

Three Phase Encapsulated Type **SF₆ Gas Insulated Switchgear** Type SDF for 170 kV



GIS

Three Phase Encapsulated Type

Fuji Electric as a manufacturer of comprehensive substation equipment is ready to supply advanced SF₆ gas insulated switchgear (GIS) superior in reliability, disaster prevention, safety and environmental harmony.

Installation of SF₆ insulated switchgear has very largely increased all over the world, because of the advantages:

- **Small space requirement**
- **High reliability**
- **Safety**
- **Environment compatibility**
- **Long maintenance intervals**
- **Minimum erection period at site**

Fuji alone has installed a great number of switch bays for 72.5 kV to 300 kV since 1970, both at home and abroad.

The three phase encapsulated switchgear for 72.5 kV was developed in 1975 and since then the installation of SF₆ switchgear has increased rapidly. After three years in 1978, Fuji has put into operation the first three phase encapsulated SF₆ switchgear for 170 kV in the world.

On the excellent experience of SF₆ switchgear, Fuji has a compact and reliable three phase encapsulated SF₆ switchgear : type SDF.

Characteristic features

Small overall dimensions

make for minimum space requirements and very low profile needs very little vertical clearance. Hence the costs of foundations and buildings can be reduced.

The steel enclosure used

is highly resistant to arcing and affords the personnel optimum protection. A further advantage of the steel enclosure is their high mechanical strength.

Long service life

of the switchgear is expected due to non-oxidizing of SF₆ gas in enclosure and oil in electro-hydraulic operating mechanism.

The modular design principle applied

permits quantity production and the use of standard parts, which increase reliability and simplifies stock-keeping.

The fully earthed enclosure

protects the operating personnel and prevents HF interference. There is no risk of touching live parts and also atmospheric pollution.

