ACS large drive family

ACS6000c

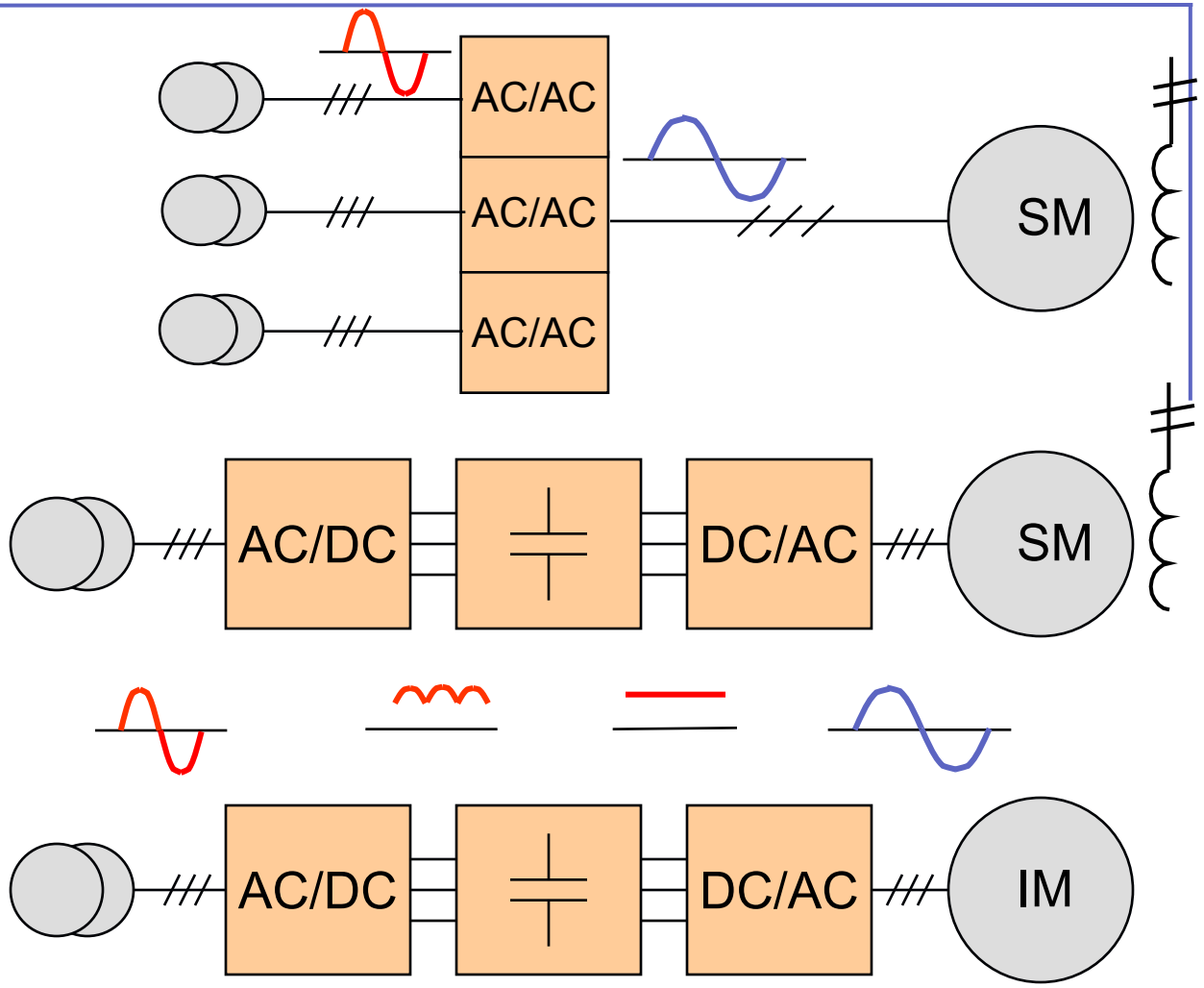
- direct AC to AC converter(cyclo), **no DC-link**
- SCR Thyristor
- synchronous motor(AC motor with DC excitation)
- high power and low speed, example roughing mills and ship main propulsion

ACS6000sd

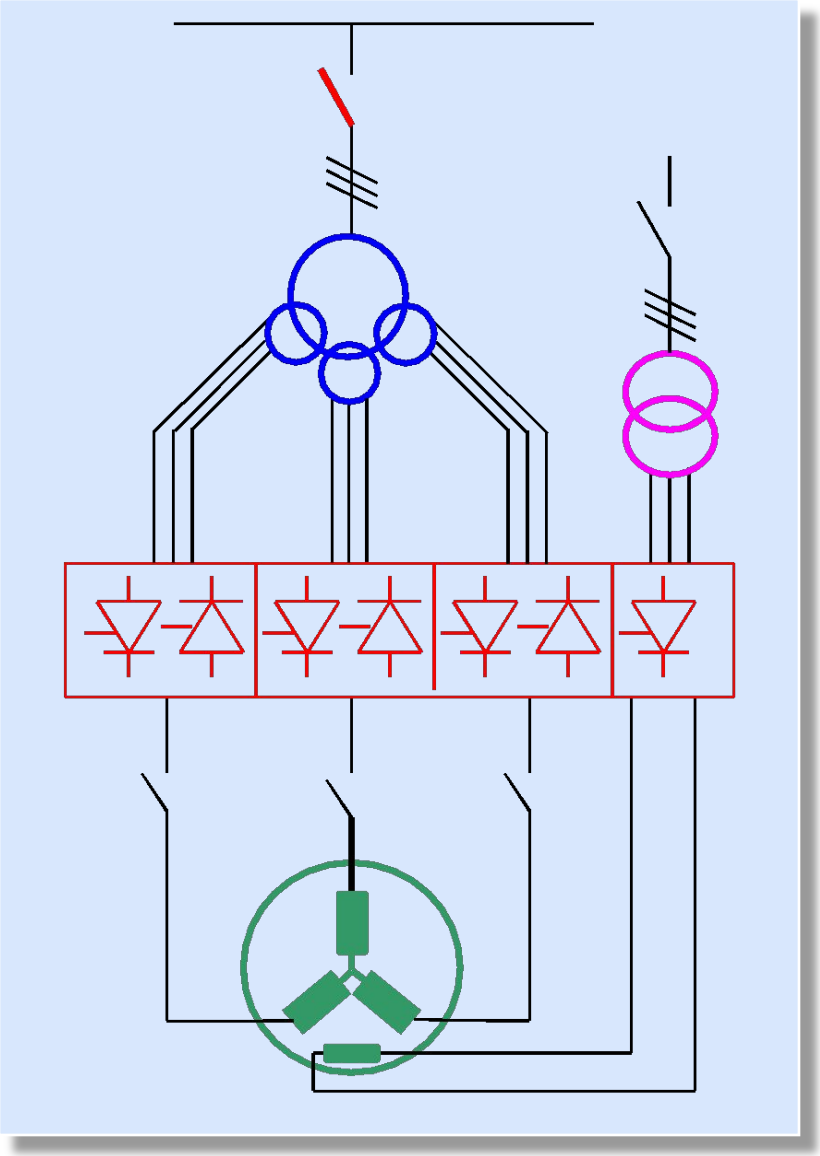
- AC/DC/AC drive with DC-link
- IGCT semiconductor which is gate commutated
- synchronous motor(AC motor with DC excitation)
- best possible performance with DTC
- cold rolling mills and mine hoists

ACS6000ad / ACS1000

- AC/DC/AC drive with DC-link
- IGCT semiconductor
- induction motor(no excitation)
- 6000ad for marine application
- 1000 for pumps and fans



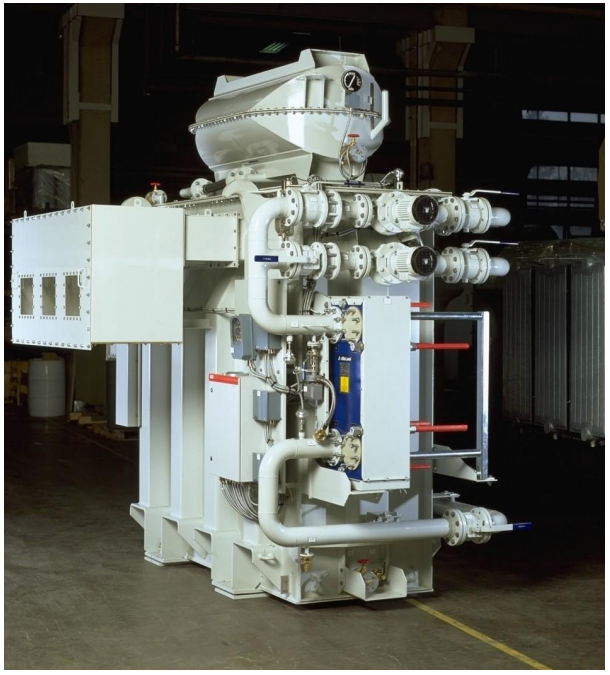
ACS6000c cycloconverter drive



Main components of cycloconverter drive:

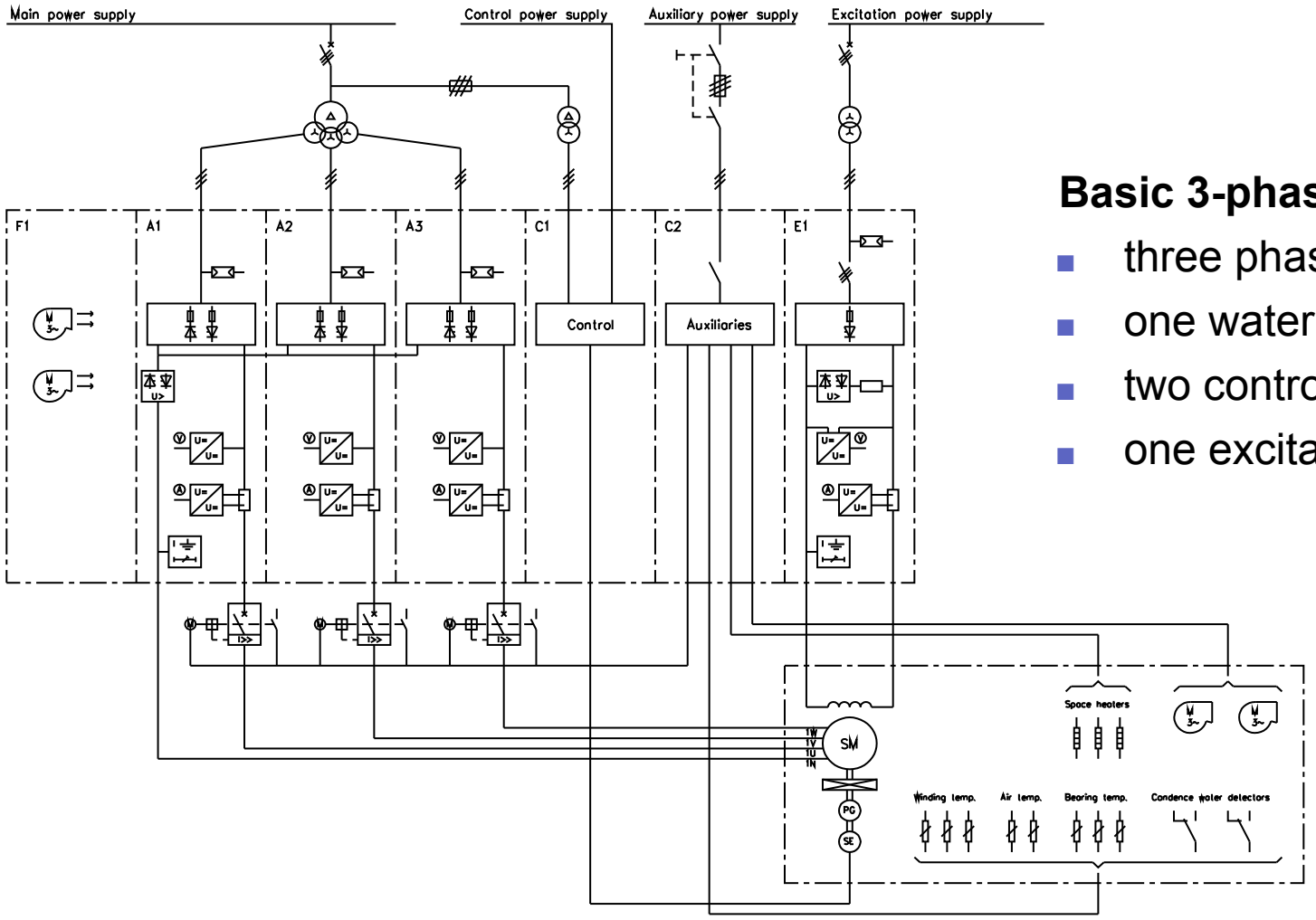
- Main circuit breaker
- Transformers to connect the drive to high voltage network 6..36kV.
- Cycloconverter
- High speed circuit breakers
- 3 or 2*3 phase Synchronous motor(AC-motor) with DC-excitation

