

LG VRF APPLICATION for AIR HANDLING UNIT Dx Coils

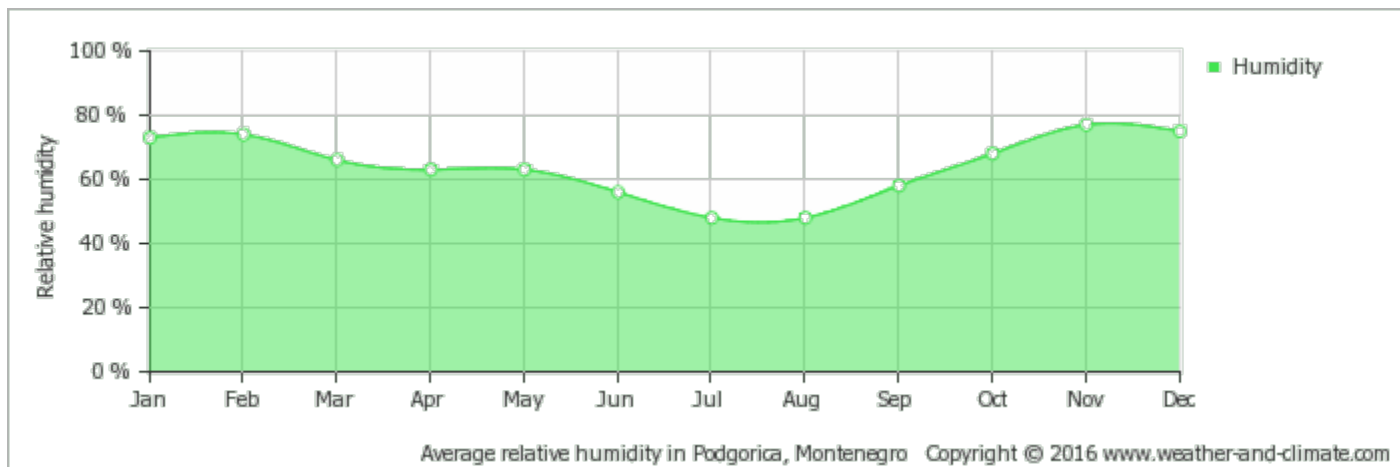
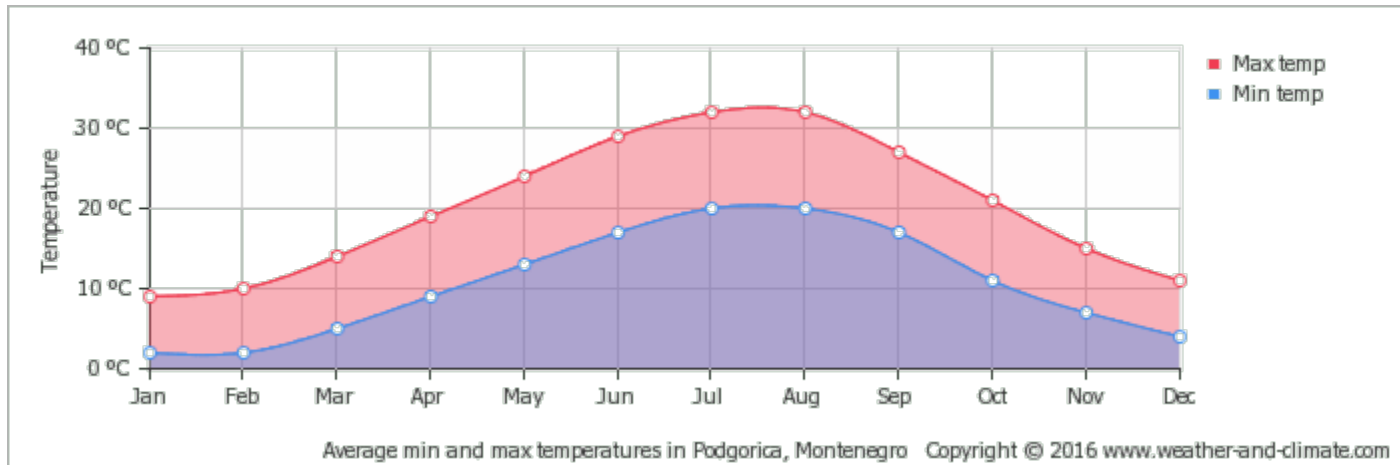


VRF AHU Dx Coils

- *Ventilation and conditions*
- *Basic on AHU designing and selection*
 - *Weather conditions*
 - *Air quality/comfort conditions*
- *Dx application and components*
- *LG VRF AHU Dx solutions*
 - *HEX (coils) structure: single, multiply*
 - *Refrigerant flow control: EEV, TEX*
- *Control solutions*

VRF AHU Dx Coils

*Weather statistic average temperature and Relative humidity in Montenegro
Podgorica*



VRF AHU Dx Coils

Solutions: **Fresh Air Supply**

Fresh Air supply + heating/Cooling load

Health & Comfort

The increase of living in closed space and concentration of polluted material gives bad effect on human health.

Gas-phase polluted material

Material	Main reason	Health
CO ₂	body, combustion	no direct harmfulness except high concentration
✓ CO	atmosphere pollution, tobacco	deadly poisonous even though low concentration
NO ₂	atmosphere pollution, tobacco	lung stimulation
✓ HCHO	veneer board adiabatic material	eye,skin stimulation headache,vomiting
SO ₂	combustion, atmosphere pollution	eye,skin,mucous membrane stimulation
O ₃	radiation, Atmosphere pollution	eye,skin upper airway stimulation
Rn	soil,stone, underground water	lung cancer
odor	body,tobacco heat/cooling system	discomfort

Particle polluted material

Material	Main reason	Health
Dust	outdoor air , clothes	allergy
Mite's excretion, fiber particle	carpet,pet, food scrap ,mite	allergy
✓ Smoke	tobacco	lung cancer, etc.
Bacteria	people, outdoor air	indoor air pollution index
Mold	construction material, outdoor air	allergy
Pollen	outdoor air	allergy
Asbestos	adiabatic material	lung cancer,skin disease tumor,etc.

VRF AHU Dx Coils

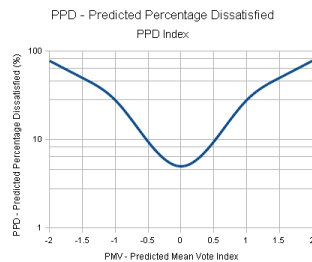
Air quality and Ventilation CR 1752, EN 15251

1. Demand by person, and Function/Category

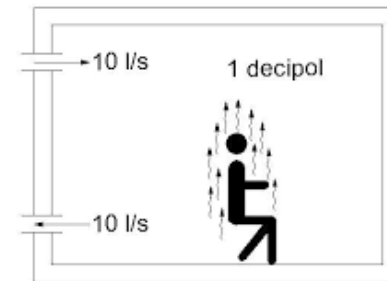
Table 1. Smoking free spaces in commercial buildings according to ASHRAE 62.1 and EN15251.

Type of building/ space	Occupancy person/m ²	Category EN	Minimum ventilation rate, i.e. for occupants only l/s person		Additional ventilation for building (add only one) l/s-m ²					Total l/s-m ²	
			ASHRAE R _p	EN	EN Very low-pollut.	EN Low-pollut.	EN Not low-pollut.	ASHRAE R _s	EN Low Pol.	ASHRAE	
											ASHRAE
Single office	0,1	I	2,5	10	10	1,0	2,0	0,3	2	0,55	
		II		7	7	0,7	1,4		1,4		
		III		4	4	0,4	0,8		0,8		
Land-scaped office	0,07	I	2,5	10	10	1,0	2,0	0,3	1,7	0,48	
		II		7	7	0,7	1,4		1,2		
		III		4	4	0,4	0,8		0,7		
Conference room	0,5	I	2,5	10	10	1,0	2,0	0,3	6	1,55	
		II		7	7	0,7	1,4		4,2		
		III		4	4	0,4	0,8		2,4		
Classroom	0,5	I	3,8	10	10	1,0	2,0	0,3	6	2,2	
		II		7	7	0,7	1,4		4,2		
		III		4	4	0,4	0,8		2,4		

2. Air quality - ventilation



The Engineering Toolbox
www.EngineeringToolBox.com



Efficiency of ventilation

$$\varepsilon_v = \frac{C_t - C_s}{C_i - C_s}$$

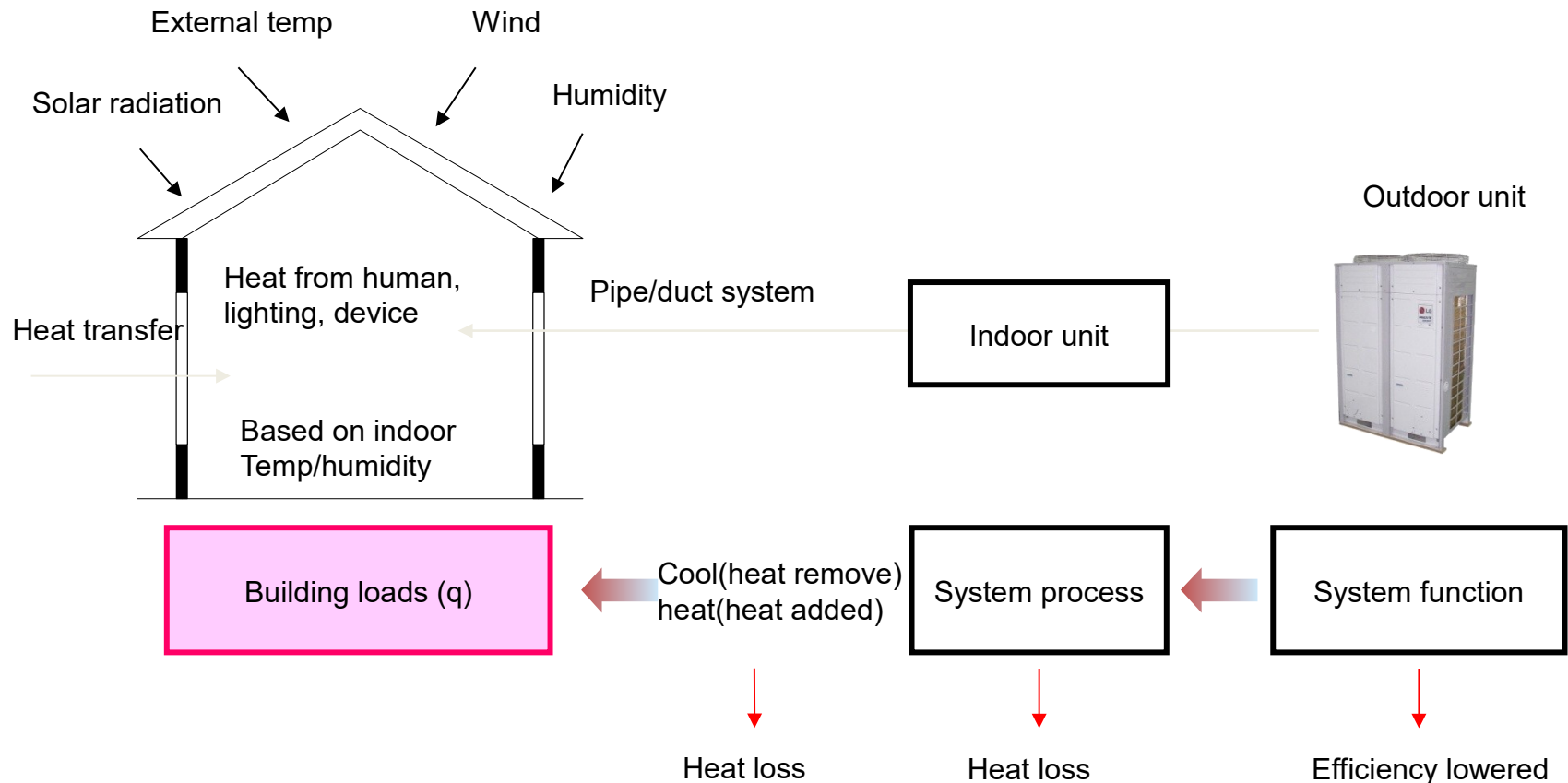
Air flow demand

$$Q = 10 \frac{G}{C_{mi} - C_{mk}} \cdot \frac{1}{\varepsilon_v} \quad \text{l/s}$$

VRF AHU Dx Coils

Selection Complex Solution by air quality + concerning building load calculation

Heating/cooling loads involved with a building include outside attributes such as external temp, solar radiation, wind and humidity as well as inside attributes such as human heat, heat from lighting and electronic appliances, in addition to loads generable thru exterior walling structure and windows of the building. Such architectural/environmental elements cause heating/cooling loads to take place.



