

Cast Resin Transformer



Introduction



Chiba works



Fuji Tusco Co., Ltd.

Works

Fuji Electric Co.,Ltd has two cast resin transformer production bases :
Chiba works in Japan, and Fuji Tusco Co.,Ltd. in Thailand

Fuji Electric (T&D Business)

- 1923** Established Fuji Electric Manufacturing Co.,Ltd.
- 1962** Started operation of Chiba factory (transformer)
- 1968** Started operation of Kobe factory (switchboard)
- 1971** Started manufacturing rectifier transformer units
- 1974** Started manufacturing cast resin transformers
- 1984** Changed company name and logo to Fuji Electric Co.,Ltd.
- 1985** Delivered the first 800kV transformers
- 1990** Delivered the first 1,100MVA transformer
- 1996** Delivered the first 8300kV Gas Insulated Switchgear
- 2002** Introduced new company symbol mark
- 2009** Delivered the first 1,750V DC, 87.5kA power supply equipment

TUSCO

- 1981** Founded Tusco Group
Established Theparak Supply Shop
- 1982** Started Manufacturing of Low Voltage & Medium Voltage Switchboards
- 1984** Founded Theparak Transformer Co., Ltd.
- 1990** Founded Thai Union Switchboard Co., Ltd.
- 1996** Established Tusco Trafo Co., Ltd.
and Thai Corrugate Co., Ltd.
Technical Assignment and Manufacturing Contract for switchboards with Fuji Electric Co., Ltd.
- 2007** Production lines of power transformers were Increased
- 2012** Grand opening of new transformer factory

Fuji Tusco has started in Oct 2013

Product Records

Fuji Electric has started manufacturing cast resin transformer since 1974 as first cast resin transformer's supplier in Japan, and accumulation total number of cast resin transformers produced in Chiba works surpassed 90,000 units including 3,000 units exported to 55 countries until now.

Product Line-Up

- Cast resin Transformers up to 4000kVA and 24kV
- Distribution Transformers
Oil immersed Transformers up to 36kV
Single Phase up to 1000kVA
Three Phase up to 30MVA
- Power Transformers
Oil immersed Transformers up to 245kV
Single & Three Phase up to 300MVA
- Special Transformers
Rectifier Transformers up to 30MVA
Furnace Transformers up to 30MVA
Testing Transformers up to 300kV
Unit or Miniature Substation up to 36kV
Made to Order Transformers



Power Transformer

Features of Product

Vacuum-Casting

Cast resin transformer is manufactured with vacuum casting method using metal pattern. Thus it has following excellent characteristics.

Void-less

Vacuum-casting method realizes highly reliable, void-less molded winding with excellent partial discharge characteristics.

Fire prevention

Molded insulated parts are fire resistant with self-extinguishing properties.

Resistance to humidity and dust

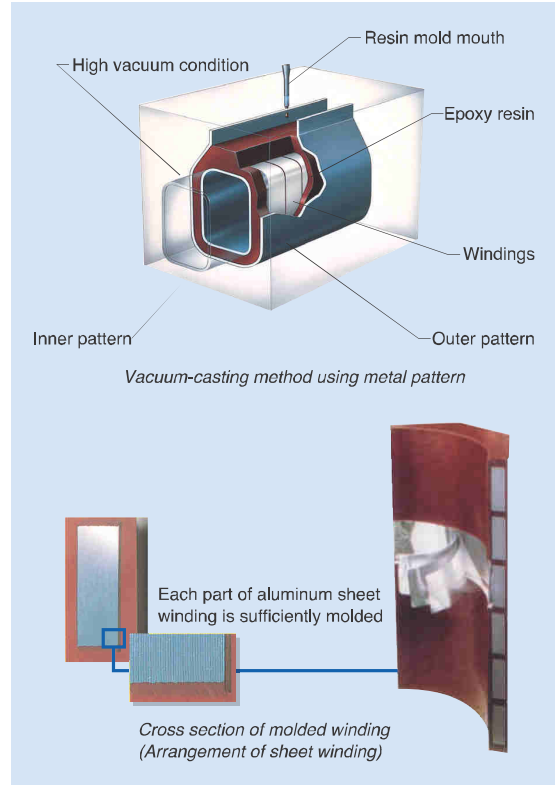
All winding conductors are molded. They have remarkable humidity resistance which prevents insulation materials from deteriorating due to dust and dirt during operation.

