore, sine wave control system is adopted for these air conditioners because it can make the phase-to-phase current waveform smoother (sine wave) in order to drive the motor more efficiently and smoothly.

2-8-4. Characteristics of sine wave control in case of brushless DC motor

- Although ordinary 3-phase induction motor requires energy to excite the magnetic field of rotor, brushless DC motor does not need it. So, higher efficiency and torque are provided.
- This control provides the most efficient waveform corresponding to the rotational speed of compressor motor.
- The rotation can be set to higher compared to the conventional motor drive system. So, the time in which air conditioner can be operated with less energy is longer than conventional models. This can save annual electric consumption.
- Compared to square wave control, the torque pulsation is reduced at rotation so that the motor operates more quietly.
- Since the response and efficiency of motor are enhanced in sine wave control, finer adjustment can be provided.

	DC Motor	AC Motor
Rotor	Permanent magnet is embedded.	Excited by magnetic field of stator
Rotor Position Signal	Necessary	Unnecessary

※ In brushless DC motor, permanent magnet is embedded in the rotor. Therefore, it does not require energy to excite the rotor like AC motor does. However, it is necessary to control the frequency of 3-phase AC current supplied to the stator according to the polar direction of magnet embedded in the rotor so as to drive the motor efficiently. Controlling 3-phase AC current frequency also means controlling the timing to switch the polarity of stator. Therefore, the polar direction of rotor needs to be detected.

2-8-5. Control Method of Rotational Speed

Sine wave control makes the current transformers conduct real time detection of the value of the current running into the motor, locates the rotor position from the detected value, and decides if voltage should be impressed and if frequency should be changed.
Compared to the conventional control and rotor position detection method, sine wave control can provide finer adjustment of the voltage of supplied power. The value of the current running into the motor is determined by each motor characteristic.

2-9. OPERATIONAL FREQUENCY CONTROL OF OUTDOOR UNIT

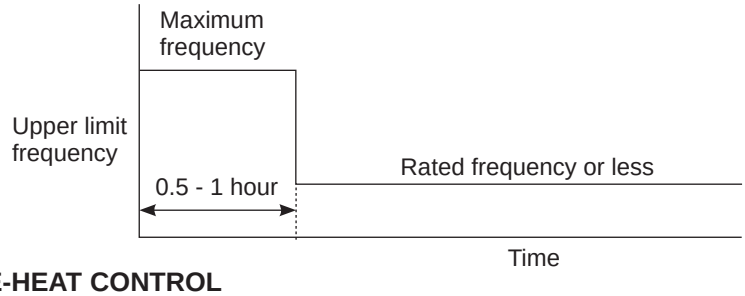
1. Outline

The operational frequency is as follows:
First, the target operational frequency is set based on the difference between the room temperature and the set temperature.
Second, the target operational frequency is regulated by discharge temperature protection, high pressure protection, electric current protection, overload protection, and the maximum/minimum frequency.

2. Maximum/minimum frequency in each operation mode

Applied model	Operational frequency (Hz)					
	COOL		HEAT		DRY	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
MUZ-GC25	32	85	28	105	32	41
MUZ-GC35	32	98	48	105	32	58
MUZ-HC25	28	85	28	105	28	41
MUZ-HC35	28	98	28	98	28	41
MUZ-FD25	10	52	18	90	28	41
MUZ-FD35VA	10	62	18	90	28	41
MUZ-FD35VAH/VABH	10	62	18	115	28	41
MUZ-FD50	20	85	20	130	20	45
MUZ-GE25	24	93	32	105	38	48
MUZ-GE35	20	98	32	98	38	55
MUZ-GE42	10	90	18	115	35	54
MUZ-GE50	20	98	20	108	20	98
MUZ-GE60	20	104	30	117	20	104
MUZ-GE71	26	120	26	124	26	120
MUZ-EF25	28	93	30	105	28	48
MUZ-EF35	20	98	30	98	20	55
MUZ-EF42	10	90	18	100	10	54
MUZ-EF50	20	98	20	108	20	83

※ The operation frequency in COOL mode is restricted by the upper limit frequency after 0.5 - 1 hour as shown below for dew prevention. It is rated frequency or less.



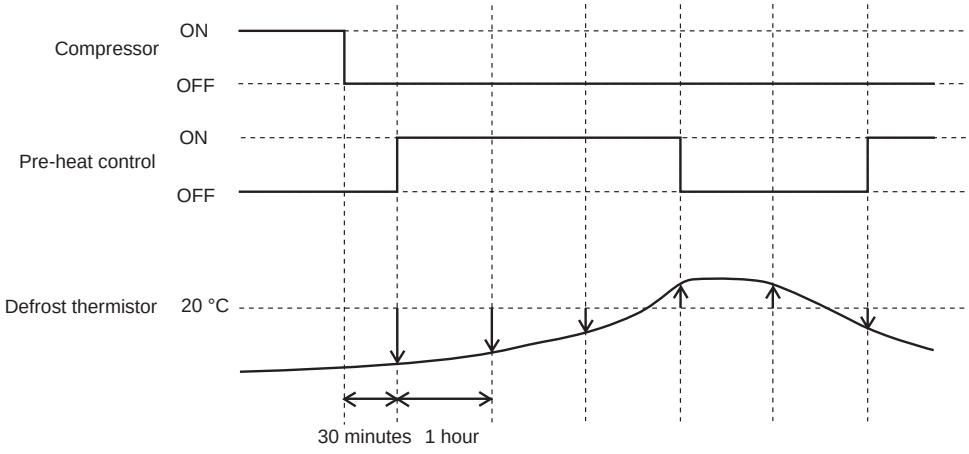
2-10. PRE-HEAT CONTROL

1. Outline

Compressor is energized to improve the start-up of compressor at a low outside temperature even when compressor is stopped.

2. Pre-heat control

MUZ-GC/HC/FD/GE



Pre-heat control ON condition

(1) Compressor is not operating. (However, pre-heat control is still OFF for 30 minutes after compressor is stopped, regardless of the outside temperature.)

(2) Defrost thermistor reads 20°C or below.

Defrost thermistor monitor hourly, and when defrost thermistor reads 20°C or below, pre-heat control is turned ON. When pre-heat control is turned ON, compressor is energized about 50 W (40-60 W). (Compressor and fan are not operated.)

MUZ-EF

Pre-heat control ON condition

(1) Compressor is not operating. (However, pre-heat control is still OFF for 60 minutes after compressor is stopped, regardless of the compressor temperature.)

(2) Compressor temperature is monitored hourly, and when the compressor temperature is 20°C or below, pre-heat control is turned ON.

(3) When the compressor temperature exceeds 30 °C, pre-heat control is turned OFF.
When pre-heat control is turned ON, compressor is energized about 50 W (40-60 W). (Compressor and fan are not operated.)

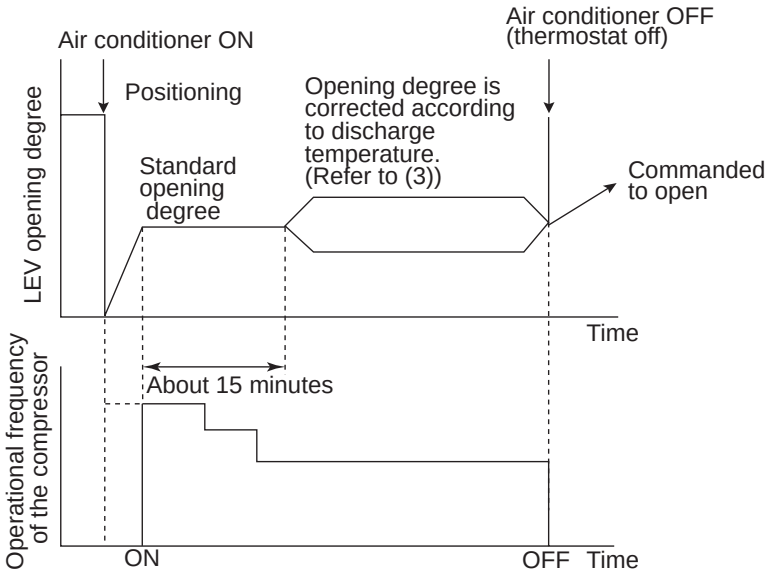
2-11. EXPANSION VALVE CONTROL/LEV CONTROL (MUZ-GC/FD/GE/EF/HC35VA(B)- E2)

(1) Outline of LEV control

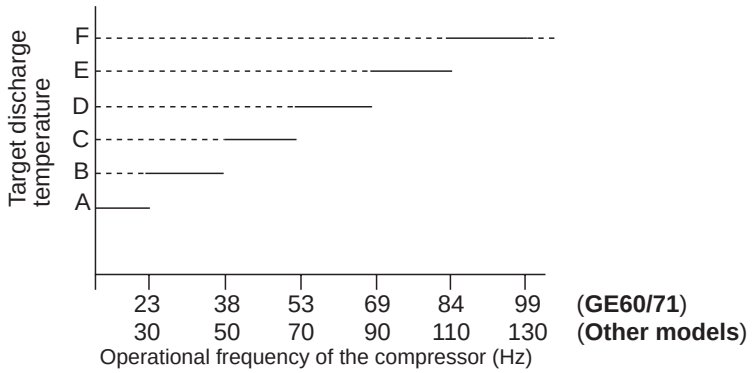
The LEV basic control is setting of LEV opening degree to the standard opening degrees set for each operational frequency of the compressor. However, when any change in indoor/outdoor temperatures or other factors cause air conditioning load fluctuation, the LEV control also works to correct LEV opening degree based on discharge temperature (Shell temperature) of the compressor, developing the unit's performance.

