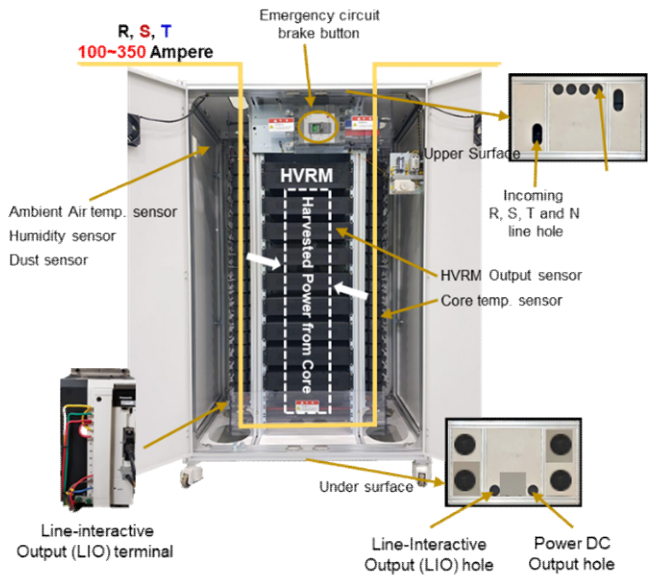
FERRARIS INC.

# Spec sheets of Ferraris ERR System

June 2019 *(Updated January 3, 2020)*

# ▪ Ferraris Core/HVRM (High Voltage Regulator Module) system




**Ferraris Core/HVRM system rack – Front side**

## Basic Operation

- Ferraris Core/HVRM system is doing Magnetic Energy Harvesting Function from R, S, T and N power lines.
- R, S, T and N power lines are passing thru inside hole of Ferraris Core (normally more than 100 to 200 cores).
- Collected power by Cores is sent to HVRM (High Voltage Regulator Module) and leveled for the Battery/BMS interface.
- HVRM output is sent to Battery/BMS as a DC power format.
- LIO (line-interactive Output) power is the redundant output power in case harvested power is more than that of required output power. This extra power can be connected to other distribution panel to supply extra power.

## Basic Features

- Emergency Shutoff Function. (R, S, T and N power line bypass)
- Core Shutoff Function. In case of Core malfunction, Core output is shutoff to protect other subsystem.
- In case of Malfunction of HVRM, connected Cores are shutoff to prevent harvesting function.
- Real-time checking Ambient condition.(Temperature, Humidity, Dust) inside Rack. In case of abnormal condition Emergency Shutoff Function (bypass) will be acting.
- For each harvested output by HVRM are monitored in real-time and these status data are sent to the host monitoring system via RS-232 or I2C.
- This system can be cascaded by connecting R, S, T and N power line to the next input R,S,T and N power lines.

| **Primary R, S, T and N power line electrical specification** | |
|---|---|
| Voltage range | 380 ~ 420 Vac |
| Current range | 100 ~ 350 A |

| **Harvested power electrical specification** | |
|---|---|
| Voltage range | 380 ~ 420 Vdc |
| Current range | 13A ~ 53A |
| Output power | 5kW ~ 22.5kW |

| **Line-interactive Output electrical specification** | |
|---|---|
| Voltage range | 380 ~ 420 Vac |
| Current range | 4 ~ 5 A (2kW) |

| **Ambient operating specification** | | |
|---|---|---|
| Temperature range | - 4 ~ 167°F | |
| Humidity range | 30 ~ 80 % | |
| Cooling function | Type A | Type B |
| | 21 Watt | 46 Watt |

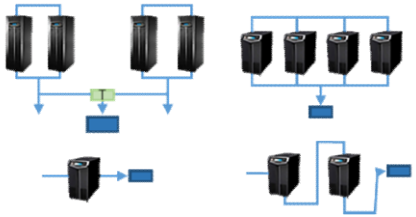
| **Physical Specification** | |
|---|---|
| Dimension (W*L*H) | 48 * 30 * 75 (inches) |
| Weight | 640 ~ 772 (lb) |
| Material | AL |
| Primary line terminal size | 0.43 * 1.38 (inches) |
| Primary line cable thickness | Ø95 ~ Ø450 |

# ▪ PCS (Power Control System) Subsystem

PCS – Front View

PCS Modules are stackable.