ACS6000c transformers



- 2, 3 or 4 winding transformers
- Primary voltage from 6 to 36kV
- In metals air cooled
- In marine water cooled
- Auxiliaries
  - Dehydrating Breathers
  - Fans/pumps
  - Gas Relays
  - Oil Level Indicators
  - Pressure Relief Devices and Over-pressure Swithes
  - Tap Changers
  - Thermometers & PT 100

ACS6000c system description

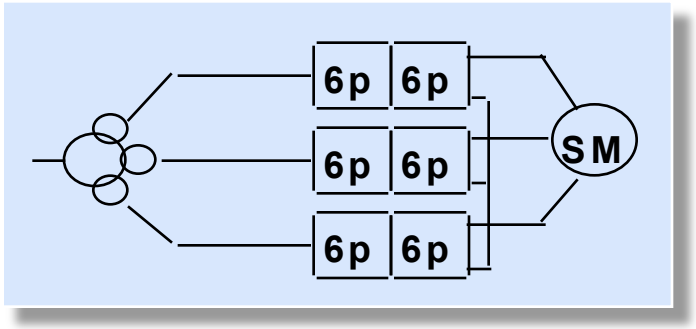


Basic 3-phase cycloconverter

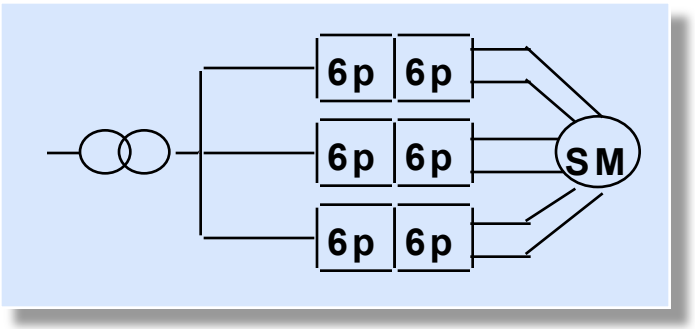
- three phase units
- one water or air cooling unit
- two control units
- one excitation unit

ACS6000c system description

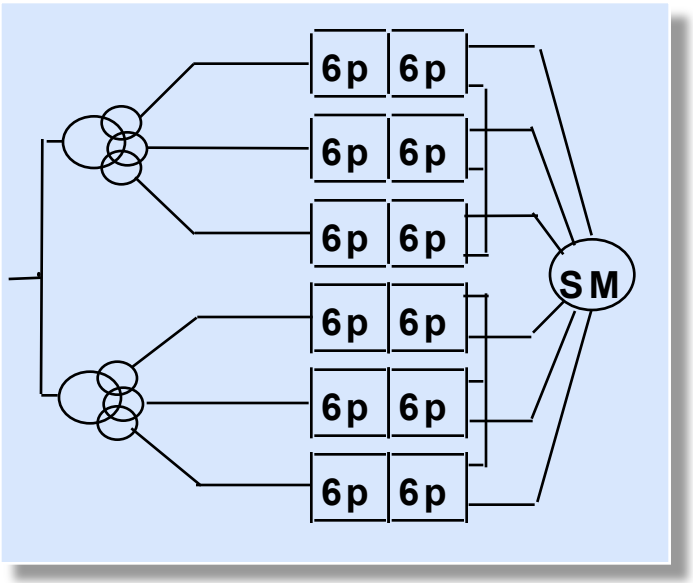
1) 6-pulse, 3-phase motor



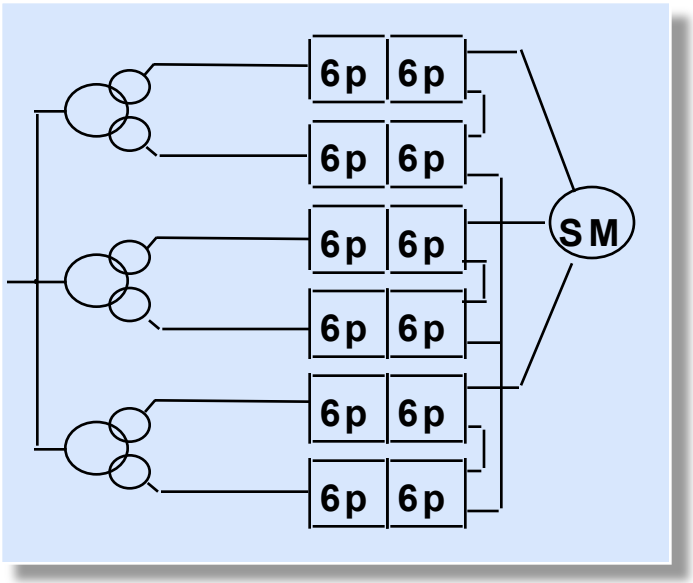
2) 6-pulse, 3-phase motor, separated phase windings



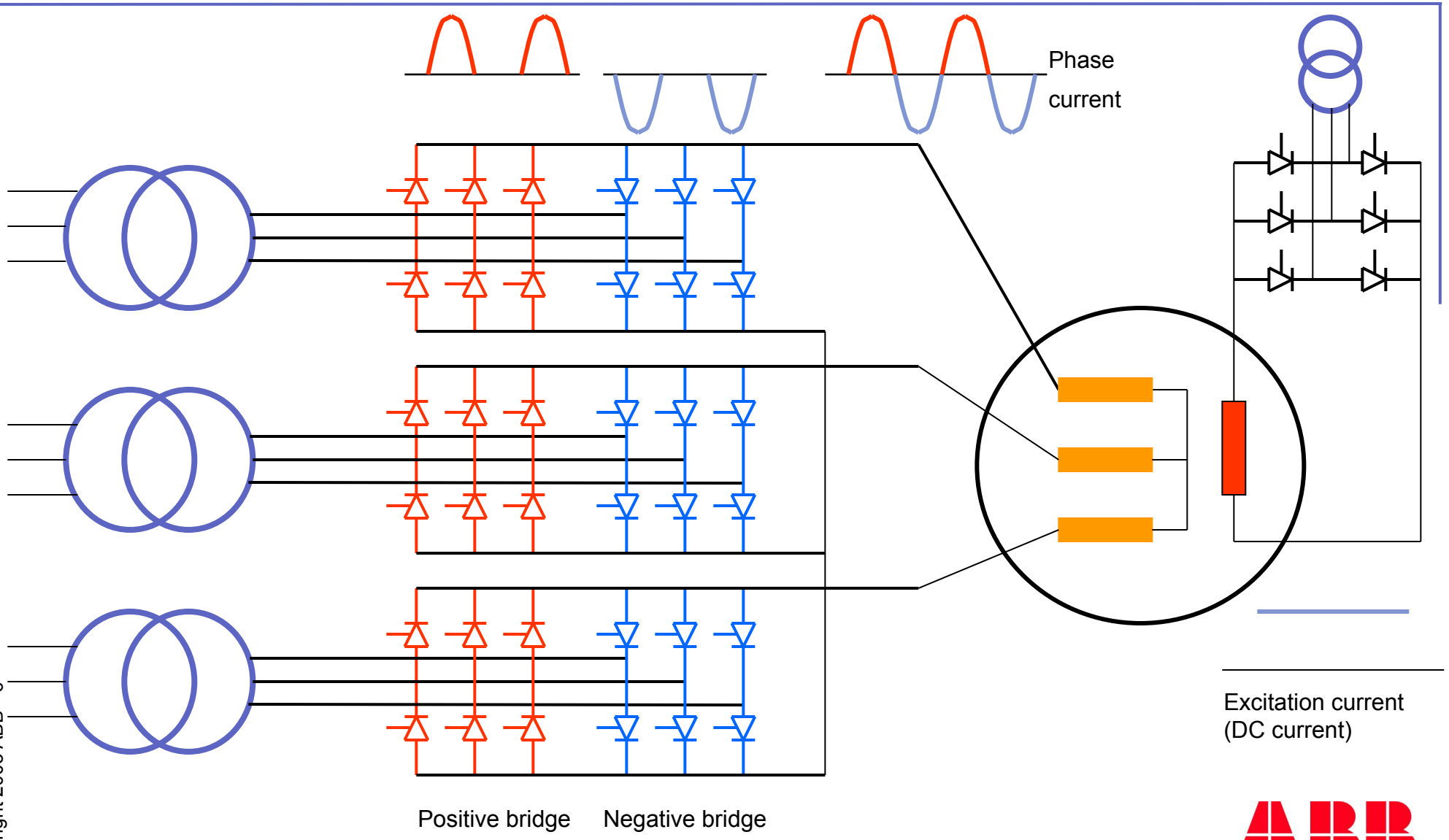
3) 6-pulse, 2*3-phase motor, separated stators