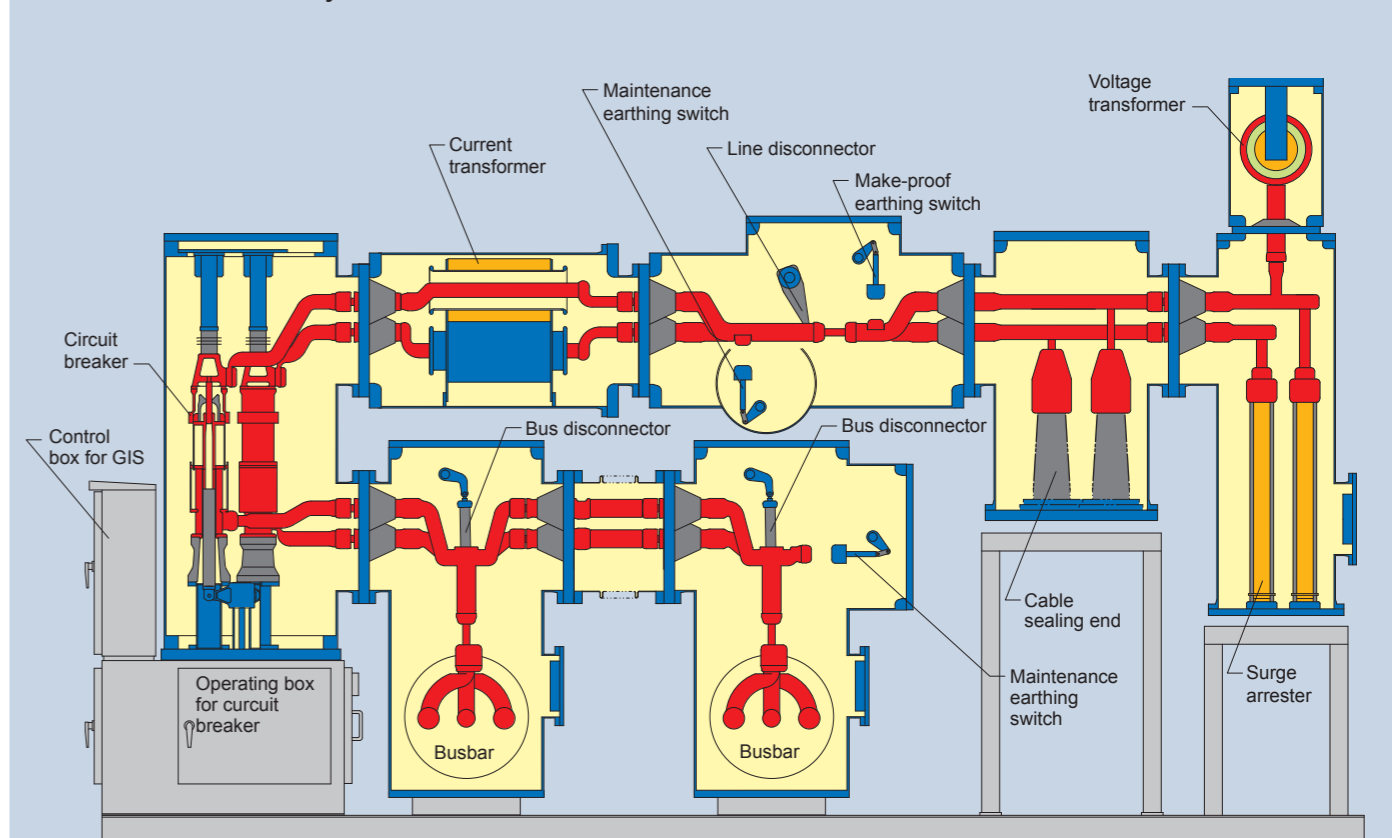
Unified SF₆ gas pressure

throughout the switchgear makes simplified gas maintenance work.

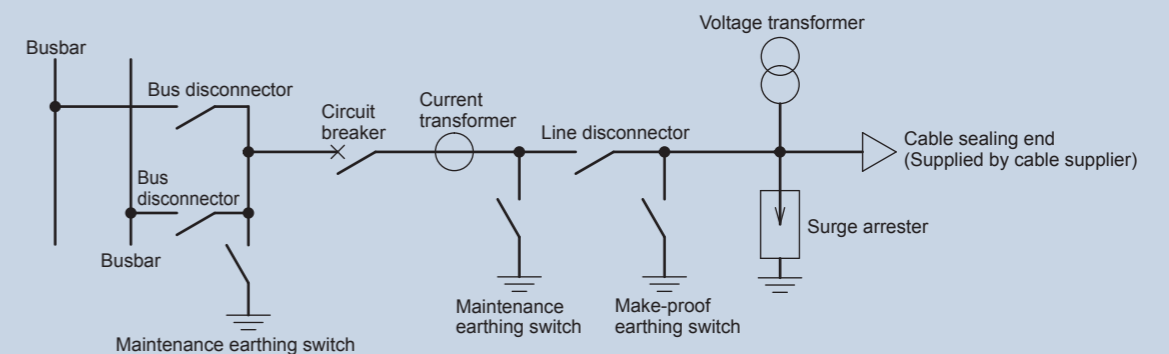
Technical data

Switchgear type	SDF120	
Rated voltage	[kV]	170
Rated power-frequency withstand voltage	[kV]	325
Rated lightning impulse withstand voltage	[kV]	750
Rated normal current	[A]	1250/2000/4000
Rated short-circuit breaking current	[kA]	40
Rated short-time withstand current (3 s)	[kA]	40
Rated peak withstand current	[kA]	100(50 Hz), 104(60 Hz)
Rated SF ₆ gas pressure, gauge (at 20 °C)	Switchgear	[MPa] 0.5
	Circuit breaker	[MPa] 0.5
Rated break time of circuit breaker	[cycles]	3
Rated operating sequence of circuit breaker (standard)	O-3 min.-CO-3 min.-CO CO-15 s-CO O-0.3 s-CO-3 min.-CO	

Section of a cable feeder bay with double busbar



Single line diagram



Thousands of Fuji SF₆ circuit breakers with hydraulic operating mechanism were delivered into all over the world and have been in satisfactory operation since 1973.

The SF₆ switchgear SDF is equipped with the single pressure puffer type gas circuit breaker with hydraulic operating mechanism which is used uniformly also for outdoor circuit breakers.

