



# All the Power You Want

Motors, Generators & Drives

2018





## Profile

We've manufactured motors and generators for 70 years. Since founded in 1949, Shanghai Electric Machinery Co., Ltd. (SEC) has been a key and the largest electric machinery manufacturer in China, with a broad range of more than 190 series, 950 varieties, and 10,000 kinds of specifications, which has been certificated by ISO9001, ISO14001, OHSAS18001. In terms of scale, equipment, technology and processing capacity, SEMC's production base is second to none. SEMC's main products include large and medium-sized AC & DC electric motors and generators, wind, steam, gas and hydro generators, etc. All these products are widely used in key industrial sectors and exported to more than 50 countries, with a good reputation.

## General Capabilities

- **Rating:** Induction Motor: ~30MW, Synchronous Motor: ~100MW  
2P Generator: ~1260MW, 4P Generator: ~60MW  
Hydro Generator: ~150MW, Wind Generator: ~8MW  
Diesel Generator: ~30MW, VFD: ~38MW
- **Voltage:** up to 15 kV
- **Frequency:** 50Hz / 60Hz, Variable Frequency Drives
- **Rotor:** Squirrel Cage, Wound Rotor, Double Squirrel Cage
- **Mounting:** Vertical & Horizontal
- **Enclosures:** ODP, TEAAC, TEWAC, TEFC, TEFV, WPI, WPII
- **Standards:** IEC, NEMA, API, IEEE, IS, GB
- **Annual Capacity:** more than 9000 pcs HV motors & generators



## Ownership

Now, SEMC is a subsidiary of Shanghai Electric Group Corporation (SEC) which listed securities in Hong Kong and Shanghai.

## About SEC

Shanghai Electric Group Co., Ltd. is one of the largest diversified equipment manufacturing groups in China. It has the strength of supplying whole sets of equipment, EPC projects and comprehensive service for modern equipment. Since 1990s, its revenue has been always ranking No.1 in China equipment manufacturing industry. High efficient clean energy and new energy equipment are core businesses of Shanghai Electric. The revenue of energy equipment takes 70% of the group total sales. SEC's leading products cover 1000MW class ultra-supercritical thermal power unit, 1000MW class nuclear unit, heavy-duty machinery, power transmission and distribution, elevator, printing machine, machine tools etc.

