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Enertech CATALOGUE 2020.07

Global Inspiration
GyeongGi-Do

enertech

Hybrid Transformer

Development Five Companies Collaborative R&D Products

한국동서발전 한국남동발전 한국중부발전 한국서부발전 한국남부발전

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Hybrid Transformer

What is a hybrid transformer?

It was developed for the first time in the industry through cooperative research and development with 5 power generation companies under Korea Electric Power Corporation. Especially, if installed in a load facility with high harmonics, it can prevent damage to electrical facilities and reduce power loss due to harmonics.

Technical certificate and patent registration certificate


우수제품지정증서

지정번호 2016192

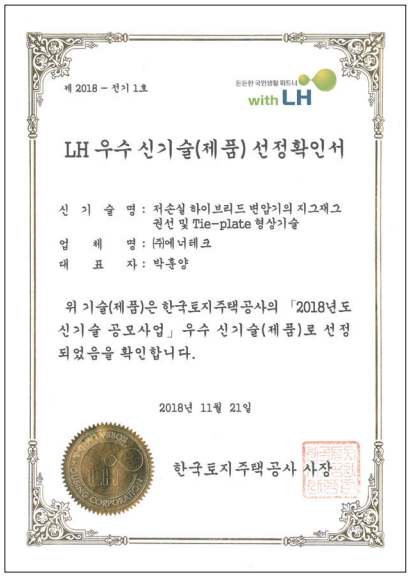
제 품 명 : 저손실 하이브리드변압기
추진기업명(참여기업명) : (주)에너테크(산업전기㈜)
대표자명 : 박 훈 양
지정기간 : 2016. 12. 22 ~ 2020. 12. 21
지정범위 : 뒷면참조

위 제품을 조달사업에관한법률
제9조의2 및 동법시행령 제18조에 따라
위와 같이 우수제품으로 지정합니다

2019년 6월 20일

조 달 청 장

Procurement Excellent Product


제 2018 – 전기 1호

with LH

LH 우수 신기술(제품) 선정확인서

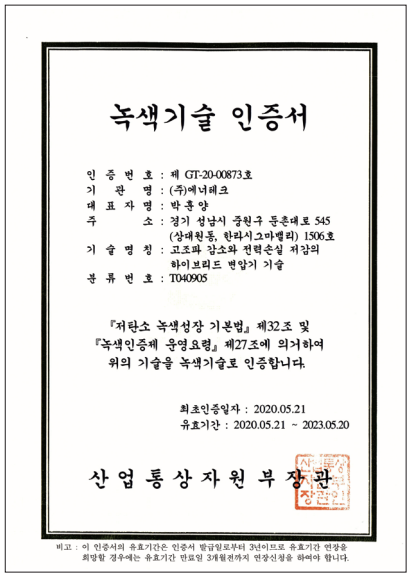
신 기 술 명 : 저손실 하이브리드 변압기의 지그재그 권선 및 Tie-plate 형상기술
업 체 명 : ㈜에너테크
대 표 자 : 박훈양

위 기술(제품)은 한국토지주택공사의 「2018년도 신기술 공모사업」 우수 신기술(제품)로 선정되었음을 확인합니다.

2018년 11월 21일

한국토지주택공사 사장

LH Certification of New Technology (Products)


녹색기술 인증서

인 증 번 호 : 제 GT-20-00873호
기 관 명 : (주)에너테크
대 표 자 명 : 박훈양
주 소 : 경기 성남시 중원구 둔촌대로 545 (상대원동, 한라시그마밸리) 1506호
기 술 명 칭 : 고조파 감소와 전력손실 저감의 하이브리드 변압기 기술
분 류 번 호 : T040905

『저탄소 녹색성장 기본법』 제32조 및
『녹색인증제 운영요령』 제27조에 의거하여
위의 기술을 녹색기술로 인증합니다.

