Free Cooling Solution for Outdoor Telco BTS Cabin



Critical Engineering (M) Sdn Bhd

Focus. Trust. Initiative.

Introduction

Conventional air conditioning is simply too costly to operators & environment. **Critical Control Free-cooling system** controls and maintain air temperature within equipment rooms in an environmentally friendly way.

- Reduces energy consumption & CO2 emission
- Recoups your investment in 1-3 years
- Easy Installation and maintenance friendly
- Intelligent control system with variable fan speeds according to room temp
- Compact & saves space
- Can be used as direct cooling system or working with the existing air-con
- Comprehensive alarms & sensors for alarm alert & monitoring
- Additional enclosure security
- Minimum maintenance & upkeep. Filter cleaning can as long as 1-2 years depending on site conditions.



Typical Cell Site location

1. Dusty Sites
   - Sites near Highway / Street
   - Sites near Quarry / Construction
2. Non-Dusty Sites
   - Sites near Plantation / Jungle
   - Sites near Hill Tops
3. Corrosive Sites
   - Sites near Sea sides
   - Sites near Factory with fume

Different type of site requires different type of cooling solution to achieve optimal result



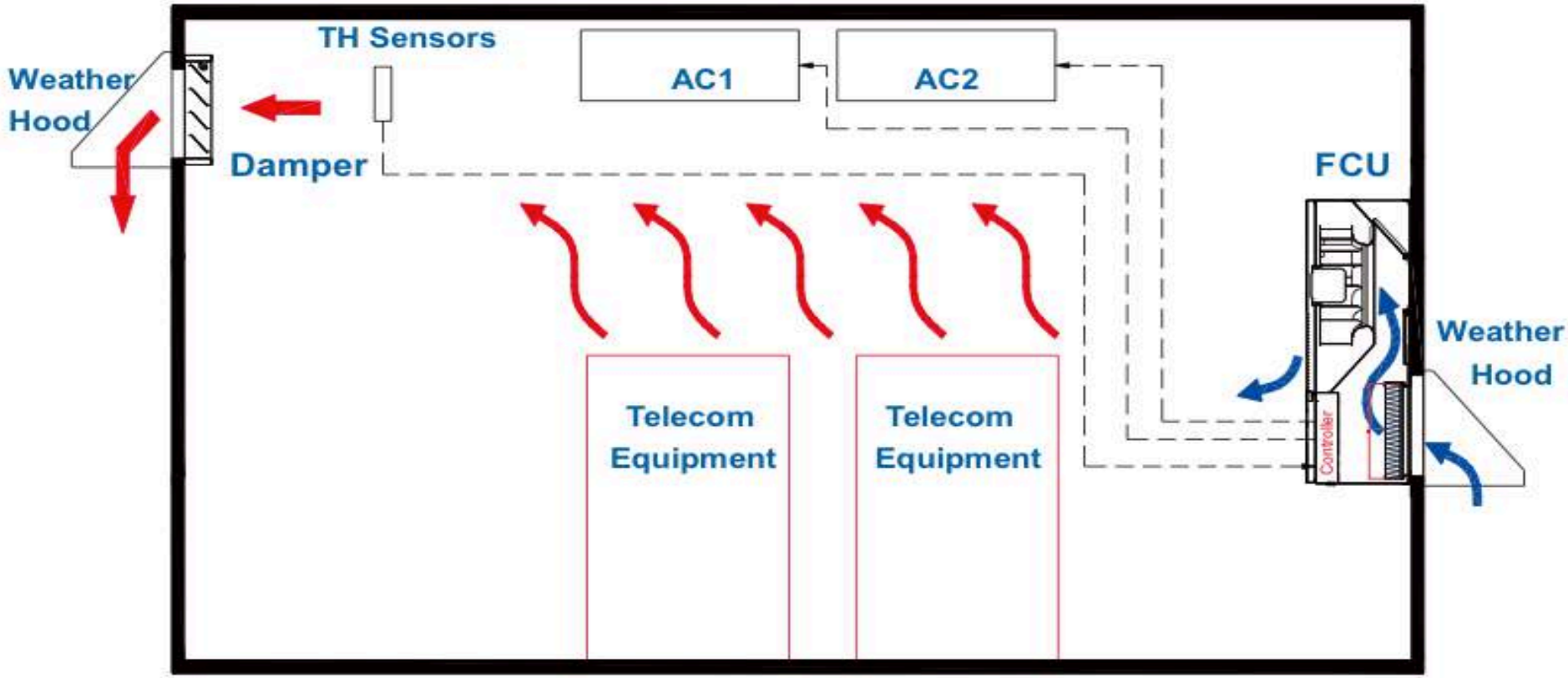
How our free-cooling systems work

Critical Control Free-cooling system can be used independently or with your existing air-conditioning system. It is best suited and perfect for cooling Telco BTS cabins.

- It controls the cabin environment by drawing filtered external air into the cabin enclosure at low level.
- This forces the internal heated air out of the cabin enclosure at a high level through a unique close control system.
- The filters remove dust and particulate moisture from the air that enters the cabin enclosure to provide clean air to the equipment.
- Sensors which monitor the cabin environment through intelligent control system will do fine adjustment and control of the fan speeds & a unique exhaust system to maintain the required ambient temperature.
- Always maintain non-condensing environment inside the cabin.
- Remote alarm alerts on system failures and cabin environment



How our free-cooling systems work





1 x EBM225 fan supplies 1130CMH fresh air, 1 CMH fresh air can reach 0.343W/K cooling capacity, then 1 fan can reach 360W/K, 2 fan can reach 720W/K, ΔT will be 3.63 °C with 1 fan and 1.8°C with 2 fans running.

Free Cooling System

FCU Inner Side With Door Open

- Suitable for non-dusty sites
- Internal & external air through filtering.
- Heat removal through air change
- Internal Temperature through Temp setting control.
- Low energy consumption
- Operating at 48V DC
- Low sound level using EBM Fan & labyrinthine Structure design
- ΔT of Internal & External can be maintained within preset value.
- ΔT of 3°C to keep non condensing indoor environment

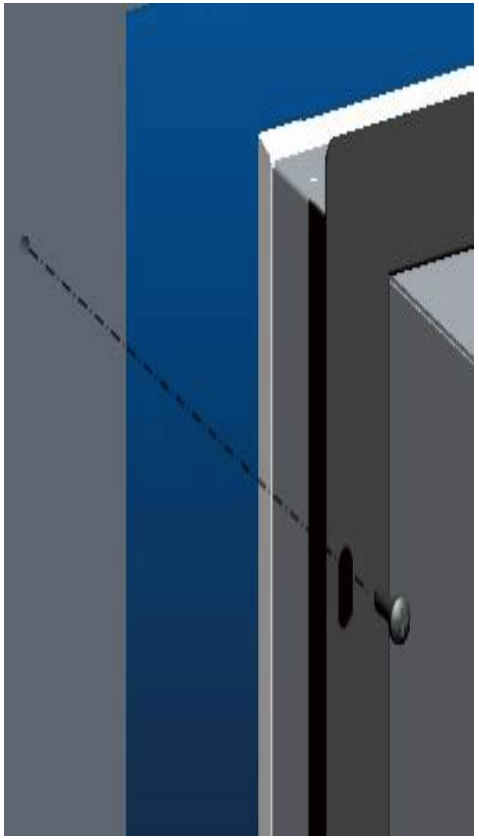
FCU Outer Side With Labyrinth



Free Cooling System – Installation Details

FCU Being Mounted Onto The Wall

- Ease of Installation
- Light Weight
- External & Internal wall mounting
- Security Enclosure
- Compact & Save Spaces
- Using bolts & Nuts for fasterning
- Labyrinthine Structure design at external cover to achieve IP45 Rating or higher
- Easily removable and deployable
- Digital Mircorprocessor Controller & wire connections
- RS485 comm port for alarm signal connection & monitoring