Robust construction

Molded winding is highly resistant to secondary short-circuit fault and surface cracking.

High reliability

Vacuum-casting process is carried out automatically with advanced customized facilities, to manufacture highly reliable molded winding.



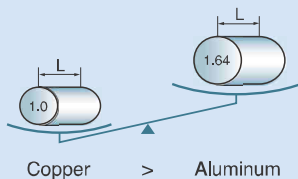
Aluminum Winding

(1) Weight reduction

The aluminum winding weights are approximately half of the copper winding, thus realizing weight reduction.

	Copper : Aluminum
Conductivity [%]	100 : 61
Cross sectional area ratio	1 : 1.64
Gravity [g/cm ³]	8.9 : 2.7
Gravity ratio	3.3 : 1
Mass ratio	100 : 50

Comparison of the weight in the same resistance

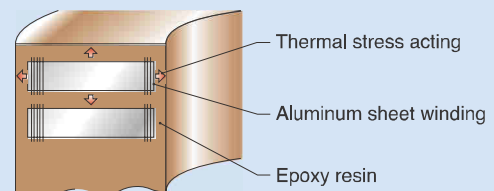


(2) Low thermal stress and excellent crack resistance

Aluminum's thermal expansion coefficient is close to resin, thus reducing thermal stress and improving crack resistance effectively.

Material	Thermal expansion coefficient [mm/mm.h.°C]
Aluminum	2.3×10^{-5}
Copper	1.6×10^{-5}
Epoxy resin	3.3×10^{-5}

Thermal stress acting on winding

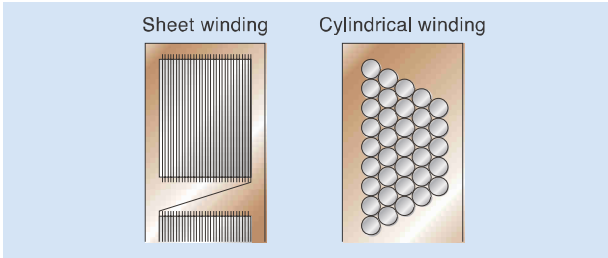




Sheet Winding

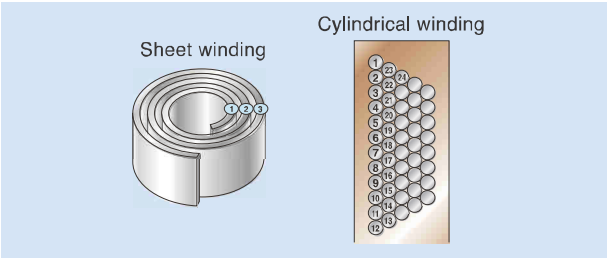
(1) Downsizing

Sheet winding has high lamination factor, thus realizing downsizing of transformers.



(2) High insulation reliability

In use of sheet winding, the voltage between turns is only for one turn, thus having high insulation reliability.



IEC Certification

Fuji Electric's cast resin transformer have passed all tests of IEC60076-11 including special test and type test in 2006.

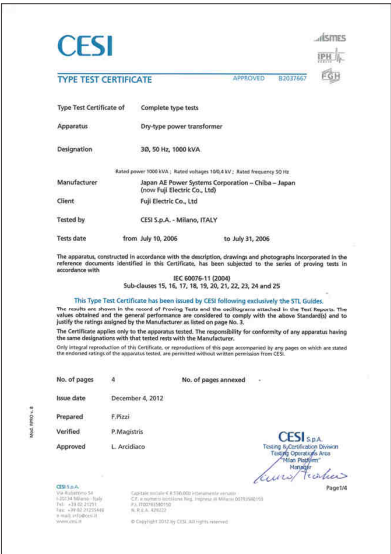
- Climatic class : **C2 (crack resistance)**
- Environmental class : **E2 (moisture resistance)**
- Fire behavior class : **F1 (fire resistance)**
- Short-circuit test



Start of fire-test



After test (completely extinguishing)