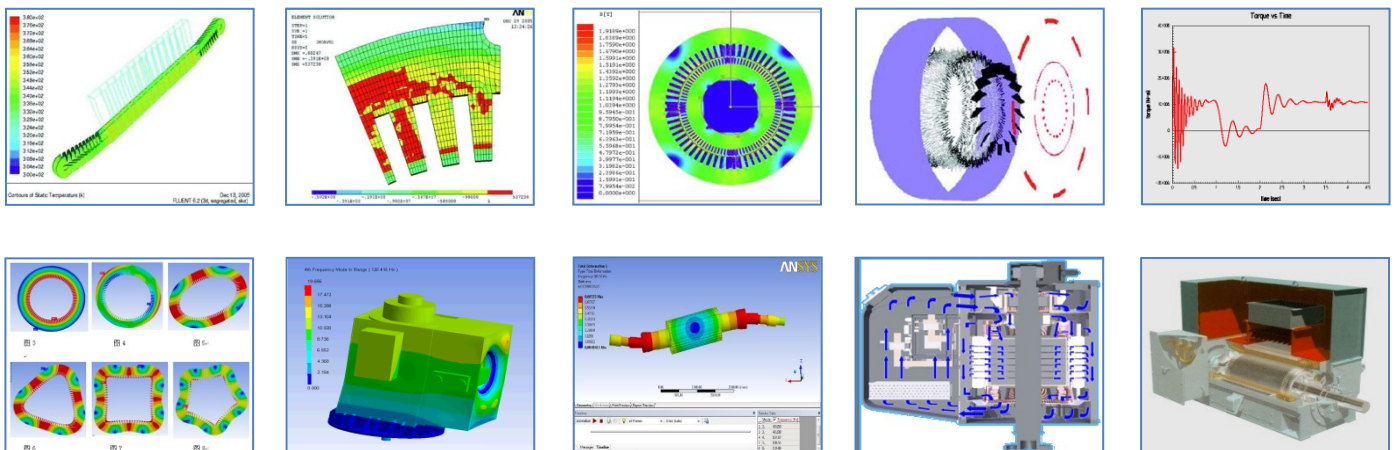


Events in history of SEMC

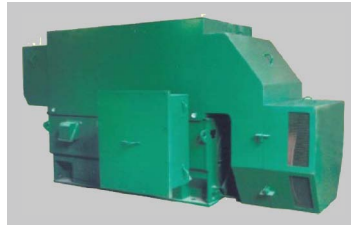
<p>1949 →</p> <p>Founded on the base of former 4<sup>th</sup> Shanghai works of Central Electrical Material Limited Company.</p> <p>- Primal unit capacity: 147kW</p>	<p>1950s →</p> <p>- First 6MW steam turbo-generator in China</p> <p>- First 12MW steam turbo-generator with double internal water-cooling system in the world</p> <p>- 1500kW 2P HV induction motor</p>	<p>1960s →</p> <p>- Medium-Sized agricultural vertical pump motors</p> <p>- All motors for 25,000 ton synthetic ammonia works</p> <p>- 800kW 24P vertical pump synchronous motor</p>	<p>1970s →</p> <p>- 3000kW 40P vertical pump synchronous motor</p> <p>- 60000kW 96p vertical water turbine generator</p>	<p>1980s →</p> <p><b>Technology introduction</b></p> <p><b>BBC:</b> medium-sized HV induction motor, DC motor;</p> <p><b>Westinghouse:</b> large-sized HV induction motor;</p> <p><b>Siemens:</b> large-sized brushless synchronous motor, DC motor</p>
<p>- →</p> <p>- 300MW hydrogen-cooled steam turbo generator</p> <p>- 125MW steam turbo-generator with double internal water-cooling system</p> <p>- 7000kW 80P vertical pump synchronous motor</p> <p>- 80MVA impulse generator</p>	<p>1990s →</p> <p>- 15,000kW 52P diesel engine generator</p> <p>- 5000kW AC-AC frequency converter synchronous motor for steel mill application</p> <p>- Established a joint venture with Westinghouse by generator manufacturing assets in the year 1995. Siemens bought out all generator manufacturing assets of Westinghouse in year 1999. A succession JV with Siemens has been set up to provide generators up to 1000MW.</p>	<p>2000s →</p> <p><b>Technology introduction</b></p> <p><b>TMEIC:</b> TM21 Series HV induction motor</p> <p>- 25000kW 4P induction motor</p> <p>- 9,350kW DC generator</p> <p>- 1E class 6300kW 6P EDG for nuclear application</p> <p>- 5000kW 24P vertical pump synchronous motor</p> <p>- 3150kW 52P vertical pump synchronous motor</p>	<p>2010s →</p> <p>- 36,000kW 4P brushless excitation synchronous motor</p> <p>- 3.6MW double-fed asynchronous wind turbine generator</p> <p>- 20,000kW 2P ultra high speed VFD explosion proof synchronous motor for west-east gas transmission project</p> <p>- SFEC, a JV by Shanghai Electric and Fuji Electric, has been set up to supply VFD up to 38MW</p>	<p>Now →</p> <p>We are stronger than ever</p>

State-of-the-art design technology

Progressive design tools such as finite element analysis, 3D solid modeling have been applied in fluid dynamics computation, flux distribution analysis, stress analysis, dynamic analysis, the likes of analysis of winding's temperature rise, magnetic field, axial fan selection, pressing ring's best construction design.



**Induction Machines**



**Medium & High Voltage Induction Y series**

- 220kW – 30MW
- Up to 13.8kV
- 2 - 18 poles
- 50Hz / 60Hz
- Frame size: 315 – 1250, horizontal
- Explosion-proof design capable
- ODF, TEAAC, TEWAC, WPI, WPII

**Medium & High Voltage Induction STM series**

- 450kW - 12,500kW
- Up to 13.8kV
- 2 - 18 poles
- 50Hz / 60Hz
- Frame size: 450 – 900, horizontal
- Explosion-proof design capable
- ODF, TEAAC, TEWAC, WPI, WPII

**Medium & High Voltage Induction YL series**

- 450kW - 8,000kW
- Up to 13.8kV
- 4 - 24 poles
- 50Hz / 60Hz
- Frame size: 355 – 1800, vertical
- ODF, TEAAC, TEWAC, WPI, WPII



**Wound Rotor Motor YR series**

- 200kW – 9,000kW
- Up to 13.8kV
- 6 - 24 poles
- 50Hz / 60Hz
- Frame size: 315 – 1000, horizontal
- ODF, TEAAC, TEWAC, WPI, WPII

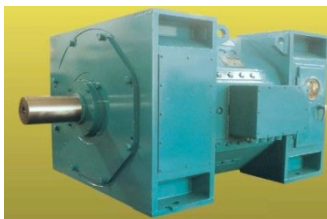
**Low & Medium Voltage induction YBJC series**