VRF AHU Dx Coils

Designing conditions

Factors

Regulations

Design Condition

Temperature

17 ~ 28 °C

Humidity

40 ~ 70 %

Cleanness

Floating dust: 0.15 mg/ m³
CO: 10 ppm
CO₂: 1000 ppm

Air current

Under 0.5 m/s

Categories	Summer	Winter
Ordinary building (office/residence)	26 °C, 50 %	22 °C, 50 %
Commercial building (bank/department)	26 °C, 50 %	21 °C, 50 %
Industrial building (factory)	28 °C, 50 %	20 °C, 50 %

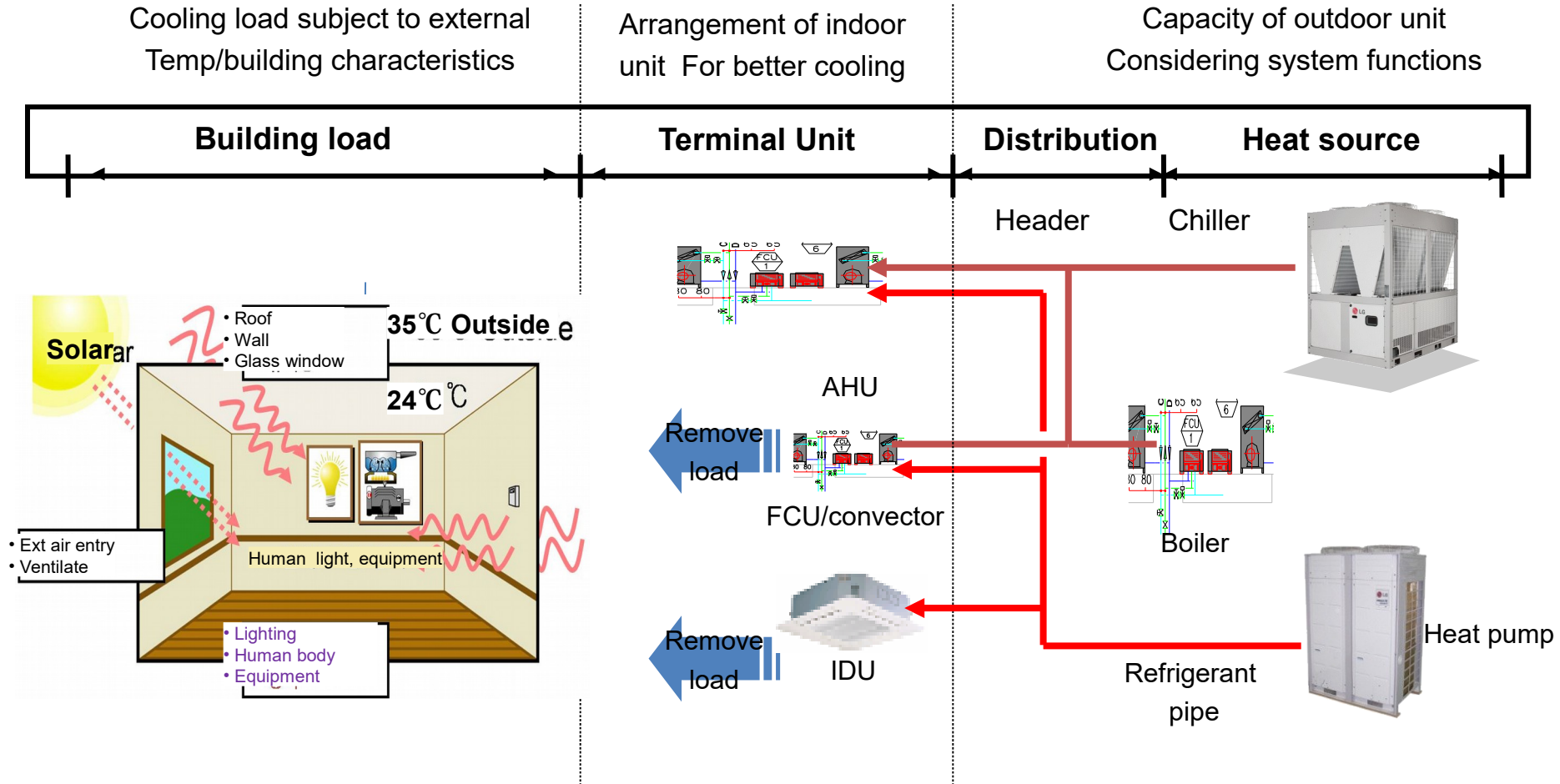
CO ₂ Standard	
Indoor design spec.	1,000 ppm
Outdoor design spec.	350 ppm

Categories	Cooling	Heating
Air velocity (m/s)	0.1 ~ 0.25	0.13 ~ 0.18
Gap between up and down	1.7 °C	2 °C

According to different countries, these regulations might be different

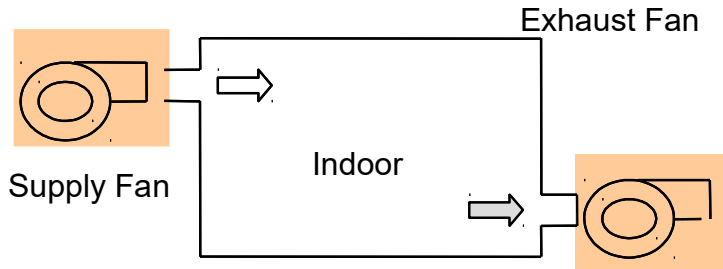
VRF AHU Dx Coils

To calculate/estimate capacity of HVAC system, in either individualized or centralized system, considerations shall be taken on loads required in terms of building load, heat source system, distribution system & air-conditioning system.

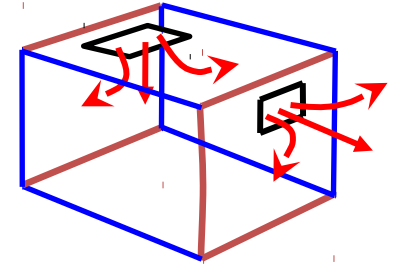


VRF AHU Dx Coils

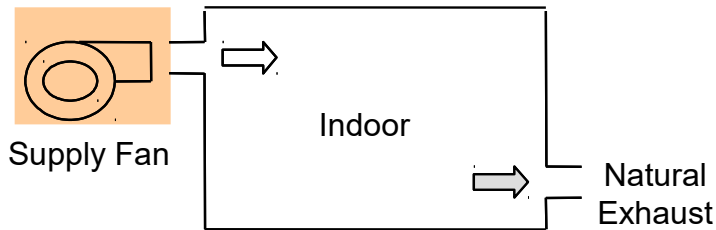
Ventilation Type 1



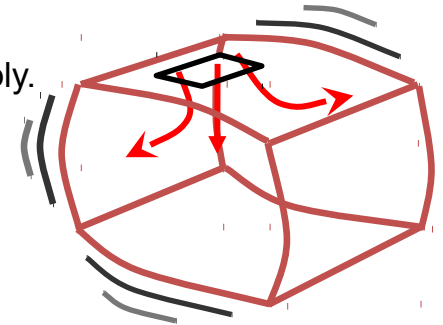
- Supply Fan and Exhaust Fan.
- The pressure in the room can be controlled by two fans.



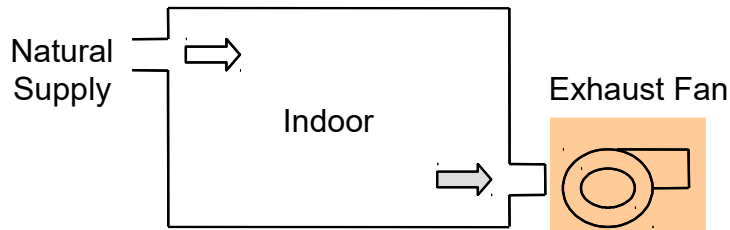
Ventilation Type 2



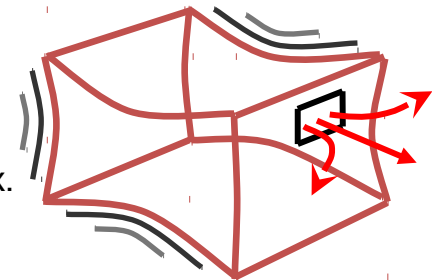
- Fresh outdoor air is mechanically supply.
- The room is in positive pressure. (ex. surgery theatre, clean room)



Ventilation Type 3



- The stale air in the room is mechanically discharged.
- The room is in negative pressure. (ex. kitchen, bathroom)



VRF AHU Dx Coils

Standard AHU - Line-up

Air flow rate of 5 Models
: 3,500 / 8,000 / 13,000 / 16,000 / 20,000 CMH

	Install Location		Rotary HEX		Silencer	Electric Heater	Spray Humidifier
	Outdoor	Indoor	Condensation Sensible Heat	Hygroscopic (Total Heat)			
Standard	✓		✓				
Option-1 (Hygroscopic)	✓			✓			
Option-2 (Silencer)	✓		✓		✓		
Option-3 (Electric Heater)	✓		✓			✓	
Option-4 (Indoor)		✓	✓				
Option-5 (Spray Humidifier)	✓		✓				✓

* Outdoor installation type AHU includes weather proof canopy and louvers.

* Accessories and utility devices such as internal light, observing glass, spring isolator, fan safety door etc. are not included.

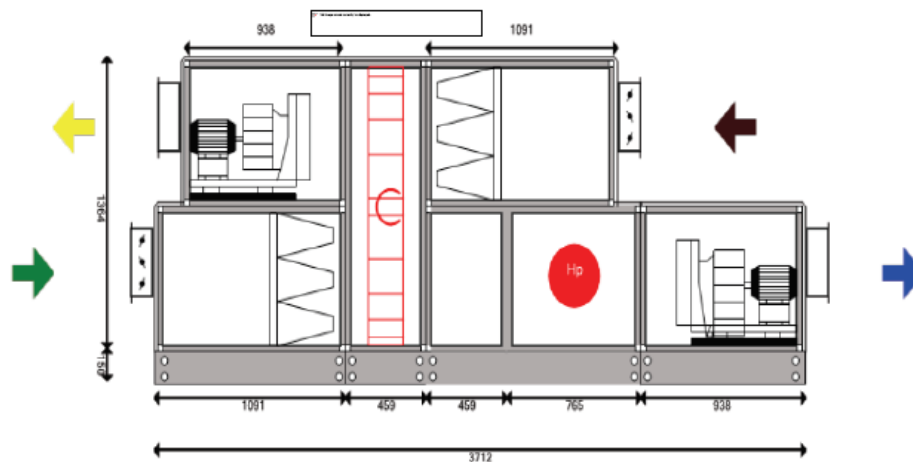
* Non-standard AHU models can be selected by Systemair AHU MSP(Model Selection Program) - Airware.

VRF AHU Dx Coils

Standard AHU – 5 different casings

5 different AHU casings can be selected as a function of the air flow rate and coil surface velocity

		AHU 01	AHU 02	AHU 03	AHU 04	AHU 05
Size	-	FL 20x40	FL 30x50	FL 40x60	FL 40x70	FL 40x80
Air Flow	m ³ /h	3500	8000	13000	16000	20000
External Static Pressure	Pa	400	400	400	400	400
Total Capacity (Summer)	kW	6,0	14,4	24,8	30,0	37,9
Total Capacity (Winter)	kW	18,0	42,3	71,7	85,3	104,3



VRF AHU Dx Coils

Filter

Flexline series AHU Benefits

Panel Filter



Class	Length (mm)	Pressure Drop(Pa)		
		Clean	Medium	Dirty
F5	48	62	131	200
G3	48	40	95	150
G4	48	50	100	150
Metalic	48	28	89	150

HEPA Filter



Class	Length (mm)	Pressure Drop(Pa)		
		Clean	Medium	Dirty
H10	292	167	383	600
H11	292	167	383	600
H12	292	167	383	600
H13	292	167	383	600

Bag Filter



Class	Length (mm)	Pressure Drop(Pa)		
		Clean	Medium	Dirty
F5	300	68	134	200
	600	44	122	200
F6	300	68	134	200
	600	44	122	200
F7	300	93	147	200
	600	60	130	200
F8	300	149	224	300
	600	96	198	300
F9	300	167	233	300
	600	107	204	300

Activated Carbon(Panel) Filter



Class	Length (mm)	Pressure Drop(Pa)		
		Clean	Medium	Dirty
AK	45	145	197	250
	95	58	154	250

Activated Carbon(Rigid) Filter



Class	Length (mm)	Pressure Drop(Pa)		
		Clean	Medium	Dirty
CH	292	40	120	200

Rigid Filter



Class	Length (mm)	Pressure Drop(Pa)		
		Clean	Medium	Dirty
F6	292	52	126	200
F7	292	61	131	200
F8	292	71	185	300
F9	292	71	185	300

Activated Carbon(Cartridge) Filter



Class	Length (mm)	Pressure Drop(Pa)		
		Clean	Medium	Dirty
AK	252	71	161	250
	452	80	165	250
	600	88	169	250

Low Depth Extended Surface Filter



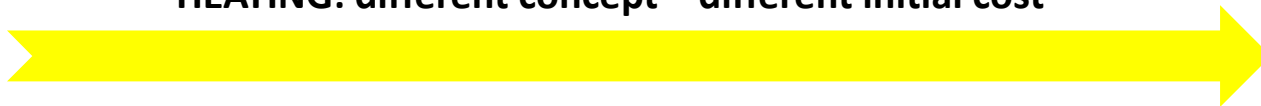
Class	Length (mm)	Pressure Drop(Pa)		
		Clean	Medium	Dirty
F6	149	112	156	200
F7	149	138	169	200
F8	149	162	231	300
F9	149	162	231	300