최초인증일자 : 2020.05.21
유효기간 : 2020.05.21 ~ 2023.05.20

산업통상자원부장관

비고 : 이 인증서의 유효기간은 인증서 발급일로부터 3년이므로 유효기간 연장을 희망할 경우에는 유효기간 만료일 3개월전까지 연장신청을 하여야 합니다.

Green Technology Certification


특허증
CERTIFICATE OF PATENT

특허 Patent Number 제 10-1573813 호
출원번호 Application Number 제 10-2015-0092161 호
출원일 Filing Date 2015년 06월 29일
등록일 Registration Date 2015년 11월 26일

발명의 명칭 Title of the Invention
저손실 하이브리드 변압기 및 그 제조 방법

특허권자 Patentee
등록사랑판매 기재

발명자 Inventor
박훈양(680110-1******)
경기도 수원시 영통구 센트럴타운로 76, 6106동 1202호 (이의동, 광교e편한세상아파트)

위의 발명은 「특허법」에 따라 특허등록원부에 등록되었음을 증명합니다.
This is to certify that, in accordance with the Patent Act, a patent for the invention has been registered at the Korean Intellectual Property Office.

2015년 11월 26일

특허청장
COMMISSIONER,
KOREAN INTELLECTUAL PROPERTY OFFICE
최 동 규

Korean patent certificate


The United States of America

The Director of the United States Patent and Trademark Office

Has received an application for a patent for a new and useful invention. The title and description of the invention are enclosed. The requirements of law have been complied with, and it has been determined that a patent on the invention shall be granted under the law.

Therefore, this

United States Patent

Grants to the person(s) having title to this patent the right to exclude others from making, using, offering for sale, or selling the invention throughout the United States of America or importing the invention into the United States of America, and if the invention is a process, of the right to exclude others from using, offering for sale or selling throughout the United States of America, or importing into the United States of America, products made by that process, for the term set forth in 35 U.S.C. 154(a)(2) or (c)(1), subject to the payment of maintenance fees as provided by 35 U.S.C. 41(b). See the Maintenance Fee Notice on the inside of the cover.

Acting Director of the United States Patent and Trademark Office

United States Patent Certificate


证书号第1087815号

发明专利证书

发明名称：包括变压功能和谐波及电流不平衡改善功能的混合变压器及包括其的供电系统
发明人：朴训莽
专利号：ZL 2009 8 0100064.6
专利申请日：2009年07月23日
专利权人：能源技术有限公司
授权公告日：2012年11月28日

局长

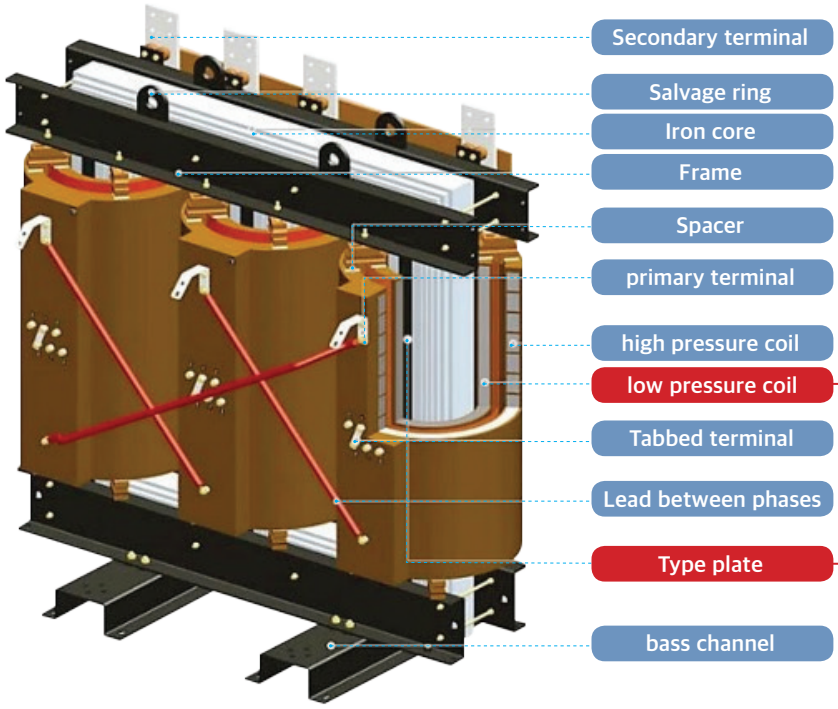
2012年11月28日

第1页（共1页）

Chinese patent certificate

Features of Hybrid Transformers

The effect of three birds with one stone with a function of 『variable + high tide attenuation + imbalance improvement』