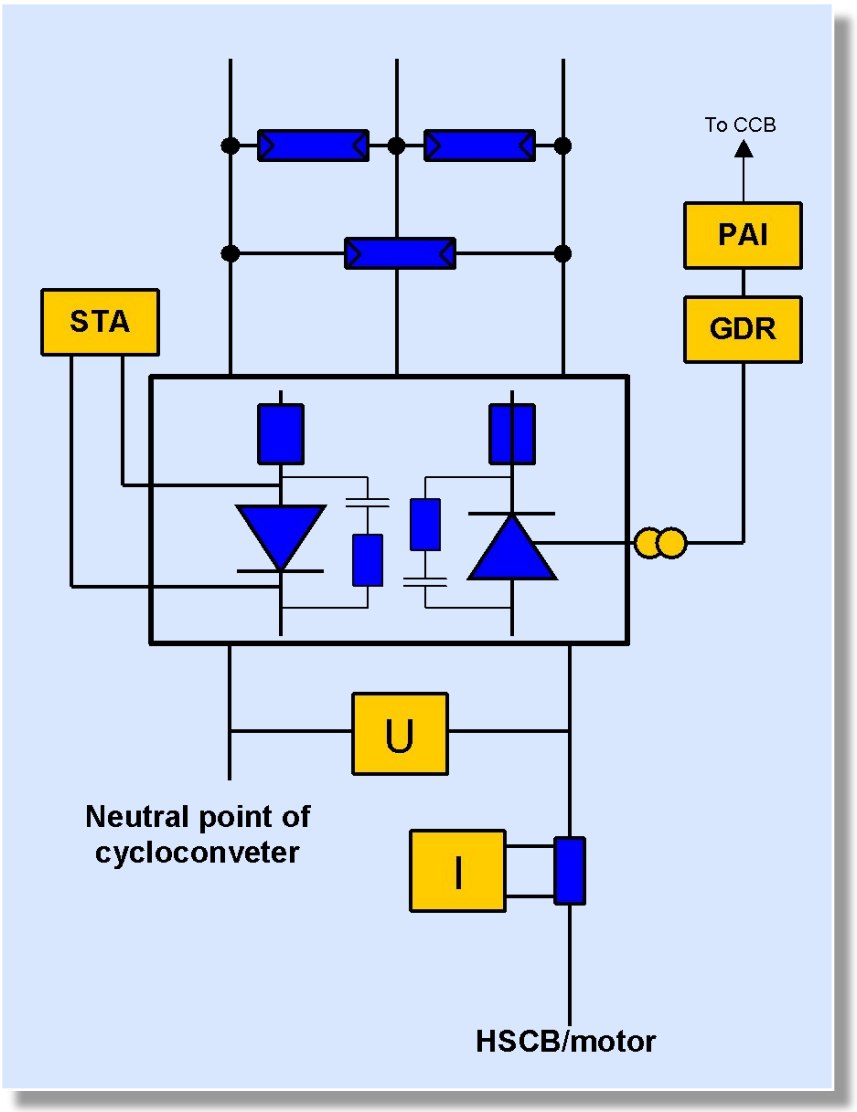
4) 12-pulse, 3-phase motor



ACS6000c cycloconverter drive

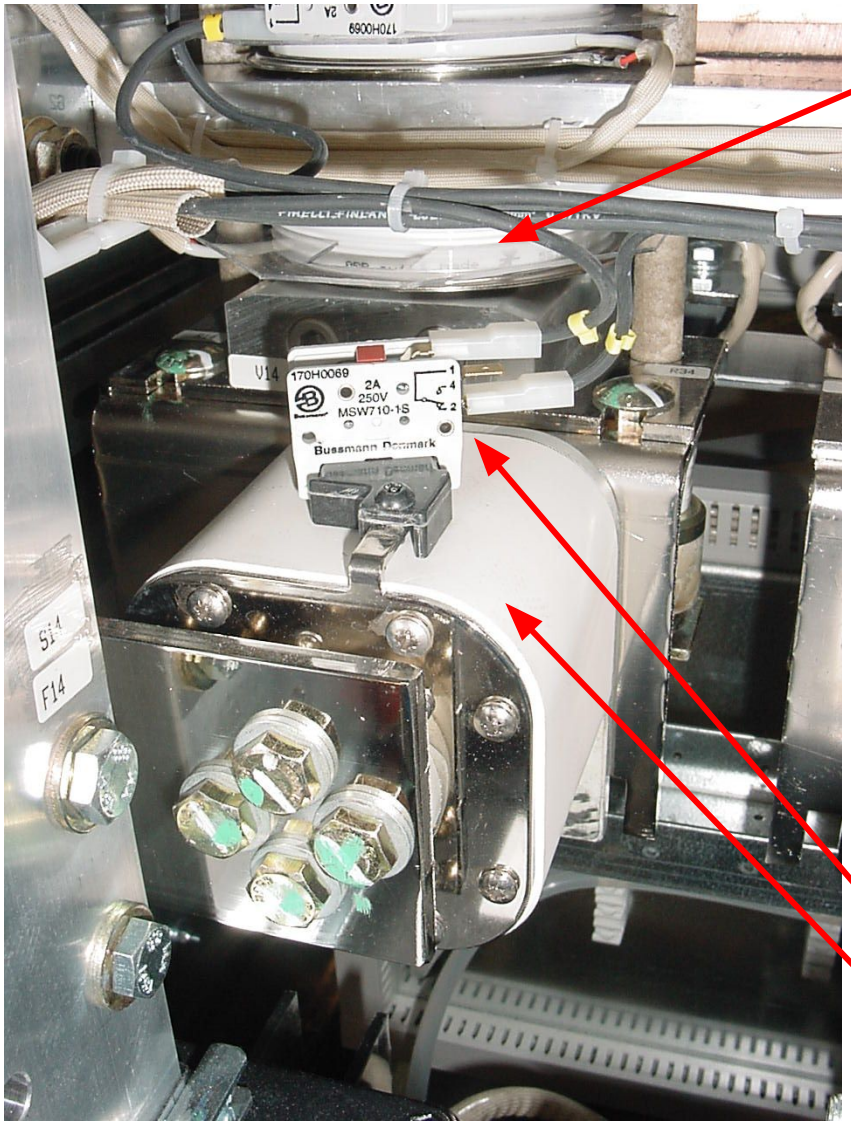


ACS6000c Phase unit main parts



- 3 phase supply(1000..1200VAC)
- 3 overvoltage suppressors
- 12 (24 if parallel) fuses
- 12 thyristor's
- 12 RC circuits
- 12 pulse transformers
- 2 **G**ate **DR**iver boards
- 1 **P**ulse **A**mplifier **I**nterface board
- 1 Thyristor **STA**tus measurement board
- 1 voltage tranducer
- 1 shunt and current tranducer

ACS6000c thyristor



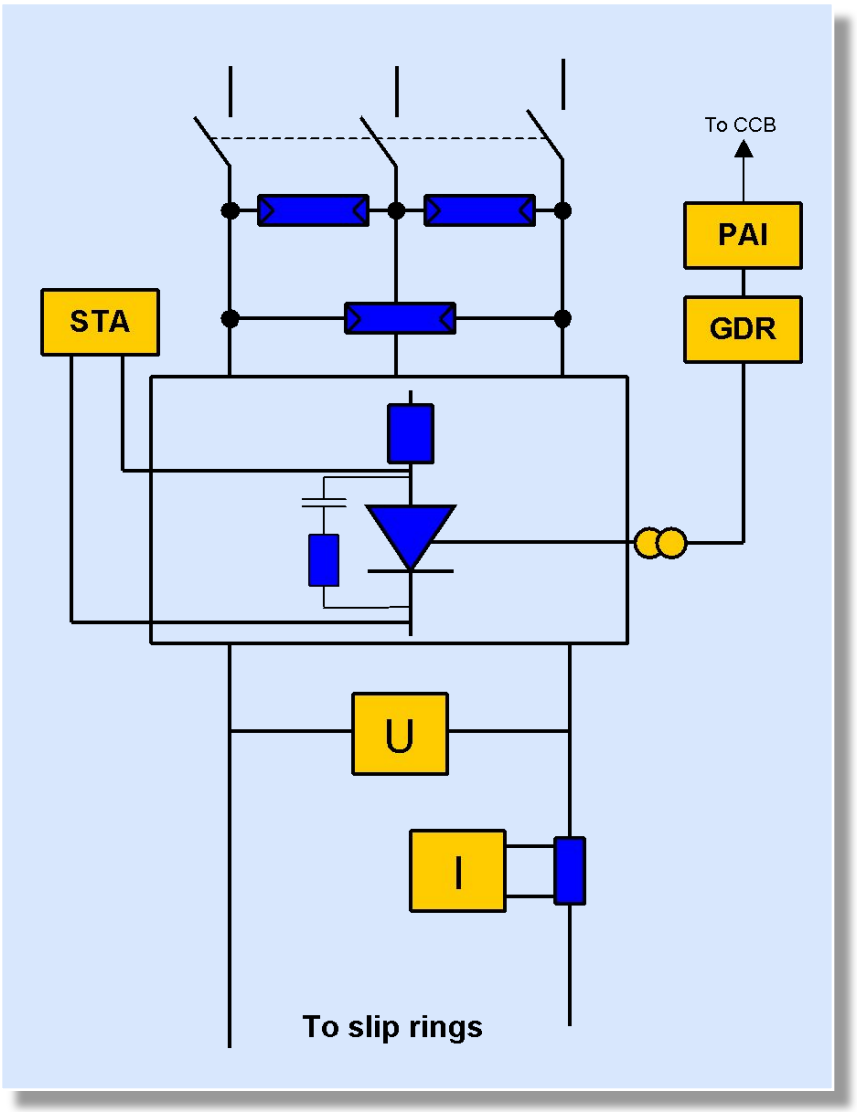
Thyristor

thyristor module type	max. continuous current [A]	overload 60 s [A] (preload 1/2 * I_{60s})		Thyristor type
		overload	preload	
W1-49-10	1600	1850	925	**5STP1242F0000**
W2-73-10	2850	3400	1700	**5STP1842F0001**
W2-84-10	4150	5250	2625	**5STP2842F0017**
W3-96-10	5200	6700	3350	**5STP3842F0007**
A2-49-10	1420	1760	880	**5STP1242F0000**
A2-73-10	2300	3050	1525	**5STP1242F0000**
A3-73-10	2700	3200	1600	**5STP1842F0001**
A3-84-10	3750	4500	2250	**5STP2842F0017**
A3-96-10	4500	5600	2800	**5STP3842F0007**