Fuji gas circuit breakers have the advantages:

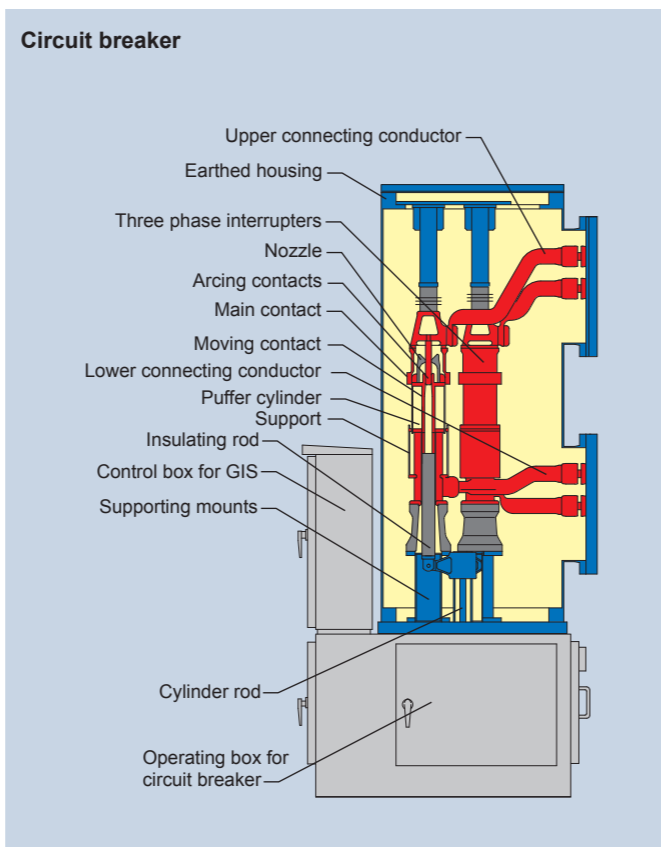
- Low noise level during operation
- Excellent interrupting performance
- Long maintenance intervals
- Individual energy supply, no air-compressor necessary

The earthed housing accommodates three phase interrupters fixed on supporting mounts. At the lower part of circuit breaker, the operating box is arranged, which accommodates hydraulic operating mechanism and monitoring unit for the circuit breaker.

The interrupter has a double-flow system and the compressed SF₆ gas, which is produced by the downward movement of the puffer cylinder at opening, flows into both directions in order to distinguish effectively the arc generated at arcing contacts.

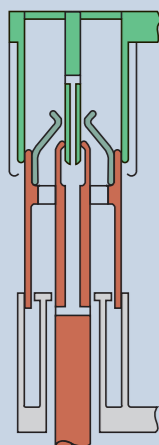
The moving section is composed of nozzle, moving contact, and a moving cylinder connected to hydraulic operating mechanism through insulating rod and cylinder rod mechanically.

The current path is composed of upper connecting conductor, fixed contact support, main contact, moving contact, support and lower connecting conductor.



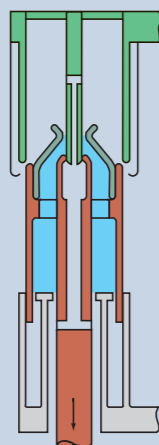
Principle of arc quenching

Closed position



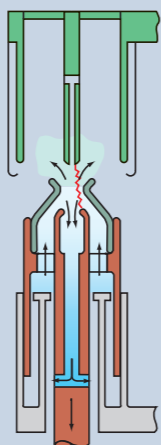
Opening

SF₆ gas in puffer cylinder is compressed.

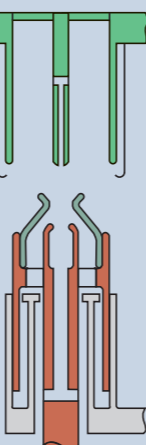


Opening (arc quenching)

SF₆ gas flows during arc quenching.