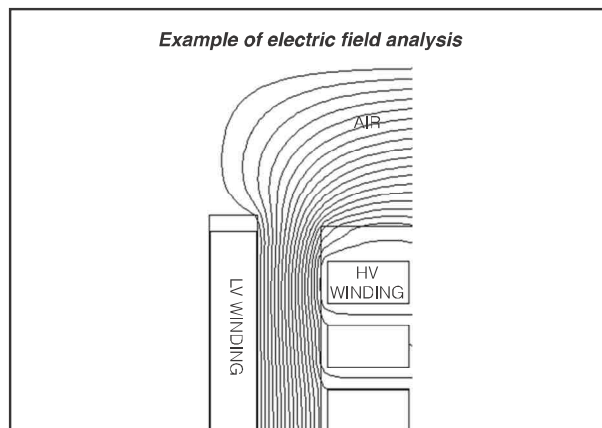


CESI Certificate

Design Techniques / Test and Inspections

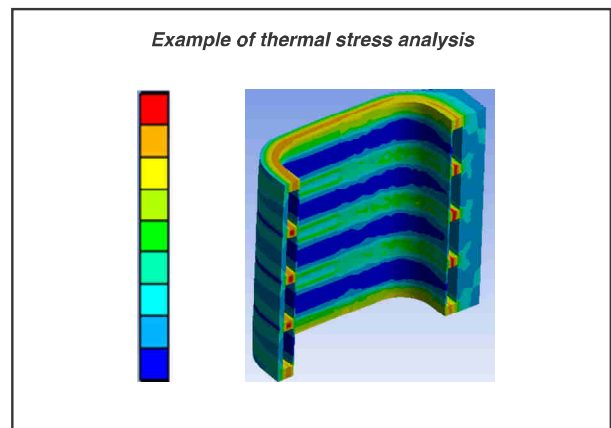
Electric field analysis

The insulation of cast resin transformer is composed of resin-air composite insulation. The distributed voltages of individual transformer part depend on their respective dimensions. Thus, appropriate dimensions for insulation are designed with electric field analysis of the individual part of winding including air space.



Thermal stress analysis

Molded winding composed of conductor and insulating material is subjected to thermal stress due to the difference in thermal expansion coefficient between conductor and resin, and thermal distribution in the winding block, where winding temperature varies with the load fluctuation of transformer. The stress value obtained in thermal stress analysis is used to design optimum winding structure for high crack-resistance of winding.



Electric field analysis

Routine test :

- Measurement of insulation resistance
- Measurement of voltage ratio and check of phase displacement
- Measurement of no-load loss and exciting current
- Measurement of short circuit impedance and load loss
- Separated-source voltage withstand test
- Induced over voltage withstand test
- Measurement of insulation resistance
- Measurement of partial discharge

Type test *

- Lightning impulse voltage withstand test
- Temperature-rise test
- Measurement of sound level

Note:

Type test will be carried out on one transformer of same specification. The costs of all tests and test reports shall be extra charge.

ISO 9001-2008



ISO 14001-2004



Production Facilities

Fuji Tusco cast resin transformers are made in the excellent workshop equipped with new facilities.



High voltage foil winding machine



Low voltage foil winding machine



Vacuum-casting plant



Hardening furnace



Core cutting machine



Laser cutting machine

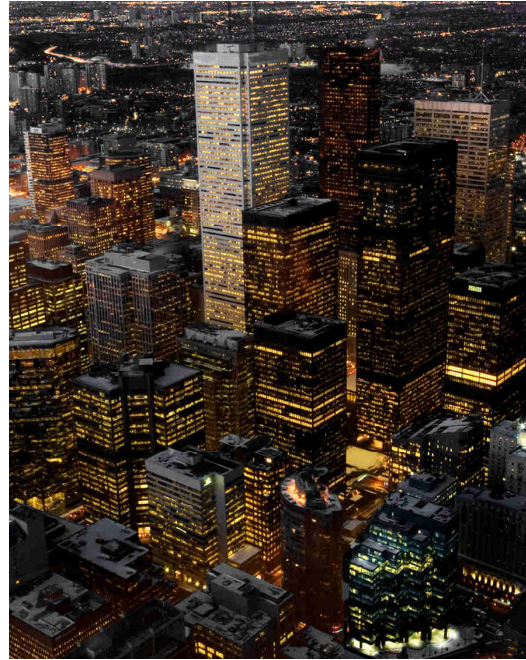
Applications

Cast resin transformer is suitable for the following places.

- Sites where compact size and light weight are required.
- Sites where easy maintenance is required.
- Sites where there are airborne contaminants and extremely severe environments.
- Sites where fire prevention is the highest priority.

