MITSUBISHI ELECTRIC

SPLIT-TYPE AIR CONDITIONERS

Changes for the Better

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.

Please void OBT17 REVISED EDITION-C.

No. OBT17
REVISED EDITION-D

SERVICE TECHNICAL GUIDE

Models

MSC-GE•VB - E
MS-GD•VB - E · **MU-GD•VB - E**
MS-GE•VB - E · **MU-GE•VB - E**
MSH-GD•VB - E · **MUH-GD•VB - E**
MSH-GE•VB - E · **MUH-GE•VB - E**
MSZ-GC•VA - E · **MUZ-GC•VA(H) - E**
MSZ-HC•VA(B) - E · **MUZ-HC•VA(B) - E**
MSZ-CHC•VA - E
MSZ-FD•VA(S) - E · **MUZ-FD•VA(H)(BH) - E**
MSZ-GE•VA - E · **MUZ-GE•VA(H) - E**
MSZ-CGE•VA - E
MLZ-KA•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.

NOTE: As for the multi system 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

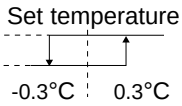
1-1. COOL (☼) OPERATION

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

Thermostat is ON or OFF by 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

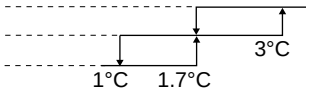


2. Indoor fan speed control

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.

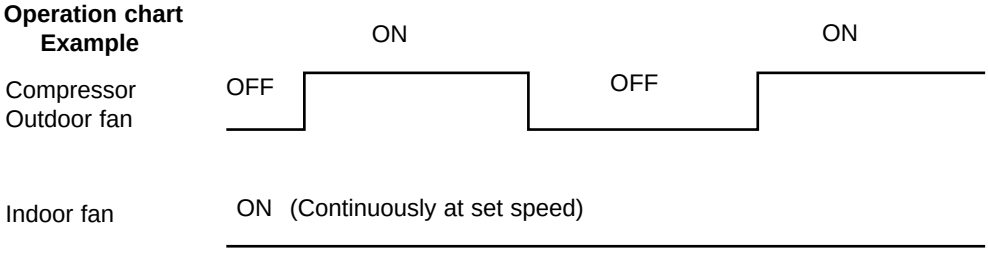
Model	Coil frost prevention	
	ON	OFF
	Indoor coil thermistor (°C)	Indoor coil thermistor (°C)
MSC-GE20VB MSC-GE25VB	4 °C or less	More than 4 °C
MSC-GE35VB	0 °C or less	More than 0 °C
MS-GD80VB	-1 °C or less	More than -1 °C
MS-GE50VB	3 °C or less	More than 3 °C
MSH-GD80VB MSH-GE50VB	1 °C or less	More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

※ The coil frost prevention doesn't work for 5 minutes since the compressor has started.

② Time control

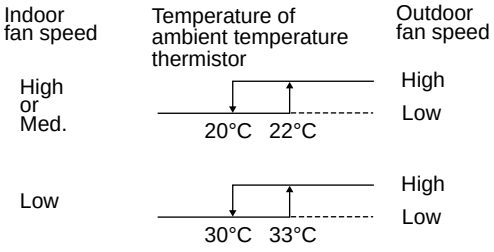
When the three conditions as follows have been satisfied for 1 hour and 45 minutes, compressor stops for 3 minutes.
a. Compressor has been continuously operating.
b. Indoor fan speed is Low or Med.
c. Room temperature is 26°C or less.
When compressor stops, the accumulated time is cancelled and when 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.

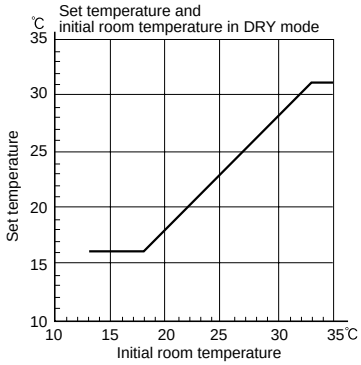
• Compressor

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.

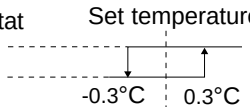
DRY operation will not work when the room temperature is 13°C or below.