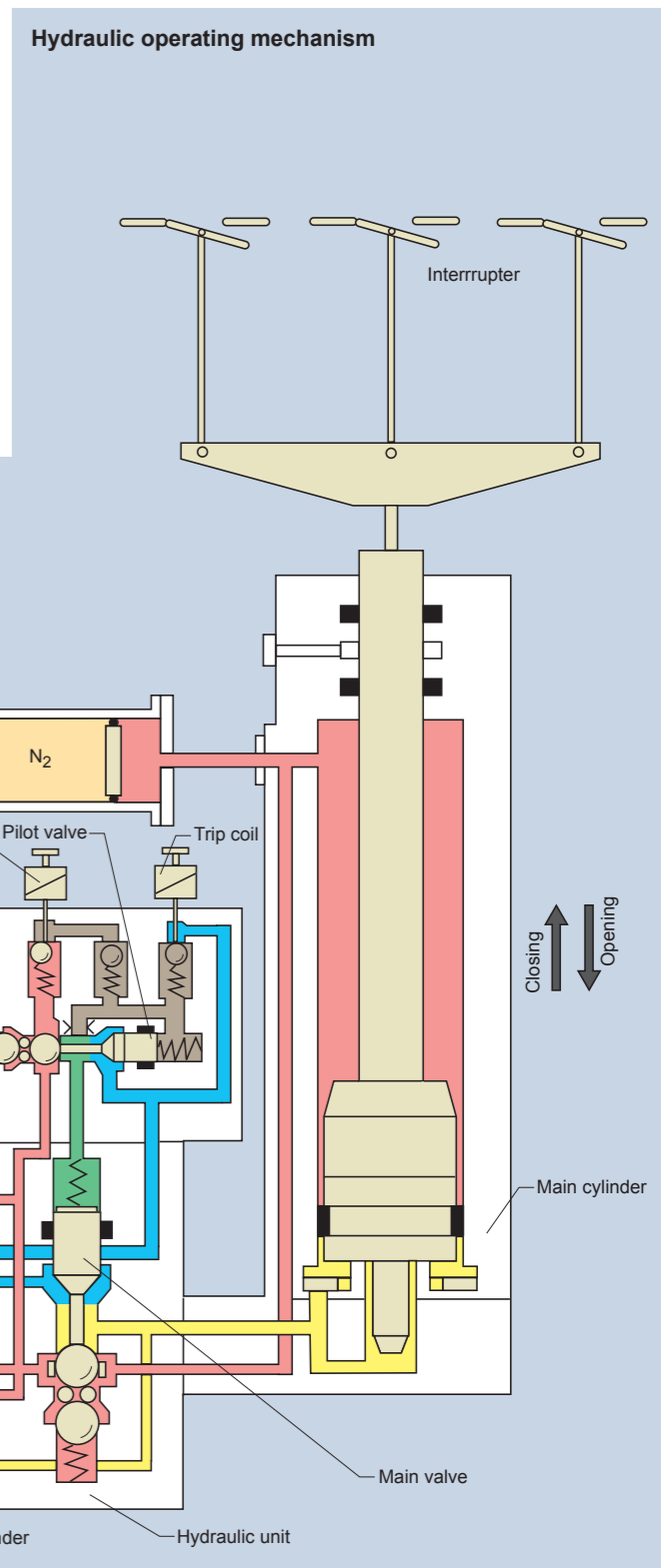
Open position



Oil pump, oil tank, main valve, auxiliary valves, pressure switches and gauges are incorporated as one block unit and connected directly to main cylinder.

Hence a compact, very reliable and pipeless hydraulic operating mechanism was realized.

The valve seal of oil system is made of metal seat and metal ball, which is good for permanent use without necessity of replacement. But the valve seal of air system is made of rubber, which degrades its quality and requires replacement periodically.



Closing

- Closing coil energized
- Pilot valve opens.
- Main valve opens.
- Main cylinder moves.

Opening

- Trip coil energized
- Pilot valve closes.
- Main valve closes.
- Main cylinder moves.
- 31.5 MPa
- 0MPa

Disconnectors and earthing switches

There are two kinds of disconnectors employed in the switchgear: the linear type disconnector provided in a linear current passage, and the right-angled type disconnector provided at right-angle of the current passage. Line disconnector is of linear type and is incorporated together with earthing switch in one housing as a combined disconnector/earthing switch. Bus disconnector is of right-angled type and is assembled in each bus enclosure. Disconnectors and earthing switches are normally motor-and manual-operated. When disconnectors are specified to have a switching capability of small current as charging current and transformer magnetizing current, they are operated by the motor-charged spring mechanism. The make-proof earthing switch is provided with the motor-charged spring mechanism. Earthed side of the earthing switch is brought out from the earthed metal housing and earthed to it through a removable bolted link for primary injection test.

Current transformer

The current transformer is of the resin molded cable through-out type or three phase foil-insulated type with ring cores mounted in a common housing. The cable through-out type current transformer is preferably used for cable feeder unit, in order to construct the switchgear more compact and economical.