- 180kW – 2,500kW
- Up to 13.8kV
- 2 - 8 poles
- 50Hz / 60Hz
- Frame size: 315 – 630, horizontal
- Explosion-proof design capable
- TEFC

**Double Squirrel Cage Induction YTM, YHP, YMPS series**

- 200kW – 3,700kW
- Up to 13.8kV
- 6 - 10 poles
- 50Hz / 60Hz
- Frame size: 400 – 900, horizontal
- ODF, TEAAC, TEWAC, WPI, WPII

**DC Machines**



**DC Motors Wide applications Z series**

- 50kW – 3,500kW
- 220 - 1000V
- 72 - 1692 rpm
- Frame size: 315 – 900, horizontal
- IC17, IC37, ICW37A86

**Large DC Motors / Generator Marine, locomotive, mining, metal applications ZD / ZF series**

- Up to 9,350kW
- 400 - 1200V
- 25 - 1000 rpm
- IC37, ICW37A86
- Split magnet frame for easy maintenance
- High thrust and torque capability

**Large DC Motors Mine hoist duty ZKTD series**

- 300kW - 3,500kW
- 400 - 1000V
- 25 - 90 rpm
- Split magnet frame for easy maintenance
- High torque capability

## AC Synchronous Motors



### Medium & High Voltage Synchronous T series

- 200kW – 100MW
- Up to 13.8kV
- Up to 5040 rpm, 50Hz / 60Hz
- Custom design available for various applications
- Non salient pole for 2 poles
- ODF, TEAAC, TEWAC, WPI, WP11

### Large AC Synchronous Motors Steel mill, mining mill, compressor, blower TD series

- 500kW – 25MW
- Up to 13.8kV
- $\geq$  6 poles, 50Hz / 60Hz
- Custom design available for various applications
- ODF, TEAAC, TEWAC, WPI, WP11

### Large AC Synchronous Motors Petrochemical & coal liquification industries Reciprocal compressor duty TAW series

- 1,000kW – 20MW
- Up to 13.8kV
- 16 - 20 poles, 50Hz / 60Hz
- Increased safety type, E11 T3
- IC 81W



### Large AC Synchronous Motors / Generators Vertical pump / Turbine duty TL / TF series

- 400kW – 150MW
- Up to 13.8kV
- 12 - 80 poles
- 50Hz / 60Hz
- TEWAC

### Large AC Synchronous Motors Mining hoist duty TDBS series

- 800kW - 5,500kW
- Up to 13.8kV
- 40 - 80 rpm, S9
- 50Hz / 60Hz
- VFD
- IC 37

### Large AC Synchronous Motors Mining mill duty TM, TMW series

- 400kW - 8,000kW
- Up to 13.8kV
- 30 - 40 poles
- 50Hz / 60Hz
- IC 01, IC37

## Generators



### Diesel Engine TF Series

- 220 - 30,000kVA
- Up to 13.8kV
- 50Hz / 60Hz
- 6 - 52 poles
- Custom design

### Steam Turbine & Gas Turbine QF Series

- 1.5 – 1260MW
- Up to 13.8kV
- 50Hz / 60Hz
- 2 poles
- Custom design

### Wind Turbine

- 1.5MW, 2MW, 2.5MW, 3.6MW, 7MW, 8MW
- Induction, Double-fed, Direct drive permanent magnet
- TEAAC, TEAWC, Water-Jacket
- Onshore and offshore

\*\*\* Please refer to the product brochures for detailed technical information and applications.

## Manufacture Facilities

SEMC is well equipped with facilities for manufacturing electrical machines. More than 3000 units of manufacturing equipments and 280 units of precision equipments are applied, which can meet all processing & test requirement for electrical machines supplied by SEMC.

### Typical facilities for reference



400 tons high accuracy automatic production line for stamping of stator and rotor silicon steel sheet



CNC 320KN numerical control high speed notching press



CNC multifunction robot for coil binding



CNC dipro sopy boring machine for motor housing



CNC machining center for boring and milling



vacuum pressure impregnation equipment



CNC coil forming machine



600 ton heavier duty dock

## Test Platform

Our test platform is one of the best equipped in China. We have recently upgraded our testing capacity and are upgrading it continuously to meet the requirement of more and more larger capacity electrical machines.

Test Platform Power Capacity up to 12,000 kVA (2\*6,000 kVA), 12~80Hz.