harmonic attenuation
Power Loss Reduction
reducing winding temperature

Patent technology (No.10-1573813)

Zig-Zag Winding
(NET New Technology)

New shape development

Five Power Generation Companies Collaborative Research and Development Products

한국동서발전㈜ KOEN 한국남동발전 KOMIPO 한국중부발전 cwp 한국서부발전㈜ 한국남부발전㈜

- Industry's first development and new technology (NET) certification
- Procurement Excellent Products and Performance Certification
- LH Excellent New Technology (Product) and Green Technology Certification
- Selection of priority purchase products for public institutions
- Korean, U.S. and China Patent Registry

New Technology (NET) and Procurement Excellent Products

01 Mandatory and Preferential Purchasing Products of Public Institutions

- Evidence: [Act on Promotion of Purchase of Small and Medium Enterprise Products and Support for Market Use] Article 14 and Article 13 of the Enforcement Decree of the same Act.
- Regulations: 10% or more of the purchases made by public institutions should be purchased as technology development products for small and medium enterprises
- Target purchase: excellent procurement products, performance certification products, NEP products, GS certified products

02 Private contract products (excluded from competitive bidding between small and medium-sized enterprises)

- [Enforcement Decree of the Act on Contracts to which the State is a Party] Article 26 paragraph 1.
- Article 25 Paragraph 1 of [Enforcement Decree of the Act on Contracts to Which a Local Government Is a Party]
- [Regulations on Contracts of Sub-Government Agencies of Public Enterprises] Article 8 No.
- Article 18 Paragraph 6 of [Enforcement Decree of the Act on Private Contractable Procurement Projects Without Limits on Purchasing Amounts]

03 Disclaimer for loss of purchase by purchasing manager

- Evidence: [Act on Promotion of Purchase of Small and Medium Business Products and Support for Sales] Article 14(3)
- Regulations: The purchasing manager of a public institution contracted to purchase a technology development product subject to preferential purchase shall not be liable for the loss caused by the purchase of the product unless proven intentional or gross negligence.
- Target : Best procurement products, performance certification products, NEP products, GS certified products

04 Granting additional points to the management evaluation of public institutions (the Ministry of Planning and Finance)

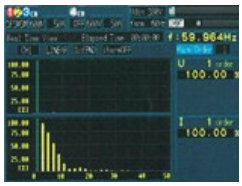
- Evidence: [Act on the Operation of Public Institutions] Article 48 (Evaluation of Management Performance)
- Regulations: The government's recommended policy gives additional points to SMEs' preferential purchase of technology development products.
- Targets: Small and medium-sized enterprises (0.4 to 1.0 points), technology development products (0.2 to 0.4 points)

05 Target for Promoting Purchase of Green Products

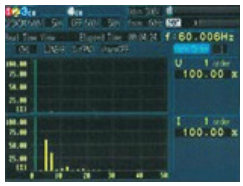
- Evidence: [Enforcement Decree of the Framework Act on Low Carbon, Green Growth] Article 20 Paragraph 1
- Regulations: Public institutions should purchase green products or reflect them in design
- Target: Products manufactured by utilizing green technology with green certification.

