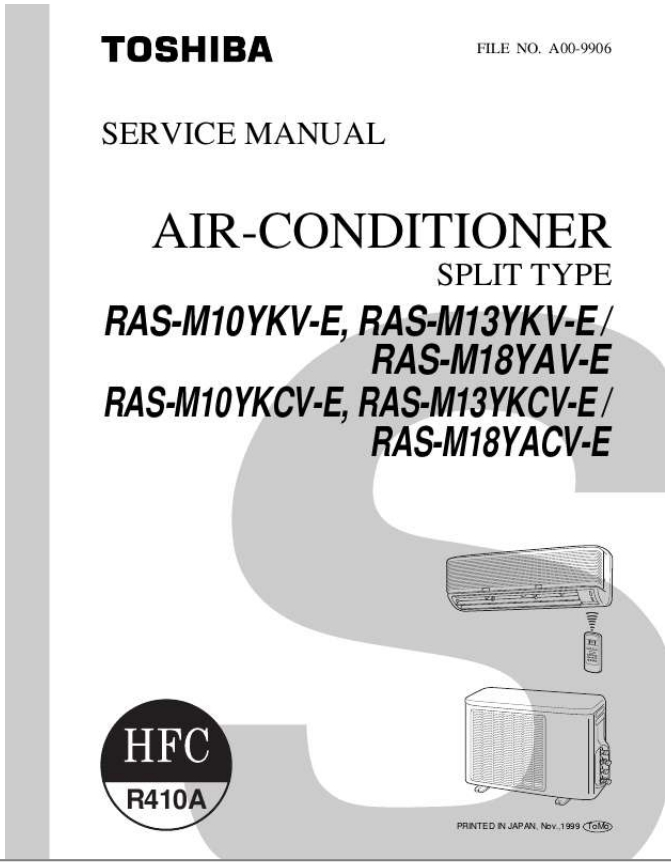
TOSHIBA

FILE NO. A00-9906

SERVICE MANUAL

AIR-CONDITIONER
SPLIT TYPE

RAS-M10YKV-E, RAS-M13YKV-E/
RAS-M18YAV-E
RAS-M10YKCV-E, RAS-M13YKCV-E/
RAS-M18YACV-E

HFC
R410A

PRINTED IN JAPAN, Nov., 1999 (ToMo)

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3 RAS-M10YKCV-E, RAS-M13YKCV-E / RAS-M18YACV-E Unit model Indoor Outdoor (kW) (kW) Unit model Running current Power consumption Power factor Unit model Running current Power consumption Power factor Starting current Unit model High Medium Low Unit model 10-1 indoor unit operating 13-1 indoor unit operating 2 indoor unit operating Height Width Depth RAS-M10YKCV-E, RAS-M13YKCV-E RAS-M18YACV-E 5,2 1,4 6,2 220 230 240V 1Ph 50 Hz RAS-M10YKCV-E RAS-M13YKCV-E 0,15 0,15 30 30 87 87 RAS-M18YACV-E 7,90 / 7,57 / 7,28 1660 95% 8,20 / 7,87 / 7,58 3,02 RAS-M10YKCV-E RAS-M13YKCV-E 36 39 33 35 30 30 RAS-M18YACV-E 42 46 46 RAS-M10YKCV-E RAS-M13YKCV-E 265 265 790 790 189 189 8 8 19 19 470 520 RAS-M18YACV-E 550 780 270 42 1100 Twin rotary type with DC-inverter variable speed control DA130A1F-21F 40 2060 Flare connection RAS-M10YKCV-E RAS-M13YKCV-E Ø6,35 Ø6,35 Ø9,52 Ø9,52 RAS-M18YACV-E Ø6,35 / Ø9,52 Ø6,35 / Ø9,52 20 30 30 10 R410A 1,15 3 Wires : includes earth 4 Wires : includes earth 21 32 21 43 1 1 2 1 2 (Ø3,1 x 16L) 1 1 2 6 (Ø4 x 25L) 1 1 1 Cooling capacity Cooling capacity range Power supply Electric Indoor characteristics (A) (W) (%) (A) (W) (%) (A) Outdoor COP Operating noise Indoor (dB·A) (dB·A) (dB·A) (dB·A) (dB·A) (dB·A) (mm) (mm) (mm) (kg) (W) (m 3/h) (mm) (mm) (mm) (kg) (W) Outdoor Indoor unit Unit model Dimension Net weight Fan motor output Air flow rate Outdoor unit Unit model Dimension Height Width Depth Net weight Compressor Motor output Type Model Fan motor output Air flow rate Piping connection Type Indoor unit Unit model Liquid side Gas side Outdoor unit Unit model A unit liquid side/gas side B unit liquid side/gas side Maximum length (per unit) Maximum length (total) Maximum chargeless length Maximum height difference Refrigerant Name of refrigerant Weight Wiring connection Power supply Interconnection Usable temperature range Indoor Outdoor Accessory Indoor unit Installation plate Wireless remote control Label Remote control holder Pan head wood screw Purifying filter Deodorizing filter Batteries Mounting screw Installation manual Outdoor unit Installation manual Owner's manual (W) (m 3/h) (m) (m) (m) (m) (kg) (°C) (°C) · For performance when each indoor unit is combined with other unit, refer to the separate table. · The specifications may be subject to change without notice for purpose of improvement. 4 1-2. Specifications of Performance When Each Indoor Unit is Combined with Other Unit <Cooling> Volts Operation status V 1 unit 220 2 units Operating indoor unit A B 10 -- 13 10 13 10 1 unit 230 2 units 13 10 13 10 1 unit 240 2 units 13 10 13 -- 10 10 -- -- 10 10 -- -- 10 10 Unit capacity (kW) A B 2,7 -- 3,7 2,55 3,01 2,7 3,7 2,55 3,01 2,7 3,7 2,55 3,01 -- 2,55 2,19 -- -- 2,55 2,19 -- -- 2,55 2,19 Cooling capacity kW 2,7 (1,1 to 3,2) 3,7 (1,1 to 4,2) 5,1 (1,4 to 6,1) 5,2 (1,4 to 6,2) 2,7 (1,1 to 3,2) 3,7 (1,1 to 4,2) 5,1 (1,4 to 6,1) 5,2 (1,4 to 6.2) 2,7 (1,1 to 3,2) 3,7 (1,1 to 4,2) 5,1 (1,4 to 6,1) 5,2 (1,4 to 6,2) Running current A 4,13 (1,65 to 4,99) 6,58 (1,65 to 7,25) 8,14 (1,68 to 10,29) 8,20 (1,68 to 10,38) 3,95 (1,59 to 4,78) 6,30 (1,59 to 6,94) 7,78 (1,62 to 9,84) 7,87 (1,62 to 9,93) 3,79 (1,52 to 4,58) 6,03 (1,52 to 6,65) 7,46 (1,55 to 9,43) 7,58 (1,55 to 9,52) Power consumption W 770 (255 to 930) 1240 (255 to 1430) 1700 (260 to 2150) 1720 (260 to 2170) 770 (255 to 930) 1240 (255 to 1430) 1700 (260 to 2150) 1720 (260 to 2170) 770 (255 to 930) 1240 (255 to

1430) 1700 (260 to 2150) 1720 (260 to 2170) Outdoor operating noise dB 42 46 46 46 42 46 46 46 42 46 46 46 <Heating> Volts Operation status V 1 unit 220 2 units Operating indoor unit A B 10 -- 13 10 13 10 1 unit 230 2 units 13 10 13 10 1 unit 240 2 units 13 10 13 -- 10 10 -- -- 10 10 -- -- 10 10 Unit capacity (kW) A B 4,0 -- 5,0 3,2 3,72 4,0 5,0 3,2 3,72 4,0 5,0 3,2 3,72 -- 3,2 2,98 -- -- 3,2 2,98 -- -- 3,2 2,98 Heating capacity kW 4,0 (0,7 to 5,2) 5,0 (0,7 to 6,5) 6,4 (0,9 to 8,3) 6,7 (0,9 to 8,7) 4,0 (0,7 to 5,2) 5,0 (0,7 to 6,5) 6,4 (0,9 to 8,3) 6,7 (0,9 to 8,7) 4,0 (0,7 to 5,2) 5,0 (0,7 to 6,5) 6,4 (0,9 to 8,3) 6,7 (0,9 to 8,7) Running current A 6,94 (1,10 to 8,13) 9,86 (1,10 to 12,11) 8,47 (1,10 to 11,43) 8,85 (1,10 to 11,72) 6,64 (1,06 to 7,78) 9,43 (1,06 to 11,58) 8,10 (1,06 to 10,94) 8,47 (1,06 to 11,21) 6,36 (1,01 to 7,46) 9,04 (1,01 to 11,10) 7,76 (1,01 to 10,48) 8,11 (1,01 to 10,75) Power consumption W 1450 (170 to 1700) 2060 (170 to 2530) 1770 (170 to 2390) 1850 (170 to 2450) 1450 (170 to 1700) 2060 (170 to 2530) 1770 (170 to 2390) 1850 (170 to 2450) 1450 (170 to 1700) 2060 (170 to 2530) 1770 (170 to 2390) 1850 (170 to 2450) Outdoor operating noise dB 45 49 49 49 45 49 49 49 45 49 49 49 · The above specification values are those under the conditions Cooling indoor : DB/WB=27/19°C Cooling outdoor : DB=35°C Heating indoor : DB=20°C Heating outdoor : DB/WB=7/6°C 5 1-2-1.