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

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

Difference between room temperature and set temperature during operation



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

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

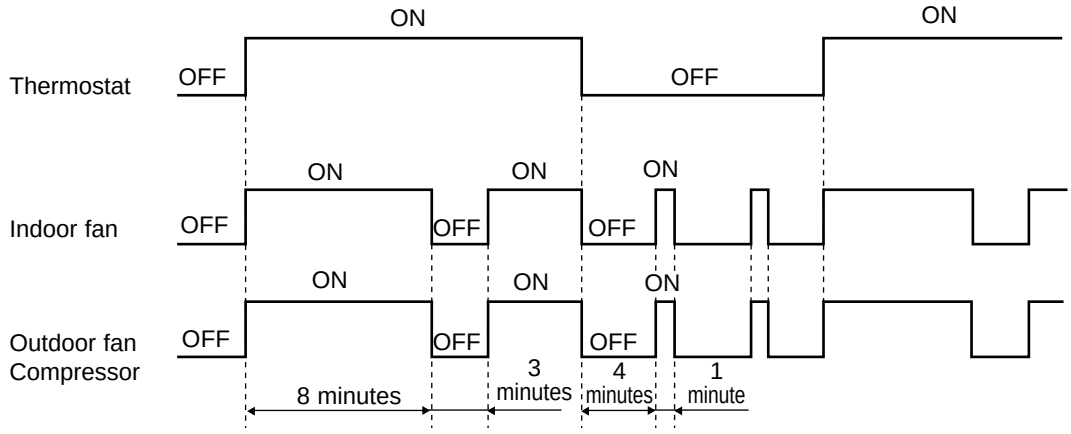
Compressor operates by room temperature control and time control.
Set temperature is controlled to fall 2°C from initial room temperature.
Indoor fan and outdoor fan operate in the same cycle as the compressor.

- 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

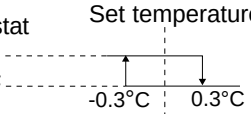
- The operation is the same as coil frost prevention during COOL mode.
- The indoor fan operates at the set speed and the compressor does not operate for 5 minutes because the coil frost prevention has priority.

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

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

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

Difference between room temperature and set temperature during operation



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

2. Indoor fan speed control

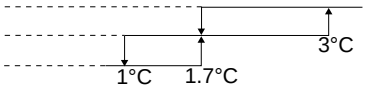
(1) In AUTO the fan speed

(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

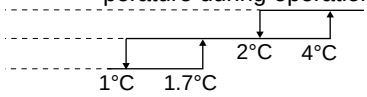
Difference between room temperature and set temperature during operation



(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.

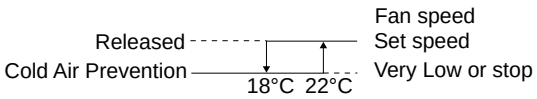
② When the compressor is operating:

(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)**

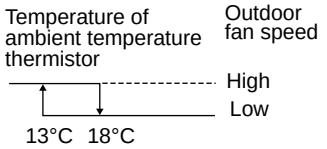
(4) Flow soft control **(MSH-GD80VB, MSH-GE50VB)**

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.

