Introducing Ferraris Tolenoid C®

June 2019 *(Updated January 3, 2020)*

Ferraris Challenge

Ever since the commercialization of electricity, there have been an untapped byproduct in form of electromagnetic field generated by flowing currents in power lines. By harnessing the forgotten and unused electromagnetic energy through electromagnetic energy recycling, Ferraris has opened a new pathway for electric power generation and energy recycling technology for the mankind. Ferraris was founded in a strive to harness the power from a magnetic field produced by power lines and transform it into a reliable and countable power source.

Dr. KOO, who is the founder of Ferraris wishes the investors to set their focus and priority environmental social governance with key focus on providing clean energy produced by Ferraris' products through the magnetic energy over the corporate management of Ferraris. The prime directive of Ferraris is to provide clean energy with no environmental pollution around the world to improve and restore environment for the benefit of current and future generations to come.

We have named Ferraris Inc. in memory of Galileo Ferraris.

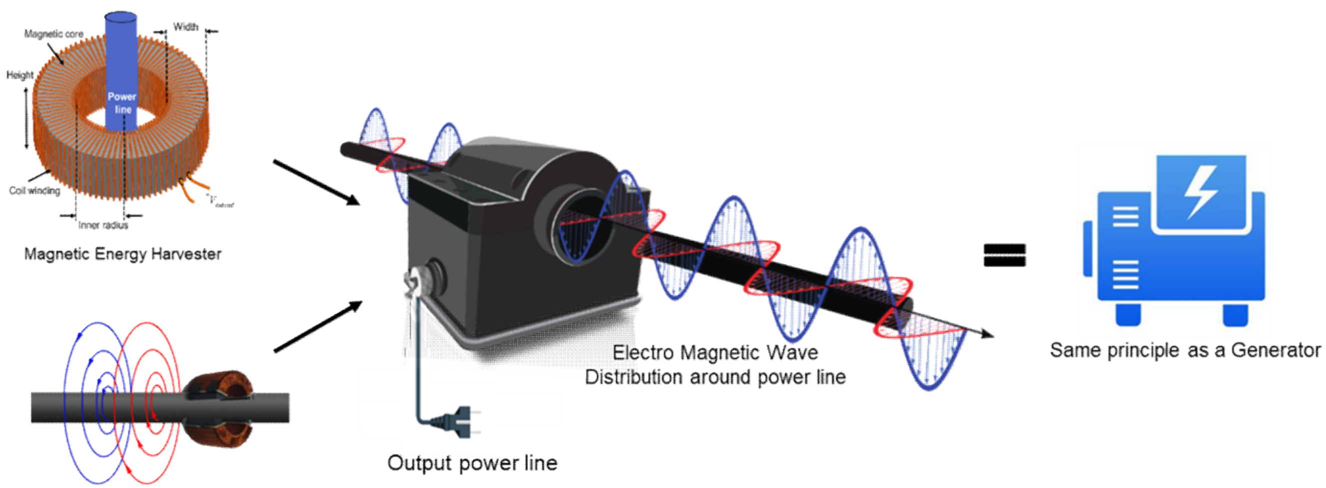
FERRARIS INC.

Table of Contents

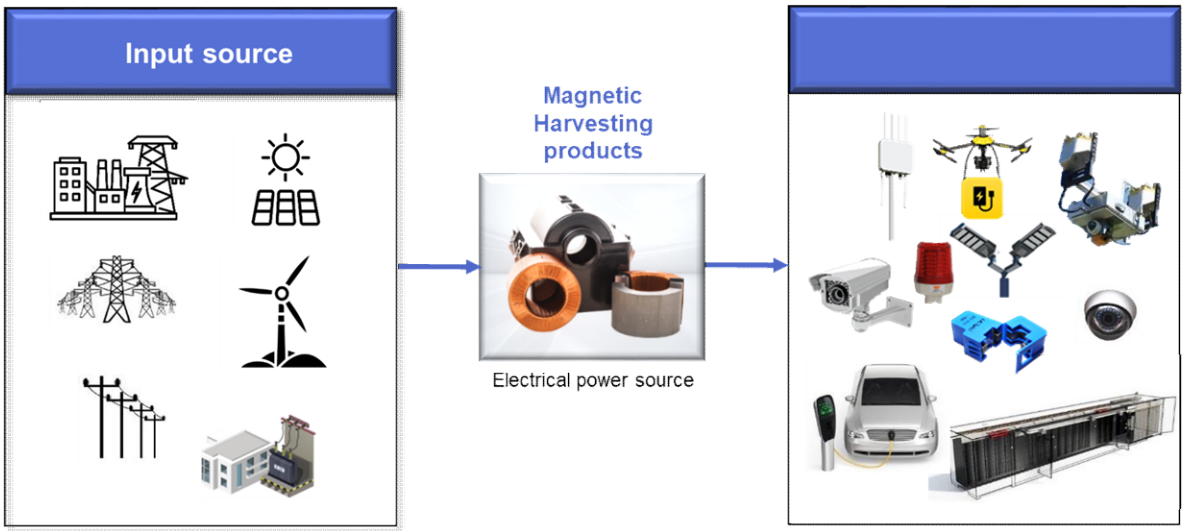
I. Introducing Ferraris Tolenoid C® Technology

1. Ferraris Tolenoid C® Technology

- A Ferraris technology which harnesses induced electrical energy from the magnetic energy variation produced from the power line regardless of the power line voltage. Ferraris Tolenoid C® is designed, developed and manufactured mainly for the electrical power generation. The world's first technology that only Ferraris has – Linear power scalability (https://youtu.be/Y3IR5djt5hg), input/output power Variation controllability (https://youtu.be/z3OLe21eFGU), Single digit mass production loss ratio.



- **The uses of Magnetic Harvesting products**



Incoming power lines from the sources, such as power generation, solar farm, wind farm, sub-station, distribution sub-station, transformer

Electric devices such as sensors, monitoring systems, aircraft warning light, CCTV, public light, public WIFI, drone charging station monitoring robots, lighting fixtures, EV chargin g station, energy storage system etc.

▪ Key Obstacles of Producing ready-made Magnetic Harvesting products

Key obstacles regarding the input source

- The current of power line is not constant, but varies in wide range, furthermore it cannot be controlled by harvesting device.
- The amplitude of current of power line may be lower than the minimum one set by regulation in many cases.
- The product must be easy and simple to Install or de-installation without power off a power line. Furthermore there should be no safety hazard issue.
- Exiting magnetic core is made mainly for sensor application, not for the power application.