Standard specification	Control range	Minimum : 54 pulse Maximum : 500 pulse
	Actuating speed	Open: 40 pulse/second Close: 90 pulse/second.
	Opening degree adjustment	LEV opening degree is always adjusted in opening direction. (When reducing the opening degree, LEV is once over-closed, and then adjusted to the proper degree by opening.
General operation	Unit OFF	LEV remains at maximum opening degree. (LEV is reached maximum opening degree approximately in 15 minutes after compressor stops.)
	Remote controller ON	LEV is positioned. (First LEV is full closed at zero pulse and then positioned.)
	During 1 to 15 minutes after compressor starts	LEV is fixed to standard opening degree according to operational frequency of compressor.
	More than about 15 minutes have passed since compressor start-up	LEV opening degree is corrected to get target discharge temperature of compressor. (For lower discharge temperature than target temperature, LEV is corrected in closing direction.) (For higher discharge temperature than target temperature, LEV is corrected in opening direction.) ※It may take more than 30 minutes to reach target temperature, depending on operating conditions.
	Thermostat OFF	LEV is adjusted to exclusive opening degree for thermostat OFF.
	Thermostat ON	LEV is controlled in the same way as that after the compressor has started up.
	Defrosting in HEAT mode	LEV is adjusted to open 500 pulse.

(2) Time chart



(3) Control data



Reference value of target discharge temperature (COOL/HEAT °C)

Applied model	A	B	C	D	E	F
MUZ-GC25	54/36	59/46	65/55	70/63	75/70	79/76
MUZ-HC35VA(B)- E2	52/46	57/50	64/55	70/64	74/73	74/73
MUZ-GC35	51/42	57/50	62/58	67/65	71/70	71/70
MUZ-FD25/35 MUZ-GE42	49/43	55/51	61/59	67/69	72/75	76/80
MUZ-FD50	45/51	58/59	65/65	72/72	72/72	72/72
MUZ-GE25	52/43	58/50	65/55	67/59	70/65	71/69
MUZ-GE35	53/43	60/51	64/58	67/59	72/69	76/75
MUZ-GE50	57/60	60/65	62/70	67/75	74/75	81/75
MUZ-GE60	49/42	53/49	59/58	64/67	69/75	74/83
MUZ-GE71	55/46	61/56	66/66	72/75	77/83	81/86
MUZ-EF25	52/43	58/50	65/55	67/59	70/65	71/69
MUZ-EF35	53/43	60/51	64/58	67/59	72/69	76/75
MUZ-EF42	49/43	55/51	61/59	67/69	72/75	76/80
MUZ-EF50	49/42	53/49	59/58	64/67	69/75	74/83

In COOL operation, the two indoor coil thermistors (one main and one sub) sense temperature ununiformity (super heat) at the heat exchanger, and when temperature difference have developed, the indoor coil thermistors adjust LEV opening degree to get approximate 10°C lower temperature than the target discharge temperature in the table on the left, thus diminishing super heat.

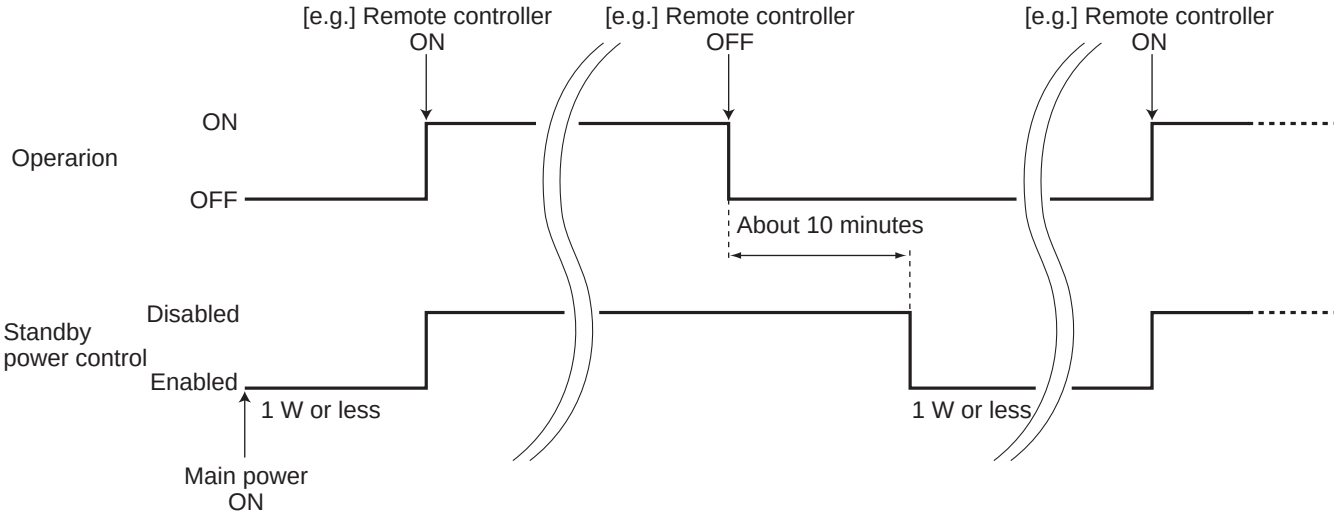
2-12. STANDBY POWER CONTROL

MUZ-EF

(1) Outline

This control allows the power consumption in the standby mode to be maintained at 1 W or less. The control is enabled from the moment the main power is turned on until the operation starts. About 10 minutes later after the operation stops, the control becomes enabled again until the main power is turned off.

(2) Standby power control time chart

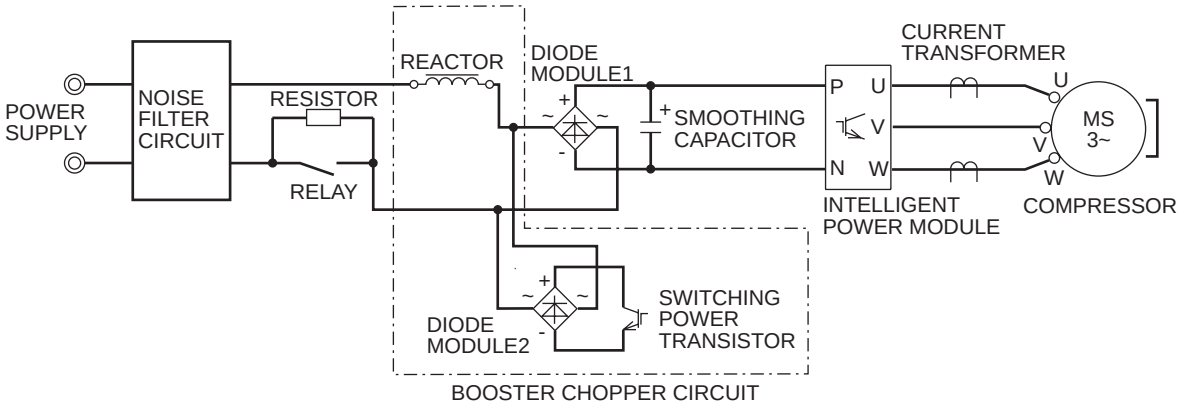


3 MXZ MICROPROCESSOR CONTROL

3-1. INVERTER SYSTEM CONTROL

3-1-1. Inverter main power supply circuit

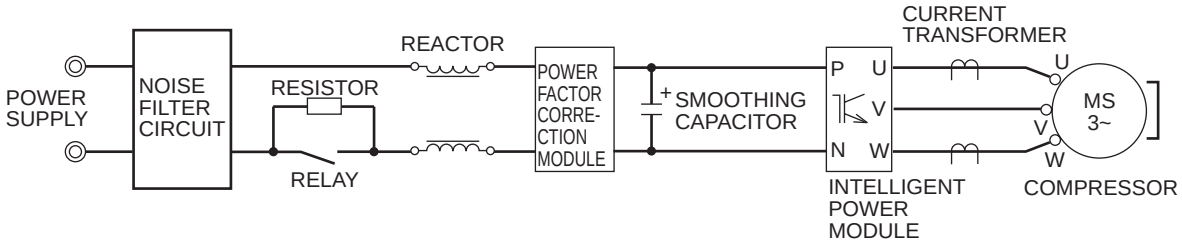
MXZ-2B30VA MXZ-2B40VA MXZ-2B52VA



Function of main parts

NAME		FUNCTION
INTELLIGENT POWER MODULE		It supplies 3-phase AC power to compressor.
SMOOTHING CAPACITOR		It stabilizes the DC voltage and supply it to INTELLIGENT POWER MODULE.
CURRENT TRANSFORMER		It measures the current of the compressor motor.
DIODE MODULE 1		It converts the AC voltage to DC voltage.
RESISTOR		It absorbs the rush current not to run into the main power supply circuit the power is turned ON.
RELAY		It keeps the RESISTOR, which restricts rush current, short-circuited while the compressor is operating
BOOSTER CHOPPER CIRCUIT	DIODE MODULE 2	It improves power factor. It controls the bus-bar voltage.
	SWITCHING POWER TRANSISTOR	
	REACTOR	