Mounting Detail

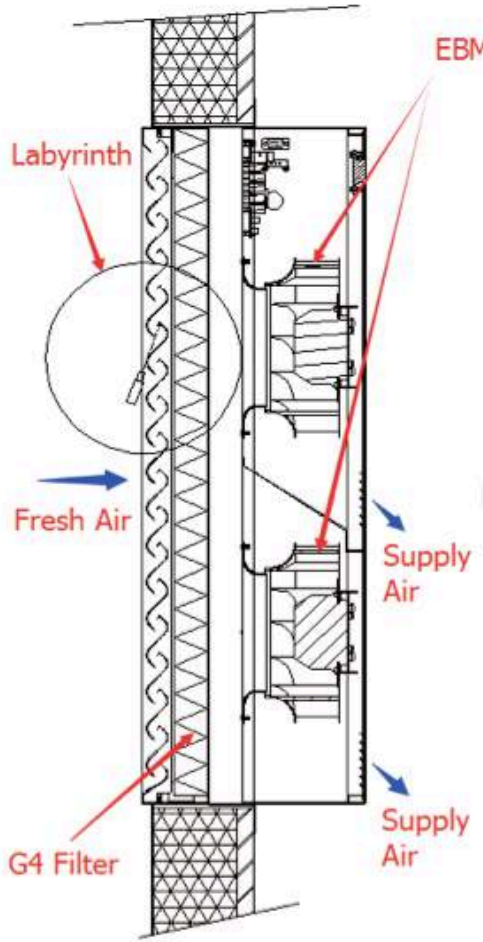


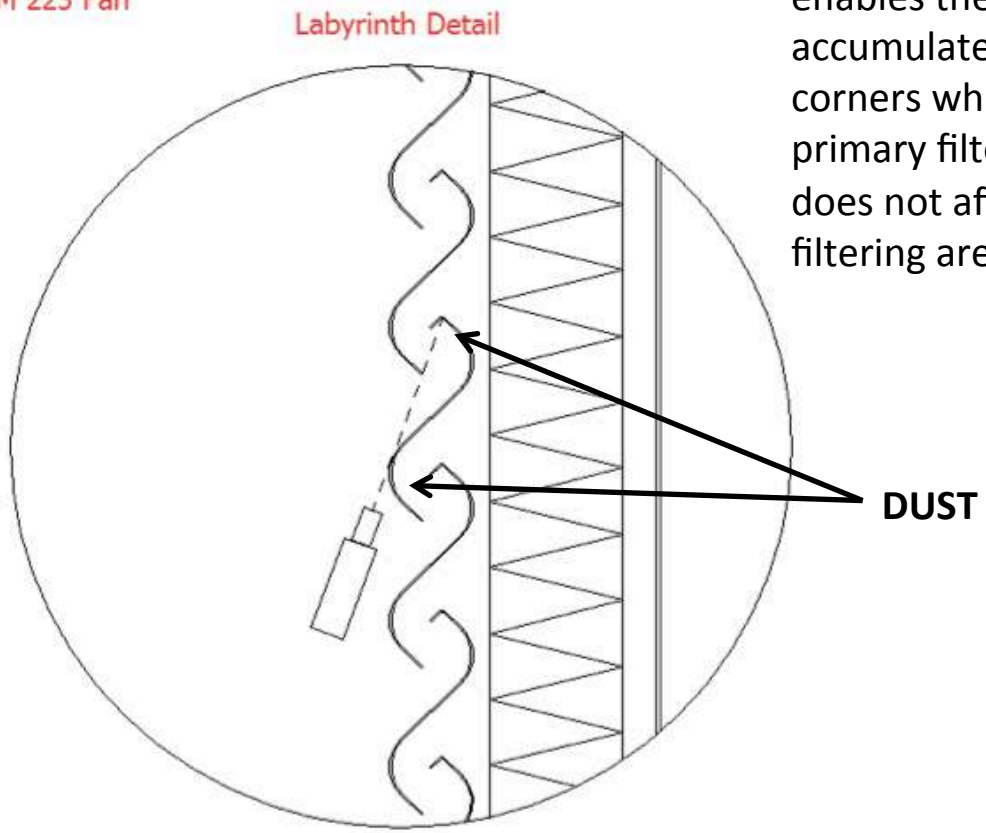
Free Cooling System - Technical Specifications

Physical & Mechanical	Requirements
Dimension	833mm(H) x 463mm(W) x 268mm(D)
Weight	Approximate 35Kg
Cabinet Paint Coating	Epoxy White Powder Coating
Corrosive Protection	NEMA 3R
Operating Voltage	-48V DC
Operating Frequency	50 Hz
FCB Controller	Digital Microprocessor Controller
Total Air Volume (m3/hr)	2300 m3/hr (2 Fans Redundancy)
Air Inlet Fan	EC Centrifugal EBM Fan with Variable Speed Control
Air Outlet Exhaust	Motorized Exhaust Damper
Air Filter	Hydrophobic GORE G4 Filter (820*420*40)
Sensors	Filter Clogged, Temperature, Humidity Sensors
Water/Weather Proof	Comply IP rating of IP45 EN 60529/10.91.
Communications	RS 485 Com Port / Free Contacts



Free Cooling System – Detailed Design



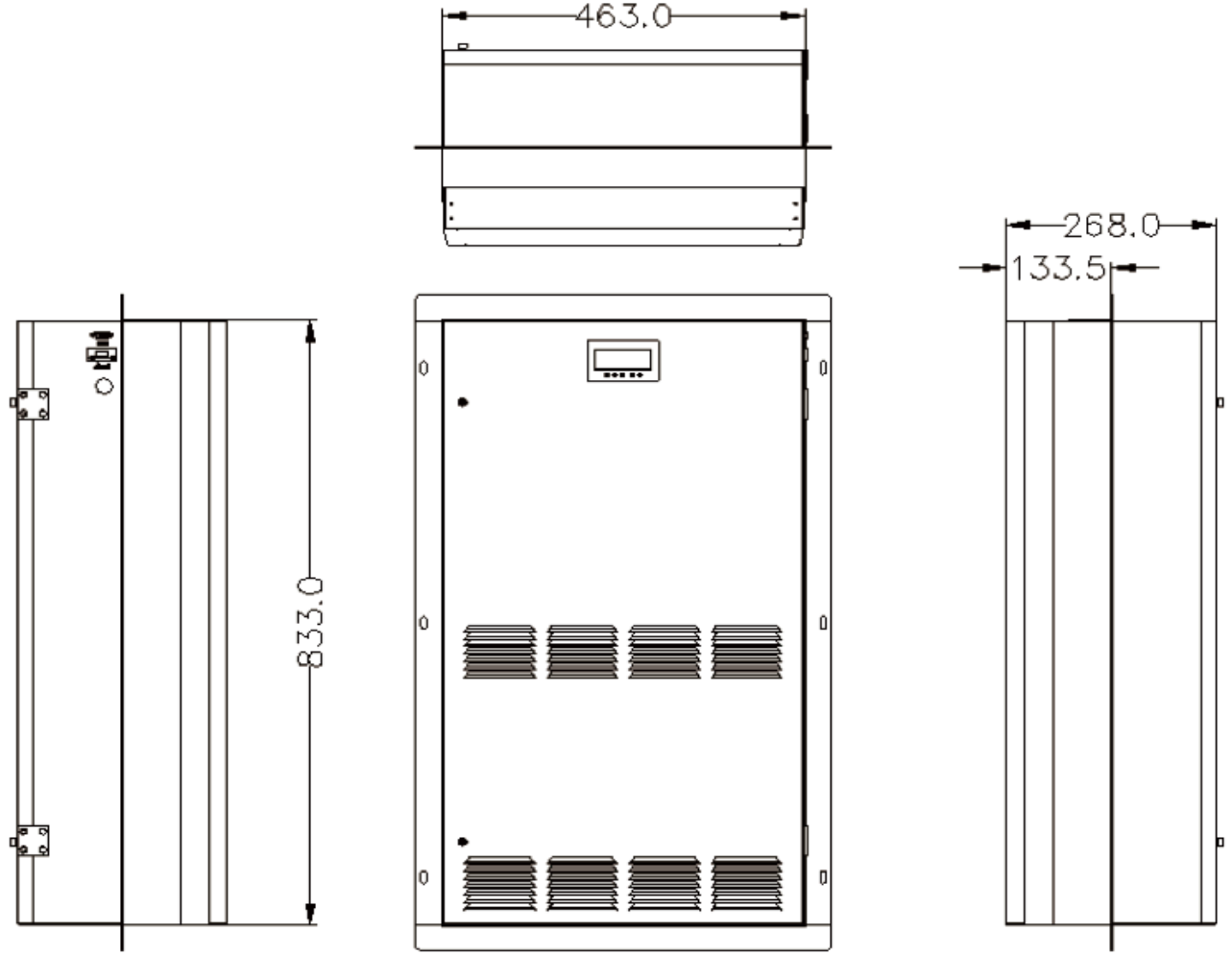


Labyrinthine damper enables the dust accumulates at the corners which enables primary filtering while does not affect the filtering area

Labyrinthine waterproof structure ensures that water won't mix with dust from the filter into mud to make the filter clogged