Magnetic Harvesting products

Key obstacles regarding the output source

- Power source should be scalable for the variable output source.
- The power usage of the electric devices for system integration by the solution provider varies by case by case, which means there is no standard output requirement, but should be adaptable in the field.
- In most cases, power supply based on magnetic harvesting method is designed by custom method, not modular design method.

Key obstacles regarding the mass production

- The production process and quality control procedures such as winding, cutting, polishing, primary test, coiling, and final tests can be automated to minimize product loss and human dependency, which enable product to be mass producible.

▪ Ferraris Manufactures ready-made Magnetic Harvesting products

The Ferraris technology of input source

- Ferraris Tolenoid C® has unique Input magnetic flux control design for Ferraris SMPS (Switching Mode Power Supply).
- Ferraris Tolenoid C®, Linear power scalability and unique splittable magnetic core design.
- Splittable magnetic core design, proper heat handling case design and unique Ferraris Separator.
- Ferraris has minimum 2~3 times higher power by magnetic core design and manufacturing process.

Magnetic Harvesting products

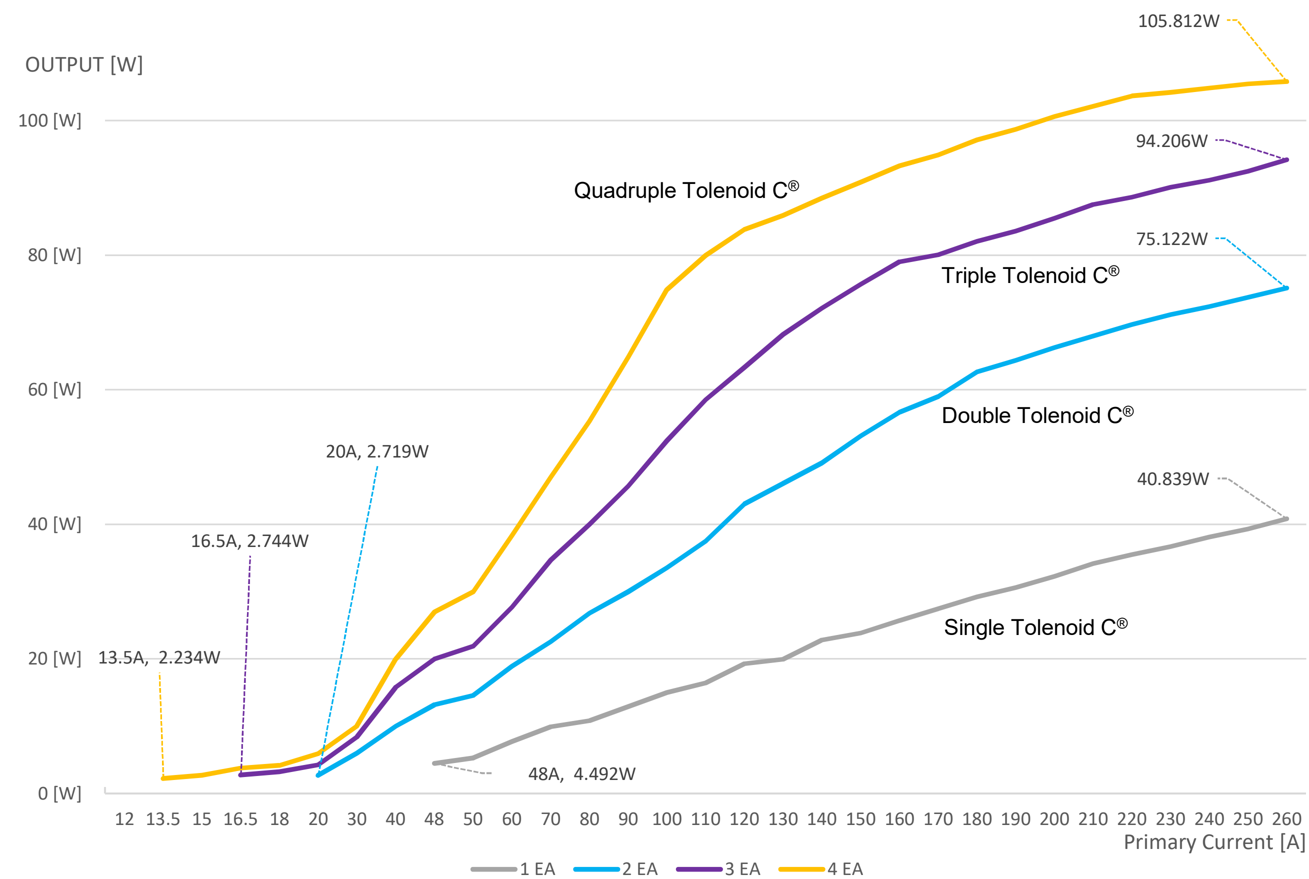
Ferraris technology for mass production

- By utilizing innovative automated production process and quality control, Ferraris has reduced loss ratio to a single digit. Furthermore, Ferraris has now operated production system to mass produce the product.