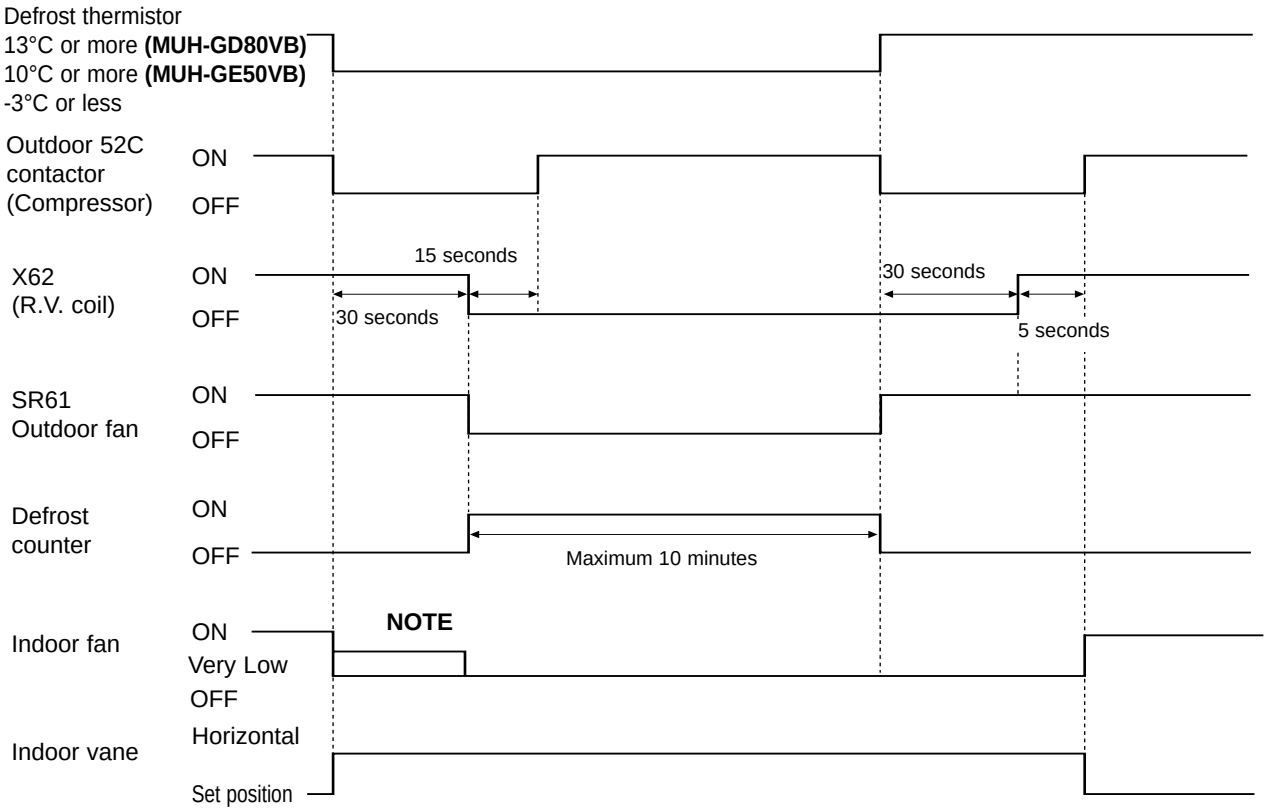
(2) Releasing conditions of defrost

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



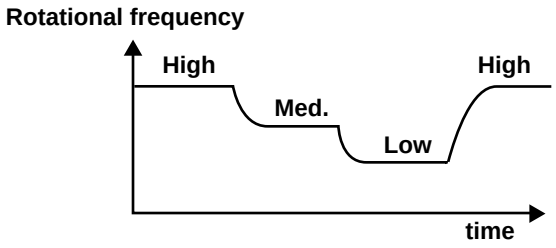
NOTE: • When the indoor coil thermistor reads above 18°C, indoor fan operates at Very Low for 30 seconds.

• 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.

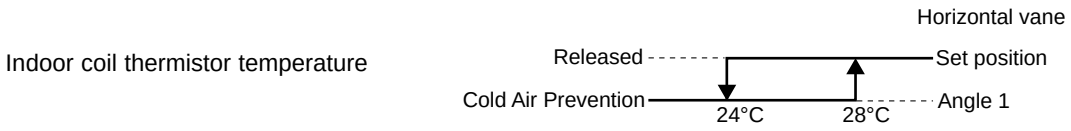
1-5. AUTO VANE OPERATION (MSC, MSH)

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 doesn't 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 (Tp(※ 1)).
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.
ECONO COOL operation is cancelled when ECONO COOL button, VANE CONTROL button, VANE button or LONG button is pressed or changed to other operation mode.

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

<SWING operation>

※ 1 Tp: • Value of indoor coil thermistor **(MSC-GE20/25/35VB, MS-GE50VB, MSH-GE50VB)**
• Average value of indoor coil thermistor (main) and indoor coil thermistor (sub) **(MS-GD80VB, MSH-GD80VB)**

In swing operation of ECONO COOL operation mode, the initial airflow direction is adjusted to “Horizontal”.
According to the temperature of indoor coil thermistor Tp(※ 1) 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 Tp(※ 1)	Downward blow time (second)	Horizontal blow time (second)
A	15°C or less	2	23
B	15 to 17°C	5	20
C	17 to 18°C	8	17
D	18 to 20°C	11	14
E	20 to 21°C	14	11
F	21 to 22°C	17	8
G	22 to 24°C	20	5
H	More than 24°C	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 once 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.

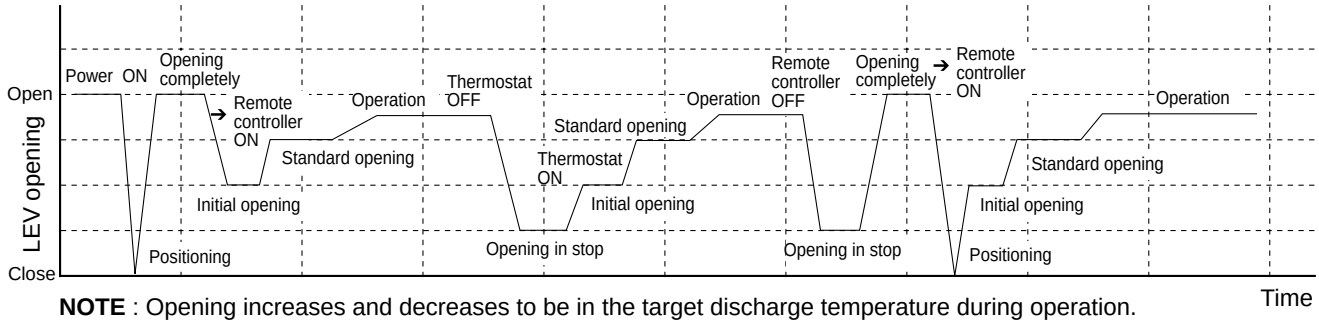
(1) Control data

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



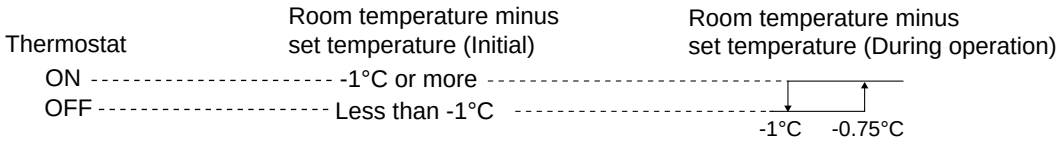
NOTE : Opening increases and decreases to be in the target discharge temperature during operation.