*Operation Characteristic Curve <Cooling> 10 9 8 7 10 <Heating> 12 8 Current (A) 5 4 3 2 1 0 Current (A) 6 6 · Conditions Indoor : DB 27°C/WB 19°C Outdoor : DB 35°C Air flow : High Pipe length : 5m x 2 2 units operating 230V 0 10 20 30 40 50 60 70 80 90 100 4 2 · Conditions Indoor : DB 20°C Outdoor : DB 7°C/WB 6°C Air flow : High Pipe length : 5m x 2 2 units operating 230V 0 20 40 60 80 100 120 140 0 Compressor speed (rps) Compressor speed (rps) 1-2-2. Cooling Capacity Variation Ratio According to Temperature 115 · Conditions Indoor : DB27°C Outdoor : DB35°C Indoor air flow : High Pipe length 5m×2 2 units operating Capacity ratio (%) 105 100 95 90 85 80 75 70 65 60 · Conditions Indoor : DB27°C/WB19°C Indoor air flow : High Pipe length 5m×2 2 units operating Current Limited Start 110 105 Capacity ratio (%) 100 95 90 85 55 0 14 16 18 20 22 24 50 32 33 34 35 36 37 38 39 40 41 42 43 Outdoor temp. (°C) * Capacity ratio : 100% = 5,2 kW Indoor air wet bulb temp. (°C) 6 1-3. Electrical Data <Cooling> Combination of indoor unit operation Hz A 10 13 10 13 B -- -- 50 10 10 2301 198 264 12,10 12,21 12,10 12,21 15 15 9,04 9,13 9,04 9,13 0,15 x 2=0,30 0,15 x 2=0,30 0,50 0,50 VoltsPh. System Compressor Voltage range Min. Max. Power supply MCA 5,81 8,51 ICF 5,81 8,51 MOCP (Amps) 15 15 MSC 4,13 6,29 RLA 4,13 6,29 Indoor 0,15 x 1=0,15 0,15 x 1=0,15 Outdoor 0,50 0,50 Fan motor FLA <Heating> Combination of indoor unit operation Hz A 10 13 10 13 B -- -- 50 10 10 2301 198 264 13,47 13,81 13,47 13,81 15 15 10,14 10,41 10,14 10,41 0,15 x 2=0,30 0,15 x 2=0,30 0,50 0,50 VoltsPh. System Compressor Voltage range Min. Max. Power supply MCA 9,56 14,31 ICF 9,56 14,31 MOCP (Amps) 15 15 MSC 7,13 10,93 RLA 7,13 10,93 Indoor 0,15 x 1=0,15 0,15 x 1=0,15 Outdoor 0,50 0,50 Fan motor FLA NOTE : Model of Indoor unit : 10 : RAS-M10YKV-E, RAS-M10YKCV-E 13 : RAS-M13YKV-E, RAS-M13YKCV-E MCA : Minimum Circuit Amps. ICF : Maximum Instantaneous Current Flow (Equivalent to MCA in case of inverter air conditioner) MOCP : Maximum Overcurrent Protection (Fuse only) MSC : Maximum Starting Current FLA : Full Load Amps. RLA : Rated Load Amps. RLA under conditions on the right. <Cooling> DB Indoor temp.*

Outdoor temp. °C °C 27 35 WB 19 -- <Heating> DB Indoor temp. Outdoor temp. °C °C 20 7 WB -- 6 7 2. REFRIGERANT R410A This air conditioner adopts the new refrigerant HFC (R410A) which does not damage the ozone layer. The working pressure of the new refrigerant R410A is 1,6 times higher than conventional refrigerant (R22). The refrigerating oil is also changed in accordance with change of refrigerant, so be careful that water, dust, and existing refrigerant or refrigerating oil are not entered in the refrigerant cycle of the air conditioner using the new refrigerant during installation work or servicing time. The next section describes the precautions for air conditioner using the new refrigerant. Conforming to contents of the next section together with the general cautions included in this manual, perform the correct and safe work. (5) After completion of installation work, check to make sure that there is no refrigeration gas leakage.

If the refrigerant gas leaks into the room, coming into contact with fire in the fan-driven heater, space heate as shown in Table 2-2-2. Table 2-2-2 Minimum thicknesses of socket joints Nominal diameter 1/4 3/8 1/2 5/8 Reference outer diameter of copper pipe jointed (mm) 6,35 9,52 12,70 15,88 Minimum joint thickness (mm) 0,50 0,60 0,70 0,80 2-2-2. Processing of Piping Materials When performing the refrigerant piping installation, care should be taken to ensure that water or dust does not enter the pipe interior, that no other oil other than lubricating oils used in the installed air conditioner is used, and that refrigerant does not leak. When using lubricating oils in the piping processing, use such lubricating oils whose water content has been removed. When stored, be sure to seal the container with an airtight cap or any other cover.

(1) Flare Processing Procedures and Precautions a) Cutting the Pipe By means of a pipe cutter, slowly cut the pipe so that it is not deformed. b) Removing Burrs and Chips If the flared section has chips or burrs, refrigerant leakage may occur. Carefully remove all burrs and clean the cut surface before installation. 9 c) Insertion of Flare Nut d) Flare Processing Make certain that a clamp bar and copper pipe have been cleaned. By means of the clamp bar, perform the flare processing correctly.

Use either a flare tool for R410A or conventional flare tool. Flare processing dimensions differ according to the type of flare tool. When using a conventional flare tool, be sure to secure "dimension A" by using a gauge for size adjustment. ØD A Fig. 2-2-1 Flare processing dimensions Table 2-2-3 Dimensions related to flare processing for R410A A (mm) Nominal diameter Outer diameter (mm) 6,35 9,52 12,70 15,88 Thickness (mm) Flare tool for R410A clutch type 0 to 0,5 0 to 0,5 0 to 0,5 0 to 0,5 Conventional flare tool Clutch type 1,0 to 1,5 1,0 to 1,5 1,0 to 1,5 1,0 to 1,5 Wing nut type 1,5 to 2,0 1,5 to 2,0 2,0 to 2,5 2,0 to 2,5 1/4 3/8 1/2 5/8 0,8 0,8 0,8 1,0 Table 2-2-4 Dimensions related to flare processing for R22 A (mm) Nominal diameter Outer diameter (mm) 6,35 9,52 12,70 15,88 Thickness (mm) Flare tool for R22 clutch type 0 to 0,5 0 to 0,5 0 to 0,5 0 to 0,5 Conventional flare tool Clutch type 0,5 to 1,0 0,5 to 1,0 0,5 to 1,0 0,5 to 1,0 Wing nut type 1,0 to 1,5 1,0 to 1,5 1,5 to 2,0 1,5 to 2,0 1/4 3/8 1/2 5/8 0,8 0,8 0,8 1,0 Table 2-2-5 Flare and flare nut dimensions for R410A Nominal diameter 1/4 3/8 1/2 5/8 Outer diameter (mm) 6,35 9,52 12,70 15,88 Thickness (mm) 0,8 0,8 0,8 1,0 Dimension (mm) A 9,1 13,2 16,6 19,7 B 9,2 13,5 16,0 19,0 C 6,5 9,7 12,9 16,0 D 13 20 23 25 Flare nut width (mm) 17 22 26 29 10 Table 2-2-6 Flare and flare nut dimensions for R22 Nominal diameter 1/4 3/8 1/2 5/8 3/4 Outer diameter (mm) 6,35 9,52 12,70 15,88 19,05 Thickness (mm) 0,8 0,8 0,8 1,0 1,0 Dimension (mm) A 9,0 13,0 16,2 19,4 23,3 B 9,2 13,5 16,0 19,0 24,0 C 6,5 9,7 12,9 16,0 19,2 D 13 20 20 23 34 Flare nut width (mm) 17 22 24 27 36 45° ~46 ° B A C D 43° ~45 ° Fig. 2-2-2 Relations between flare nut and flare seal surface (2) Flare Connecting Procedures and Precautions a) Make sure that the flare and union portions do not have any scar or dust, etc. b) Correctly align the processed flare surface with the union axis. c) Tighten the flare with designated torque by means of a torque wrench. The tightening torque for R410A is the same as that for conventional R22. Incidentally, when the torque is weak, the gas leakage may occur.