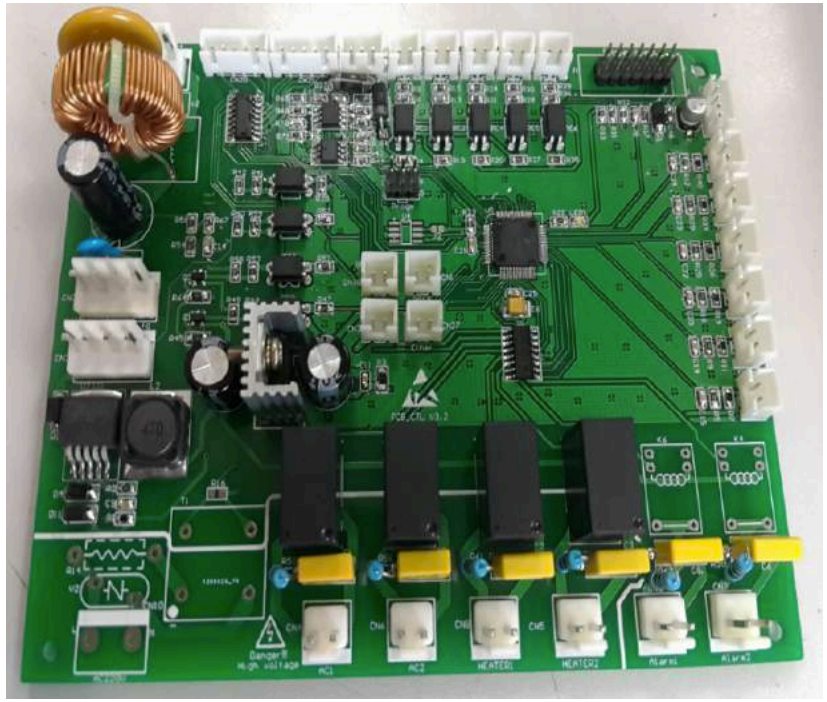


Free Cooling System – Detailed Dimension





Smart Controller Board



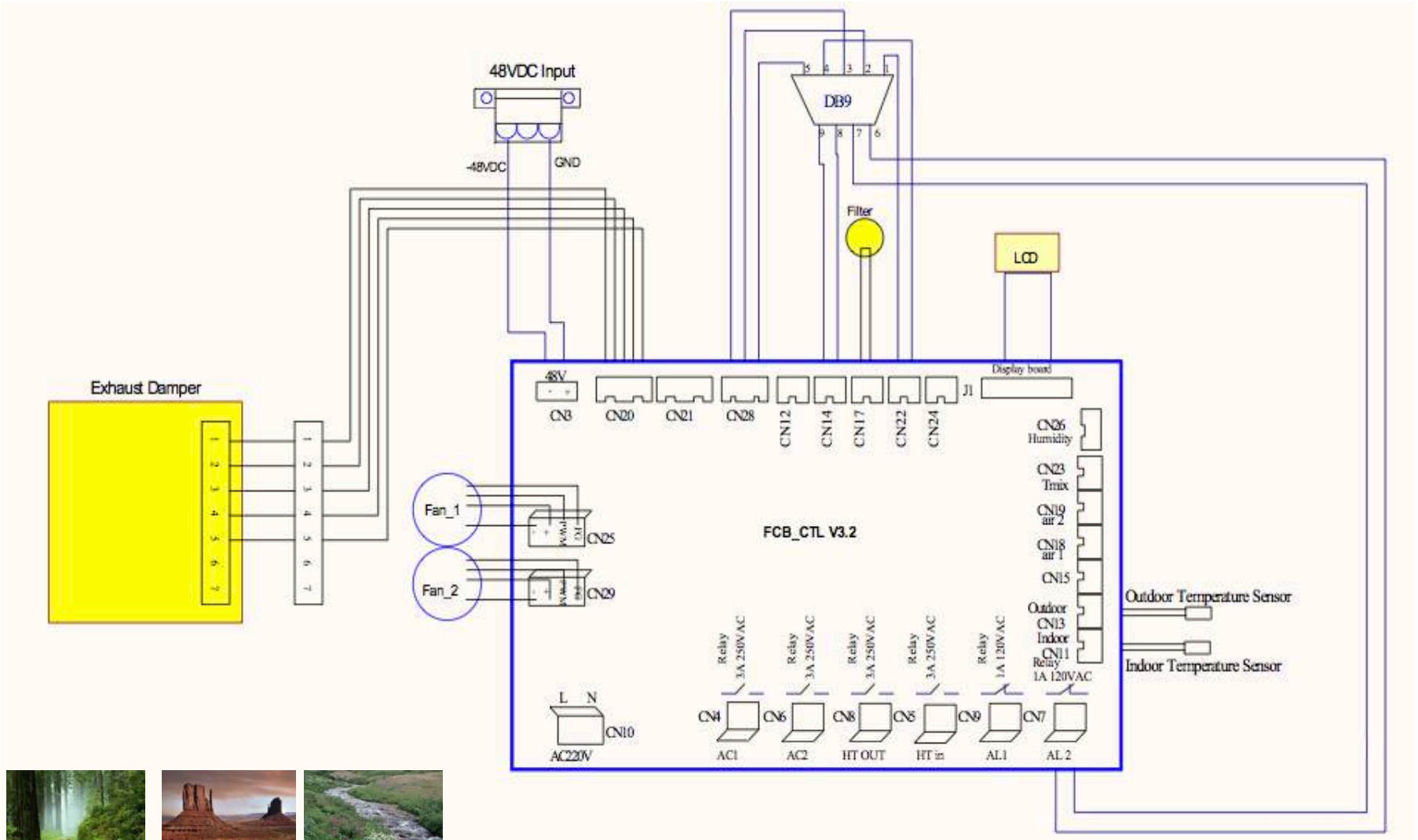
FCB Smart controller

All cables terminate to the controller

- Power – 48VDC (10A MCB required)
- AC mains monitoring (if required)
- Alarms
- Fan
- Filter Guard
- Alarms
- Comms
- Temperature Probe/s



Smart Controller – Schematic Diagram



EC Centrifugal EBM Fan – Technical Details

EC centrifugal fan

backward curved, single inlet

Nominal data

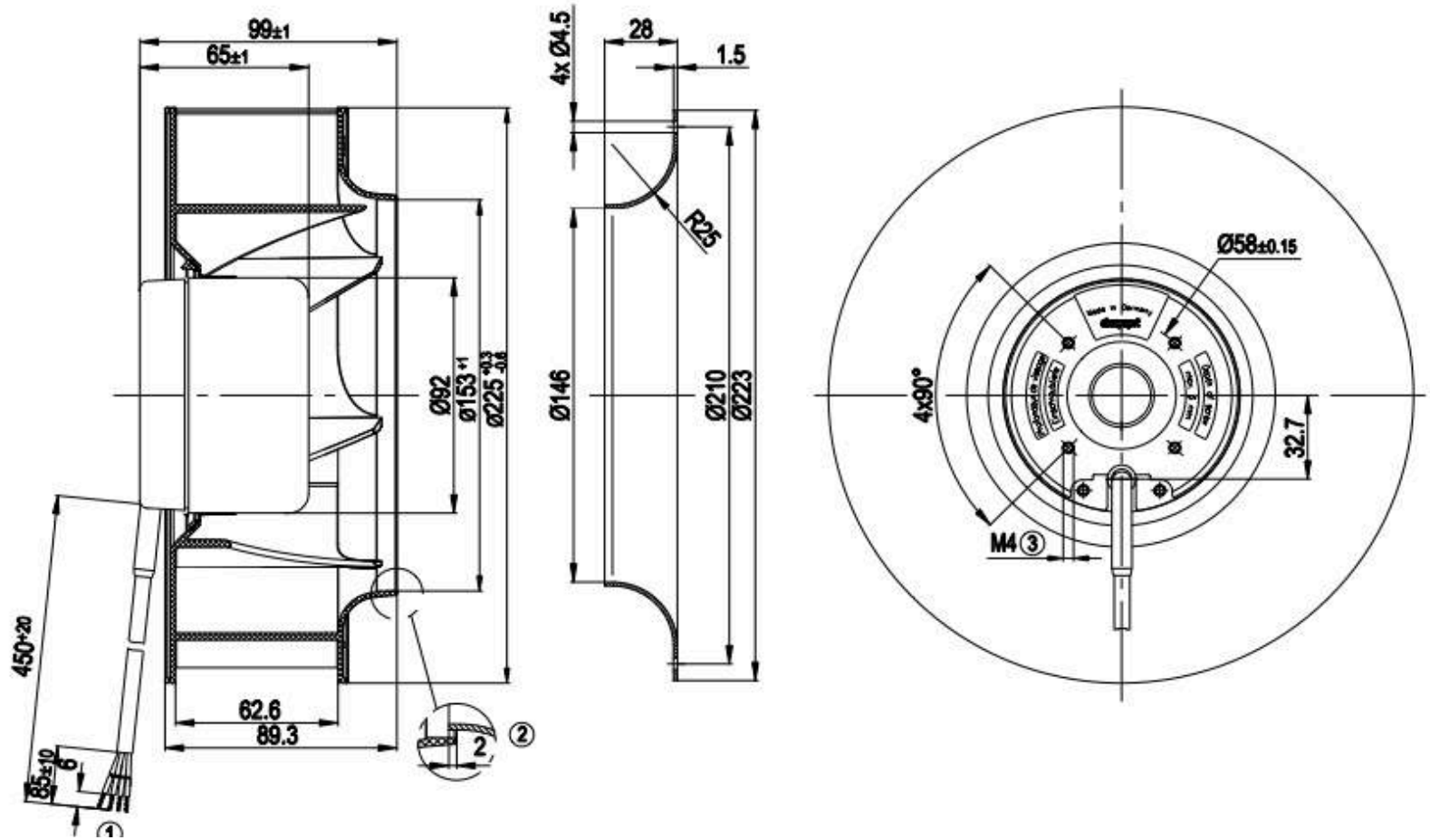
Type	**R1G225-AF11-52**
Motor	**M1G074-BF**

