SORENTO

FULL AUTOMATIC AIR CONDITIONING SYSTEM

Produced by Chonan Technical Service Training Center

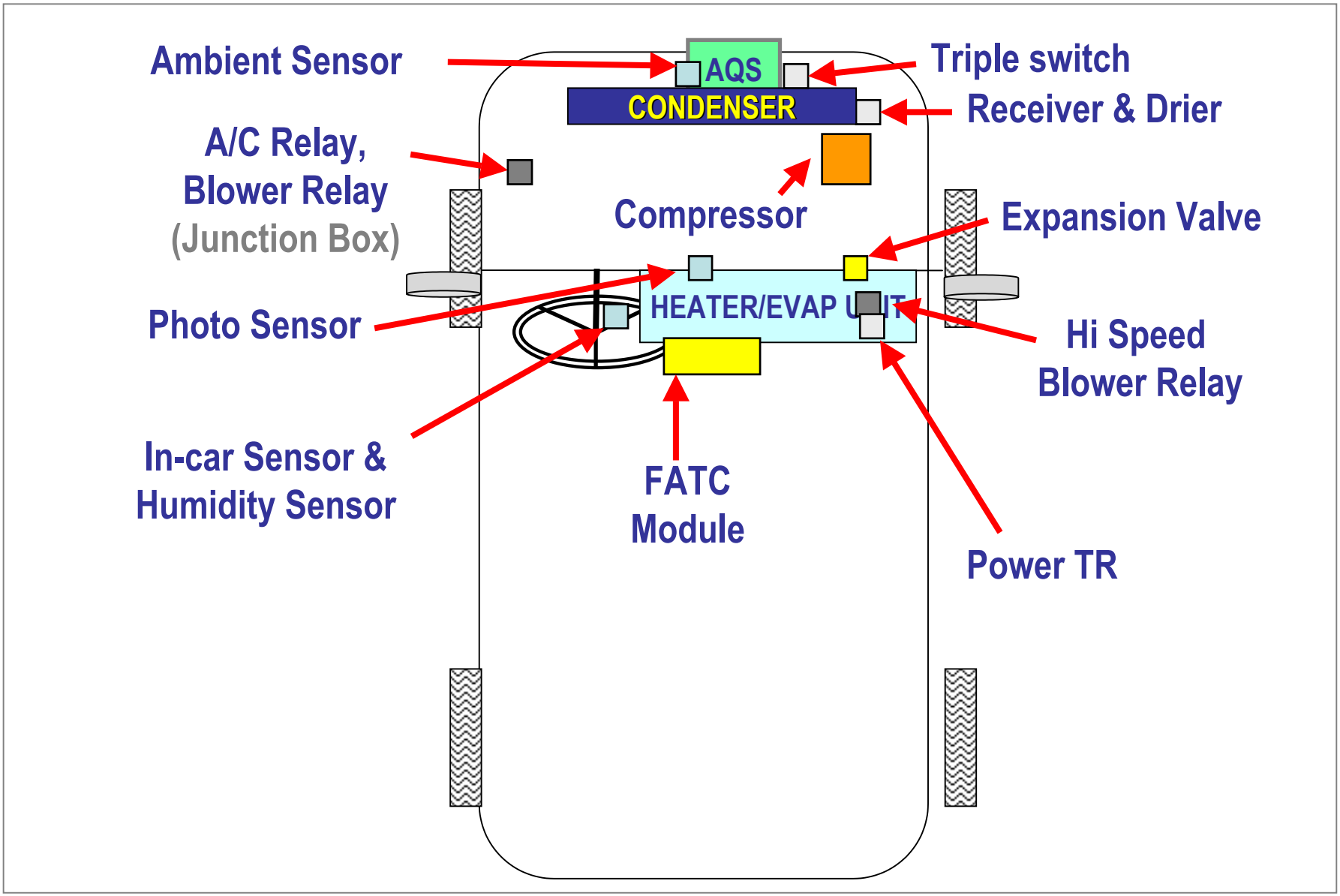
CONTENTS

SYSTEM SPECIFICATION

PARTS		SPECIFICATION
COMPRESSOR	TYPE	10PA17C (SWASH TYPE)
	OIL	150±10 g
	CAPACITY	180 cc/rev
REFRIGERENT AND QUANTITY		R-134a, 600±25 g
TRIPLE S/W (Kg/㎠G)	H/P	32.0 ± 2.0
	M/P	15.5 ± 0.8
	L/P	2.3 ± 0.25

※ H/P: HIGH PRESSURE, M/P: MIDDLE PRESSURE, L/P: LOW PRESSURE

SYSTEM LOCATION



REFRIGERANT CIRCUIT

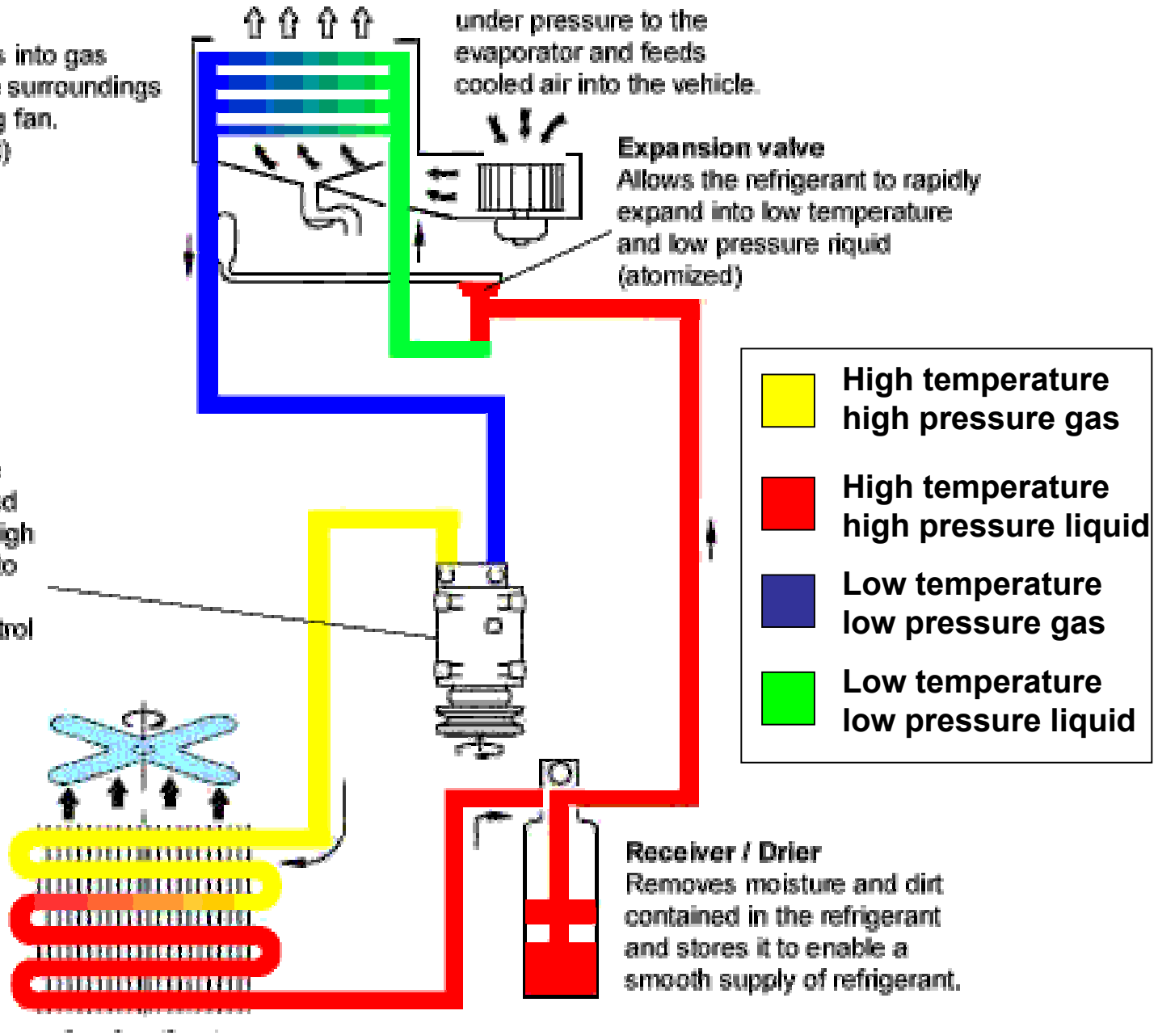
Evaporator
Atomized refrigerant evaporates into gas while taking heat away from the surroundings through the action of the cooling fan. (the surroundings will be cooled)

Blower
Feeds air in the vehicle under pressure to the evaporator and feeds cooled air into the vehicle.

Expansion valve
Allows the refrigerant to rapidly expand into low temperature and low pressure riquid (atomized)

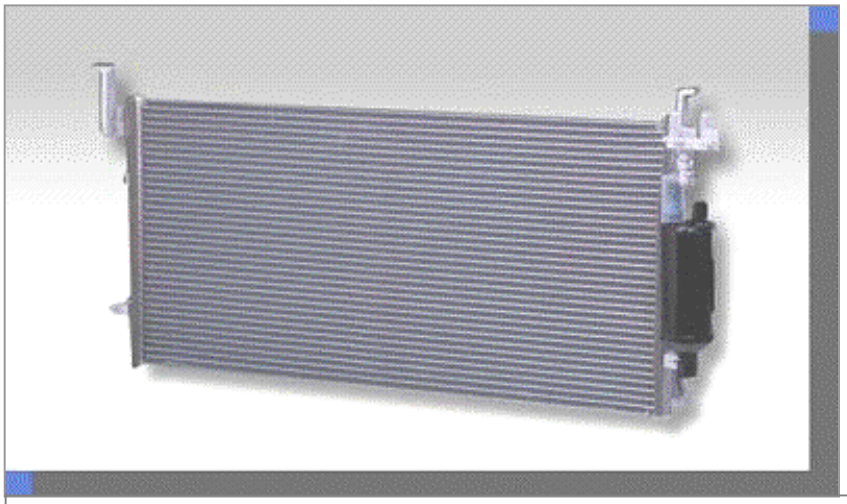
Compressor
This is driven by V-belt from the engine to change the evaporated refrigerant into high pressure (high temperature) gas and supply it to the condenser. The magnetic clutch is installed to enable control of the compressor.

Condenser
This is installed in front of the radiator. Cools high pressure and high temperature refrigerant to its condensation point to return to high pressure liquid with air from the cooling fan and the vehicle speed.



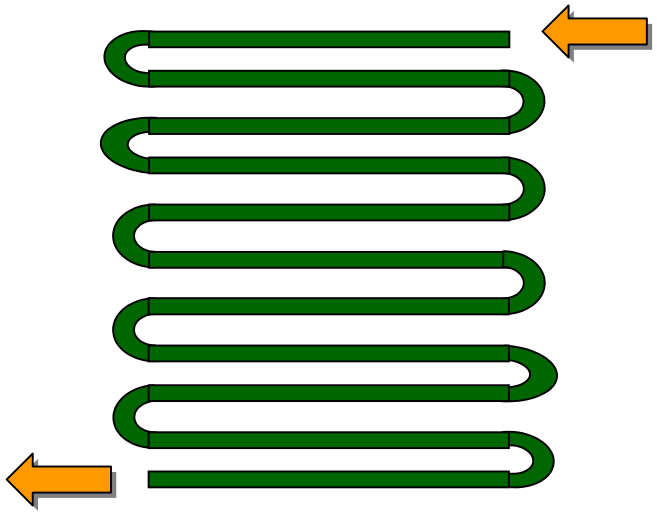
Receiver / Drier
Removes moisture and dirt contained in the refrigerant and stores it to enable a smooth supply of refrigerant.

CONDENSER

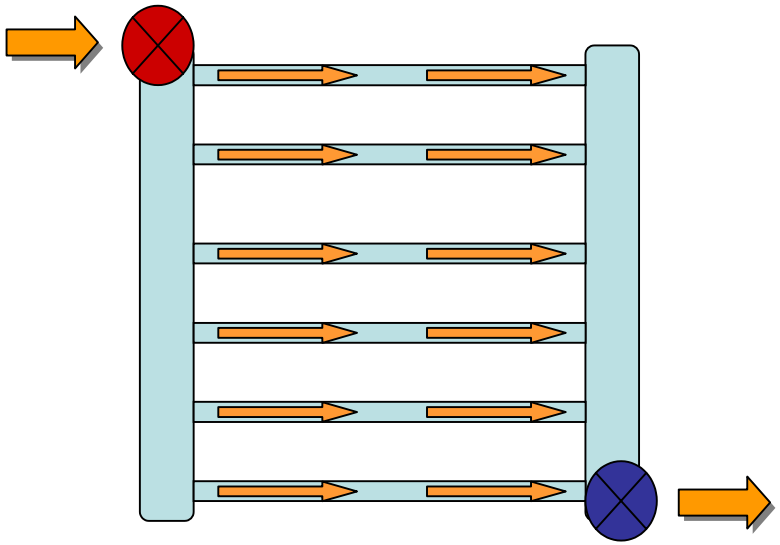


R-134A, PARALLEL FLOW TYPE

CORRUGTED TYPE

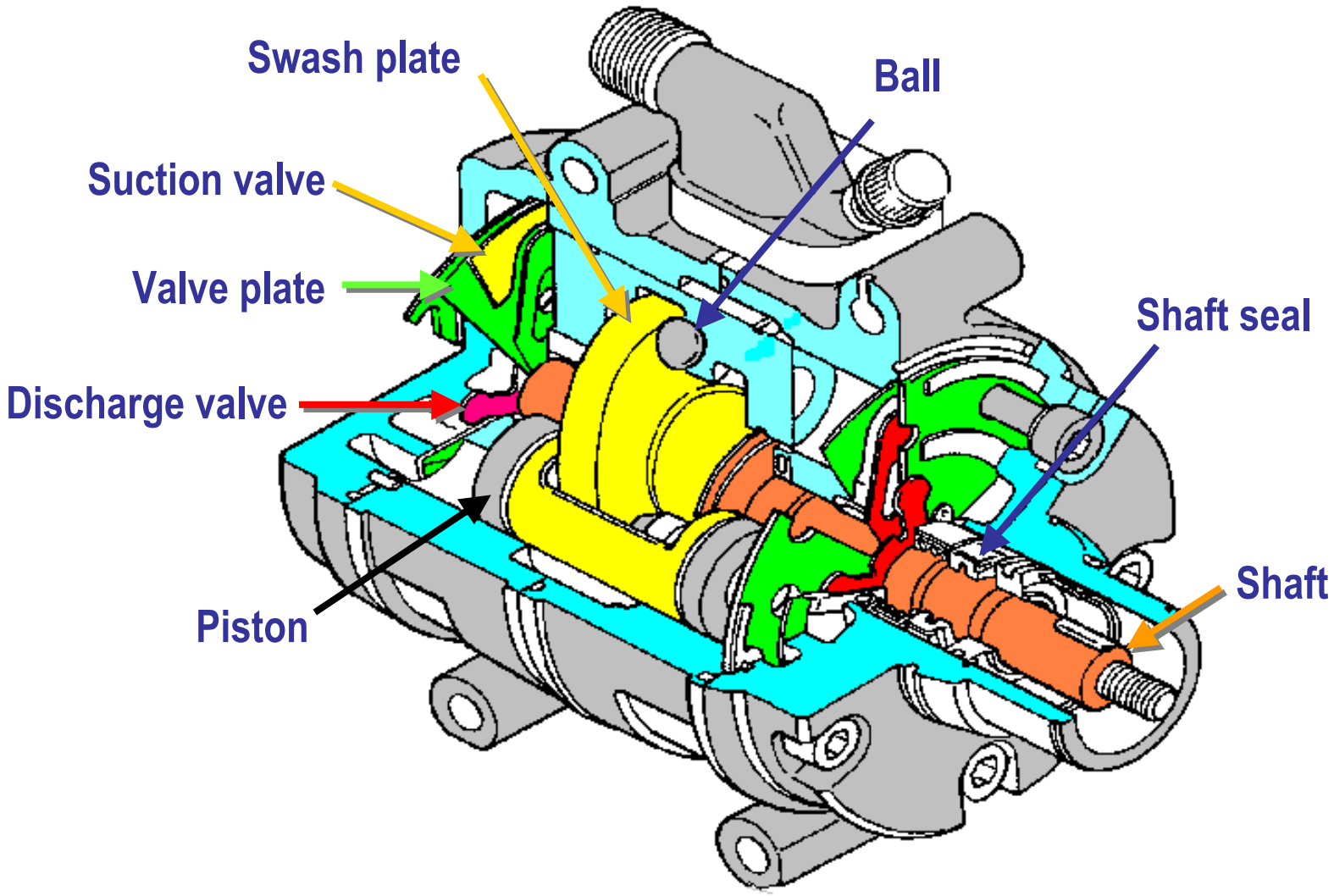


PARALLEL FLOW TYPE



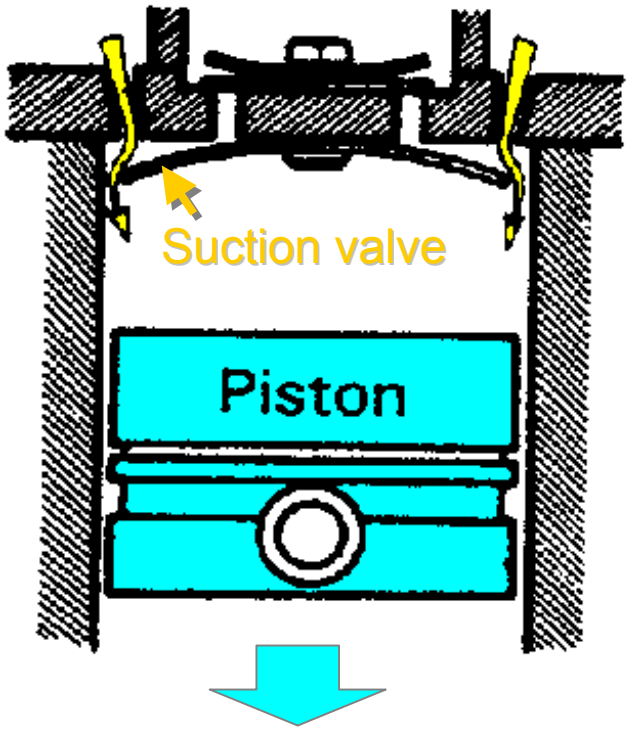
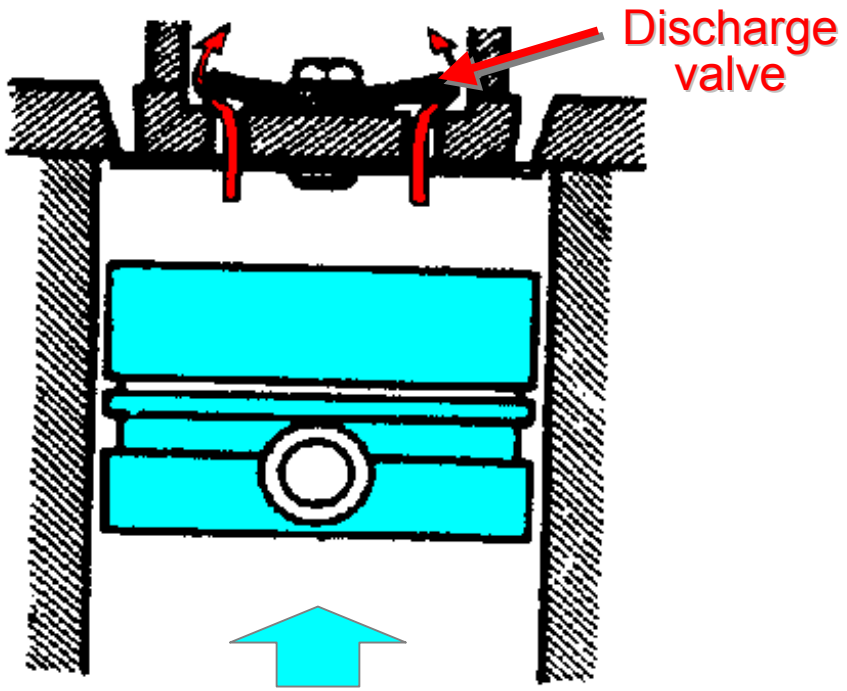
COMPRESSOR (SWASH PLATE TYPE)