Micro switch

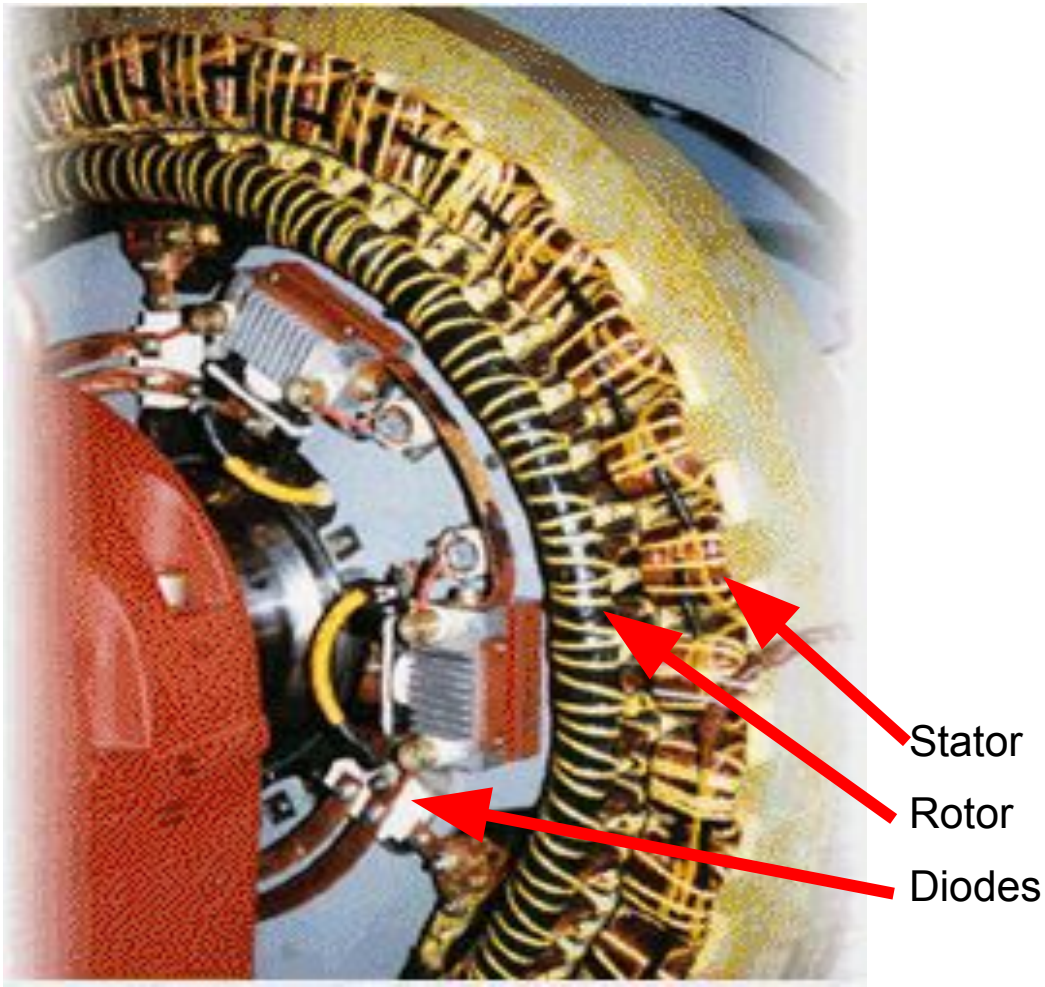
Fuse

ACS6000c Excitation unit main parts



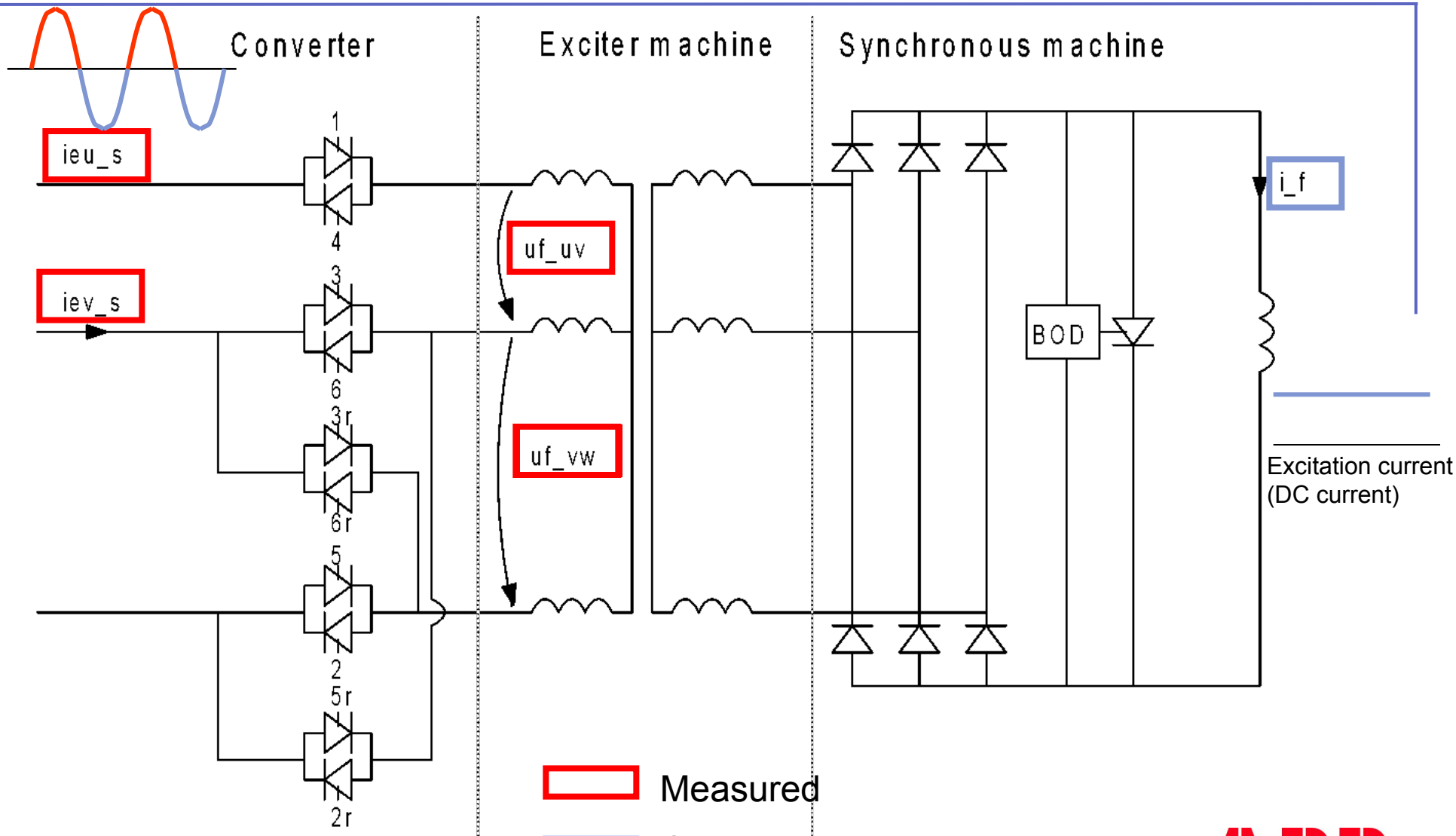
- 3 phase supply(400..690VAC)
- 1 contactor
- 3 overvoltage suppressors
- 6 fuses
- 6 thyristor's
- 6 RC circuits
- 6 pulse transformers
- 1 **G**ate **DR**iver boards
- 1 **P**ulse **A**mplifier **I**nterface board
- 1 Thyristor **STA**tus measurement board
- 1 shunt and current tranducer
- 1 voltage tranducer

ACS6000c brushless excitation

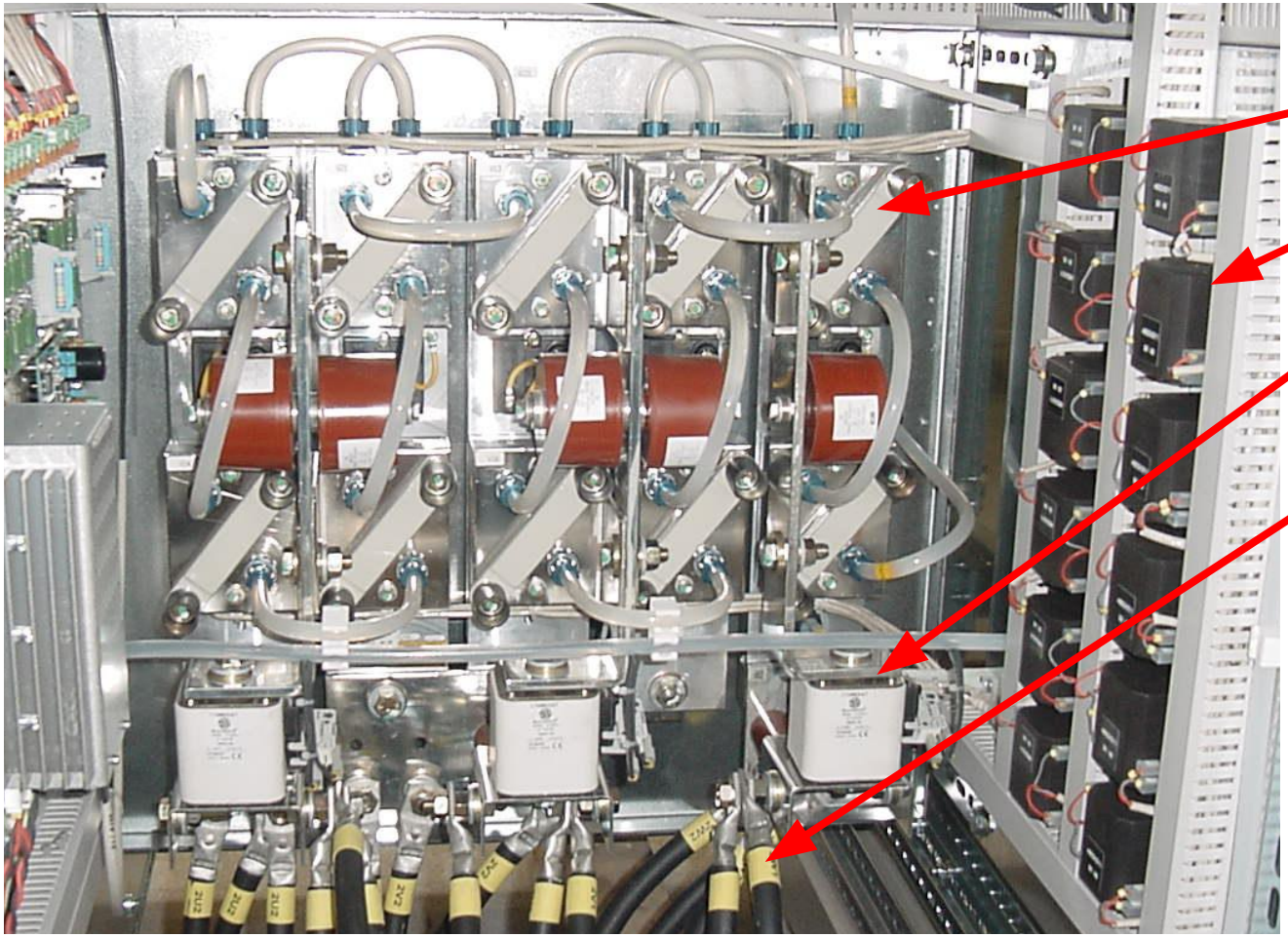


- Both brushless excitation and excitation with sliprings and brushes are available
- When performance requirements are high excitation with sliprings and brushes will be used
- Brushless excitation is the alternative e.g. in fan, compressor and pump drives
- Explosive environments require brushless excitation