Voltage transformer

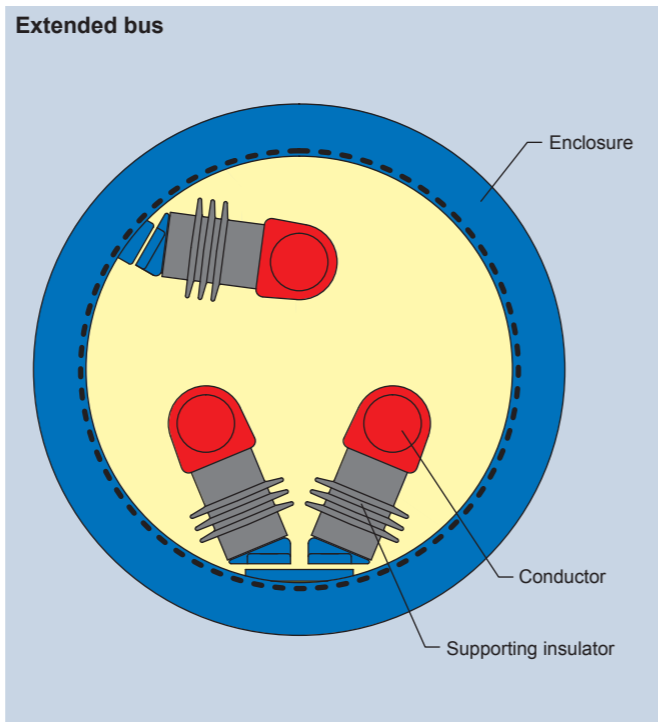
The voltage transformer is of the inductive type. SF₆ gas provides the high-voltage insulation. The high-voltage winding discs are well insulated by plastic foils. The SF₆ gas provides permanent impregnation for the foil insulation.

Surge arrester

The surge arrester consists of zinc oxide (ZnO) element with excellent low residual voltage characteristics and long service life.

Busbar

The three phase conductors made of aluminum or copper, depending on the current rating, are supported by gas tight insulator (for standard bay bus) or individual supporting insulators (for extended bus). The three phase conductors are arranged in a rational disposition to reduce the intensity of electric field on the surface of lower part of enclosure and hence be reliable against the metallic dust, which can possibly enter during site erection.

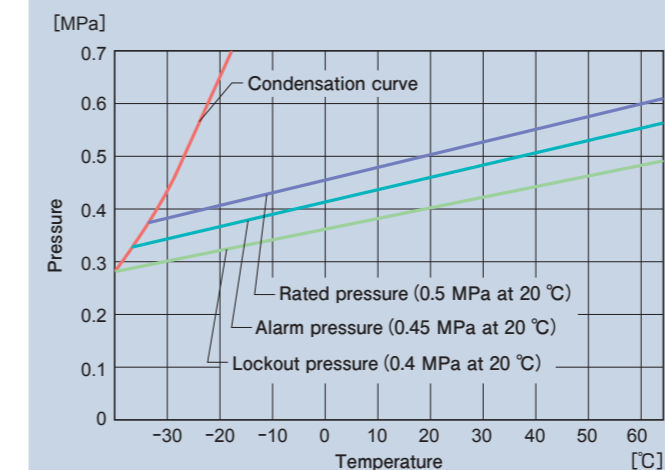


Rated SF₆ gas pressure is unified at 0.5 MPa for all components. SF₆ gas pressure changes depending on the ambient temperature as shown in pressure-temperature characteristic curve. The monitoring of SF₆ gas is carried out by means of temperature compensated pressure switches in the manner as tabled below.