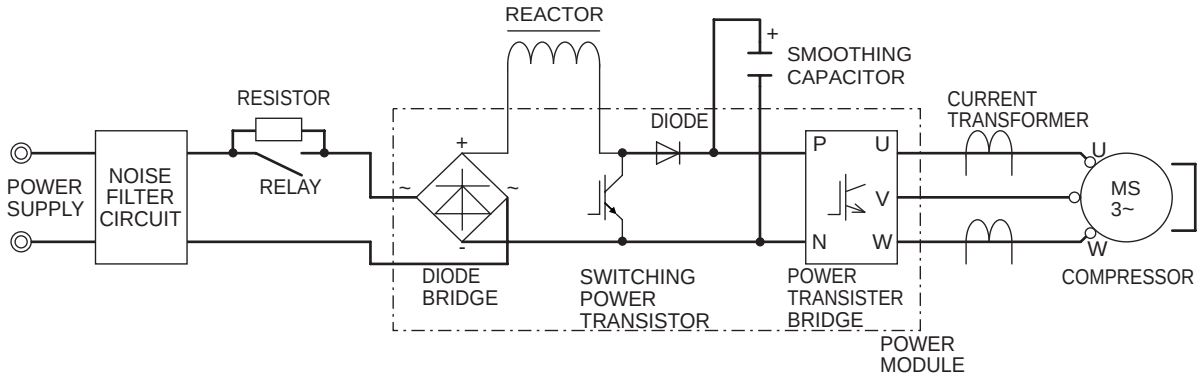
MXZ-3B54VA MXZ-3B68VA MXZ-4B71VA MXZ-4B80VA MXZ-5B100VA
MXZ-3C54VA MXZ-3C68VA MXZ-4C71VA MXZ-4C80VA MXZ-5C100VA



Function of main parts

NAME	FUNCTION
INTELLIGENT POWER MODULE	It supplies 3-phase AC power to compressor.
SMOOTHING CAPACITOR	It stabilizes the DC voltage and supplies it to INTELLIGENT POWER MODULE.
CURRENT TRANSFORMER	It measures the current of the compressor motor.
REACTOR	It rectifies AC, controls its voltage and improves the power factor of power supply.
POWER FACTOR CORRECTION MODULE	
RESISTOR	It absorbs the rush current not to run into the main power supply circuit the power is turned ON.
RELAY	It keeps the RESISTOR, which restricts rush current, short-circuited while the compressor is operating.

MXZ-6C120VA



Function of main parts

NAME	FUNCTION
RESISTOR	It absorbs the rush current not to run into the main power supply circuit when the power is turned ON..
RELAY	It keeps the RESISTOR, which restricts rush current, short-circuited while the compressor is operating.
DIODE BRIDGE	It converts the AC voltage to DC voltage.
REACTOR	It improves power factor. It controls the bus-bar voltage.
SWITCHING POWER TRANSISTOR	
DIODE	
SMOOTHING CAPACITOR	It stabilizes the DC voltage and supply it to INTELLIGENT POWER MODULE.
POWER TRANSISTOR BRIDGE	It supplies 3-phase AC power to compressor.
CURRENT TRANSFORMER	It measures the current of the compressor motor.

3-1-2. Outline of main power supply circuit

MXZ-2B30VA MXZ-2B40VA MXZ-2B52VA

1. At the start of operation

Main power supply circuit is formed when RELAY is turned ON at COMPRESSOR startup.

To prevent rush current from running into the circuit when power supply is turned ON, RESISTOR is placed in sub circuit.

2. At normal operation

① When AC runs into P.C. board, its external noise is eliminated in NOISE FILTER CIRCUIT.

② After noise is eliminated from AC, it is rectified to DC by DIODE MODULE 1.

③ DC voltage, to which AC has been rectified by process ②, is stabilized by SMOOTHING CAPACITOR and supplied to INTELLIGENT POWER MODULE.

④ DC voltage, which has been stabilized in process ③, is converted to 3-phase AC by INTELLIGENT POWER MODULE and supplied to COMPRESSOR.

⑤ CURRENT TRANSFORMER which is placed in the power supply circuit to COMPRESSOR, is used to measure the value of phase current and locates the polar direction of rotor with algorithm. PWM (Pulse width modulation) controls impressed voltage and frequency with those pieces of information.

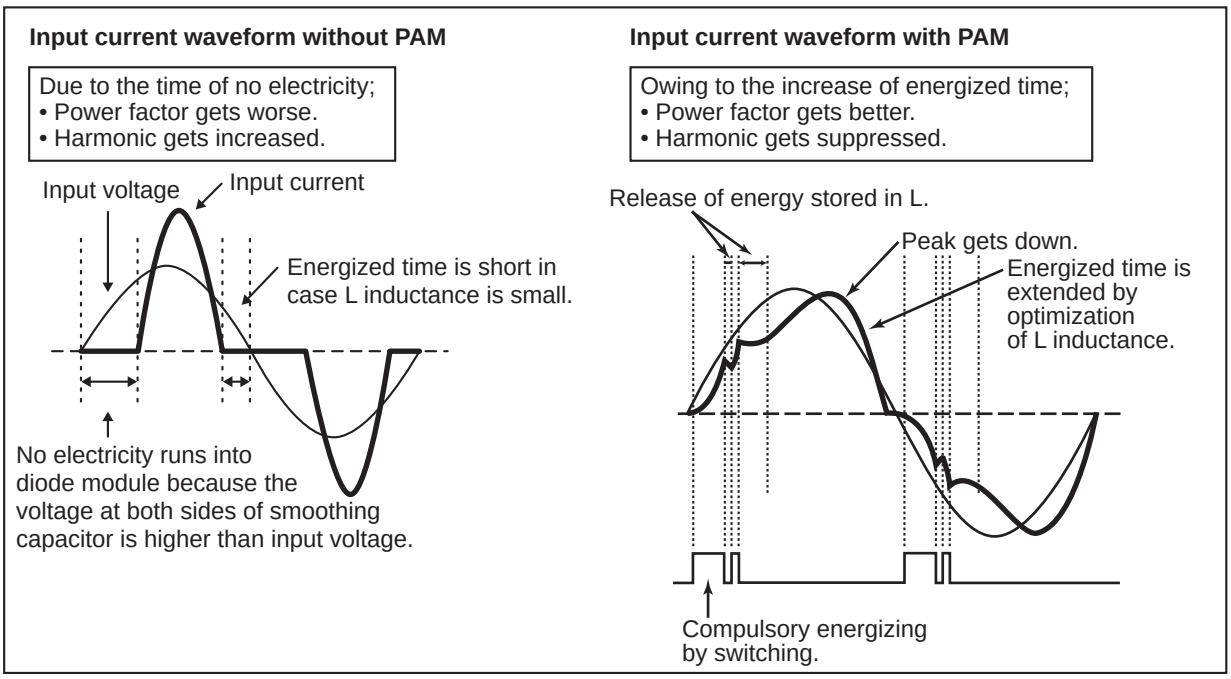
3. Purpose of PAM adoption

PAM: Pulse Amplitude Modulation

PAM has been adopted for the efficiency improvement and the adaptation to IEC harmonic current emission standard.