Nominal voltage	[VDC]	48
Nominal voltage range	[VDC]	36 .. 57
Frequency	[Hz]	-
Type of data definition		rfa
Speed	[min^{-1}]	2700
Power input	[W]	95
Current draw	[A]	2,2
Min. ambient temperature	[°C]	- 25
Max. ambient temperature	[°C]	+ 60
Air flow	[m^3/h]	1130
Back pressure	[Pa]	0

ml = max. load · me = max. efficiency · rfa = running at free air · cs = customer specs · cu = customer unit
Subject to alterations

EC Centrifugal EBM Fan – Technical Details

Product drawing



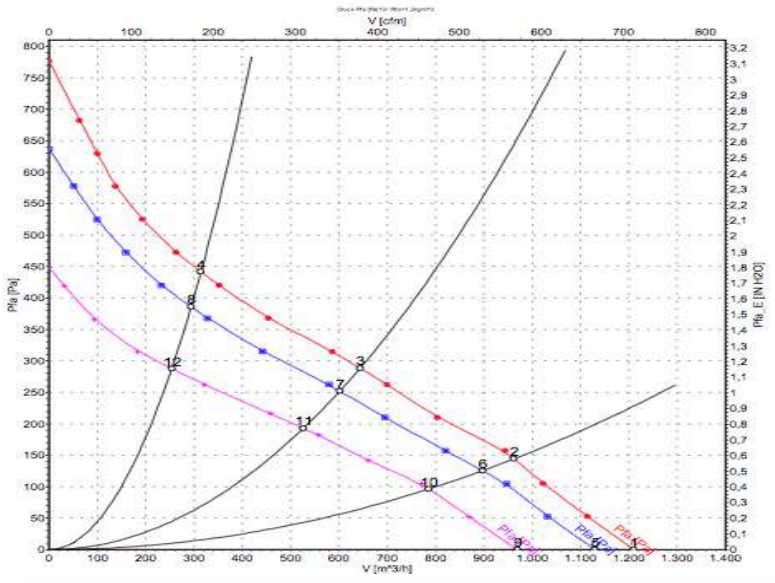
1	Connection line AWG20, 4 x brass lead tips crimped
2	Accessory part: Inlet nozzle 96358-2-4013, not included in the standard scope of delivery
3	Depth of screw max. 6 mm

EC Centrifugal EBM Fan - Technical Details

Technical features

Leackage current	<= 0,25 mA
Size	225 mm
Operation mode	S1
Direction of rotation	Clockwise, seen on rotor
Mounting position	Any
EMC interference emission	Acc. to EN 55022 (Class B)
EMC interference immunity	Acc. to EN 61000-6-2
Insulation class	"B"
Cable exit	Variable
Condensate discharge holes	None
Bearing motor	Ball bearing
Mass	1.45 kg
Material of impeller	Plastic PA66, fibreglass-reinforced
Motor protection	Reverse polarity and locked-rotor protection
Product conforming to standard	EN 60950-1
Surface of rotor	Coated in black
Number of blades	7
Type of protection	IP 42
Technical features	- Control input 0-10 VDC / PWM - Tach output - Motor current limit - Soft start
Max. permissible ambient motor temp. (transp./ storage)	+80 °C
Min. permissible ambient motor temp. (transp./storage)	-40 °C
Approval	CCC; CSA C22.2 Nr.77; UL 1004

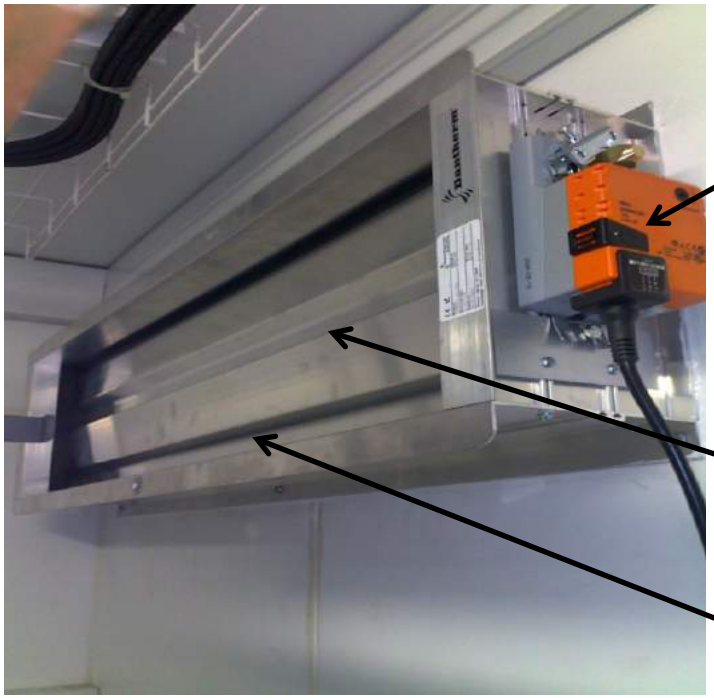
Charts: Air flow



Measured values

	U	n	P_1	I	$\dot{V}$	p_{fa}
	[V]	[min^{-1}]	[W]	[A]	[m^3/h]	[Pa]
1	57	2780	112	2.39	1210	0
2	57	2635	116	2.52	960	146
3	57	2580	117	2.58	645	288
4	57	2755	113	2.42	315	442
5	48	2600	91	2.20	1130	0
6	48	2475	93	2.28	895	126
7	48	2410	95	2.34	600	252
8	48	2580	92	2.21	295	386
9	36	2235	59	1.84	970	0
10	36	2150	63	1.96	785	98
11	36	2115	64	2.00	525	193
12	36	2230	59	1.84	255	288

Motorised Exhaust Damper – Technical Details

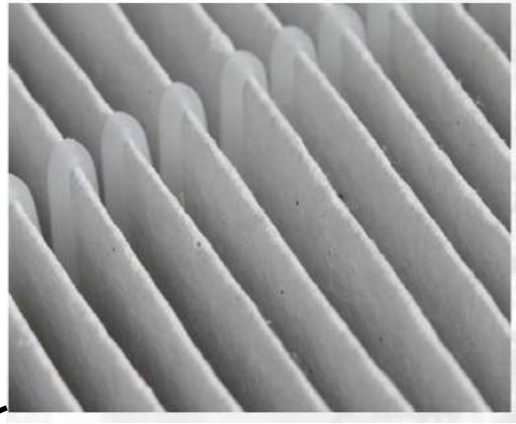


Damper Motor

Damper

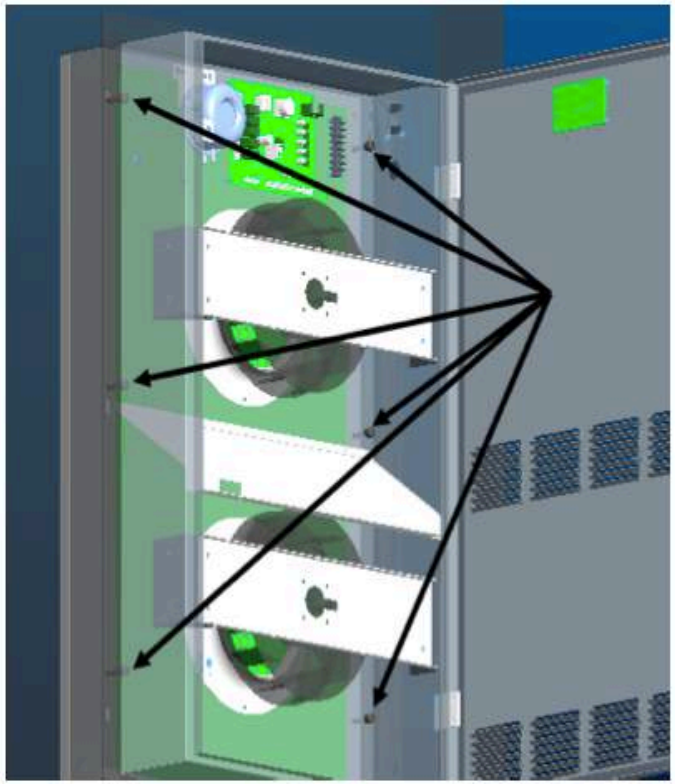
IP4x sealing

Hydrophobic Filter – Technical Details

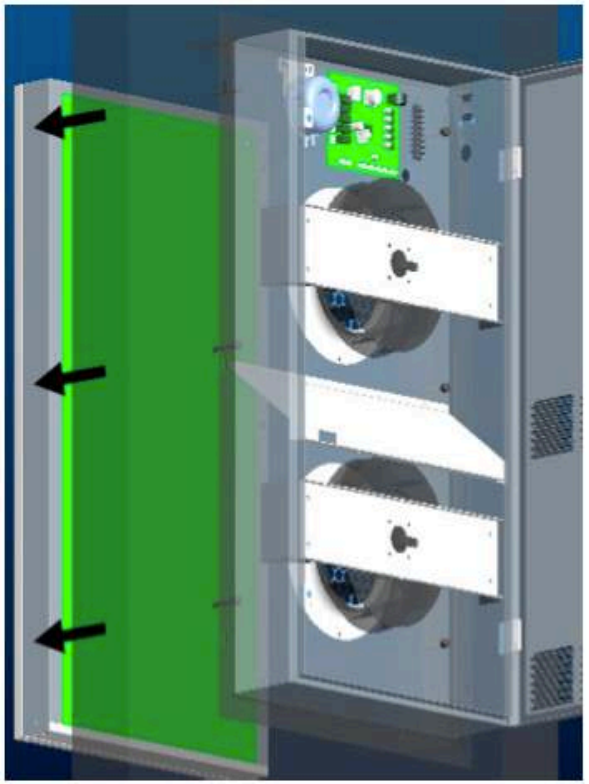


- Filter Size : 420mm(W) x 820mm(H) x 40mm(D)
- Type : Hydrophobic GORE G4 Filter
- Design : V-Shape Folded Structure
- Maintenance frequency : > 1 year (site condition)