2 MSZ/MLZ MICROPROCESSOR CONTROL

2-1. COOL (☼) OPERATION

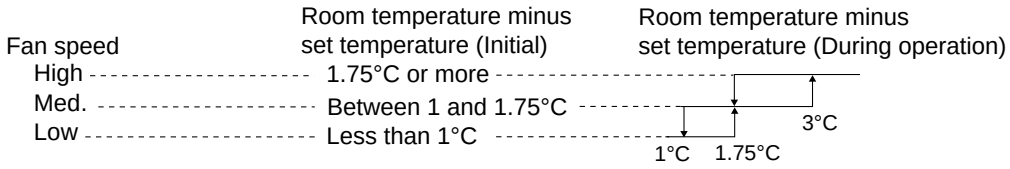
1. Thermostat control (MSZ)

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



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. In AUTO, the fan speed is as follows.



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)

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.

GC35 FD GE

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 (**GC35, FD25/35, GE25/35/42**)
- -15°C or less (**FD50**)
- -12°C or less (**GE50**)

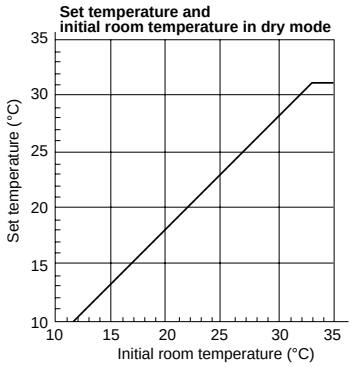
(3) Outdoor temperature detecting control

To detect the exact outdoor temperature in this mode, the compressor turns OFF but the outdoor fan stays ON for 3 minutes once evrey 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 is 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	-2 °C or more	-2°C
OFF	Less than -2 °C	-0.75°C

2. Indoor fan speed control

Indoor fan operates at the set speed by FAN SPEED CONTROL button.
When thermostat OFF (compressor OFF), fan speed becomes Very Low.
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°C
Low	Less than 1°C	1.75°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)

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

2-3. HEAT (☼) OPERATION

1. Thermostat control (MSZ)

Thermostat is 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 2°C	1.75°C
OFF	2°C or more	2°C

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	2°C 4°C
Low	2°C or more	

(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)**

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 (**GC, HC, FD25/35, GE**).
-0.6°C or less (**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:

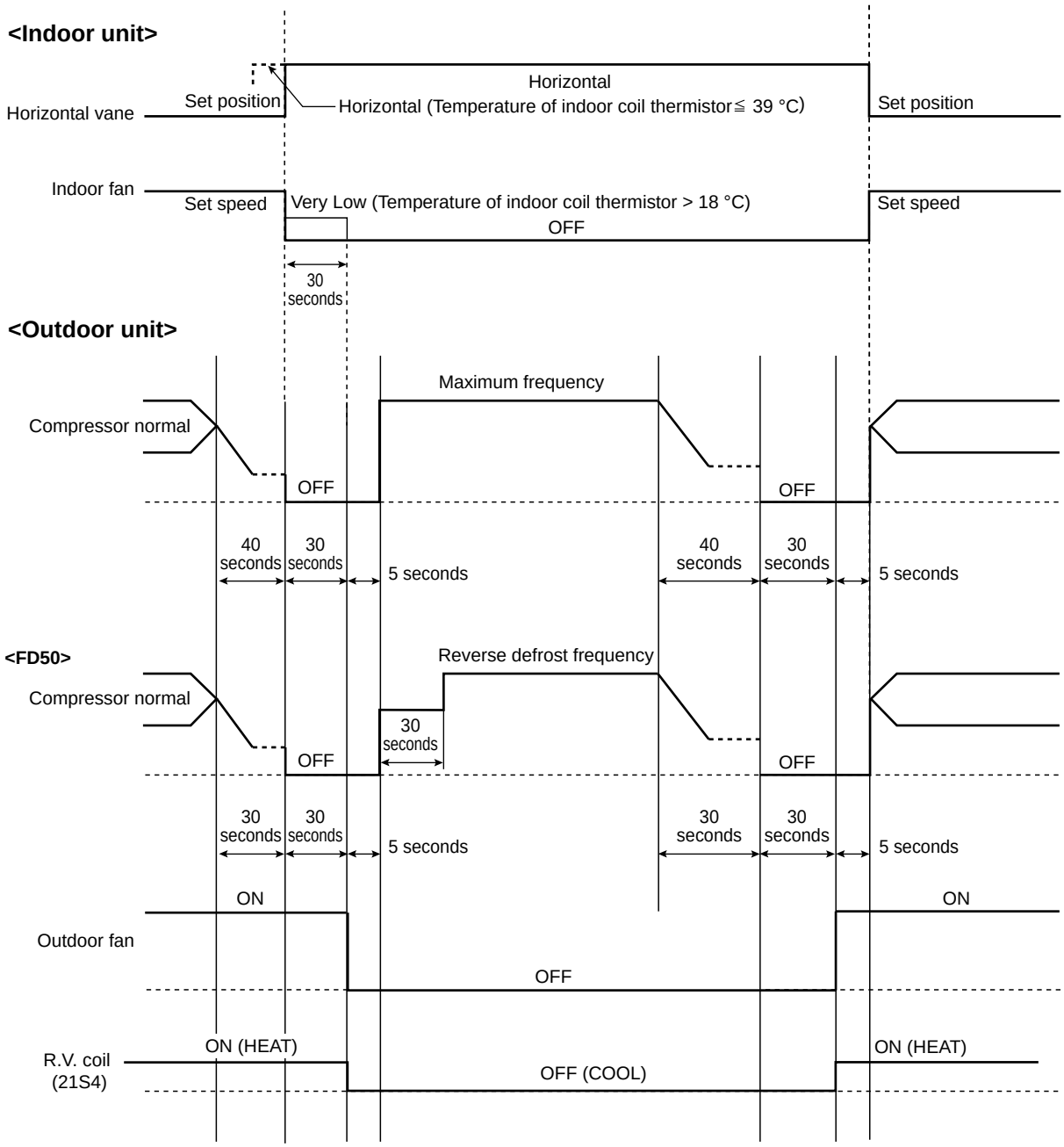
a) The defrost thermistor continues to read following temperature for 30 seconds:

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

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 (GC·VAH, FD·VAH/VABH, GE·VAH)

(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. (**NOTE1**).

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.

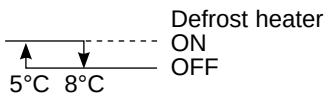
a) Any other mode than HEAT mode is selected. (**NOTE2**).

b) The ambient temperature thermistor reads 8°C or more for 5 minutes continuously. (**NOTE1**).

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

d) Outdoor fan motor is turned OFF.

NOTE1: Ambient temperature thermistor



NOTE2: During defrosting operation, defrost heater continues to be ON.

2-4. AUTO CHANGE OVER ··· AUTO MODE OPERATION (MSZ-GC/FD/GE/CGE, 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.

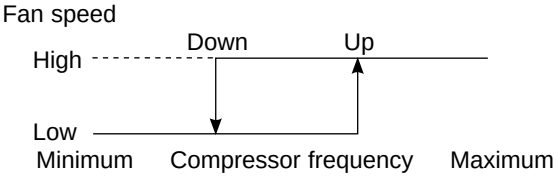
NOTE2: If two or more indoor units are operating in multi system, there might be a case that the indoor unit, which is operating in AUTO (), cannot change over the other operating mode (COOL ↔ HEAT) and becomes a state of standby.

(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	33	43
MUZ-FD50	25	33
MUZ-GE25	41	54
MUZ-GE50	33	44

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 doesn't work in the indoor unit.

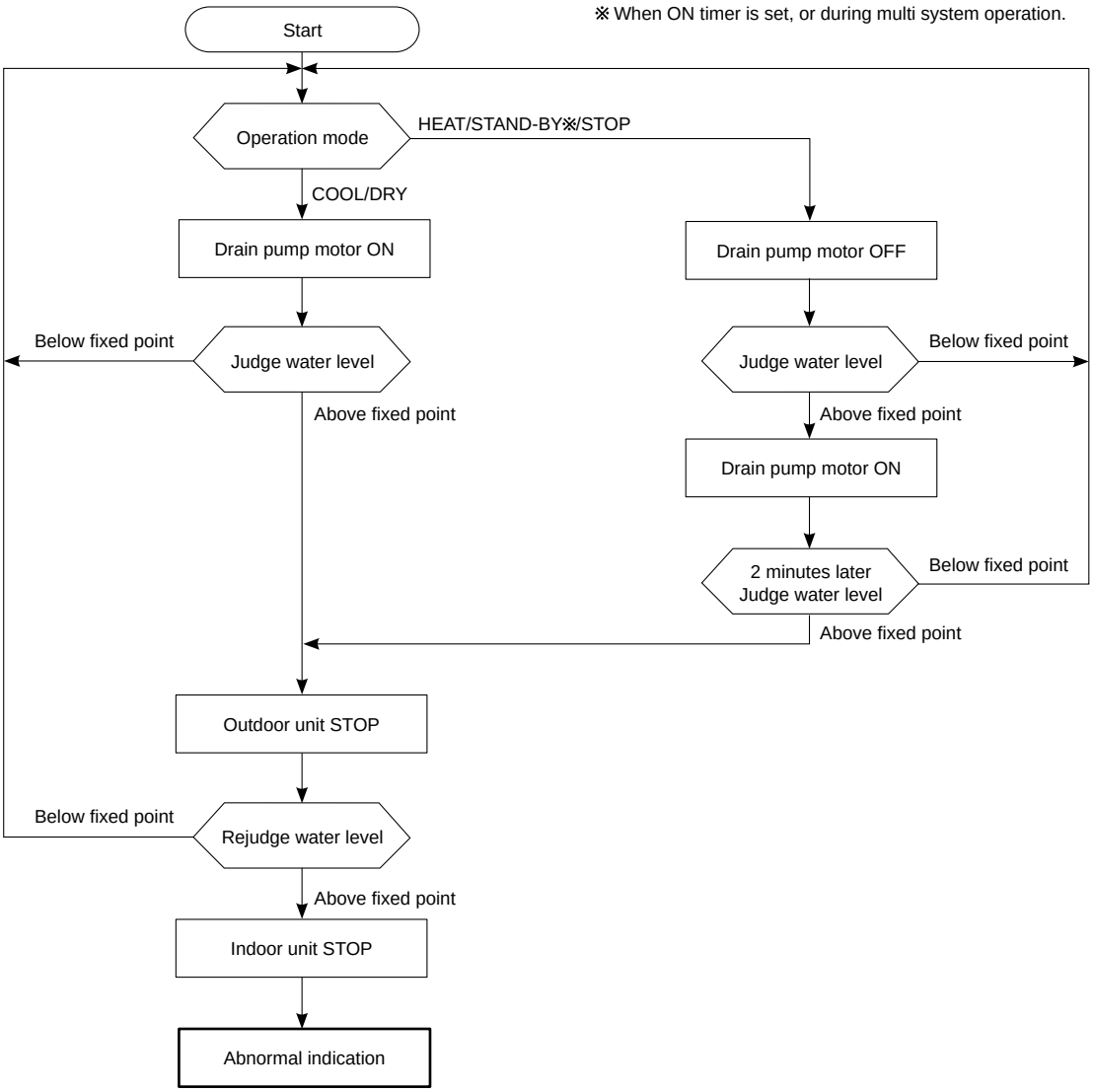
(2) ECONO COOL () operation (ECONOmical operation)