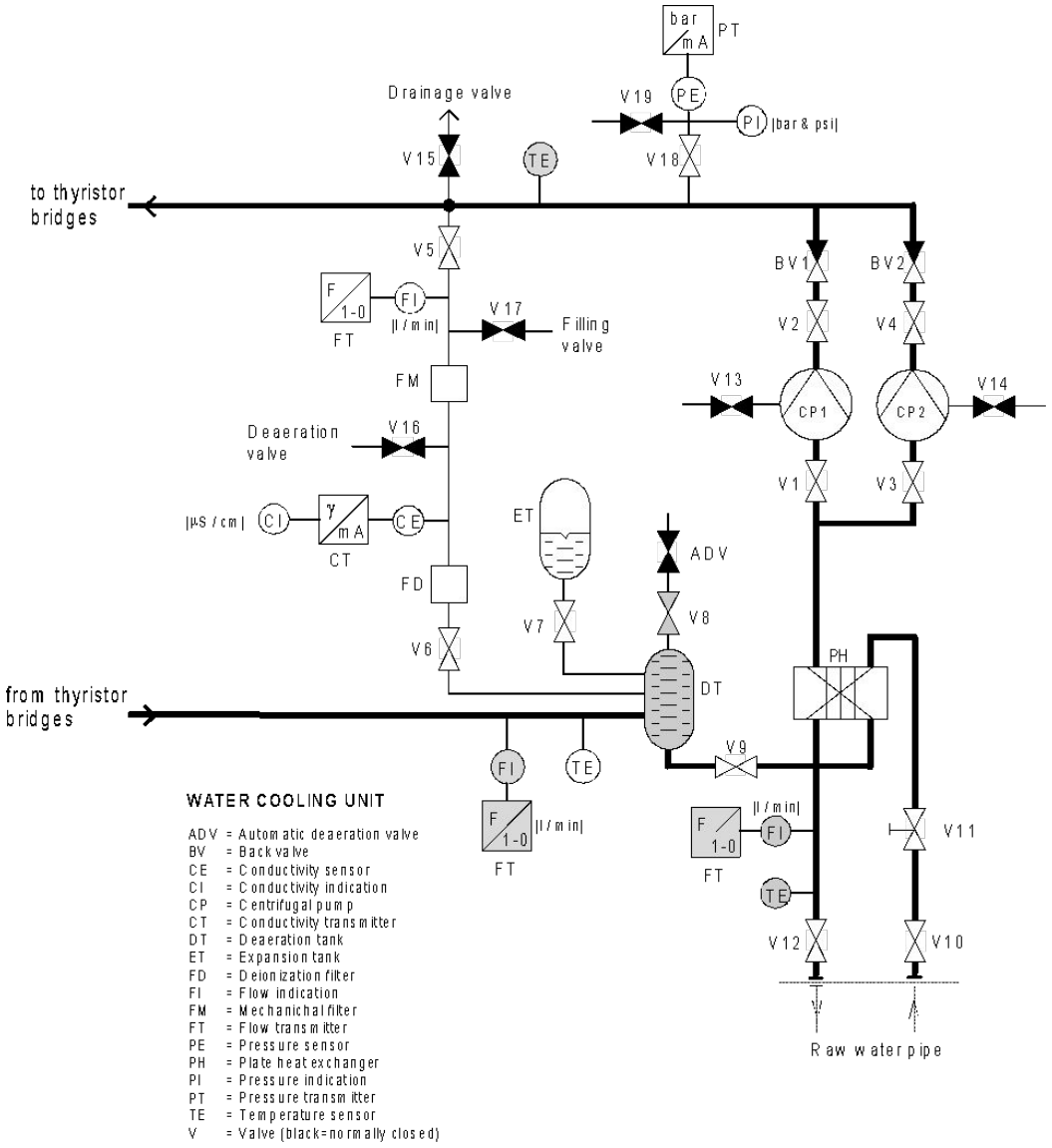
ACS6000c brushless excitation



ACS6000c brushless excitation



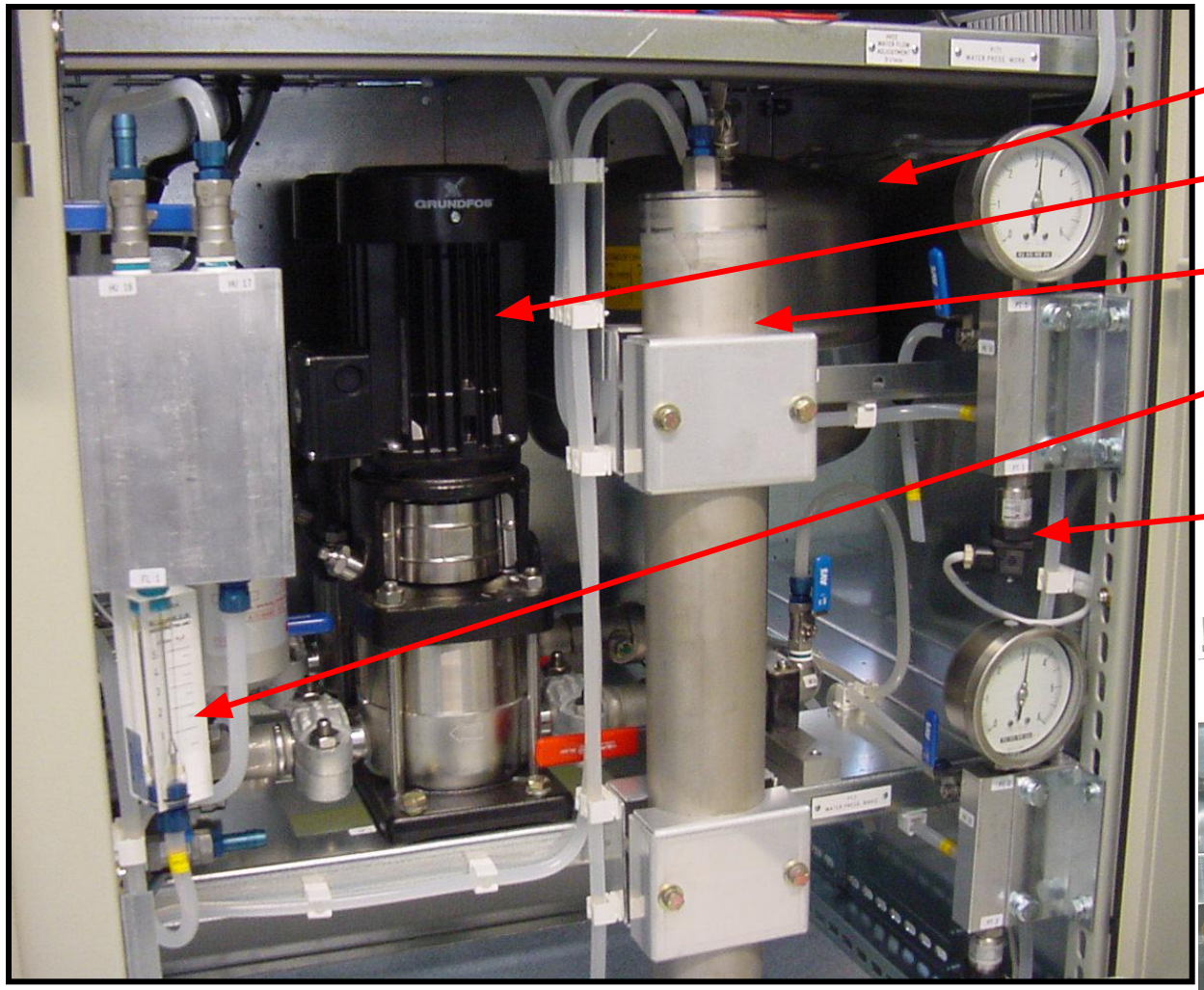
ACS6000c Water cooling unit



Water cooling benefits:

- increased thyristor loadability
- minimum air-conditioning needed
- no dust filtering problems or maintenance needs
- practically noiseless
- smaller cubicles
- no fans needed - better efficiency

ACS6000c Water cooling unit



Expansion vessel

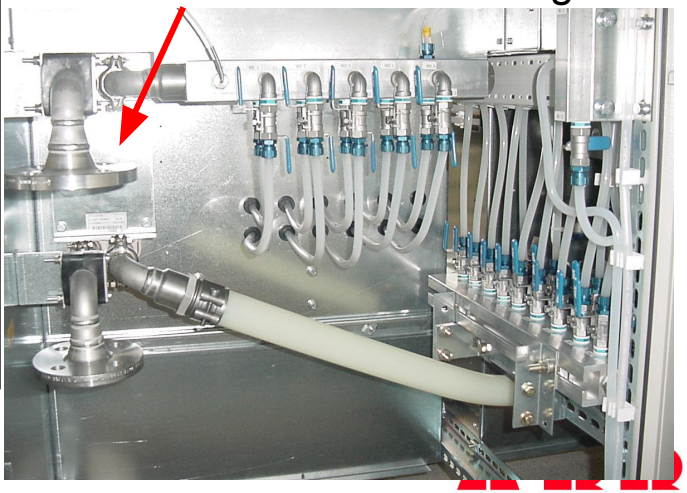
Two pumps

Ion-compound

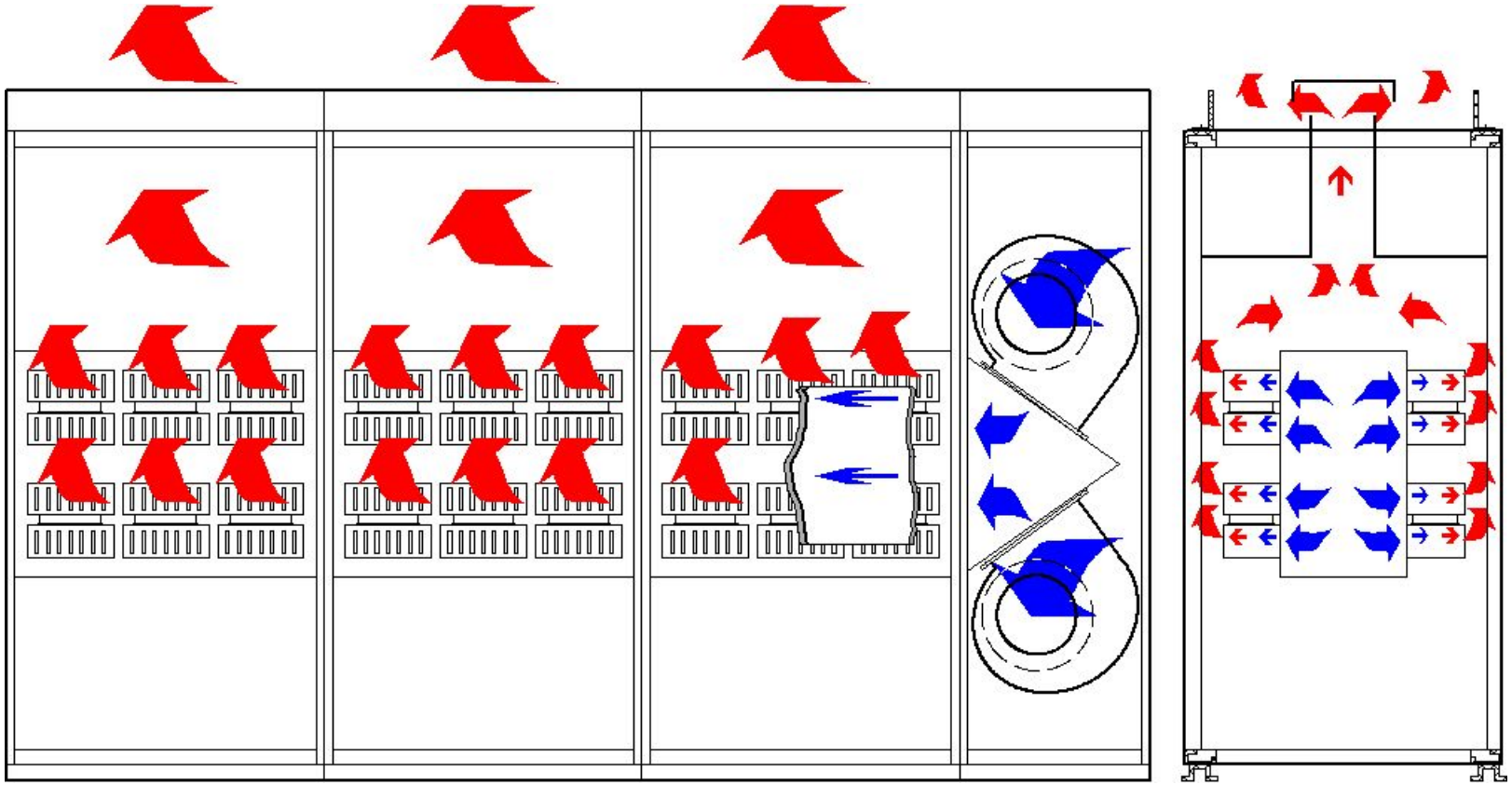
ion-compound water flow meter

Pressure sensors

External water cooling

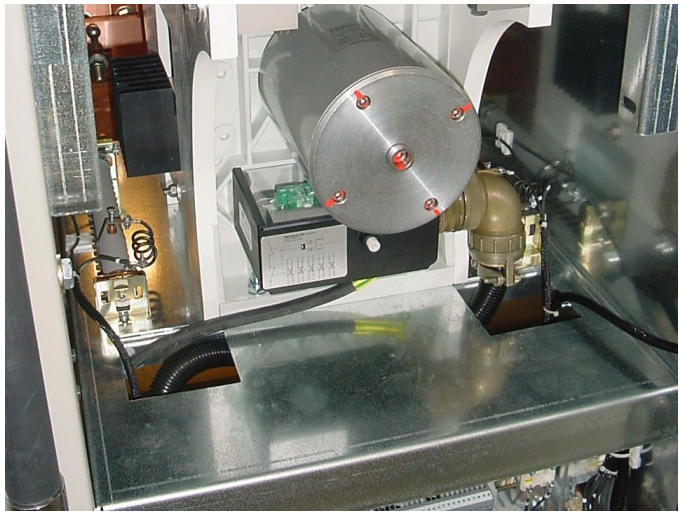


ACS6000c air cooling



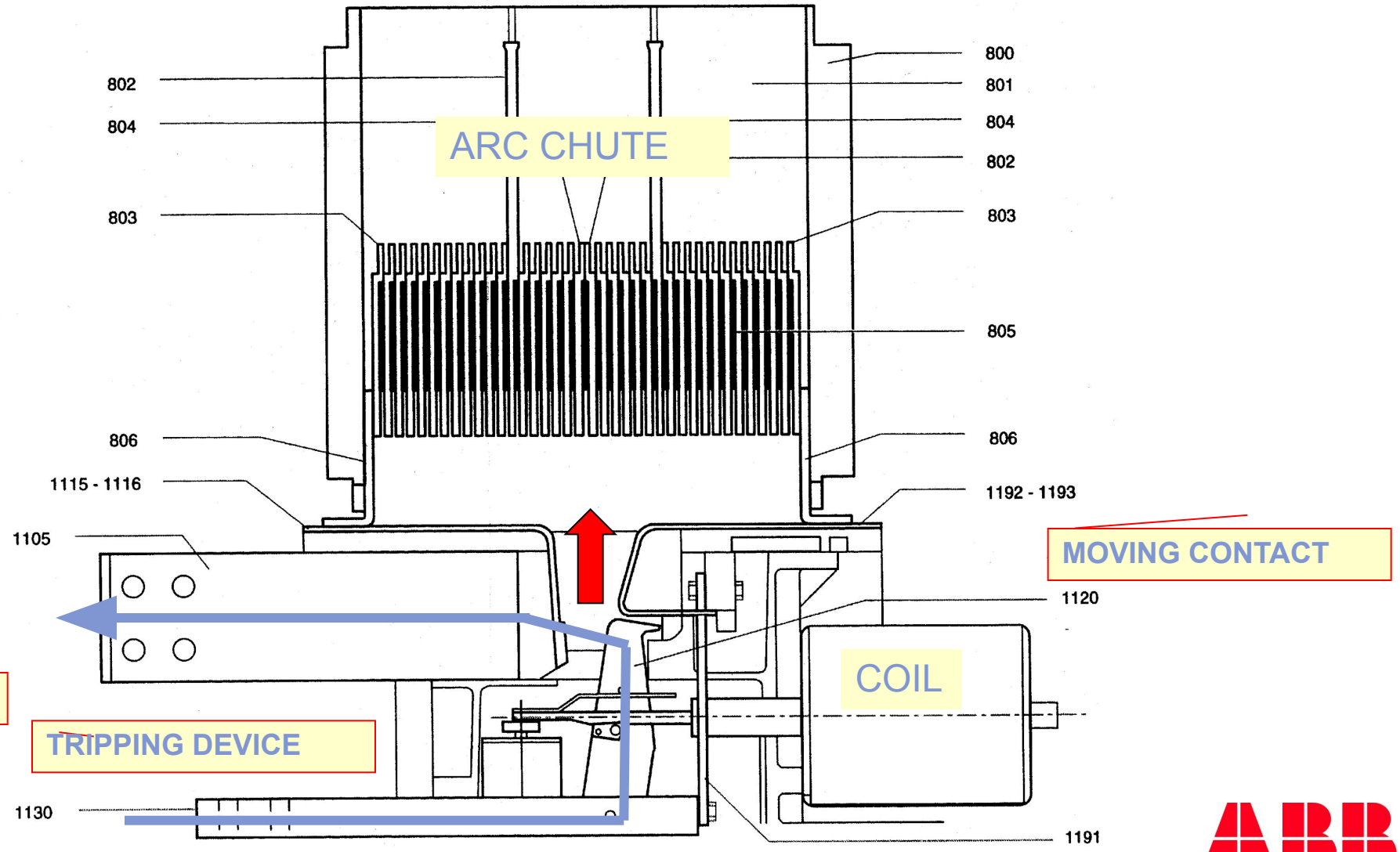
- Common air channel through max. three phase cabinets
- Redundant blower option