COMPRESSOR CONSTRUCTION



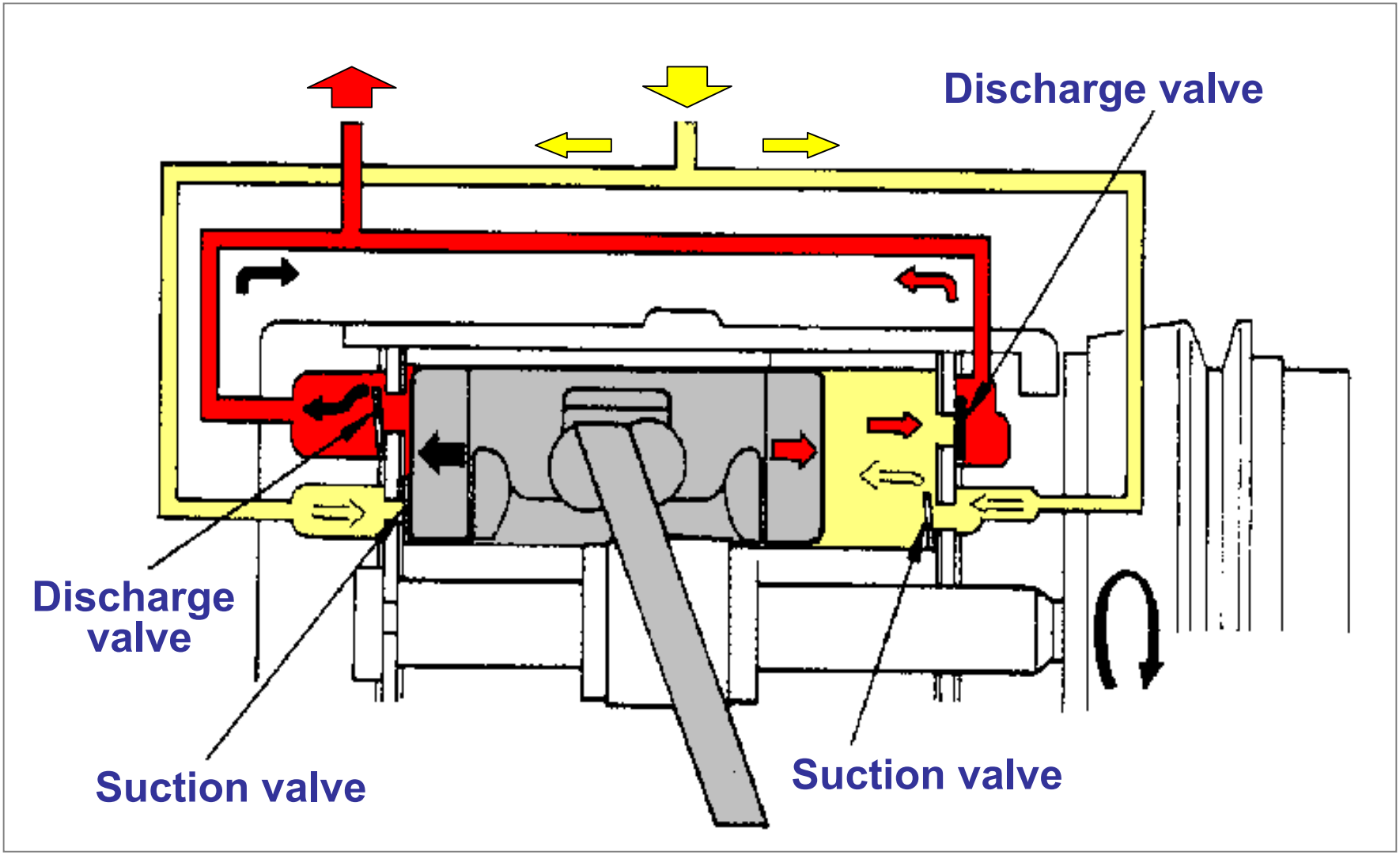
COMPRESSOR OPERATION (SWASH PLATE TYPE)

SUCTION & DISCHARGE STROKE

SUCTION	DISCHARGE
	
Down-stroke	Up-stroke

COMPRESSOR OPERATION (SWASH PLATE TYPE)

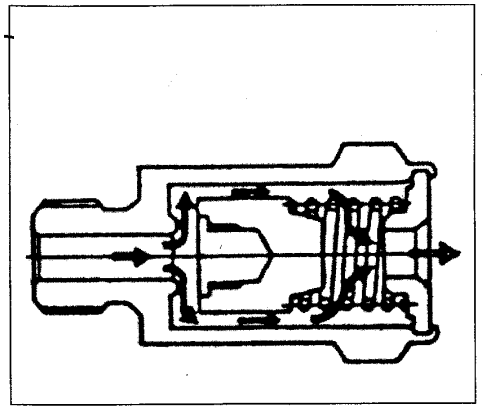
COMPRESSION MECHANISM



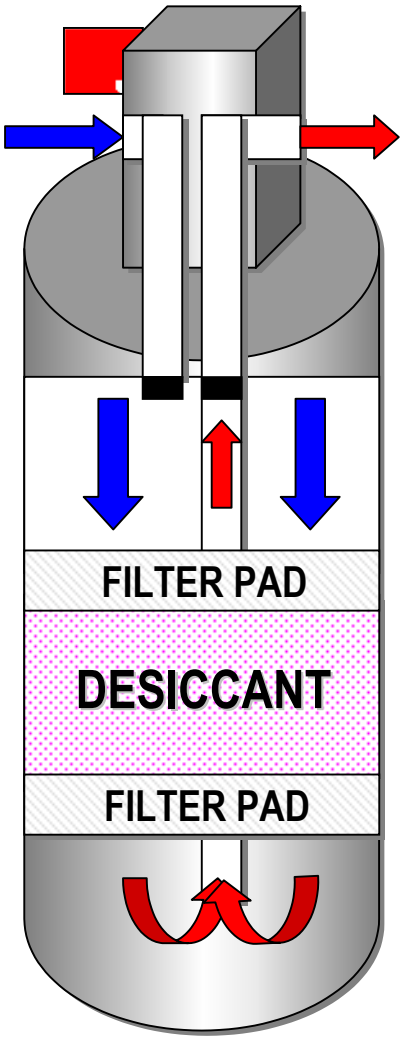
SAFETY VALVE (Pressure Relief Valve)

: Release the high pressurized refrigerant and oil

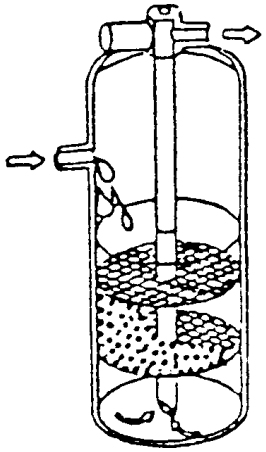
- Operating pressure: **35.3~42.2kg/㎠**

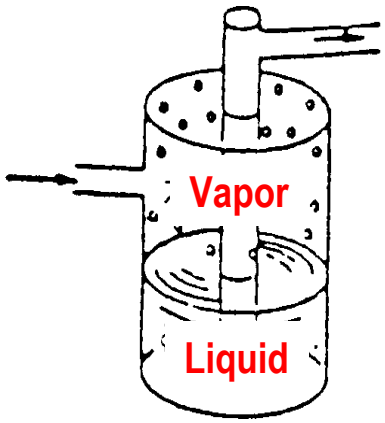


RECEIVE AND DRIER



FUNCTION





1) REFRIGERANT PURIFICATION

2) REFRIGERANT STORAGE

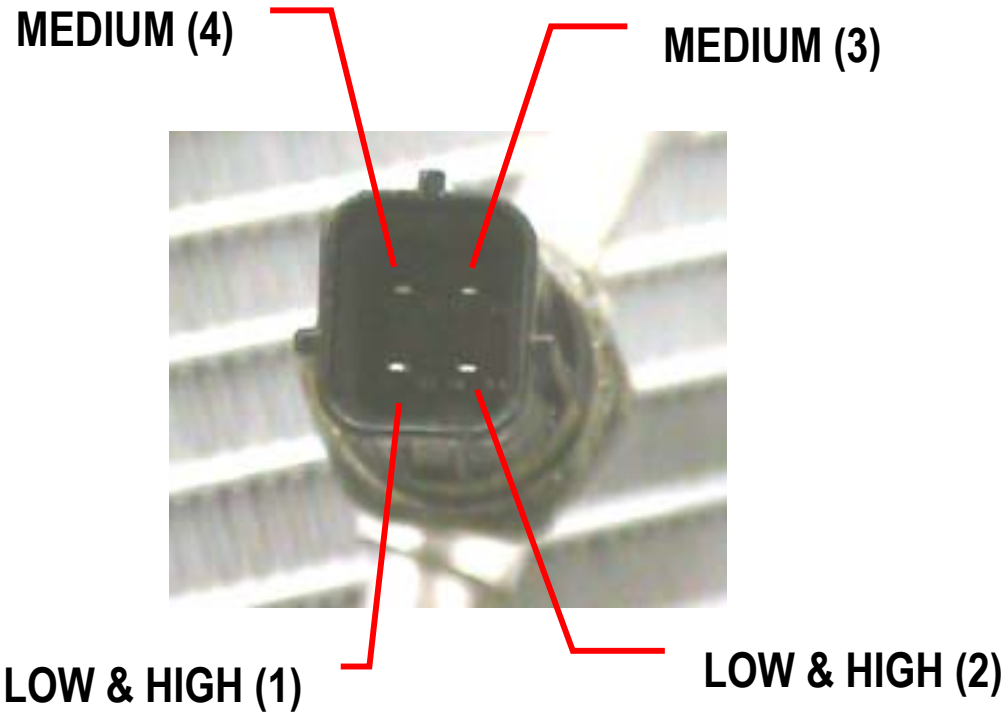
3) VAPOR BUBBLE SEPARATION

TRIPLE SWITCH

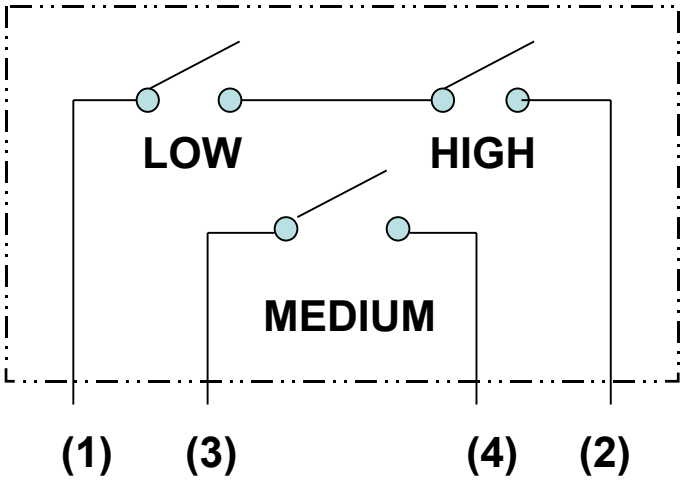
HIGH
MIDDLE
LOW

→ ECM →

Low & high switch : Compressor control
Middle switch : Condenser fan control



ELECTRIC DIAGRAM



TRIPLE SWITCH

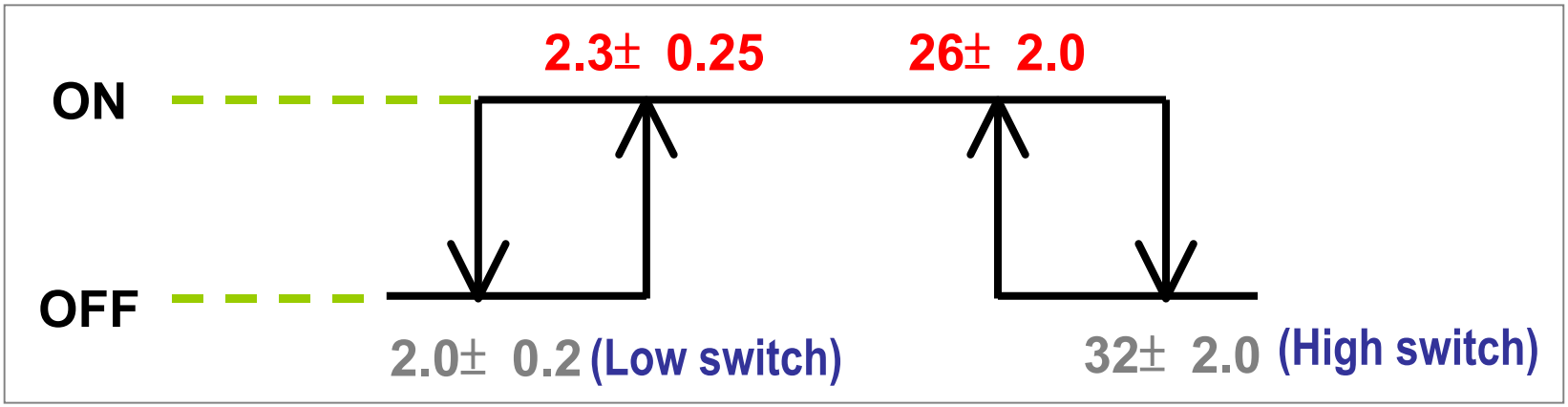
1. COMPRESSOR & CONDENSER FAN CONTROL TABLE

PRESSURE (Kg/cm^2)	COMPESSOR	CONDENSER FAN	REMARK
2.3 ~ 15.5	ON	OFF	Pressure increasing
15.5 ~ 32.0	ON	ON	Pressure increasing
32.0 ~	OFF	ON	Excessive pressure
26.0 ~ 11.5	ON	ON	Pressure decreasing
11.5 ~ 2.0	ON	OFF	Pressure decreasing

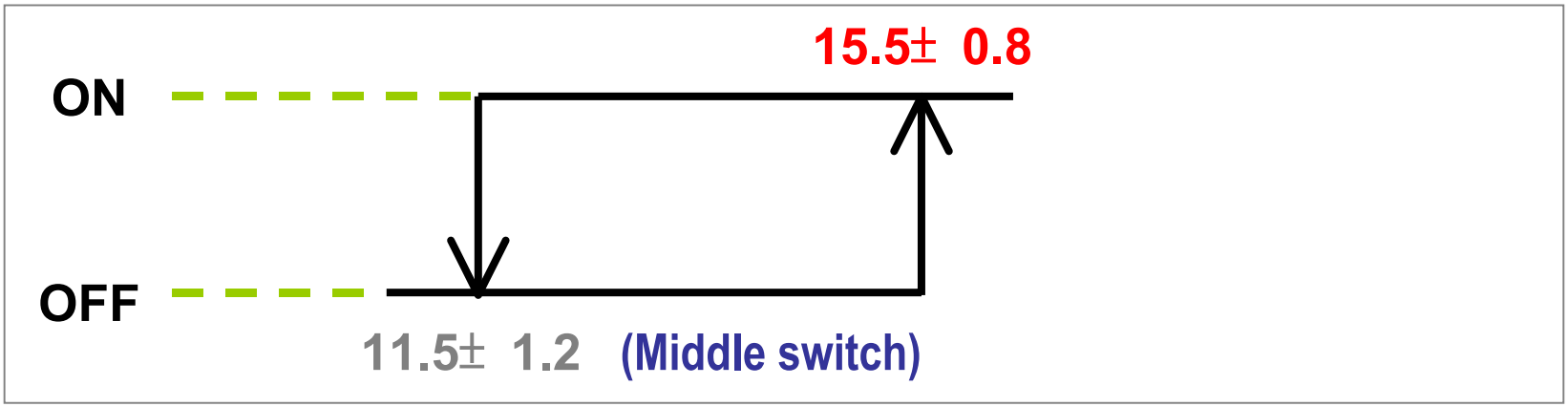
TRIPLE SWITCH

2. SWITCH ON & OFF RANGE

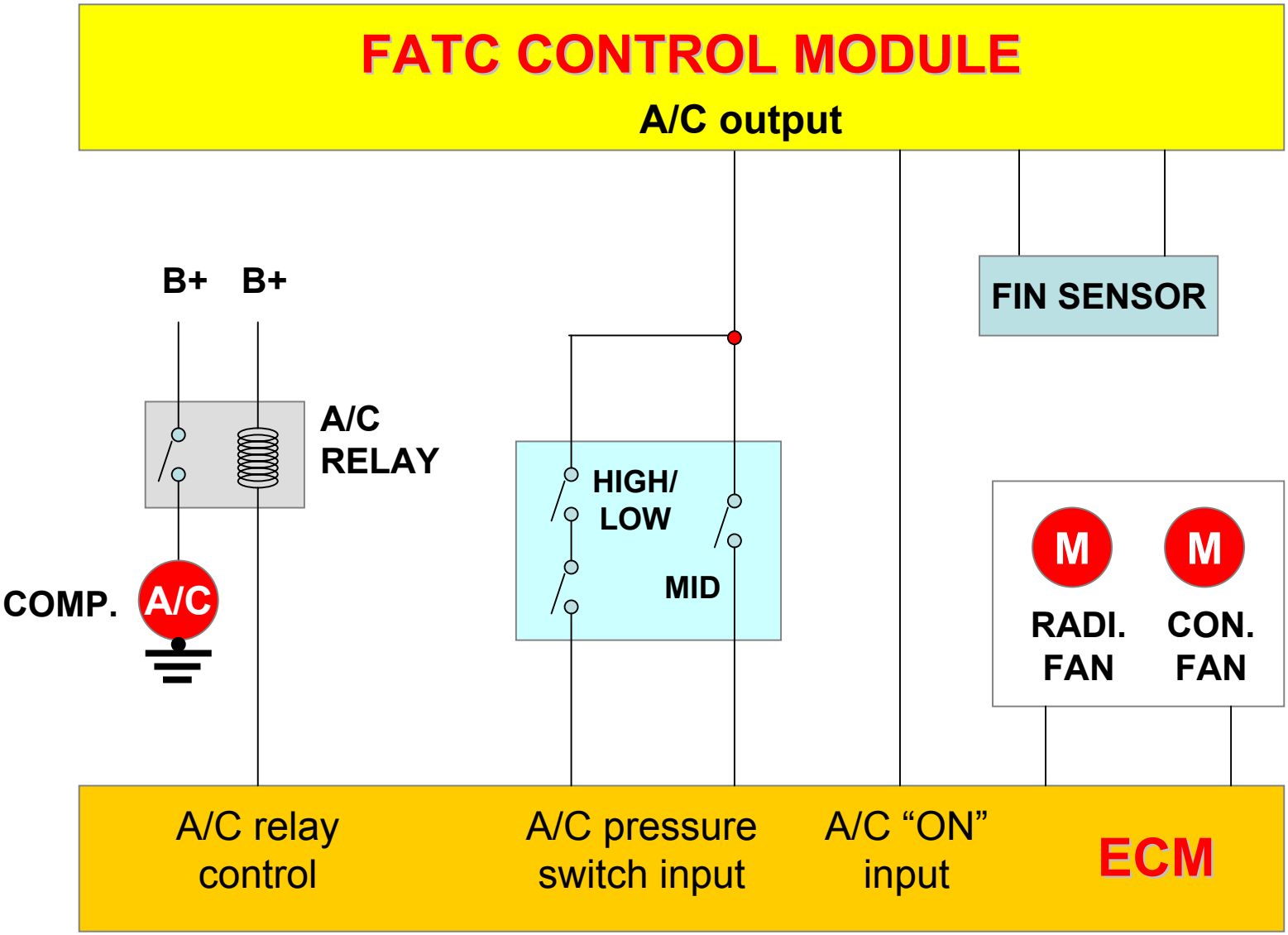
• **LOW & HIGH SWITCH** (kg/cm²)



