EMC Consideration of Project FAST

Part 1: (1) Reflector control system architecture

The active main reflector of FAST is composed of cable-net as back up ~~–~~and the reflector elements. The 2300 crossed nodes of the cable-net are used as control points, which are tied to the control actuator by down-tied cables. By controlling the actuator using the feedback from the measurement and control system, the position of these control points can be adjusted to form the illuminated aperture of diameters 300m in different region of the cable-net.

Comments:

1) Both mechanical and hydraulic are under consideration.

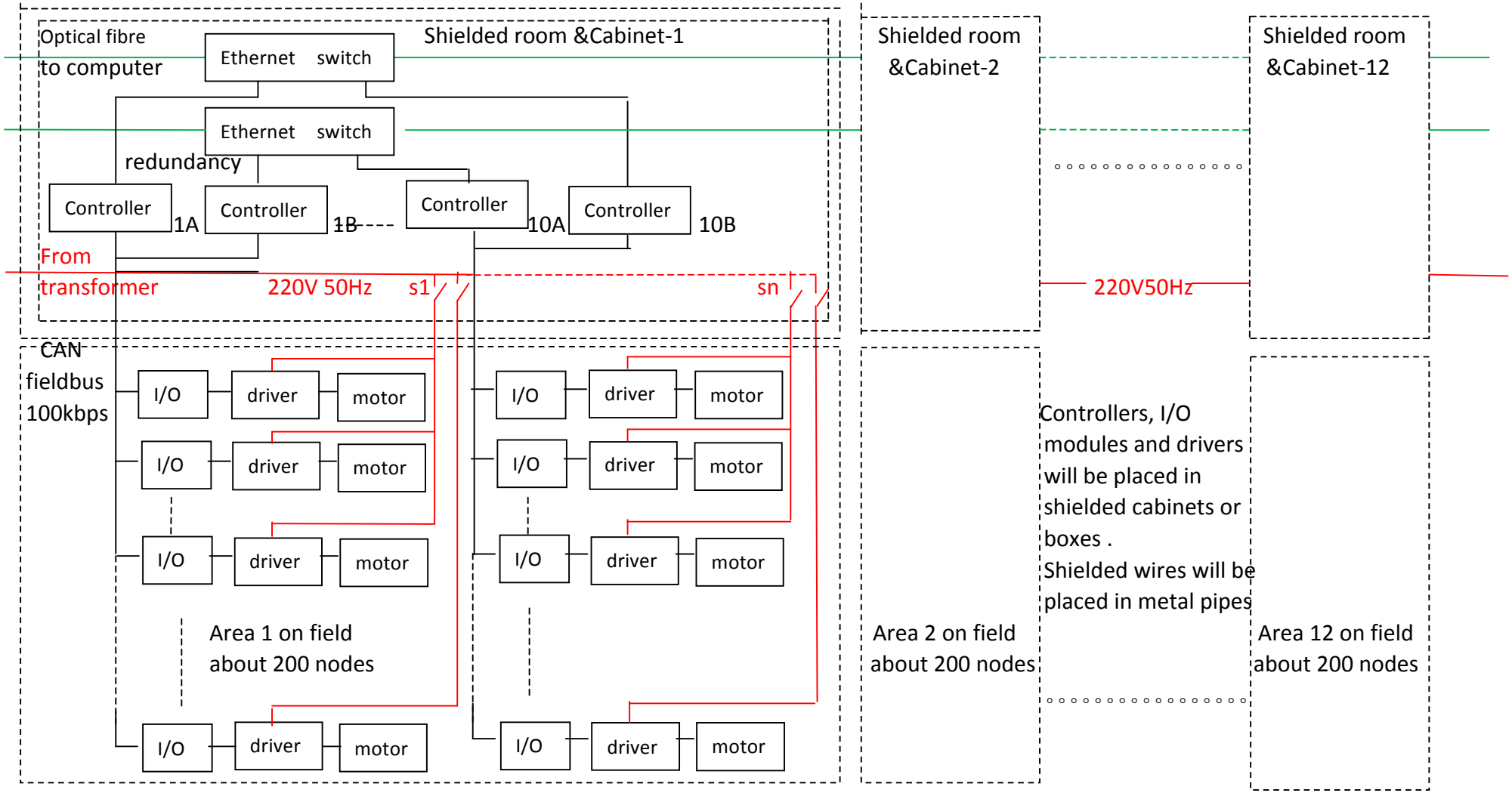
2) For mechanical, 750w servo motor is proposed. For hydraulic, t~~T~~he motor of the pump will be driven by an inverter of lower power to 400W.

3) For the drivers and motors, we want to know which is the best choice between DC power supply and AC power supply in the view of EMC.