Several different kind of configuration of PCS



Plug & Play Module Maintenance


## Basic Operation

- PCS deliver the powers either from the Battery/BMS or Core/HVRM System to the load.
- In case of Emergency, outside normal AC power line can be supported to the Load in real-time.
- **PCS capacity ranges from 20kW and increased up to 120kW by six stacking 20kW module and up to two 120kW module can be connected in parallel (240kW) depending on their configuration.**
- Support Remote monitoring and control feature for easy maintenance.

## Basic Features

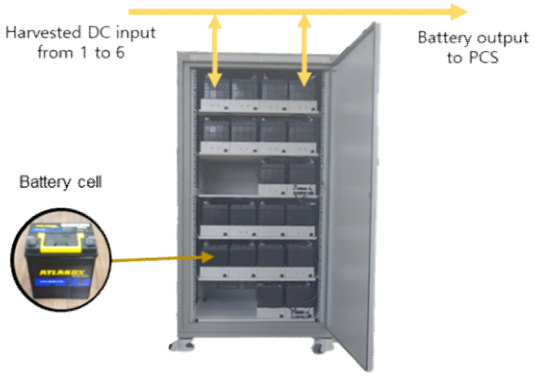
- Support Input bypass breaker for emergency situation.
- **Wide range of input Voltage (208Vac ~ 477Vac) and frequency range (45Hz ~ 65Hz).**
- **N+X Redundancy feature from 20kW module base to unit base, system reliability is increased dramatically.**
- **In multi-module or unit configuration, output power are self synchronizing itself.**
- The PCS monitor consists of buttons with functions such as data settings, menu movements, warning when errors occur, and system settings for different configuration.
- With remote access power based on RS232 and I2C interface protocols, remote monitoring and control are possible.

| Input / Output electrical specification | |
|---|---|
| Typical Input voltage | 380 ~ 420 Vdc + N + PE |
| Input current | Max. 52 A per Module |
| Backup input power | 380/400/415 Vac + N + PE |
| Output capacity | 20kW per Module |
| Output voltage range | 380/400/415 Vac + N + PE |
| Output frequency | 50/60 Hz ± 0.1 % |
| Output rate of change (Slew Rate) | 1 Hz / Sec |

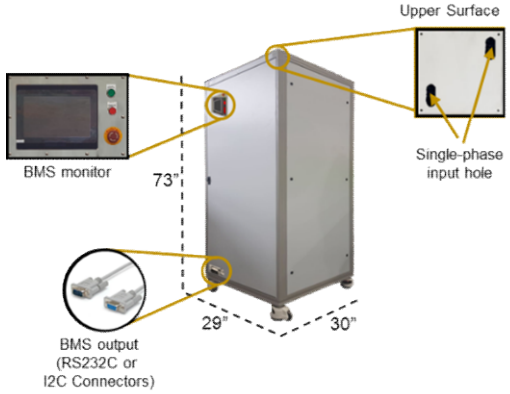
| Ambient operating specification | |
|---|---|
| Temperature range | 32 ~ 167°F |
| Humidity range | 30 ~ 95 % |
| Cooling function | Air-cooled (Multi-FAN with adjustable speed depending on load) |

| Physical specification | |
|---|---|
| Dimension (W*L*H) | 45 * 18 * 74 (inches) |
| PCS terminal size | 0.22 * 0.4 (inches) |
| Material | AL |

# ▪ Battery Subsystem with BMS (Battery Management System)




**Battery System – Front Side**




## Basic Operation

- This system is storing magnetic energy into Battery rack for the buffering and pass them into PCS.
- Battery cell composed of 11 battery has one more extra battery for the redundancy feature (Urgent replacement, Plug in Play).
- It has its own BMS including several types of sensors together and it BMS detects malfunction of certain battery, then automatically that battery will be replaced with redundancy one and send emergency signal to the host monitoring and control system.
- This system can accept up to 6 input from Ferraris Core/HVRM systems depending on the configuration.
- Two battery subsystem Outputs can be connected in parallel (Doubling battery capacity) for future backup.
- Harvested input can pass thru to PCS directly when it is needed. Pseudo battery operation of magnetic Core.
- Excellent local communication features with BMS monitors..

