EONGE 永锦电气

国家级绿色供应链示范企业

国家级高新技术企业

EONGE 专注电力 服务全球
FOCUS ON POWER·SERVE THE WORLD

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电力电子电容器

POWER ELECTRONIC CAPACITOR

专注电力 服务全球
FOCUS ON POWER·SERVE THE WORLD

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产品目录

公司简介 COMPANY INTRODUCTION

自1988年创立，永锦电气始终以“助力电网高效安全运行”为使命，深耕高端电气装备领域。作为国家火炬计划重点单位、国家绿色供应链示范企业，凭借国家级高新技术企业的硬核实力，成为国家电网、南方电网核心战略合作伙伴。
Shanghai Yongjin Electric Technology Co., Ltd. was founded in 1988, and has always taken "Facilitating the efficient and safe operation of power grids" as its mission, while deeply focusing on the high-end electrical equipment field. As a key unit of the National Torch Program and a demonstration enterprise of the National Green Supply Chain, relying on the solid strength of a national high-tech enterprise, it has become a core strategic partner of State Grid Corporation of China (SGCC) and China Southern Power Grid (CSG).

永锦电气构建“院士工作站&研究院 + 双省级研发 / 技术中心”创新矩阵，依托上海、台州、嘉兴三大智慧生产基地，形成“研发 - 智造 - 服务”全产业链结构；产品覆盖高低压电力电容器、1~500kV 中高压电缆附件等核心领域，业务遍布全国及海外市场。
Yongjin Electric has established an innovation matrix comprising "Academician Workstations & Research Institutes, as well as two provincial-level R&D and Technology Centers". Leveraging its three smart production bases in Shanghai, Taizhou and Jiaxing, the company has built a complete industrial chain integrating "R&D - Intelligent Manufacturing - Services". Its product portfolio covers core sectors including high and low voltage power capacitors and medium to high voltage cable accessories (1~500kV), with business operations spanning across domestic and overseas markets.

永锦电气深度参与国家重点工程建设，为酒泉卫星发射基地、北京奥运会、上海世博会、杭州G20峰会、北京大兴机场、白鹤滩特高压输电等标志性工程项目提供了优质产品，以“全生命周期保障体系”为电力安全保驾护航。
Yongjin Electric has played an active and pivotal role in the construction of national key projects, delivering high-quality, reliable products to numerous iconic landmark projects such as the Jiuquan Satellite Launch Center, the 2008 Beijing Olympic Games, the 2010 Shanghai World Expo, the G20 Hangzhou Summit, the Beijing Daxing International Airport, and the Baihetan UHV Power Transmission Project. It safeguards power system security through its proprietary "Full Life Cycle Support System".

展望未来，永锦电气将加速智能电网与低碳技术高效融合，致力成为电气制造与服务领域的头部企业。
Looking ahead, Yongjin Electric will continue to explore innovative approaches to integrating smart grids and low-carbon technologies. Guided by its vision to become a leading player in the niche sector, the company is committed to driving the high-quality development of the industry.

企业愿景 Corporate Vision：

成为细分领域的头部企业。
To be a top enterprise in the niche segment.

企业理念 Corporate Philosophy：

助力电网高效、安全、可靠运行。
To facilitate the efficient, safe and reliable operation of power grids.

企业价值观 Corporate Value：

客户第一，拥抱创新。 团结、协作、诚信、友善、学习、进取。
Customer First, Embrace Innovation Unity, Collaboration, Integrity, Amity, Learning, Progress.

重大业绩 Corporate Resources

- 酒泉卫星发射基地
  Jiuquan Satellite Launch Center
- 北京奥运会
  Beijing Olympic Games
- 上海世博会
  Shanghai World Expo
- 杭州G20峰会
  G20 Hangzhou Summit
- 北京大兴机场
  Beijing Daxing International Airport
- 特高压直流输电雅中-南昌、白鹤滩-江苏、白鹤滩-浙江、陇东-山东、哈密-重庆、陕北-安徽等标志性工程
  Landmark UHVDC (Ultra-High Voltage Direct Current) transmission projects including Yazhong-Nanchang, Baihetan-Jiangsu, Baihetan-Zhejiang, Longdong-Shandong, Hami-Chongqing and Shanbei-Anhui projects