ACS6000c high speed circuit breakers(HSCB)

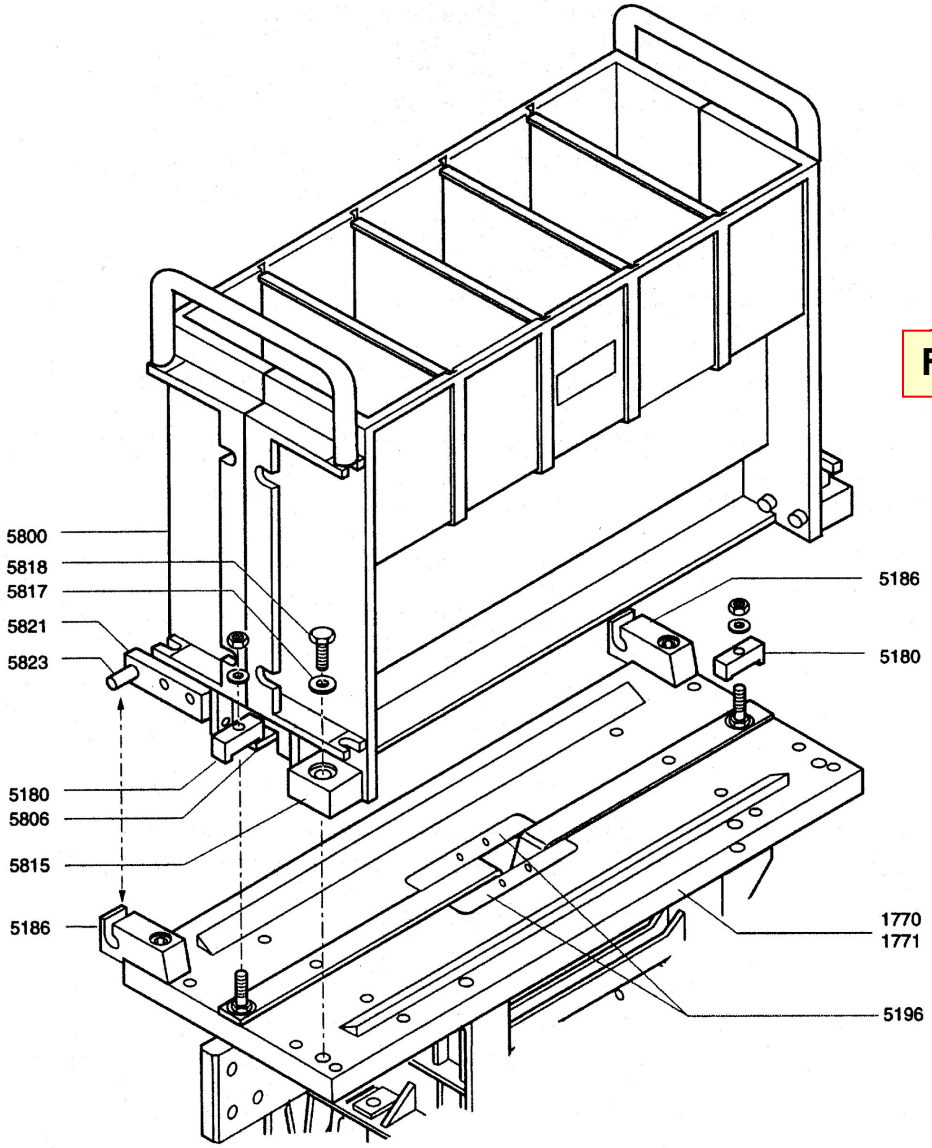


- Made by Secheron, Geneva, Switzerland
- Nominal voltages up to 4000V
- Maximum rated currents up to 6000A
- More selective protection in case of short circuit in motor or commutation failure during regenerating(loss of supply voltage)
- Voltage level of the fuses lower. 1.25kV instead of 2.0kV without HSCB

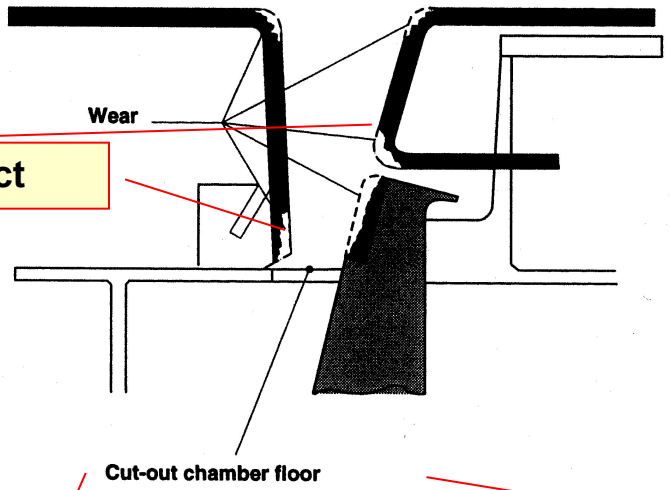
ACS6000c HSCB operation



ACS6000c HSCB wearing



ARC CHUTE

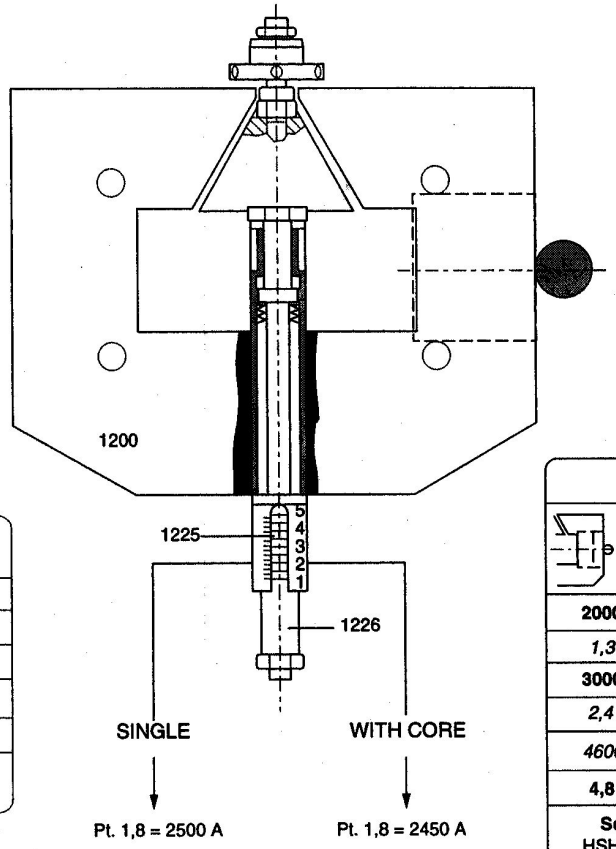


Fixed contact

Pole

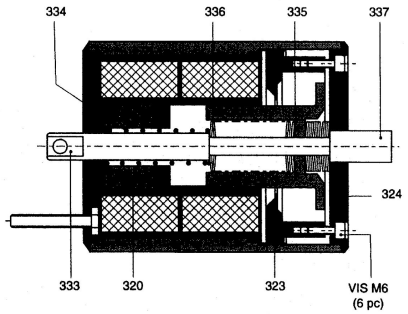
Moving contact

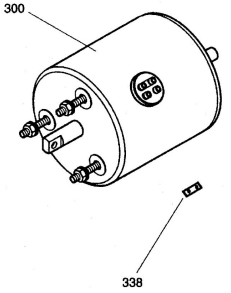
ACS6000c HSCB setting

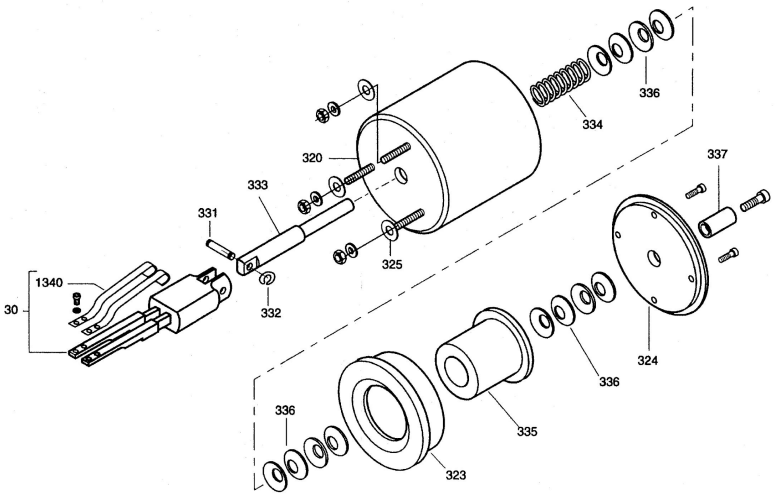


Ids (A)	
2000	*1,1*
3000	*2,1*
3500	*2,6*
4000	*3,1*
5000	*4,8*
Sécheron SA HSBA 400 226 P1	

Ids (A)	
2000	*4300*
1,3	1
3000	6500
2,4	*3,0*
4600	8000
4,8	*4,9*
Sécheron SA HSHR 430 390 P1	