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.
ECONO COOL operation is cancelled when ECONO COOL button is pressed once again or VANE CONTROL button is pressed or change to other operation mode.

<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 of 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

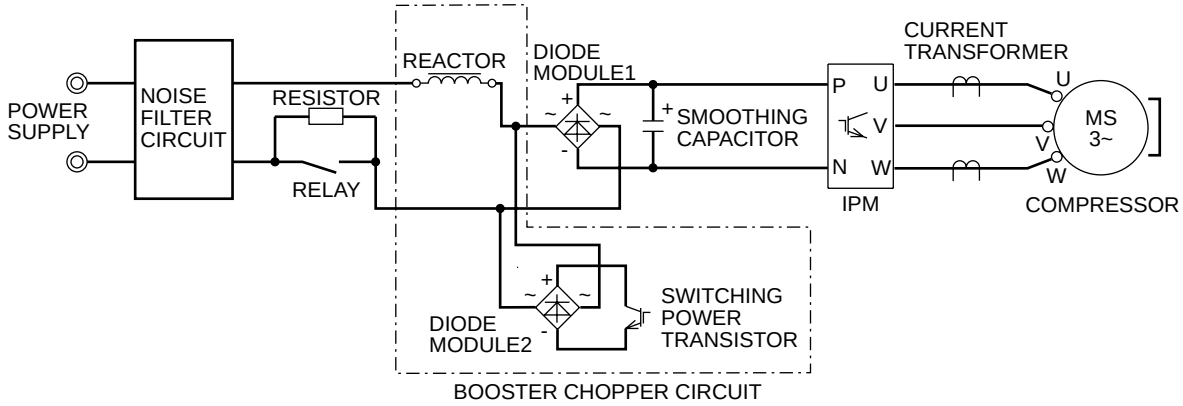
2-7. DRAIN PUMP/FLOAT SENSOR CONTROL (MLZ)



2-8. INVERTER SYSTEM CONTROL

2-8-1. Inverter main power supply circuit

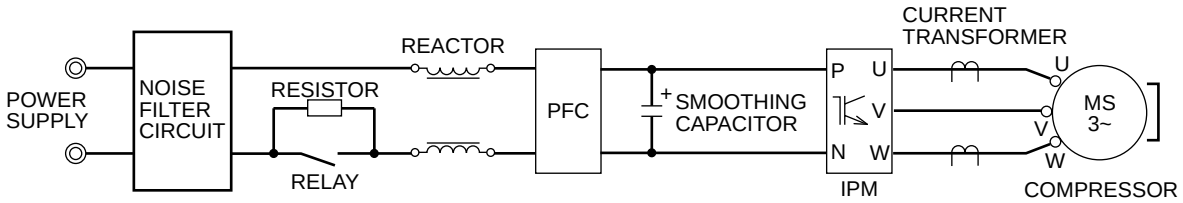
MUZ-GC, HC, FD25/35, GE



Function of main parts

NAME		FUNCTION
INTELLIGENT POWER MODULE (IPM)		It supplies three-phase AC power to compressor.
SMOOTHING CAPACITOR		It stabilizes the DC voltage and supply it to IPM.
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 electricity turns ON.
RELAY		It short-circuits the resistance which restricts rush current during the normal operation after the compressor startup.
BOOSTER CHOPPER CIRCUIT	DIODE MODULE 2	It improves power factor. It controls the bus-bar voltage.
	SWITCHING POWER TRANSISTOR	
	REACTOR	