企业资源 Corporate Resources

1. 公司核心团队由行业内知名专家、学者构成；
   The core team is composed of well-known experts and scholars in the industry.
2. 公司主要生产设备购置美国、德国、日本、瑞士等国家及地区：
   The main production equipment is procured from the United States, Germany, Japan, Switzerland and etc.
3. 公司是电力电容器、电缆附件国家标准、行业标准的编制、修订的成员单位；
   Eonge is a participating member in the formulation and revision of national and industrial standards for power capacitors and cable accessories.
4. 公司与国网电力科学研究院武汉分院、西安高压电器研究院、上海电缆研究所、上海电力公司松江供电公司、浙江大学等产学研单位建立了密切的科技协作关系；
   Eonge has established close scientific and technological cooperation ties with industry-university-research institutions including Wuhan Branch of State Grid Electric Power Research Institute, Xi'an High Voltage Apparatus Research Institute, Shanghai Cable Research Institute, Songjiang Power Supply Company of Shanghai Electric Power Company, and Zhejiang University.
5. 公司现有上海、台州、嘉兴三大制造基地,拥有超600余名的员工和60余项的产品资质和专利
   Eonge operates three major manufacturing bases in Shanghai, Taizhou and Jiaxing, with a workforce of over 600 employees, as well as more than 60 product certifications and patents

企业资质

重大业绩
Major Achievements

国家级高新技术企业
National High-Tech Enterprise

国家级绿色供应链示范企业
National-level Green Supply Chain Demonstration Enterprise

国家级绿色工厂
National and Municipal-level Green Factory

省市级企业技术中心
Provincial and Municipal-level Enterprise Technology Center

省市级企业研发中心
Provincial and Municipal-level Enterprise R&D Center

院士专家工作站
Academician and Expert Workstation

省市级重点专精特新企业
Provincial and Municipal-level Key Specialized, Sophisticated, Unique and Novel Enterprise

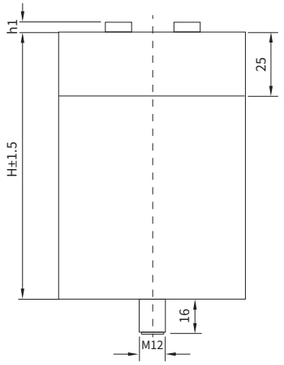
ISO 9001:2015质量管理体系认证
ISO 9001:2015 Quality Management System CertificationISO

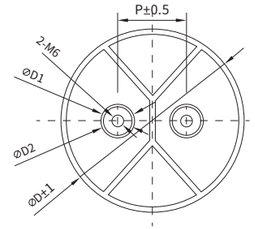
14001:2015环境管理体系认证ISO
ISO 14001:2015 Environmental Management System Certification

ISO 45001:2018职业健康安全管理体系认证
ISO 45001:2018 Occupational Health and Safety Management System Certification

ISO 50001:2018能源管理体系认证
ISO 50001:2018 Energy Management System Certification

ISO 14067-2018： 温室气体 产品碳足迹 量化要求和指南
ISO 14067:2018 Greenhouse Gases – Carbon Footprint of Products – Requirements and Guidelines for Quantification





概述 Overview

直流支撑电容器，又称DC-link电容器，属于无源器件的一种。永锦公司生产的直流支撑电容器，主要采用金属化聚丙烯薄膜介质，具有优良的自愈性能，采用UL94-V0级阻燃树脂在真空下浇注封装，安全可靠。被广泛应用于电力电子行业。

DC-link capacitors, also known as DC support capacitors, are a type of passive component. The DC-link capacitors produced by Yongjin Company mainly adopt metallized polypropylene film dielectric, featuring excellent self-healing performance.Encapsulated with UL94-V0 grade flame-retardant resin under vacuum, they are safe and reliable,and widely used in the power electronics industry.