When it is strong, the flare nut may crack and may be made non-removable. When choosing the tightening torque, comply with values designated by manufacturers. Table 2-2-7 shows reference values. Note: When applying oil to the flare surface, be sure to use oil designated by the manufacturer. If any other oil is used, the lubricating oils may deteriorate and cause the compressor to burn out. Table 2-2-7 Tightening torque of flare for R410A [Reference values] Nominal diameter 1/4 3/8 1/2 5/8 Outer diameter (mm) 6,35 9,52 12,70 15,88 Tightening torque N·m (kgf·cm) 14 to 18 (140 to 180) 33 to 42 (330 to 420) 50 to 62 (500 to 620) 63 to 77 (630 to 770) Tightening torque of torque wrenches available on the market N·m (kgf·cm) 16 (160), 18 (180) 42 (420) 55 (550) 65 (650) 11 2-3. Tools 2-3-1. Required Tools The service port diameter of packed valve of the outdoor unit in the air conditioner using R410A is changed to prevent mixing of other refrigerant. To reinforce the pressure-resisting strength, flare processing dimensions and opposite side dimension of flare nut (For Ø12,7 copper pipe) of the refrigerant piping are lengthened. The used refrigerating oil is changed, and mixing of oil may cause a trouble such as generation of sludge, clogging of capillary, etc.

*Accordingly, the tools to be used are classified into the following three types. (1) Tools exclusive for R410A (Those which cannot be used for conventional refrigerant (R22)) (2) Tools exclusive for R410A, but can be also used for conventional refrigerant (R22) (3) Tools commonly used for R410A and for conventional refrigerant (R22) The table below shows the tools exclusive for R410A and their interchangeability. Tools exclusive for R410A (The following tools for R410A are required.) Tools whose specifications are changed for R410A and their interchangeability R410A air conditioner installation No. Used tool Usage Existence of new equipment for R410A Yes Yes Yes Yes Yes Yes Yes Yes (Note 2) Whether conventional equipment can be used Conventional air conditioner installation Whether new equipment can be used with conventional refrigerant Flare tool Copper pipe gauge for adjusting projection margin Torque wrench (For Ø12,7) Gauge manifold Charge hose Vacuum pump adapter Electronic balance for refrigerant charging Refrigerant cylinder Leakage detector Charging cylinder Pipe flaring Flaring by conventional flare tool Connection of flare nut Evacuating, refrigerant charge, run check, etc. Vacuum evacuating Refrigerant charge Refrigerant charge Gas leakage check Refrigerant charge *(Note 1) *(Note 1) X X X X X X X ¡ *(Note 1) X X ¡ ¡ ¡ X X (Note 1) When flaring is carried out for R410A using the conventional flare tools, adjustment of projection margin is necessary. For this adjustment, a copper pipe gauge, etc. are necessary. (Note 2) Charging cylinder for R410A is being currently developed. General tools (Conventional tools can be used.) In addition to the above exclusive tools, the following equipments which serve also for R22 are necessary as the general tools. (1) Vacuum pump Use vacuum pump by attaching vacuum pump adapter. (2) Torque wrench (For Ø6,35) (3) Pipe cutter (4) (5) (6) (7) (8) Reamer Pipe bender Level vial Screwdriver (+,) Spanner or Monkey wrench (9) Hole core drill (Ø65) (10) Hexagon wrench (Opposite side 5mm) (11) Tape measure (12) Metal saw Also prepare the following equipments for other installation method and run check. (1) Clamp meter (2) Thermometer (3) Insulation resistance tester (4) Electroscope 12 2-4. Recharging of Refrigerant When it is necessary to recharge refrigerant, charge the specified amount of new refrigerant according to the following steps. Recover the refrigerant, and check no refrigerant remains in the equipment. Connect the charge hose to packed valve service port at the outdoor unit's gas side. When the compound gauge's pointer has indicated 0,1 Mpa (76 cmHg), place the handle Low in the fully closed position, and turn off the vacuum pump's power switch. Connect the charge hose of the vacuum pump adapter. Keep the status as it is for 1 to 2 minutes, and ensure that the compound gauge's pointer does not return.*

Open fully both packed valves at liquid and gas sides. Set the refrigerant cylinder to the electronic balance, connect the connecting hose to the cylinder and the connecting port of the electronic balance, and charge liquid refrigerant. (For refrigerant charging, see the figure below.) Place the handle of the gauge manifold Low in the fully opened position, and turn on the vacuum pump's power switch. Then, evacuating the refrigerant in the cycle. Never charge refrigerant exceeding the specified amount. If the specified amount of refrigerant cannot be charged, charge refrigerant bit by bit in COOL mode. Do not carry out additional charging. When additional charging is carried out if refrigerant leaks, the refrigerant composition changes in the refrigeration cycle, that is characteristics of the air conditioner changes, refrigerant exceeding the specified amount is charged, and working pressure in the refrigeration cycle becomes abnormally high pressure, and may cause a rupture or personal injury. (INDOOR unit) (Liquid side) (OUTDOOR unit) Opened (Gas side) Refrigerant cylinder (With siphon pipe) Check valve Closed Open/Close valve for charging Service port Electronic balance for refrigerant charging Fig. 2-4-1 Configuration of refrigerant charging 13 Be sure to make setting so that liquid can be charged. When using a cylinder equipped with a siphon, liquid can be charged without turning it upside down. It is necessary for charging refrigerant under condition of liquid because R410A is mixed type of refrigerant. Accordingly, when charging refrigerant from the refrigerant cylinder to the equipment, charge it turning the cylinder upside down if cylinder is not equipped with siphon. [Cylinder with siphon] Gauge manifold OUTDOOR unit [Cylinder without siphon] Gauge manifold OUTDOOR unit Refrigerant cylinder Electronic balance R410A refrigerant is HFC mixed refrigerant.

Therefore, if it is charged with gas, the composition of the charged refrigerant changes and the characteristics of the equipment varies. Fig. 2-4-2 2-5. Brazing of Pipes 2-5-1. Materials for Brazing (1) Silver brazing filler Silver brazing filler is an alloy mainly composed of silver and copper.

It is used to join iron, copper or copper alloy, and is relatively expensive though it excels in solderability. (2) Phosphor bronze brazing filler Phosphor bronze brazing filler is generally used to join copper or copper alloy. (3) Low temperature brazing filler Low temperature brazing filler is generally called solder, and is an alloy of tin and lead. Since it is weak in adhesive strength, do not use it for refrigerant pipes.

2-5-2. Flux (1) Reason why flux is necessary · By removing the oxide film and any foreign matter on the metal surface, it assists the flow of brazing filler. · In the brazing process, it prevents the metal surface from being oxidized. · By reducing the brazing filler's surface tension, the brazing filler adheres better to the treated metal. 14 Refrigerant cylinder Electronic balance Siphon Phosphor bronze brazing filler tends to react with sulfur and produce a fragile compound water solution, which may cause a gas leakage. Therefore, use any other type of brazing filler at a hot spring resort, etc.