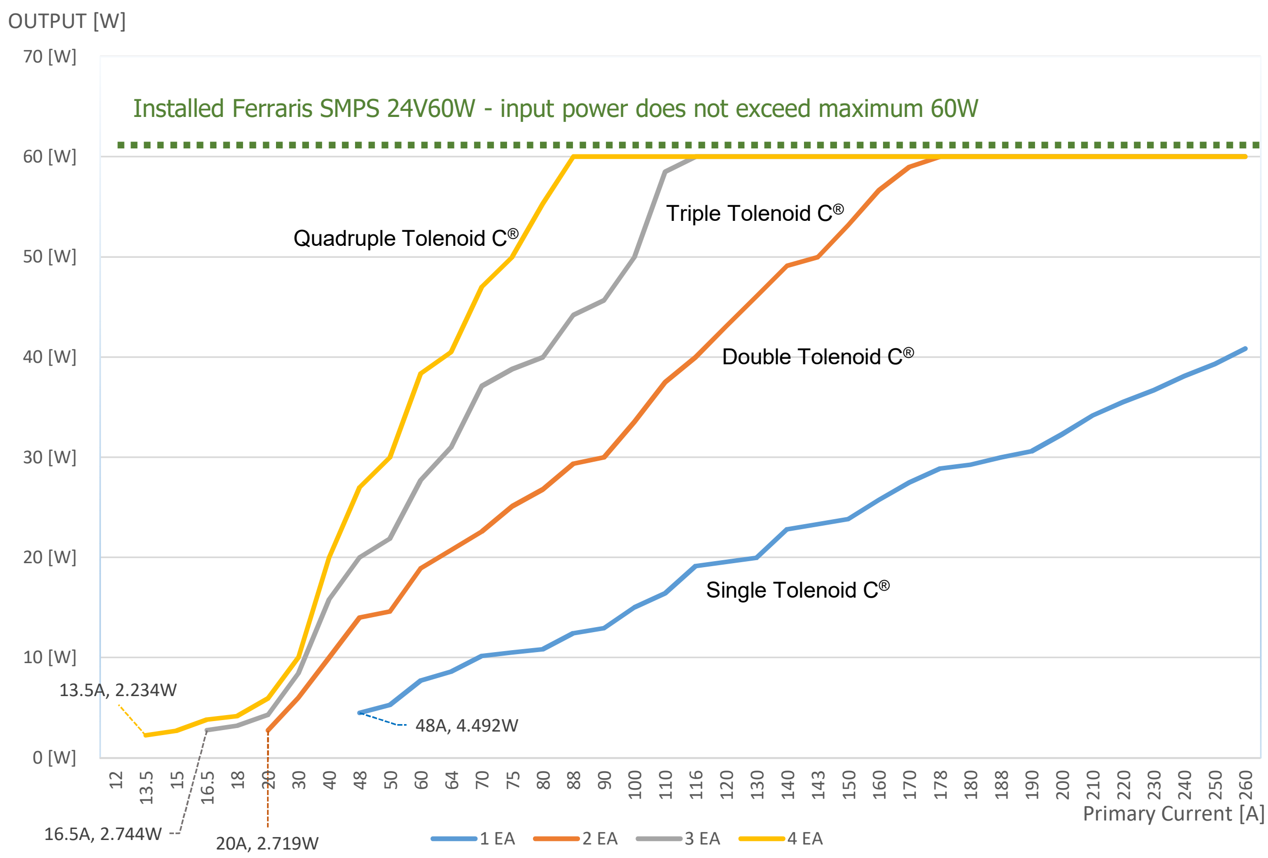
The Ferraris technology of output source

- Ferraris Tolenoid C®, Linear power scalability and Ferraris SMPS (Switching mode power supply) design technology, Input controllability and Output load variation.

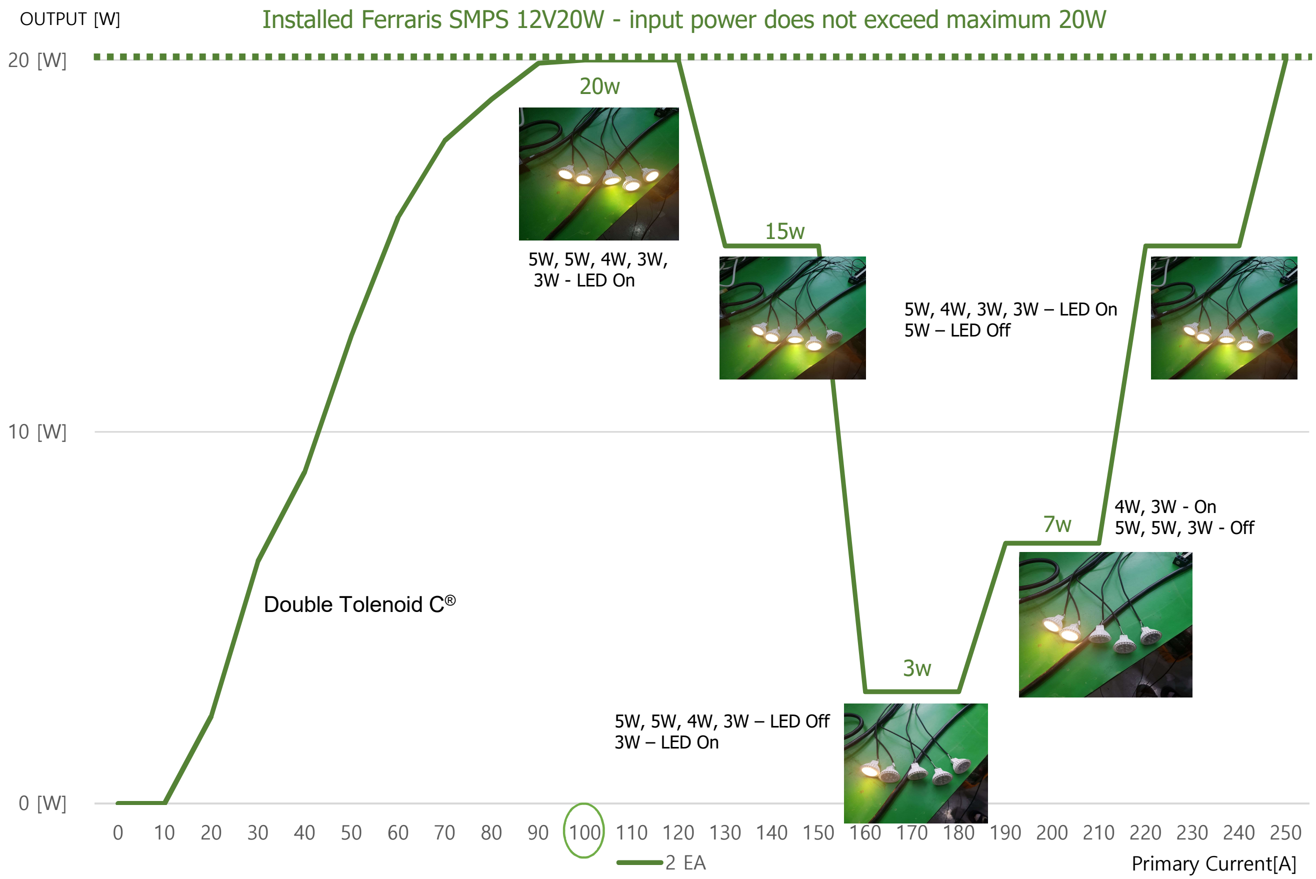
2. Ferraris Tolenoid C® Technology - Linear power scalability