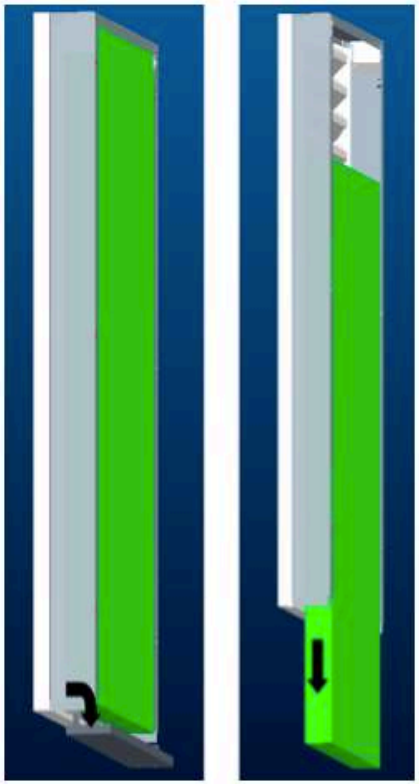
Hydrophobic Filter – Filter Replacement



1. Open the door of the SSCU and dismount the six screws as shown in the pic above.



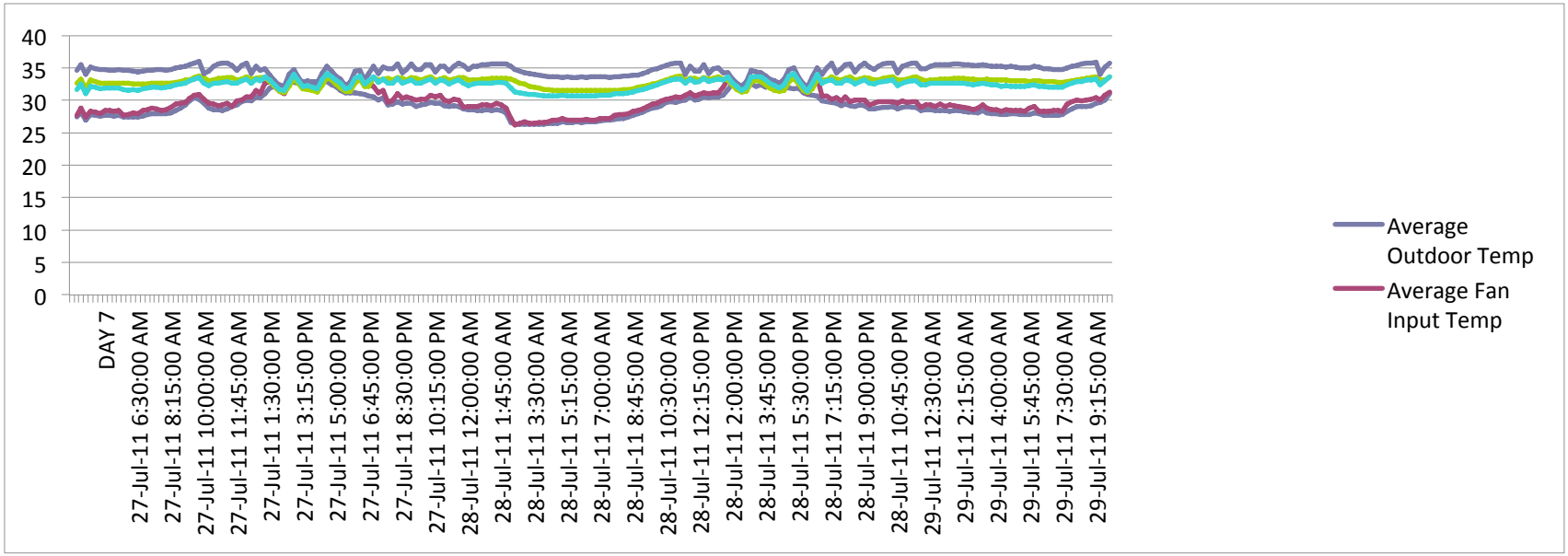
2. Take out the waterproof module from outside, as shown in the pic above



3. Take out the board of the filter and replace the filter.

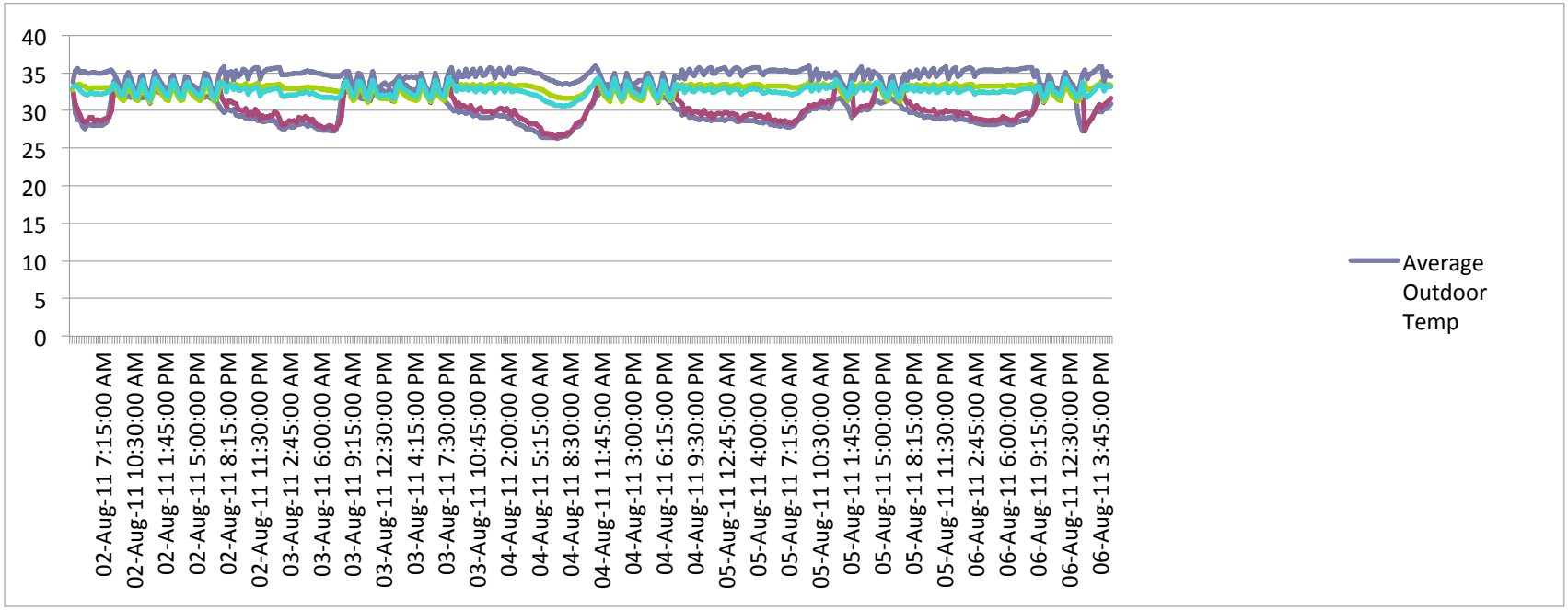
Test Results for FCB + Existing Aircon – (Week 1)

Timestamp	Average Outdoor Temp	Average Fan Input Temp	Average Indoor Temp 2	Average Indoor Temp 1	Avrg Room Temp
DAY 1	27.4	27.7	32.7	34.6	31.7
DAY 2	28.2	28.8	33.3	35.5	32.5
DAY 3	27	27.4	31.8	34	31.1
DAY 4	27.8	28.3	33.1	35.1	32.2
DAY 5	27.7	28.2	32.9	34.9	32
DAY 6	27.6	28	32.7	34.7	31.8
DAY 7	27.7	28.5	32.6	34.7	31.9