Outline of simple partial switching method

In conventional inverter models, DIODE MODULE rectifies AC voltage to DC voltage, SMOOTHING CAPACITOR makes its DC waveform smooth, and INTELLIGENT POWER MODULE converts its DC voltage to imitate AC voltage again in order to drive the compressor motor. However, it has been difficult to meet IEC harmonic current emission standard by above circuit because harmonic gets generated in the input current waveform and power factor gets down. The simple partial switching method with PAM, which has been adopted this time, places and utilizes BOOSTER CHOPPER CIRCUIT before rectifying AC voltage in the general passive-method converter circuit. As harmonic gets suppressed and the peak of waveform gets lower by adding BOOSTER CHOPPER CIRCUIT as mentioned above and by synchronizing the timing of switching with the zero-cross point of waveform, the input current waveform can be improved and the requirement of IEC harmonic current emission standard can be satisfied. Since the switching is synchronized with the zero cross point, this simple partial switching method has the feature of lower energy loss compared to active filter method. In addition, output and efficiency is enhanced by combining with vector-controlled inverter in order to boost the voltage of power supplied to INTELLIGENT POWER MODULE.



4. Intelligent power module

INTELLIGENT POWER MODULE consists of the following components

- IGBT (x6): Converts DC waveform to 3-phase AC waveform and outputs it.
- Drive Circuit: Drives transistors.
- Protection circuit: Protects transistors from overcurrent.

Since the above components are all integrated in INTELLIGENT POWER MODULE, INTELLIGENT POWER MODULE has a merit to make the control circuit simplify and miniaturize.

5. Elimination of electrical noise

NOISE FILTER CIRCUIT, which is formed by *CMC COILS capacitors placed on P.C. board, eliminates electrical noise of AC power that is supplied to main power supply circuit. And this circuit prevents the electrical noise generated in the inverter circuit from leaking out.

*CMC COILS; Common mode choke coils

MXZ-3B54VA MXZ-3B68VA MXZ-4B71VA MXZ-4B80VA MXZ-5B100VA
MXZ-3C54VA MXZ-3C68VA MXZ-4C71VA MXZ-4C80VA MXZ-5C100VA

1. At the start of operation

Main power supply circuit is formed when RELAY is turned ON at COMPRESSOR startup.
To prevent rush current from running into the circuit when power supply is turned ON, RESISTOR is placed in sub circuit.

2. At normal operation

① When AC runs into noise filter P.C. board, its external noise is eliminated in NOISE FILTER CIRCUIT.
② After noise is eliminated from AC, it is rectified to DC by REACTOR and POWER FACTOR CORRECTION MODULE. If the operating frequency becomes 25 Hz or more, DC voltage rises to 370 V.
③ DC voltage, to which AC has been rectified by process ②, is stabilized by SMOOTHING CAPACITOR and supplied to INTELLIGENT POWER MODULE.
④ The DC (Bus voltage), which has been stabilized in process ③, is converted to 3-phase AC by INTELLIGENT POWER MODULE and supplied to COMPRESSOR.
⑤ CURRENT TRANSFORMER which is placed in the power supply circuit to COMPRESSOR, is used to measure the value of phase current and locates the polar direction of rotor with algorithm. PWM (Pulse width modulation) controls impressed voltage and frequency with those pieces of information.

3. Power factor improvement

Booster coil reactor and POWER FACTOR CORRECTION MODULE rectify AC to DC and control its voltage.
In the motor drive system of sine wave control, power factor can be improved by reducing harmonics. POWER FACTOR CORRECTION MODULE and reactor stabilize the voltage of DC supplied to inverter circuit and make its waveform smooth.

4. Intelligent power module

INTELLIGENT POWER MODULE consists of the following components.

- IGBT (x6): Converts DC waveform to 3-phase AC waveform and outputs it.
- Drive Circuit: Drives transistors.
- Protection circuit: Protects transistors from over current.

Since the above components are all integrated in INTELLIGENT POWER MODULE, INTELLIGENT POWER MODULE has a merit to make the control circuit simplified and miniaturized.

5. Elimination of electrical noise

NOISE FILTER CIRCUIT, which is formed by *CMC COILS, *NMC COILS and capacitors placed on P.C. board, eliminates electrical noise of AC power that is supplied to main power supply circuit. This circuit also prevents electrical noise generated in the inverter circuit from leaking out.

*CMC COILS; Common mode choke coils
*NMC COILS; Normal mode choke coils

MXZ-6C120VA

1. At the start of operation

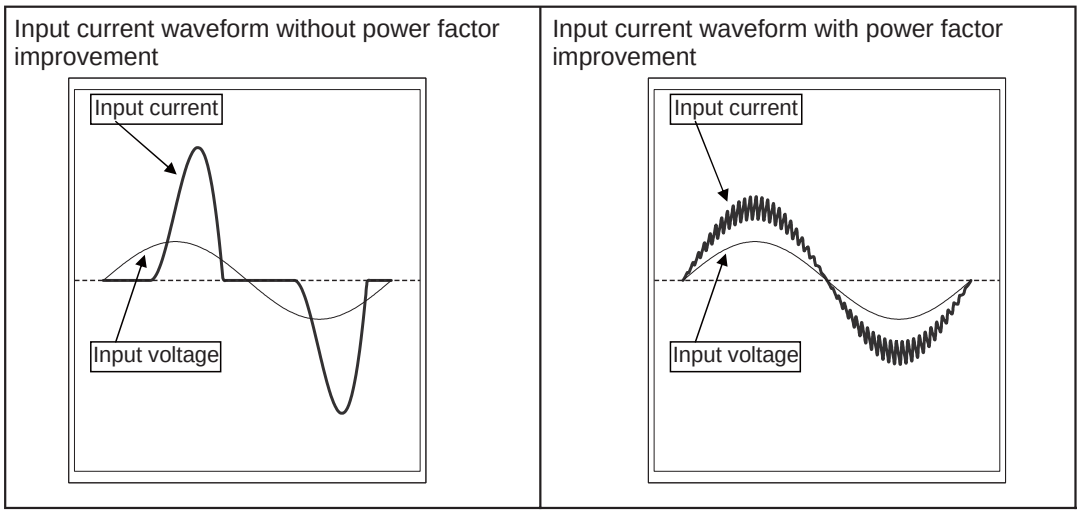
Main power supply circuit is formed when RELAY is turned ON at COMPRESSOR startup.
To prevent rush current from running into the circuit when power supply is turned ON, RESISTOR are placed in sub circuit.

2. At normal operation

① When AC runs into P.C. board, its external noise is eliminated in NOISE FILTER CIRCUIT.
② After noise is eliminated from AC, it is rectified to DC by DIODE BRIDGE.
Then REACTOR ,SWITCHING POWER TRANSISTOR and DIODE boost the DC voltage to 350V.
③ DC voltage, to which AC has been rectified by process ②, is stabilized by SMOOTHING CAPACITOR and supplied to POWER TRANSISTOR BRIDGE.
④ The DC (Bus voltage), which has been stabilized in process ③, is converted to 3-phase AC by POWER TRANSISTOR BRIDGE and supplied to COMPRESSOR.
⑤ CURRENT TRANSFORMER which is placed in the power supply circuit to COMPRESSOR, is used to measure the value of phase current and locates the polar direction of rotor with algorithm. PWM (Pulse width modulation) controls impressed voltage and frequency with those pieces of information.

3. Power factor improvement

An AC/DC converter circuit made up of DIODE BRIDGE and SMOOTHING CAPACITOR causes waveform distortion of the input current. Waveform distortion leads to lower input power factor and higher input current.
It also causes increase of harmonic current.
A circuit made up of REACTOR, SWITCHING POWER TRANSISTOR and DIODE controls the input current and thus smoothes the input current waveform. This circuit improves the power factor and reduces the input current.
Also, the input current waveform will satisfy the harmonic current standard.



4. Power module

Power module consists of the following components.
• Diode bridge (Diode x4): It converts AC voltage to DC votage.
• Switching power transistor, Diode: It improves the power factor and controls the bus-bar voltage with the reactor.
• Power transistor bridge (Transistor x6): It converts DC voltage to 3-phase AC voltage.

5. Elimination of electrical noise

NOISE FILTER CIRCUIT, which is formed by choke coils and capacitors placed on P.C. board, eliminates electrical noise of AC power that is supplied to main power supply circuit.
And this circuit prevents the electrical noise generated in the inverter circuit from leaking out.

3-1-3. Sine wave control

In these air conditioners, compressor equips brushless DC motor which does not have Hall element.
In short, the motor is sensorless. However, it is necessary to locate the polar direction of rotor in order to drive brushless DC motor efficiently. The general detection method of the polar direction for such a DC motor is to locate it from the voltage induced by unenergized stator.
Therefore, it is necessary to have a certain period of time in which the stator is being unenergized for the rotor position detection when the voltage of supplied power is impressed.
So the motor has been driven by square wave control (the conventional motor drive system) which energizes the motor only when the range of electrical angle is within 120° because it is forced to be unenergized within 30° at start and end of one heap in one waveform cycle (180°) when the voltage is impressed.
However, torque pulsation occurs at rotation in this method when the current-carrying phases are switched over to other phases in sequence. Therefore, sine wave control system is adopted for these air conditioners because it can make the phase-to-phase current waveform smoother (sine wave) in order to drive the motor more efficiently and smoothly.