VRF AHU Dx Coils

HEATING: different concept – different energy consumption



HEATING: different concept – different initial cost



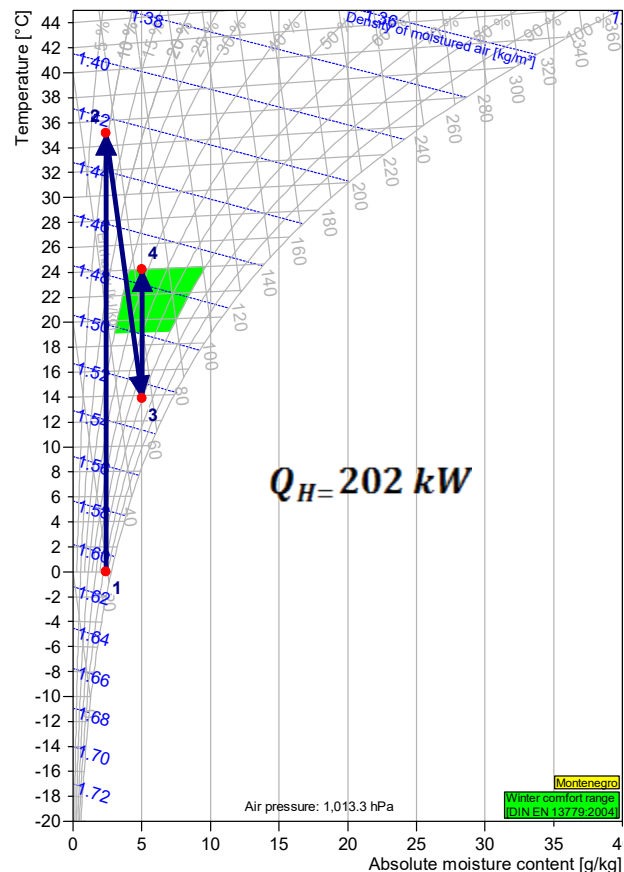
preheating – humidification – post heating

heat recovery – humidification – heating

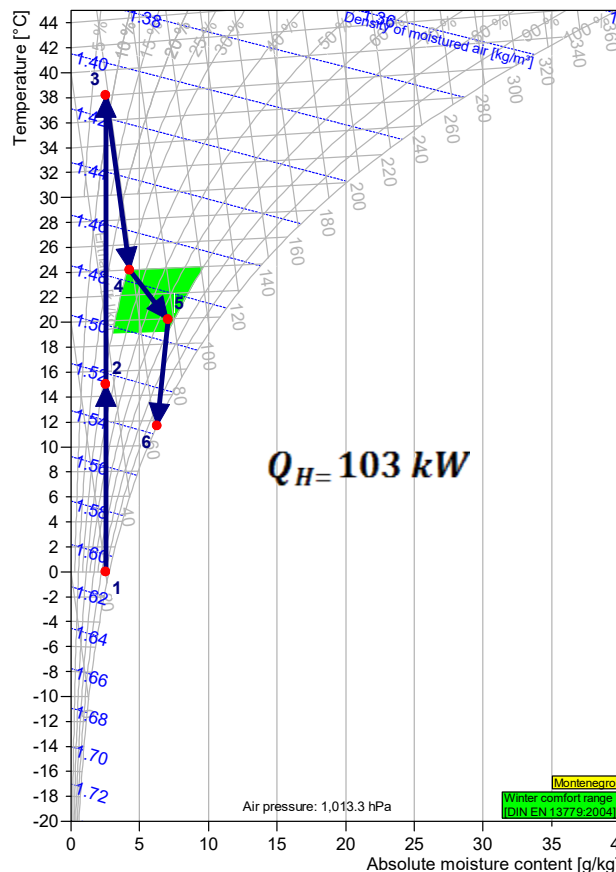
heat recovery – no humidification – heating

Sensible heat transfer – Plate HEX

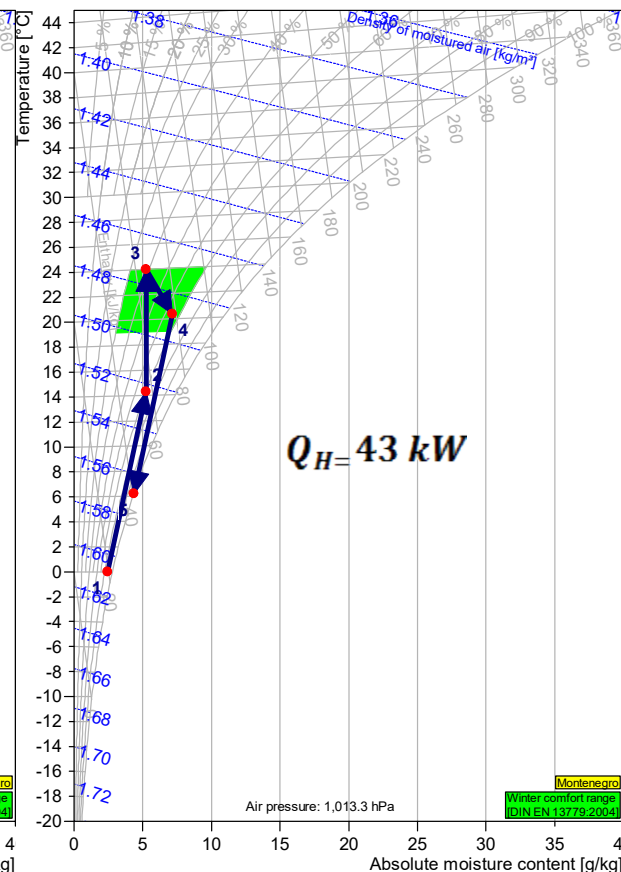
Total heat transfer – Enthalpy HEX



100%



51%



21%

VRF AHU Dx Coils

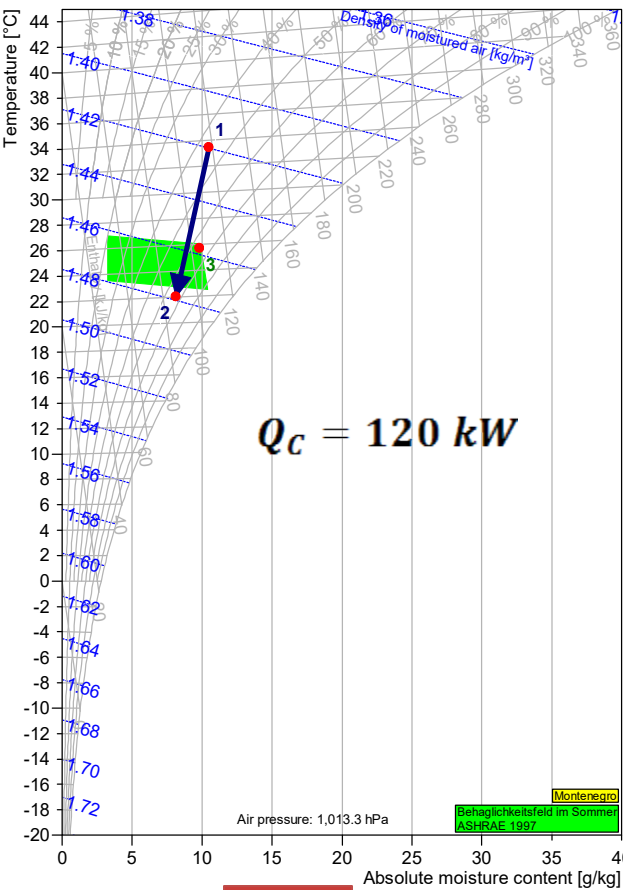
COOLING: different concept – different energy consumption



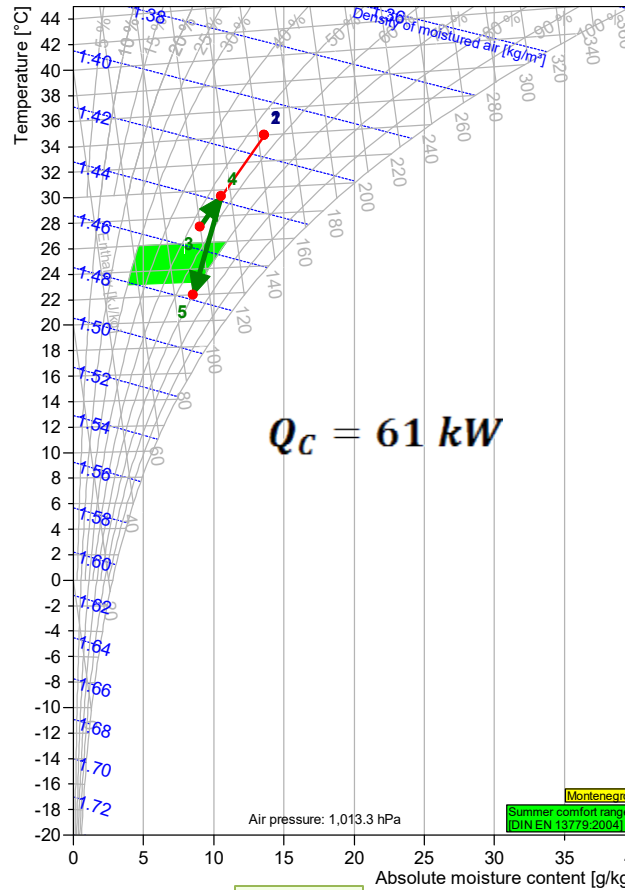
COOLING: different concept – different initial cost



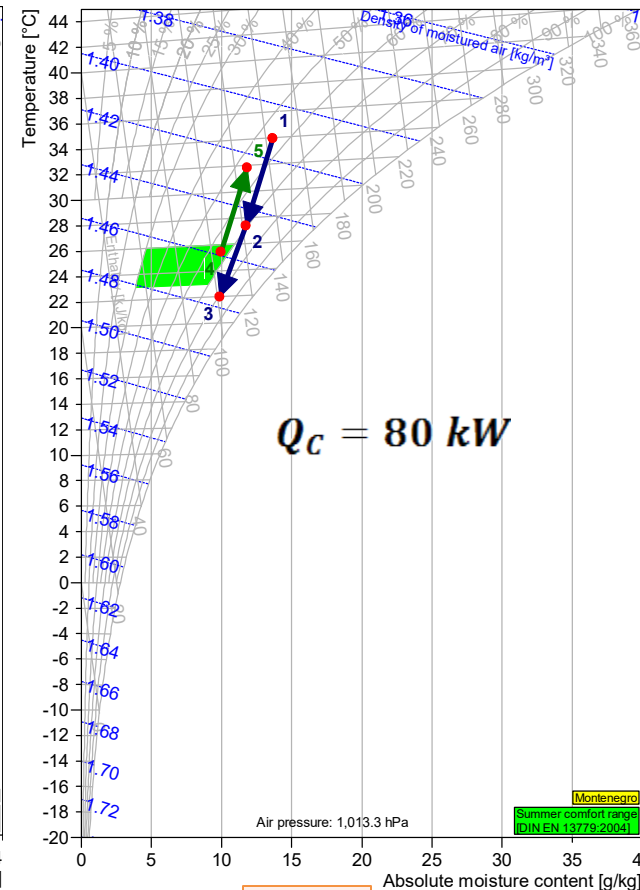
cooling only



mixing - cooling



heat recovery - cooling



VRF AHU Dx Coils

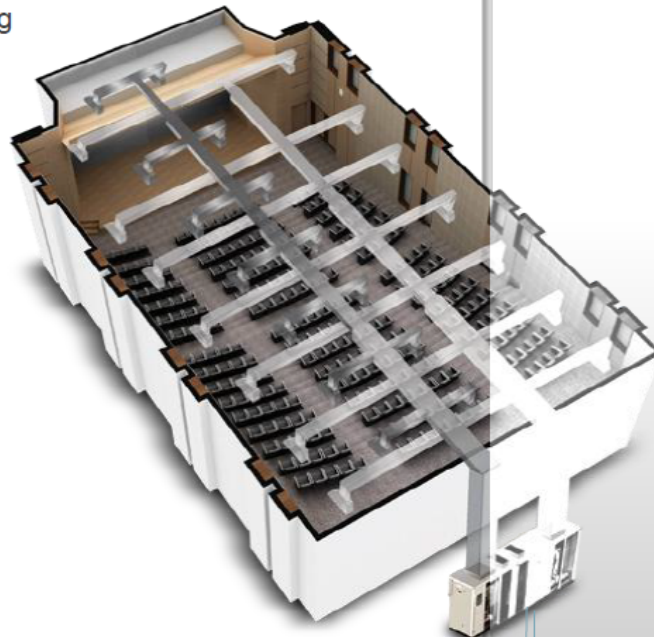
WHY DX AHU SOLUTION?

S I M P L E

Simple and space saving

Easy installation

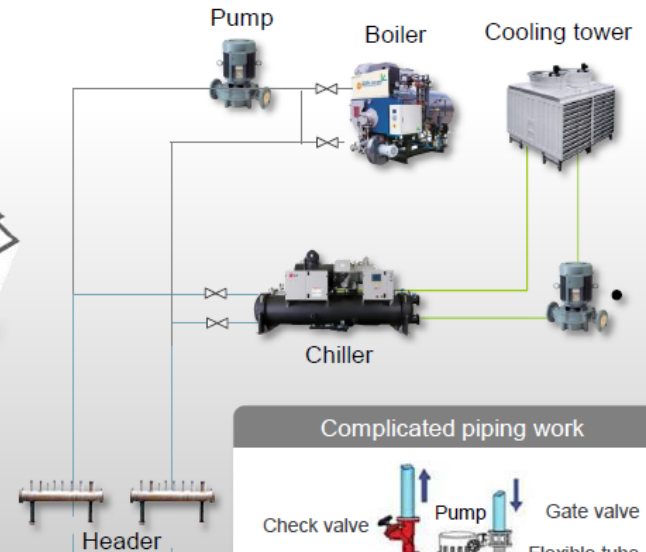
Low maintenance cost



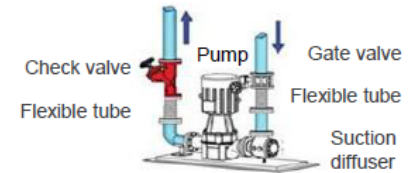
Refrigerant Pipe



COMPLICATED



Complicated piping work

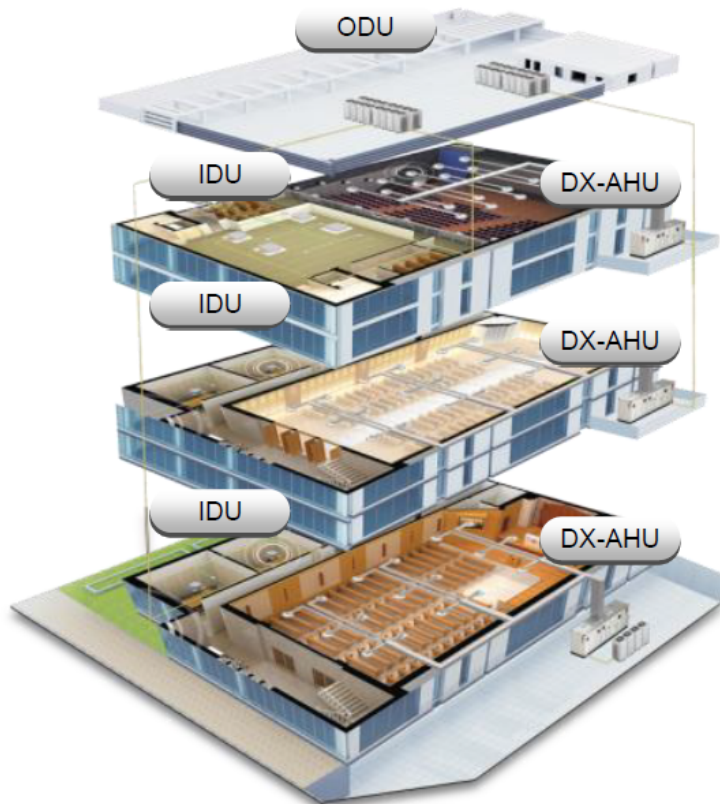


VRF AHU Dx Coils

INTEGRATED CONTROL SYSTEM

LG DX-AHU can be controlled by integrated control system. (including IDU and DX-AHU)