主要用途 Main Applications

- 新能源行业：光伏逆变器、风电变流器等；
  New Energy Industry: PV inverters, wind power converters, etc.;
- 节能行业：高压变频器等；
  Energy-Saving Industry: High-voltage frequency converters, etc.;
- 焊机行业：大功率逆变焊机等；
  Welding Machine Industry: High-power inverter welding machines, etc.;
- 电源行业：大型高频开关电源、不间断电源UPS、应急电源EPS、中频电源、直流稳压电源、电镀电源、化成电源等；
  Power Supply Industry: Large-scale high-frequency switching power Supplies, Uninterruptible Power Supplies (UPS), Emergency Power Supplies (EPS), intermediate frequency power supplies, DC regulated power supplies, electroplating power supplies, formation power supplies, etc.;
- 电能质量行业：静止无功发生器SVG、有源电力滤波器APF等；
  Power Quality Industry: Static Var Generators (SVG), Active Power Filters (APF), etc.;
- 新能源汽车行业：纯电动汽车、混合动力汽车等；
  New Energy Vehicle Industry: Battery electric vehicles, hybrid electric vehicles, etc.;
- 电力机车行业：机车牵引变流器，地铁、高铁、轻轨、有轨电车等。
  Electric Locomotive Industry: Locomotive traction converters, subways, high-speed railways, light rail, trams, etc.

主要作用 Main Functions

- 在逆变电路中对整流器的输出电压给与支撑，防止电压突变，同时滤除直流母线的高频纹波。
  Support the output voltage of the rectifier in the inverter circuit to prevent voltage mutations, and filter out high-frequency ripples on the DC bus.
- 平滑逆变器向“DC-Link”索取的高幅值脉动电流，阻止其在“DC-Link”的阻抗上产生高幅值脉动电压，使直流母线上的电压波动保持在允许范围。
  Smooth the high-amplitude pulsating current drawn by the inverter from the "DC-Link", prevent it from generating high-amplitude pulsating voltage across the impedance of the "DC-Link", and keep the voltage fluctuation on the DC bus within the allowable range.
- 抑制“DC-Link”的电压过冲和瞬时过电压，保护IGBT等开关器件。
  Suppress voltage overshoot and transient overvoltage of the "DC-Link" to protect switching devices such as IGBTs.

产品特点 Product Features

- 耐受电压高，介损小，能耗低；
  High voltage resistance, low dielectric loss, and low energy consumption;
- 等效串联电感ESL小，适用于高频回路；
  Small Equivalent Series Inductance (ESL), suitable for high-frequency circuits;
- 铝制外壳，散热性好；
  Aluminum shell with good heat dissipation;
- 阻燃树脂封装，安全可靠；
  Flame-retardant resin encapsulation, safe and reliable;
- 无极性，无接反击穿风险；
  Non-polar, no risk of reverse connection breakdown;
- 等效串联电阻ESR小，可承受较大的纹波电流；
  Small Equivalent Series Resistance (ESR), capable of withstanding large ripple current;
- 绝缘强度高，漏电流小；
  High insulation strength and low leakage current;
- 耐冲击电流能力强；
  Strong resistance to inrush current;
- 使用寿命长，失效率低；
  Long service life and low failure rate;
- 干式结构，无渗漏风险。
  Dry structure, no leakage risk.

技术参数 Technical Parameters

环境条件 Environmental Conditions

工作温度范围 Operating Temperature Range	-40°C～+85°C
贮存温度范围 Storage Temperature Range	-40°C～+85°C
海拔高度 Altitude	≤2000m
安装场所 Installation Site	室内 或 机柜内 Indoor or inside the cabinet
其它 Others	周围环境无导电或爆炸尘埃，无腐蚀性气体或蒸汽，无剧烈的机械振动 No conductive or explosive dust, corrosive gas or vapor, or severe mechanical vibration in the surrounding environment

技术性能 Technical Performance

电压范围 Voltage Range		600Vdc～4000Vdc
电容量范围 Capacitance Range		120μF～2400μF
电容量偏差 Capacitance Tolerance		±5%(J)；±10%(K)
耐电压 Withstand Voltage	端子间 Between Terminals	1.5U_{NDC}，10s
	端子对壳 Terminal to Shell	4000V，10s，50Hz
介质损耗角正切 tanδ₀		≤0.0002
绝缘电阻（Ri×C_N）		≥20,000s(20°C±5°C,500Vdc)

过电压 Overvoltage	1.1U_N有负荷时间30% / 1.1UN with 30% load duration 1.15U_N 30min/day 1.2U_N 5min/day 1.3U_N 1min/day 1.5U_N 30ms every time,1000 times during the life
预期寿命 Expected Life	100,000h @U_N, θhs=70°C
失效率 Failure Rate	50FIT