3. Ferraris Tolenoid C® Technology - Input controllability

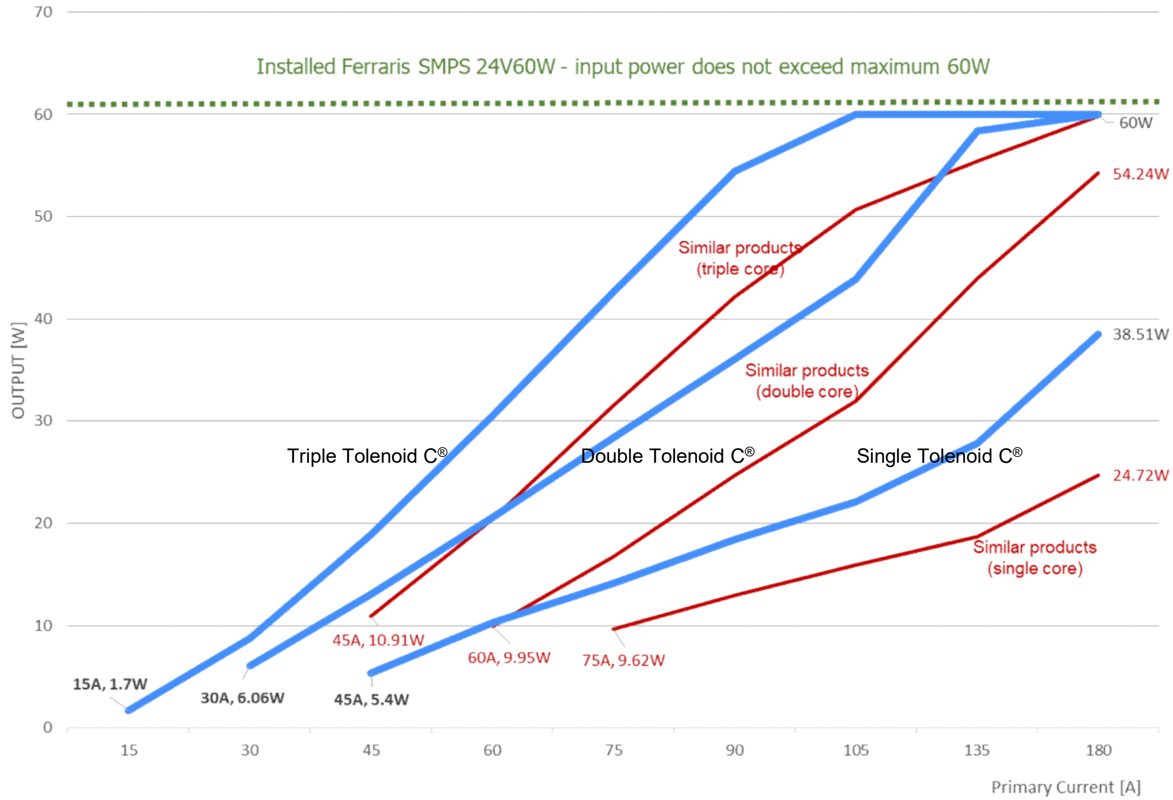


4. Ferraris Tolenoid C® Technology - Output Load variation / traceability



5. Ferraris Tolenoid C® Technology - Performance Evaluation

- In the 15 ~ 60A primary current line, Ferraris Tolenoid C® produced higher output power (Watt) of 49.73% ~ 107.06% than other companies' core products.



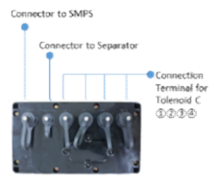
II. Introducing Ferraris Tolenoid C®

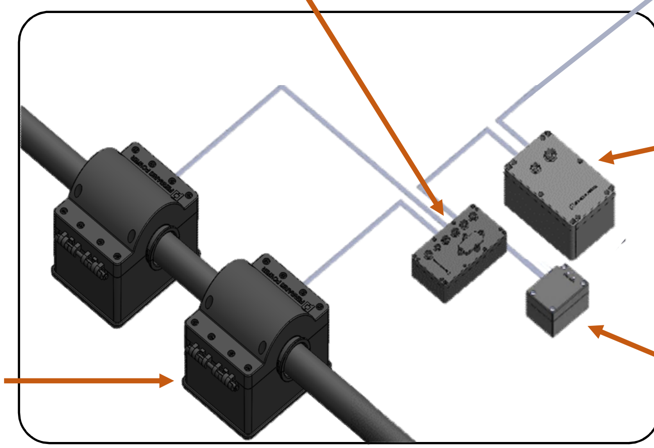
1. Ferraris Tolenoid C® products

- For further information of the products, refer to chapter V. Spec sheets.

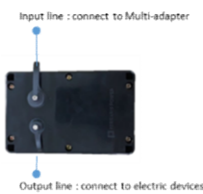
(2) Ferraris Multi-adapter

- Connect Ferraris Tolenoid C®, Ferraris SMPS and separator
- Able to connect 4ea of Ferraris Tolenoid C® per multi-adapter





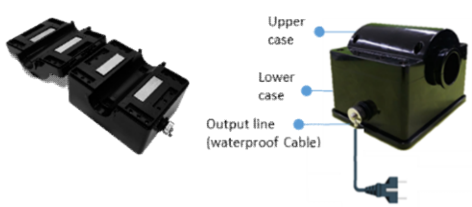
(3) Ferraris SMPS



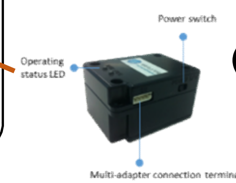
- Switching Mode Power Supply
- Prevent overvoltage, overcurrent, overload
- Stability with power line regulation less than 1%

(1) Ferraris Tolenoid C®

- Contactless Power Supply
- Power generation and supply to electric devices by simply attaching Ferraris Tolenoid C® to an existing power line
- No transformer is required



(4) Ferraris Separator



- The separator eliminates the magnetization that occurs when the Ferraris Tolenoid C® is installed in the magnetic field around the power line and enable safe install or de-installation

2. Four kind of Ferraris Tolenoid C®

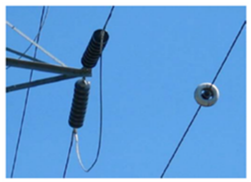
- Ferraris Tolenoid C® can be installed wherever power lines are regardless of its voltage such as high-voltage distribution lines, underground lines.

Tolenoid C®		for Home IoT	for IoT / Smart grid (underground/distribution line)		
					
Power line specifications	line thickness (inches)[*1]	Under 0.90	Under 1.30	Under 2.48	Under 5.90
	line current (A)	~ 15	10 ~ 650	10 ~ 650	10 ~ 650
	line voltage	~380 V	~ 30 kV		154 kV
	line diameter (inches)	~ 0.90	~ 1.30	~ 2.48	~ 5.90
Environmental specifications	operating temp.(°F)	-13 ~ 158	- 40 ~ 185	- 40 ~ 185	- 40 ~ 185
	ingress protection (dust/water proof)	IP65	IP67/68	IP67/68	IP67/68
Dimensions	size (inches)	4.37×3.15×3.23	5.12×3.94×4.33	6.69×3.94×5.90	11.30×7.87×4.02
	weight (lb)	2.20	4.70	7.05	5.29

1 : The line diameter is determined by the line voltage.