Performance Up, Cost Down

01 Harmonics up to 70% reduction

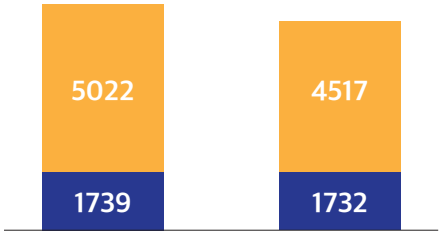


high efficiency transformer



hybrid transformer

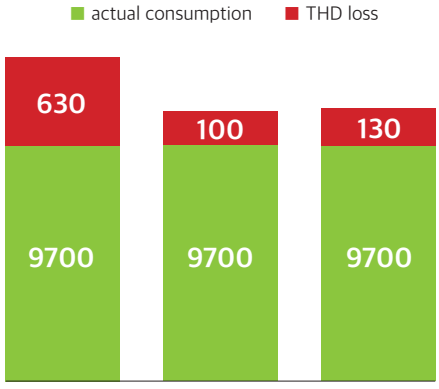
02 Transformer loss 7.6% reduction



high efficiency transformer

hybrid transformer

03 Electric charges 3-5% reduction

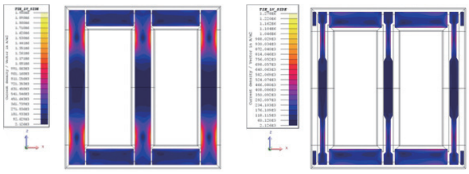


high efficiency transformer

high efficiency transformer +active filter

Hybrid Transformer

04 Hot-spot temperature 13.3% reduction



high efficiency transformer

hybrid transformer

※ It may vary depending on the load type and the environment.

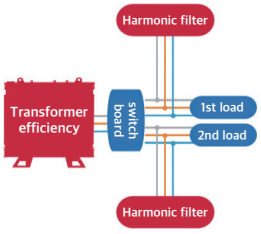
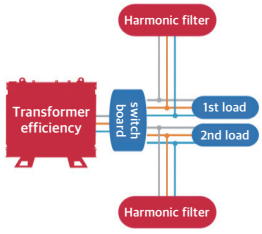
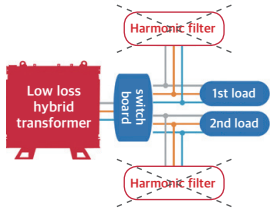
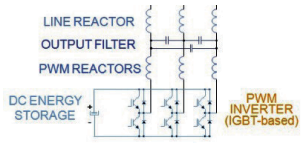
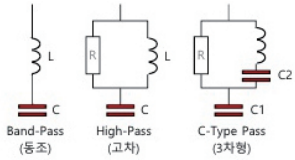
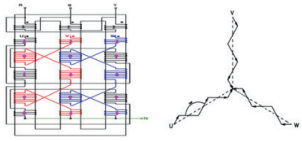
Certified Agency Test Report

- **Testing institution:**
  Korea Electrotechnology Research Institute (KERI)

- **Product specifications:**
  22,900V-380/220V
  Mold Transformer 1000kVA

Evaluation item	Evaluation standard	Test result		
		Existing Technology	Hybrid transformer	rate of increase and decrease
1. winding resistance	within 10% of the line's non-conformity	pass	pass	-
2. Transformer	within 0.5%	pass	pass	-
3. Impedance voltage [%]	within 6% ± 10%.	6.1	5.4	▼ 11.5%
4. Load Losses [W] (Resistance hand) (Pyoyu load loss)	Standard consumption efficiency reference value	5,022 (3,619) (1,403)	4,517 (3,633) (895)	▼ 10.1% ▲ 0.3% ▼ 36.2%
5. No-loader [W]	Standard consumption efficiency reference value	1,739	1,732	▼ 0.4%
6. Efficiency [%]	99.40 and above	99.40	99.43	-
7. Insulation test • Internal voltage of brain impulse • Commercial frequency internal voltage • Induced internal voltage	No Insulation Destruction	pass	pass	-
8. Partial Discharge [pC]	not more than 10 pC	6	6	-
9. Rising Temperature [K]	under 80K	1st: 23.1 2nd: 50.4	1st: 21.1 2nd: 43.7	▼ 8.6% ▼ 13.3%
10. Noise [dB]	not more than 70 dB	49.6	49.9	▲ 0.6%
11. Harmonics Test [A]	Reduced THD by 30%	76.8	49.3	▼ 35.8%