, and coat the surface with a paint. When performing brazing again at time of servicing, use the same type of brazing filler. (2) Characteristics required for flux · Activated temperature of flux coincides with the brazing temperature. · Due to a wide effective temperature range, flux is hard to carbonize. · It is easy to remove slag after brazing. · The corrosive action to the treated metal and brazing filler is minimum. · It excels in coating performance and is harmless to the human body. As the flux works in a complicated manner as described above, it is necessary to select an adequate type of flux according to the type and shape of treated metal, type of brazing filler and brazing method, etc. (3) Types of flux · Noncorrosive flux Generally, it is a compound of borax and boric acid. It is effective in case where the brazing temperature is higher than 800°C.
· Activated flux Most of fluxes generally used for silver brazing are this type. It features an increased oxide film removing capability due to the addition of compounds such as potassium fluoride, potassium chloride and sodium fluoride to the borax-boric acid compound. (4) Piping materials for brazing and used brazing filler/flux 2-5-3. Brazing As brazing work requires sophisticated techniques, experiences based upon a theoretical knowledge, it must be performed by a person qualified. In order to prevent the oxide film from occurring in the pipe interior during brazing, it is effective to proceed with brazing while letting dry Nitrogen gas (N2) flow.
Never use gas other than Nitrogen gas. (1) Brazing method to prevent oxidation Attach a reducing valve and a flow-meter to the Nitrogen gas cylinder. Use a copper pipe to direct the piping material, and attach a flow-meter to the cylinder. Apply a seal onto the clearance between the piping material and inserted copper pipe for Nitrogen in order to prevent backflow of the Nitrogen gas. When the Nitrogen gas is flowing, be sure to keep the piping end open.
Adjust the flow rate of Nitrogen gas so that it is lower than 0,05 m3/Hr or 0,02 MPa (0,2kgf/ cm2) by means of the reducing valve. After performing the steps above, keep the Nitrogen gas flowing until the pipe cools down to a certain extent (temperature at which pipes are touchable with hands). Remove the flux completely after brazing. Piping material Copper - Copper Copper - Iron Iron - Iron Used brazing filler Phosphor copper Silver Silver Used flux Do not use Paste flux Vapor flux Stop valve Nitrogen gas cylinder From Nitrogen cylinder M Flow meter Do not enter flux into the refrigeration cycle. When chlorine contained in the flux remains within the pipe, the lubricating oil deteriorates. Therefore, use a flux which does not contain chlorine. When adding water to the flux, use water which does not contain chlorine (e.g. distilled water or ion-exchange water). Remove the flux after brazing.

Pipe Nitrogen gas Rubber plug Fig. 2-5-1 Prevention of oxidation during brazing 15 3. CONSTRUCTION VIEWS 3-1. Indoor Unit RAS-M10YKV-E, RAS-M13YKV-E RAS-M10YKCV-E, RAS-M13YKCV-E Air inlet Air filter 790 Heat exchanger 189 ,,,,,,, ,,,,,,, ,,,,,,, ,,,,,,, ,,,,,,, ,,,,,,, ,,,,,,, ,,,,,,, ,,,,,,, ,,,,,,, ,,,,,,, ,, ,, ,, ,, ,, ,, ,, ,, Knock out system 50 94 790 Hanger 232 326 232 47 Front panel Back body 47 50 10 321 External length reference Connecting pipe (0,39m) (Flare ø9,52) 65,5 659 450 344 326 66 or more Minimum distance to ceiling Hanger Drain hose (0,54m) Knock out system Connecting pipe (0,49m) (Flare ø6,35) 65,5 Hanger For stud bolt (ø8~ø10) For stud bolt (ø6) 20 Hanger 2,5 46 26 20 178,5 265 Minimum distance to wall 17 37 10,5 76 Installation plate outline 319 790 Center line 269 60,5 126 40,5 3,5 Hanger Hanger 37 Wireless remote control 55 16 16 136 120 or more 120 or more 20 Minimum distance to wall 10 Air outlet 47 50 ,,,,,,, @@@@@@@@ PPPPPPPP ,,,,,,, @@@@@@@@ PPPPPPPP ,,,,,,, @@@@@@@@ PPPPPPPP ,,,,,,, @@@@@@@@ PPPPPPPP 265 3-2. Outdoor Unit (Anchor bolt long hole pitch) RAS-M18YAV-E RAS-M18YACV-E A leg part 115 600 90 50 ø25 drain hole ø11 × 17U-shape hole (For ø8-ø10 anchor bolt) (ø6 hole pitch) 310 296 270 76 8-ø6 hole (For fixing outdoor unit) 16 B leg part ø4,5 embossing (ø4STS used) (For sunshade roof attaching) 49,5 147 ø11 × 17 long hole (For ø8-ø10 anchor bolt) 21 Fan guard Valve cover 115,5 157 59 Hanger 540 550 53 21 Charging port Z 53 53 8 122,8 780 61 332 Earth terminal Connecting pipe port (Pipe dia.

ø6,35) Detailed A leg part 600 50 Connecting pipe port (Pipe dia.ø9,52) 36 11 R15 Z view Outside line of product 310 296 R5,5 Mounting dimensions of anchor bolt 600 4 × ø11 × 17U-shape hole (For ø8-ø10 anchor bolt) 2-ø6 hole 50 or more D Intake A 2-ø6 hole 310 Intake 250 or more 296 11 Outside line of product 310 C 100 or more Outside line of product (Minimum distance from wall) 36 50 R15 200 or more Outlet B 4 × ø11 × 17 long hole (For ø8-ø10 anchor bolt) 600 Detailed B leg part 17 96,2 R5 ,5 4. WIRING DIAGRAM FAN MOTOR 4-1. Indoor Unit RAS-M10YKV-E, RAS-M13YKV-E RAS-M10YKCV-E, RAS-M13YKCV-E LOUVER MOTOR BLU PNK YEL ORN RED BRW DC MOTOR 654321 654321 BLK P04 R109 VARISTOR SG01 DSA J04 CN07 R116 IC04 L01 R01 DB01 R21 C15 C01 C02 54321 54321 CN10 5 6 T6,3A 250V F01 FUSE INDOOR TERMINAL BLOCK TO1 DC35V DC12V DC7V 3 2 BLK 1 WHI CN30 2 RED 3 MAIN P.C.

BOARD (MCC-772) DC0V C06 IC02 GRN & YEL CN23 OUTDOOR INDOOR UNIT UNIT CN13 IC IC01 4 CN03 CN01 123456789 BLU BLU BLU BLU BLU BLU PNK BLK WHI 12 12 BLK BLK 12 12 BLK BLK 1 123456789 1 2 3 4 5 6 7 8 9 CN25 INFRARED RAYS RECEIVE AND INDICATION PARTS THERMO SENSOR (TA) HEAT EXCHANGER SENSOR (TC) Table 4-1-1 Simple check points for diagnosing faults Check items Diagnosis result Check to see if the OPERATION indicator goes on and off when the main OPERATION switch or breaker is turned on, or the power cord is plugged in the wall indicator outlet. (Check the primary and secondary voltage of transformer.) Terminal block Fuse 6,3A DC 5V DC 12V DC 35V Check for power supply voltage between . (Refer to the name plate.) (Check the primary and secondary voltage of transformer.

) Check for fluctuate voltage between . (DC 15 to 60V) Check to determine if the fuse is open. (Check Varistor : R109, R21) Check for voltage at the pink lead of the infrared rays receive parts. (Check the transformer and the rated voltage power supply circuit.) Check for voltage at the lead of louver motor. (Check the transformer and the rated voltage power supply circuit.) Check for voltage at the CN10 connector side point. (Check the transformer and the rated voltage power supply circuit.) COLOR IDENTIFICATION BRW : BROWN RED : RED WHI : WHITE YEL : YELLOW BLU : BLUE BLK : BLACK GRY : GRAY PNK : PINK ORN : ORANGE GRN : GREEN & &YEL YELLOW For detailed diagnostic procedure, refer to the service data. DSA : Surge Absorber 18 4-2. Outdoor Unit RAS-M18YAV-E FAN MOTOR REACTOR To POWER INDOOR SUPPLY 220230240V~ UNIT A 50/60Hz To INDOOR UNIT B 4 way valve GRY PNK 12 12 321 321 FM ~~~ LN ~~~~ 123 ~~~~ 123 RED WHI BLK YEL THERMOSTAT for COMPRESSOR TE WHI BLK SURGE ABSORBER BLK REACTOR F01 FUSE 25A VARISTOR 1 BRW 2 RED CN704 3 ORN 4 YEL 11 54321 54321 123 123 CN01 1 1 WHI 2 2 ORN P04 RED P05 WHI P06 1 2 3 4 1 2 3 CN15 4 CN701 P08 P07 CN301 CN300 RELAY RY04 P06 CN08 1 1 WHI 2 2 TD CN02 2 2 WHI 3 3 TO CN03 1 1 WHI 2 2 TS CN04 1 1 BLK 2 2 CN05 2 2 YEL 3 3 PHOTO COUPLER 6 5 CN14 4 3 2 1 6 5 4 CN13 3 2 1 6 5 4 3 2 1 6 5 4 3 2 1 11 11 P09 ORN P10 POWER RELAY C13 CT BRW RED ORN YEL C15 F03 FUSE 15A L03 CN501 F01 FUSE 6,3A CONVERTER MODULE G E A ~ P19 P20 BLK P02 GRY P01 11 22 BLK TGa YEL GRY RED BLU ORN YEL WHI GRY RED BLU ORN YEL WHI 33 ELECTRONIC STARTER L01 C12 C14 P11 YEL ~ DB01 + YEL + BU EU BV EV BW EW BX BY BZ - F04 FUSE 3,15A RELAY RY06 P12 YEL P13 REACTOR PUR P14 P.M.V. A UNIT SUB P.C.