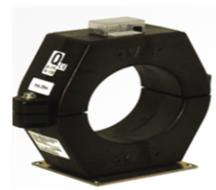
3. Similar products

1. USA USI

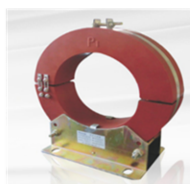


2. UK IPEC

3. Austria ZELISKO

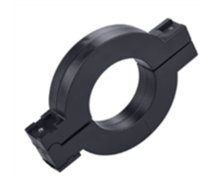


4. China MINRONG



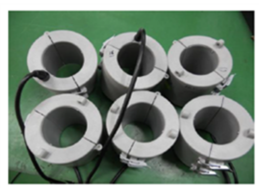
5. China HYLITON

6. China EChun



7. China Xiamen

8. Korea KEPCO KDN



9. Korea Hyundai Heavy Industry

III. Comparing Ferraris Tolenoid C® and its Technology

1. Ferraris Tolenoid C® is designed, developed and manufactured mainly for the Electrical Power Generation.
2. **Linear power scalability -** Ferraris Tolenoid C® can produce upto desired output level by simply adding Tolenoid C® module step by step if incoming power line has more than enough power from the desired one.
3. **Input controllability -** Ferraris SMPS can control the maximum wattage Tolenoid C® power generation through its logics system so that the Tolenoid C® produce input power does not exceed maximum desired wattage. (Maximum wattage can be set by the user)
4. 2 and 3 Full-motion video demo https://youtu.be/Y3IR5djt5hg
5. **Output load variation/traceability -** Under load variation situations, Ferraris SMPS will produce stable output power the user demands. Any further surplus output power caused by load variation control is managed by Ferraris SMPS's control logics system of the production system. Full-motion video demo https://youtu.be/z3OLe21eFGU
6. Even under the simultaneous variation in primary line and load, Ferraris SMPS supplies stable output power.
7. Ferraris Tolenoid C® is easy and simple to Install or uninstall without switching off a power line and thus minimizes any safety hazard issue.
8. Innovative method of magnetic energy harvesting and large-scale system over kilowatt to megawatt level is easily implementable. (Ferraris ERR System)
9. Ferraris is the first to have adopted an operational production system to mass produce its products. By utilizing innovative automated production process and quality control, Ferraris has reduced **loss ratio to a single digit**.

IV. Ferraris Patents and Research efforts

1. Ferraris Patents

Patentee	Patent	Korea		PCT Application & Filing date	USA	CANADA	JAPAN	EUROPE	CHINA
		Application Number & Filing date	Registration Number & date		Registration Number & date	Registration Number & date	Registration Number & date	Registration Number & date	Registration Number & date
JA-IL Koo	Systems, Methods and Devices for Induction-Based Power Harvesting in Battery-Powered Vehicles			PCT/US2017/037668 12/21/2017	[UH20:I22SA] 16/220.692	1060P-AAA-CAP1	1060P-AAA-JPP1	EP17814088.5	1060P-AAA-CNP1
Ferrarispower	Wiring method and apparatus of magnetic field energy harvesting considering voltage drop of power cable	10-2018-0167391 12/21/2018							
Ferrarispower	Networked partial discharge detection system using power supply of magnetic induction type	10-2018-0087268 7/26/2018							
Ferrarispower	Separable current transformer	10-2015-0160586 11/16/2015	10-1586785 1/13/2016	PCT/KR2016/011392 10/12/2016					
Ferrarispower	Method for manufacturing split electromagnetic inductive apparatus for power supply	01-2014-0044862 4/15/2014	10-1505873 3/19/2015	PCT/KR2015/003279 4/2/2015	SN. 15/304.373	2945940 9/26/2017	SN 2016-563043	EP157793336.5	SN201580023179.5 2/22/2017
Ferrarispower	Unit current transformer device and magnetic induction power supplying device for linearly controlling output power by using the same	10-2014-0025317 3/4/2014	10-1459336 11/3/2014	PCT/KR2014/011120 11/19/2014	US 9,793,818 B2 10/17/2017	2941529 7/10/2018	6104457 3/10/2017	14882783.5 2/19/2018	ZL 2014 8 0007684.6 11/14/2017
Ferrarispower	Current transformer	10-2013-0053188 5/10/2013	10-1323607 10/24/2013						
Ferrarispower	Security camera system using of electromagnetic inductive power supply	10-2013-0036946 4/4/2013	10-1320339 10/15/2013	PCT/KR2014/002932 4/4/2014	US 9,824,282 B2 11/21/2017		6161785 6/23/2017		ZL 2014 8 0019561.4 3/18/2019
Ferrarispower	Current transformer system with sensor CT and generator CT separately arranged in paralled in electric power line, and integrated system for controlling same in wireless communications network	10-2013-0018739 2/21/2013	10-1317220 10/4/2013	PCT/KR2014/001374 2/20/2014	US 10,192,678 B2 1/29/2019		6204505 9/8/2017	In progress	
Ferrarispower	Electromagnetic Inductive Power Supply Apparatus	10-2013-0005968 1/18/2013	10-1444371 9/18/2014	PCT/KR2014/000517 1/17/2014	US 9,673,694 B2 6/6/2017	2934854 8/21/2018	6129347 4/21/2017	2947751 4/11/2018	ZL 2014 8 0005251.7 2/6/2018
Ferrarispower	Zig System for Polishing of Magnetic Core and the Method for the same	10-2012-0080730 7/24/2012	10-1252011 4/2/2013	PCT/KR2013/006632 7/24/2013					
Ferrarispower	Zig System for Cutting of Magnetic Core and the Method for the same	10-2012-0080724 7/24/2012	10-1255180 4/10/2013	PCT/KR2013/006631 7/24/2013					

- **US Patent –US 9,673,694 B2**

US009673694B2

(12) **United States Patent**
Koo

(10) **Patent No.: US 9,673,694 B2**
(45) **Date of Patent: Jun. 6, 2017**

(54) **ELECTROMAGNETIC INDUCTION TYPE POWER SUPPLY DEVICE**

(71) Applicant: **TERA ENERGY SYSTEM SOLUTION CO. LTD.**, Hwaseong-si, Gyeonggi-do (KR)

(72) Inventor: **Ja-Il Koo**, Seongnam-si (KR)

(73) Assignee: **FERRARISPOWER CO., LTD**, Gyeonggi-do (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 90 days.