Comparison of the pros and cons of harmonic reduction measures

division	High-efficiency transformer + harmonic filter		Hybrid transformer
	Active filter	Manual filter	
Installation drawing			
Core technology	 PWM control using IGBT	 L-C manual filter	 Zig-Zag Winding
Advantages	• The best THD reduction performance • No influence on system %Z	• Low cost compared to active filter • Reduction of harmonics of a specific order	• 「Transformer + Harmonic Filter」 integrated • LCC cost, minimum installation space • Best safety and durability
Dis-advantages	• 2.5~4 times more expensive than manual filter • Multiple installation by harmonic load • Filter power consumption and durability	• Impact of system %Z and resonance • Multiple installation by harmonic load • Increased installation space and maintenance cost	• Applicable to 22.9kV or less • Maximum capacity 3,000kVA • THD reduction up to 70%

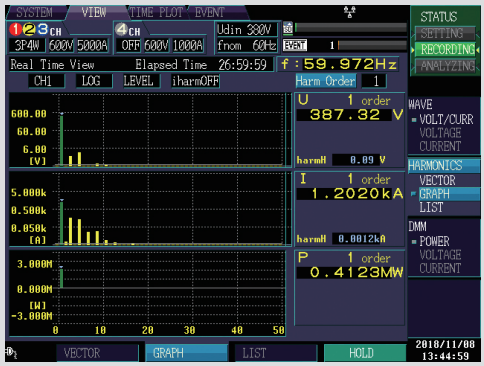
Hybrid Transformer Installation Case

Case 1. Gimpo Airport

- Equipment/load: Hybrid transformer 2,500kVA / LED load
- Installation effect

division	unit	before installation	after installing	change rate (%)
VTHD	%	1.7	0.9	▼ 47.1
ITHD	%	31.9	16.5	▼ 48.3
Unbalance	%	6.8	5.5	▼ 19.1

Before installation



after installing

- Harmonics (ITHD) 48.3%▼, Unbalanced 19.1%▼

Case 2. Ulsan Airport

- Equipment/load: Hybrid transformer 200kVA (aircraft lighting), 750kVA (general power)
- Installation effect

equipment		Aviation lighting (200kVA)			General power (750kVA)		
division	unit	before installation	after installing	change rate (%)	before installation	after installing	change rate (%)
Active power	kW	97	122	▲ 25.8	99	48	▼ 51.5
ITHD	%	35.3	11.1	▼ 68.6	20.2	10.1	▼ 50.0
Unbalance	%	5.3	4.0	▼ 24.5	35.6	11.5	▼ 67.7
PF	%	90.1	92.3	▲ 2.4	95.5	98.3	▲ 2.9

- Aviation lighting >>> Harmonic (ITHD) 68.6%▼, Unbalance 24.5%▼
- General power >>> Harmonic (ITHD) 50.0%▼, Unbalance 67.7%▼

Case 3. Nongshim

- Equipment/load: Hybrid transformer 1,500kVA, 1000kVA
- Installation effect

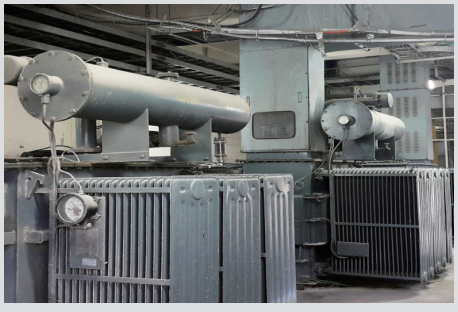
equipment	division	Power factor (%)	Voltage imbalance (%)	Current imbalance (%)	Voltage harmonic (%)	Current harmonic (%)
Hybrid transformer 1,500kVA	Before installation	86.4	0.66	10.41	1.44	5.11
	after installing	89.2	0.31	6.28	1.12	2.67
	change rate (%)	▲ 3.2%	▼ 53.0%	▼ 39.7%	▼ 22.2%	▼ 47.7%
Hybrid transformer 1,500kVA	Before installation	73.3z	0.69	6.02	1.32	13.80
	after installing	81.2	0.16	2.93	1.07	5.75
	change rate (%)	▲ 10.8%	▼ 76.8%	▼ 51.3%	▼ 18.9%	▼ 58.3%