3-1-4. Characteristics of sine wave control in case of brushless DC motor

- Although ordinary 3-phase induction motor requires energy to excite the magnetic field of rotor, brushless DC motor does not need it. So, higher efficiency and torque are provided.
- This control provides the most efficient waveform corresponding to the rotational speed of compressor motor.
- The rotation can be set to higher compared to the conventional motor drive system. So, the time in which air conditioner can be operated with less energy is longer than conventional models. This can save annual electric consumption.
- Compared to square wave control, the torque pulsation is reduced at rotation so that the motor operates more quietly.
- Since the response and efficiency of motor are enhanced in sine wave control, finer adjustment can be provided.

	DC Motor	AC Motor
Rotor	Permanent magnet is embedded.	Excited by magnetic field of stator
Rotor Position Signal	Necessary	Unnecessary

※ In brushless DC motor, permanent magnet is embedded in the rotor. Therefore, it does not require energy to excite the rotor like AC motor does. However, it is necessary to control the frequency of 3-phase AC current supplied to the stator according to the polar direction of magnet embedded in the rotor so as to drive the motor efficiently. Controlling 3-phase AC current frequency also means controlling the timing to switch the polarity of stator. Therefore, the polar direction of rotor needs to be detected.

3-1-5. Control Method of Rotational Speed

Sine wave control makes the current transformers conduct real time detection of the value of the current running into the motor, locates the rotor position from the detected value and decides if voltage should be impressed and if frequency should be changed.
Compared to the conventional control and rotor position detection method, sine wave control can provide finer adjustment of the voltage of supplied power. The value of the current running into the motor is determined by each motor characteristic.

3-2. EXPANSION VALVE CONTROL (LEV CONTROL)

Linear expansion valve (LEV) is controlled by "Thermostat ON" commands given from each unit.

Indoor unit status	LEV opening
Stop of all indoor unit	Opening before stop → 500 pulse in 15 minutes
When outdoor unit is operating, some indoor units stop and some operate.	COOL: 5 pulse (fully closed) HEAT: 59 pulse (slightly opened) (**MXZ-2B**), 100 → 52 pulse (**MXZ-3B/4B71/3C/4C71VA**), 100 → 59 pulse (**MXZ-4B80/5B/4C80/5C/6C**)
Thermostat OFF in COOL or DRY mode	When the outdoor unit operates (When the other indoor unit operates): 5 pulse. When the outdoor unit stops. (When the other indoor unit stops or thermo OFF): Maintain LEV opening before stop → 500 pulse in 15 minutes
Thermostat ON in COOL or DRY mode	• LEV opening for each indoor unit is determined by adding adjustment according to the number of operating unit and the capacity class to standard opening, based on the operation frequency: e.g.) Opening 130 pulse in standard opening 1 → Minimum 80 pulse, Maximum 205 pulse. (Capacity code 4 at 1 unit operation) (Capacity code 1 at 4 units operation) • After starting operation, adjustment according to intake superheat, discharge temperature is included in standard opening. ※1 **NOTE**: LEV opening in each frequency at DRY operation and COOL operation is the same. However, velocity and compressor operation frequency controls are different. (Refer to 3-3. OPERATIONAL FREQUENCY RANGE) (As far as the indoor unit velocity control goes, refer to DRY operation in MICRO-PROCESSOR CONTROL in indoor unit.)
Thermostat OFF in HEAT mode	• When the outdoor unit operates. (When the other indoor unit operates): 59 pules (**MXZ-2B**), 140 pulse (**MXZ-3B/4B/5B/3C/4C/5C/6C**). • When the outdoor unit stops. (When the other indoor unit stops or thermo OFF): Maintain LEV opening before stop → 500 pulse in 15 minutes.
Thermostat ON in HEAT mode	• LEV opening for each indoor unit is determined by adding adjustment according to the number of operating unit and the capacity class to standard opening, based on the operation frequency: e.g.) Opening 120 pulse in standard opening 1 → Minimum 70 pulse, Maximum 165 pulse. (Capacity code 4 at 1 unit operation) (Capacity code 1 at 4 units operation) • After starting operation, opening becomes the one that adjustment according to discharge temperature that was added to basic opening. ※1

※1 LEV opening when the outdoor unit is operating: Upper limit 500 pulse, Lower limit 59 pulse (**MXZ-2B/4B80/5B/4C80/5C/6C**), 53 pulse (**MXZ-3B/4B71/3C/4C71**).

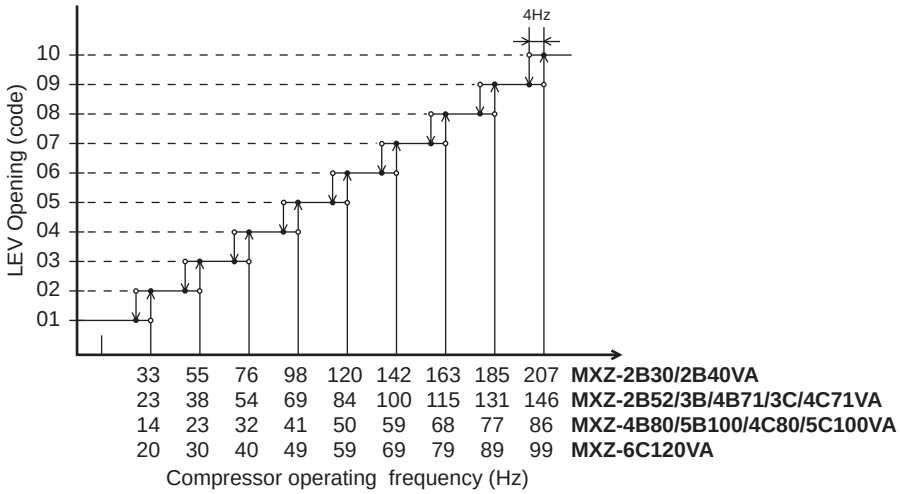
• The standard opening is on the straight line, which connects an each standard point in the section where divided into seven according to the operation frequency of compressor as shown in the figure below.
(LEV opening is controlled in proportion to the operation frequency.)

NOTE: Opening is adjusted at the standard opening according to the indoor unit conditions.
However, inclination of standard opening in each point of opening does not change with the original curve.

• Add opening provided in Difference in Capacity in the table below to the standard opening from 1 to 8 (**MXZ-2B**)/ 1 to 15 or above (**MXZ-3B/4B/5B/3C/4C/5C/6C**), when capacity of the indoor unit is excluding code 1.

• Add opening provided in Difference in Operation number in the table below to determined LEV opening for each indoor unit, when 2, 3, 4, 5 or 6 indoor units are operated at the same time.

NOTE: Even when the adjusted standard opening exceeds the driving range from 59 to 500 pulse, actual driving output opening is in a range from 59 to 500 pulse.



MXZ-2B30VA

	Standard opening (pulse)									
LEV Opening(code)	1	2	3	4	5	6	7	8	9	10
COOL	340	360	360	360	390	390	390	390	400	410
HEAT	200	220	250	280	300	320	340	360	380	400

MXZ-2B40VA

	Standard opening (pulse)									
LEV Opening(code)	1	2	3	4	5	6	7	8	9	10
COOL	240	260	280	300	330	350	370	390	400	410
HEAT	200	220	250	280	300	320	340	360	380	400

MXZ-2B52VA

	Standard opening (pulse)									
LEV Opening(code)	1	2	3	4	5	6	7	8	9	10
COOL	340	360	360	360	390	390	390	390	400	410
HEAT	200	220	250	280	300	320	340	360	380	400

Operation number	Difference in capacity			Difference in operation number
	Code3,4	Code5,6	Code7,8	2
COOL	10	20	30	-60
HEAT	5	10	15	-100

MXZ-3B54VA MXZ-3B68VA MXZ-4B71VA
MXZ-3C54VA MXZ-3C68VA MXZ-4C71VA
Exclusive LEV

	Standard opening (pulse)									
LEV Opening (code)	1	2	3	4	5	6	7	8	9	10
COOL	120	130	136	146	156	160	170	180	190	200
HEAT	248	248	258	266	274	280	286	292	300	306

	Difference in capacity								Difference in operation number		
	Code 1,2	Code 3,4	Code 5,6	Code 7,8	Code 9,10	Code 11,12	Code 13,14	Code 15 or above	2	3	4
COOL	0	3	6	9	12	15	25	35	-20	-30	-40
HEAT	0	3	6	9	52	55	65	75	30	0	-12

Receiver LEV

	Standard opening (pulse)									
LEV Opening (code)	1	2	3	4	5	6	7	8	9	10
COOL	140	150	160	170	180	190	200	200	200	200
HEAT	80	84	90	110	120	130	140	150	160	170