For example

- Multi Storey Buildings
- Hospitals
- Hotels
- Laboratories
- Shopping centers
- Building complexes
- Schools
- Art galleries
- Theaters
- Stadiums
- Underground shopping centers
- Petrochemical plants
- Industrial complexes
- Underground railways
- Railway substations
- Tunnels
- Cranes
- Water and sewerage plants
- Power supply for construction sites
- Refuse disposal plants
- Wind power sites



Multi Storey buildings



Wind power sites



Railways



Petrochemical plants



Stadiums

References (Made in Chiba works)



Transformer cubicle for substation in building



Ship Applications
3-phase 60Hz 3000kV 6.6/0.45kV



High-rise Building Applications
3-phase 60Hz 13MVA(AN)/17MVA(AF) 22.0/6.6kV



Railway Applications
3-phase 50 Hz 2700kVA 33.0/2x0.59kV

High-rise Building Applications

- The largest capacity in Japan
- Provision for restriction of weight and dimension

Ship Applications

- Provision for rolling

Railway Applications

- Withstand cyclic load
- Provision for harmonics of rectifier

Wind Turbine Applications

- Compact and light by optimum design
- Possible to install inside the nacelle

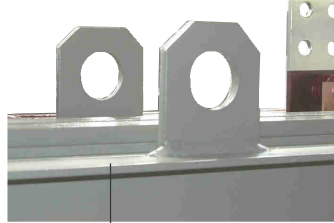


Wind Turbine Applications
3-phase 60Hz 2700kV 0.69/34.5kV

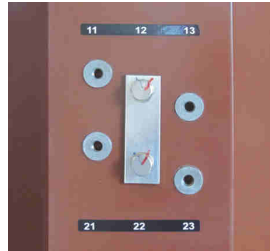
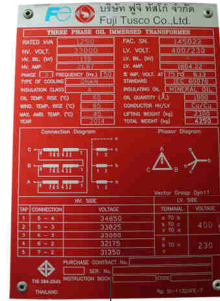
Accessories

Lifting lugs

Four lifting lugs are provided as standard fixtures on the transformer body.



Nameplate

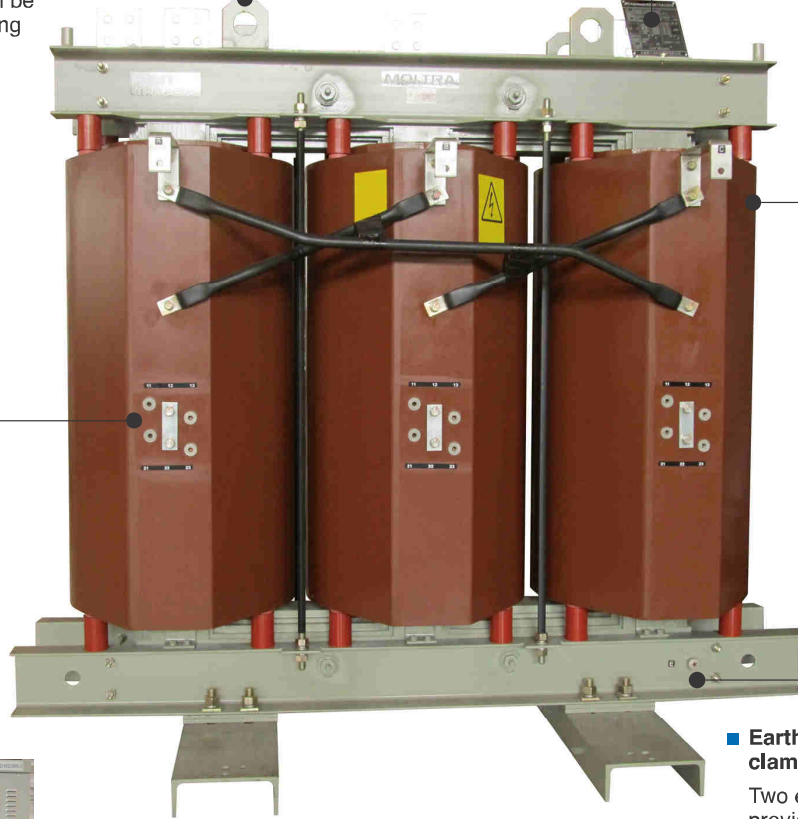


Off-circuit tap changer terminals

The tap voltage can be changed by switching the shorting bar connector.

Warning label

A danger label is attached to warn against contacting surface of the HV windings.



Earthing terminals with clamping bolts

Two earthing terminals are provided at the lower frame ends : one on the primary side and one on the secondary side.(One of these earthing terminals is in use.)