- 1,500kVA >>> Harmonic (ITHD) 47.7%▼, Unbalanced 39.7%▼, Power Factor 3.2%▲
- 1,000kVA >>> Harmonics (ITHD) 58.3%▼, unbalanced 51.3%▼, power factor 10.8%▲

Case 4. Ssangyong C&B

- Equipment/load: Hybrid transformer 2,000kVA and others
- Installation effect

Installation date	Volume	Quantity	Investment cost	Annual electricity fee	Saving energy	Annual savings	Investment cost recovery
2016. 06	8,700VA	5 units	439 million	4,156 million	3.2%	133 million	3.3 years
2017. 12	4,550VA	5 units	261 million	1,436 million	3.9%	56 million	4.7 years



Before installation

after installing

Case 5. Haitai

- Equipment/load: Hybrid transformer 450kVA and others
- Installation effect

Installation date	Volume	Quantity	Investment cost	Annual electricity fee	Saving energy	Annual savings	Investment cost recovery
2016. 08	8,250kVA	8 units	445 million	1,976 million	4.9%	97 million	4.6 years

Before installation

after installing

Case 6. Monalisa

- Equipment/load: Hybrid transformer 2,500kVA and others
- Installation effect

Installation date	Volume	Quantity	Investment cost	Annual electricity fee	Saving energy	Annual savings	Investment cost recovery
2016. 08	4,500VA	3대	232 million	1,987 million	5.1%	101 million	2.3 years
2019. 08	3,300VA	2대	140 million	1,045 million	4.3%	45 million	3.1 years

Before installation

after installing

Hybrid mold transformer

Manufactured with new technology, it is a compact size, low-loss, high-efficiency transformer that is easy to maintain, has excellent short-circuit mechanical strength, moisture resistance, and flame retardancy, and is suitable for facilities with heavy load fluctuations, such as electric power supply facilities.

The short circuit strength is strong.

Epoxy resin, which has excellent electrical and mechanical strength, is a structure that is resistant to short circuit accidents and external shocks by vacuum casting the coil.

Excellent charging voltage (Impulse Voltage Strengh) characteristics.

Epoxy resin insulation effect and the design method of split winding are excellent in the withstand voltage characteristics.

It has excellent fire retardant properties.

Epoxy resin, which has excellent flame retardant performance, is used to reduce the risk of fire caused by electric arcs, and it is self-extinguishing and resistant to fire.

It has excellent insulation performance.

Epoxy Resin coil greatly improves the dielectric strength and blocks external moisture.

The overload capacity is large.

Compared to the inflow transformer, the temperature time constant of the winding is designed so that it can be used without abnormality even under temporary overload.

It is suitable for power supply of facilities with heavy load fluctuations.

It is suitable for rapidly fluctuating loads such as train power supply equipment and rolling equipment.

It is environmentally friendly.