(21) Appl. No.: **14/761,938**

(22) PCT Filed: **Jan. 17, 2014**

(86) PCT No.: **PCT/KR2014/000517**
§ 371 (c)(1),
(2) Date: **Jul. 17, 2015**

(87) PCT Pub. No.: **WO2014/112827**
PCT Pub. Date: **Jul. 24, 2014**

(65) **Prior Publication Data**
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(30) **Foreign Application Priority Data**
Jan. 18, 2013 (KR) 10-2013-0005968

(51) **Int. Cl.**
H02M 1/32 (2007.01)
H01F 38/28 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***H02M 1/32*** (2013.01); ***H01F 38/28*** (2013.01); ***H02J 5/005*** (2013.01); ***H02J 50/10*** (2016.02);
(Continued)

(58) **Field of Classification Search**
CPC H02M 1/32; H02M 5/40; H02M 7/06; H02M 7/08
See application file for complete search history.

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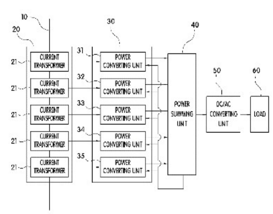
Primary Examiner — Timothy J Dole
Assistant Examiner — Yusef Ahmed
(74) *Attorney, Agent, or Firm* Masuvalley & Partners

(57) **ABSTRACT**

Disclosed is an electromagnetic induction type power supply device, which generates electric power through an electromagnetic induction method using a transformer from current flowing through a transmission line, can adjust an output thereof by detecting and feeding back the output, enables a transformer and a power converting unit to be added or removed as necessary. The electromagnetic induction type power supply device includes a transformer module including a plurality of transformers for outputting electric power by inducing, in an electromagnetic induction method, secondary current from primary current flowing through a transmission line; a power source module including a plurality of power converting units for converting the electric power output from the plurality of transformers to direct current power and outputting the converted power; and a power summing unit for summing the direct current power output from the plurality of transformers and providing the summed power to a load.

5 Claims, 2 Drawing Sheets



(51) **Int. Cl.**
H02M 7/06 (2006.01)
H02M 5/40 (2006.01)
H02J 5/00 (2016.01)
H02M 7/08 (2006.01)
H02J 50/10 (2016.01)

(52) **U.S. Cl.**
CPC ***H02M 5/40*** (2013.01); ***H02M 7/06*** (2013.01); ***H02M 7/08*** (2013.01)

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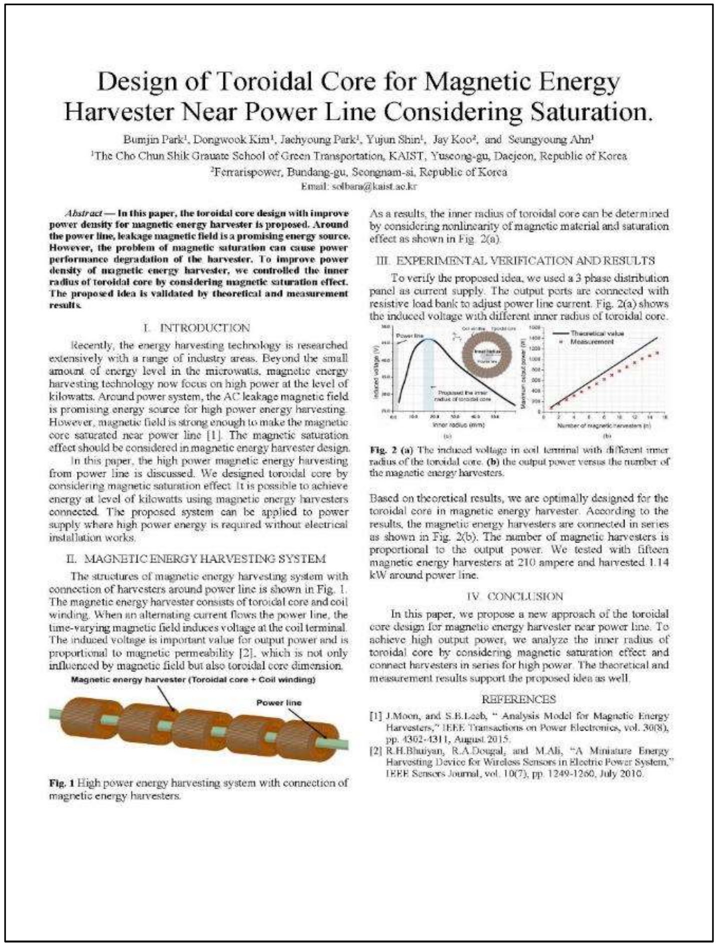
2. Ferraris Research efforts

Paper title	Academic conference / Journal	Co-auther
Magnetic energy harvesting from traction return current in railway system	Korea Metropolitan Railway Association (2018 Autumn Conference)	Jay(JA-IL) Koo, Bumjin Park, Chan Joon Park, Ok-Hyoun Jung, Seungyoung Ahn
Analytic Computation of Power Line Voltage Drop Produced by Magnetic Energy Harvesting Device	INTERMAG 2018 (Academic conference)	Jay(JA-IL) Koo, Kibeom Kim, Bumjin Park, Jedok Kim, Seungyoung Ahn
A 1.14 kW Magnetic Energy Harvesting Near Power Line by Considering Saturation Effect	EVS31 & EVTeC 2018 (Academic conference)	Jay(JA-IL) Koo, Bumjin Park, Dongwook Kim, Jaehyoung Park, Yujun Shin, Seung young Ahn, Okhyun Jeong
Design of Toroidal Core for Magnetic Energy Harvester near Power Line Considering Saturation	Joint IEEE & APEMC 2018 (Academic conference)	Jay(JA-IL) Koo, Bumjin Park, Dongwook Kim, Jaehyoung Park, Yujun Shin, Seung young Ahn
Design of magnetic energy harvesting core using saturation effect	Electronic Society of Korea (2018 Summer Conference)	Jay(JA-IL) Koo, Bumjin Park, Dong Wook Kim, Jae Hyung Park, Yujun Shin, Chan J oon Park, Ok-Hyoun Jung, Seungyoung A hn
Application of magnetic field energy harvesting near power line for maintenance sensors in railway system	Korea Metropolitan Railway Association (2018 Spring Conference)	Jay(JA-IL) Koo, Bumjin Park, Yujun Shin, Jaehyoung Park, Jong-Kew Won, Ki Hyun g Kim, Seungyoung Ahn
Optimization Design of Toroidal Core for Magnetic Energy Harvesting Near Power Line by Considering Saturation Effect	AIP Advances 8 (2018 Journal)	Jay(JA-IL) Koo, Bumjin Park, Dongwook Kim, Jaehyoung Park, Kibeom Kim, Hyun Ho Park, Seungyoung Ahn
Design methodology of toroidal core for magnetic energy harvesting based on magnetic field dependence of permeability near power line	MMM 2017 (Academic conference)	Jay(JA-IL) Koo, Bunjin Park, Dongwook Kim, Jaehyoung Park, Hyunho Park, Seun gyoung Ahn
Study on the CT-based wide range current detection system combined with contactless power	Korea Institute of Lighting & Electrical Equipment(2016 Spring Conference)	Jay(JA-IL) Koo, Jong-Kew Won, Dong-Kw an Seo, Jin-Ouk Kim, Hwa-Young Kim, Ok-Hyoun Jung