MUZ-FD50



Function of main parts

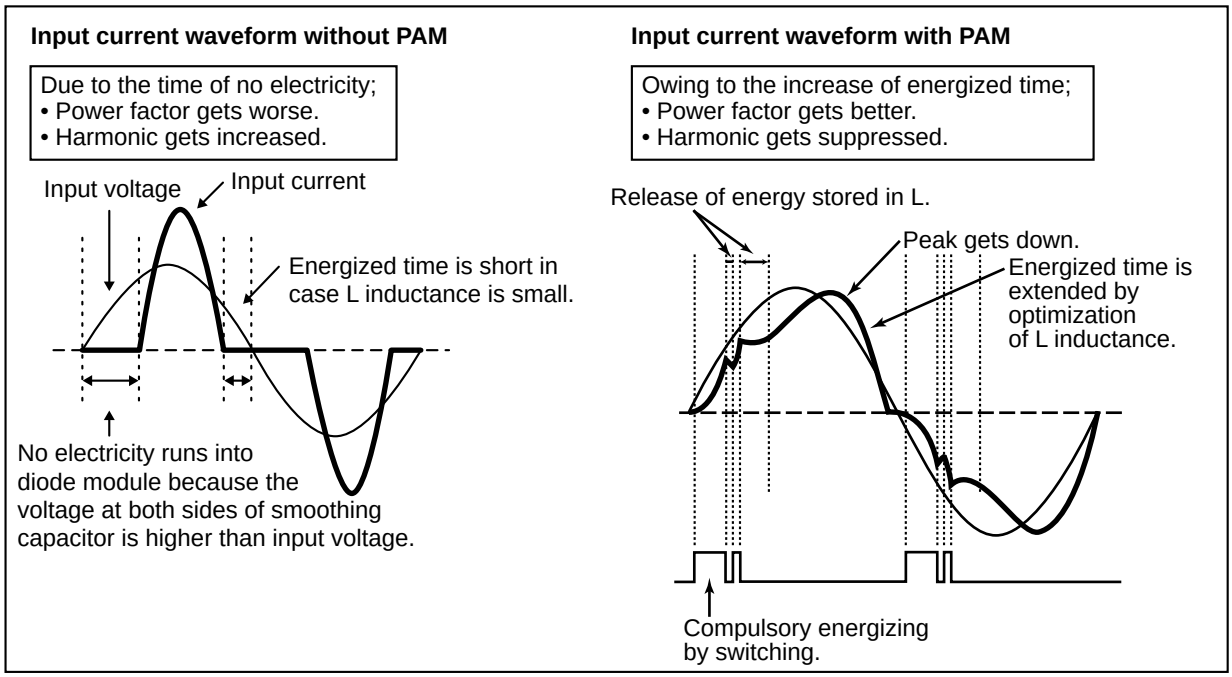
NAME	FUNCTION
INTELLIGENT POWER MODULE (IPM)	It supplies 3-phase AC power to compressor.
SMOOTHING CAPACITOR	It stabilizes the DC voltage and supplies it to IPM.
CURRENT TRANSFORMER	It measures the current of the compressor motor. It measures the current of the main power supply circuit.
REACTOR	It rectifies AC, controls its voltage and improves the power factor of power supply.
POWER FACTOR CORRECTION MODULE (PFC)	
RESISTOR	It restricts rush current with the resistance.
RELAY	It short-circuits the resistance which restricts rush current during the compressor operates.

2-8-2. Outline of main power supply circuit
MUZ-GC, HC, FD25/35, GE
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 IPM.
④ DC voltage, which has been stabilized in process ③, is converted to three-phase AC by IPM 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 IPM 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 IPM.



4. Intelligent power module
IPM 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 IPM, IPM 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

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 PFC. 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 IPM.
④ The DC (Bus voltage), which has been stabilized in process ③, is converted to 3 phase AC by IPM 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 information.

3. Power factor improvement

Booster coil reactor and power factor controller 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. PFC and reactor that stabilizes the voltage of DC supplied to inverter circuit and makes its waveform smooth.

4. Power transistor module

IPM 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 IPM, IPM 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 induced voltage 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 supplied power voltage 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 three-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 rotation times 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 saved 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 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 three-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 three-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 Rotation Times

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:

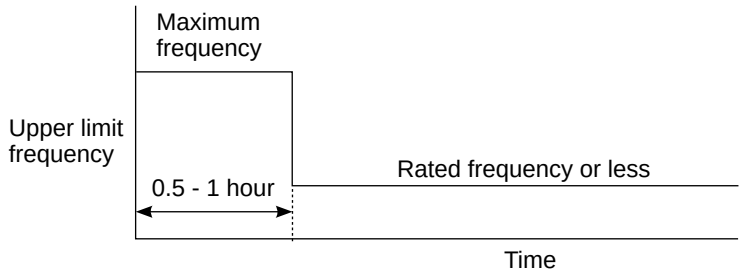
First, the target operational frequency is set based on the difference between the room temperature and the set temperature.