Integrated Control System Diagram



AHU Benefits

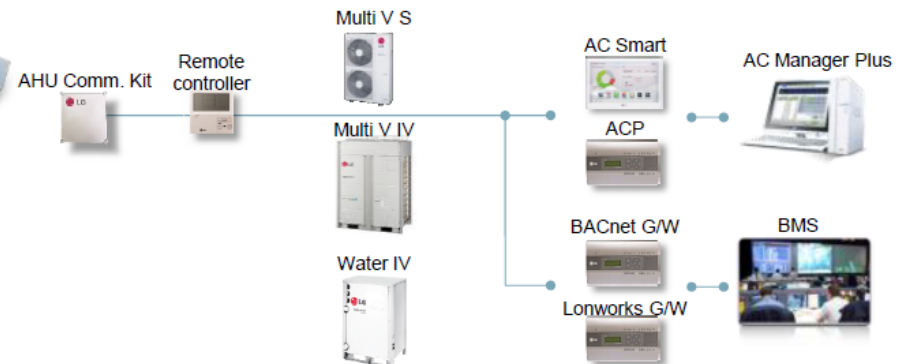
- Large air flow rate & high static pressure
- Various configuration(heat recovery, heat pipe, filter etc)

VRF System Benefits

- High efficiency inverter VRF system for partial load
- Various ODU system(Multi V S, Multi V IV, Water IV)
- Wide DX-AHU refrigerant control range(3~448HP)

Easy Integral Control

- Various AHU control(SA or RA temp. control)
- Central HVAC control through AC Manager Plus
- Interlocking with BMS (BACnet, Lonworks, Modbus)



VRF AHU Dx Coils

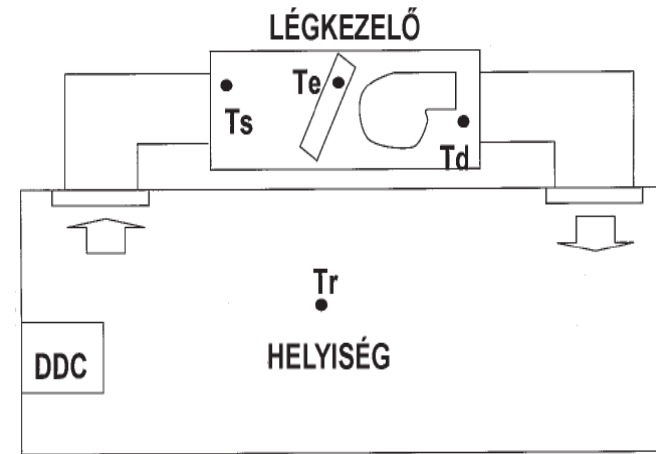
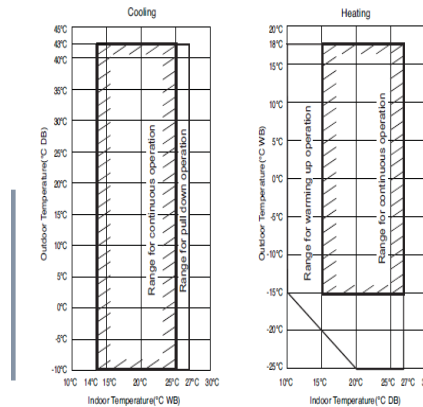
LGE AE CONTROL SOLUTIONS :

Room temperature (exhaust) controlled

It means higher capacity IDU

Control: Temperature sensor
DDC
BMS

APPLICATION RANGE: depends on VRF (-25°C)
+ DX COIL air in temperature min. +5°C!

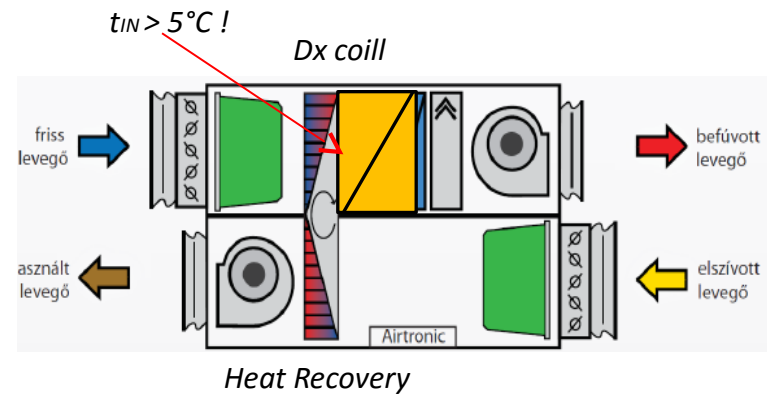


Supply air controlled

Fresh air supply systems

Control: AI: 0-10V
DDC/PLC
BMS

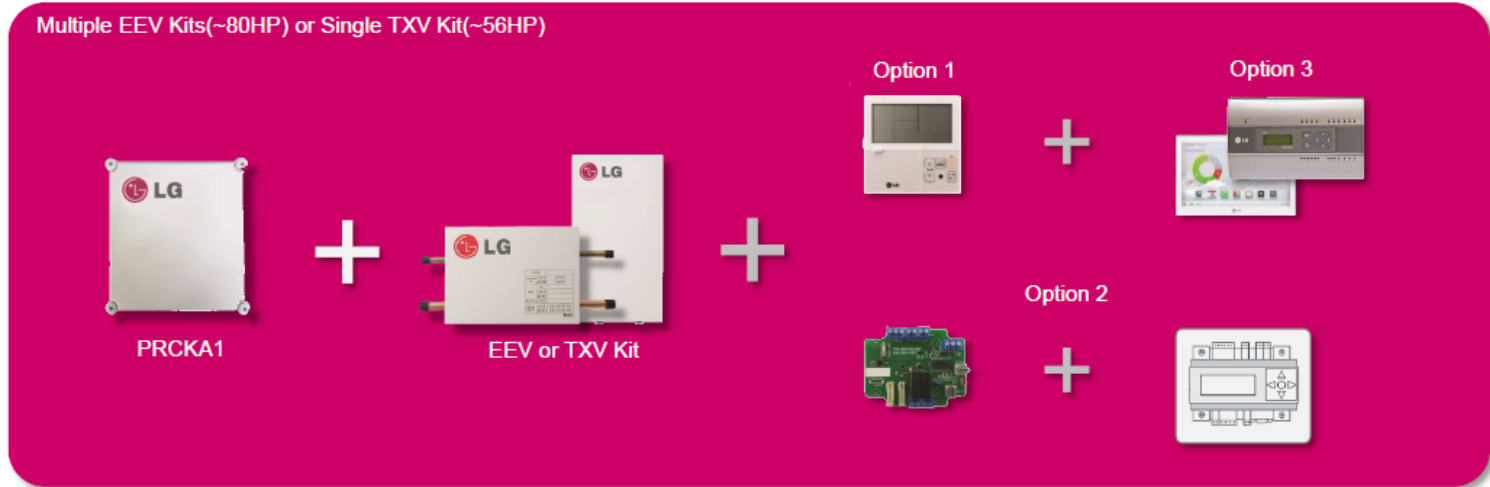
APPLICATION RANGE: depend on VRF + DX COIL air in temperature > +5 °C



VRF AHU Dx Coils

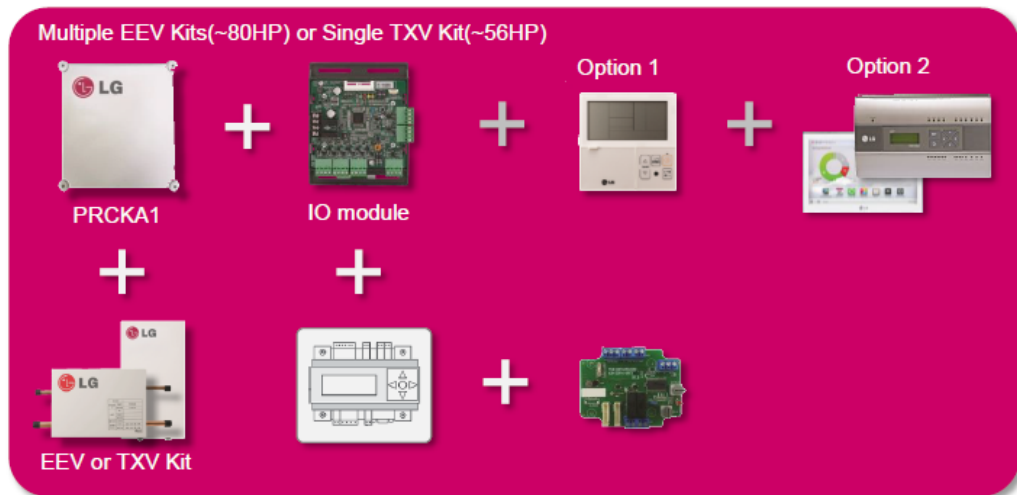
LGE AE CONTROL SOLUTIONS :

RETRUN AIR



* Option 1 : LG Remote controller, Option 2 : LG Dry contact + DDC(Field supply), Option 3 : LG Centralized control

SUPPLY AIR via DDC



** Option 1 : LG Remote controller(monitored only) *** Option 1 : LG Remote controller, Option 2 : LG Centralized control

COMMUNICATION KIT



Communication Kit (PRCKA1)

Controlled by Remote controller or Dry contact via DDC



Support LG Centralized controllers

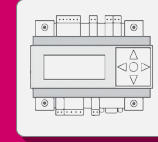


Multiple AHUs + EEV kits with Indoor units



Communication Kit (PRDCA0)

Controlled by DDC



LG Centralized controllers are not applicable



Not applicable

1 AHU + 1 EEV Kit without indoor units



REFRIGERANT CONTROLLER



EEV Kit (PRLK048A0, PRL096A0)

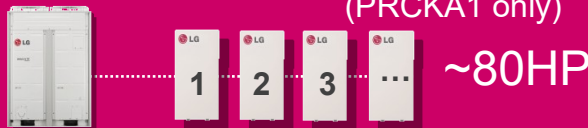


EEV : Electronic Expansion Valve

2 Models

~10HP ~20HP

Multiple EEV kits in 1 MULTI V system (PRCKA1 only)



TXV Kit (Expansion Kit)
PATX13A0E
PATX20A0E
PATX25A0E
PATX30A0E
PATX35A0E

TXV : Thermal Expansion Valve



5 Models ~16HP ~26HP
~36HP ~46HP ~56HP

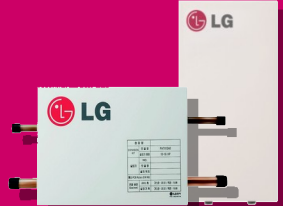
1 TXV kit in 1 MULTI V system



Multiple EEV Kits(~80HP) or Single TXV Kit(~56HP)



PRCKA1



EEV or TXV Kit



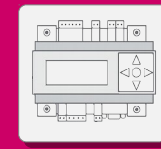
Option 1



Option 3



Option 2

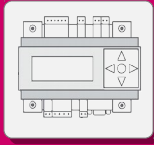


* Option 1 : LG Remote controller, Option 2 : LG Dry contact + DDC(Field supply), Option 3 : LG Centralized control

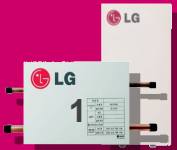
Single EEV(~20HP) or TXV Kit(~56HP)



PRDCA0

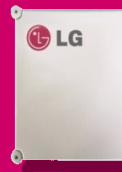


Option 1



EEV or TXV Kit

Multiple EEV Kits(~80HP) or Single TXV Kit(~56HP)