### Routine test items

#### Induction motors

- Visual and dimensional check
- Windings' DC resistance measurement
- Winding's insulation resistance measurement
- RTD's DC & insulation resistance measurement
- Direction of rotation check
- No-load characteristic determination
- Locked rotor test
- Over speed test
- Vibration level measurement
- AC High voltage withstand test

#### Synchronous motors

- Visual and dimensional check
- Windings' DC resistance measurement
- Winding's insulation resistance measurement
- RTD's DC & insulation resistance measurement
- Direction of rotation check
- No-load characteristic determination
- Steady-state short-circuit characteristic determination
- Over speed test
- Vibration level measurement
- AC High voltage withstand test

#### DC machines

- Visual and dimensional check
- Windings' DC resistance measurement
- Winding's insulation resistance measurement
- RTD's DC & insulation resistance measurement
- Direction of rotation check
- Determination of brush centering position
- Over speed test
- Short-time step-up voltage test
- Vibration test
- AC High voltage withstand test

### Type tests which may be carried out

#### Induction motors

- Temperature rise test
- Efficiency determination
- Power factor determination
- Starting current determination
- Max. Torque determination
- Noise at no-load

#### Synchronous motors

- Temperature rise test
- Efficiency determination
- Starting current determination
- Starting torque determination
- Max. Torque determination
- Noise at no-load

#### DC machines

- Temperature rise test
- Efficiency determination
- No spark zone determination
- No-load characteristic test
- Loading characteristic test
- Noise at no-load

### Special test which may be carried out

Heat run test; shaft voltage; inertia moment evaluation; polarization index; dielectric loss factor on test coils; impulse voltage test; current, speed and torque vs. time during acceleration (squirrel cage motors only.)

\*\*\*Remarks: For special or type tests as well as tests for synchronous & DC machines, please contact sales or engineers.

Application Industries	Driven Equipments	Standards
Fossil Power Plants	induced draft fan, forced draught fan, primary air fan, Boiler feed pump, circulating water pump, condensation water pump, auxiliary cooling water pump, coal mill, coal conveyor, other fans & pumps, gas/steam turbine generator	IEC, NEMA, GB, IS
Metallurgy & Steel Rolling	plates & belts rolling mills, wire rod mills, blast furnace blowers, sintered exhausters, converter blowers, oxygen making compressors	IEC, NEMA, GB
Mining	ball mill, SAG mill, crusher, conveyor, mine hoist, ventilation fan, captive power, shovel, crane, synchronous condenser	IEC, NEMA, GB
Oil & Petrochemical	pipeline compressors, blower, centrifugal & axial compressor, booster pump, API process pump, pipeline pump, reciprocating compressor, synchronous generator, sea water lift pump, transfer pump, water injection pump	IEC, NEMA, API541, API546, API547, GB
Building Materials	limestone crusher, coal mill main drive, raw mill, rotary kiln main drive, blower, roller press, cement mill, raw grinding separator fan, cement mill air separator fan, pre-heater fan, coal mill fan, cooler exhaust	IEC, NEMA, GB
Water Conservation	large-sized high thrust vertical pump, horizontal pump	IEC, NEMA, GB
Wind Power Plants	wind turbine generator, 1.5MW, 1.7MW, 2MW, 2.5MW, 3.6MW, 4.0MW, 4.16MW, 7MW, 8MW	IEC, NEMA, GB
Nuclear Power Plants	boiler feed pump, circulating water pump, condensation water pump, auxiliary cooling water pump, fuel rod power generator for conventional island; pump motors for nuclear island applied in M310, EPR, AP1000, MIR-1200, such as RRA, ASG, EAS, RCV, RIS, SEC, RRI, JND, KAA, KBA, JNG, JMN.	IEC, NEMA, GB
Pulp & Paper	rewinder, refiner, vacuum pump, chip crusher	IEC, NEMA, GB
Marine	generator, thruster motor	IEC, NEMA, GB