## Basic Features

- Emergency shutoff function support (Bypass input to output without battery).
- Support Urgent swap from battery to cell level for minimum MTTR and easy maintenance.
- With extended capacity of battery, Emergency backup power supply configuration is possible with proper PCS features together.
- With BMS monitoring system, customer can monitor all of internal battery's operation in real-time thru BMS output line.
- Has Internal ambient temp. sensor, humidity sensors.

| Input / Output electrical specification | |
|---|---|
| Input voltage range | 380 ~ 420 Vdc |
| Output voltage range | 380 ~ 420 Vdc |

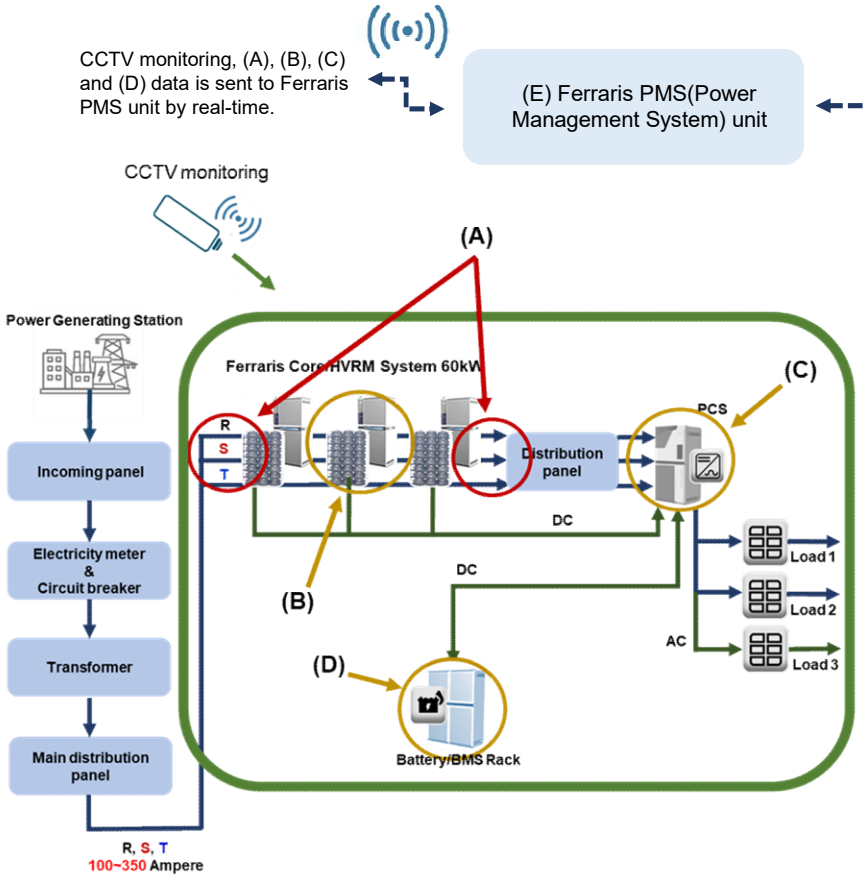
| Battery specification | |
|---|---|
| Battery type (Deep cycle) | Lead–Acid Battery |
| | 24Vdc 40AH |
| Amount of battery per cell | 11 EA +1EA (Redundancy) |
| Capacity of battery per cell | 10 kW |
| Usage by capacity | Depend on power usage 10kW ~ 2kW |
| Extensibility | Basic 10kW, expandable up to 6 racks (20kW x 6 ea = 120kW) |

| Input / Output line specification | |
|---|---|
| Input/output method | Single-phase |
| Input channel quantity | Max 6 channel |
| Output channel quantity | 1 Channel |

| Ambient operating specification | |
|---|---|
| Temperature range | - 4 ~ 167°F |
| Humidity range | 30 ~ 80 % |

| Physical specification | |
|---|---|
| Dimension (W*L*H) | Basic rack : 29*30*73 (inches) |
| | Customized |
| Weight | Customized |
| Material | AL |

# ▪ RMPC (Remote Monitoring Power and Control) system for Multi-site




- This RMPC system make customers maintenance. Their multi-site operation and risk management of Ferraris solution.

(A) R, S, T & N power line temp. sensor is monitoring main power line status.
(B) Monitoring Core & HVRM operation status, Real time monitoring ambient condition inside, Support emergency backup power system.
(C) Monitoring power generation and consumption in real-time, Support emergency backup power from normal power, In case of power outage situation, support emergency power supply with battery system for specific load.
(D) Support BMS and other sensors, Support battery redundancy feature from battery level to cell level, Support emergency power source in case of power outage case, Support remote monitoring power generation from each stacked PCS outputs.
(E) The Ferraris PMS unit device is located on the Ferraris ERR System site.