BOARD MCC-775 IGBT MODULE P.M.V. B UNIT Q200 BLU P18 P17 P.C. BOARD MCC-758 P21 RED P22 WHI P23 BLK 11 22 33 CM COMPRESSOR COLOR IDENTIFICATION BLK BLU ORN GRY PNK SKB : BLACK : BLUE : ORANGE : GRAY : PINK : SKY-BLUE WHI BRW RED YEL PUR : WHITE : BROWN : RED : YELLOW : PURPLE P.M.V. : PULSE MODULATING VALVE 19 RAS-M18YACV-E FAN MOTOR To POWER INDOOR SUPPLY 220230-240V~ UNIT A 50/60Hz To INDOOR UNIT B FM REACTOR GRY PNK RED WHI BLK YEL ~~~ LN ~~~~ 123 ~~~~ 123 12 12 321 54321 54321 123 123 BLK P06 CN701 P08 P07 CN301 CN300 WHI SURGE ABSORBER BLK REACTOR F01 FUSE 25A THERMOSTAT for COMPRESSOR ORN P04 RED P05 WHI P06 1 2 3 4 1 2 3 4 P.C.

BOARD MCC-758 P09 ORN P10 POWER RELAY CONVERTER MODULE G E A ~ ~ + P19 P20 C13 C15 F03 FUSE 15A L01 C12 C14 F04 FUSE 3,15A RELAY RY06 CT VARISTOR CN08 1 1 WHI 2 2 TD CN02 2 2 WHI 3 3 11 1 BRW 2 RED CN704 3 ORN 4 YEL 11 BRW RED ORN YEL CN15 F01 FUSE 6,3A TO CN03 1 1 WHI 2 2 TS CN04 1 1 BLK 2 2 CN05 2 2 YEL 3 3 PHOTO COUPLER CN14 6 5 4 3 2 1 6 5 4 3 2 1 6 5 4 3 2 1 6 5 4 3 2 1 11 L03 CN501 BLK P02 GRY P01 11 22 BLK TGa YEL GRY RED BLU ORN YEL WHI GRY RED BLU ORN YEL WHI 33 ELECTRONIC STARTER P11 P12 P13 YEL YEL REACTOR DB01 YEL PUR P14 P.M.V. A UNIT + BU EU BV EV BW EW BX BY BZ P18 P17 SUB P.C.

BOARD MCC-775 CN13 IGBT MODULE P.M.V. B UNIT Q200 BLU P21 RED P22 WHI P23 BLK 11 22 33 CM COMPRESSOR COLOR IDENTIFICATION BLK BLU ORN GRY PNK SKB : BLACK : BLUE : ORANGE : GRAY : PINK : SKY-BLUE WHI BRW RED YEL PUR : WHITE : BROWN : RED : YELLOW : PURPLE P.M.

V. : PULSE MODULATING VALVE 20 5. SPECIFICATIONS OF ELECTRICAL PARTS 5-1. Indoor Unit RAS-M10YKV-E, RAS-M13YKV-E / RAS-M10YKCV-E, RAS-M13YKCV-E No. 1 2 3 4 5 6 7 8 9 10 11 12 13 Parts name Fan motor (for indoor) Thermo. sensor (TA-sensor) DC-DC transformer (T01) Microcomputer Heat exchanger temp. sensor (TC-sensor) Line filter (L01) Diode (DB01) Capacitor (C02) Fuse (F01) Power supply IC (IC01) Varistor (R21, R109) Resistor (R01) Louver motor Type TICF-35-19-4 () SWT-34 or SWT-46 TMP87PM40AF or TMP87CM40AF () UF-253Y0R7 RBV-406 or D3SBA60 KMH450VNSN100M25B TSCR6,3A MA2830-FJ 15G561K ERF-5TK5R6 MP35EA7 Specifications DC35V, 19W 10k at 25°C DC390V, Secondary DC35V, 12V, 7V 10k at 25°C 25mH, AC0,7A 4A, 600V 100µF, 450V T6,3A, 250V 4A, 600V 560V 5,6, 5W Output (Rated) 2W, 10poles, 1phase DC12V 5-2. Outdoor Unit RAS-M18YAV-E / RAS-M18YACV-E No. 1 2 3 4 5 6 7 8 9 10 11 12 Parts name SC coil (Noise filter) DC-DC transformer Reactor Reactor Outside fan motor Fan control relay Suction temp. sensor (TS sensor) Discharge temp.

sensor (TD sensor) Outside air temp. sensor (TO sensor) Temp. sensor at A room gas side (TGa sensor) Terminal block (9P) Terminal block (3P) L03 L01 Model name SC-15-S06J SC-20-01J SWT-43 CH38Z-K CH43Z-K ICF-140-40-7 AJQ1341 (Inverter attached) (Inverter attached) (Inverter attached) (Inverter attached) ------ ------ For protection of switching power source For protection of transistor module breakage For protection of inverter input overcurrent LLQ2G501KHUATF 400LISN500K35F 6MBI25GS-060-01 DA130A1F-21F PW-2AL MP7002 (Inverter attached) Rating 15A, 0,6mH 20A, 150µH Primary side DC280V Secondary side 7,5V x 1, 13V x 1, 26,5V x 3, 16V x 1, 15V x 1 L=10mH, 16A x 2 L=10mH, 1A DC140V, 40W Coil DC12V Contact AC125V, 3A 10k (25°C) 62k (20°C) 10k (25°C) RAS-M18YACV-E .

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.. 10k (25°C) RAS-M18YAV-E ...

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..... 62k (20°C) 20A, AC250V 20A, AC250V 3,15A, AC250V 15A, AC250V 25A, AC250V 500µF, DC400V X 4 pieces 25A, 600V 3-phases 4-poles 1100W OFF: 125 ± 4°C, ON: 90 ± 5°C Diode: 25A, 600V, IGBT: 40A, 600V 10k at 25°C 13 Fuse 14 15 16 17 18 19 Electrolytic capacitor Transistor module Compressor Compressor thermo. Converter module Heat exchanger temp. sensor (TE-sensor) (H/P only) 21 6. REFRIGERANT CYCLE DIAGRAM 6-1. Refrigerant Cycle Diagram RAS-M10YKV-E, RAS-M13YKV-E RAS-M18YAV-E To B room T1 INDOOR UNIT Indoor heat exchanger Temp.

measurement To B room Cross flow fan P Pressure measurement Gauge attaching port Vacuum pump connecting port Allowable pipe length Allowable height difference : 10m Deoxidized copper pipe Both A and B rooms Outer dia. : 9,52mm Thickness : 0,8mm Muffler Ø25 x 80 4 way valve (VHV-0213) Deoxidized copper pipe Both A and B rooms Outer dia. : 6,35mm Thickness : 0,8mm Sectional shape of heat insulator Per 1 unit Max. : 20m Total : 30m Muffler Ø25 x 80 TGa Strainer Strainer Capillary Ø2,2 x 200 Muffler Ø25 x 80 Accumulating tank Ø51 x 200 (290cc) Muffler Ø25 x 160 TD Pulse modulating valve at liquid side (SEV15RC2) Compressor DA130A1F-21F TS Outdoor heat exchanger Split capillary Ø1,5 x 200 Ø1,5 x 200 TE Temp. measurement T2 Propeller fan Refrigerant amount : 1,15kg NOTE : Gas leak check position Refrigerant flow (Cooling) Refrigerant flow (Heating) OUTDOOR UNIT Table 6-1-1 Total length in two rooms (Standard) 10 m (Maximum) 30 m NOTE : · The maximum pipe length of this air conditioner is 30 m. The additional charging of refrigerant is unnecessary because this air conditioner is designed with charge-less specification. · To connect only one indoor unit, use connecting pipe with length by 5m or more. Each length in one room A room 5m 20 (10) m B room 5m 10 (20) m Unnecessary to add refrigerant Do not add the refrigerant Do not add the refrigerant 22 RAS-M10YKCV-E, RAS-M13YKCV-E RAS-M18YACV-E T1 INDOOR UNIT To B room Indoor heat exchanger Temp. measurement To B room Cross flow fan P Pressure measurement Gauge attaching port Vacuum pump connecting port Allowable pipe length Allowable height difference : 10m Deoxidized copper pipe Both A and B rooms Outer dia. : 9,52mm Thickness : 0,8mm Muffler Ø25 x 80 Deoxidized copper pipe Both A and B rooms Outer dia.