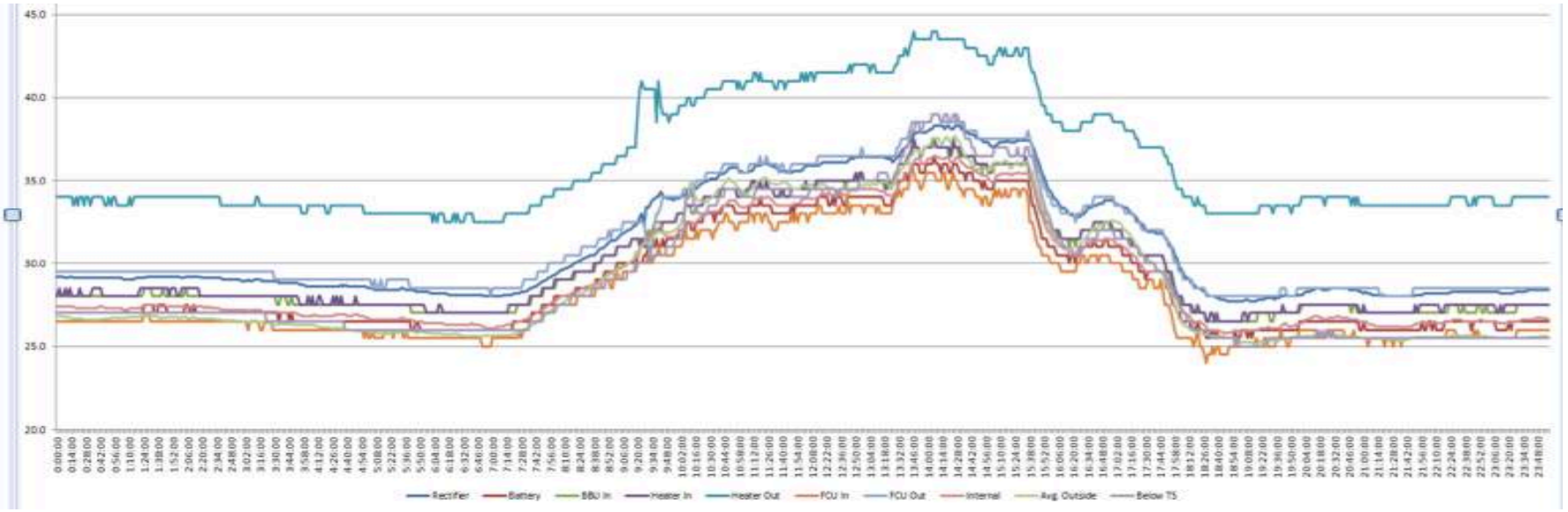
Test Results for FCB + Existing Aircon – (Week 2)

Timestamp	Average Outdoor Temp	Average Fan Input Temp	Average Indoor Temp 2	Average Indoor Temp 1	Avrg Room Temp
DAY 8	32.8	32.9	32.7	33.8	33.1
DAY 9	29.7	30.9	33.4	35.3	33.2
DAY 10	28.8	30.1	33.5	35.6	33.1
DAY 11	28.8	29.4	33.5	35.1	32.7
DAY 12	27.9	28.7	33.2	35.2	32.4
DAY 13	27.6	28.4	33.2	35.2	32.2
DAY 14	28.1	28.6	32.9	34.9	32.1



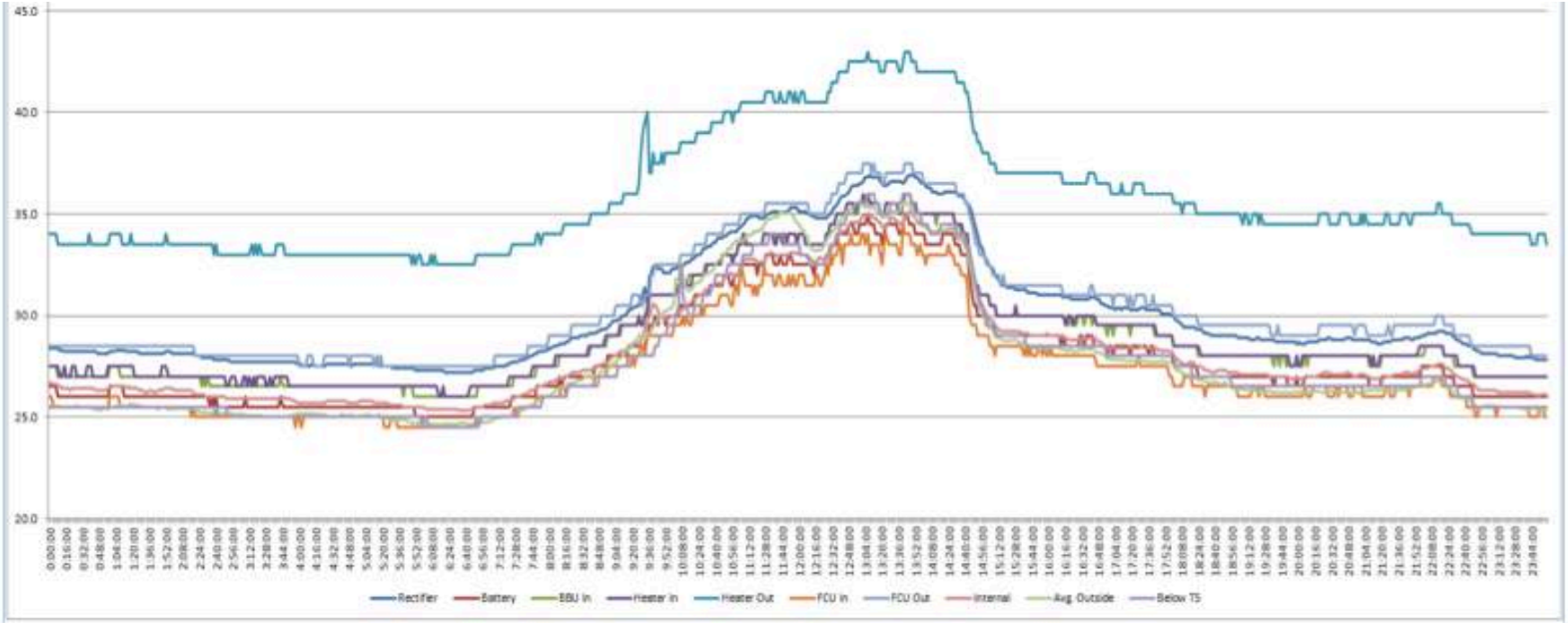
Test Results for Free Cooling System – (Day 1)

TEMPERATURE (°C)									
	Rectifier	Battery	BBU In	Heater In	Heater Out	FCU In	FCU Out	Internal	Avg. Outside
Average	31.1	28.9	29.9	30.0	36.2	28.3	31.3	29.2	29.0
ΔT Average	2.0	-0.2	0.8	0.9	7.1	-0.8	2.3	0.1	-0.1
Min	27.7	25.5	26.5	26.5	32.5	24.0	28.0	25.8	25.1
ΔT Min	2.7	0.5	1.5	1.5	7.5	-1.0	3.0	0.8	0.1
Max	38.3	36.5	37.5	37.5	44.0	36.0	39.0	36.5	37.7
ΔT Max	-0.7	-2.5	-1.5	-1.5	5.0	-3.0	0.0	-2.5	-1.3



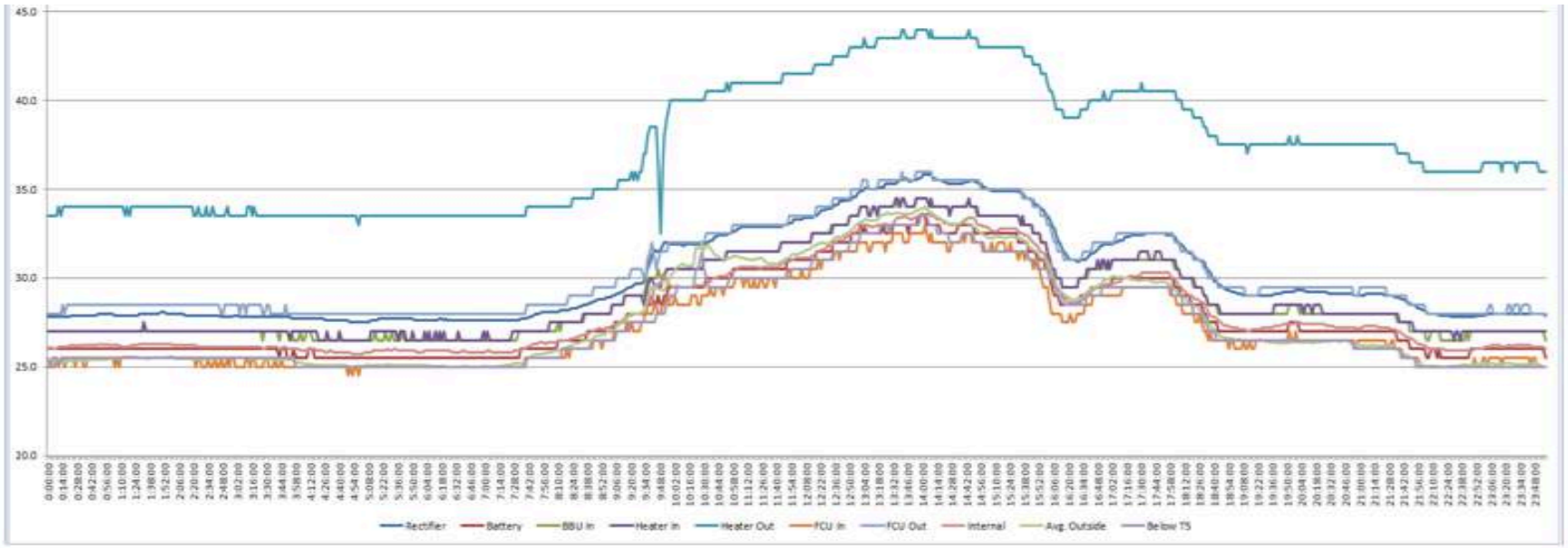
Test Result for Free Cooling System - (Day 2)