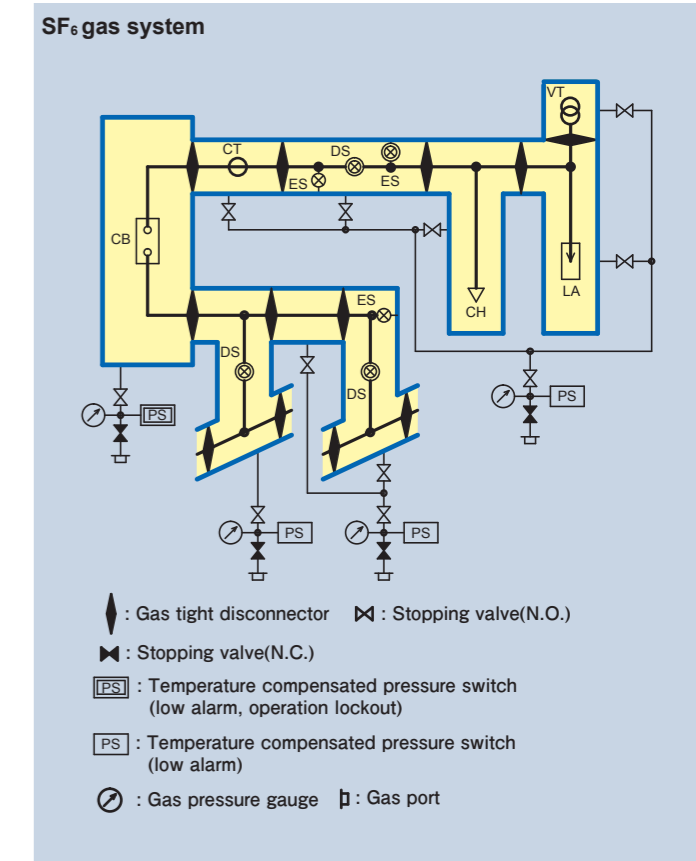
[at 20 °C]			
SF ₆ gas pressure	Rated SF ₆ gas pressure [MPa]	Low alarm pressure [MPa]	Operation lockout pressure [MPa]
Components			
Circuit breakers	0.5	0.45	0.4
Disconnectors earthing switches	0.5	0.45	(Note)
Other components	0.5	0.45	—