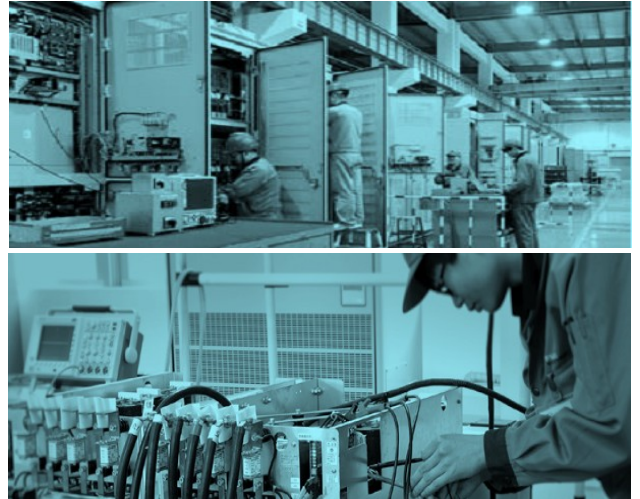
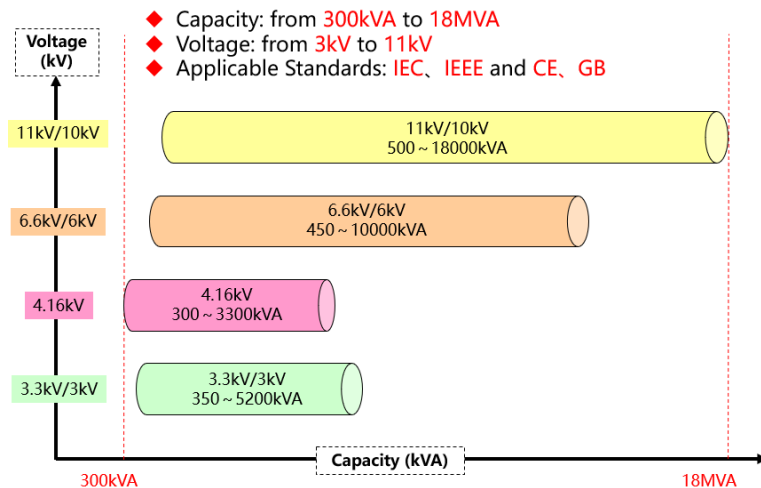


*Create the future together with creators*

# Variable Frequency Drives — running everywhere

## FRENIC4600 Series MV Variable Frequency Drives (VFD)

Standard Lineup: ~18MVA, Custom-design: ~38MW



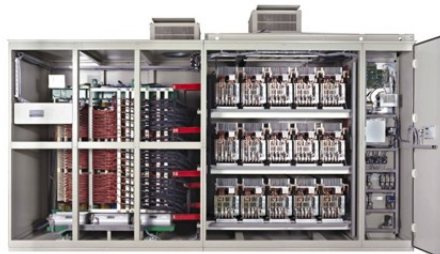
### Panel Structure

#### Cooling Fan

- Air-cooled fans make maintenance easy.

#### Input Multiplex-winding Transformer

- Harmonic current on the power source side is low due to the multiplex configuration of the secondary winding.
- Harmonic filters and power factor improving capacitors are not necessary.
- Adopt integrated design, external cabling work between transformer and cell panel is no need.



Designed by Fuji



Easy to Change

#### Master Control Board

- Mounting of a 32-bit MPU, and with special voltage and current detection system offers a quick response and high accuracy.

#### Power Cell

- Use the latest Fuji 1700V IGBT, achieves high-reliability operation and the MTBF is over 100,000h.
- Each inverter cell alone can be replaced easily, because the parts are combined into an integral body.



### VFD Applications

#### ■ Cement

- Kiln cooling fan
- Kiln high temperature fan
- Grinding mills
- Rotary kilns
- ...



#### ■ Iron & Steel

- Blast furnace blower
- Dedusting fan
- CDQ circulating fan
- Phosphorus removal pump
- ...

#### ■ Petrochemical

- draft fan / Blower
- Primary/secondary air fan
- Condensate pump
- Circulating pump
- ...



#### ■ Power Plant

- Draft fan / Blower
- Primary/secondary air fan
- Condensate pump
- Circulating pump
- ...

#### ■ Mining

- Conveyor
- Grinding mills
- Mine Ventilator
- ...

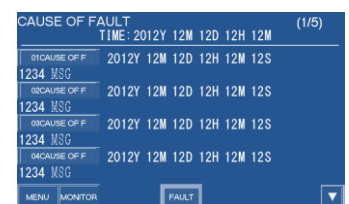
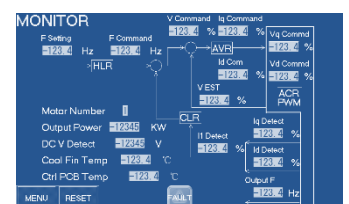
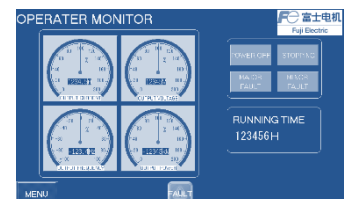
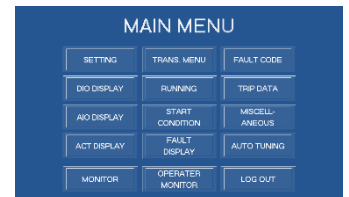


#### ■ Water conservancy

- Fetch pump
- Feed pump
- Suction pump
- ...