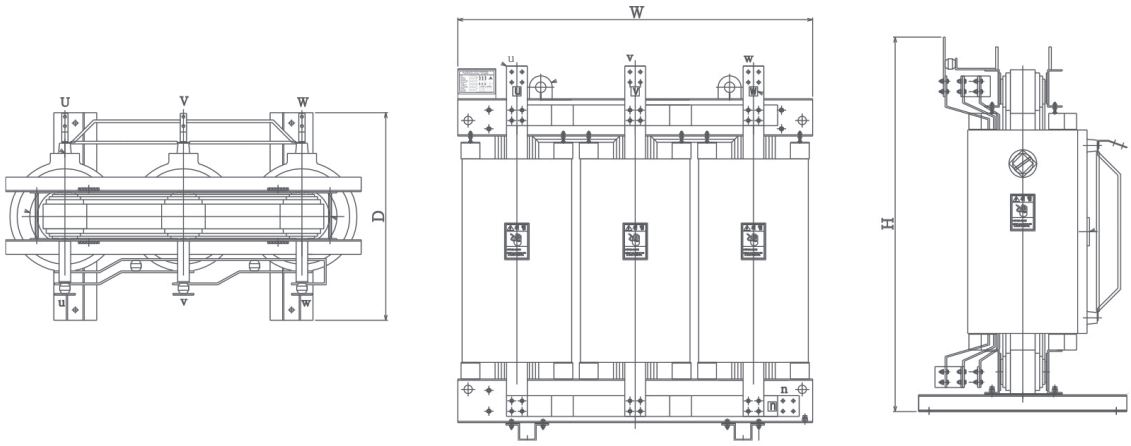
Since no oil is used, there is no risk of environmental contamination by oil spill.

Easy maintenance.

Oil change and separate firefighting equipment are unnecessary compared to the inlet transformer.

division		Standard rating			
Installation place		Indoor/outdoor			
frequency		50/60Hz			
Insulation type		Class B, Class F			
Allowable winding temperature		80K			
Insulation level	Grid voltage	24kV	7.2kV	3.6kV	0.6kV or less
	Commercial frequency	50kV	20kV	10kV	3kV
	Impact withstand voltage	95kV	60kV	40kV	-
Applicable standards		KSC 4311, IEC 60726			
1st rated voltage (kV)		22.9		6.6/3.3	
Primary TAP voltage (kV)		F23.9-R22.9-21.9-19.9		F6.9-R6.6-6.3-6.0-5.7 F3.45-R3.3-3.15-3.0-2.85	
Secondary rated voltage (kV)		380/220V, 440V			
Constant		3P			
Angular displacement		Dzn0			
Rated capacity (kVA)		100~3000 or less			

Hybrid Mold Transformer-External Dimension



Rated specification

3P 22.9kV-LV (Standard consumption efficiency)

Volume (kVA)	impedance (±10%)	Voltage fluctuation rate(%)	No-load current (%)	Standard consumption efficiency (At 50% load)	External dimensions			weight (kg)
					W	D	H	
100	4.5	2.2	2.0	98.9	1340	850	1340	1100
200	4.5	2.0	1.7	99.0	1400	860	1580	1350
300	5.5	1.7	1.5	99.1	1540	890	1530	1780
400	5.5	1.6	1.4	99.2	1560	910	1720	2300
500	6.5	1.5	1.3	99.2	1560	910	1720	2450
600	6.0	1.4	1.2	99.3	1740	950	1800	3100
750	6.0	1.4	1.1	99.3	1780	980	1900	3250
1000	6.0	1.3	1.0	99.4	1920	1000	2170	4500
1250	7.0	1.3	1.0	99.4	1980	1055	2370	5100
1500	7.5	1.2	0.9	99.5	2240	1200	2560	7100
2000	8.0	1.1	0.8	99.5	2430	1300	2700	8800
2500	8.0	1.1	0.7	99.5	2570	1400	2890	11000

※ Above specifications are subject to change depending on the installation location and options.

Rated specification

Hybrid inlet transformer is a new technology transformer that realizes low loss and high efficiency through the double Zig-Zag winding method by optimizing the working environment and significantly reducing noise by using high-permeability oriented silicon steel sheet with no aging.

Iron core

The iron core is made of highly permeable, oriented silicon steel sheet with no aging change to minimize no-load current and loss, and reduces noise and vibration through precision machining.

Winding

The winding depends on the type of transformer, and the optimal winding method is applied. Conductors are selected for high quality to sufficiently withstand the allowable current, temperature rise, and electromagnetic force generated in the event of an external short circuit, and are designed to have optimal efficiency in consideration of insulation class and mechanical strength.

Isolation

The insulation effect is maximized by using the best insulation material to withstand abnormal voltage and breakdown tests.