: 6,35mm Thickness : 0,8mm Sectional shape of heat insulator Per 1 unit Max. : 20m Total : 30m Strainer TGa Muffler Ø25 x 80 Capillary Ø2,2 x 200 TD Accumulating tank Ø51 x 200 (290cc) Pulse modulating valve at liquid side (SEV15RC2) Compressor DA130A1F-21F TS Outdoor heat exchanger Split capillary Ø1,5 x 200 Ø1,5 x 200 TE Temp. measurement T2 Propeller fan Refrigerant amount : 1,15kg NOTE : Gas leak check position Refrigerant flow OUTDOOR UNIT Table 6-1-2 Total length in two rooms (Standard) 10 m (Maximum) 30 m NOTE : · The maximum pipe length of this air conditioner is 30 m. The additional charging of refrigerant is unnecessary because this air conditioner is designed with charge-less specification. Each length in one room A room 5m 20 (10) m B room 5m 10 (20) m Unnecessary to add refrigerant Do not add the refrigerant Do not add the refrigerant 23 6-2. Operation Data <Cooling> No. of operating units Indoor Outdoor Temperature condition (°C) Operating combination Standard (Unit) pressure P (MPa) A B M13YKCV-E M13YKV-E 1 unit M10YKCV-E 0,9 to 1,1 11 to 13 M10YKV-E 27/19 35/ M13YKCV-E M10YKCV-E 0,8 to 1,0 11 to 13 M13YKV-E M10YKV-E 2 units M10YKCV-E M10YKCV-E 0,8 to 1,0 10 to 12 M10YKV-E M10YKV-E 50 to 52 High High 74 50 to 52 High High 74 45 to 47 High MED. 38 0,7 to 0,9 Heat exchanger pipe temp. T1 (°C) 9 to 11 T2 (°C) 46 to 48 Indoor Outdoor Compressor fan fan revolution mode mode (rps) High High 62 <Heating> No. of operating units Indoor Outdoor Temperature condition (°C) Operating combination Standard (Unit) pressure P (MPa) A B M13YKV-E 1 unit M10YKV-E 3,3 to 3,5 48 to 50 20/ 7/6 M13YKV-E M10YKV-E 2,5 to 2,7 41 to 43 2 units M10YKV-E M10YKV-E 2,5 to 2,7 41 to 43 2 to 0 High High 97 2 to 0 High High 97 0 to 2 High MED.

63 Heat exchanger pipe temp. T1 (°C) T2 (°C) 0 to 2 Indoor Outdoor Compressor fan fan revolution mode mode (rps) High High 79 3,5 to 3,7 53 to 55 NOTES : (1) Measure surface temperature of heat exchanger pipe around center of heat exchanger path U bent. (Thermistor themometer) (2) Connecting piping condition : 5 m x 2 units 24 7. CONTROL BLOCK DIAGRAM 7-1. Indoor Unit Indoor Unit Control Panel M.C.U Heat Exchanger Sensor Temperature Sensor Infrared Rays Signal Receiver Functions · Louver Control · 3-minute Delay at Restart for Compressor · Motor Revolution Control · Processing (Temperature Processing) · Timer · Serial Signal Communication Power Supply Circuit Indoor Fan Motor Timer Display ECONO. Sign Display FAN-ONLY Sign Display Operation Display Infrared Rays Initializing Circuit Clock Frequency Oscillator Circuit Remote Control Louver ON/OFF Signal Louver Motor Noise Filter Louver Driver Serial Signal Transmitter/Receiver From Outdoor Unit Serial Signal Communication REMOTE CONTROL RAS-M10YKV-E, RAS-M13YKV-E (Heat pump model) Infrared Rays RAS-M10YKCV-E, RAS-M13YKCV-E (Cooling only model) Infrared Rays Remote Control Operation (START/STOP) Operation Mode Selection AUTO, COOL, DRY, FAN ONLY Thermo. Setting Fan Speed Selection ON TIMER Setting OFF TIMER Setting Louver AUTO Swing Louver Direction Setting ECONO. Remote Control Operation (START/STOP) Operation Mode Selection AUTO, COOL, DRY, HEAT Thermo.

Setting Fan Speed Selection ON TIMER Setting OFF TIMER Setting Louver AUTO Swing Louver Direction Setting ECONO. 25 7-2. Outdoor Unit (Inverter Assembly) RAS-M18YAV-E CONTROL BLOK DIAGRAM (Outdoor unit) 220230240 V ~ 50 Hz MCC-775 (SUB P.C.B) A unit send/receive circuit B unit send/receive circuit MCC-758 (MAIN P.C.B) M.C.U · PWM synthesis function · Input current release control · IGBT over-current detect control · Outdoor fan control Gate drive circuit Over current detect circuit Rotor position detect circuit Rotor position detect circuit Outdoor Heatexchanger temp.sensor Discharge temp.

sensor Suction temp. sensor Gas side pipe temp. sensor Outdoor air temp. sensor · High power factor correction control · Signal communication to MCU M.C.

U · Inverter output frequency control · A/D converter function · P.M.V. control · Discharge temp. control · Error display · Signal communication to MCU Noise filter Driver circuit of P.

M.V. Relay RY04 A unit P.M.V. B unit P.M.V. Input current Sensor Converter DC) (AC High power factor correction circuit 26 Over current detect circuit Gate drive circuit Over current sensor Inverter AC) (DC Outdoor fan motor Over current sensor Inverter AC) (DC Compressor P.M.

V. : Pulse Modulating Valve PWM : Pulse Width Modulation IGBT : Insulated Gate Bipolar Transistor 4 way valve RAS-M18YACV-E CONTROL BLOK DIAGRAM (Outdoor unit) 220230240 V ~ 50 Hz MCC-775 (SUB P.C.B) A unit send/receive circuit B unit send/receive circuit MCC-758 (MAIN P.C.B) M.C.U · PWM synthesis function · Input current release control · IGBT over-current detect control · Outdoor fan control · High power factor correction control Gate drive circuit Over current detect circuit Rotor position detect circuit Rotor position detect circuit 27 Discharge temp. sensor Suction temp. sensor Gas side pipe temp.
sensor Outdoor air temp. sensor · Signal communication to MCU M.C.U · Inverter output frequency control · A/D converter function · P.M. V. control · Discharge temp. control · Error display · Signal communication to MCU Noise filter Driver circuit of P.M.V.
Input current Sensor Converter (AC DC) High power factor correction circuit Over current detect circuit Gate drive circuit Over current sensor Inverter (DC AC) Outdoor fan motor A unit P.M.V. B unit P.M.V. Over current sensor Inverter AC) (DC Compressor P.M.V. : Pulse Modulating Valve PWM : Pulse Width Modulation IGBT : Insulated Gate Bipolar Transistor 8.