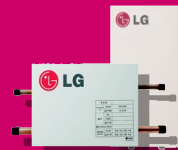
PRCKA1



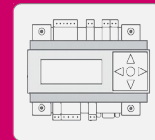
IO module



Option 1



EEV or TXV Kit

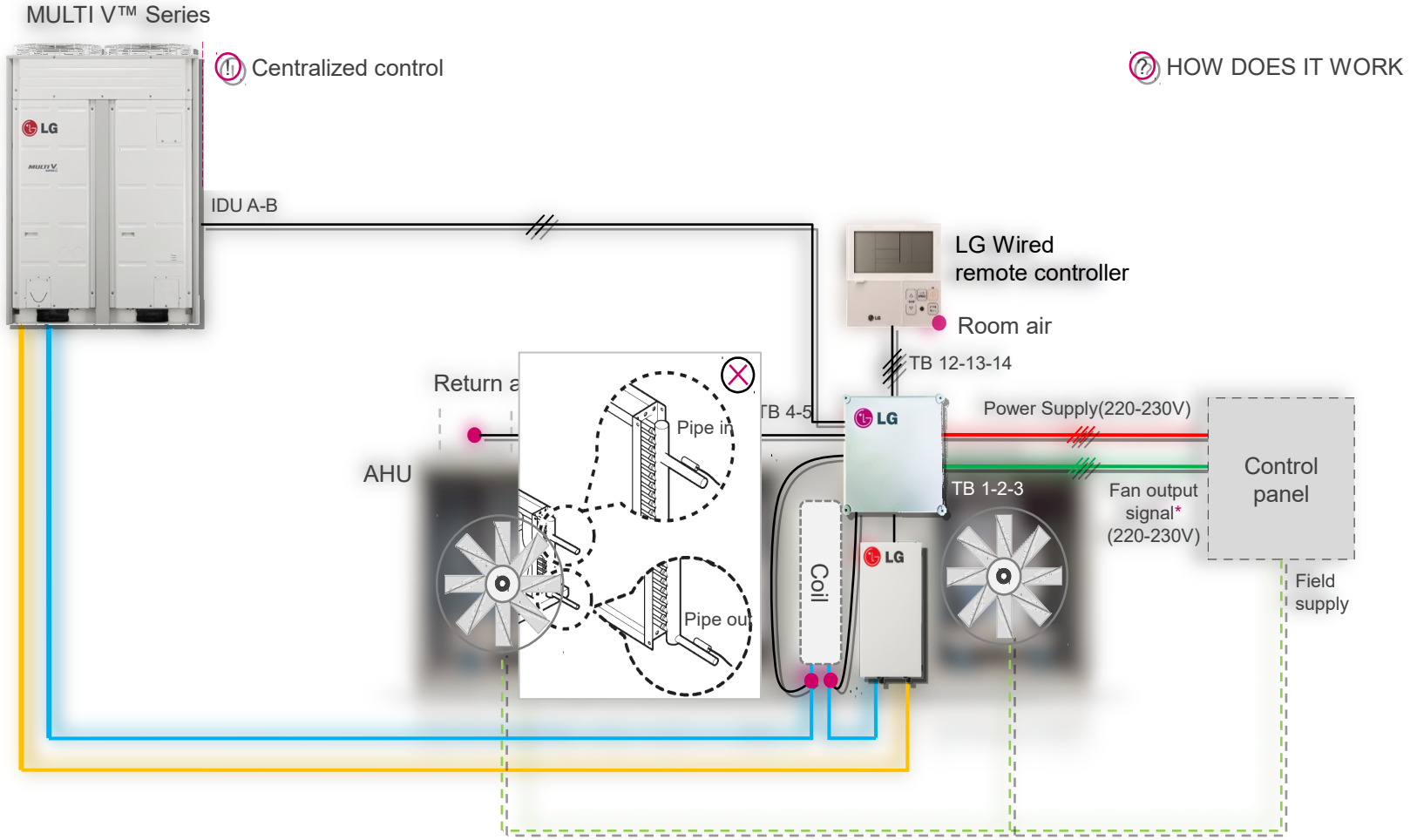


** Option 1 : LG Remote controller(monitoring only) Option 1 : LG Remote controller, Option 2 : LG Centralized control

Simple AHU control with return(room) air control (When applying PRCKA1 model)

CONCEPT - Simple AHU control with return(room) air control (When applying PRCKA1 model)

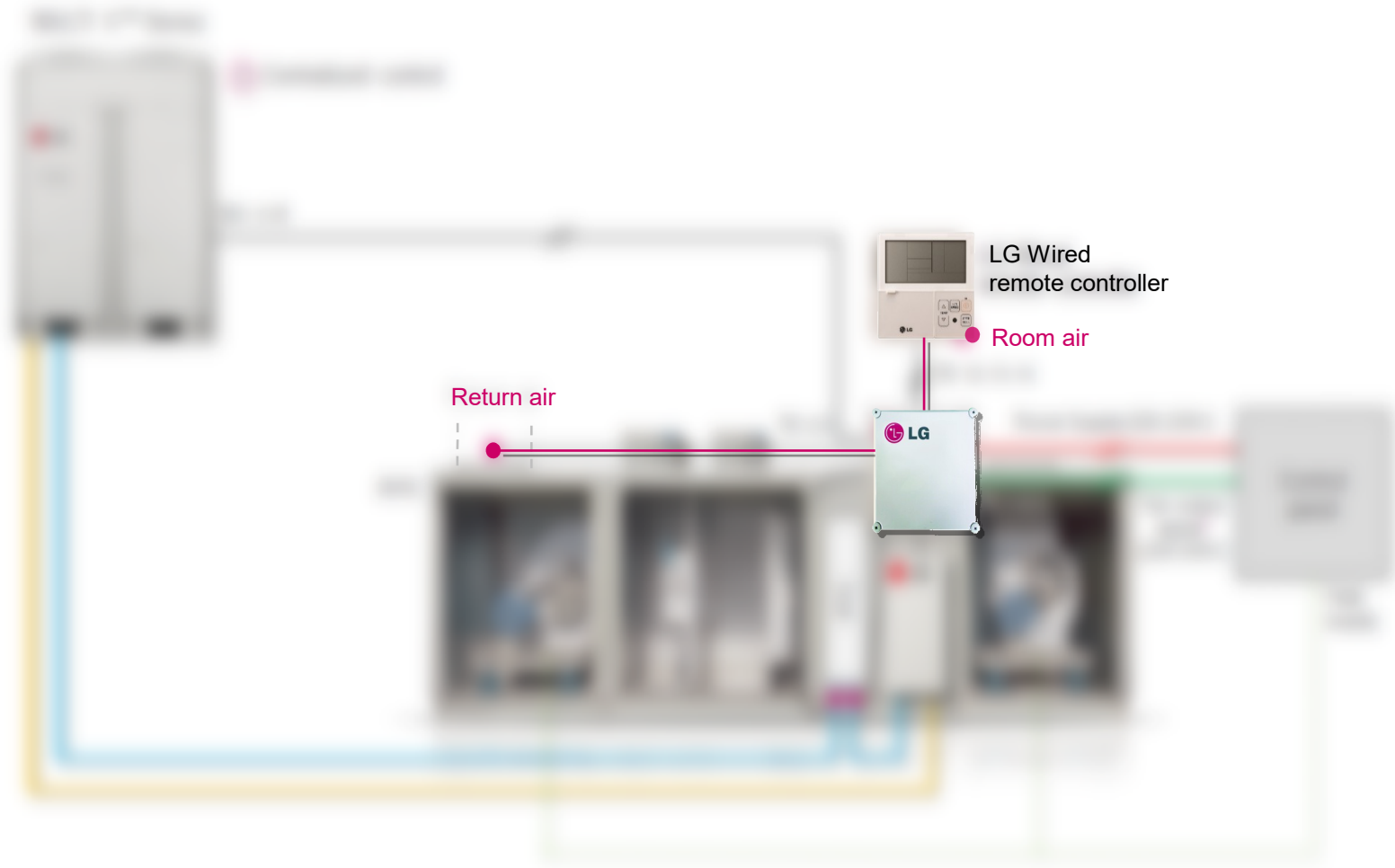
Concept



* Fan output signal should be connected to relay coil.
Direct connection from AHU comm. kit to fan will cause a critical product damage.

RA PRCKA1 – How does it work? #1

1 AHU Comm. Kit senses return/room air(selectable) temperature

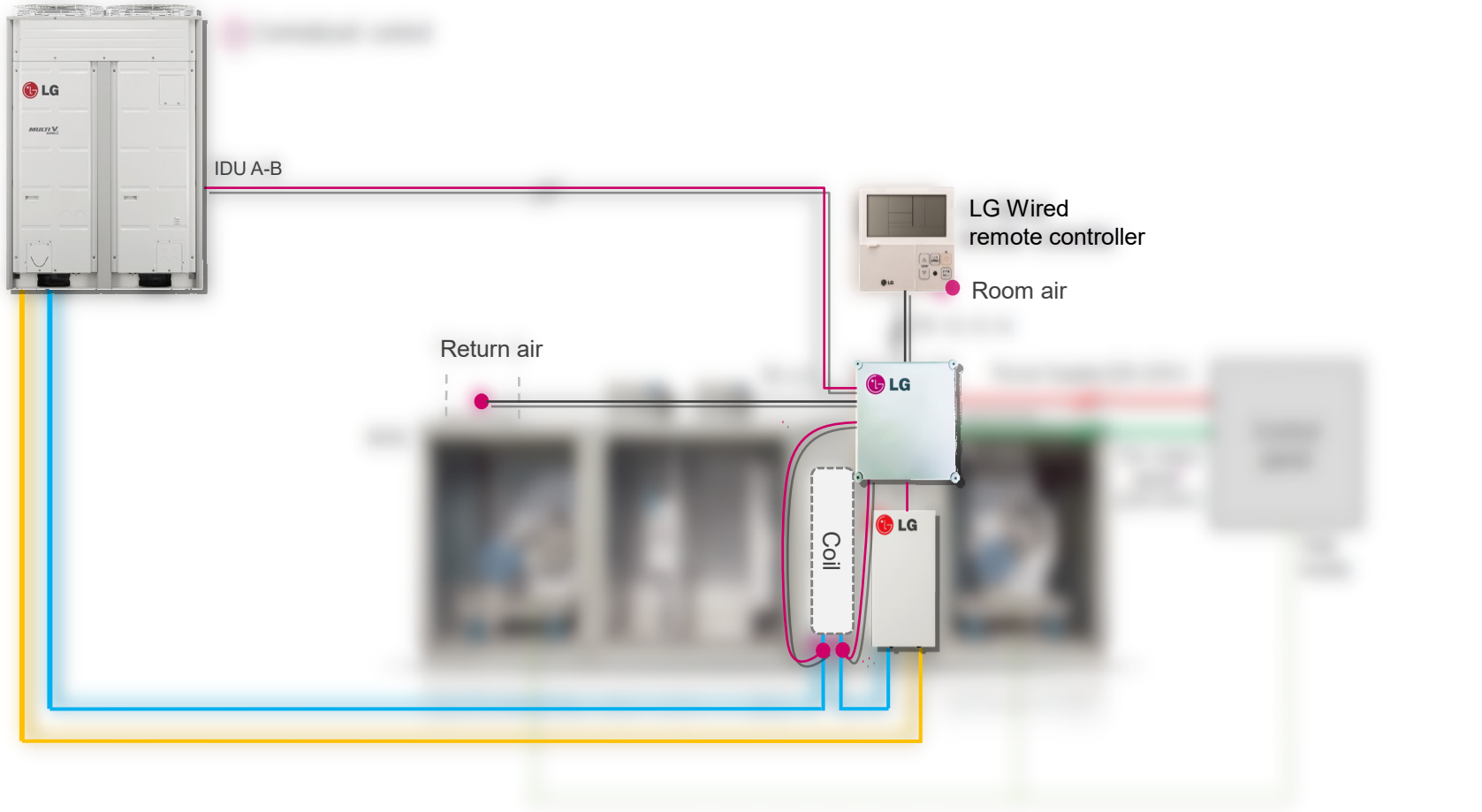


RA PRCKA1 - How does it work? #2

1 AHU Comm. Kit senses return/room air(selectable) temperature

2 If return(room) air is higher than setting temperature, outdoor unit will start operation (based on cooling operation)

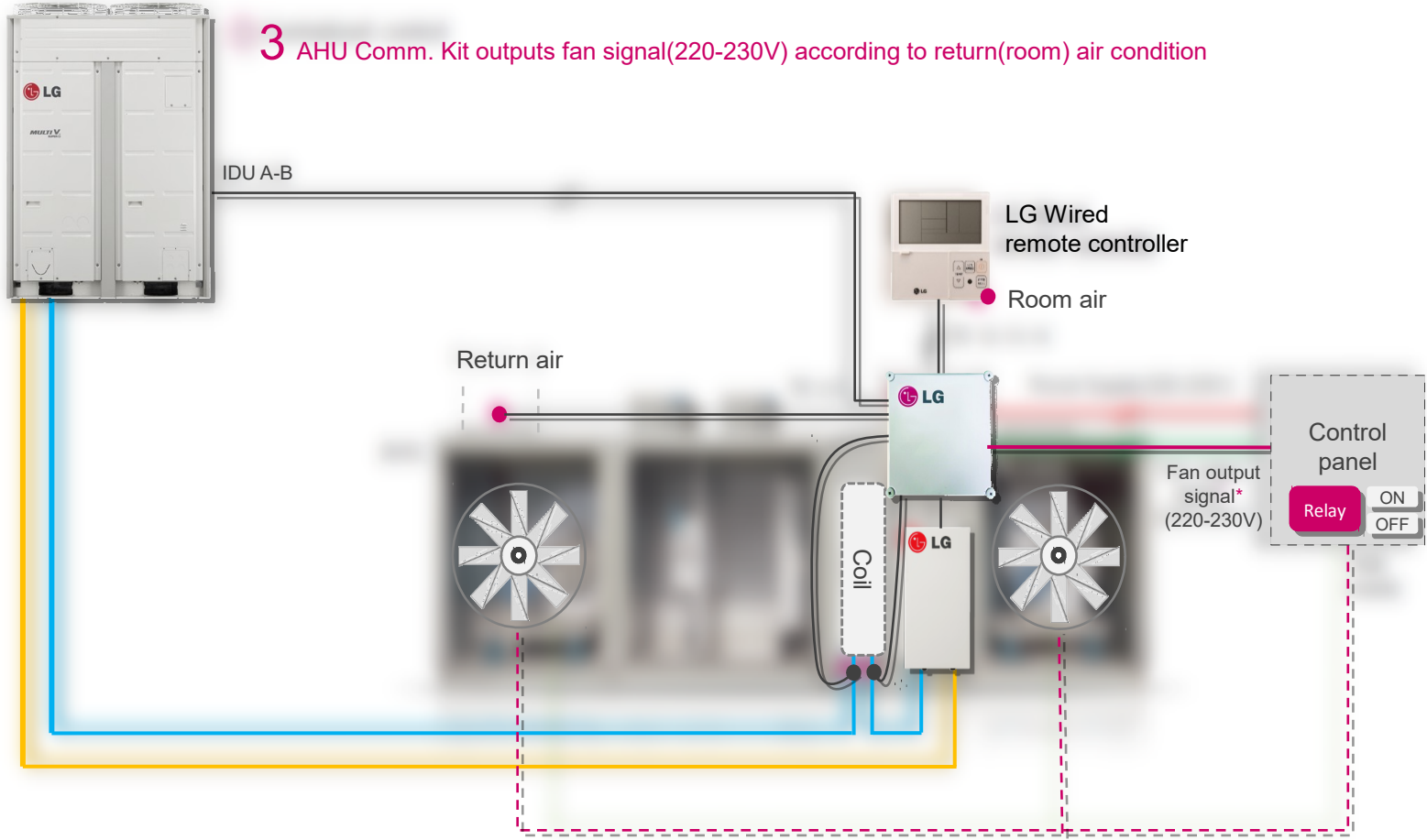
MULTI V™ Series



RA PRCKA1 - How does it work? #3

- 1 AHU Comm. Kit senses return/room air(selectable) temperature
- 2 If return(room) air is higher than setting temperature, outdoor unit will start operation
- 3 AHU Comm. Kit outputs fan signal(220-230V) according to return(room) air condition