#### ■ Others

- Rubber Mixer
- Sugar Mills
- ...





## High efficiency & High power factor

**Total efficiency approximate 97% (Including transformer)**

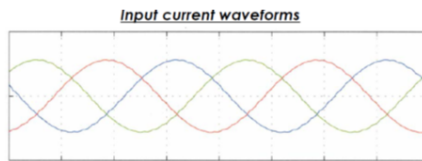
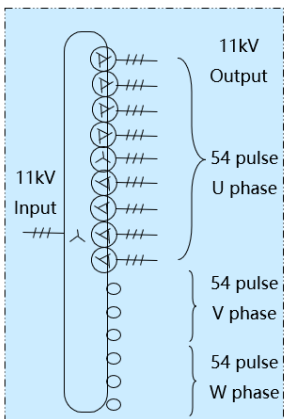
- ◆ Because output transformer is unnecessary, system loss is much lower.
- ◆ Fuji's unique Multi-level PWM control minimizes IGBT switching loss.
- ◆ Because the harmonic current is less, reduces the higher harmonic loss of input transformer primary winding.

**Source side Power factor Higher than 0.95**

- ◆ Using multi-pulse full bridge diode rectifier provides a high-power factor on the power source.
- ◆ Using Cell series multilevel voltage source inverter structure, reduces the reactive power loss.
- ◆ A phase advancing capacitor or reactor for improving the source power factor is unnecessary.

## Clean power input

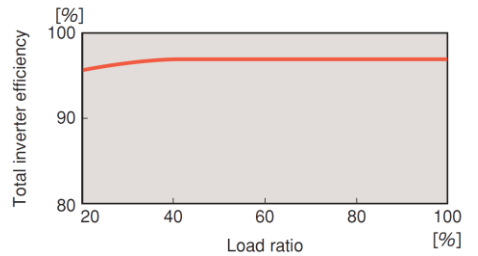
- Reducing the input current harmonics by shifted the phase difference between the secondary winding of the main transformer to the appropriate.



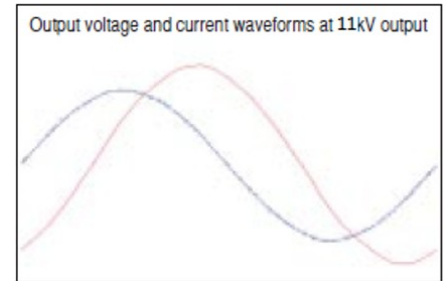
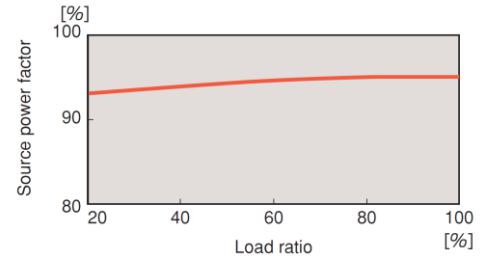
★ The harmonic generation level is satisfied the IEEE-519 (1992) standard. Lowest harmonics (with No Harmonic Filters)

### ■ Much Lower harmonics content

Order	5	7	11	13	17	19	23	25	35	37
IEEE Value	4.00	2.86	1.83	1.49	1.14	1.02	0.87	0.80	0.80	0.80
Measured Value	0.58	1.00	0.20	0.32	0.75	0.54	0.06	0.24	0.58	0.27