• **MIDDLE SWITCH (kg/cm²)**



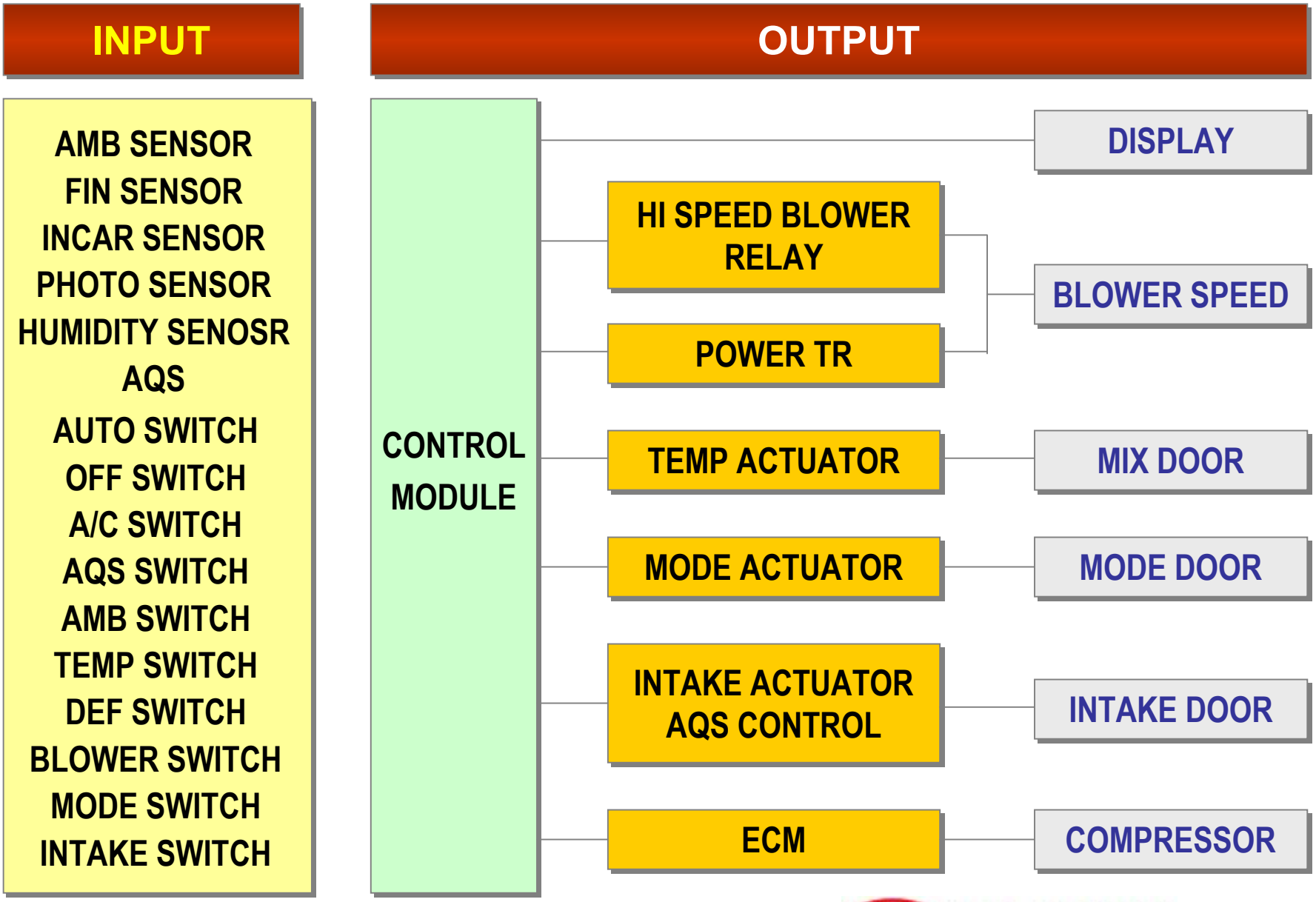
TRIPLE SWITCH



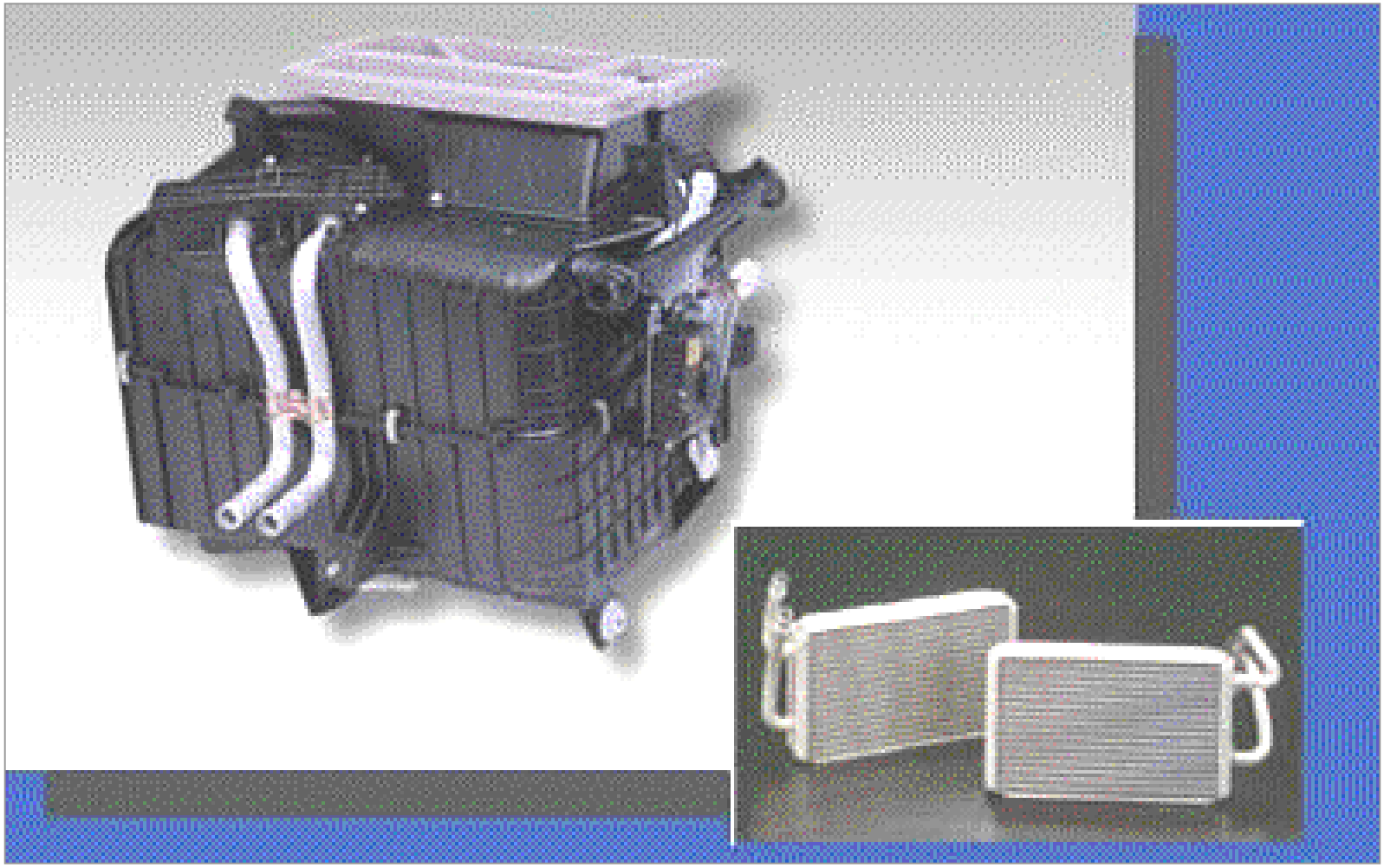
REFRIGERANT COMPARISON

REFRIGERANT	R-134a	R-12
Molecular formula	CH_2FCF_3	CCL_2F_2
Molecular weight	102.03	120.91
Boiling point (1atm,℃)	-26.14	-29.79
Freezing point (℃)	-108.0	-155.0
Critical temperature (℃)	101.29	111.8
Saturated vapor pressure	2.98 kg/㎠ (0℃)	3.15 kg/㎠ (0℃)
	17.11 kg/㎠ (60℃)	15.51 kg/㎠ (60℃)
Evaporation latent heat	47.04 kcal/㎠ (0℃)	36.43 kcal/㎠ (0℃)
	33.18 kcal/㎠ (60℃)	27.33 kcal/㎠ (60℃)
Inflammability	No	No
Toxicity	Possible (burning)	No
Remaining time in the atmosphere	8~11 Year	95~150 Year
Mineral oil solubility	Bad	Good