Operation number	Difference in operation number		
	2	3	4
COOL	0	0	0
HEAT	-16	-60	-125

MXZ-4B80VA MXZ-5B100VA
MXZ-4C80VA MXZ-5C100VA
Exclusive LEV

	Standard opening (pulse)									
LEV Opening (code)	1	2	3	4	5	6	7	8	9	10
COOL	126	130	134	138	150	160	170	180	190	200
HEAT	248	248	258	266	274	280	286	292	300	306

	Difference in capacity								Difference in operation number			
	Code 1,2	Code 3,4	Code 5,6	Code 7,8	Code 9,10	Code 11,12	Code 13,14	Code 15 or above	2	3	4	5
COOL	0	3	6	9	12	15	25	35	-20	-30	-30	-30
HEAT	0	3	6	9	52	55	65	75	-4	-8	-12	-16

Receiver LEV

	Standard opening (pulse)									
LEV Opening (code)	1	2	3	4	5	6	7	8	9	10
COOL	270	280	290	300	310	320	330	340	350	360
HEAT	140	152	160	170	180	200	224	244	274	280

Operation number	Difference in operation number			
	2	3	4	5
COOL	28	56	84	112
HEAT	-45	-60	-60	-60

Capacity code

Capacity code	2	3	4	7	9	10	12	13
Indoor unit capacity (kW)	1.5/2.0	2.2	2.5	3.5	4.2	5.0	6.0	7.1

MXZ-6C120VA

Exclusive LEV

	Standard opening (pulse)									
LEV Opening (code)	1	2	3	4	5	6	7	8	9	10
COOL	204	204	204	216	216	216	216	216	216	216
HEAT	130	130	130	140	140	150	150	160	160	170

	Difference in capacity								Difference in operation number			
	Code 1,2	Code 3,4	Code 5,6	Code 7,8	Code 9,10	Code 11,12	Code 13,14	Code 15 or above	2	3	4	5/6
COOL	0	3	6	9	52	55	65	75	0	0	-128	-128
HEAT	0	53	56	59	50	20	20	20	-4	-8	-12	-16

Receiver LEV

	Standard opening (pulse)									
LEV Opening (code)	1	2	3	4	5	6	7	8	9	10
COOL	190	190	200	200	210	210	220	230	240	250
HEAT	60	70	80	90	100	110	130	150	150	200

Operation number	Difference in operation number			
	2	3	4	5/6
COOL	0	0	100	100
HEAT	0	0	0	0

Capacity code

Capacity code	2	3	4	7	10	12	13
Indoor unit capacity (kW)	1.5/2.0	2.2	2.5	3.5	5.0	6.0	7.1

<Correction>

	COOL	DRY	HEAT
① Discharge temperature	●※	●※	●
② Each correction (Main indoor coil thermistor - Sub indoor coil thermistor)	●	●	-

※ Correct the LEV opening by discharge temperature.

(1) LEV opening correction by discharge temperature
The target discharge temperature is determined according to frequency zone and number of operation unit of the compressor.

MXZ-2B30VA MXZ-2B40VA

Operation frequency of compressor (Hz)	Target discharge temperature (°C)			
	COOL		HEAT	
	1 unit	2 units	1 unit	2 units
Minimum ~ 33	56	60	55	51
34 ~ 55	59	61	60	58
56 ~ 76	59	64	65	64
77 ~ 98	60	67	70	71

MXZ-2B52VA

Operation frequency of compressor (Hz)	Target discharge temperature (°C)			
	COOL		HEAT	
	1 unit	2 units	1 unit	2 units
Minimum ~ 23	56	60	57	51
24 ~ 38	59	61	63	58
39 ~ 54	59	64	69	64
55 ~ 69	60	67	75	71
70 ~ 85	61	67	80	77
86 ~ 100	62	69	86	83
101 ~ Maximum	63	70	90	90

MXZ-3B54VA MXZ-3B68VA MXZ-4B71VA
MXZ-3C54VA MXZ-3C68VA MXZ-4C71VA

Operation frequency of compressor (Hz)	Target discharge temperature (°C)							
	COOL				HEAT			
	1 unit	2 units	3 units	4 units (MXZ-4B71VA) (MXZ-4C71VA)	1 unit	2 units	3 units	4 units (MXZ-4B71VA) (MXZ-4C71VA)
Minimum ~ 23	35	58	62	62	50	50	50	50
24 ~ 38	40	60	65	65	56	50	55	55
39 ~ 54	49	65	70	70	60	56	60	60
55 ~ 69	58	68	70	70	63	60	60	60
70 ~ 85	65	70	72	72	66	60	60	60
86 ~ 100	70	70	72	72	67	60	60	60
101 ~ Maximum	70	70	85	85	70	60	60	60

MXZ-4B80VA MXZ-5B100VA
MXZ-4C80VA MXZ-5C100VA

Operation frequency of compressor (Hz)	Target discharge temperature (°C)							
	COOL				HEAT			
	1 unit	2 units	3 units	4,5 units ※	1 unit	2 unit	3 units	4,5 units ※
Minimum ~ 14	35	55	57	60	52	62	50	50
15 ~ 23	42	55	57	60	58	66	55	50
24 ~ 32	49	58	63	60	65	74	60	50
33 ~ 41	58	60	65	62	68	78	67	50
42 ~ 50	65	65	65	65	68	78	72	55
51 ~ 59	68	68	73	65	68	78	76	60
60 ~ 68	70	70	75	70	68	78	76	60
69 ~ 77	75	70	80	72	68	78	76	60
78 ~ 86	75	70	82	72	68	78	76	60
87 ~ Maximum	75	75	82	72	78	78	76	60

※ "5 units" is MXZ-5B/5C

MXZ-6C120VA

Operation frequency of compressor (Hz)	Target discharge temperature (°C)							
	COOL				HEAT			
	1 unit	2 units	3,4 units	5,6 units	1 unit	2 unit	3,4 units	5,6 Units
Minimum ~ 19	40	55	55	59	54	62	54	50
20 ~ 29	55	61	64	62	64	74	63	52
30 ~ 39	64	64	68	64	67	77	67	55
40 ~ 48	70	68	73	67	70	79	71	57
49 ~ 58	75	72	78	69	72	79	76	59
59 ~ 68	78	76	83	72	74	79	80	61
69 ~ 78	80	80	88	74	75	85	85	64
79 ~ 88	80	83	88	77	75	85	88	66
89 ~ 98	80	87	88	80	80	85	88	68
99 ~ Maximum	80	87	88	84	80	85	88	70

Correct the LEV opening according to the difference between target discharge temperature and discharge temperature.

MXZ-2B30VA

Discharge temperature (°C)	LEV opening correction (pulse)	
	COOL	HEAT
More than Target discharge temperature + 10	5	10
Target discharge temperature + 10 to Target discharge temperature + 5	4	4
Target discharge temperature + 5 to Target discharge temperature + 2	2	1
Target discharge temperature + 2 to Target discharge temperature - 2	0	0
Target discharge temperature - 2 to Target discharge temperature - 5	-1	-1
Target discharge temperature - 5 to Target discharge temperature - 10	-3	-2
Target discharge temperature - 10 or less	-4	-3

MXZ-2B40VA MXZ-2B52VA

Discharge temperature (°C)	LEV opening correction (pulse)	
	COOL	HEAT
More than Target discharge temperature + 10	5	8
Target discharge temperature + 10 to Target discharge temperature + 5	4	3
Target discharge temperature + 5 to Target discharge temperature + 2	2	1
Target discharge temperature + 2 to Target discharge temperature - 2	0	0
Target discharge temperature - 2 to Target discharge temperature - 5	-1	-1
Target discharge temperature - 5 to Target discharge temperature - 10	-3	-2
Target discharge temperature - 10 or less	-4	-3

MXZ-3B54VA MXZ-3B68VA MXZ-4B71VA
MXZ-3C54VA MXZ-3C68VA MXZ-4C71VA

Discharge temperature (°C)	LEV opening correction (pulse)	
	COOL	HEAT
More than Target discharge temperature + 10	5	8
Target discharge temperature + 10 to Target discharge temperature + 5	4	3
Target discharge temperature + 5 to Target discharge temperature + 2	2	1
Target discharge temperature + 2 to Target discharge temperature - 2	0	0
Target discharge temperature - 2 to Target discharge temperature - 5	-1	-1
Target discharge temperature - 5 to Target discharge temperature - 10	-3	-2
Target discharge temperature - 10 or less	-4	-3

MXZ-4B80VA MXZ-5B100VA
MXZ-4C80VA MXZ-5C100VA

Discharge temperature (°C)	LEV opening correction (pulse)	
	COOL	HEAT
More than Target discharge temperature + 12	4	6
Target discharge temperature + 12 to Target discharge temperature + 5	2	2
Target discharge temperature + 5 to Target discharge temperature + 3	1	1
Target discharge temperature + 3 to Target discharge temperature - 3	0	0
Target discharge temperature - 3 to Target discharge temperature - 5	-1	-1
Target discharge temperature - 5 to Target discharge temperature - 12	-3	-2
Target discharge temperature - 12 or less	-8	-8

MXZ-6C120VA

Discharge temperature (°C)	LEV opening correction (pulse)	
	COOL	HEAT
More than Target discharge temperature + 12	4	6
Target discharge temperature + 12 to Target discharge temperature + 5	2	2
Target discharge temperature + 5 to Target discharge temperature + 3	1	1
Target discharge temperature + 3 to Target discharge temperature - 3	0	0
Target discharge temperature - 3 to Target discharge temperature - 5	-1	-1
Target discharge temperature - 5 to Target discharge temperature - 12	-3	-2
Target discharge temperature - 12 or less	-8	-8

(2) Separate correction (COOL, DRY)
(Correction by the separate superheat)

Correct the LEV separately by temperature difference "ΔRT" between main/sub indoor coil thermistor.