### ■ Source power factor curve

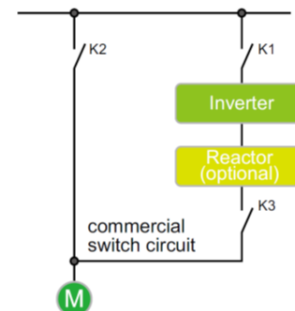


## Friendly to Motor & Machine

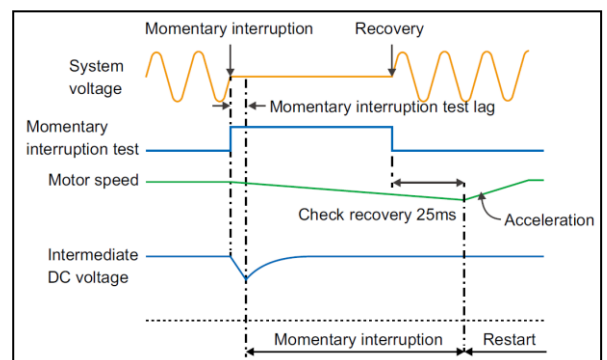
- ◆ Fuji's unique Multi-level PWM control provides an almost sinusoidal output current waveform, thus reducing torque ripple.
- ◆ The multi-level (11kV 19 levels) PWM control minimizes switching surge and thereby reduces stress on the motor.
- ◆ Because the output current is almost sinusoidal, a motor suffers less loss due to harmonics.
- ◆ For driving a large-capacity motor in a system may cause voltage fluctuation due to the starting current of motor. However, VFD can limited the starting and soft start the motor & machine.

## Commercial power supply bypass Function

Smooth switching between VFD operation and commercial power operation allowed by phase control according to system voltage. (Synchronizing/parallel off function: option) An electric reactor must be installed.



### Time Chart



## Restarting function after momentary interruption

In the event of a voltage drop due to a momentary power interruption, the operation processing pattern can be selected according to the application

### 1. Selection of major fault

VFD will stop when the major fault occurred and the motor will stop in the free run status.

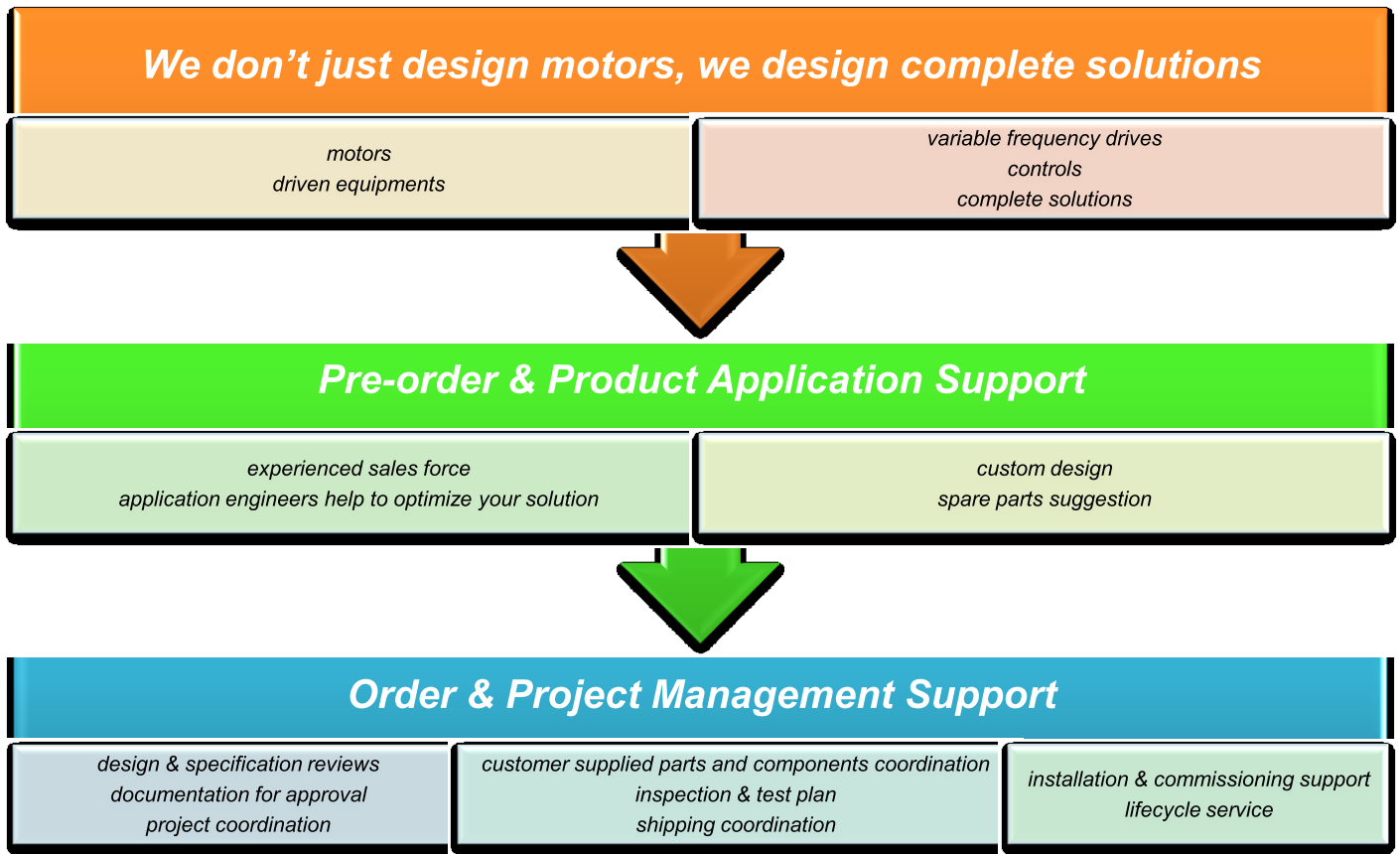
### 2. Selection of restart under free run