MULTI V™ Series



Summary of return air control with PRCKA1

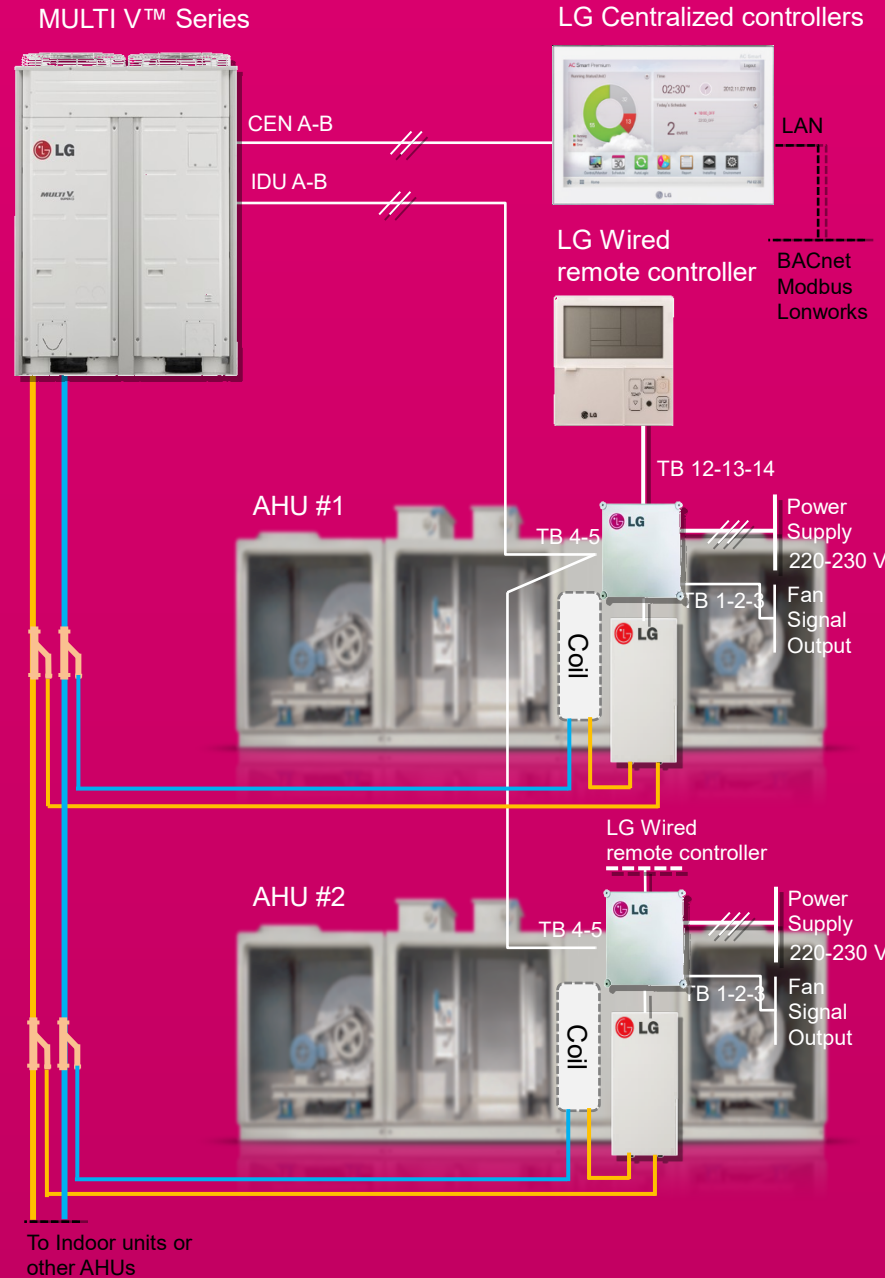


AHU Communication KIT
(Model : PRCKA1)

Main features

- For simple AHU control with return air control
: Refrigerant coil on/off, mode change, fan on/off, etc
- Support LG Centralized controllers
- EEV Kit or TXV(Expansion) Kit can be applicable

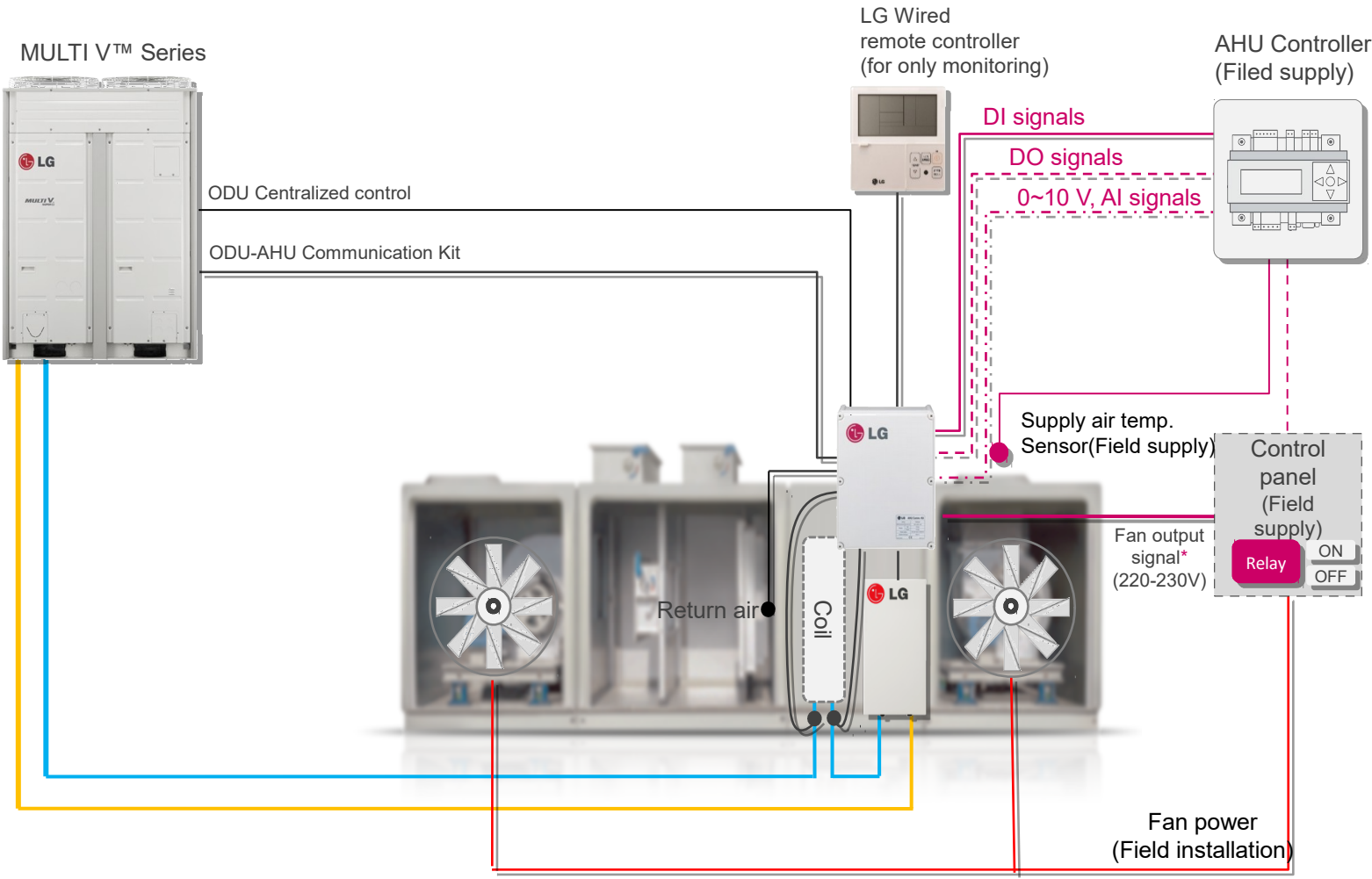
Function	By LG Remote controller	
	Control	Monitor
AHU Comm. Kit ON/OFF	○	○
Outdoor unit operation (Compressor operation)	-	○
Mode	Fan/Heating/Cooling	Fan/Heating/Cooling
Fan Step	High/Mid/Low	High/Mid/Low
Return(room) air temperature	Cooling 18~ 30°C Heating 16 ~ 30°C	○
Supply air temperature control via DDC	With IO Module (PVDSMN000)	-
Error status	-	○



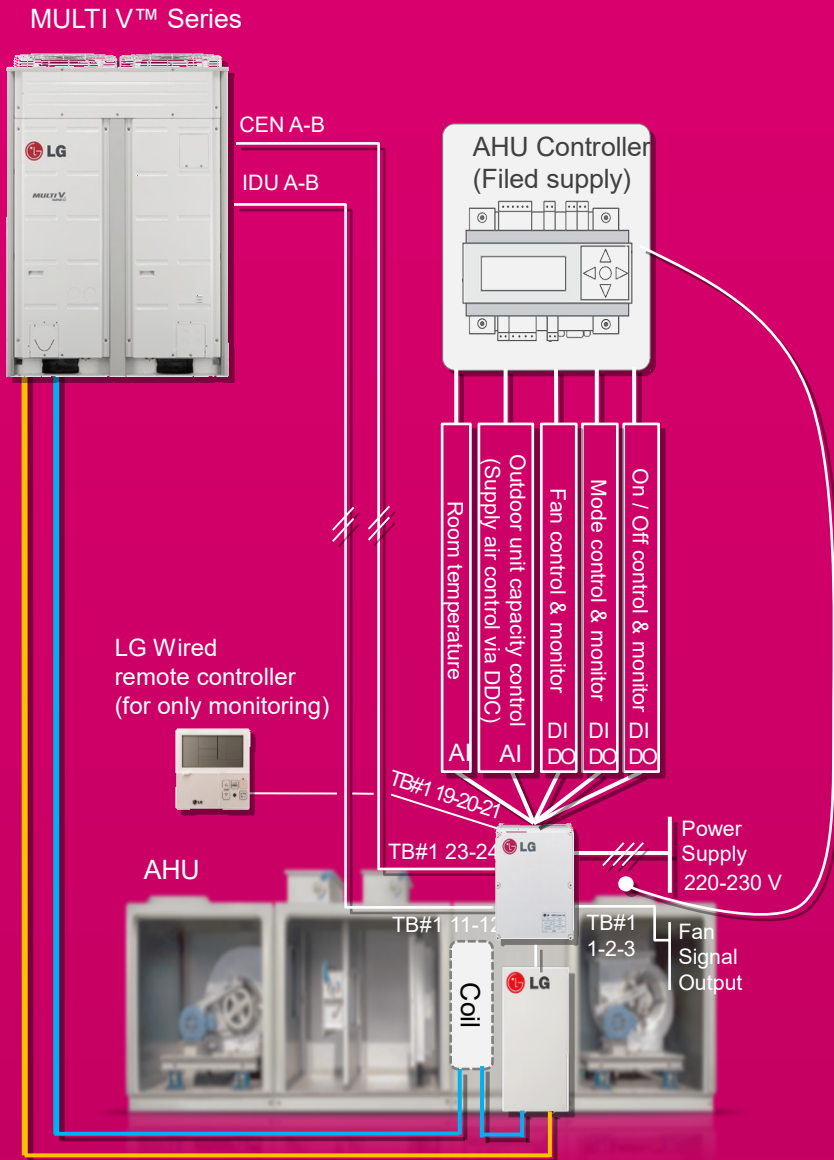
Supply air control via DDC with PRDCA0

Concept

CONCEPT - SA control via DDC with PRDCA0



Summary of supply air control with PRDCA0



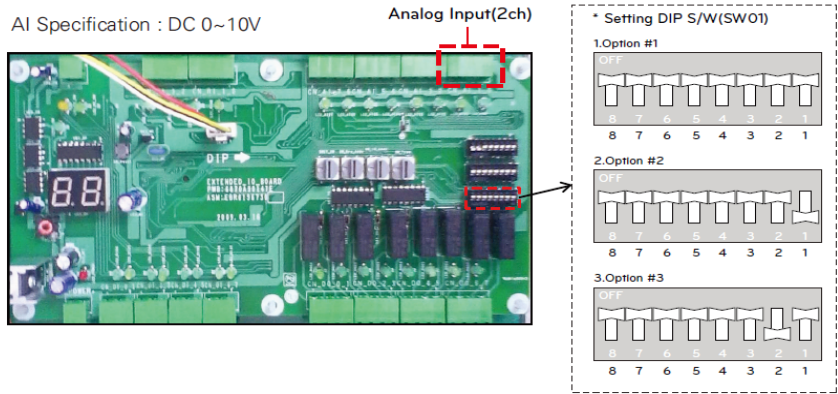
AHU Communication KIT
(Model : PRDCA0)

Control specification for DDC wiring

Function	By AHU Comm. Kit (PRDCA0)	
	Control	Monitor
AHU Comm. Kit ON/OFF	Digital input (Non voltage)	Digital output (Non voltage)
Outdoor unit operation (Compressor operation)	-	Digital output
Mode	Fan/Heating/Cooling Digital input	Fan/Defrost/Heating/Cooling Digital output
Fan Step	High/Mid/Low Digital input	High/Mid/Low Digital output
Return(room) air temperature	Cooling 18~ 30°C Heating 16 ~ 30°C DC 0~ 10V Input	With remote controller (PQRCVSL0QW)
Supply air temperature control via DDC	40~100% DC 0 ~ 10V Input	-
Error status	-	Digital output