4) The I/O module should also allow analog or digital input from tension sensors or other devices. The Ain and Din will be transferred to CAN signals in the I/O module.

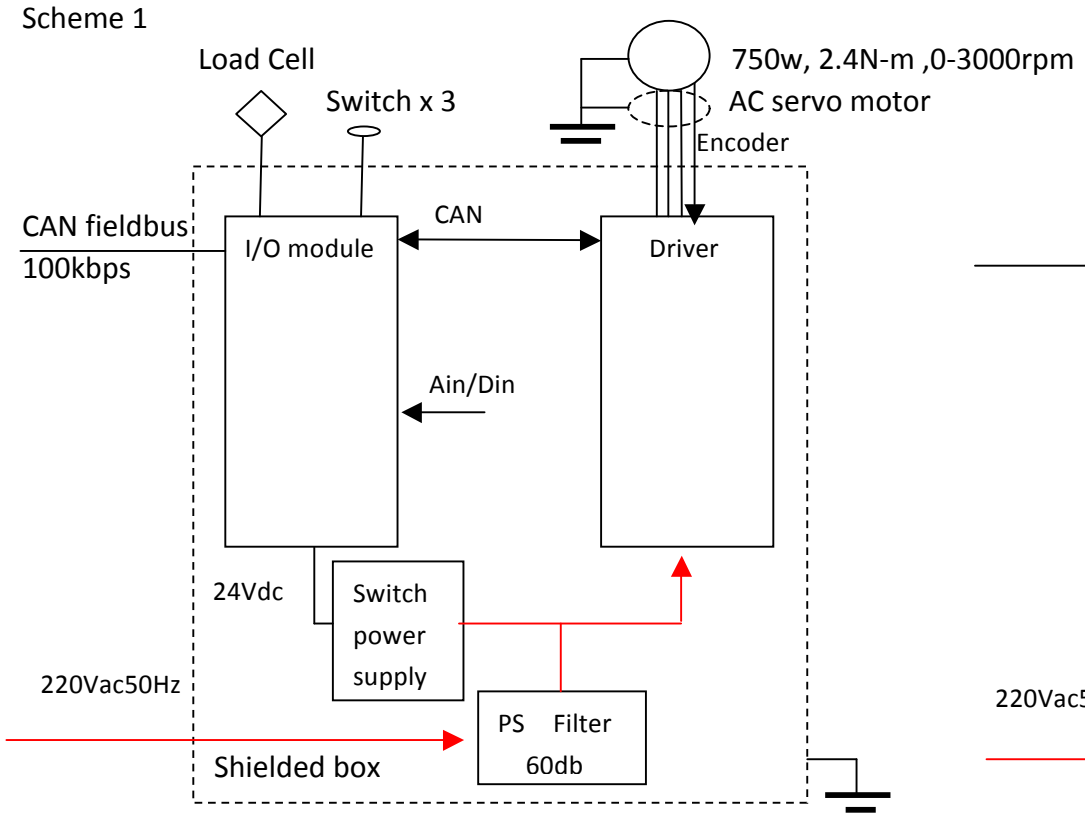
5) Drivers with CAN interface and internal position mode are preferred for simplicity with no need for external pulses.

6) Is CAN to optical coupler necessary?