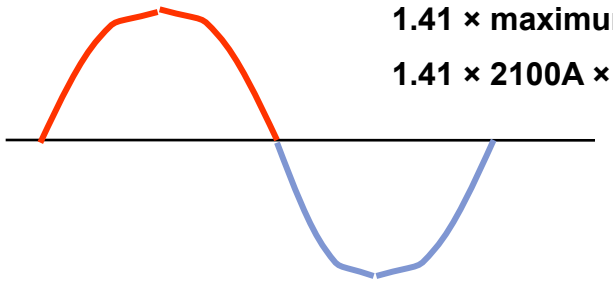




Trip limit=

1.41 × maximum motor current ×1.3

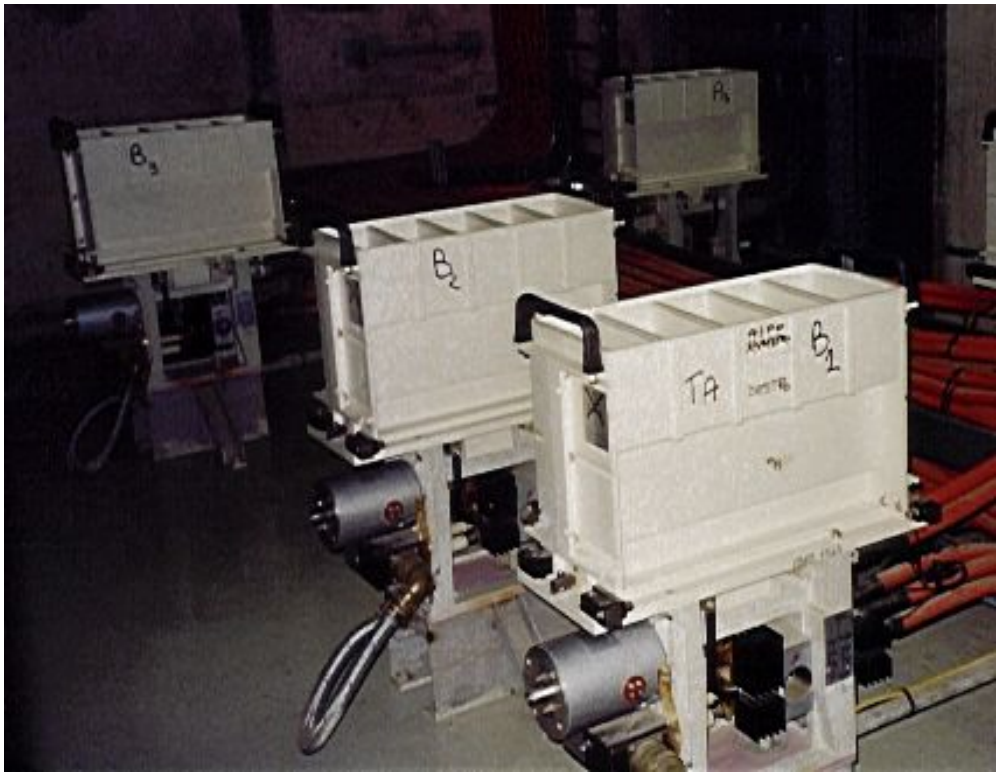
1.41 × 2100A × 1.3=3850A



Phase current

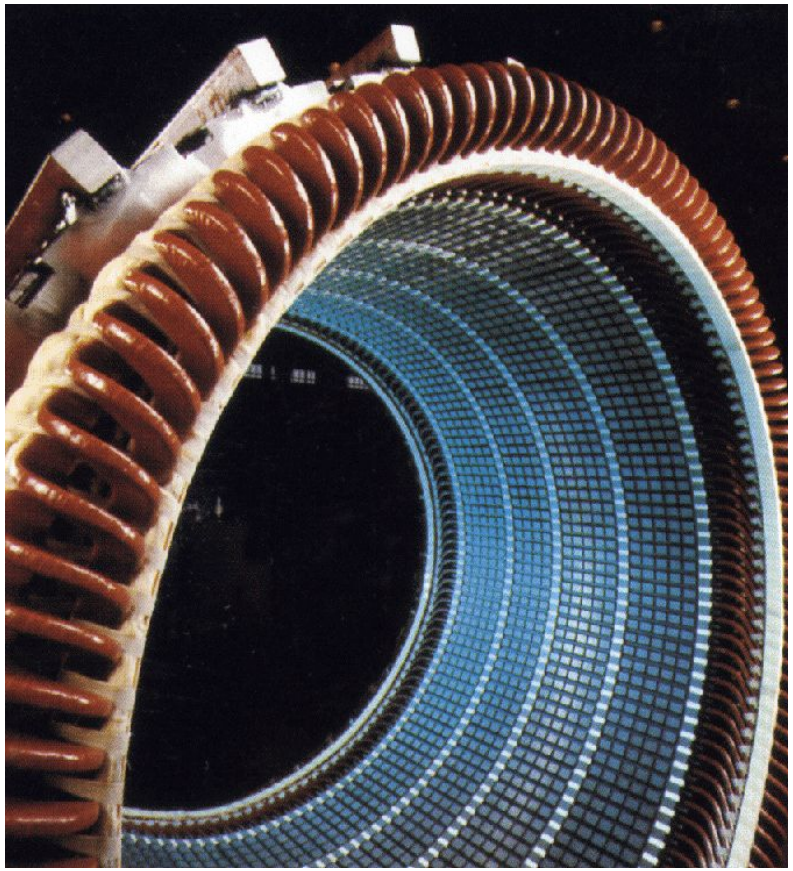
ACS6000c HSCB installation

MARINE



METALS

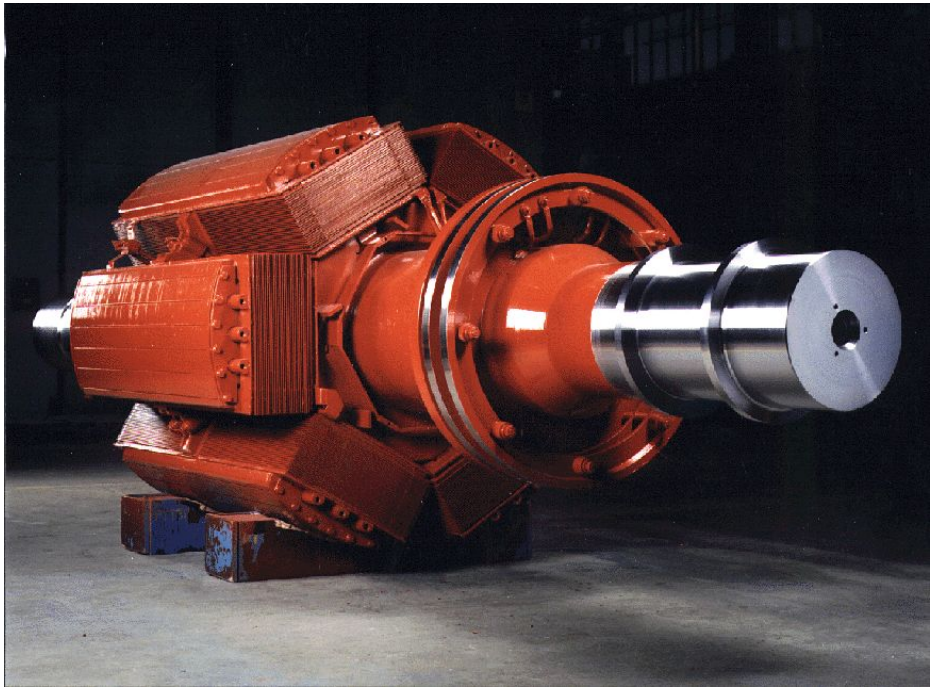
ACS6000c, Synchronous motor compared to DC



Smaller mechanical size

- No commutation problems
- Lower losses
- Full overload up to max speed
- Less maintenance
- Moment of inertia can be kept low: long rotor, small diameter
- AC-Synchronous motor is thermally less critical
  - Stator monitored with Pt-100 elements
  - Rotor construction is not thermally critical
- Gearless solutions: noise - losses

ACS6000c, SM rotor design



Salient pole motor with high overloadability and easy cooling of rotor

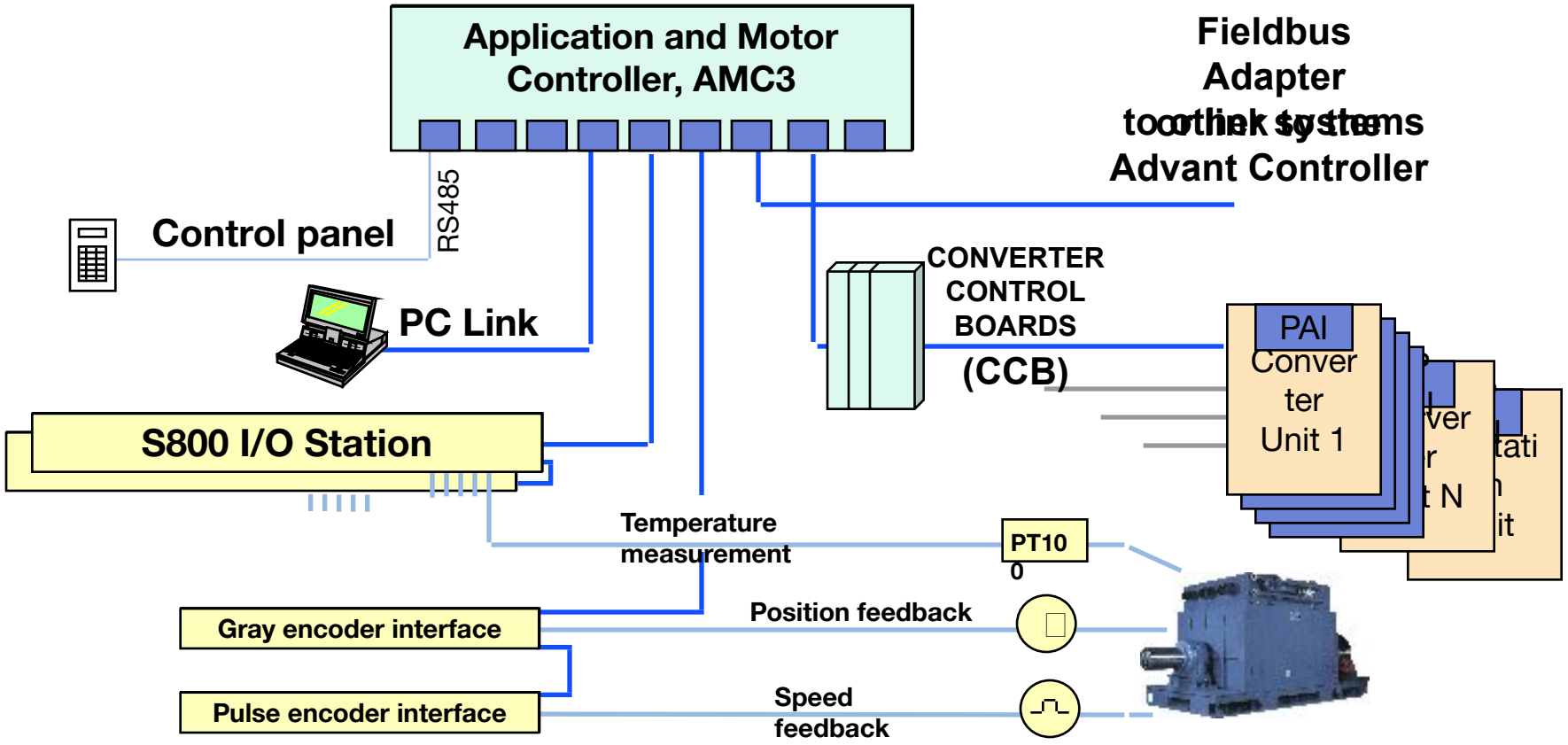
- means smaller inertia and lower weight
- means lower losses in the rotor
- means higher margins to the pole angle limit (90 degrees)
- direct cooling of the excitation windings

Salient pole rotor with removable poles

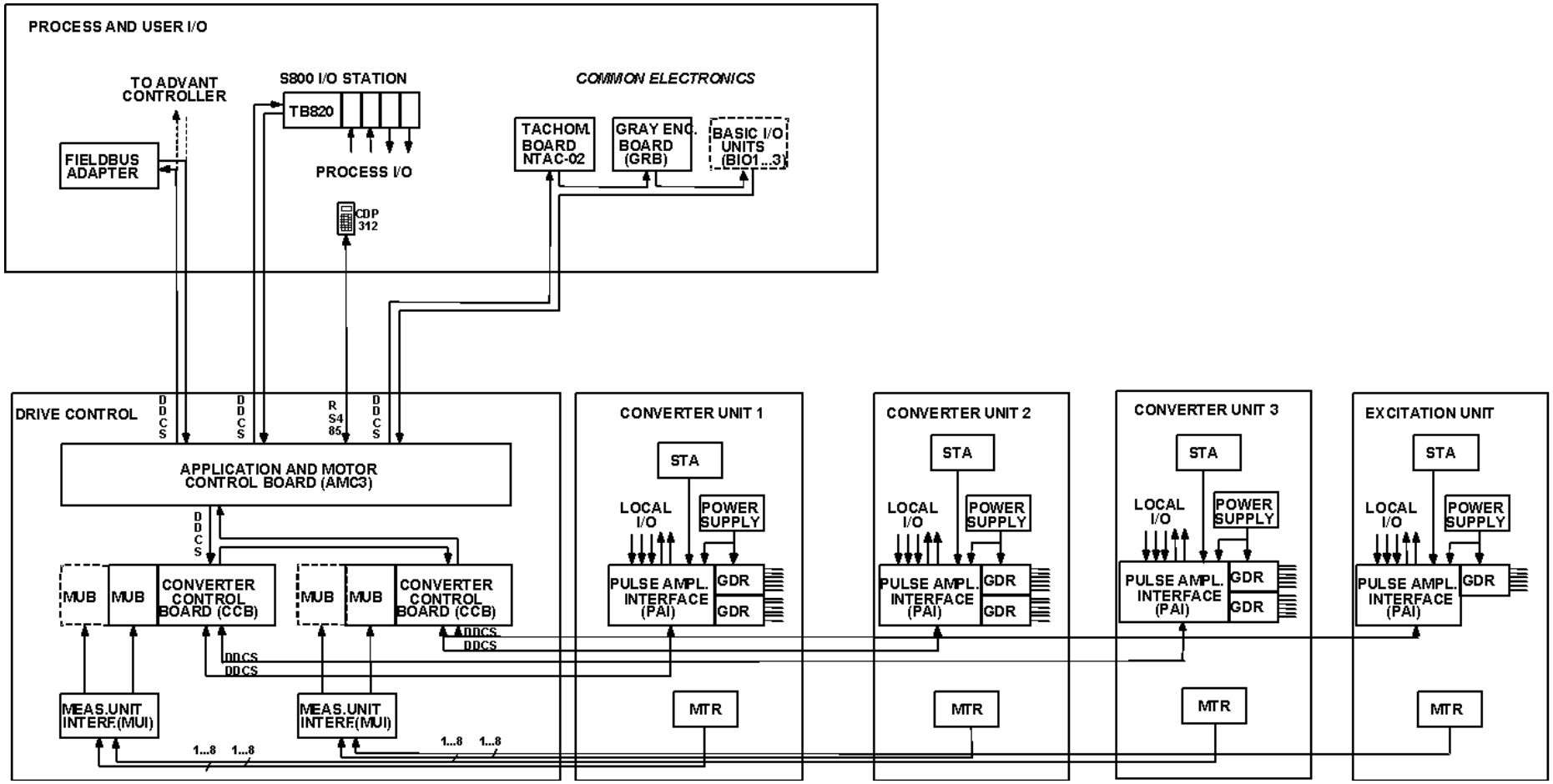
- means only a pole as a spare part, not the whole rotor
- means that the rotor can be repaired at site