VRF AHU Dx Coils

Summary of supply air control with PRDCA0: AI 0 -10V



Target pressures/temperature
HEX – Coils in AHUs

SW name	No	Item	Setting Dip SW			AI Function
			1	2	3	
SW01_SW	1 ~3	ODU Capacity Option Setting	Off	Off	Off	Option #1
			On	Off	Off	Option #2
			Off	On	Off	Option #3
	4~8	Not available	-	-	-	-

2. Option #2

AI No.	Input voltage [Vdc]	Low [Vdc]	High [Vdc]	Capacity of unit [%]	Cooling		Heating		Control
					Target Low Pressure [kPa]	Temperature at HEX [°C]	Target High Pressure [kPa]	Temperature at HEX [°C]	
AI 10-2	0	0	0.4	Comp. off	-	-	-	-	DO 01-4 is short, DO 01-2 is open.
	1	0.6	1.4	40	1160	20.3	1800	28.4	DI will determine fan mode and operation mode
	2	1.6	2.4	45	1100	19.0	1950	31.5	
	3	2.6	3.4	50	1070	17.9	2080	34.1	
	4	3.6	4.4	60	990	15.8	2340	38.9	
	5	4.6	5.4	70	930	14.0	2560	42.5	
	6	5.6	6.4	80	870	12.5	2730	45.1	
	7	6.6	7.4	90	830	11.3	2990	49.0	
	8	7.6	8.4	100	800	10.5	3000	49.2	
	9	8.6	9.4	100	800	10.5	3000	49.2	
10	9.6	10	100	800	10.5	3000	49.2		

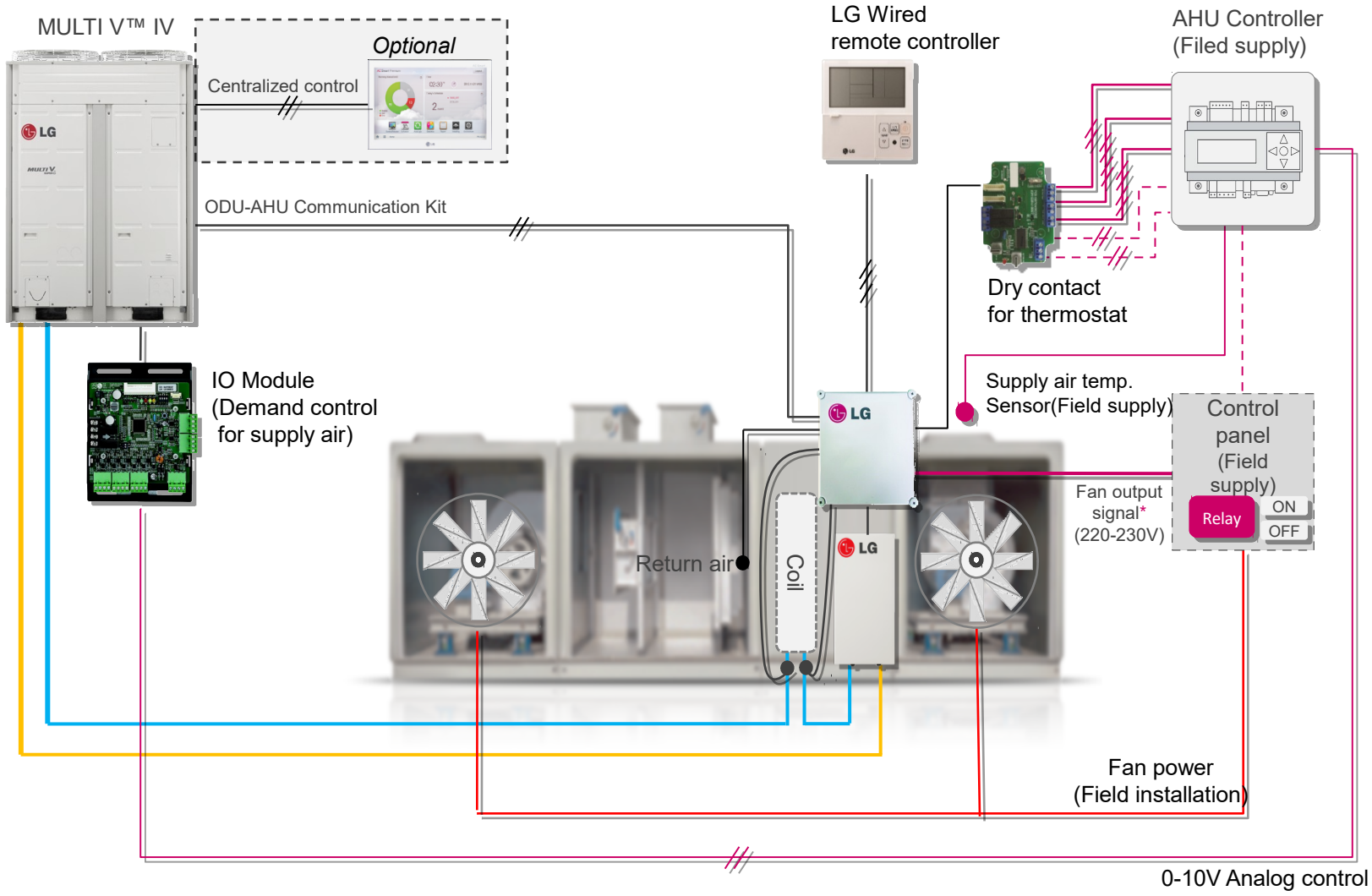
3. Option #3

AI No.	Input voltage [Vdc]	Low [Vdc]	High [Vdc]	Capacity of unit [%]	Cooling		Heating		Control
					Target Low Pressure [kPa]	Temperature at HEX [°C]	Target High Pressure [kPa]	Temperature at HEX [°C]	
AI 10-2	0	0	0.4	Comp. off	-	-	-	-	DO 01-4 is short, DO 01-2 is open.
	1	0.6	1.4	Comp. off	-	-	-	-	DI determinará el modo ventilador y funcionamiento.
	2	1.6	2.4	40	1,160	20.3	1,800	28.4	
	3	2.6	3.4	45	1,100	19.0	1,950	31.5	
	4	3.6	4.4	50	1,070	17.9	2,080	34.1	
	5	4.6	5.4	60	990	15.8	2,340	38.9	
	6	5.6	6.4	70	930	14.0	2,560	42.5	
	7	6.6	7.4	80	870	12.5	2,730	45.1	
	8	7.6	8.4	90	830	11.3	2,990	49.0	
	9	8.6	9.4	100	800	10.5	3,000	49.2	
10	9.6	10	100	800	10.5	3,000	49.2		

Supply air control via DDC with PRCKA1

Concept

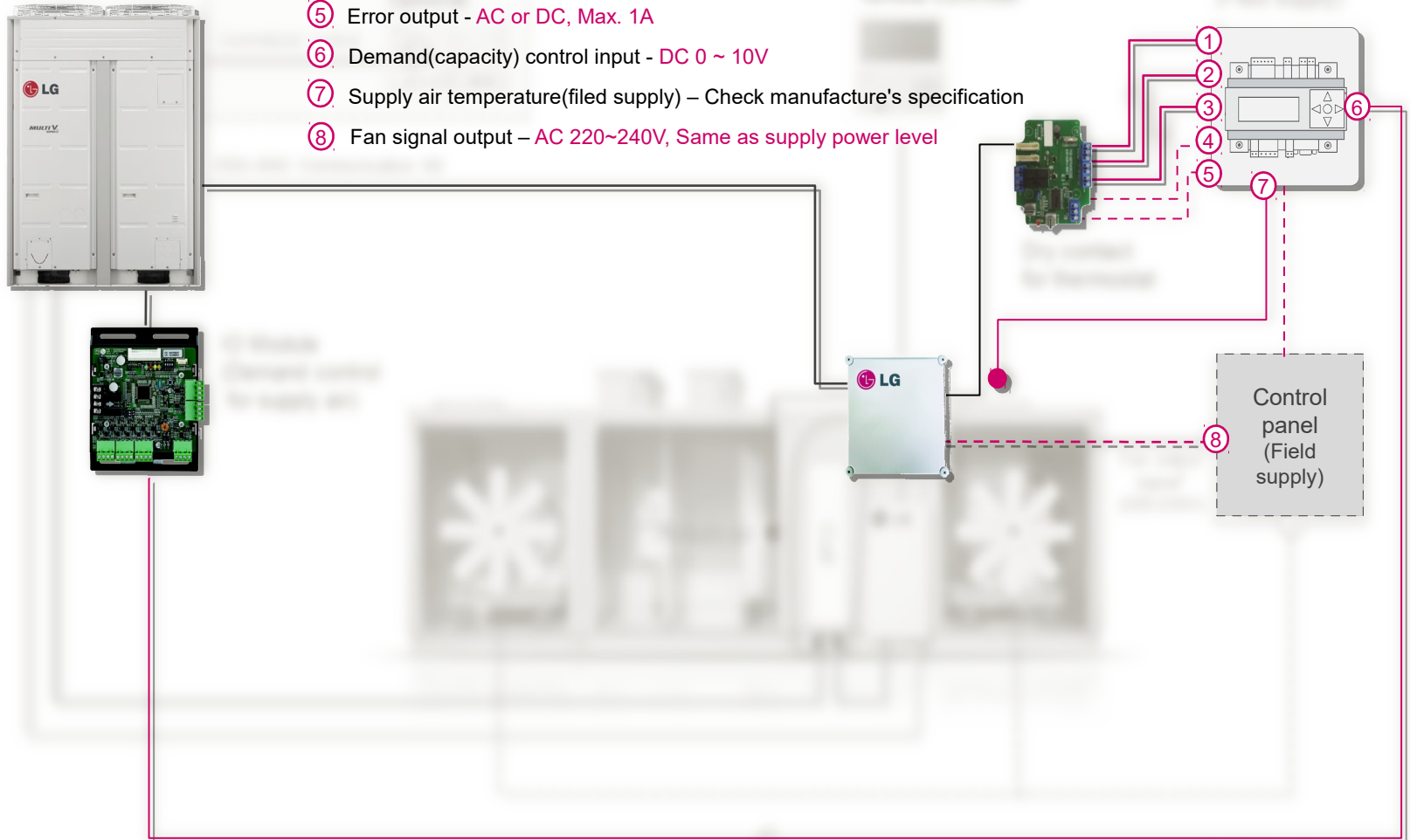
CONCEPT - SA control via DDC with PRCKA1



Control summary of supply air control via DDC with PRCKA1

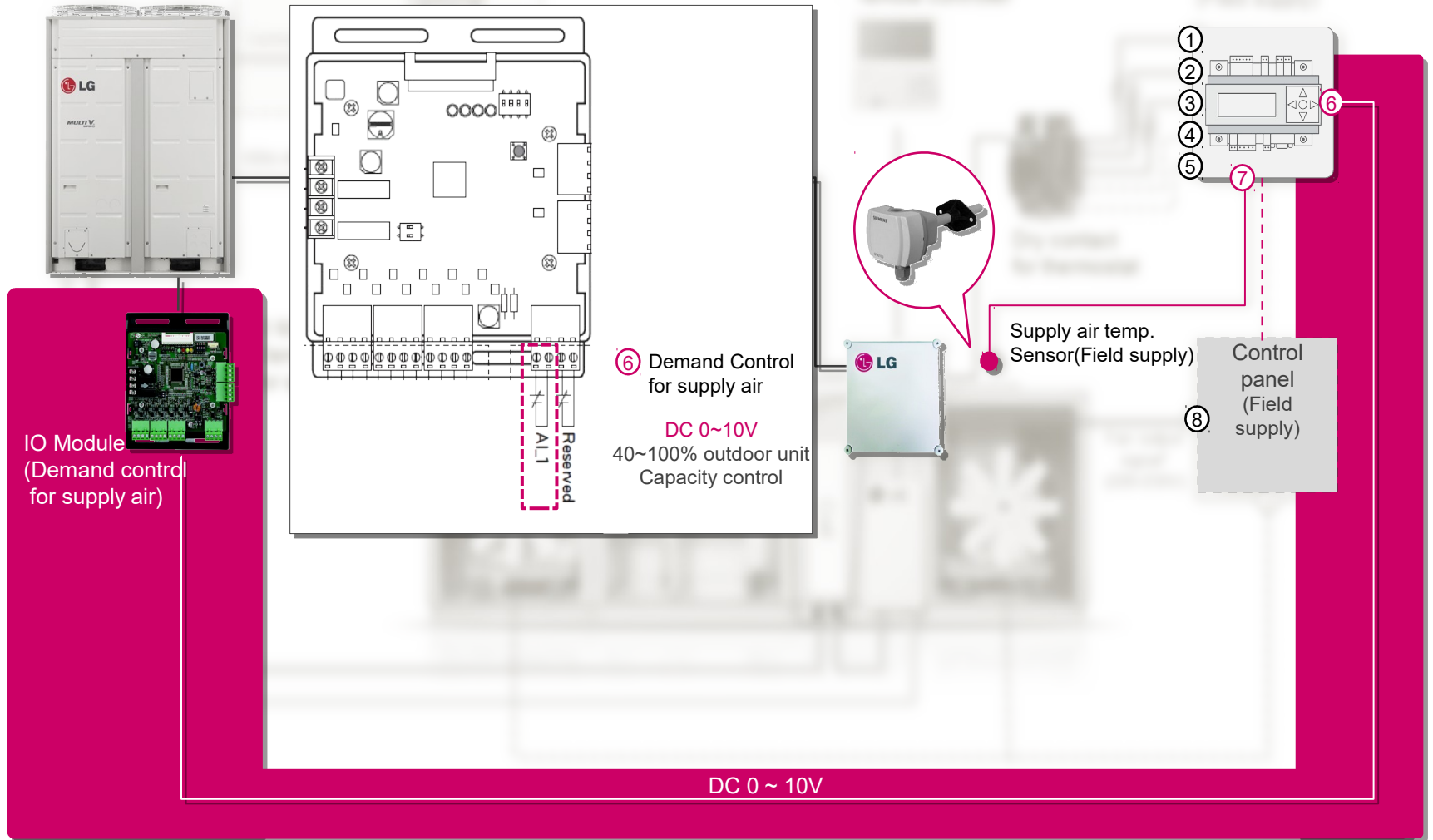
Control

- ① Fan speed input - Non voltage input
- ② Mode input - Non voltage input
- ③ Operation input - Non voltage input
- ④ Operation output - AC or DC, Max. 1A
- ⑤ Error output - AC or DC, Max. 1A
- ⑥ Demand(capacity) control input - DC 0 ~ 10V
- ⑦ Supply air temperature(filed supply) – Check manufacture's specification
- ⑧ Fan signal output – AC 220~240V, Same as supply power level