● **执行标准 Compliance Standards**

GB/T 17702、IEC61071

型号规格与外形尺寸 Model Specifications & Overall Dimensions

型号Model	CN (μF)	*I_{max} (A)	ESR (mΩ)	Ls (nH)	R_{th} (K/W)	ΦD (mm)	H (mm)	重量 (Kg)
U_N 700Vdc								
MKP 700-480	480	44	2.2	60	4.7	76	120	0.70
MKP 700-580	580	42	2.5	65	4.5	76	140	0.75
MKP 700-620	620	55	1.4	50	4.3	76	155	0.90
MKP 700-720	720	55	1.5	55	4.2	76	175	1.00
MKP 700-650	650	50	1.7	60	4.7	86	120	1.00
MKP 700-780	780	48	1.9	65	4.5	86	140	1.15
MKP 700-820	820	55	1.4	50	4.3	86	155	1.25
MKP 700-950	950	55	1.5	55	4.1	86	175	1.30
MKP 700-1200	1200	44	1.2	60	4.6	116	120	1.50
MKP 700-1500	1500	42	1.3	65	4.5	116	140	1.75
MKP 700-1500	1500	85	0.8	50	3.5	116	160	2.00
MKP 700-1800	1800	76	1.0	55	3.4	116	175	2.20
MKP 700-2300	2300	100	0.8	50	3.2	116	230	2.80
U_N 800Vdc								
MKP 800-400	400	44	2.2	60	4.7	76	120	0.70
MKP 800-480	480	42	2.6	65	4.5	76	140	0.75
MKP 800-480	480	52	1.7	50	4.3	76	155	0.90
MKP 800-560	560	52	1.8	55	4.2	76	175	1.00
MKP 800-520	520	47	1.9	60	4.7	86	120	1.00
MKP 800-630	630	48	2.2	65	4.5	86	140	1.15
MKP 800-650	650	55	1.5	50	4.3	86	155	1.25
MKP 800-750	750	55	1.6	55	4.1	86	175	1.30
MKP 800-980	980	44	1.2	60	4.6	116	120	1.50
MKP 800-1200	1200	42	1.3	65	4.5	116	140	1.75
MKP 800-1200	1200	85	1.0	50	3.5	116	160	2.00
MKP 800-1500	1500	76	1.0	55	3.4	116	175	2.20
MKP 800-1800	1800	100	0.8	50	3.2	116	230	2.80