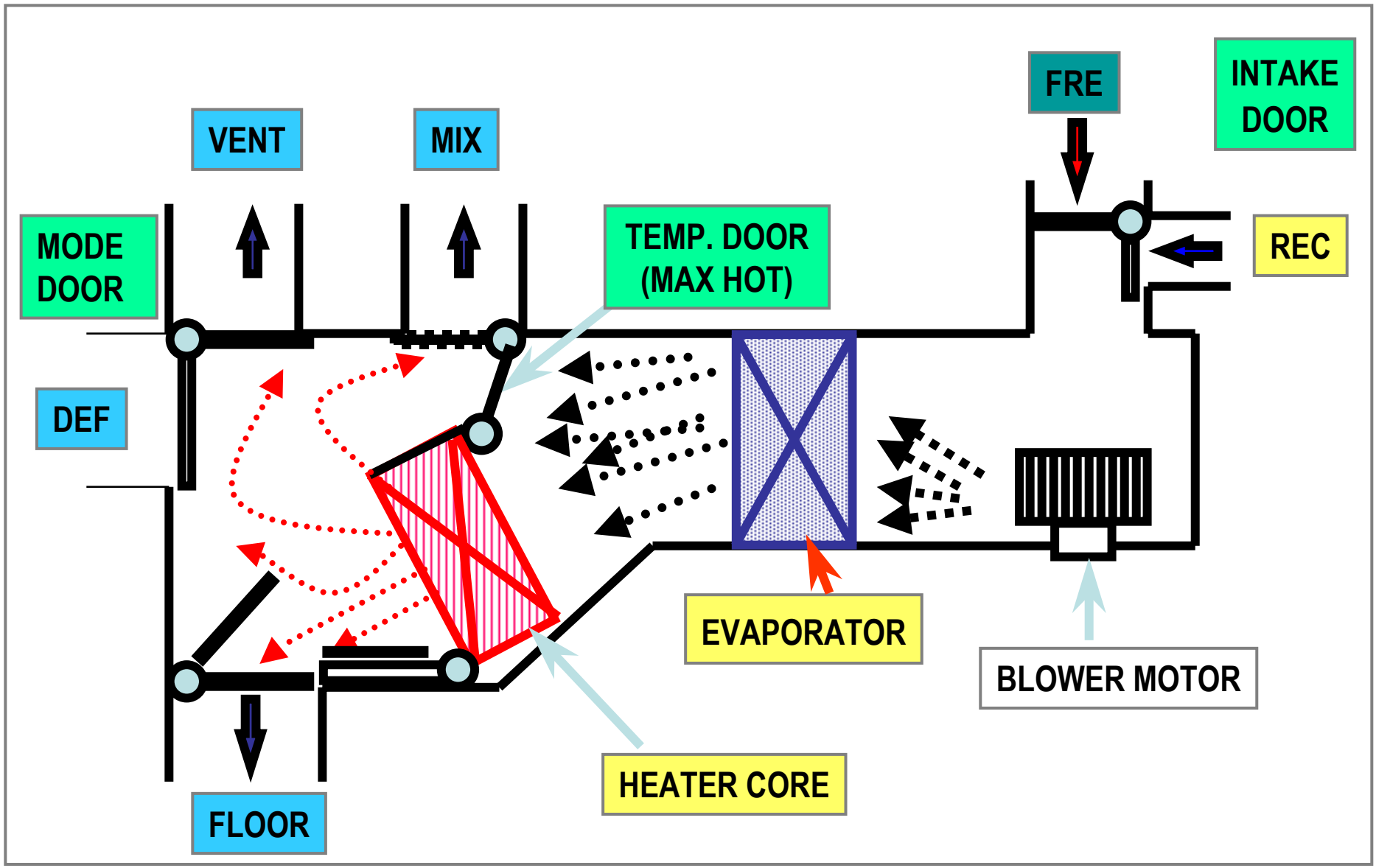
FATC INPUT & OUTPUT



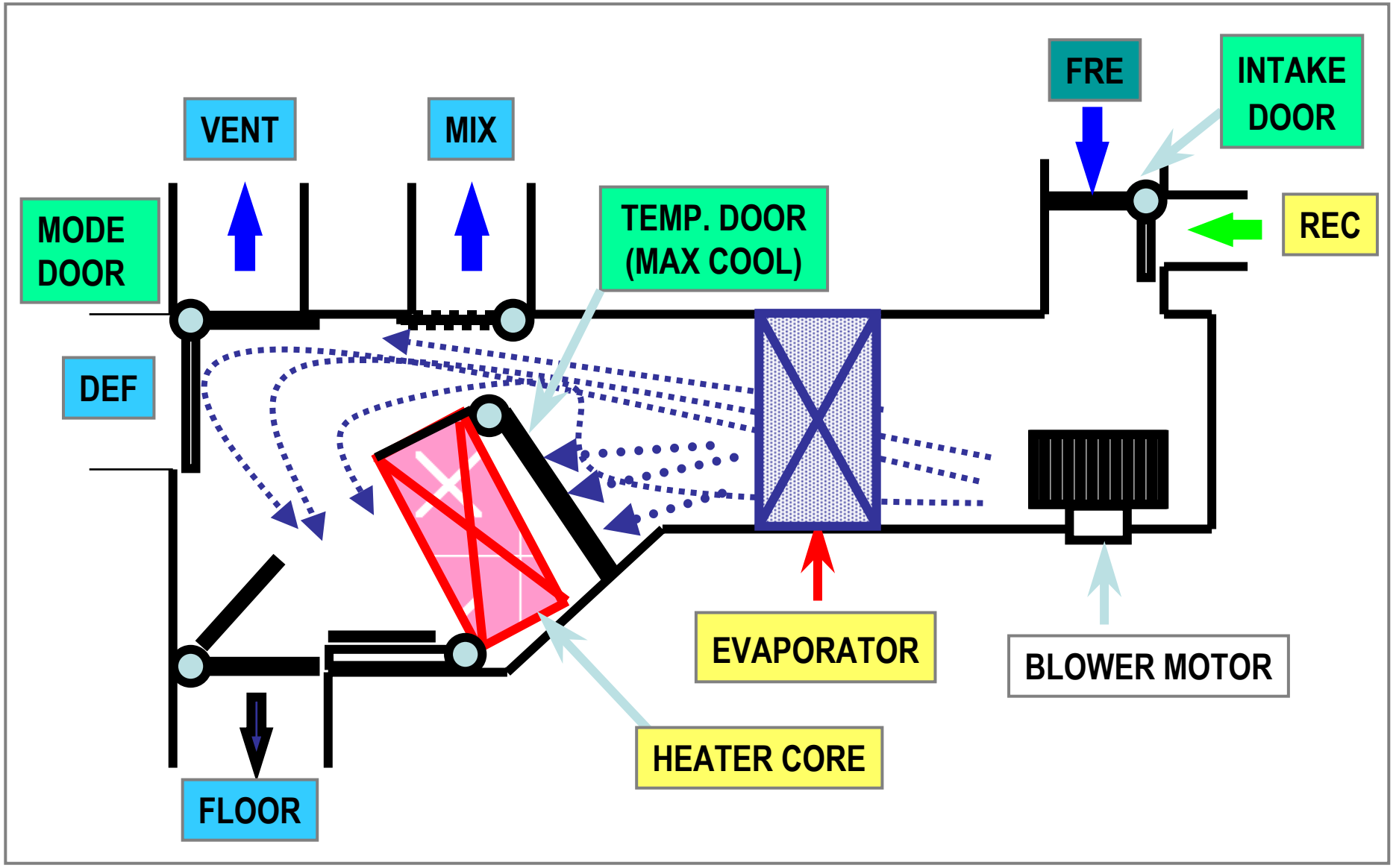
HEATER UNIT



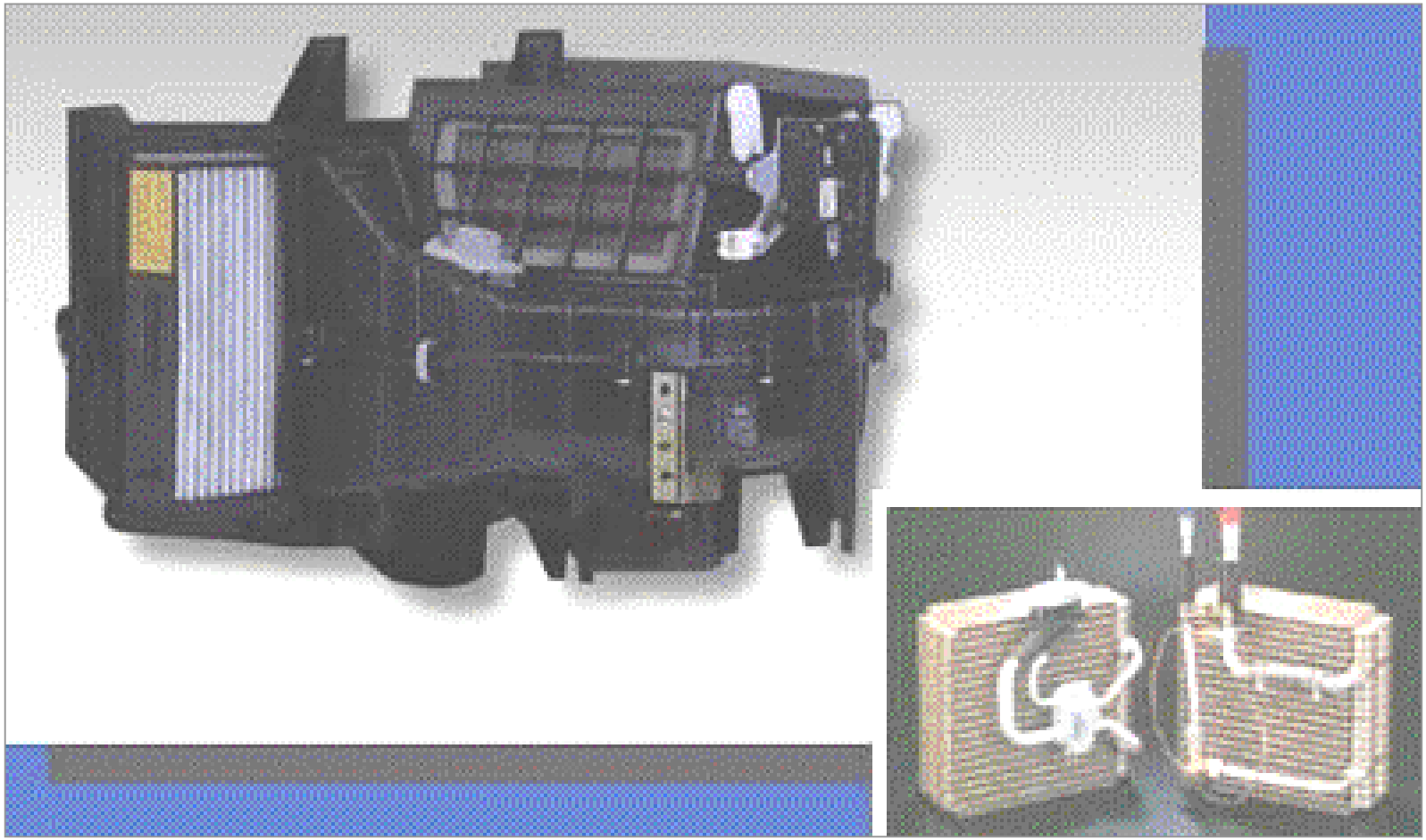
HEATER UNIT


VENT
MIX
FRE
INTAKE DOOR
MODE DOOR
TEMP. DOOR (MAX HOT)
REC
DEF
EVAPORATOR
BLOWER MOTOR
HEATER CORE
FLOOR

HEATER UNIT

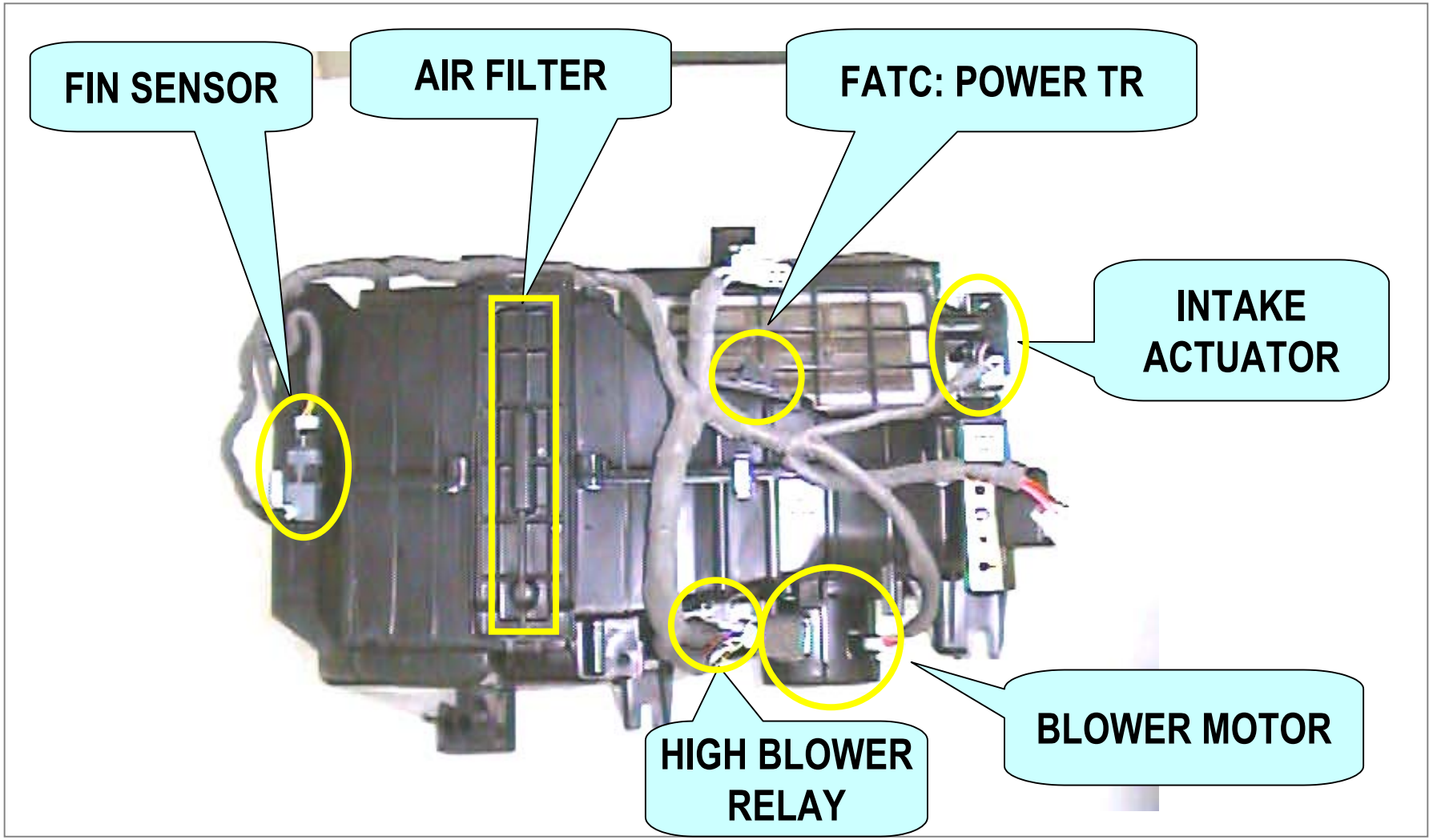

FRE
INTAKE DOOR
VENT
MIX
REC
MODE DOOR
TEMP. DOOR (MAX COOL)
DEF
EVAPORATOR
BLOWER MOTOR
HEATER CORE
FLOOR

EVAPORATOR UNIT



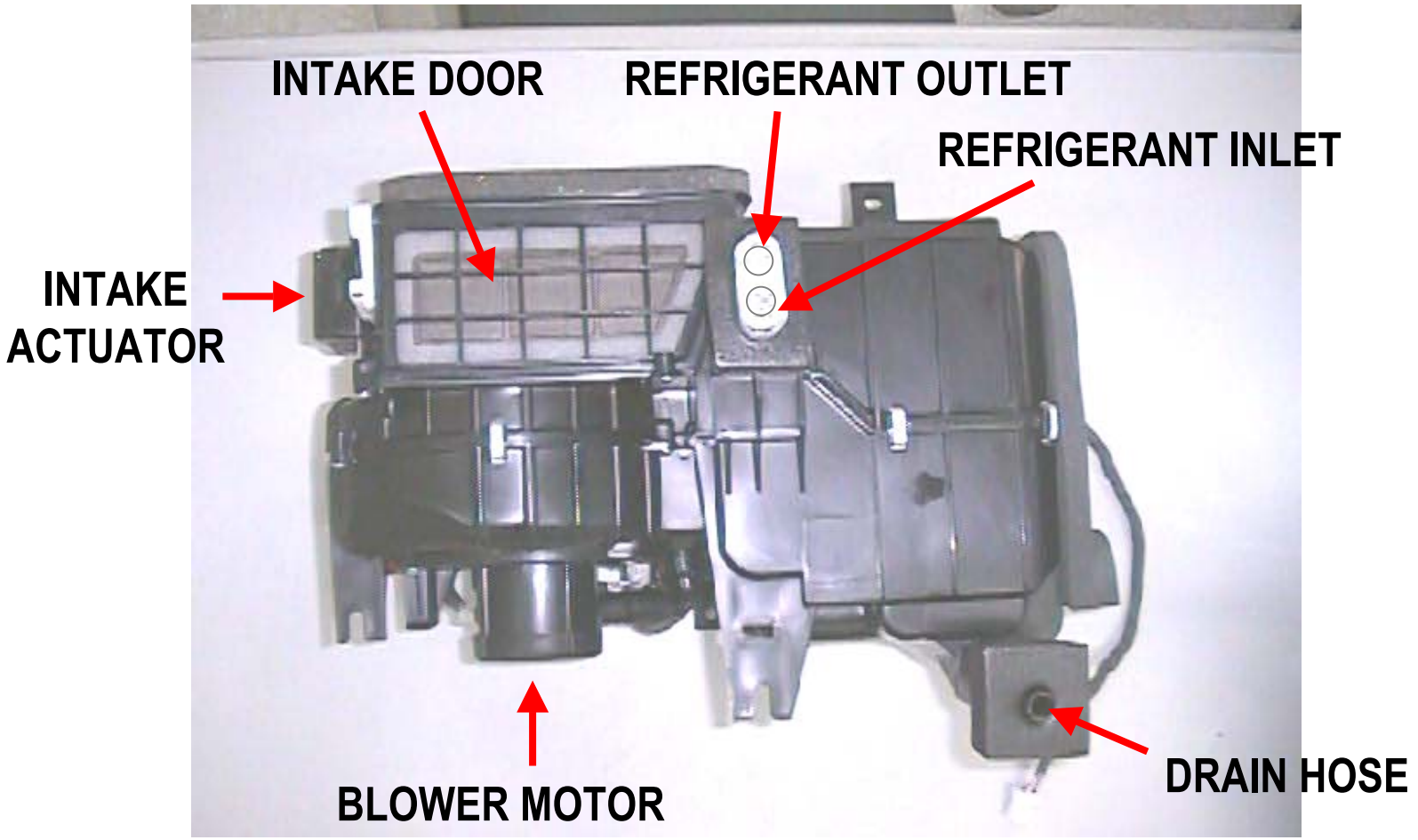
EVAPORATOR AND BLOWER UNIT

1. FRONT VIEW



EVAPORATOR AND BLOWER UNIT

2. REAR VIEW



EVAPORATOR AIR FILTER

1. DESCRIPTION

Employing combination filter, dust and odor in the air is effectively removed.

2. LIFE TIME

Filter replacement period is 5000 ~ 12,000km. But this can be shorten if the road condition is bad causing more dust and black smoke in the air.

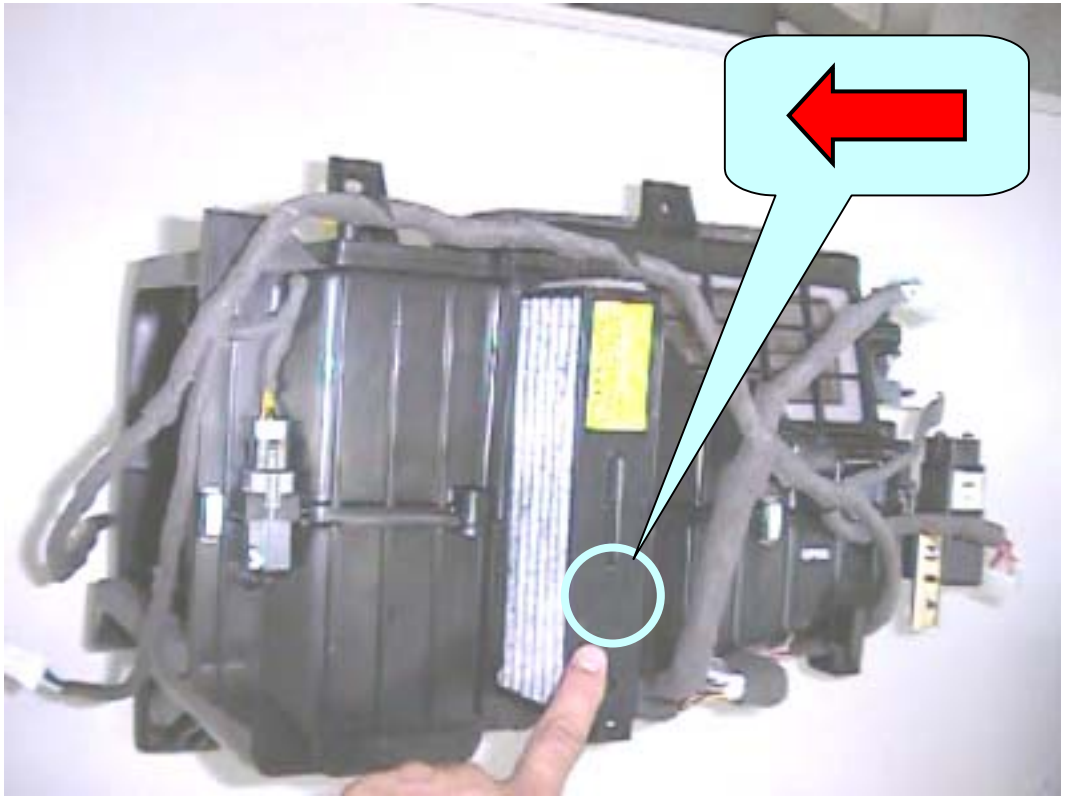
3. HOW TO REPLACE

① Remove the glove box.
② Pull the locking part of the air filter cover

EVAPORATOR AIR FILTER

CAUTION!!

Make sure that arrow mark on the filter is pointing the evaporator core side.



BLOWER MOTOR ASSEMBLY

Motor : magnet motor(ϕ 70)

① Rated voltage : 12V

② Without load
- speed : 3300 rpm (min)
- current : 3.0A (max)

③ With load
- rated load : 4.4 kgf-cm
- speed : 2900 ± 300 rpm
- current : 18.3 ± 1.3a (max)