OPERATION DESCRIPTION 8-1. Outline of Air Conditioner Control This air conditioner is a capacity-variable type air conditioner, which uses DC motor for the indoor fan motors and the outdoor fan motor. And the capacityproportional control compressor which can change the motor speed in the range from 13 to 120 rps is mounted. The DC motor drive circuit is mounted to the indoor unit. The compressor and the inverter to control fan motor are mounted to the outdoor unit. The entire air conditioner is mainly controlled by the indoor unit controller. The indoor unit controller drives the indoor fan motor based upon command sent from the remote control, and transfers the operation command to the outdoor unit controller. The outdoor unit controller receives operation command from the indoor unit side, and controls the outdoor fan and the pulse modulating valve. Besides, detecting revolution position of the compressor motor, the outdoor unit controller controls speed of the compressor motor by controlling output voltage of the inverter and switching timing of the supply power (current transfer timing) so that motors drive according to the operation command. And then, the outdoor unit controller transfers reversely the operating status information of the outdoor unit to control the indoor unit controller.
As the compressor adopts four-pole brushless DC motor, the frequency of the supply power from inverter to compressor is two-times cycles of the actual number of revolution. (1) Role of indoor unit controller The indoor unit controller judges the operation commands from the remote control and assumes the following functions. · Judgment of suction air temperature of the indoor heat exchanger by using the indoor temp. sensor. · Temperature setting of the indoor heat exchanger by using heat exchanger sensor (Prevent-freezing control) · Louver motor control · Indoor fan motor operation control · LED display control · Transferring of operation command signal (Serial signal) to the outdoor unit · Reception of information of operation status (Serial signal including outside temp.
data) to the outdoor unit and judgment/display of error (2) Role of outdoor unit controller Receiving the operation command signal (Serial signal) from the indoor controller, the outdoor unit performs its role. · Compressor operation control · Operation control of outdoor fan motor · P.M.V. control Operations followed to judgment of serial signal from indoor side.
· Detection of inverter input current and current release operation · Over-current detection and prevention operation to transistor module (Compressor stop function) · Compressor and outdoor fan stop function when serial signal is off (when the serial signal does not reach the board assembly of outdoor control by trouble of the signal system) · Transferring of operation information (Serial signal) from outdoor unit to indoor unit · Detection of outdoor temperature and operation revolution control · Defrost control in heating operation (Temp. measurement by outdoor heat exchanger and control for four-way valve and outdoor fan) 28 (3) Contents of operation command signal (Serial signal) from indoor unit controller to outdoor unit controller The following three types of signals are sent from the indoor unit controller. · Operation mode set on the remote control · Compressor revolution command signal defined by indoor temperature and set temperature (Correction along with variation of room temperature and correction of indoor heat exchanger temperature are added.) · For these two types of signals ([Operation mode] and [Compressor revolution]), the outdoor unit controller monitors the input current to the inverter, and performs the followed operation within the range that current does not exceed the allowable value. · Temperature of indoor heat exchanger by indoor heat exchanger sensor (Minimum revolution control) (4) Contents of operation command signal (Serial signal) from outdoor unit controller to indoor unit controller The following signals are sent from the outdoor unit controller. · The current operation mode · The current compressor revolution · Outdoor temperature · Existence of protective circuit operation For transferring of these signals, the indoor unit controller monitors the contents of signals, and judges existence of trouble occurrence. Contents of judgment are described below. · Whether distinction of the current operation status meets to the operation command signal · Whether protective circuit operates When no signal is received from the outdoor unit controller, it is assumed as a trouble. 8-1-1. Capacity Control The cooling capacity is varied by changing compressor motor speed.

The inverter changes compressor motor speed by changing AC 220230240V power to DC once, and controls capacity by changing supply power status to the compressor with transistor module (includes 6 transistors). The outline of the control is as follows: The revolution position and revolution speed of the motor are detected by detecting winding electromotive force of the compressor motor under operation, and the revolution speed is changed so that the motor drives based upon revolution speed of the operation command by changing timing (current transfer timing) to exchange inverter output voltage and supply power winding.

Detection of the revolution position for controlling is performed 12 times per 1 revolution of compressor. The range of supply power frequency to the compressor differs according to the operation status (COOL, DRY). Table 8-1-1 Compressor revolution range No. of Operation Combination operating mode of indoor units unit M10 -- 1 unit M13 -- COOL M10 M10 2 units M13 M10 M10 -- 1 unit M13 -- HEAT M10 M10 2 units M13 M10 Compressor revolution (rps) 13 to 45 13 to 69 13 to 91 13 to 91 13 to 72 13 to 92 13 to 120 13 to 120 8-1-2. Current Release Control The outdoor main circuit control section (Inverter assembly) detects the input current to the outdoor unit. If the current value with compressor motor speed instructed from indoor side exceeds the specified value, the outdoor main circuit control section controls compressor motor speed by reducing motor speed so that value becomes closest to the command within the limited value. 8-1-3. Power Factor Improvement Control Power factor improvement control is performed mainly aiming to reduce the current on much power consumption of cooling / heating operation.

Controlling starts from the time when input power has reached at a certain point. To be concrete, IGBT of the power factor improvement circuit is used, and the power factor is improved by keeping IGBT on for an arbitrary period to widen electro-angle of the input current. 29 8-1-4. Prevent-Freezing Control The indoor heat exchanger sensor detects refrigerant vapor temperature in COOL/DRY operation. If the temperature is below the specified value, compressor motor speed is reduced so that operation is performed in temperature below the specified value to prevent-freezing of indoor heat exchanger.

8-1-6. Louver Control (1) Vertical air flow louvers Positions of vertical air flow louvers are automatically controlled according to the operation status (AUTO, COOL, DRY, HEAT). Besides, positions of vertical air flow louvers can be arbitrarily set by pressing the [SET] button. The louver position which has been set by the [SET] button is stored in microcomputer, and the louver is automatically set at the stored position in the next operation. (2) Swing If the [AUTO] button is pressed during running operation, vertical air flow louvers start swinging.

When the [AUTO] button is pressed again, swinging stops. 8-1-5. P. M. V. (Pulse Modulating Valve) Using P.M.V., refrigerant flow of refrigeration cycle is varied for the optimum temperature. Controlling each unit separately by two P.

M.V. corresponds to difference of pipe length, fan speed, and unit temperature. If an error occurs on cycle temperature when power source of the air conditioner has been turned on, and if start/stop times of the outdoor unit are 30 times, move the valve once until it hits on the stopper for positioning of the valve. In this case, ticktack sound may be heard. 8-1-7. Indoor Fan Control (DC Fan Motor) The indoor fan is operated by motor speed non-step variable DC drive system motor. For flow rate, motor speed is controlled manually in three steps (LOW, MED, HIGH), and with the unit of 10 rpm from upper limit to lower limit in AUTO mode as described in Table 8-1-2. It is not selected by relay, so selecting sound does not generate. Table 8-1-2 M10 Operation mode Fan mode H COOL M L DRY -- H HEAT M L Motor speed (rpm) 1100 1010 910 810 1200 1100 930 Air flow rate (m³/h) 470 440 380 320 520 470 390 Motor speed (rpm) 1200 1140 1050 820 1280 1100 930 M13 Air flow rate (m³/h) 520 470 380 330 560 470 390 30 8-1-8.

*Outdoor Fan Control (DC Fan Motor) Although the outdoor fan motor drives the outdoor fan by non-step variable system of the revolution speed, the revolution speed is restricted to three steps on the convenience of controlling. If a strong wind is lashing outside of the room, the operation may be continued as the outdoor fan stops in order to protect the outdoor fan motor. If a fan lock occurred due to entering of foreign matter, the air conditioner stops and an alarm is displayed. <COOL, DRY> Table 8-1-3 Compressor revolution (rps) TO 38°C Outdoor temp. sensor TO TO < 38°C TO 38°C ECONO. operation TO < 38°C TO is abnormal ~ 17,4 500 (rpm) 500 (rpm) 500 (rpm) 500 (rpm) 700 (rpm) ~ 47,9 820 (rpm) 700 (rpm) 700 (rpm) 500 (rpm) 700 (rpm) 48 ~ 820 (rpm) 820 (rpm) 820 (rpm) 700 (rpm) 820 (rpm) <HEAT> Table 8-1-4 Compressor revolution (rps) TO 5°C Outdoor temp. sensor TO TO < 5°C TO 5°C ECONO. operation TO < 5°C TO is abnormal ~ 28,1 450 (rpm) 650 (rpm) 450 (rpm) 450 (rpm) 450 (rpm) ~ 72,9 650 (rpm) 650 (rpm) 450 (rpm) 650 (rpm) 650 (rpm) 73,0 ~ 820 (rpm) 820 (rpm) 650 (rpm) 650 (rpm) 820 (rpm) 8-2. Description of Operation Circuit (Room temp.) (Set temp.) · Turning [ON] the breaker flashes the operation lamp. This is the display of power-ON (or notification of power failure). · When pushing [START/STOP] button of the remote control, receive sound is issued from the main unit, and the next operations are performed together with opening the vertical air flow louvers. °C +3 +2,5 +2 +1,5 +1 +0,5 0 M+ *1 *1 *1 L 8-2-1. Fan Only Operation (The Remote Control MODE Button is Set to the FAN ONLY Operation) · Once the setting is made, the operation mode is memorized in the microcomputer so that the same operation can be effected thereafter simply by pushing [START/STOP] button. · When the FAN button is set to the AUTO position, the indoor fan motor operates as shown in Fig. 82-1. When the FAN SPEED button is set to LOW, MED, or HIGH, the motor operates with a constant air flow. · ECONO. mode cannot be set.*