Enclosure

The enclosure is manufactured using cold-rolled steel sheet, and is sufficiently manufactured to take into account the sufficient mechanical strength to withstand the internal pressure and to prevent deformation from transport and impact.

stamp

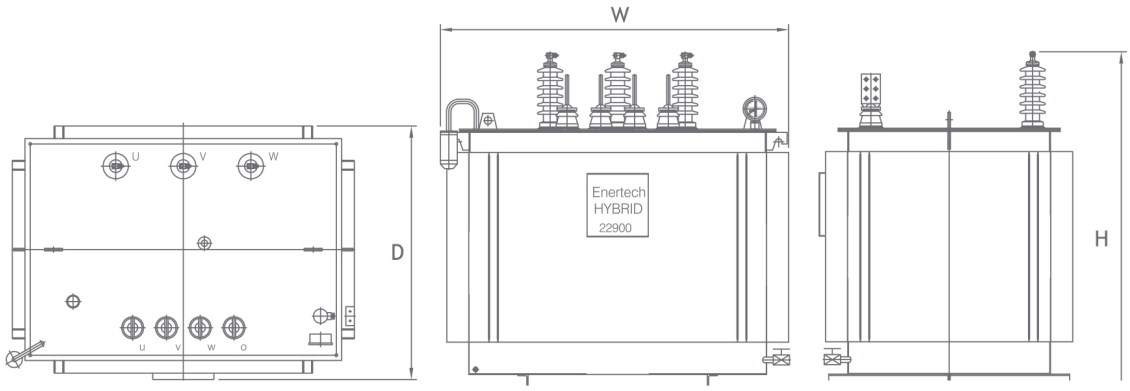
Short peening and powder coating prevent rust of the enclosure.

Preservation method of insulating oil

To prevent the aging of insulating oil, small and medium-sized transformers contain Silica Gel. A hygroscopic respirator is used, and a large transformer is equipped with a conservator.

division		Standard rating			
Installation place		Indoor/outdoor			
frequency		50/60Hz			
Insulation type		Class A			
Allowable winding temperature		60K			
Insulation level	Grid voltage	24kV	7.2kV	3.6kV	3kV
	Commercial frequency	50kV	20kV	10kV	
	Impact withstand voltage	125kV	60kV	40kV	-
Applicable standards		IEC 60076-11			
1st rated voltage (kV)		22.9		6.6/3.3	
Primary TAP voltage (kV)		F23.9-R22.9-21.9-19.9		F6.9-R6.6-6.3-6.0-5.7 F3.45-R3.3-3.15-3.0-2.85	
Secondary rated voltage (kV)		380/220V, 440V			
Constant		3P			
Angular displacement		Dzn0			
Rated capacity (kVA)		100~3000 or less			

Hybrid Inlet Transformer-External Dimension



Rated specification

3P 22.9kV-LV (Standard consumption efficiency)

Volume (kVA)	impedance (±10%)	Voltage fluctuation rate(%)	No-load current (%)	Standard consumption efficiency (At 50% load)	External dimensions			weight (kg)
					W	D	H	
100	6.0	1.7	3.5	99.0	1420	930	1480	1600
200	5.1	1.7	3.5	99.1	1350	950	1480	1600
300	5.5	1.6	3.0	99.2	1410	1000	1540	2000
400	4.3	1.6	3.0	99.2	1350	980	1560	2050
500	5.2	1.6	3.0	99.2	1390	1040	1590	2300
600	5.5	1.5	3.0	99.3	1600	1070	1710	3150
750	5.0	1.5	3.0	99.3	1600	1070	1710	3150
1000	5.6	1.4	3.0	99.3	1750	1150	1800	4000
1250	5.8	1.4	3.0	99.4	1800	1300	2000	5300
1500	6.0	1.4	2.5	99.4	1800	1300	2000	5300
2000	6.0	1.3	2.5	99.4	1900	1450	2030	5850
2500	6.9	1.3	2.5	99.5	2550	1750	2370	7300

※ Above specifications are subject to change depending on the installation location and options.