④ Temperature range in use
: -30℃ ~ 80 ℃

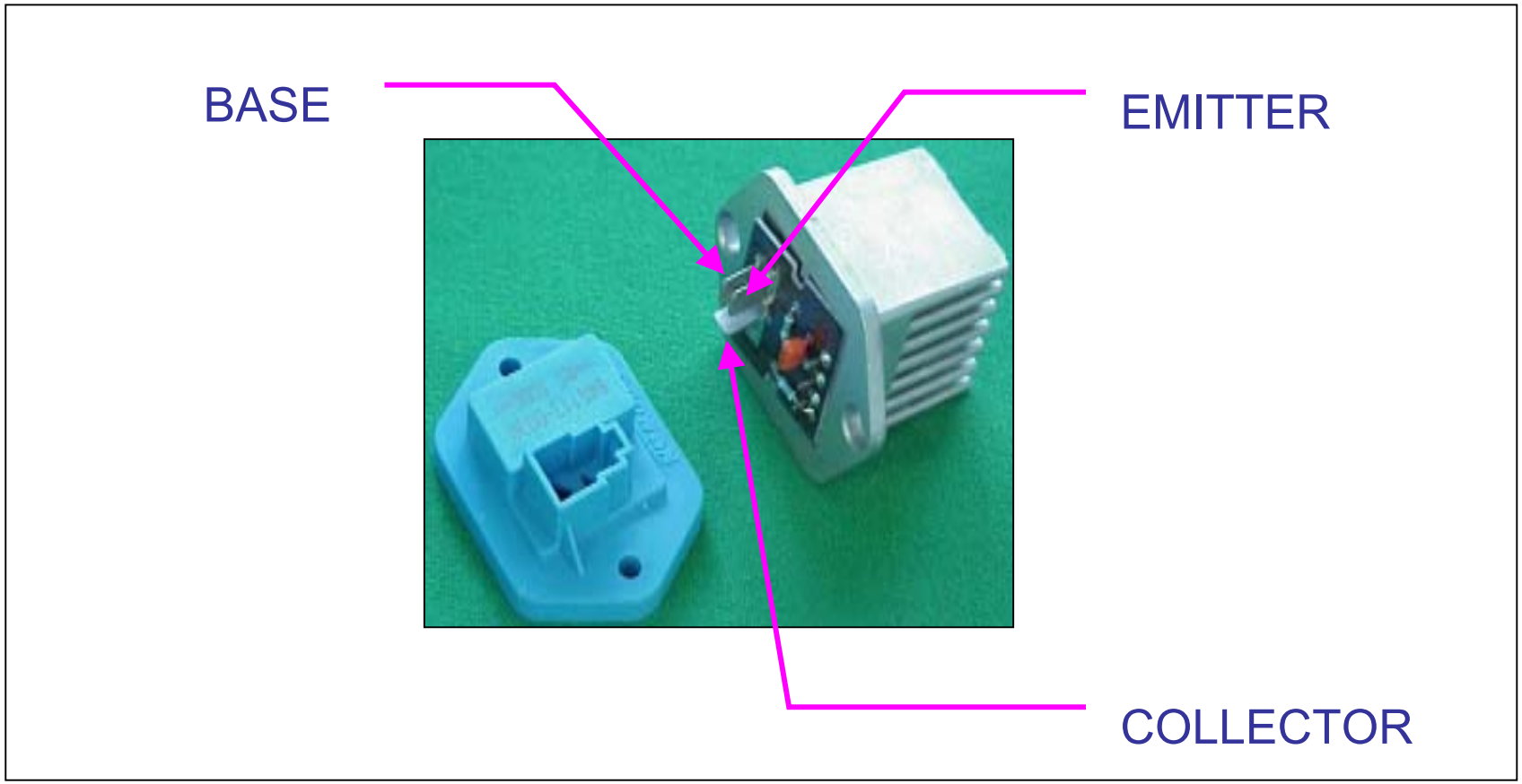
BLOWER SPEED CONTROL DEVICE

1. POWER TR

① INSTALL LOCATION

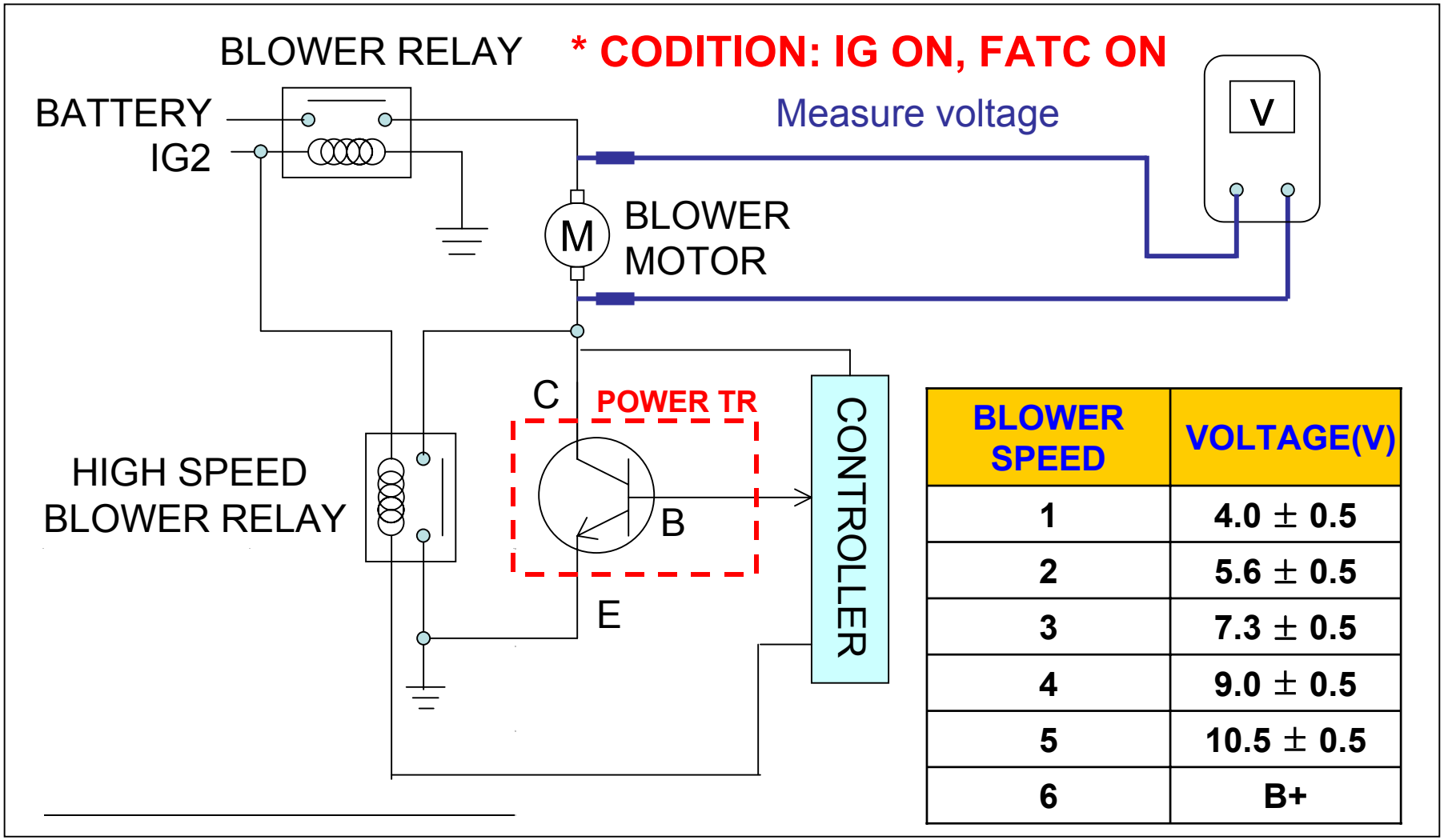
BLOWER SPEED CONTROL DEVICE

② POWER TR AND PIN ASSIGNMENT



BLOWER SPEED CONTROL DEVICE

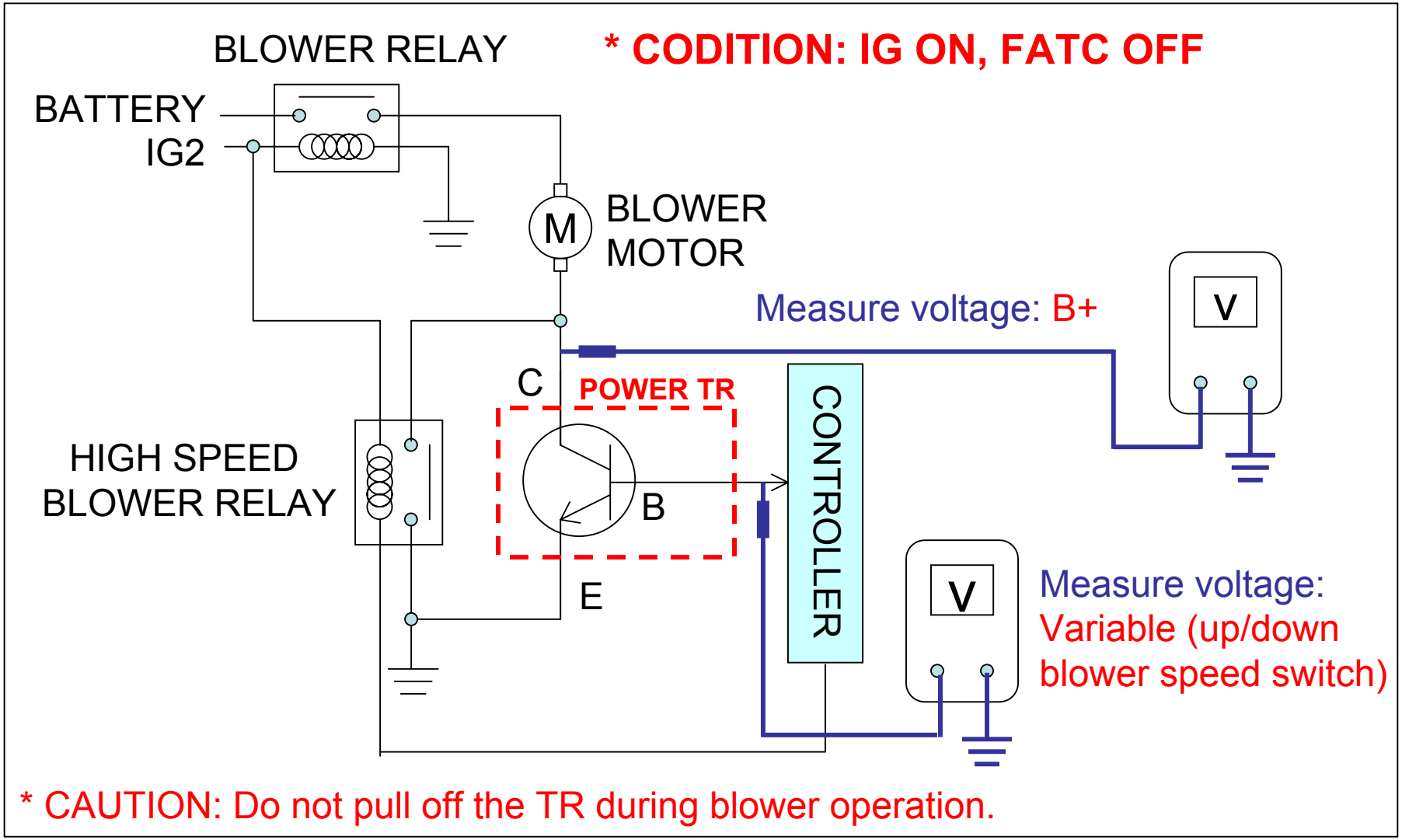
③ POWER TR INSPECTION METHOD 1



BLOWER SPEED	VOLTAGE(V)
1	4.0 ± 0.5
2	5.6 ± 0.5
3	7.3 ± 0.5
4	9.0 ± 0.5
5	10.5 ± 0.5
6	B+

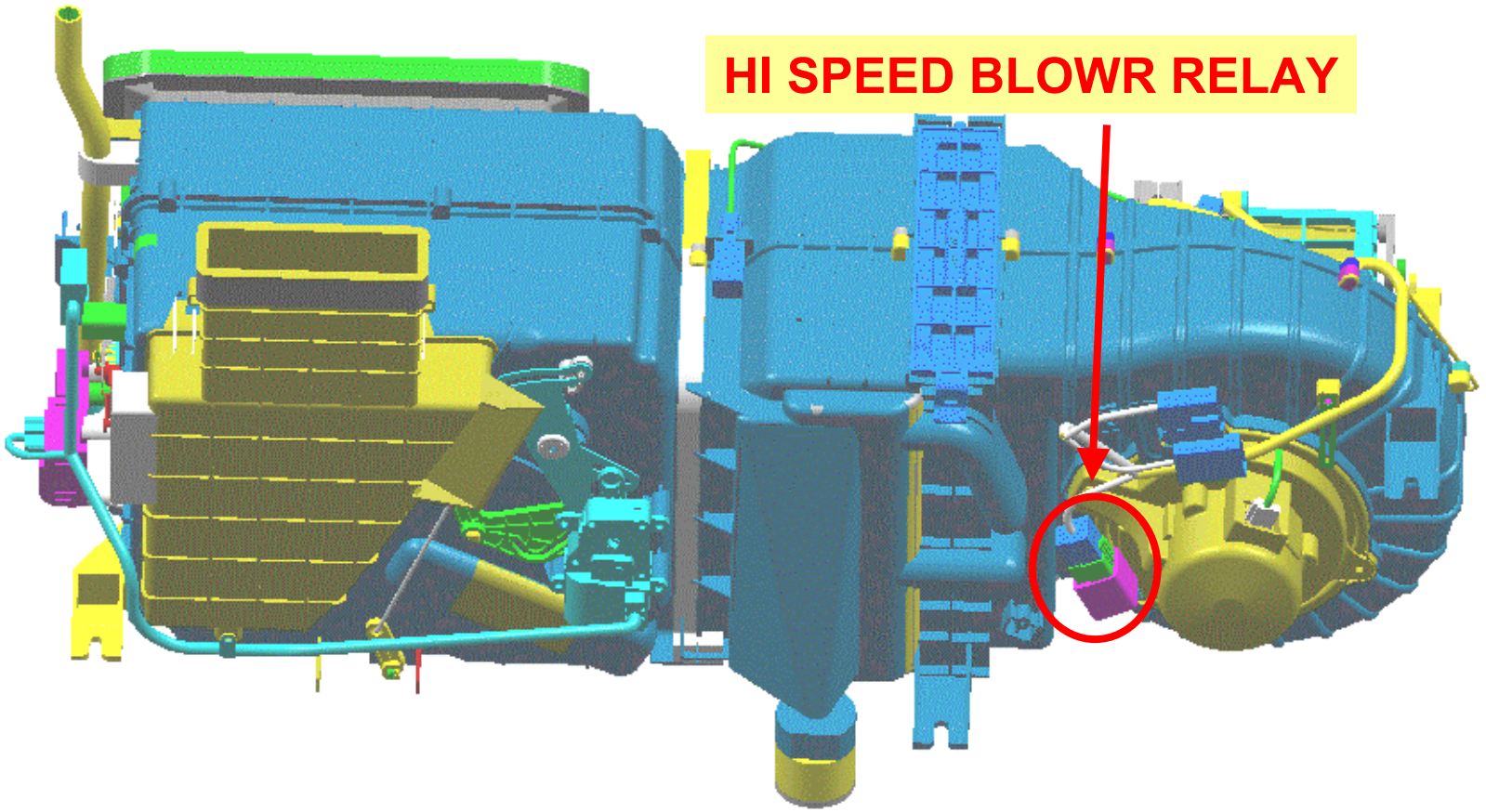
BLOWER SPEED CONTROL DEVICE

④ POWER TR INSPECTION METHOD 2

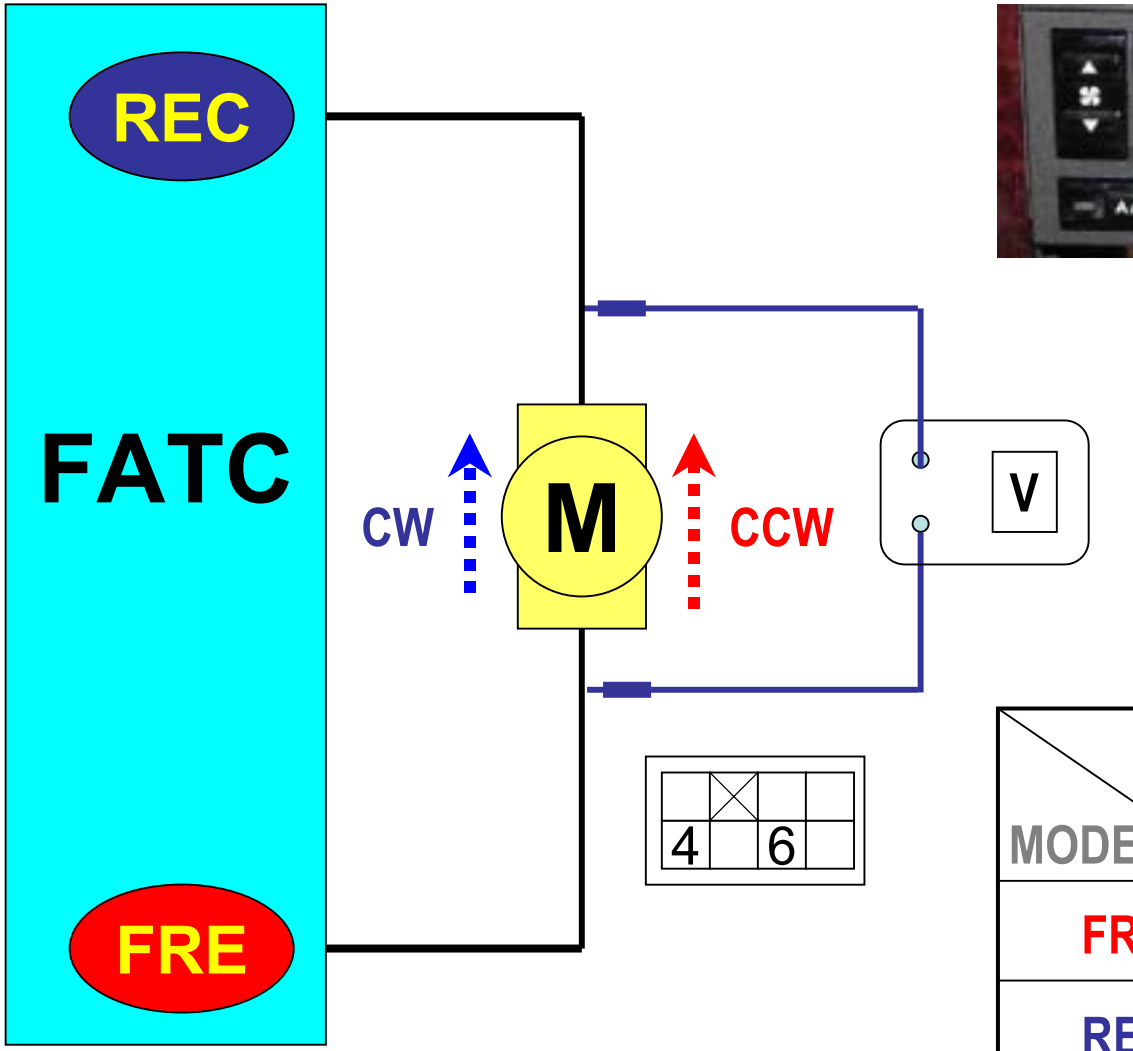


2. HIGH SPEED BLOWER RELAY

INSTALL LOCATION



INTAKE ACTUATOR

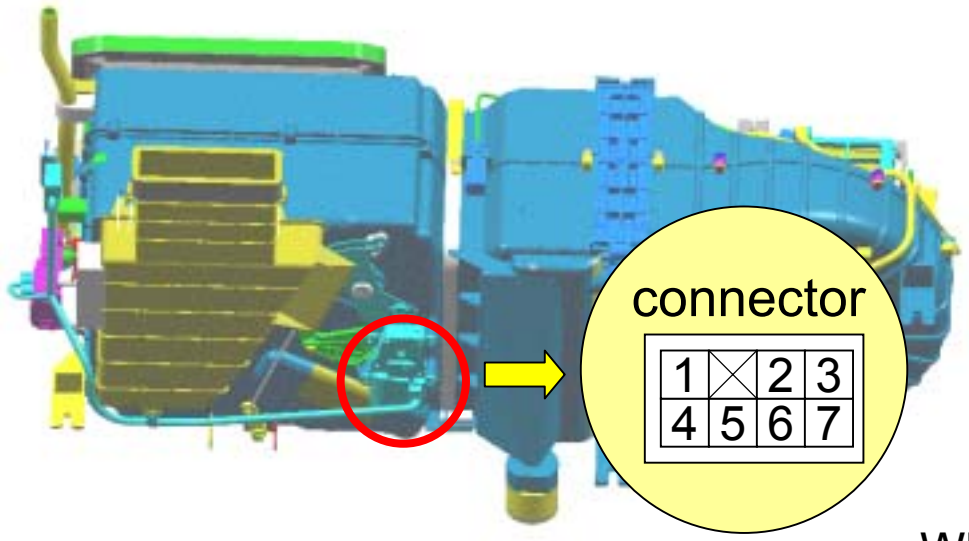


* Check the voltage pressing the intake switch

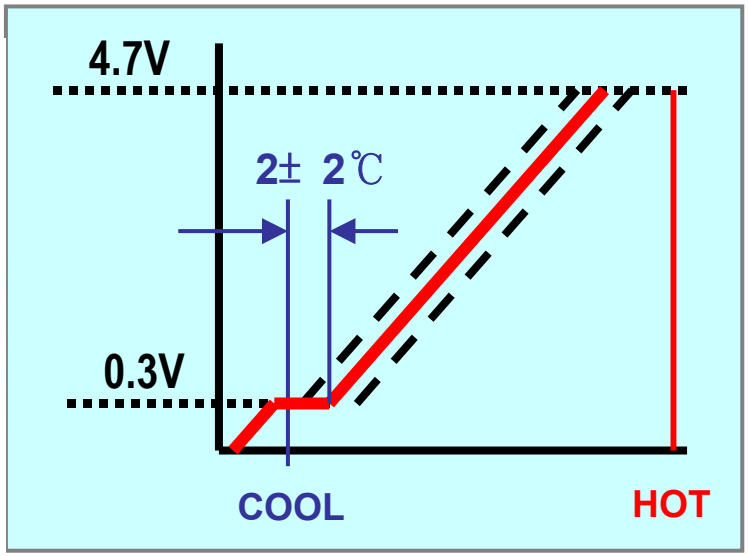
MODE	TERMINAL NO.	
	NO. 4	NO. 6
FRE	-	+
REC	+	-

TEMP DOOR ACTUATOR

TEMP DOOR ACTUATOR is located in the bottom of the heater unit. The actuator controls the position of the temperature blend door based on the voltage signal from the FATC module. Potentiometer inside actuator sends a feedback signal to the controller and controller cuts off the voltage signal coming from the controller when the required door position is achieved.



[POTENTIOMETER CHARACTERISTICS]

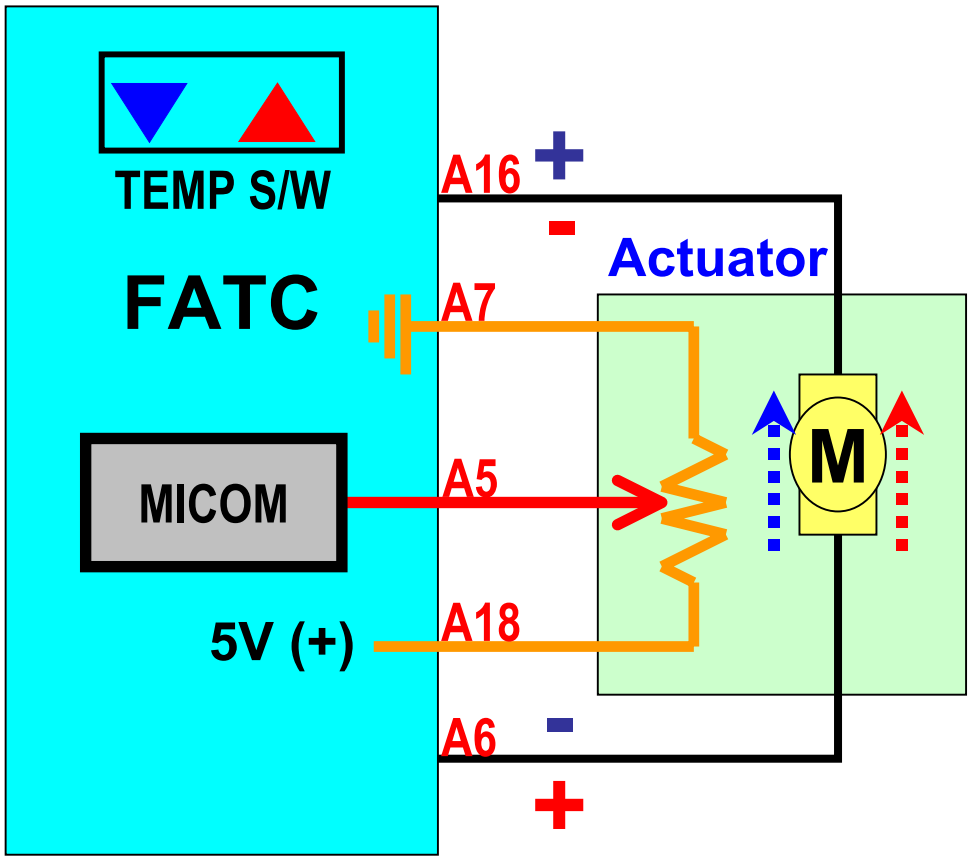


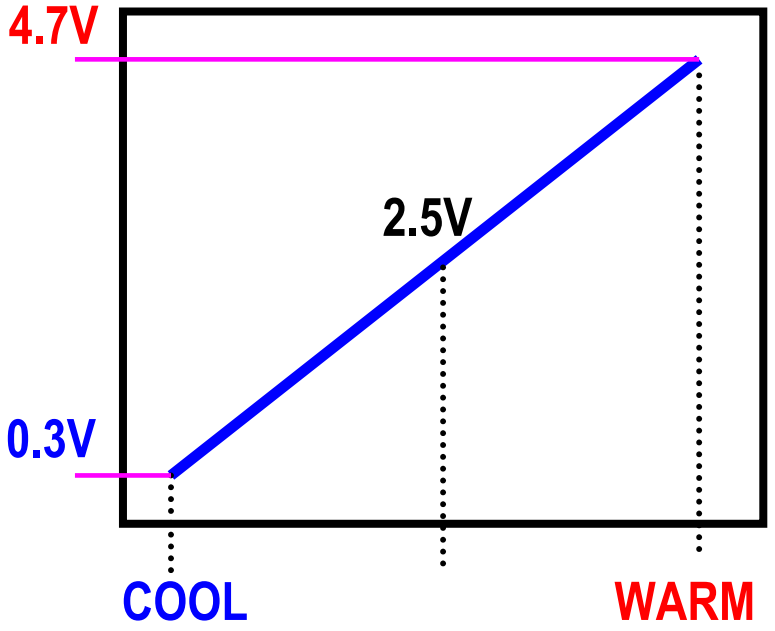
When 5V between terminal 2-1, above voltage is obtained between terminal 5-1.