- **Joint IEEE & APEMC 2018** Design of Toroidal Core for Magnetic Energy Harvester near Power Line Considering Saturation



Design of Toroidal Core for Magnetic Energy Harvester Near Power Line Considering Saturation.

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[2]Ferrarispower, Bundang-gu, Seongnam-si, Republic of Korea
Email: solbara@kaist.ac.kr

Abstract — **In this paper, the toroidal core design with improve power density for magnetic energy harvester is proposed. Around the power line, leakage magnetic field is a promising energy source. However, the problem of magnetic saturation can cause power performance degradation of the harvester. To improve power density of magnetic energy harvester, we controlled the inner radius of toroidal core by considering magnetic saturation effect. The proposed idea is validated by theoretical and measurement results.**

I. INTRODUCTION

Recently, the energy harvesting technology is researched extensively with a range of industry areas. Beyond the small amount of energy level in the microwatts, magnetic energy harvesting technology now focus on high power at the level of kilowatts. Around power system, the AC leakage magnetic field is promising energy source for high power energy harvesting. However, magnetic field is strong enough to make the magnetic core saturated near power line [1]. The magnetic saturation effect should be considered in magnetic energy harvester design.

In this paper, the high power magnetic energy harvesting from power line is discussed. We designed toroidal core by considering magnetic saturation effect. It is possible to achieve energy at level of kilowatts using magnetic energy harvesters connected. The proposed system can be applied to power supply where high power energy is required without electrical installation works.

II. MAGNETIC ENERGY HARVESTING SYSTEM

The structures of magnetic energy harvesting system with connection of harvesters around power line is shown in Fig. 1. The magnetic energy harvester consists of toroidal core and coil winding. When an alternating current flows the power line, the time-varying magnetic field induces voltage at the coil terminal. The induced voltage is important value for output power and is proportional to magnetic permeability [2], which is not only influenced by magnetic field but also toroidal core dimension.

Fig. 1 High power energy harvesting system with connection of magnetic energy harvesters.

As a results, the inner radius of toroidal core can be determined by considering nonlinearity of magnetic material and saturation effect as shown in Fig. 2(a).

III. EXPERIMENTAL VERIFICATION AND RESULTS

To verify the proposed idea, we used a 3 phase distribution panel as current supply. The output ports are connected with resistive load bank to adjust power line current. Fig. 2(a) shows the induced voltage with different inner radius of toroidal core.

Fig. 2 (a) The induced voltage in coil terminal with different inner radius of the toroidal core. **(b)** the output power versus the number of the magnetic energy harvesters.

Based on theoretical results, we are optimally designed for the toroidal core in magnetic energy harvester. According to the results, the magnetic energy harvesters are connected in series as shown in Fig. 2(b). The number of magnetic harvesters is proportional to the output power. We tested with fifteen magnetic energy harvesters at 210 ampere and harvested 1.14 kW around power line.

IV. CONCLUSION

In this paper, we propose a new approach of the toroidal core design for magnetic energy harvester near power line. To achieve high output power, we analyze the inner radius of toroidal core by considering magnetic saturation effect and connect harvesters in series for high power. The theoretical and measurement results support the proposed idea as well.

REFERENCES

[1] J.Moon, and S.B.Leeb, " Analysis Model for Magnetic Energy Harvesters," IEEE Transactions on Power Electronics, vol. 30(8), pp. 4302-4311, August 2015.
[2] R.H.Bhuiyan, R.A.Dougal, and M.Ali, "A Miniature Energy Harvesting Device for Wireless Sensors in Electric Power System," IEEE Sensors Journal, vol. 10(7), pp. 1249-1260, July 2010.

V. Spec sheets of Ferraris Tolenoid C® products

▪ Tolenoid C® (Contactless power supply)

Line thickness
Under 1.30 inches

Line thickness
Under 2.48 inches

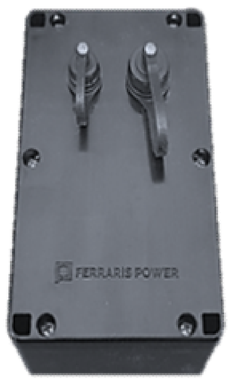
Split form factor

Tolenoid C® (1.30 / 2.48 inches)

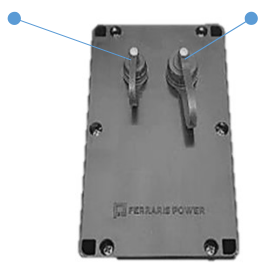
- Tolenoid C® convert magnetic energy around power line into electric power form for various electric devices.
- Tolenoid C® can be installed into power lines regardless of its voltage such as high voltage distribution lines, underground lines as a form factor of splitable one which make them possible easy install Tolenoid C®.
- Tolenoid C® can save electric device installation cost and time compare to conventional way which requires transformer and complex wiring process for 110 or 220Vac power line.
- Maximize efficiency of induction electricity generation by effective Core design and manufacturing process from Ferraris technology.
- Secure electric power energy generation from 10 ~ 650 Ampere power line.
- Water proof case design. (IP65 ~ IP68)
- Electric power generation capacity depends on the current of the primary power line and this can be controlled Ferraris designed SMPS type.