ACS6000c control

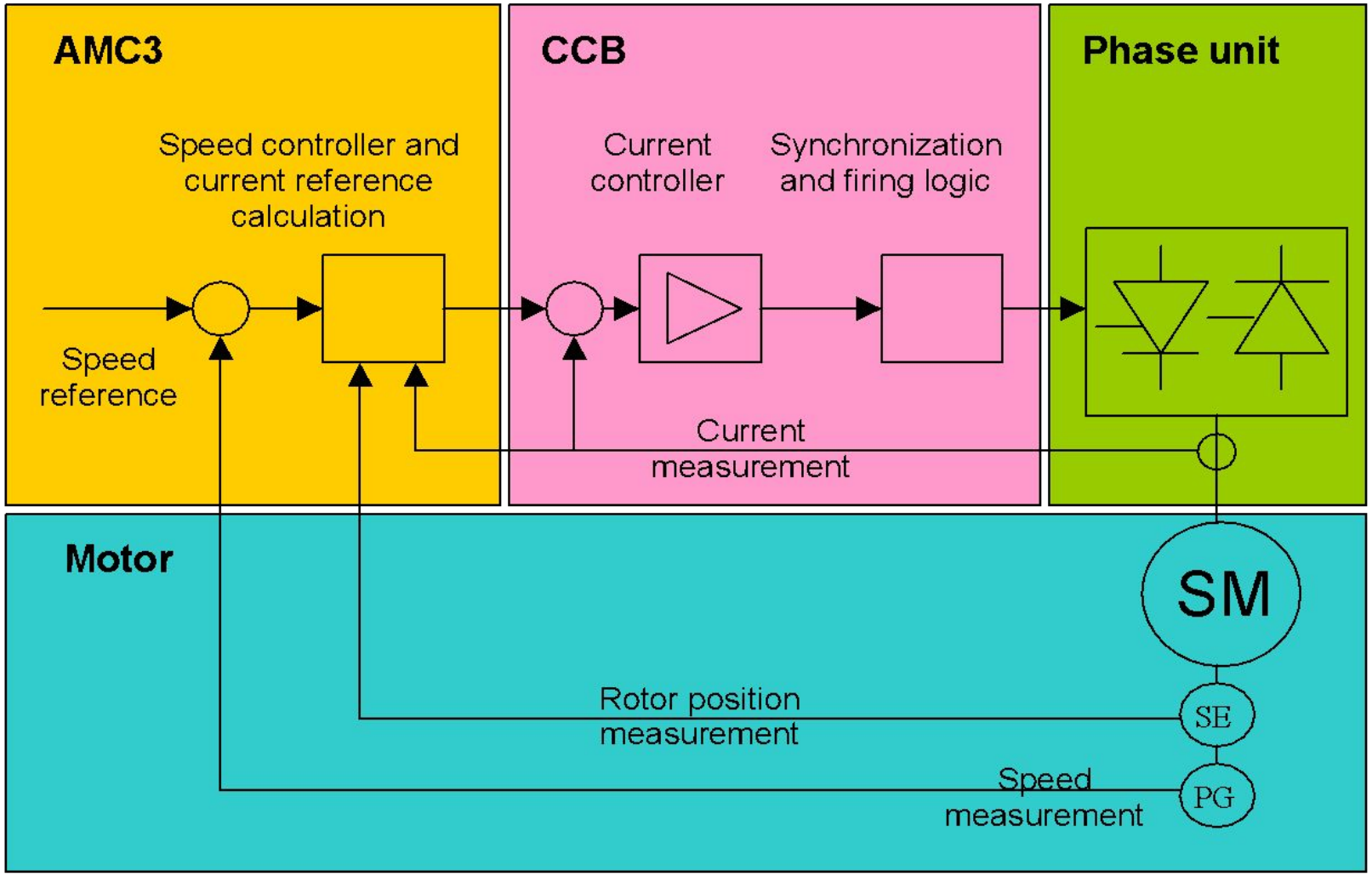
AMC3 with DDCS -Optic Links



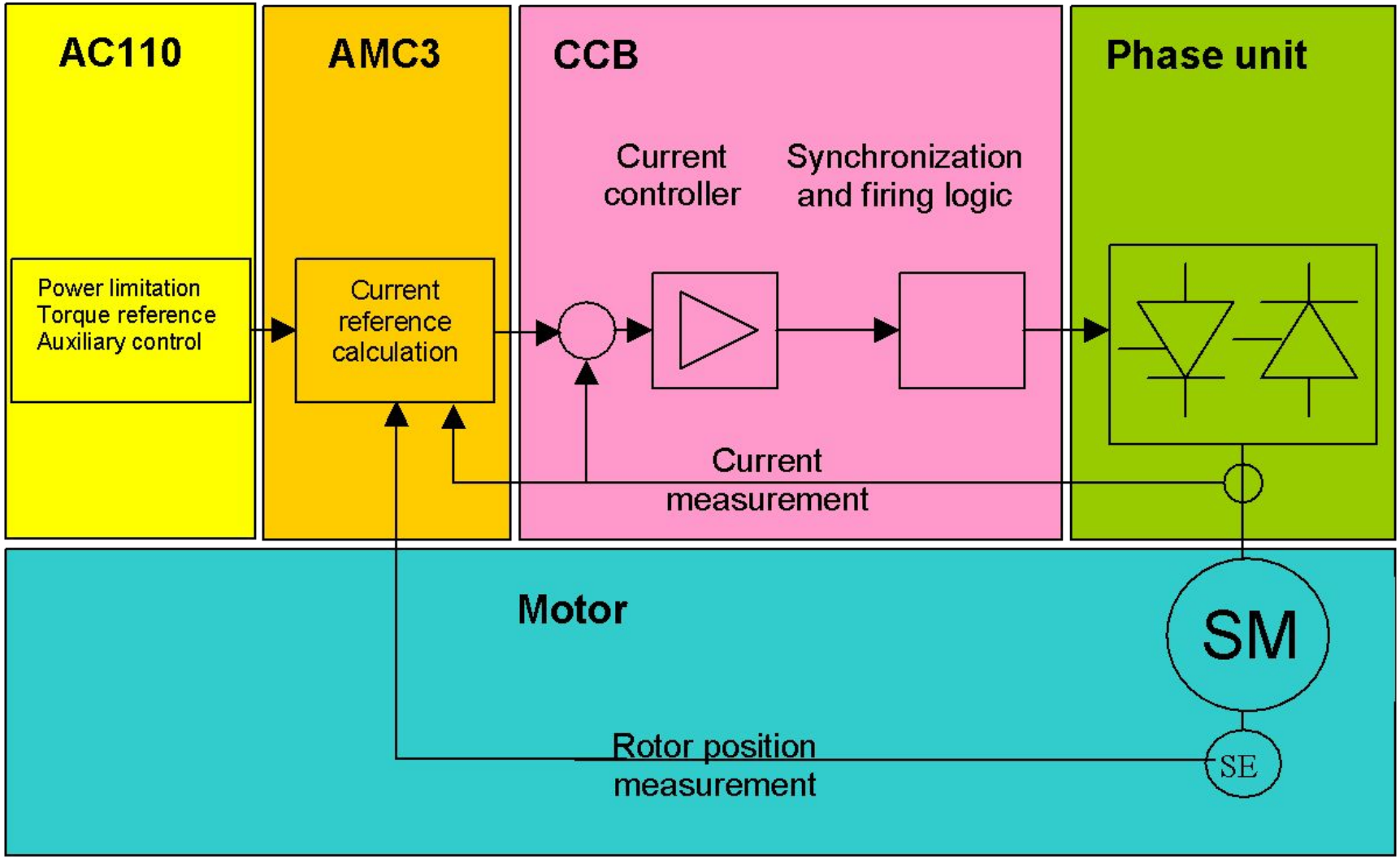
ACS6000c control



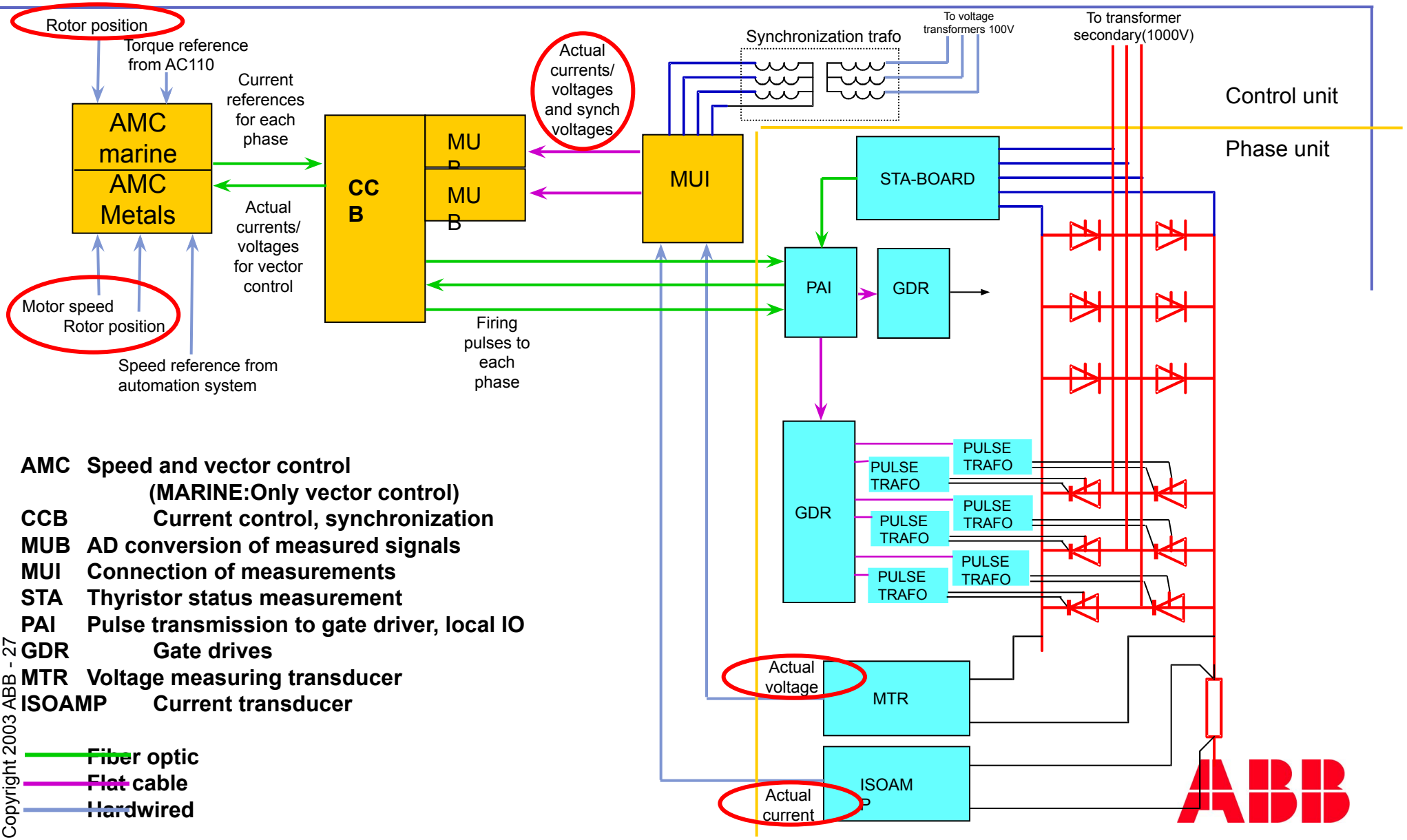
ACS6000c speed and current control loops



ACS6000c control in MARINE application



ACS6000c control



AMC Speed and vector control (MARINE:Only vector control)
CCB Current control, synchronization
MUB AD conversion of measured signals
MUI Connection of measurements
STA Thyristor status measurement
PAI Pulse transmission to gate driver, local IO
GDR Gate drives
MTR Voltage measuring transducer
ISOAMP Current transducer

Fiber optic
Flat cable
Hardwired