TEMP DOOR ACTUATOR

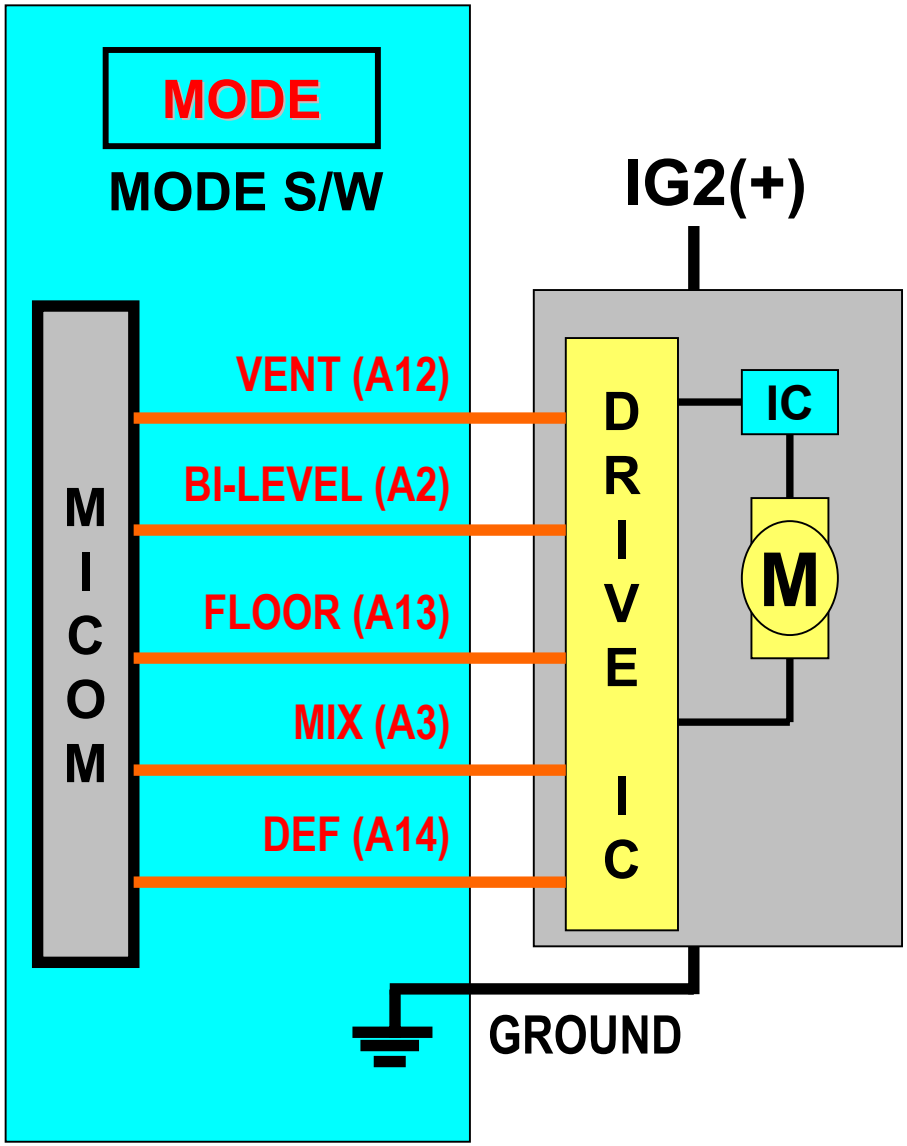
* Feedback line open or short: 17～24.5℃ : MAX COOL

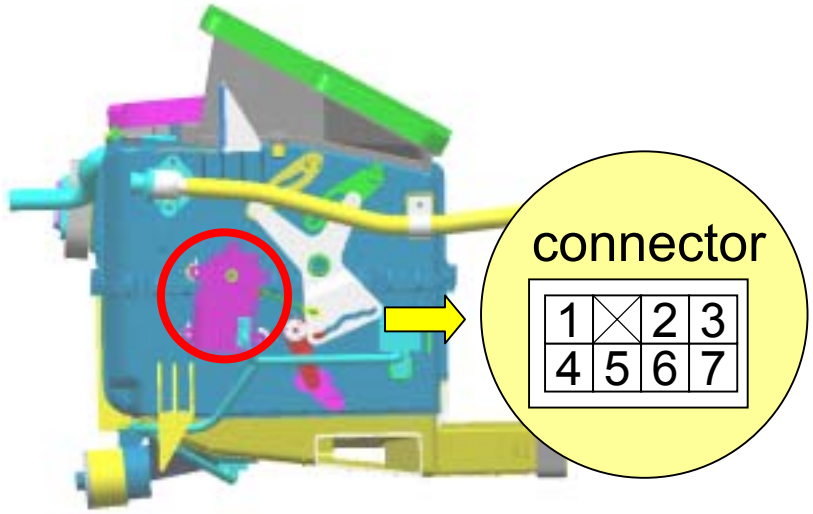
25～32℃ : MAX WARM





MODE ACTUATOR





MODE	5	4	3	2	1
VENT	G	+	+	+	+
Bi-LEV	+	G	+	+	+
FLOOR	+	+	G	+	+
MIX	+	+	+	G	+
DEF	+	+	+	+	G

* G: Ground

FIN SENSOR

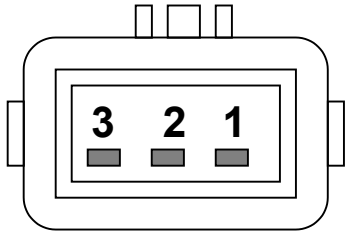
1. DESCRIPTION

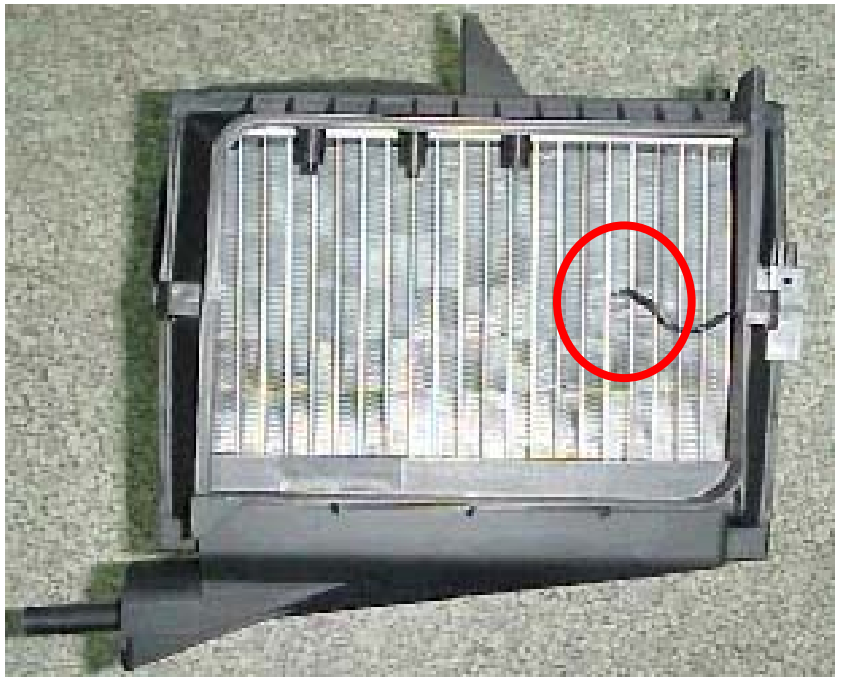
Fin sensor is installed in the evaporator in order to detect the temperature of evaporator. It prevents evaporator from freezing.

2. FIN SENSOR

① LOCATION

: inserted into the evaporator pin





FIN SENSOR

② CHARACTERISTICS OF FIN SENSOR

TEMP. (℃)	RESISTANCE (Ω)	TEMP. (℃)	RESISTANCE (Ω)	TEMP. (℃)	RESISTANCE (Ω)
-10	18012.8	8	8015.1	26	3875.2
-8	16387.9	10	7365	28	3590.8
-6	14927.4	12	6774.5	30	3330.1
-4	13612.9	14	6237.4	32	3090.9
-2	12428.5	16	5748.4	34	2871.3
0	11360	18	5302.8	36	2669.3
2	10394.8	20	4896.3	38	2483.6
4	9521.9	22	4525	40	2312.5
6	8731.5	24	4185.7	42	2154.9

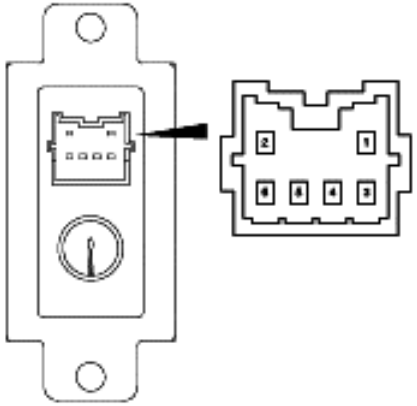
③ ON/OFF TEMPERATURE: 0 ~ 0.5℃ OFF
3.5 ~ 4℃ ON

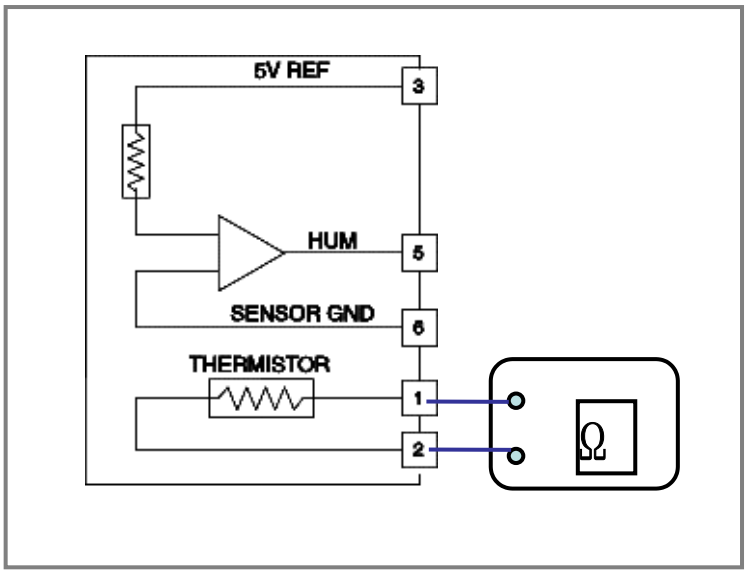
INCAR SENSOR

The in-car sensor is located on the lower crash pad as shown in the picture. It contains a thermister, which measures the temperature of the air inside the passenger compartment. It senses the passenger compartment temperature, changes the resistance value, and enters the corresponding voltage into the automatic temperature control module (FATC).

INCAR SENSOR

INSPECTION





▣ **Resistance characteristic**

(NTC: negative thermal coefficient)

TEMP.(°C)	RESISTANCE (Ω)
18	3403
21	2976
25	2500
28	2199
32	1862

PHOTO SENSOR

The photo sensor is located on the left side of crash pad assembly.
It contains a photovoltaic (sensitive to sunlight) diode.

Characteristics of photo sensor

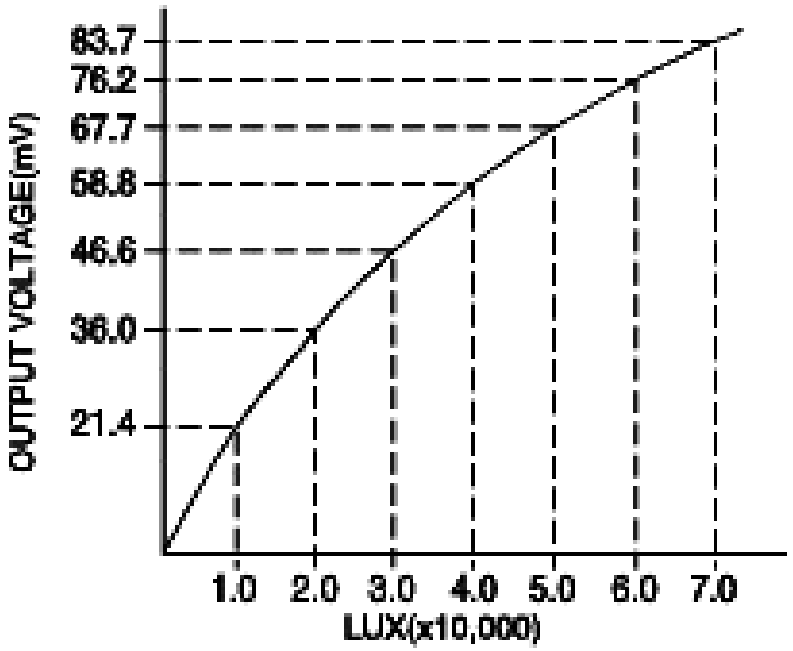
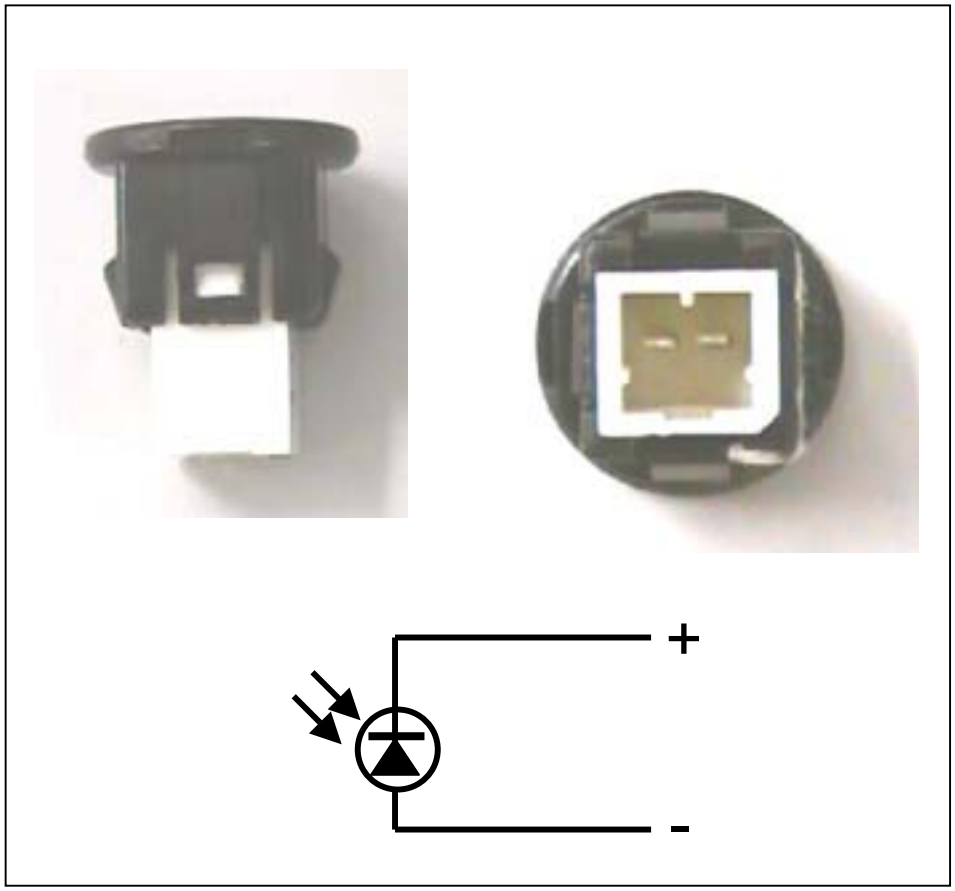
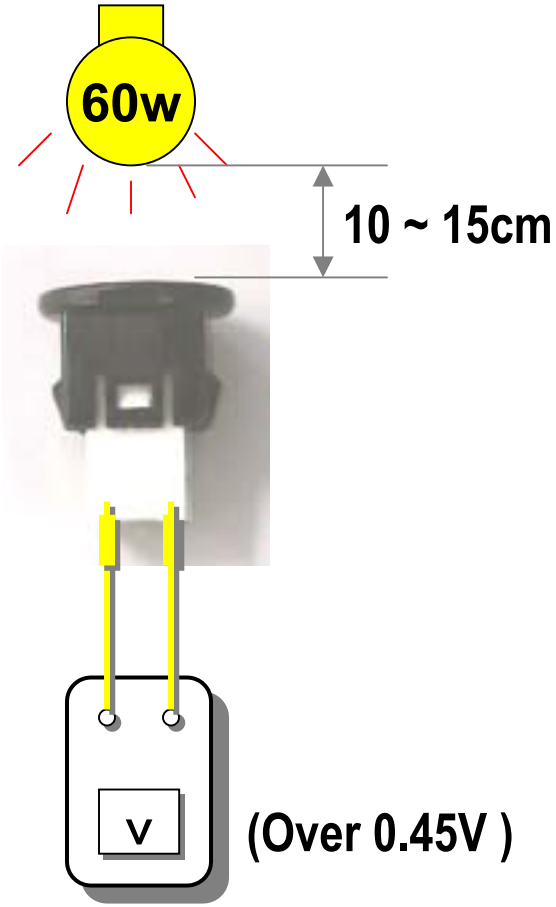


PHOTO SENSOR (FATC)

INSPECTION



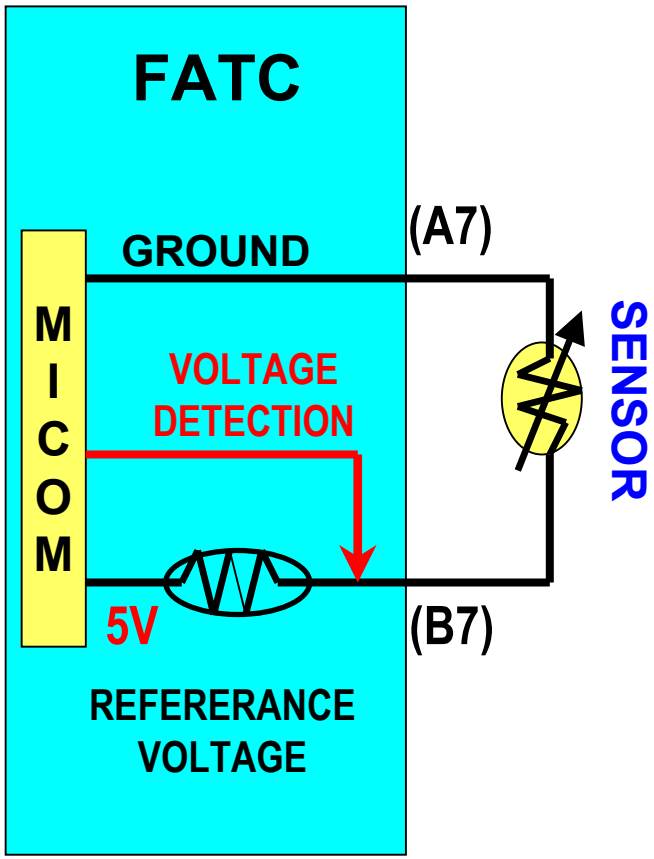


AMBIENT SENSOR

The ambient temperature sensor is located in front of the condenser fan shroud. This sensor detects the temperature of outside air and sends voltage signals to the controller.

AMBIENT SENSOR (FATC)

INSPECTION



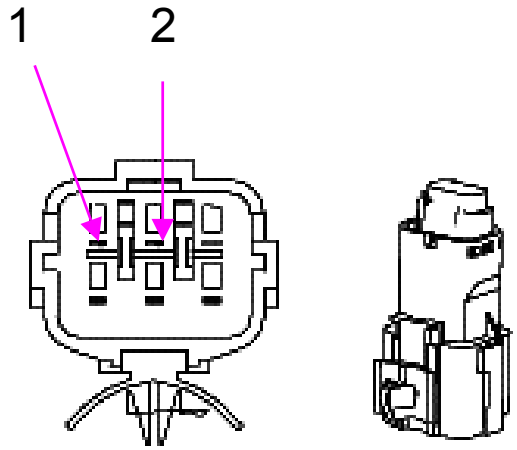
* Resistance between **B7** & **A7**

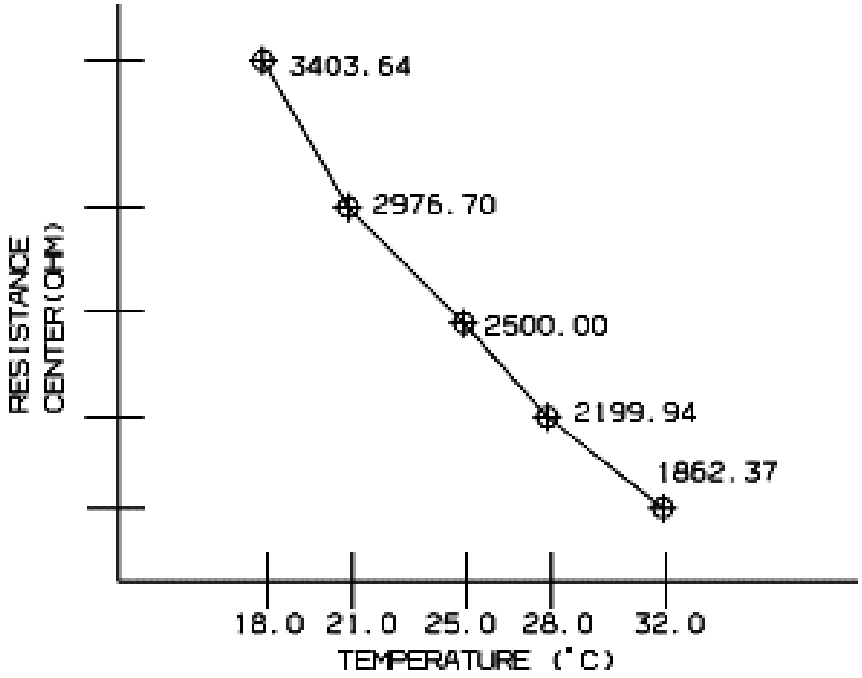
Temperature (℃)	Resistance (kΩ)
-20	24.4
-10	13.8
0	8.1
10	4.9
20	3.1
30	2
40	1.4

Resistance characteristic:
(NTC: negative thermal coefficient)

AMBIENT SENSOR (FATC)

INSPECTION





Resistance characteristic:

(NTC: negative thermal coefficient)

AQS (FATC OPTION:DOMESTIC AREA ONLY)

The Air Quality System detects exhaust gas of neighboring vehicles and intercepts automatically. AQS controls the inlet of car automatically and can be easily installed to the existing vehicle. Manual operation is also available.