Enclosure (Option)

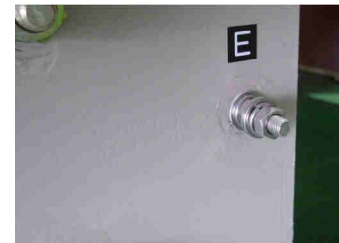


Bi-directional wheels (Option)

Rubber vibration isolator (Option)



Dial thermometer (Option)



■ Inquiry Specification Sheet for Cast Resin Transformer

Your Ref.no :

Date :

To : Fuji Tusco Co.,Ltd. Attn. : _____ Email : _____ Tel : _____	Client requesting a quote Company name : _____ Person in charge : _____ Email : _____ Tel : _____
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Technical Specification

Item	Standard specification	Optional specification
Number of Unit		
Rated Capacity (kVA)		
Primary Voltage (kV)	<input type="checkbox"/> 11kV <input type="checkbox"/> 22kV <input type="checkbox"/> 24kV	<input type="checkbox"/> Other :
Secondary Voltage (kV)	<input type="checkbox"/> 400V	<input type="checkbox"/> Other :
Tapping range	<input type="checkbox"/> ±2×2.5%	<input type="checkbox"/> Other :
Number of Phase	<input type="checkbox"/> 3φ	<input type="checkbox"/> Other :
Vector Group	<input type="checkbox"/> Dyn11	<input type="checkbox"/> Other :
Impedance Voltage(%)	<input type="checkbox"/> Manufacturer Standard	<input type="checkbox"/> Other :
Cooling Method (*)	<input type="checkbox"/> AN	<input type="checkbox"/> AF <input type="checkbox"/> AN/AF
Insulation class (Thermal)	<input type="checkbox"/> F	<input type="checkbox"/> Other :
Frequency (Hz)	<input type="checkbox"/> 50 <input type="checkbox"/> 60	
Standards	<input type="checkbox"/> IEC60076-11	<input type="checkbox"/> Other :
Ambient temperature	<input type="checkbox"/> Standard -5~40°C	<input type="checkbox"/> Other :
Altitude	<input type="checkbox"/> Standard 0~1000m	<input type="checkbox"/> Other :
Overload	<input type="checkbox"/> Continuous 100%	<input type="checkbox"/> Other :
K-Rating (if any)	-	

<Insulation levels>

Separate -source AC withstand voltage	Primary(kV)	<input type="checkbox"/> 28kV	<input type="checkbox"/> 50kV	<input type="checkbox"/> Other :
	Secondary(kV)	<input type="checkbox"/> 3kV		<input type="checkbox"/> Other :
Lightning Impulse Test	Primary(kV)	<input type="checkbox"/> 75kV	<input type="checkbox"/> 95kV	<input type="checkbox"/> 125kV <input type="checkbox"/> Other :
	Secondary(kV)	-		<input type="checkbox"/> Other :

<OPTION Optional Accessories>

Dial Thermometer	<input type="checkbox"/> Unnecessary	<input type="checkbox"/> Necessary
Wheels	<input type="checkbox"/> Unnecessary	<input type="checkbox"/> Necessary
Resistance thermometer bulb(Pt 100Ω)	<input type="checkbox"/> Unnecessary	<input type="checkbox"/> Necessary
Rubber vibration isolator	<input type="checkbox"/> Unnecessary	<input type="checkbox"/> Necessary
Protection Enclosure	<input type="checkbox"/> Unnecessary	<input type="checkbox"/> Necessary
if Yes, Degree of Protection will be selected	-	
if Yes, cable entry will be selected	-	<input type="checkbox"/> Bottom <input type="checkbox"/> Top <input type="checkbox"/> Other :