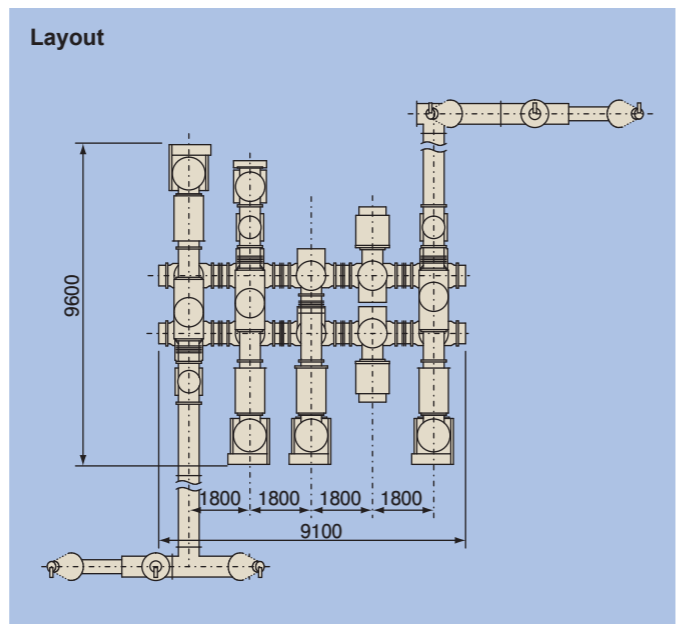
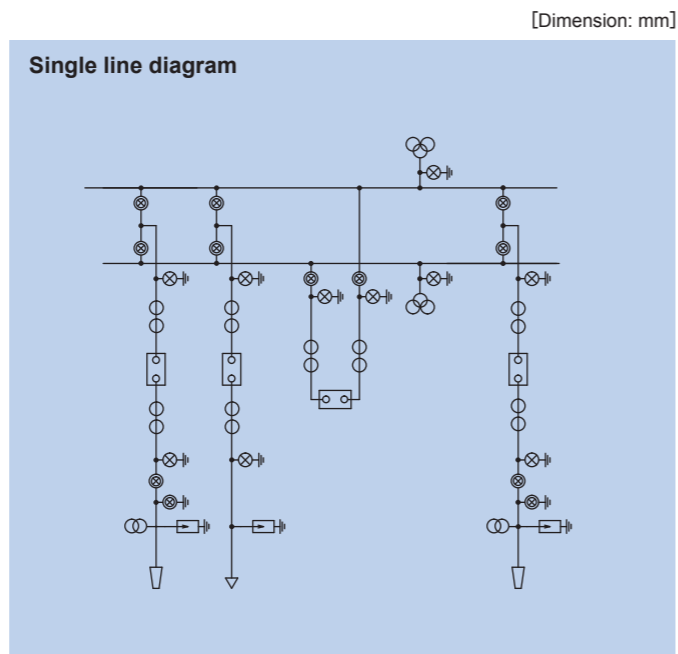
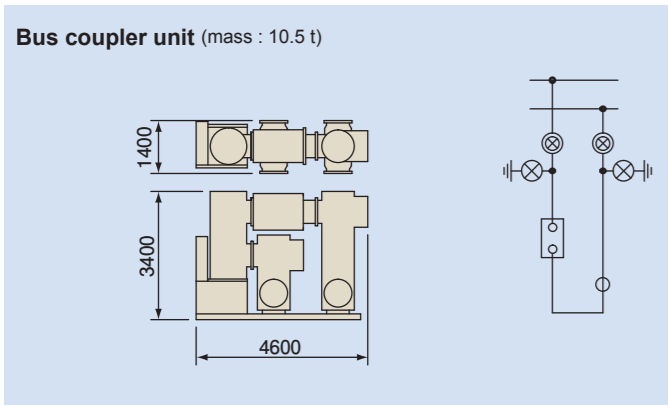
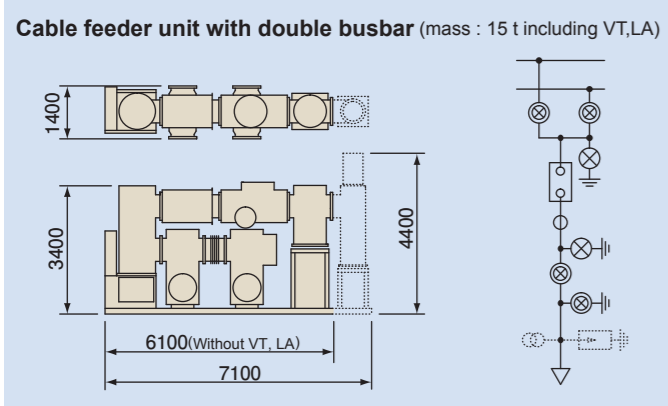
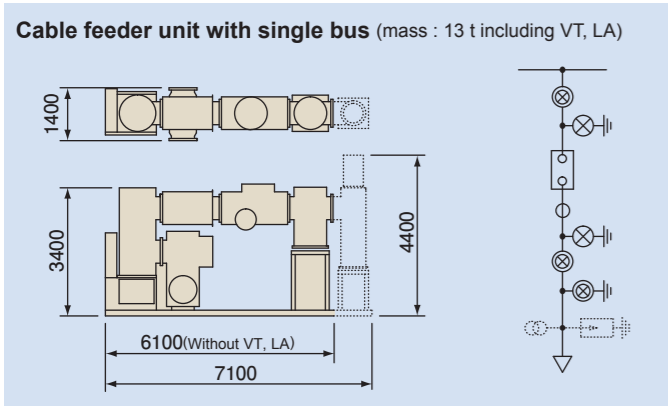
Note: Operation lockout at 0.4 MPa (20 °C), upon request.

Pressure-temperature characteristic curve of SF₆ gas



The gas system for the circuit breaker is independent of the other parts of the switchgear. The SF₆ gas filled disconnector/bus chamber is sealed off from the adjacent bays by gastight and arc-proof disconnectors. A similar insulator seals off this chamber from the circuit breaker. All gas zones are monitored by gas density relays. The switchgear has a very low gas leakage rate. Guaranteed gas loss is less than 0.5 % per annum.





The first three phase encapsulated SF₆ switchgear for 170 kV



N99-908-11

SDF120 for mobile substation for 170 kV 1250 A 40 kA



AF568018

SDF for 170 kV 1250/2000 A 25 kA



N99-2029-12

Printed on recycled paper

 **Fuji Electric Co., Ltd.**

Gate City Ohsaki, East Tower, 11-2, Osaki 1-chome, Shinagawa-ku, Tokyo 141-0032, Japan
Phone : (03)5435-7111

Internet address : <http://www.fujielectric.co.jp>

Information in this catalog is subject to change without notice.

2013-3(B2013/F1983)DE-H/CTP3M Printed in Japan