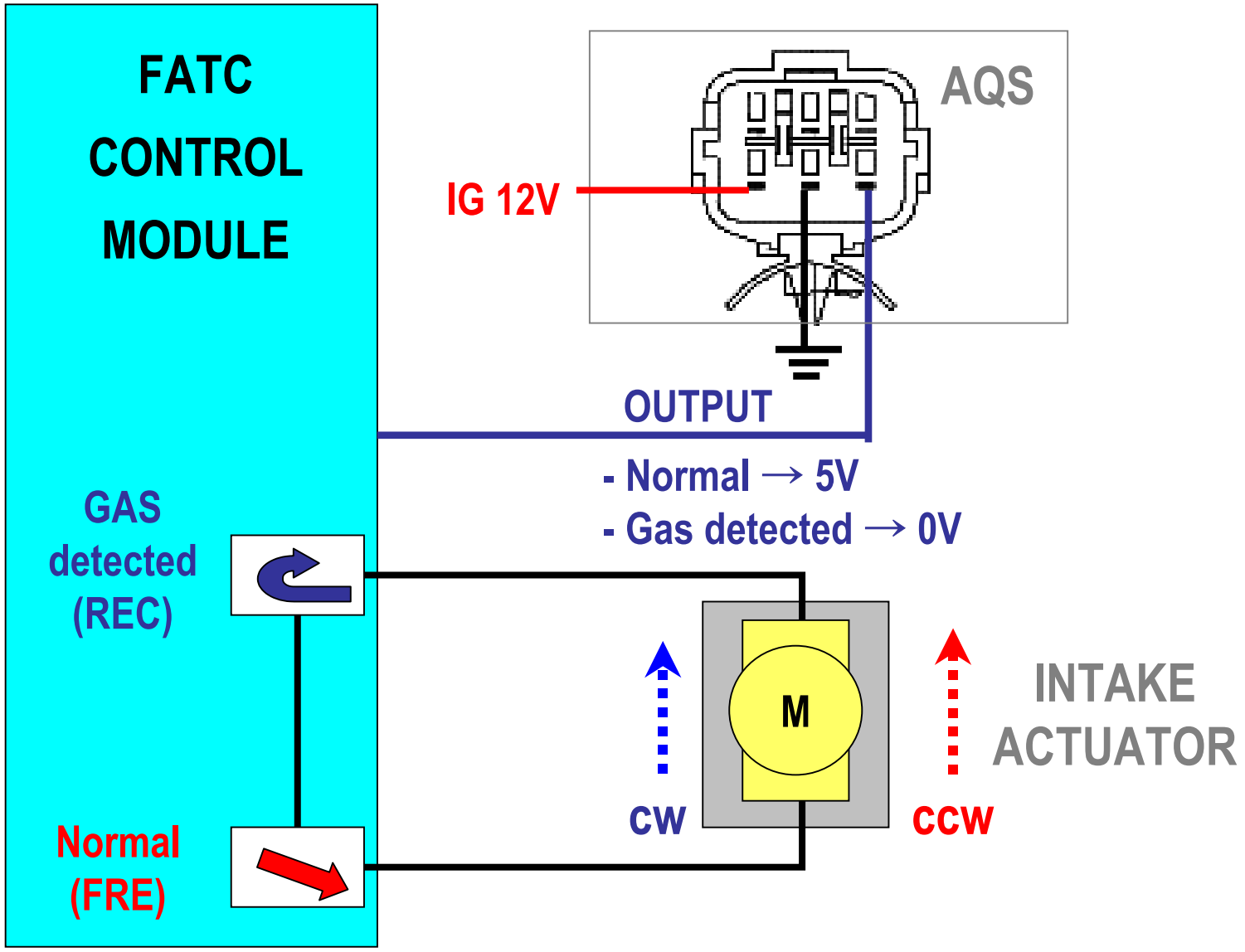
SPECIFICATION		
Operating voltage		9 ~ 16V DC
Rated voltage		12V DC
Operating temperature		-30 ~ 105℃
Detectable gas	Gasoline engine gas	CXHY, CO
	Diesel engine gas	NOX, SO2
Reaction time		less 1 sec

AQS (FATC OPTION:DOMESTIC AREA ONLY)

* LOCATION: In front of condenser

* AQS SWITCH

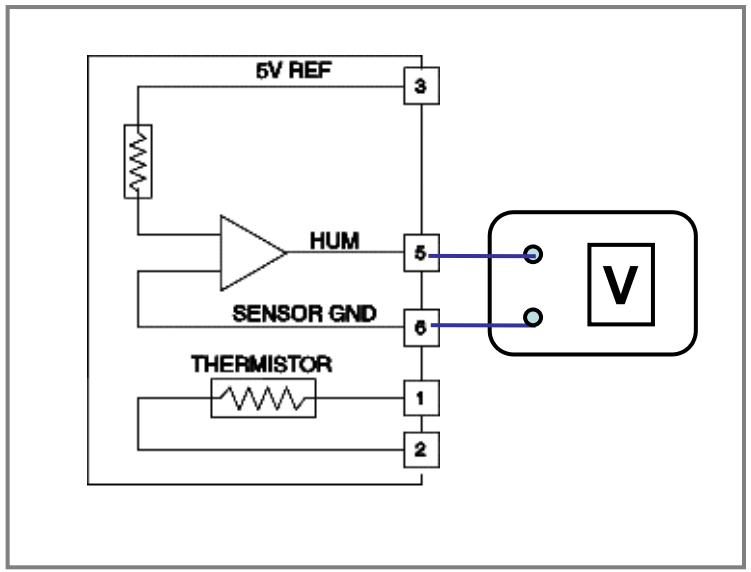
AQS (FATC OPTION:DOMESTIC AREA ONLY)



HUMIDITY SENSOR

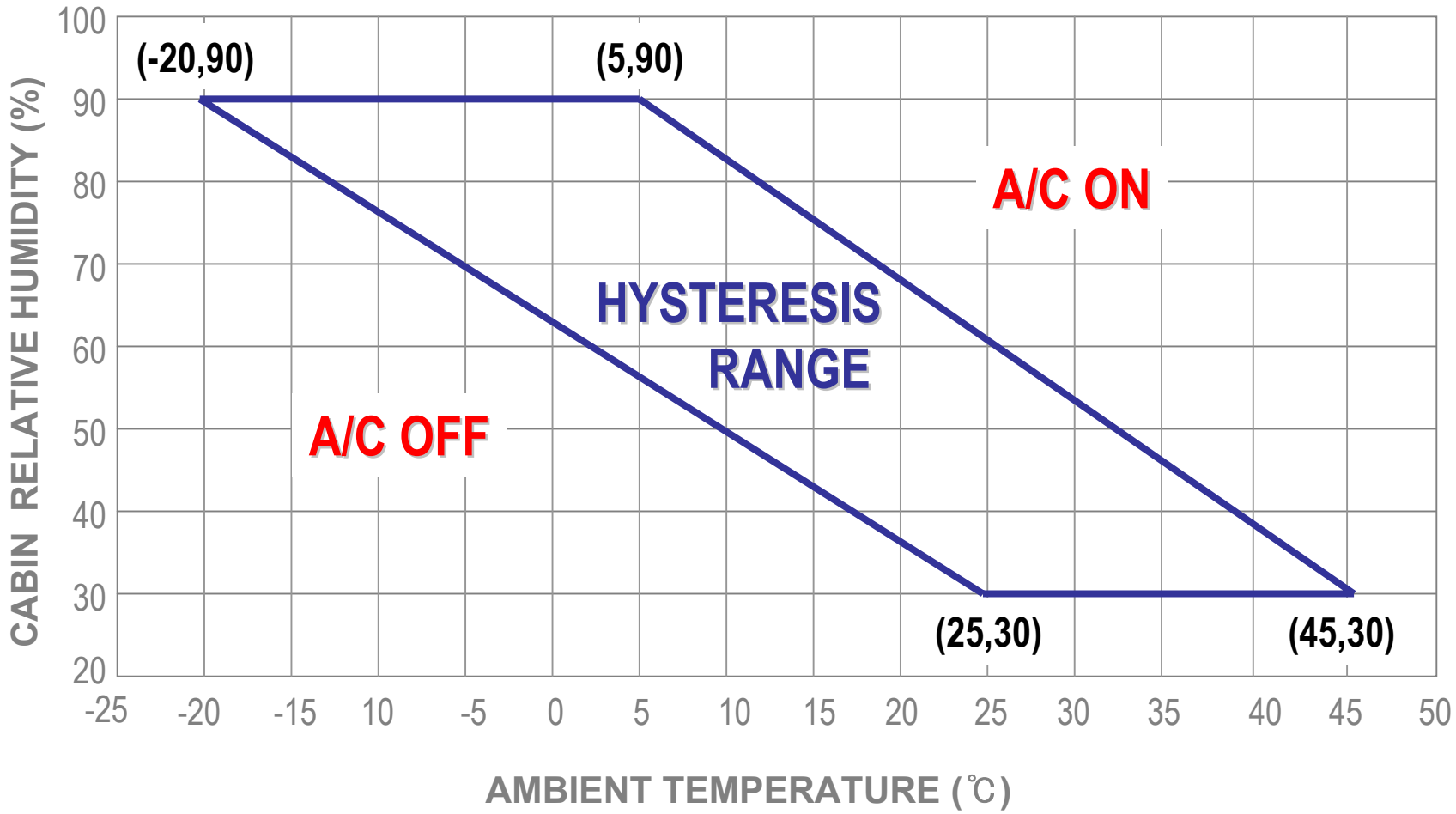
Humidity sensor detects the relative humidity of the car's cabin. This sensor converts it into the voltage signal and sends the signal to the FATC controller.

1. SENSOR CHARACTERISTICS



HUMIDITY	VOLTAGE (V)	HUMIDITY	VOLTAGE (V)
30%	3.13	65%	1.29
35%	3.07	70%	1.12
40%	2.94	75%	1.05
45%	2.67	80%	1.01
50%	2.35	85%	0.98
55%	2.01	90%	0.94
60%	1.54		

HUMIDITY SENSOR



HUMIDITY SENSOR

2. SPECIFICATIONS

1). Sensor type: High polymer impedance variation sensor

2). Rated voltage: DC 5V.

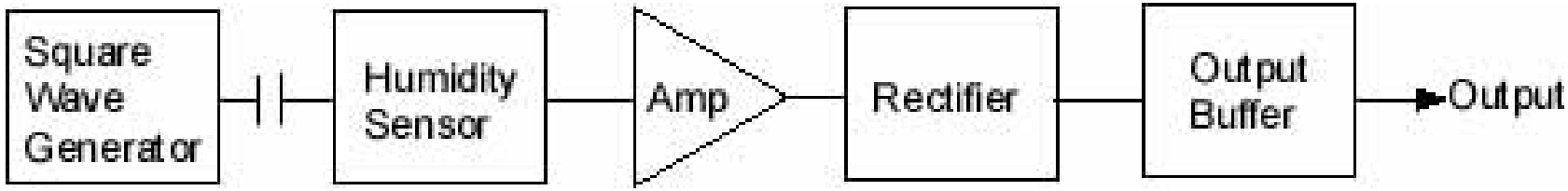
3). Current consumption: below 10 mA

4). Temperature range: 0 - 60 ℃

5). Humidity range: below 99% RH(Relative Humidity)

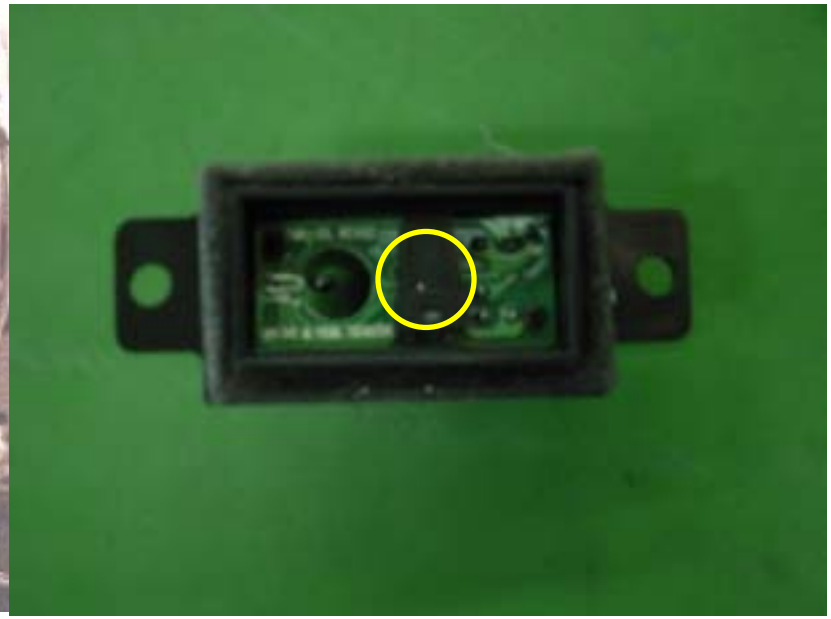
6). Terminals: 3 terminals (DC 5V, Ground, Sensor output)

3. Block Diagram



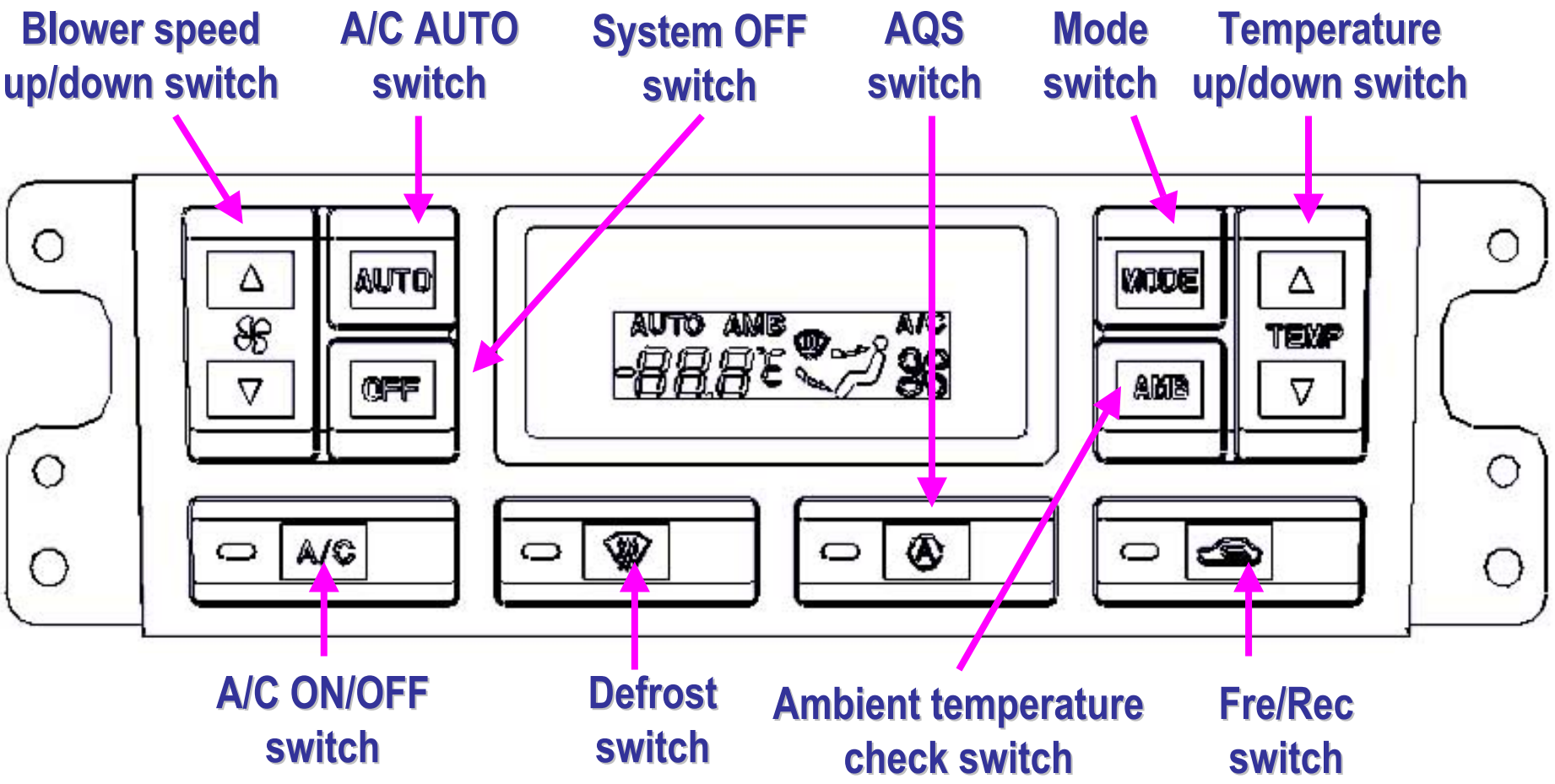
HUMIDITY SENSOR

LOCATION: Lower Crash Pad



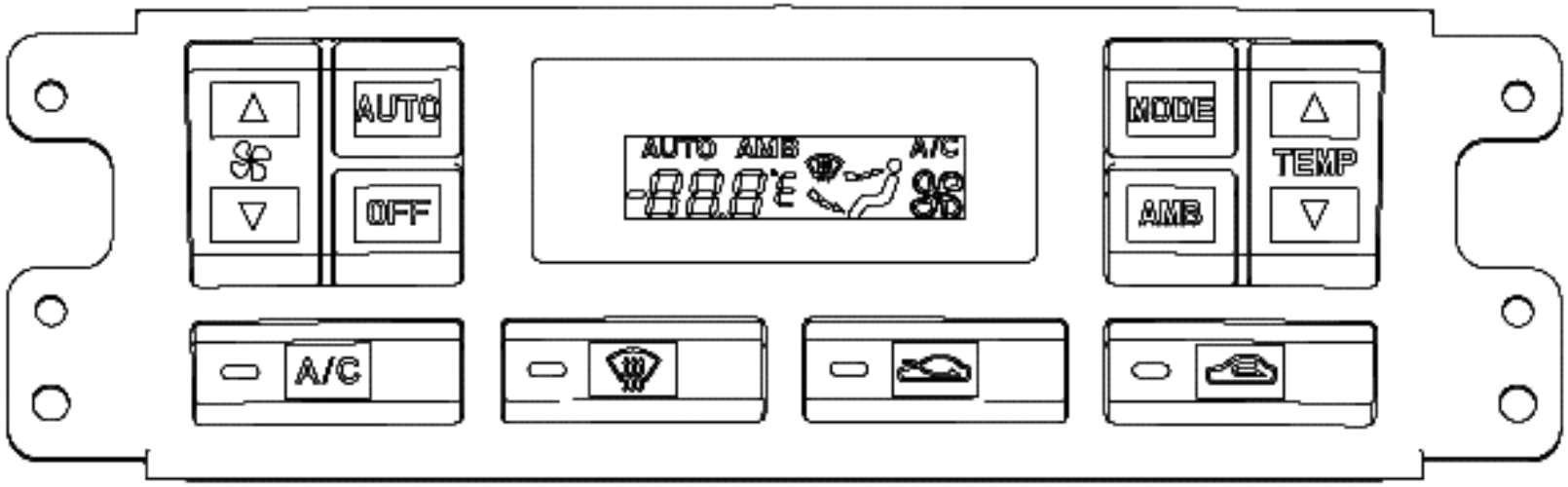
CONTROL PANNEL (FATC, AQS)

1. FATC WITH AQS



CONTROL PANNEL (FATC,NON AQS)