*Set temp. (Set temp.) 25°C NOTE : *1: Calculated from difference in motor speed of M+ and L, and controlled. Fig. 8-2-1 Auto setting of air flow 31 8-2-2. Cooling Operation (The Remote Control MODE Button is Set to the COOL Position) · Once the setting is made, the operation mode is memorized in the microcomputer so that the same operation can be effected thereafter simply by pushing [START/STOP] button. · A cooling operation signal is transmitted to outdoor unit. · The indoor fan motor operates as shown in Fig.82-2 when FAN button is set to AUTO. · The motor operates with a constant air flow when the FAN button is set to LOW, MED, or HIGH.*

*· The outdoor unit controls the outdoor fan relay R01, R02 and R03, and the compressor motor speed according to the operation command signal sent from the indoor unit. °C +3 +2,5 +2 +1,5 +1 +0,5 0 0,5 M+ *1 *1 *1 L In normal operation (1) Cooling capacity control · The cooling capacity and room temperature are controlled by changing the compressor motor speed according to both the difference between the temperature detected by the room temperature sensor and the temperature set by TEMP button and also any change in room temperature. · When compressor has been activated or reactivated, it operates with Max.*

*28 rps for 1 minute, with Max. 57 rps from 1 minute to 3 minutes, and with Max. 83 rps after 3 minutes passed. · When room temperature is lower than set temperature, indoor fan motor is operated at fan speed L as shown in Fig. 8-2-2 while the outdoor unit stops. (2) Prevent-freezing control If temperature of indoor heat exchanger detected by the indoor heat exchanger sensor is 5°C or lower, compressor motor speed is gradually lowered to prevent freezing of the indoor heat exchanger. If temperature is 7°C or higher, return the operation to the above item (1). (3) Current release control The input current of compressor and outdoor fan motor (Precisely inverter main circuit control section) which occupy most of air conditioner input is detected by the outdoor current sensor, and compressor motor speed is gradually lowered so that current value does not exceed 11,5A if current value exceeds 11,5A. When the current value lowers to 11,0A, return the operation to the above item (1). Current value (A) Comp. motor speed down Set temp. NOTE : *1: (Room temp.) (Set temp.) Calculated from difference in motor speed of M+ and L, and controlled. Fig. 8-2-2 Setting of air flow [Fan AUTO] 11,5 11,0 Normal control Comp. motor speed keep Fig. 8-2-3 (4) Outdoor temperature release control The outdoor temperature release is controlled by changing the current release points 11,5 and 11,0 in the above item according to temperature detected by the outdoor temperature sensor. For example, if the outdoor temperature is 43°C, the value of current release point becomes 8,0A. 32 (5) Limit for maximum compressor motor speed by indoor fan speed When outdoor temperature sensor detected 32°C or lower, and indoor heat exchanger sensor detected 17°C or lower, the maximum compressor motor speed is limited by the indoor fan speed. For example, when 1 unit only operates, the compressor motor speed is limited as described in the table below. Table 8-2-1 Air flow rate HIGH M+ MED. L, L UL, SUL M10 (rps) 46 42 34 31 31 M13 (rps) 69 59 40 31 31 (7) Discharge temperature control (Common control to cooling and heating) The discharge temperature of refrigerant gas from the compressor is detected by the discharge temperature sensor, and controls operating compressor motor speed. 1) Control 1 (A zone) : Normal operation zone When TD detect value is 101°C or lower, the operation is performed with operating motor speed instructed by the serial signal. 2) Control 2 (B zone) : Slow-up zone of motor speed When TD detect value is 101°C or higher, operating motor speed is slowly up. 3) Control 3 (C zone) : Keep zone When TD detect value is 108°C or higher, operating motor speed is not changed if raising operation speed. 4) Control 4 (D zone) : Slow down zone of motor speed When TD detect value is 111°C or higher, operating motor speed is slowly down. 5) Control 5 (E zone) : Normal down of motor speed When TD detect value is 115°C or higher, operating motor speed is down. 6) Control 6 (F zone) : Operation stop zone If TD detect value exceeds 120°C during operation, stop the operation immediately. Then, restart the operation when TD detect value becomes 108°C or lower. (6) Louver control The vertical air flow louvers are automatically set to horizontal or cool memory position. When temperature of indoor heat exchanger becomes 5°C or lower by the prevent-freezing control and the compressor is turned off, the vertical air flow louvers close once and then return to the position of previous time. TD (°C) 120 115 111 Zone F E D Operation stop zone Normal down zone of motor speed Slow down of motor speed Release of motor speed 108 C Keep zone : Motor speed is not changed. 101 B Slow-up zone of motor speed A Normal operation zone Fig. 8-2-4 Compressor motor speed control 33 (8) ECONO. operation control When the ECONO. button of the remote control is pushed, quiet and mild operation is performed by restraining air flow and operating motor speed. 1) Indoor air flow is controlled between SUL and L (Low air ()). 2) Setting M10 at 23,3 rps and M13 at 26,3 rps as the maximum operating compressor motor speed, the minimum capacity operation range is widened every 1 hour and 2 hours have passed after ECONO. operation had started. Compressor motor speed Air volume L (Room temp.) (Set temp.) M10 16 rps 13 to 16 rps M13 20 rps 13 to 20 rps 3,5 UL 3 2,5 2 SUL 1,5 1 0,5 1H 2H Time 13 rps 13 rps Fig. 8-2-5 8-2-3. DRY Operation (The Remote Control MODE Button is Set to the DRY Position) · Once the setting is made, the operation mode is memorized in the microcomputer so that the same operation can be effected thereafter simply by pushing [START/STOP] button. · Dry operation signal is transmitted to outdoor unit. · The Cooling operation giving priority to dehumidifying, which restrains the indoor fan speed and compressor motor speed, is performed. · The indoor fan motor operates as shown in Fig. 8-2-6. (Fan speed is AUTO only.) · The outdoor unit controls the outdoor fan relay R01, R02 and R03, and the compressor motor speed according to the operation command signal sent from the indoor unit. (Room temp.) (Set temp.) +2,5 +2,0 +1,5 *1 +1,0 SUL +0,5 0 0,5 L Set temp. NOTE : *1 : Middle motor speed between L and SUL Fig. 8-2-6 Setting of air flow 34 8-2-4. Heating Operation Transferring of heating operation signal from indoor unit to outdoor unit starts. The indoor fan motor operates by the room temperature when selecting "AUTO" of "FAN" as shown in Fig. 8-2-7, and operates with a set air flow when selecting "Low" to "High". However, to prevent cold draft, revolution speed of the fan is restricted by indoor heat exchanger when air flow is AUTO (Fig. 8-2-8) and starting of FAN Manual. [In starting and in stability] In starting In stability FAN AUTO · Until 12 minutes · When 12 to 25 passed after minutes passed operation start after operation start and room temp. is · When 12 to 25 higher than (set minutes passed temp. 3°C) after operation start and room temp. is · When 25 minutes or 3°C or lower than more passed after set temp. operation start · Room temp. Set temp. 4°C · Room temp. > Set temp. 4°C [Basic control] Set temp. 0 0,5 1 1,5 2 LOW FAN Manual (Room temp.) (Set temp.) *1 *2 MED. The outdoor unit controls the outdoor fan based upon the operation signal sent from the indoor unit, and also controls revolution speed of the compressor motor. The power coupler (IC20) for four-way valve is turned on, and turned off in defrost operation. (1) Heating capacity control Calculate the difference between temperature detected by room temp. sensor every minute and the set temp.*