型号Model	CN (μF)	*I_{max} (A)	ESR (mΩ)	Ls (nH)	R_{th} (K/W)	ΦD (mm)	H (mm)	重量 (Kg)
U_N 900Vdc								
MKP 900-400	400	42	2.5	60	4.7	76	120	0.70
MKP 900-480	480	39	2.9	65	4.5	76	140	0.75
MKP 900-480	480	52	1.7	50	4.3	76	155	0.90
MKP 900-560	560	52	1.8	55	4.2	76	175	1.00
MKP 900-520	520	47	2.2	60	4.7	86	120	1.00
MKP 900-630	630	48	2.5	65	4.5	86	140	1.15
MKP 900-650	650	55	1.5	50	4.3	86	155	1.25
MKP 900-750	750	55	1.6	55	4.1	86	175	1.30
MKP 900-980	980	44	1.3	60	4.6	116	120	1.50
MKP 900-1200	1200	42	1.4	65	4.5	116	140	1.75
MKP 900-1200	1200	85	1.0	50	3.5	116	160	2.00
MKP 900-1500	1500	76	1.1	55	3.4	116	175	2.20
MKP 900-1800	1800	100	0.8	50	3.2	116	230	2.80
U_N 1000Vdc								
MKP 1000-300	300	38	2.9	60	4.7	76	120	0.70
MKP 1000-360	360	36	3.3	65	4.5	76	140	0.75
MKP 1000-360	360	50	1.9	50	4.3	76	155	0.90
MKP 1000-420	420	50	2.0	55	4.2	76	175	1.00
MKP 1000-400	400	45	2.3	60	4.7	86	120	1.00
MKP 1000-480	480	45	2.6	65	4.5	86	140	1.15
MKP 1000-500	500	55	1.6	50	4.3	86	155	1.25
MKP 1000-560	560	55	1.7	55	4.1	86	175	1.30
MKP 1000-740	740	55	1.4	60	4.6	116	120	1.50
MKP 1000-900	900	54	1.5	65	4.5	116	140	1.75
MKP 1000-900	900	75	1.0	50	3.5	116	160	2.00
MKP 1000-1100	1100	67	1.3	55	3.4	116	175	2.20
MKP 1000-1400	1400	80	1.0	50	3.2	116	230	2.80
U_N 1100Vdc								
MKP 1100-250	250	38	3.0	60	4.7	76	120	0.70
MKP 1100-300	300	36	3.5	65	4.5	76	140	0.75
MKP 1100-310	310	50	1.9	50	4.3	76	155	0.90
MKP 1100-360	360	49	2.0	55	4.2	76	175	1.00
MKP 1100-330	330	42	2.4	60	4.7	86	120	1.00
MKP 1100-420	420	44	2.3	60	4.5	86	135	1.15
MKP 1100-420	420	52	1.7	50	4.3	86	155	1.25
MKP 1100-480	480	52	1.8	55	4.1	86	175	1.30
MKP 1100-600	600	65	2.1	60	3.8	96	135	1.20
MKP 1100-620	620	55	1.5	60	4.6	116	120	1.50
MKP 1100-750	750	52	1.6	65	4.5	116	140	1.75
MKP 1100-780	780	80	0.9	50	3.5	116	160	2.00
MKP 1100-820	820	100	0.9	50	4.6	116	136	1.70
MKP 1100-920	920	73	1.1	55	3.4	116	175	2.20
MKP 1100-1200	1200	83	0.9	50	3.2	116	230	2.80

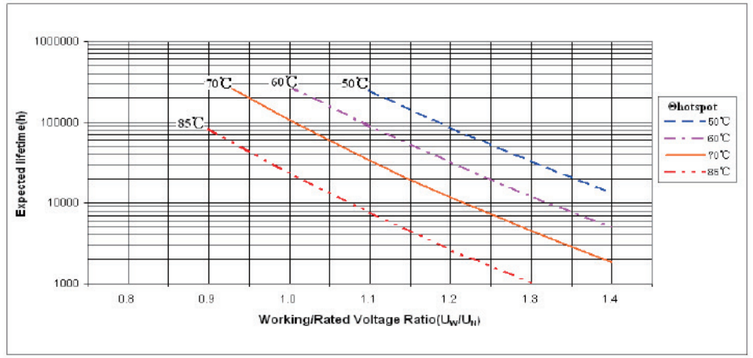
型号Model	CN	*I_{max}	ESR	Ls	R_{th}	ΦD	H	重量
	(μF)	(A)	(mΩ)	(nH)	(K/W)	(mm)	(mm)	(Kg)
				U_N 1200Vdc				
MKP 1200-200	200	30	4.7	60	4.7	76	120	0.70
MKP 1200-240	240	21	4.6	65	4.5	76	140	0.75
MKP 1200-240	240	33	4.3	50	4.3	76	155	0.90
MKP 1200-280	280	37	4.2	55	4.2	76	175	1.00
MKP 1200-260	260	30	4.7	60	4.7	86	120	1.00
MKP 1200-330	330	31	4.6	65	4.5	86	140	1.15
MKP 1200-330	330	33	4.4	50	4.3	86	155	1.25
MKP 1200-380	380	30	4.3	55	4.1	86	175	1.30
MKP 1200-500	500	42	5.0	60	4.6	116	120	1.50
MKP 1200-600	600	44	4.9	65	4.5	116	140	1.75
MKP 1200-620	620	80	3.6	50	3.5	116	160	2.00
MKP 1200-620	650	70	1.5	60	3.7	96	155	1.50
MKP 1200-720	720	73	3.4	55	3.4	116	175	2.20
MKP 1200-950	950	83	2.7	50	3.2	116	230	2.80
				U_N 1300Vdc				
MKP 1300-170	170	30	4.7	60	4.7	76	120	0.70
MKP 1300-210	210	21	4.6	65	4.5	76	140	0.75
MKP 1300-210	210	33	4.3	50	4.3	76	155	0.90
MKP 1300-240	240	37	4.2	55	4.2	76	175	1.00
MKP 1300-230	230	30	4.7	60	4.7	86	120	1.00
MKP 1300-270	270	31	4.6	65	4.5	86	135	1.15
MKP 1300-280	280	33	4.4	50	4.3	86	155	1.25
MKP 1300-320	320	30	4.3	55	4.1	86	175	1.30
MKP 1300-430	430	42	5.0	60	4.6	116	120	1.50
MKP 1300-520	520	44	4.9	65	4.5	116	140	1.75
MKP 1300-540	540	80	3.6	50	3.5	116	160	2.00
MKP 1300-630	630	73	3.4	55	3.4	116	175	2.20
MKP 1300-820	820	83	2.7	50	3.2	116	230	2.80