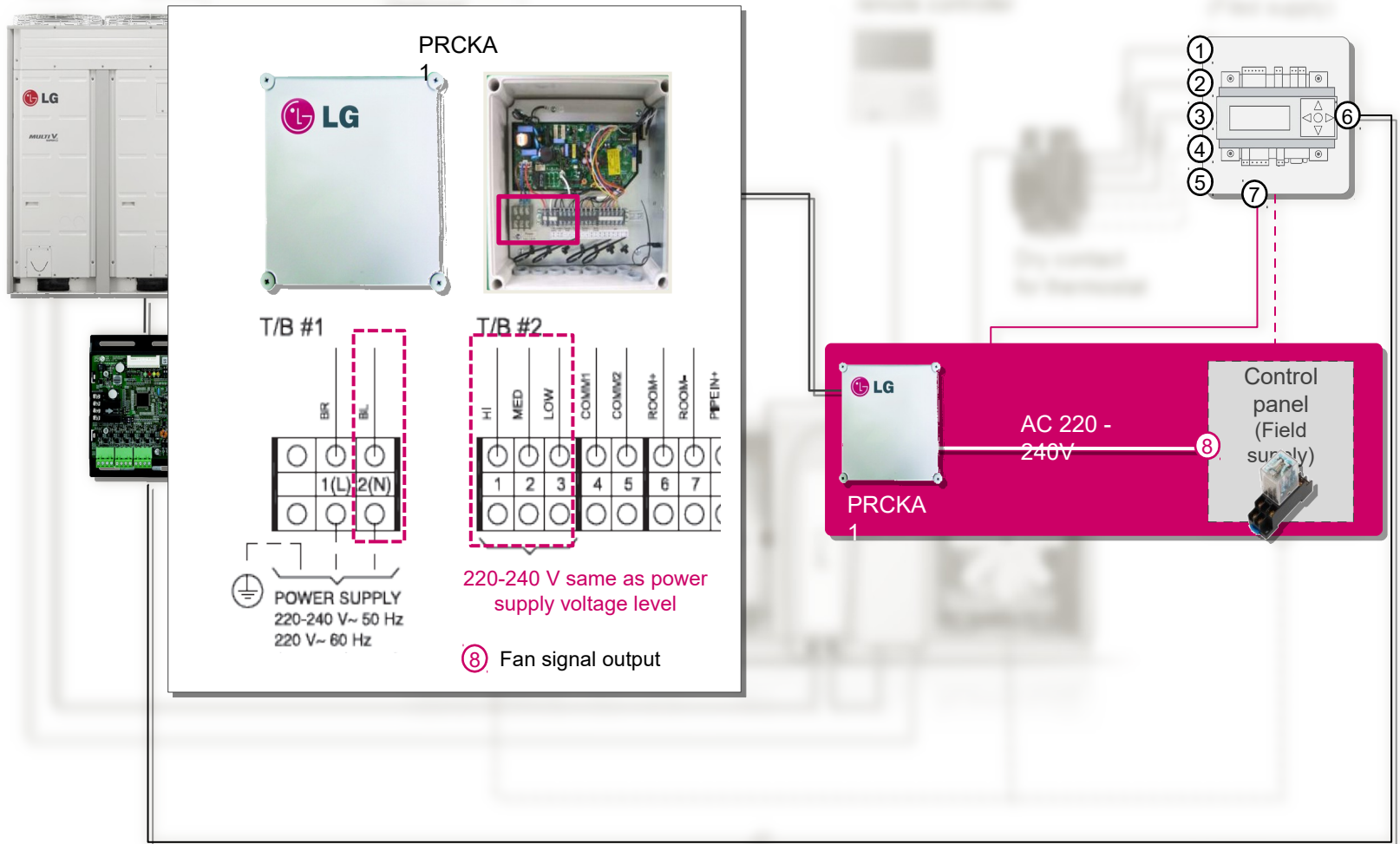
Supply air control via DDC with PRCKA1

SA PRCKA1 – Detail #2 IO Module



Supply air control via DDC with PRCKA1

SA PRCKA1 – Detail #2 IO Module



Summary of supply air control with PRCKA1



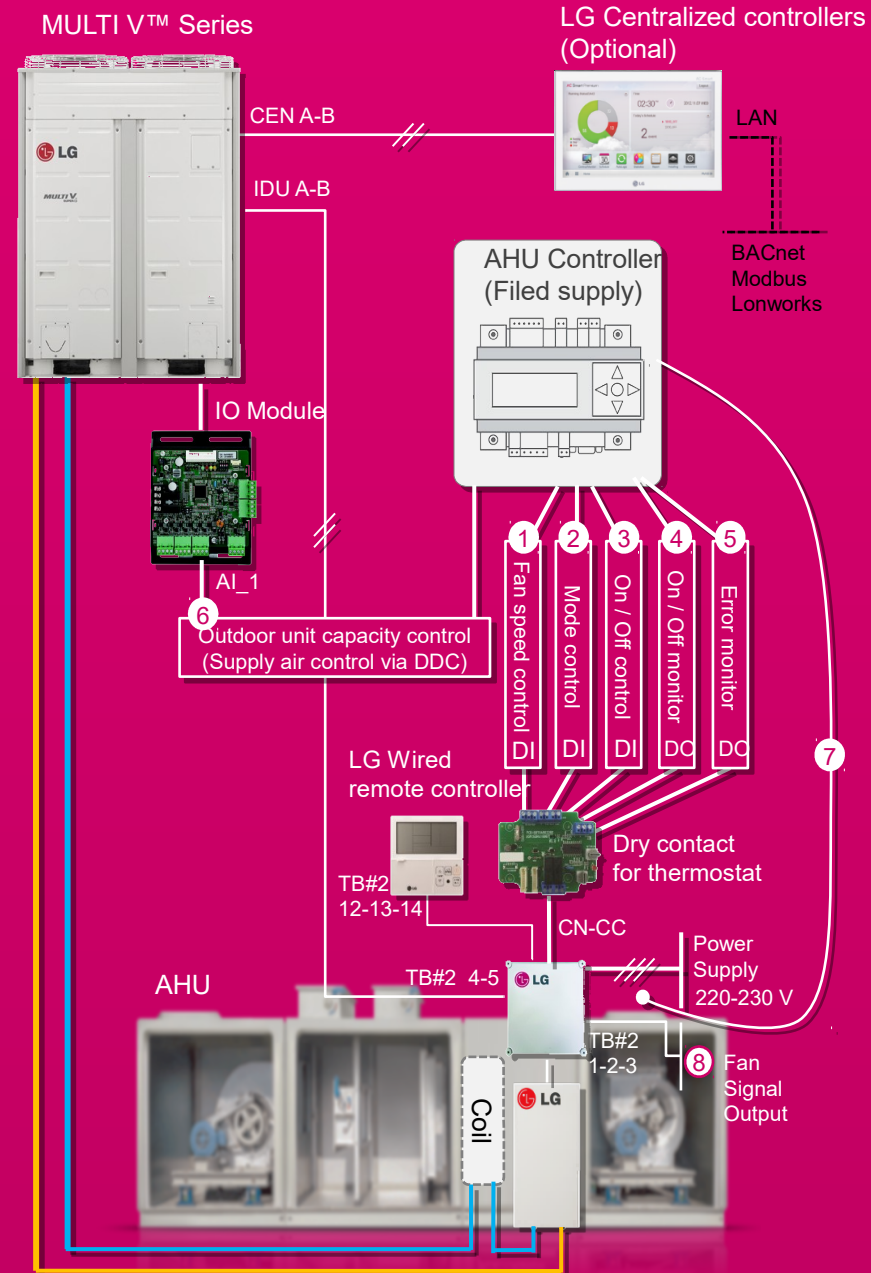
AHU Communication KIT
(Model : PRCKA1)

Control specification for DDC wiring

- ① Fan speed input - Non voltage input
- ② Mode input - Non voltage input
- ③ Operation input - Non voltage input
- ④ Operation output - AC or DC, Max. 1A
- ⑤ Error output - AC or DC, Max. 1A
- ⑥ Demand(capacity) control input - DC 0 ~ 10V
- ⑦ Supply air temperature(filed supply) – Check manufacture's specification
- ⑧ Fan signal output – AC 220~240V, Same as supply power level

Function of LG remote controller

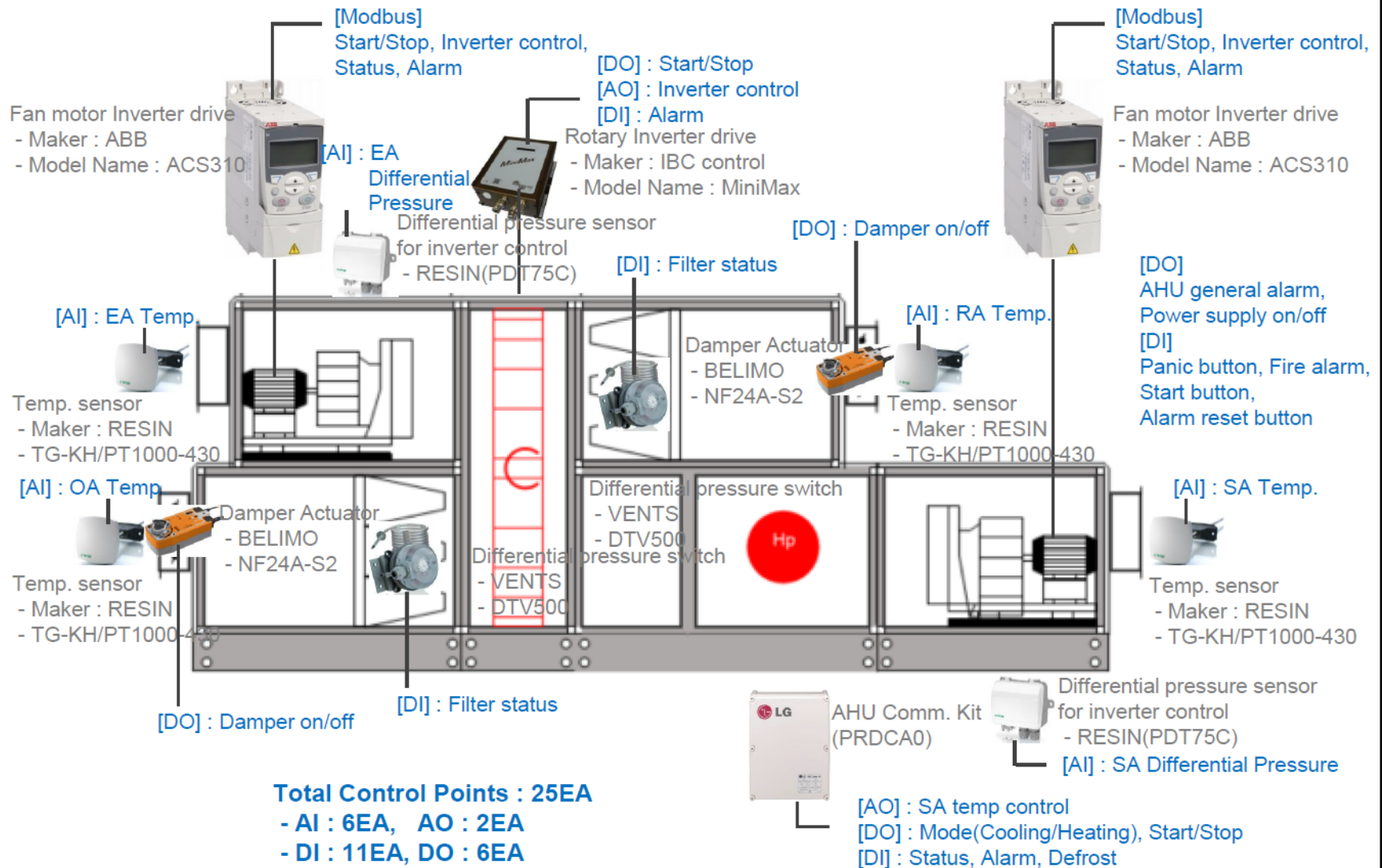
Function	By LG Remote controller	
	Control	Monitor
AHU Comm. Kit ON/OFF	○	○
Outdoor unit operation (Compressor operation)	-	○
Mode	Fan/Heating/Cooling	Fan/Heating/Cooling
Fan Step	High/Mid/Low	High/Mid/Low
Return(room) air temperature	Cooling 18~ 30°C Heating 16 ~ 30°C	○
Supply air temperature control via DDC	With IO Module (PVDSMN000)	-
Error status	-	○



VRF AHU Dx Coils

LGE AE CONTROL DEVICES SUPPLY AIR CONTROL:

Standard AHU - DDC Control Points (Standard, Option-1/2/4)



VRF AHU Dx Coils

LGE AE CONTROL DEVICES SUPPLY AIR CONTROL:

Standard AHU - DDC Control Points (Option-3)