2. FATC WITHOUT AQS



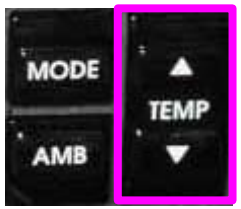
TEMPERATURE UNIT CHANGE

Temp unit change: ℃ ⟷ °F

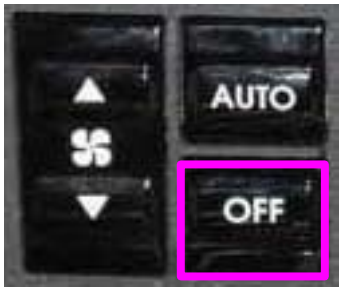
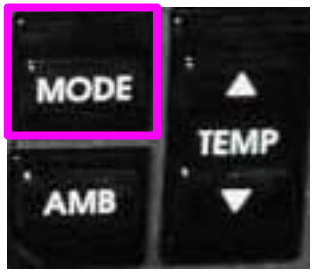
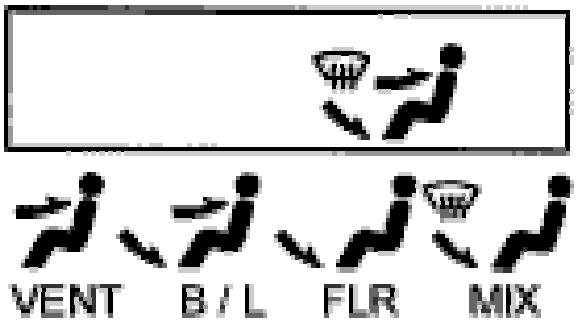
*** Setting unit: ℃ (Battery disconnection)**

*** How to operate**

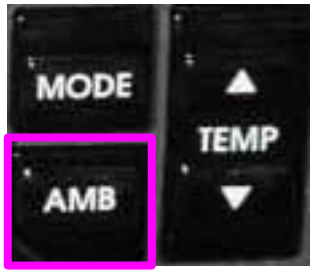
CONTROL PANNEL SWITCH FUNCTION

SWITCH		FUNCTION
TEMP. SWITCH		- TEMPERATURE SETTING RANGE: 17℃ ↔ 32℃ - TEMPERATURE INTERVAL: 0.5 ℃
AUTO SWITCH		- SYSTEM OFF or MANUAL STATE ▶ AUTO SW ▶ A/C SYSTEM AUTOMATICALLY CONTROLLED
DEFROST SWITCH		- MODE DOOR: DEF MODE - A/C: ON - INTAKE DOOR: FRESH MODE - OTHERS: SAME STATE AS BEFORE 'OFF'
A/C SWITCH		'- A/C ON - A/C OFF (IF PUSH THE SWITCH AGAIN)

CONTROL PANNEL SWITCH FUNCTION

SWITCH		FUNCTION
OFF SWITCH		- SYSTEM OFF: BLOWER, COMPRESSOR OFF - TEMP DOOR: AUTOMATICALLY CONTROLLED - MODE DOOR: ▶ AUTO CONTROL (IF 'AUTO' BEFORE 'OFF') ▶ SAME POSITION (IF 'MANUAL' BEFORE 'OFF') - INTAKE DOOR ▶ REC (IF 'AUTO' BEFORE 'OFF') ▶ SAME POSITION (IF 'MANUAL' BEFORE 'OFF')
MODE SWITCH		 * VENT → B/L → FLOOR → MIX → VENT

CONTROL PANNEL SWITCH FUNCTION

SWITCH		FUNCTION
REC. SWITCH		- RECIRCULATION
FRESH SWITCH		- FRESH
AQS SWITCH		- ACTIVATION: AQS INDICATOR ON (INTAKE DOOR: FRE ↔ REC)
AMB SWITCH		- AMBIENT TEMPERATURE IS DISPLAYED (FOR 5 SECONDS)

CONTROL LOGIC

1. In-car temperature correction

When the in-car sensor detects a sudden steep temperature change, controller corrects the temperature differences slowly.

- 1℃ up / 4sec delay
- 1℃ down / 4sec delay

2. . Ambient temperature correction

When the ambient sensor detects a sudden steep temperature change, controller corrects the temperature differences slowly.

- 1℃ up / 3 min delay (ex. Underground, tunnel)
- 1℃ down / 4sec delay

3. Heat radiation correction

When the photo sensor detects a sudden steep solar radiation change, controller compensates it slowly.

- 350 → 1000 (W/m$^{2)}$ / 1 min delay
- 350 ← 1000 (W/m$^{2)}$ / 5 min delay

4. Temp. door control

Temp. door angle (0% ~ 100%) is automatically controlled according to the selected temperature and other sensor signals.

: Available selected temperature range

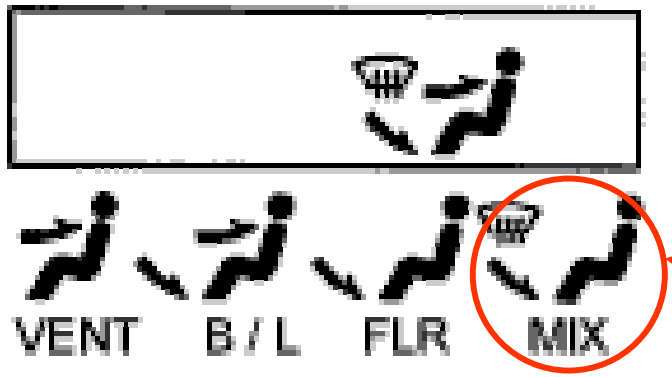
- MAX COOL: 17℃
- MAX HOT: 32℃
- 17℃ ↔ 32℃, 0.5℃ step (62°F ↔ 90°F, 1°F step)

5. Blower speed control

- AUTO mode: linear control
- MANUAL mode: 7 step control

6. Mode control

- AUTO: Mode changes automatically according to the selected temperature and other sensor signals.
- Manual: Mode changes when the mode switch is selected.



VENT → B/L → FLOOR → MIX → VENT

If selected, A/CON operates to remove defrost.

7. Intake door mode

- The FRE/REC door state can be changed at AUTO mode according to the input data combination.

8. Compressor ON/OFF control (AUTO mode)

- Fin sensor: lower 0.5℃ ▶ Compressor OFF
  over 3℃ ▶ Compressor ON

9. MAX HOT function (When 32℃ is selected at AUTO mode)

- ▶ Temp door: MAX HOT side
- ▶ Mode door: Floor mode
- ▶ Intake door: FRE mod
- ▶ Compressor: OFF
- ▶ Blower speed: MAX high

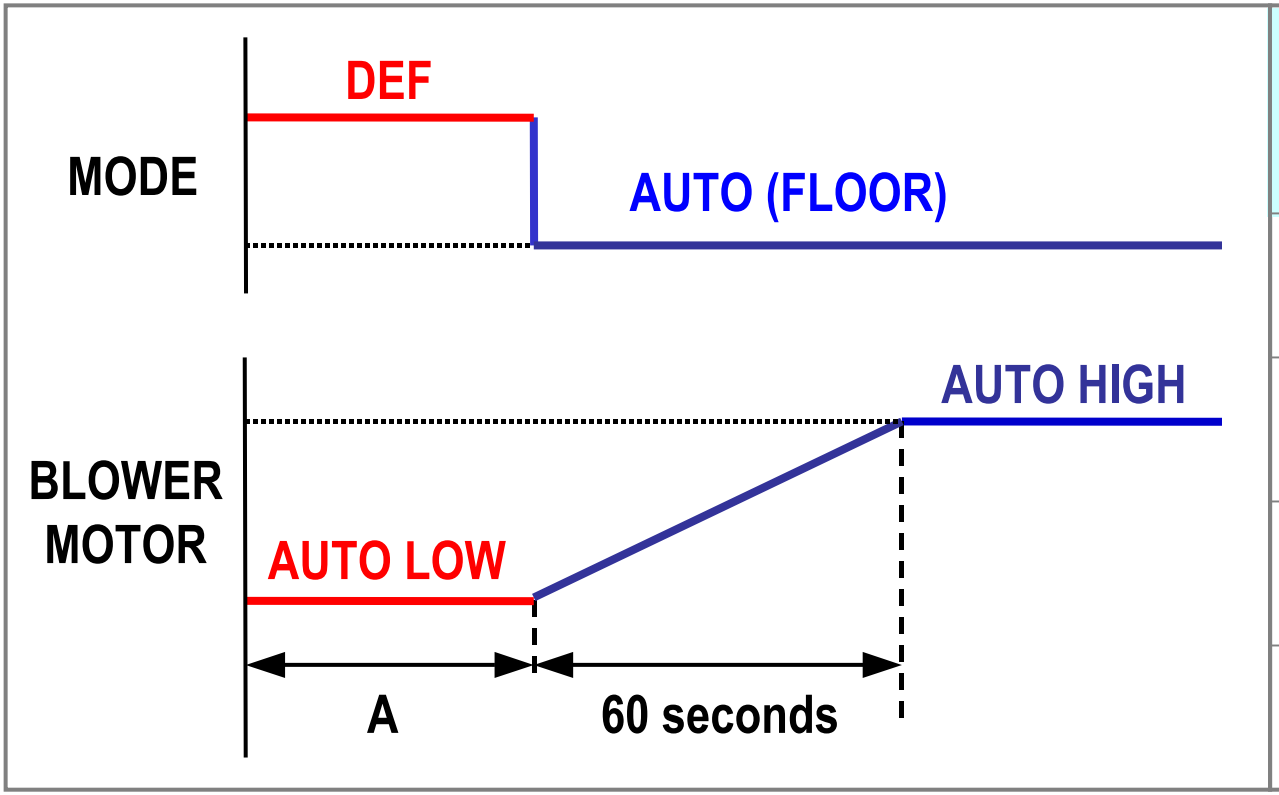
10. MAX COOL function (When 17℃ is selected at AUTO mode)

- ▶ Temp door: MAX COOL side
- ▶ Mode door: VENT mode
- ▶ Intake door: REC mode
- ▶ Compressor: ON
- ▶ Blower speed: MAX HIGH

11. WARM AIR PREVENTION FUNCTION (Initial A/C operation)

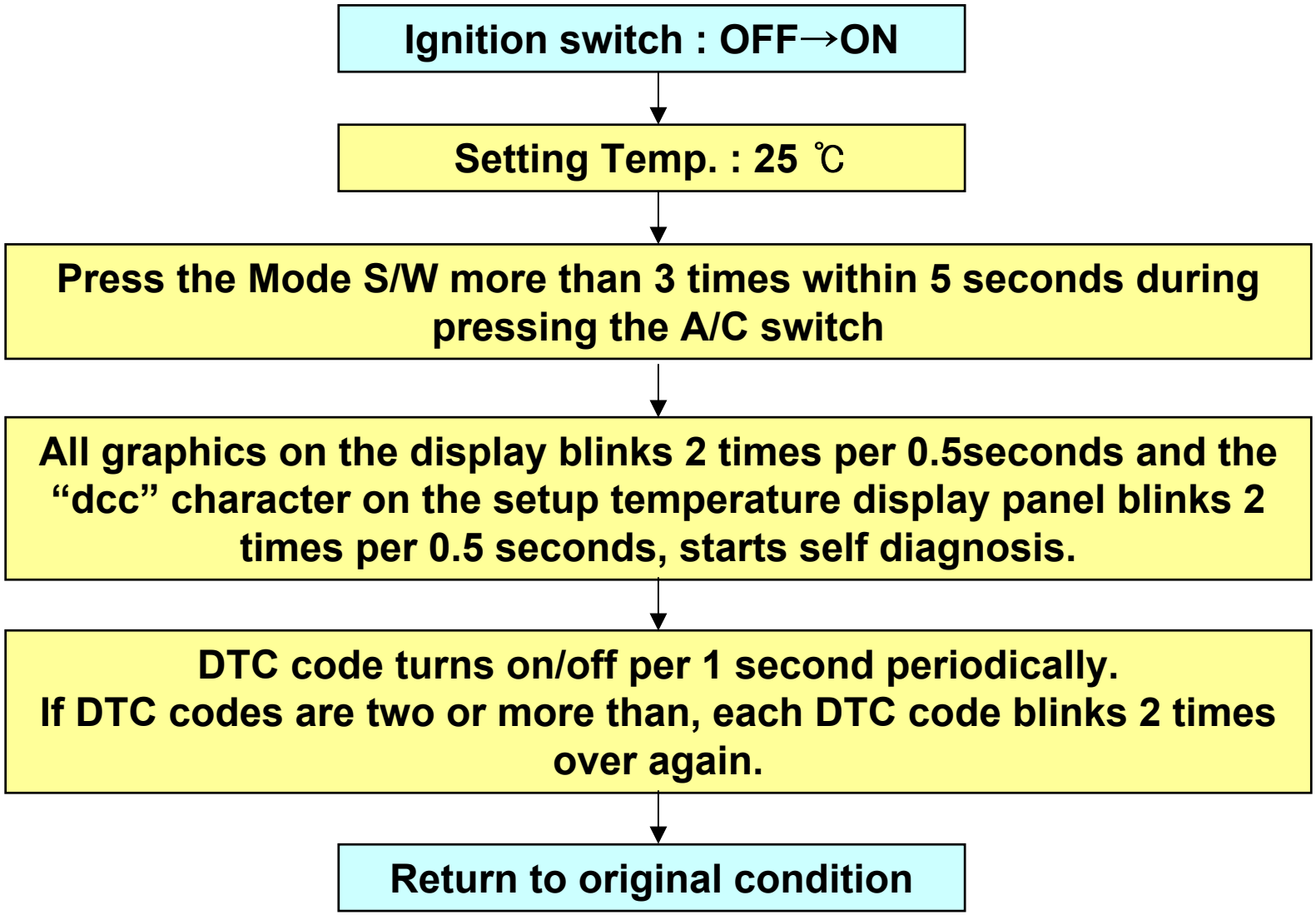
CONDITION	CONTROL	OUTPUT
- AUTO MODE - A/C ON - FIN sensor > 30℃	FATC	- BLOWER SPEED: • AUTO low: 12 seconds • AUTO low ▶ AUTO high: 30 seconds

12. COLD AIR PREVENTION FUNCTION (ON WINTER TIME)



Ambient Temp. (℃)	Time (A)
~ -15℃	8 min.
-14.5 ~ 10℃	6 min.
-9.5 ~ 1℃	4 min.
-0.5 ~ 5℃	2 min.

SELF DIAGNOSIS

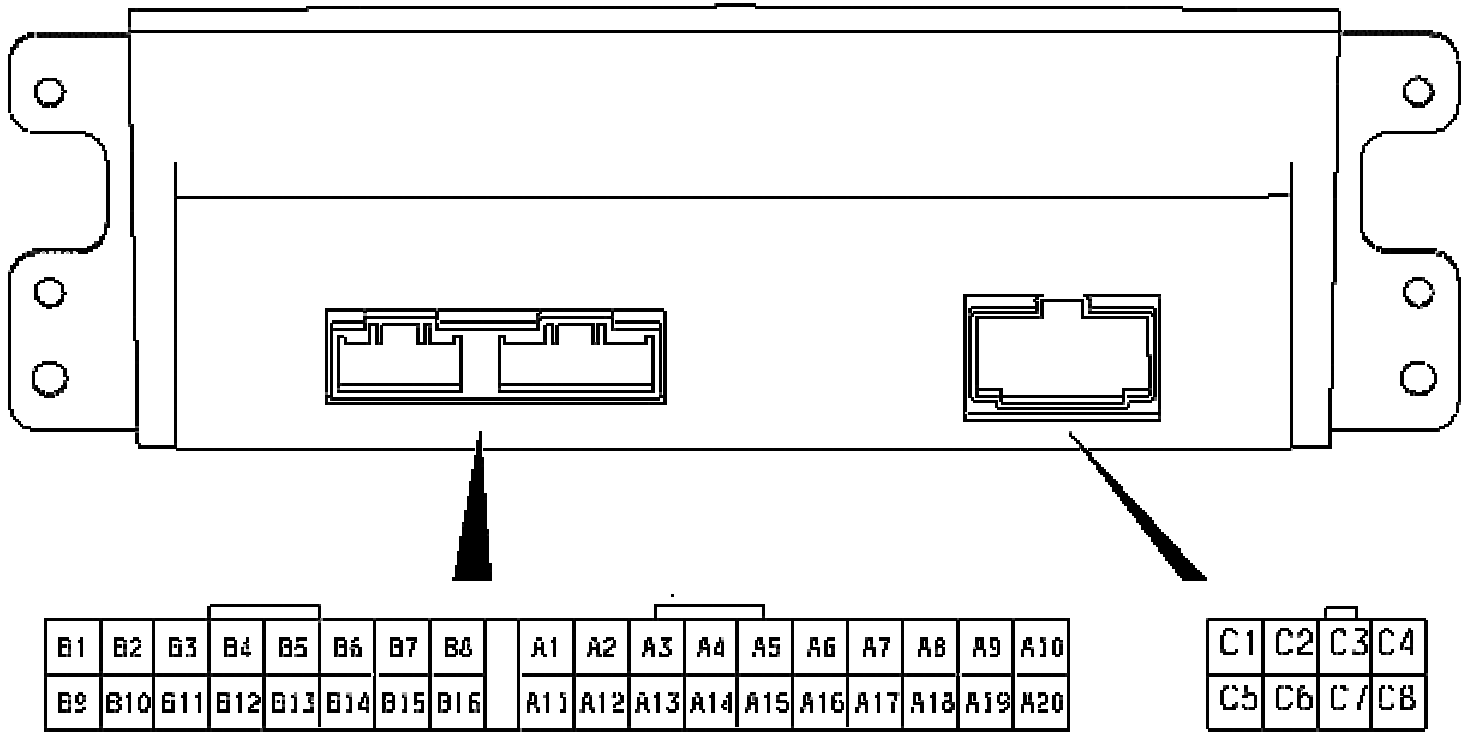


DTC LIST & FAILSAFE

DTC CODE	DESCRIPTION	FAILSAFE
E0	NORMAL	-
E1	IN-CAR SENSOR FAIL	25 ℃ FIXED
E2	AMBIENT SENSOR FAIL	25 ℃ FIXED
E3	FIN SENSOR FAIL	- 2 ℃ FIXED
E5	PHOTO SENSOR FAIL	-
E6	TEMP DOOR POETENTIOMETER FAIL	SETTING TEMP. 17~25 ℃: MAX COOL SETTING TEMP. 25~32 ℃: MAX HOT

CONNECTOR SPECIFICATION

CONNECTOR



CONNECTOR SPECIFICATION

C/NO	USE	TMNL NO	CIRCUIT	REMARK
A	FATC COMPONENT	1	IG1(METER 10A)	
		2	MODE BI-LEVEL	
		3	MODE DEF/HEAT (MIX)	
		4	A/C SELECT HIGH	
		5	MIX PBR (TEMP. DOOR ACTUATOR)	POTENTIOMETER
		6	MIX HOT (TEMP. DOOR ACTUATOR)	
		7	SENSOR GROUND	
		8	INTAKE ACTUATOR (FRESH)	
		9	3B JOIN (BLOWER COMM.)	A/C ON/ OFF SIGNAL
		10	TNS (ILL-)	RHEOSTAT
		11	GROUND	
		12	MODE VENT	
		13	MODE HEAT	
		14	MODE DEF	
		15	A/C THERMO HIGH	TRIPLE P / SWITCH
		16	MIX COOL (TEMP. DOOR ACTUATOR)	
		17	DUCT SENSOR	FIN SENSOR
		18	VCC (5V)	SENSOR V REF
		19	INTAKE ACTUATOR (RECIRCULATION)	
		20	TNS (ILL+)	

CONNECTOR SPECIFICATION

C/NO	USE	TMNL NO	CIRCUIT	REMARK
B	FATC COMPONENT	1	MAX. HIGH SPEED RELAY	
		2	CHECKER COUPLER(DCC: GRD)	
		3	N.C	
		4	N.C	
		5	N.C	
		6	AQS SENSOR	
		7	AMB SENSOR	
		8	BATTERY	
		9	BLOWER MOTOR FEEDBACK	
		10	POWER TR – BASE	
		11	N.C	
		12	N.C	
		13	N.C	
		14	HUMIDITY SENSOR	
		15	INCAR SENSOR	
		16	SUN SENSOR (PHOTO SENSOR)	

FATC WIRING DIAGRAM