TEMPERATURE (°C)									
	Rectifier	Battery	BBU In	Heater In	Heater Out	FCU In	FCU Out	Internal	Avg. Outside
Average	30.1	28.0	29.0	29.1	35.8	27.3	30.5	28.2	27.9
ΔT Average	2.3	0.2	1.3	1.3	8.0	-0.5	2.7	0.4	0.1
Min	27.2	25.0	26.0	26.0	32.5	24.5	27.5	25.3	24.6
ΔT Min	2.7	0.5	1.5	1.5	8.0	0.0	3.0	0.8	0.1
Max	36.9	35.0	36.0	36.0	43.0	34.5	37.5	35.1	35.6
ΔT Max	0.9	-1.0	0.0	0.0	7.0	-1.5	1.5	-0.9	-0.4



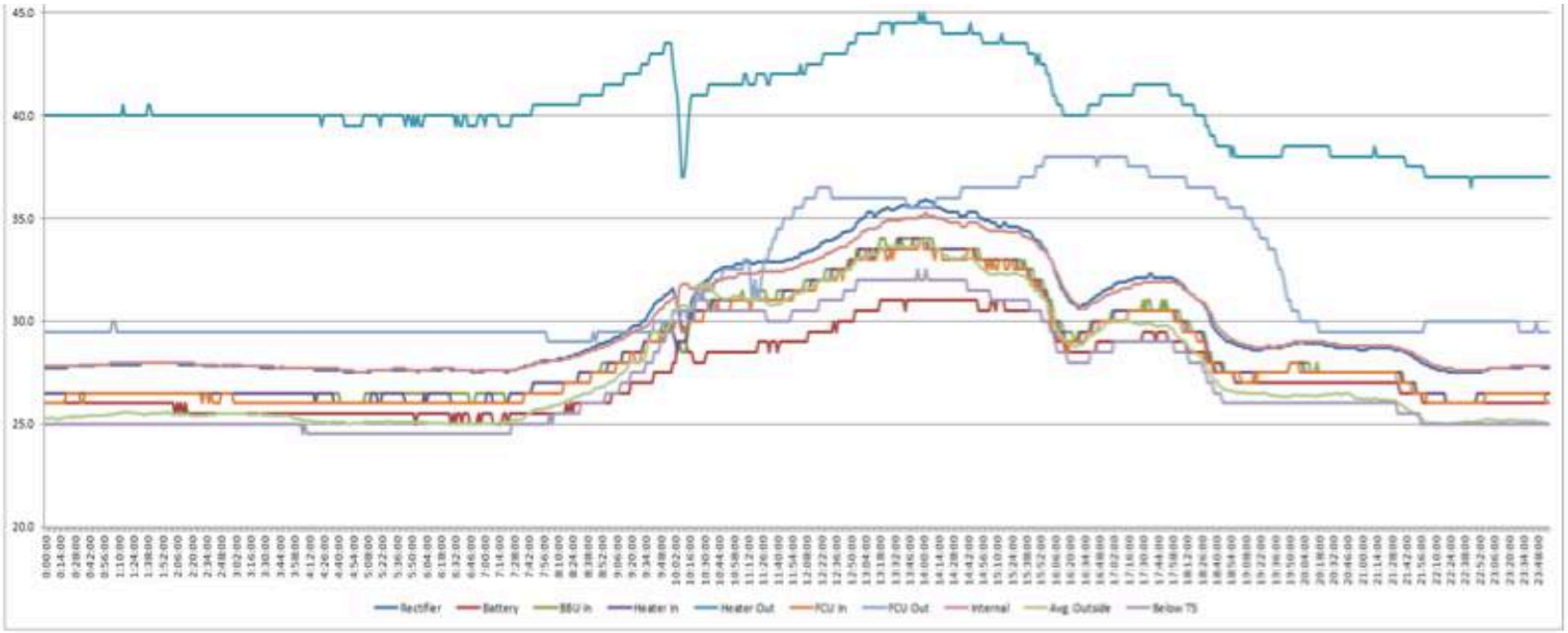
Test Result for Free Cooling System - (Day 3)

	TEMPERATURE (°C)								
	Rectifier	Battery	BBU In	Heater In	Heater Out	FCU In	FCU Out	Internal	Avg. Outside
Average	30.1	27.9	29.0	29.0	37.4	27.3	30.4	28.2	27.8
ΔT Average	2.7	0.5	1.6	1.6	10.0	-0.1	3.0	0.7	0.3
Min	27.5	25.5	26.5	26.5	32.5	24.5	28.0	25.7	25.0
ΔT Min	2.5	0.5	1.5	1.5	7.5	-0.5	3.0	0.7	0.0
Max	35.8	33.5	34.5	34.5	44.0	33.0	36.0	33.6	34.0
ΔT Max	2.3	0.0	1.0	1.0	10.5	-0.5	2.5	0.1	0.5



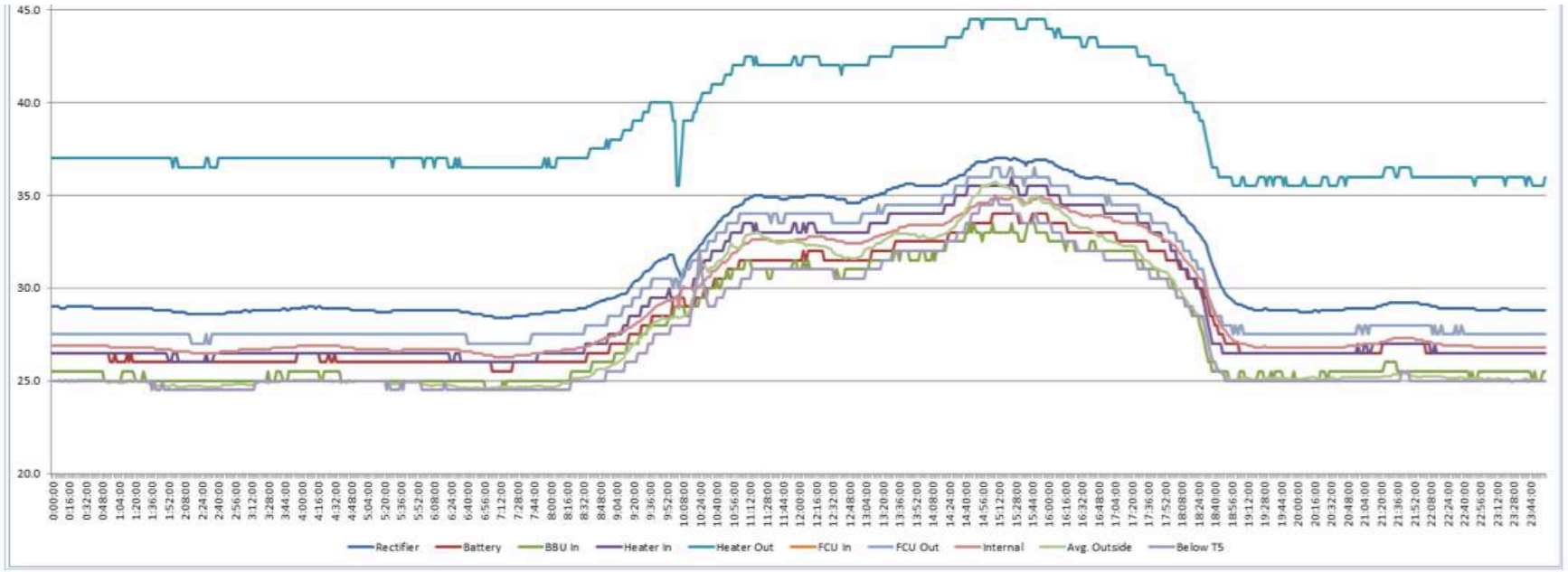
Test Result for Free Cooling System - (Day 4)

TEMPERATURE (°C)									
	Rectifier	Battery	BBU In	Heater In	Heater Out	FCU In	FCU Out	Internal	Avg. Outside
Average	30.0	27.3	28.6	28.5	40.4	28.3	32.0	29.9	27.8
ΔT Average	2.9	0.2	1.5	1.4	13.3	1.2	4.9	2.8	0.6
Min	27.5	25.0	26.0	26.0	36.5	26.0	29.0	27.5	25.0
ΔT Min	3.0	0.5	1.5	1.5	12.0	1.5	4.5	3.0	0.5
Max	35.9	31.0	34.0	34.0	45.0	34.0	38.0	35.3	34.0
ΔT Max	3.4	1.5	1.5	1.5	12.5	1.5	5.5	2.8	1.5