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

※ 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.



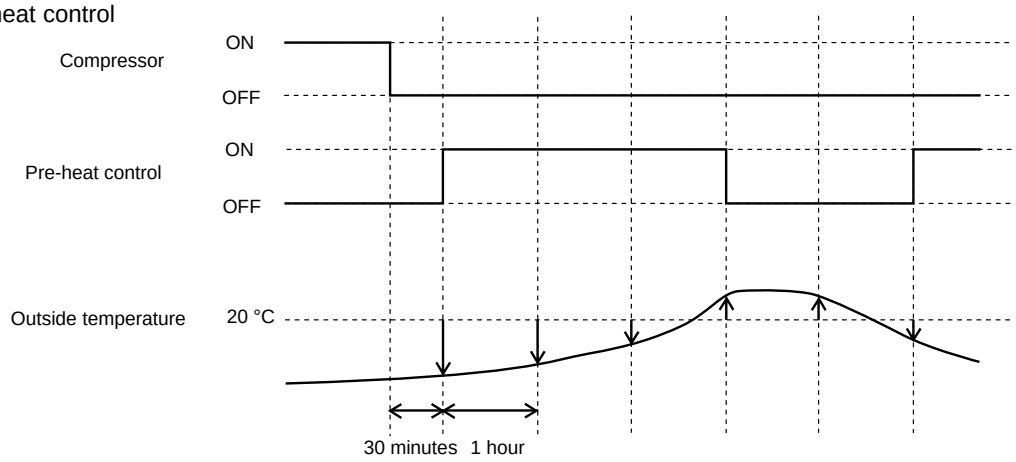
2-10. PRE-HEAT CONTROL

MUZ-GC, HC, FD, GE

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



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) Outside temperature is 20°C or below.

Outside temperature is monitored hourly, and when outside temperature is 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.)

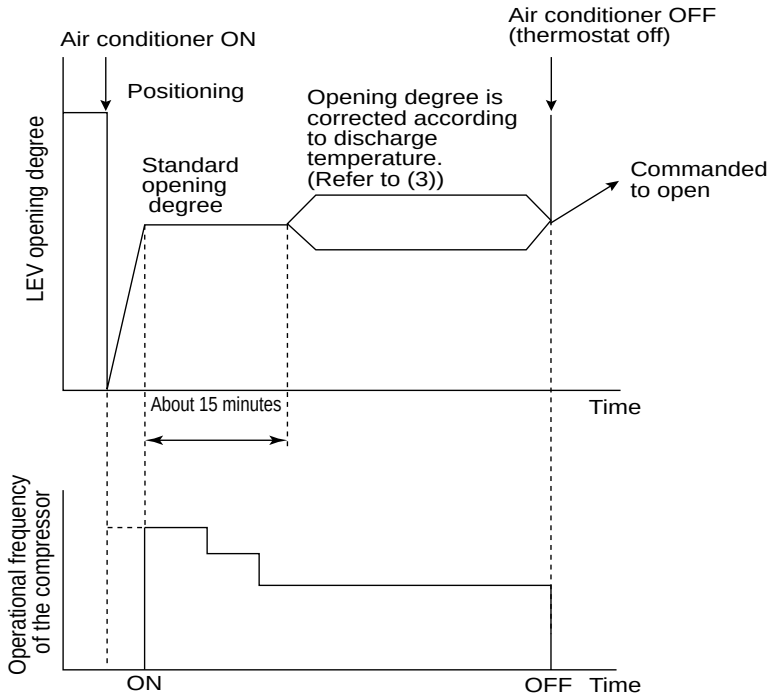
2-11. EXPANSION VALVE CONTROL/LEV CONTROL (MUZ-GC/FD/GE HC35)

(1) Outline of LEV control

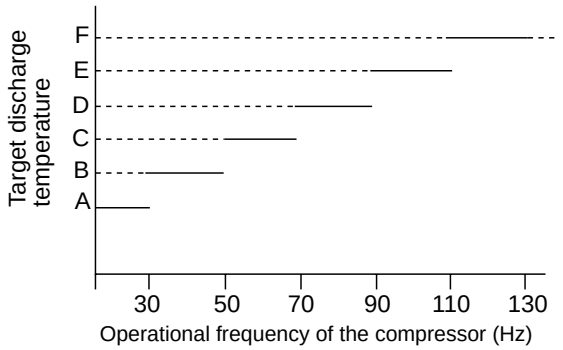
The LEV basic control is setting of LEV opening degree to the standard opening degrees set for each operational frequency of the compressor. However, when any change in indoor/outdoor temperatures or other factors cause air conditioning load fluctuation, the LEV control also works to correct LEV opening 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 approximate 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-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

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.

MITSUBISHI ELECTRIC CORPORATION

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