Specifications	Under 1.30 "	Under 2.48 "
Primary power line current (A)	10 ~ 650 A	
Primary power line voltage (V)	~ 30 ㎸	
Primary power line wire thickness (inches)	~ 1.30	~ 2.48
Output current type	AC output	
Working temperature (°F)	- 40 ~ 185	
Waterproof (IP)	IP 65 ~ 68 (KS C IEC 60529)	
Size (W*D*H inches)	5.12 * 3.94* 4.33	6.69 * 3.94 * 5.90
Weight (lb)	4.70	7.05
Case material	PC GF 20	

▪ SMPS (Switching mode power supply)



Output : connector to system



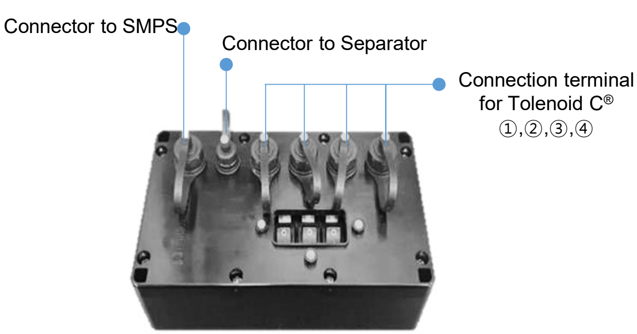
Input : connector to multi-adapter

SMPS (12V 20W / 60W)

- SMPS block is a semiconductor based circuit board which convert AC input from Tolenoid C® into to a DC output for the user requirement or multi-adapter for multiple Tolenoid C®.
- Ferraris SMPS block is basically composed of two component. Incoming AC signal is converting into DC signal by regulator sub-block and this DC signal is smooth by advanced SMPS block for stable DC output.
- Ferraris SMPS block has the following features.
  1) Preventing overvoltage, overcurrent, overload feature
  2) Line regulation less than 1%
  3) Control maximum output controllability
  4) Incoming input controllability
- Available IP65 to IP68 case design available.
- Scalable power output capacity is possible depending on customer need.

Specifications	12V/20W	24V/60W
Input	Output of Tolenoid C®	
Output	DC 12V/20W	DC 24V/60W
Working temperature (°F)	- 40 ~ 185	
Waterproof (IP)	IP 65 ~ 68 (KS C IEC 60529)	
Size (W*D*H inches)	3.54 * 5.51 * 2.36	
Weight (lb)	1.87	
Case material	PC GF 20	

▪ Multi-adapter



Multi-adapter

- Multi-adapter is a sub-block tool that allows multiple Tolenoid C® to be connected and operated.
- This one make system allow output power scalability, such as increasing power from 10 to 40Watt and also reducing the required minimum current of power line for Tolenoid C® power generation.
- The multi-adapter has four Tolenoid C® connectors and one for each SMPS and Separator.
- For the future usage, Tolenoid C® connectors can be added more, such as up to eight.
- Deliver generated power from these multiple Tolenoid C® to SMPS block.
- Separator is for safe installing and disassembling Tolenoid C® to SMPS block. This is mandatory one for safety.
- You can switch on and off each Tolenoid C® by pressing switch even if you connect them up to multiple Tolenoid C®.

Tolenoid C®	Up to 4ea
Separator	For installation/de-installation
SMPS	SMPS connections based on desired voltage and output
Working temperature (ºF)	- 40 ~ 185
Waterproof (IP)	IP 65 ~ 68 (KS C IEC 60529)
Size (W*D*H inches)	7.09 * 3.94 * 1.77
Weight (lb)	2.09
Case material	PC GF 20

▪ Separator

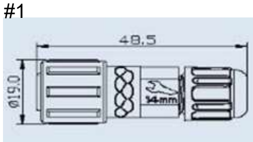
Separator

- The Separator is tool for safe installation or de-installation of Tolenoid C®. at active power line without shutting down power line.
- The Separator make it possible of demagnetization of Tolenoid C® occurred when the Tolenoid C® is installed in the magnetic field around the active power line.
- Install or de-installation using physical force or other equipment without the Separator causes a safety problems such as finger jammed in between and there is a risk of injury by cutting surface of the core.
- With Separator on, you can install or de-install Tolenoid C® at active power line without physical force or other big tools.
- Be sure to sue the designated Separator for Tolenoid C® check product serial numbers.

Specifications	
Working temperature (ºF)	- 40 ~ 185
Waterproof (IP)	IP 40 (KS C IEC 60529)
Size (W*D*H inches)	1.93 * 2.60 * 1.50
Weight (lb)	0.29
Case material	Plastic

▪ Cable and Connector - Obtain UL & CUL Certification, Waterproof test pass - IP 68

#1



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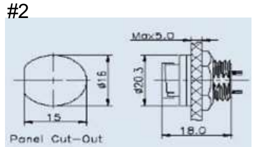

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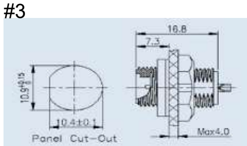
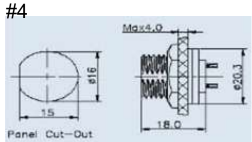


#4



Cable

- Internal wiring of electrical electronic equipment

Cable Connector

- #1 Connector connected to cable
- male & female pin (screw type, solder)

Output Connector

- #2 Tolenoid C®, Multi-adapter output connector, panel mount & female pin (lock bayonet type, solder)
- #3 SMPS output Connector, rear panel mount & male (screw type, solder)

Input Connector

- #4 Multi-Adapter, SMPS input connector, panel mount & male pin (screw type, solder)

Interface Cables	
Rated	(UL) 221ºF 300V
Insulation vessel	UL 1007, UL 1061 Type
Flammability	VW-1, FT-1 Satisfied
Application specification	UL Subject 758, 1581 CSA C22.2 No. 210

Cable Connector	
Panel thickness (inches)	0.138 ~ 0.268 inches
Environmental protection	IP 67 or 68 (IEC 60529)
Mechanical life	500 Mating cycles
Operating temperature (ºF)	- 49 ~ 221
Voltage rating	110 V
Rated current (104 ºF)	5 A

Output Connector	
Panel thickness (inches)	Max 0.196 inches
Environmental protection	IP 67 or 68 (IEC 60529)
Mechanical life	500 Mating cycles
Operating temperature (ºF)	- 49 ~ 221
Voltage rating	30 ~ 300 V
Rated current (104 ºF)	2 ~ 10 A

Input Connector	
Panel thickness (inches)	Max 0.157 inches
Environmental protection	IP 67 or 68 (IEC 60529)
Mechanical life	500 Mating cycles
Operating temperature (ºF)	221
Voltage rating	30 ~ 300 V
Rated current (104 ºF)	2 ~ 10 A

FERRARIS INC.

Electric energy is Electromagnetic energy,

Our approach to a new paradigm of efficient electric power generation and recycling !

If there are any questions, please feel free to contact Ferraris Inc. as below,

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