<OPTION Special test & Witness test>

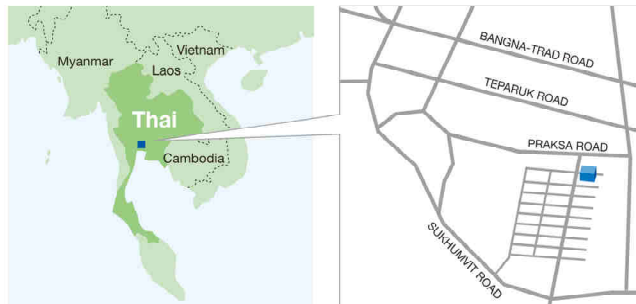
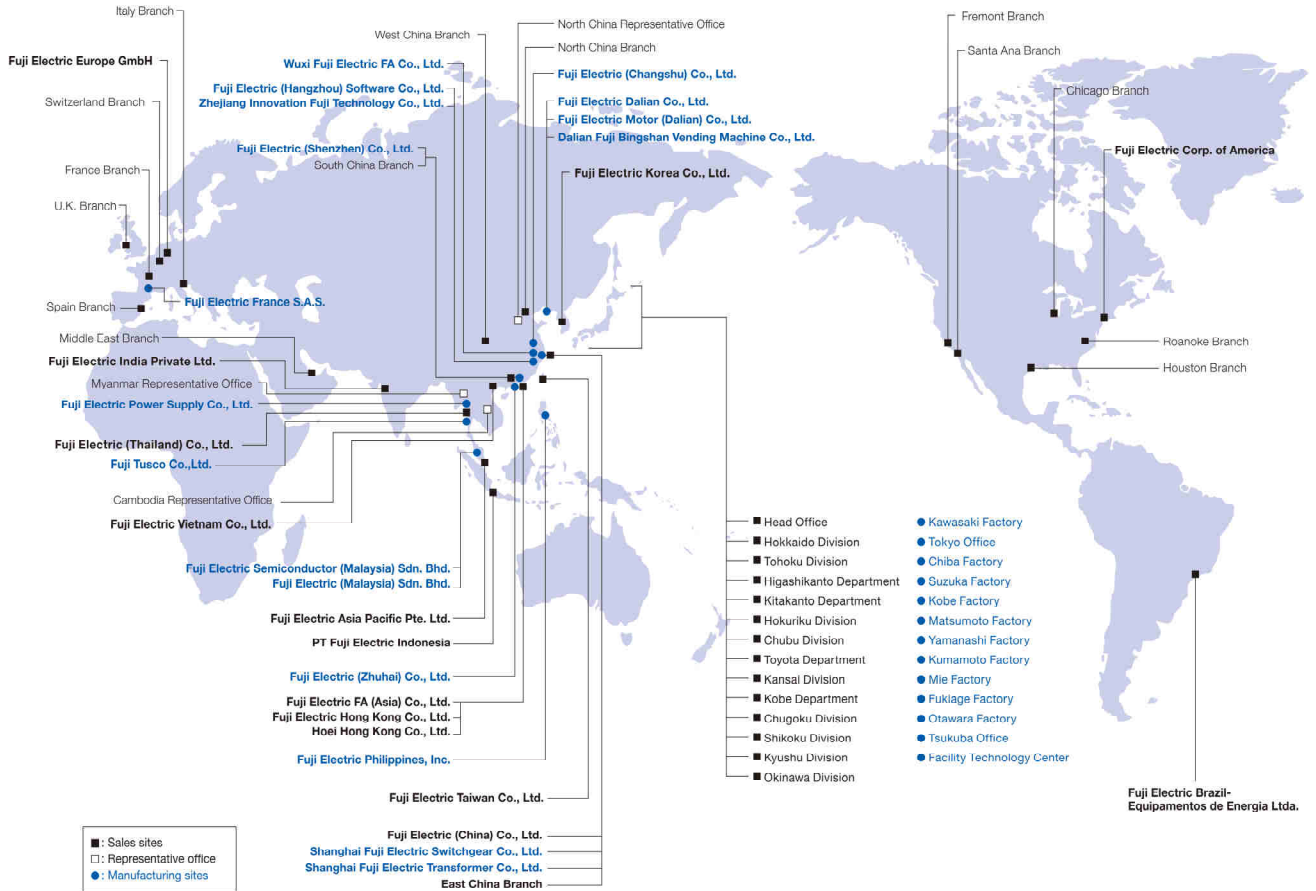
Temperature rise test	<input type="checkbox"/> Unnecessary	<input type="checkbox"/> Necessary
Lightning impulse test	<input type="checkbox"/> Unnecessary	<input type="checkbox"/> Necessary
Measurement of sound level	<input type="checkbox"/> Unnecessary	<input type="checkbox"/> Necessary
Witness Routine test	<input type="checkbox"/> Unnecessary	<input type="checkbox"/> Necessary

<OPTION Other request item>

Other request item	-	
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(*) Remarks AN: Naturally-air-cooled type
 AF: Forced-air-cooled type with cooling fan
 AN/AF: Naturally-air-cooled/Forced-air-cooled type with cooling fan

Global Network



Fuji Tusco Co., Ltd.

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