产品直径 Diameter(mm)	引出端子 Lead Terminal					固定端子 Fixed Torminal	
铝壳 Aluminum Shell	螺母Nut	扭矩 Max Torque	P	D1	h1	S	扭矩Max Torque
D=76, 86	M6×10 i	5N*m	32	15	5	M12	10N*m
D=96	M6×10 i	5N*m	45	15	5	M12	10N*m
D=116	M6×10 i	5N*m	50	15	5	M12	10N*m

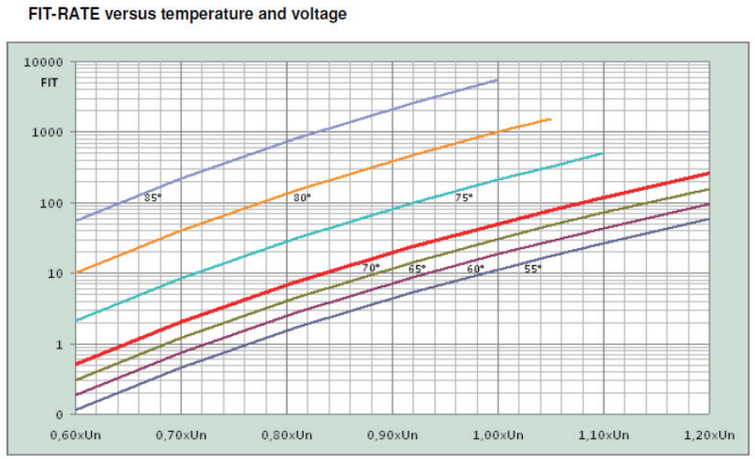
*注(Notes)：1、产品尺寸以双方最终确认的设计方案为准；
The product dimensions are subject to the final confirmed design plan by both parties;
2、订货时应提供产品额定电压、额定容量、纹波电流、纹波频率及环境条件等信息；
Please provide information such as the product's rated voltage, rated capacity, ripple current, ripple frequency and environmental conditions when ordering.
3、支持特殊规格产品定制化设计、供货，比如，应用于光伏、风电等新能源并网等中小功率SVG的方形直流支撑电容器单元。
Customized design and supply of products with special specifications are supported, such as square DC-link capacitor units for medium and low power SVG used in new energy grid connection such as PV and wind power.

产品特性曲线 Product Characteristic Curves

● 电容器预期寿命曲线 Capacitor Expected Life Curve



● 失效率与温度、电压的关系曲线 Relationship Curve Between Failure Rate, Temperature and Voltage



产品概述 Product Overview

柔性直流输电是基于电压源换流器(VSC)的新型电力输送方式,主要分为两电平、三电平和模块化多电平换流器三种结构方式。模块化多电平换流器(MMC)具备损耗低、谐波小、扩展性好等优点,已成为目前柔性直流输电领域主流的技术方案。MMC换流阀由三个相单元组成,每个相单元由上下桥臂组成,每个桥臂由多个子模块构成。直流支撑电容器是子模块的重要组部件,作为换流器直流侧的储能元件,为换流器提供直流电压,同时缓冲系统故障时直流侧电压波动、减小直流侧电压纹波,并为受端侧提供直流电压支撑。直流支撑电容器对于换流阀的安全稳定,乃至整个输电系统的安全稳定运行至关重要。