VFD will not stop but output will pulse off and the motor is set in the free run status. Upon power recovery, the motor will automatically accelerated again through a speed search function.

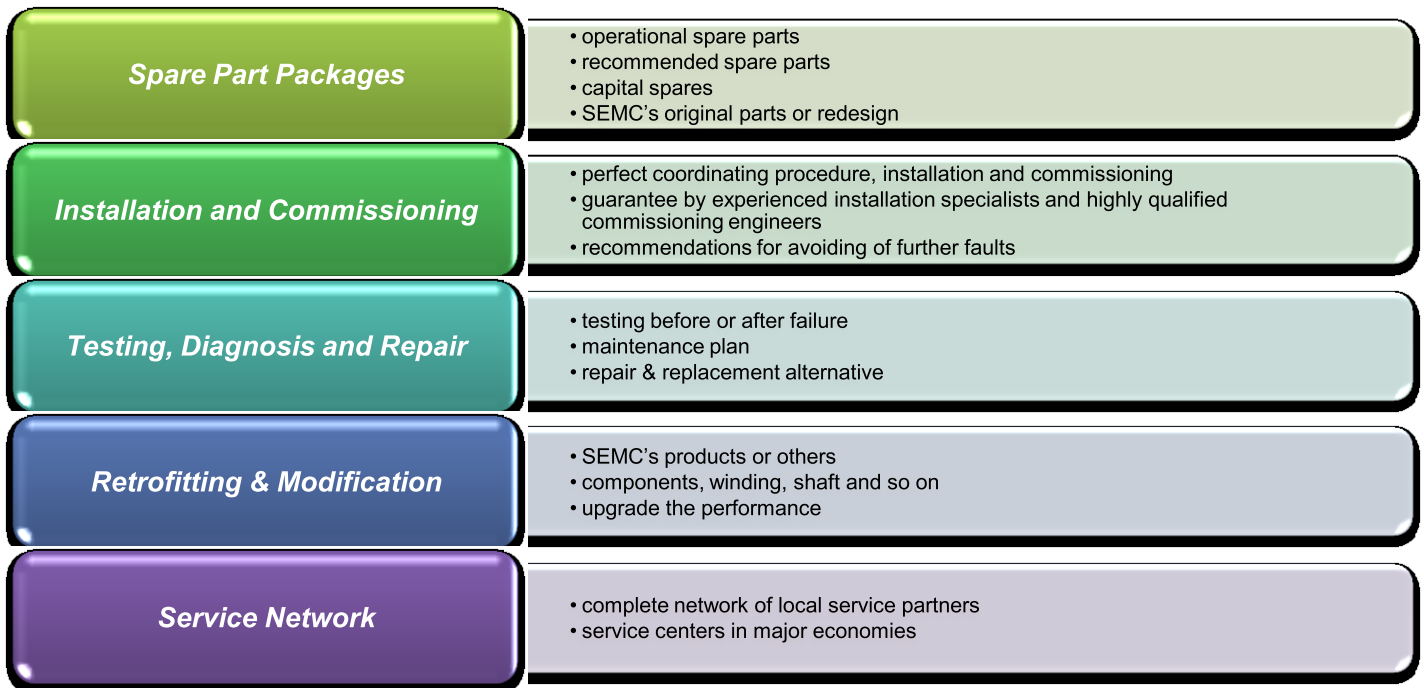
### 3. Selection of continuing operation

VFD can output power within 300ms, and then become restart under free run mode(No.2). As soon as line voltage is recovered, the motor will accelerate back to the operating speed.

SEMC has a team of highly motivated and technically skilled electrical & mechanical engineers, sales and project management personnel that help to ensure planning an optimal and cost-efficient solution for your requirement.



**After-sales Service**



OEMs



EPCs



### CORPORATE

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***Motors    Variable Frequency Drives    Integrated Drive Package (Pump, Blower, Turbine)***

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