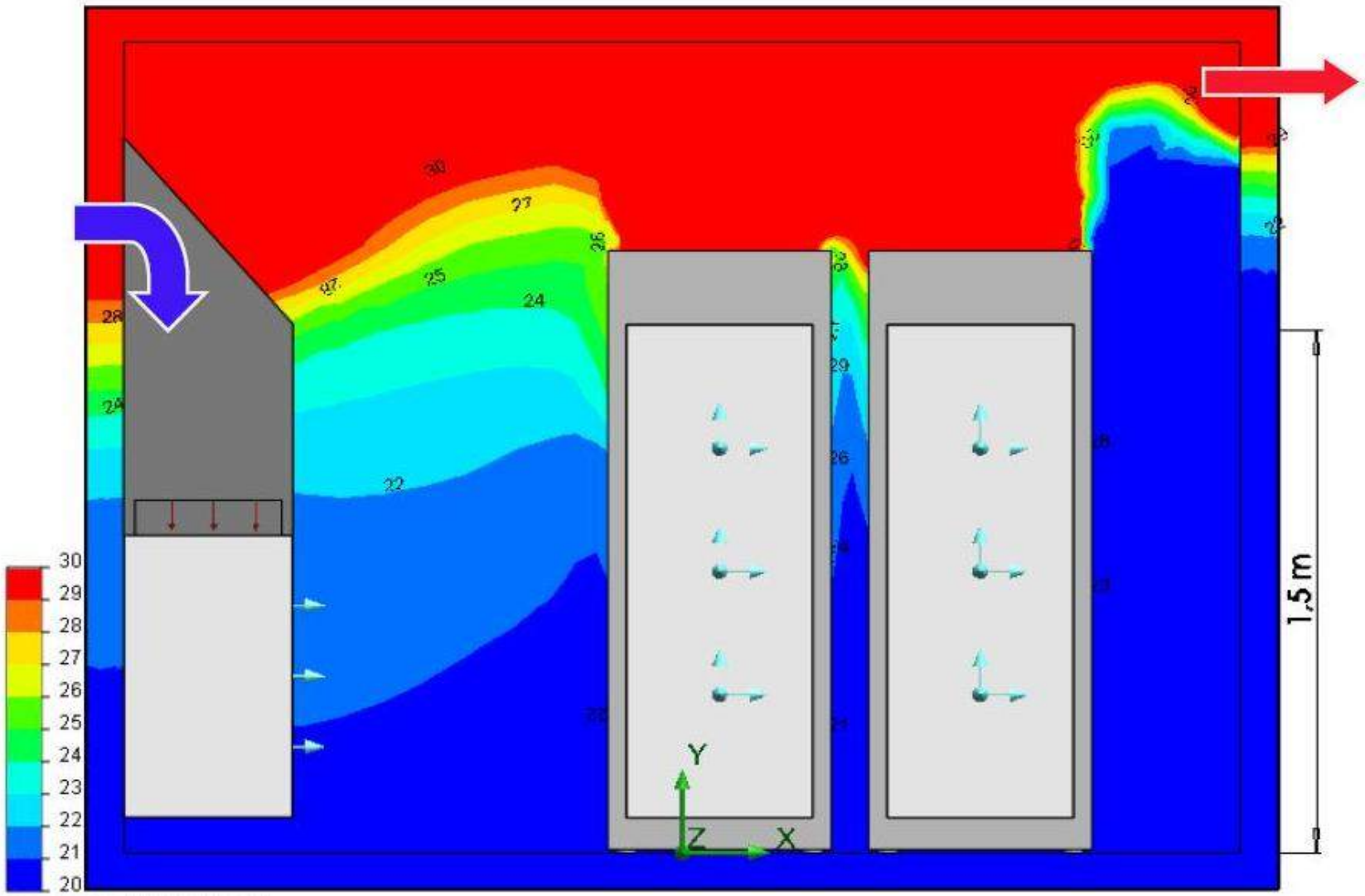


Test Result for Free Cooling System - (Day 5)

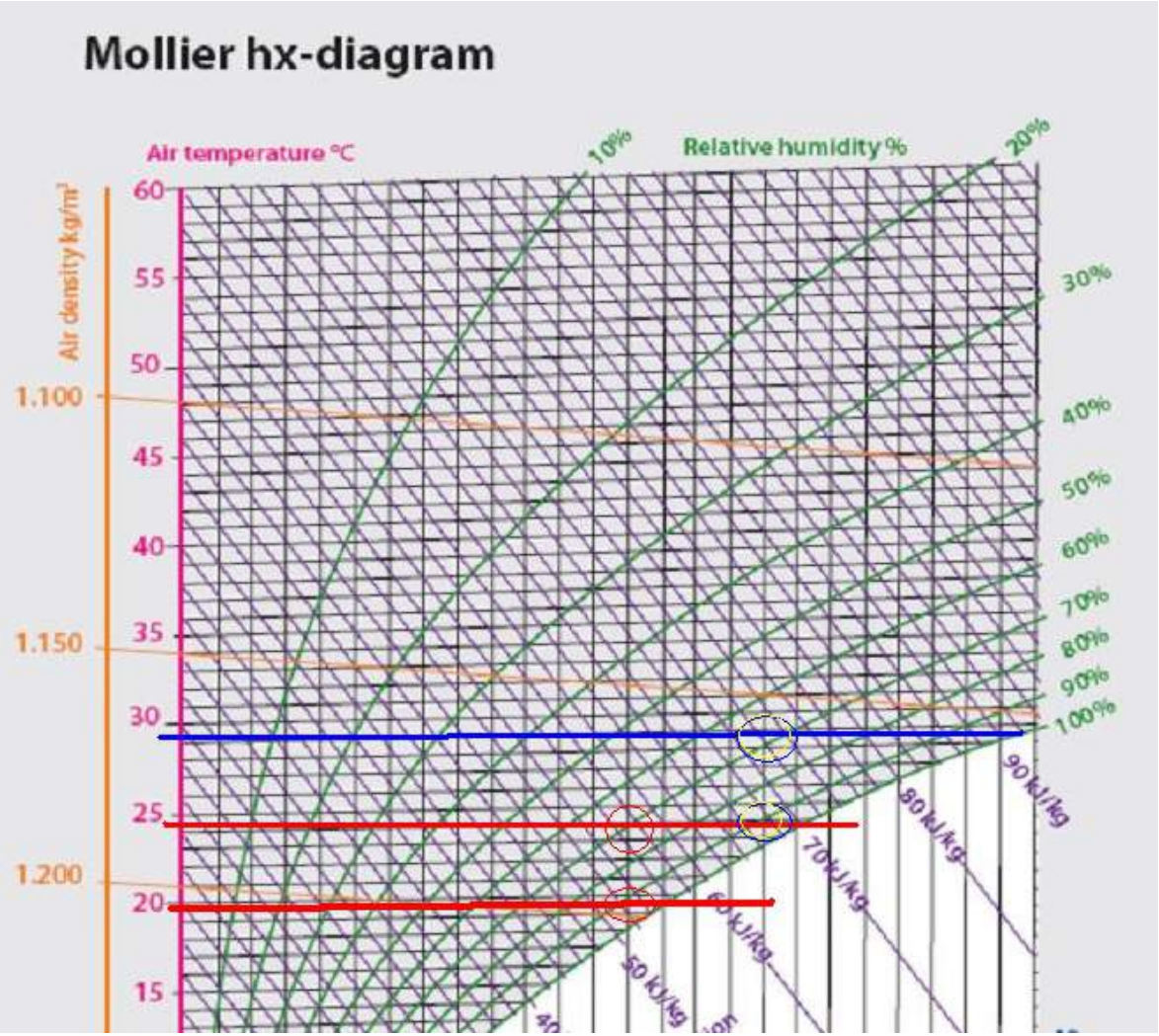
TEMPERATURE (°C)									
	Rectifier	Battery	BBU In	Heater In	Heater Out	FCU In	FCU Out	Internal	Avg. Outside
Average	31.2	28.4	27.5	29.1	38.7	30.0	30.0	29.1	27.8
ΔT Average	3.9	1.1	0.2	1.8	11.5	2.7	2.7	1.8	0.5
Min	28.4	25.5	24.5	26.0	35.5	27.0	27.0	26.3	24.6
ΔT Min	3.9	1.0	0.0	1.5	11.0	2.5	2.5	1.8	0.1
Max	37.0	34.0	33.5	36.0	44.5	36.5	36.5	34.9	35.7
ΔT Max	2.0	-1.0	-1.5	1.0	9.5	1.5	1.5	-0.1	0.7



Temperature Profile Imaging



Moller Chart – Non-condensing Environment



- **<u>FACTS</u>**
- > Condensation forms when Humid air contacts with cold surface.
- > Humidity will decrease when temperature increases.

Conclusion

Why Choose Critical Control FCB?

- FCB System that meets and matches different type site conditions and Client's requirements
- Solution that provides energy saving and reduces CO2 emission.
- Capitalising Malaysia climate profile to map the cooling and achieving optimal CAPEX & OPEX saving and meeting equipment's operating environment.
- Ease of installation and low maintenance frequency.
- Achieving Green Initiative