Voltage Source Converter High-Voltage Direct Current (VSC-HVDC) transmission is a new type of power transmission method based on Voltage Source Converters (VSC), mainly divided into three topological structures: two-level, three-level and Modular Multilevel Converter (MMC). MMC has the advantages of low loss, small harmonics and good scalability, and has become the mainstream technical solution in the field of VSC-HVDC transmission. The MMC converter valve consists of three phase units, each phase unit is composed of upper and lower bridge arms, and each bridge arm is composed of multiple sub-modules. The DC-link capacitor is an important component of the sub-module. As an energy storage element on the DC side of the converter, it provides DC voltage for the converter, buffers the DC side voltage fluctuation during system faults, reduces the DC side voltage ripple, and provides DC voltage support for the receiving end. The DC-link capacitor is crucial for the safe and stable operation of the converter valve and even the entire power transmission system.

主要用途:柔性直流输电用直流支撑电容器是柔性直流输电的关键器件之一;与换流器件开关器件IGBT、IGCT一起组成模块应用于阀塔中,支撑直流母线电压,吸收纹波电流,同时保护IGBT、IGCT等开关器件的安全。

Main Applications: The DC-link capacitor for VSC-HVDC transmission is one of the key components of VSC-HVDC transmission; it forms a module with converter switching devices such as IGBT and IGCT and is applied in the valve tower to support the DC bus voltage, absorb ripple current, and protect the safety of switching devices such as IGBT and IGCT.

通用技术要求 General Technical Requirements

- 长期使用寿命长:不小于40年且容值变化不超过5%;
  Long service life: Not less than 40 years and the capacitance change does not exceed 5%;
- 可靠性要求高:故障率低,小于100FIT;
  Long service life: Not less than 40 years and the capacitance change does not exceed 5%;
- 防火要求:干式、无油且满足UL-94V0级阻燃;
  Fire protection requirement: Dry type, oil-free and meeting UL-94V0 flame retardant grade;
- 防爆要求:设有压力释放阀和(或)压力开关。
  Explosion-proof requirement: Equipped with pressure relief valve and/or pressure switch.

特殊技术要求 Special Technical Requirements

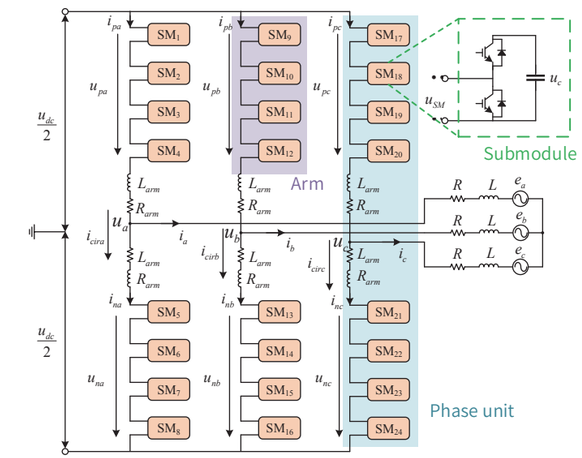
- 高纹波电压;
  High ripple voltage;
- 低自感,低等效串联电阻;
  Low self-inductance and low equivalent series resistance;
- 高谐波电流;
  High harmonic current;

柔性直流输电换流阀用直流支撑电容器
DC-Link Capacitors for VSC-HVDC Converter Valves

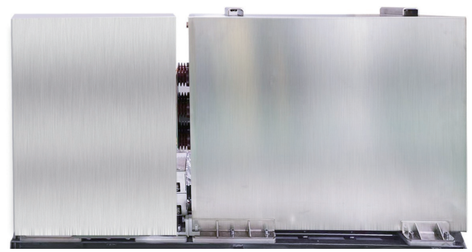
产品尺寸 Product Dimensions

- 按工程要求,支持定制化设计。
  Customized design is supported according to engineering requirements.

原理图 Schematic Diagram



子模块图 Sub-module Diagram



典型工程 Typical Projects

工程名称	系统参数	电容台数
上海南汇直工程	±30kV/20MW	672
南澳四端柔直工程	±160kV	2500
舟山五端柔直工程	±200kV	4500
厦门柔直工程	±320kV/1000MW	5184
鄂渝直流工程	±500kV/2500MW	12960
张北四端直流工程	±500kV/3000MW	19008
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