Power Source System
of
DC Electric Arc Furnace

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Preface

Chindow designed AFE(active front end) IGBT Power Source for DC arc furnace provides a satisfactory solution for the shortcomings of SCR power supply system as listed below:

- low PF (0.65 for reference) inherent with the nature of SCR
- high THDi (35% for reference) inherent with nature of SCR
- efficiency (65~75% for reference) due to he at loss
- frequent voltage flicker due to electric arc

Feature of AFE IGBT Power Source

a) The total harmonic distortion of power supply system THDi ≤ 5%

b) The efficiency of power supply system ≥97%

c) The power supply actor (PF) of power supply system ≥0.99 under rated load

d) The power supply system should be free from flicker with technology of constant current control,

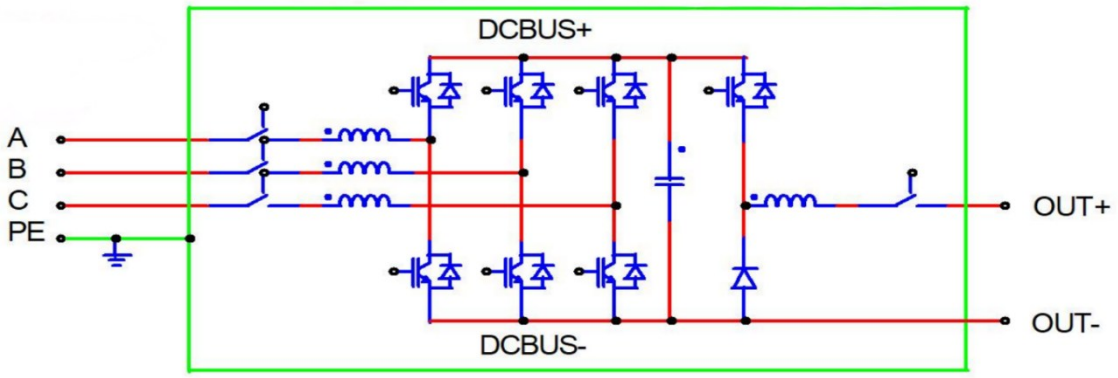
e) Stability and Reliability: Adopt modular redundancy design. A single-point fault will not affect the overall operation of the system, and the Mean Time Between Failures (MTBF) is ≥50,000 hours.

f) Convenient Operation and Maintenance: Support dual modes of remote monitoring and local operation. The fault location accuracy reaches a single power unit, and the maintenance response time is ≤1 hour.

g) Investment saving and energy saving of IGBT-based constant-current power supply system will save investment in way of Avoidance of power factor correction equipment, avoidance of harmonic filter equipment

h) IGBT-based constant-current power supply system with efficiency of ≥97%, will save energy (detailed saving will be calculated based on the actual efficiency of SCR-based power supply system)

Work principle of AFE IGBT Power Source



AFE IGBT Power Source module

Technical Category	Specific Indicators	Remarks
Basic Specifications	Rated power: 250kW; Topology: IGBT three-phase rectification + IGBT chopping + closed-loop water cooling system	Adopt 1700V-rated SiC module
Input Side Parameters	Grid voltage: 725V AC (±10% fluctuation tolerance); Rated current: 200A; Frequency: 50Hz (±2Hz)	Support three-phase three-wire input. The input end is equipped with an EMC filter
Power Quality Indicators	Total Harmonic Distortion (THDi): <5%@125kW (50% load), <3%@250kW (100% load)	Adopt APFC control algorithm based on instantaneous reactive power theory to actively suppress harmonics
	Power Factor (PF): >0.97@125kW, >0.99@250kW	When the load rate is ≥30%, the PF is stably above 0.95
Output Side Parameters	DC voltage: 0~1100V (continuously adjustable, adjustment accuracy ±1V); DC current: 0~230A (constant current control)	The output current ripple coefficient is ≤2%, meeting the "low ripple + arc stabilization" requirements of arc furnaces

Operation Mode and Protection	Output mode: Constant current priority (supports long-term short-circuit of the load, unlimited short-circuit withstand time)	Equipped with overvoltage (1200V protection), overcurrent (250A protection), and overtemperature (IGBT junction temperature 100℃ protection) functions
Physical dimensions	Width 550mm × Depth 650mm × Height 150mm (independent unit chassis, adopting IP21 protection rating)	
Water cooling system	Adopt closed-loop water cooling. The cooling liquid is a mixture of 50% deionized water + 50% ethylene glycol.	
Interface configuration	Input side: 3 sets of 60mm² copper bar interfaces (with insulating sleeves); Output side: 2 sets of 80mm² copper bar interfaces; Control side: 1 EtherCAT communication interface (for communicating with the power cabinet EMS system), 1 RS485 backup interface	

AFE IGBT Power Source Cabinet

Component	Specifications and Functional Details
Basic Specifications	Rated power: 2.5MW (10 G5-250kW-1100V units in parallel)
Power Unit Integration	10 G5-250kW-1100V units adopt an "upper and lower layered" layout (10 layers ×1 unit/layer), with a spacing of ≥10mm between units
Copper Sleeve Assembly	10 sets of customized red copper sleeves (material: T2 red copper, conductivity ≥98%); Input copper sleeve: Adapt to 725V AC input, current-carrying capacity 2000A (total current of 10 parallel units); Output copper sleeve: Adapt to 0~1100V DC output, current-carrying capacity 2300A
HMI Human-Machine Interface	10-inch touch screen; Supported display parameters: Total voltage/current in the cabinet, status of each unit, fault codes, water cooling system parameters; Supported operations: Parameter setting, manual/automatic mode switching, fault reset
EMS Power Sharing System	Core functions: Real-time collect the output current of 10 units, dynamically adjust the output of each unit through PID algorithm to ensure the current deviation between units is ≤3%; Communication delay ≤10ms; Support "automatic exit of faulty units + power compensation of remaining units" function
Dimensions:	Width 1000mm × Depth 1000mm × Height 2200mm (including base, base height 100mm, facilitating forklift transportation)

Standard Adopted & Working Environment

Standard Adopted

- IEC60947-1:2007
- IEC61439-1:2009
- CE marking
- IEC61000-6
- IEC61000-4
- IEC61000-3

Working Environment

- Ambient temperature: -10℃~50℃
- Temperature for storage: -40℃~65℃
- Relative humidity: up to 99%
- Altitude above sea: 1000 meters

Industries Applicable

- steel smelting
- Non-ferrous metal smelting
- metal purification
- Preparation of special materials