ΔRT	LEV opening correction (pulse)	
	MXZ-2B/3B/4B71/3C/4C71	**MXZ-4B80/5B/4C80/5C/6C**
4 ≦ ΔRT	2	3
2 ≦ ΔRT< 4	1	1
ΔRT< 2	0	0

3-3. OPERATIONAL FREQUENCY RANGE

MXZ-2B30VA

Number of operating unit	Capacity code	COOL(Hz)		DRY(Hz)	HEAT(Hz)		
		Min	Max		Min	Max	defrost
1	1,2	40	64	40	35	97	97
	3,4	40	64	44	35	97	97
2	~4	55	97	78	35	97	97
	5~7	55	97	78	35	97	97
	8	55	97	86	35	97	97

MXZ-2B40VA

Number of operating unit	Capacity code	COOL(Hz)		DRY(Hz)	HEAT(Hz)		
		Min	Max		Min	Max	defrost
1	1,2	30	58	30	35	98	98
	3,4	30	58	34	35	98	98
	7	30	68	34	35	98	98
2	~4	37	98	48	35	98	98
	5~7	37	98	48	35	98	98
	8~10	37	98	48	35	98	98
	11	37	98	68	35	98	98

MXZ-2B52VA

Number of operating unit	Capacity code	COOL(Hz)		DRY(Hz)	HEAT(Hz)		
		Min	Max		Min	Max	defrost
1	1,2	12	48	20	21	57	57
	3,4	12	48	25	21	71	71
	7	12	48	25	21	80	80
	9	12	48	44	21	80	80
2	~4	16	80	39	40	95	95
	5~7	16	105	48	40	105	105
	8~10	16	105	48	40	15	15
	11~13	16	105	52	40	105	105
	14	16	105	52	40	105	105

MXZ-3B54VA
MXZ-3C54VA

Number of operating unit	Capacity code	COOL (Hz)		DRY (Hz)	HEAT (Hz)		
		Min.	Max.		Min.	Max.	Defrost
1	1,2	20	58	23	48	72	72
	3,4	20	72	23	48	92	92
	7	20	85	23	48	92	92
	9,10	20	101	45	48	101	100
	12	34	101	58	48	101	100
	13	34	101	58	48	101	100
2	~4	34	101	44	58	112	100
	5~7	34	101	52	58	112	100
	8~10	34	101	52	58	112	100
	11~13	34	101	52	58	112	100
	14~16	34	101	52	58	112	100
	17~	34	101	80	58	112	100
3	3~	40	101	58	58	112	100

MXZ-3B68VA MXZ-4B71VA
MXZ-3C68VA MXZ-4C71VA

Number of operating unit	Capacity code	COOL (Hz)		DRY (Hz)	HEAT (Hz)		
		Min.	Max.		Min.	Max.	Defrost
1	1,2	20	52	20	36	52	52
	3,4	20	52	20	36	70	70
	7	20	58	20	36	76	76
	9	20	76	36	36	76	76
	10	26	76	36	36	76	76
	12	26	76	44	36	76	76
	13	26	76	44	36	76	76
2	~4	26	76	30	44	85	76
	5~7	26	76	39	44	85	76
	8~10	26	76	39	44	85	76
	11~13	26	76	39	44	85	76
	14~16	26	76	40	44	85	76
	17~	26	76	48	44	85	76
3	3~	30	76	48	44	114	76
4	4~	39	76	64	64	114	76

MXZ-4B80VA MXZ-5B100VA
MXZ-4C80VA MXZ-5C100VA

Number of operating unit	Capacity code	COOL (Hz)		DRY (Hz)	HEAT (Hz)			
		Min.	Max.		Min.	Max.		Defrost
						4B	5B	
1	1,2	15	40	15	22	58	58	58
	3,4	15	58	18	22	70	70	70
	7	15	58	18	22	70	70	70
	9	15	68	31	22	80	80	80
	10	18	68	31	22	80	80	80
	12	18	68	42	22	90	90	80
	13	18	79	42	22	90	90	80
2	~4	24	72	30	35	80	80	80
	5~7	24	80	30	35	80	80	80
	8~10	24	80	31	35	80	80	80
	11~13	24	90	31	35	94	94	80
	14~16	24	90	31	35	94	94	80
	17~	24	90	52	35	94	94	80
3	3~	42	90	42	39	94	105	80
4	4~	53	94	53	52	94	120	80
5	5~	53	94	53	52	94	120	80

MXZ-6C120VA

Number of operating unit	Capacity code	COOL (Hz)		DRY (Hz)	HEAT (Hz)	
		Min.	Max.		Max.	Defrost
1	2	15	40	15	85	48
	3,4	15	40	15	85	48
	7	15	40	15	85	48
	9,10	15 (code 9)/ 18 (code 10)	52	22	85	48
	12	18	52	28	85	48
	13	18	57	28	85	48
2	~4	15	53	22	85	48
	5~7	15	62	22	85	48
	8~10	15 (code 8,9)/ 18 (code 10)	62	22	85	48
	11~13	18	65	22	85	48
	14~16	18	65	22	85	48
	17~	18	65	37	85	48
3,4	3~9	15	80	38	93	48
	10~	18				
5,6	5~9	15	84	42	110	48
	10~	18				

Connecting units	HEAT (Hz)
	Min.
2	18
3,4	18
5,6	18

3-4. HEAT DEFROSTING CONTROL

(1) Starting conditions of defrosting

When the following conditions a) ~ c) are satisfied, the defrosting starts.

a) The defrost thermistor reads -2.3°C or less.

b) The cumulative operation time of the compressor has reached any of the set values※ (31, 35, 45, 55, 65, 75, 85, 95, 105, 115, 150 minutes).

c) More than 5 minutes have passed since the start-up of the compressor.

※ Set value of compressor operation time (hereinafter referred to as defrost interval)

This is decided by the temperature of defrost thermistor and ambient temperature thermistor, the previous defrosting time. For example, the first defrost interval is 40 minutes long, and the second is 45 minutes long. The third and subsequent intervals are set to be longer, and less frequent, depending on defrosting time.

The third and subsequent defrost intervals follow any of the three patterns ···5 or 10 to 20 minutes longer, the same, or 5 or 10 to 20 minutes shorter compared with the previous defrost interval ··· with the longest 125 minutes and the shortest 40 minutes.

(2) Releasing conditions of defrosting

Defrosting is released when any of the following conditions is satisfied:

a) The defrost thermistor continues to read 10.4°C (**MXZ-2B/3B/4B71/3C/4C71**)/13°C (**MXZ-4B80/5B/4C80/5C/6C**).

b) Defrosting time exceeds 10 minutes.

c) Any other mode than HEAT mode is set during defrosting.

3-5. DISCHARGE TEMPERATURE PROTECTION CONTROL

This protection controls the compressor ON/OFF and operation frequency according to temperature of the discharge temperature thermistor.

(1) Compressor ON/OFF

When the temperature of the discharge temperature thermistor exceeds 116°C (**MXZ-2B/3B/4B/5B/3C/4C/5C**)/114°C (**MXZ-6C**) the control stops the compressor.

When the temperature of the discharge temperature thermistor is 80°C (**MXZ-2B40/2B52/3B/4B71/3C/4C71**)/100°C (**MXZ-2B30/4B80/5B/4C80/5C/6C**) or less, the controls start the compressor.

(2) Compressor operation frequency

When the temperature of the discharge temperature thermistor is expected to be higher than 116°C (**MXZ-2B/3B/4B/5B/3C/4C/5C**)/113°C (**MXZ-6C**) the control decreases 12 Hz from the current frequency.

When the temperature of the discharge temperature thermistor is expected to be higher than 111°C and less than 116°C (**MXZ-2B/3B/4B/5B/3C/4C/5C**)/113°C (**MXZ-6C**) the control decreases 6 Hz from the current frequency.

When the temperature of the discharge temperature thermistor is expected to be higher than 104°C and less than 111°C, the control is set at the current frequency.

3-6. REFRIGERANT RECOVERY CONTROL ON HEATING

MXZ-2B30VA MXZ-2B40VA MXZ-2B52VA

<Control status>

The control performs when the all the following status are satisfied;

- When one or more indoor units are operating in HEAT mode. (Excluding thermostat OFF)
- When the discharge temperature becomes 107°C or more.
- When it passed 60 minutes or more since the operation has started or the last refrigerant recovery has controlled.

<Control details>

LEV opening of indoor unit not operating is controlled to be 80 pulse.

<Control finish status>

The control finishes either as follows. However, the LEV opening is considered to be 59 pulse.

- When it passed 60 seconds since the control has started.
- When the discharge temperature is 90°C or less.

3-7. OUTDOOR FAN CONTROL

MXZ-3B54VA MXZ-3B68VA MXZ-4B71VA MXZ-4B80VA MXZ-5B100VA
MXZ-3C54VA MXZ-3C68VA MXZ-4C71VA MXZ-4C80VA MXZ-5C100VA MXZ-6C120VA

COOL

Fan speed changes so that the condensing temperature stays within the target range.

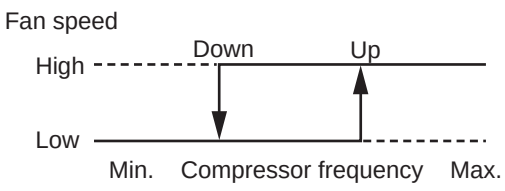
Fan speed	Revolution per minutes (rpm)			
	MXZ-2B30VA MXZ-2B40VA MXZ-2B52VA	**MXZ-3B54VA MXZ-3B68VA MXZ-4B71VA MXZ-3C54VA MXZ-3C68VA MXZ-4C71VA**	**MXZ-4B80VA MXZ-5B100VA MXZ-4C80VA MXZ-5C100VA**	**MXZ-6C120VA**
1	100	100	100	120
2	150	150	150	150
3	200	200	200	175
4	250	250	250	225
5	300	300	300	275
6	350	350	350	325
7	400	400	400	325
8	450	450	450	425
9	500	500	500	425
10	550	550	550	525
11	600	600	600	575
12	700	650	650	585
13	800	700	700	590
14	900	750	750	750

Frequency (Hz)	Target condensing temperature (ºC)	
	MXZ-2B30/40/52VA MXZ-3B54/68VA MXZ-4B71/80VA MXZ-5B100VA MXZ-3C54/68VA MXZ-4C71/80VA MXZ-5C100VA	**MXZ-6C120VA**
~24	31~35	38~42
25~34	33~37	37~41
35~44	35~39	37~41
45~54	37~41	37~41
55~64	37~41	37~41
65~	37~41	37~41

HEAT

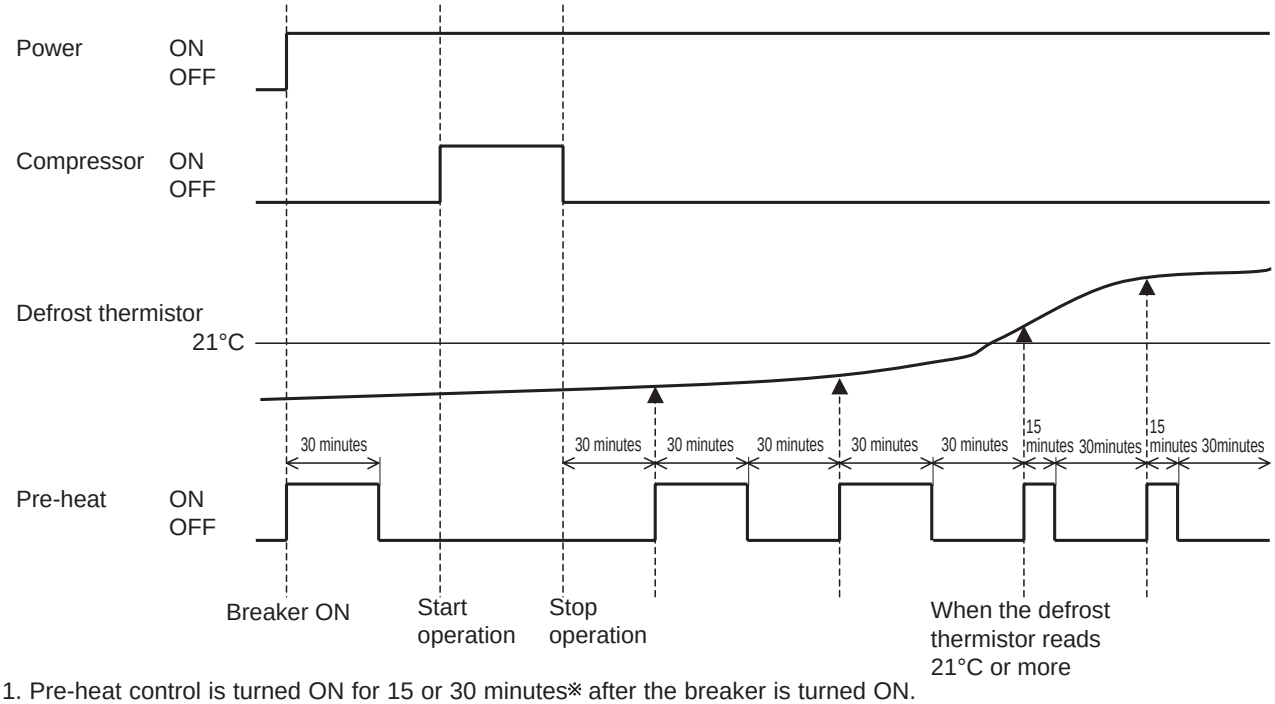
Fan speed is switched according to the compressor frequency.

Fan speed	Compressor speed (Hz)						
	MXZ-2B30VA	**MXZ-2B40VA**	**MXZ-2B52VA**	**MXZ-3B54VA MXZ-3C54VA**	**MXZ-3B68VA MXZ-4B71VA MXZ-3C68VA MXZ-4C71VA**	**MXZ-4B80VA MXZ-5B100VA MXZ-4C80VA MXZ-5C100VA**	**MXZ-6C120VA**
Up	71	56	40	58	30	50	53
Down	53	42	30	52	23	40	40



3-8. PRE-HEAT CONTROL

The compressor is energized even while it is not operating.
This is to generate heat at the winding to improve the compressor's start-up condition.



1. Pre-heat control is turned ON for 15 or 30 minutes※ after the breaker is turned ON.
2. 30 minutes after the unit is stopped, pre-heat control is turned ON for 15 or 30 minutes※ and turned OFF for 30 minutes. This is repeated as shown in the graph until the breaker is turned OFF.

※ When the defrost thermistor reads less than 21°C, pre-heat control is ON for 30 minutes.
When the defrost thermistor reads 21°C or more, pre-heat control is ON for 15 minutes.

NOTE: When the unit is started with the remote controller, pre-heat control is turned OFF.
Compressor uses 50 W when pre-heat control is turned ON.

3-9. COOL OPERATION

1. Thermostat control

Thermostat is ON or OFF by the difference between room temperature and set temperature.

Thermostat	Room temperature minus set temperature (Initial)	Room temperature minus set temperature (During operation)
ON	-1°C or more	-1°C
OFF	less than -1°C	-0.7°C

2. Coil frost prevention

The the compressor operational frequency is controlled to prevent the indoor heat exchanger temperature from falling excessively.
Compressor is turned OFF for 5 minutes when the temperature of indoor coil thermistor continues 3°C or less for 5 minutes or more.

3-10. DRY OPERATION

1. Thermostat control

Thermostat is ON or OFF by the difference between room temperature and set temperature.

Thermostat	Room temperature minus set temperature (Initial)	Room temperature minus set temperature (During operation)
ON	-1°C or more	-1°C
OFF	less than -1°C	-0.7°C

2. Coil frost prevention

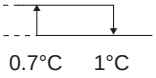
Coil frost prevention is as same as COOL mode. (3-8.2.)

3-11. HEAT OPERATION

1. Thermostat control

Thermostat turns ON or OFF by difference between room temperature and set temperature.

Thermostat	Room temperature minus set temperature (Initial)	Room temperature minus set temperature (During operation)
ON	less than 1°C	
OFF	1°C or more	



2. High pressure protection

In HEAT operation the indoor coil thermistor detects the temperature of the indoor heat exchanger. The compressor operational frequency is controlled to prevent the condensing pressure from increasing excessively.

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