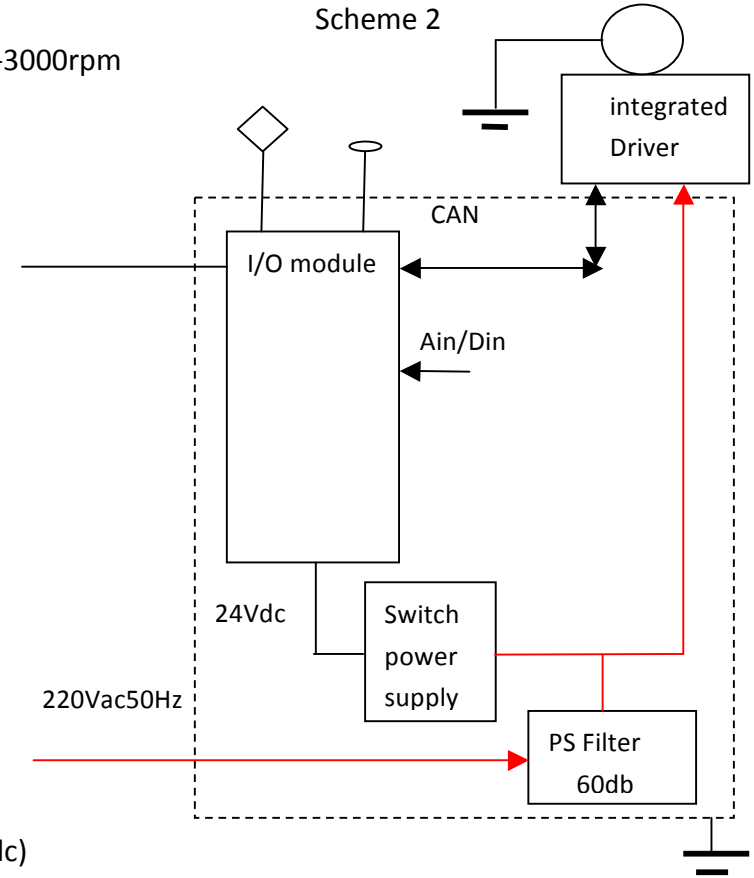

Optical fibre
to computer
Ethernet switch
Ethernet switch
redundancy
Shielded room &Cabinet-1
Shielded room
&Cabinet-2
Shielded room
&Cabinet-12
Controller
1A
Controller
1B
Controller
10A
Controller
10B
From
transformer
220V 50Hz
s1
sn
220V50Hz
CAN
fieldbus
100kbps
I/O
driver
motor
Area 1 on field
about 200 nodes
Area 2 on field
about 200 nodes
Area 12 on field
about 200 nodes
Controllers, I/O
modules and drivers
will be placed in
shielded cabinets or
boxes .
Shielded wires will be
placed in metal pipes

(2) About I/O module ,Driver and AC servo motor

Scheme 1



Scheme 2

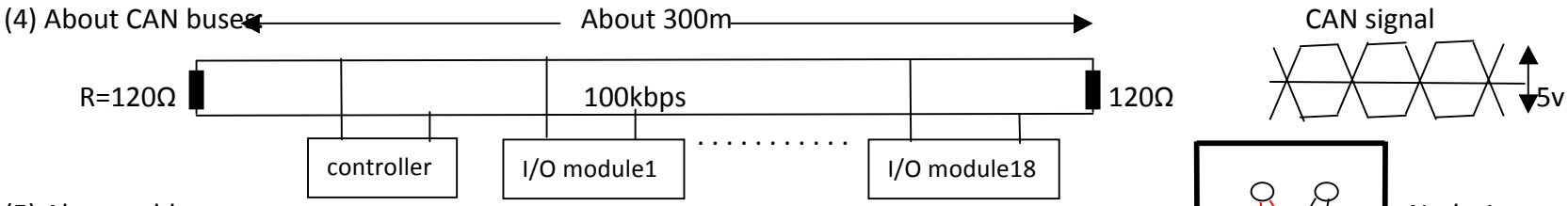


All signals between I/O module and driver are digital ON/OFF (V=0-24vdc)

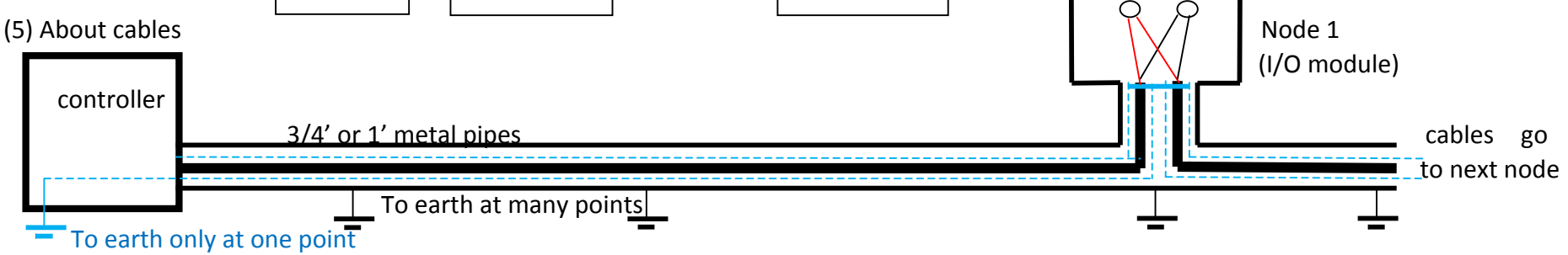
(3) About processors: There are some Processors in controllers, I/O modules and drivers, and their main frequency is about 30MHz, power is

about 1-3 watt.

(4) About CAN buses



(5) About cables



(6) Potential EMI sources

Kind of Devices	Power	Main frequency	Quantity	Which we need pay more attention to?
Servo motor	750W	20-30kHz	2230	
Computer	200W	3G	5	
Controller	10W	30MHz	200	
I/O Module	3W	30MHz	2230	
Switch power supply	100W	50 kHz	30	

Our means to fight against to EMI

a:Select device with low EMI.

b: EMC shield by metal box.

c: shielded wire in metal pipe.

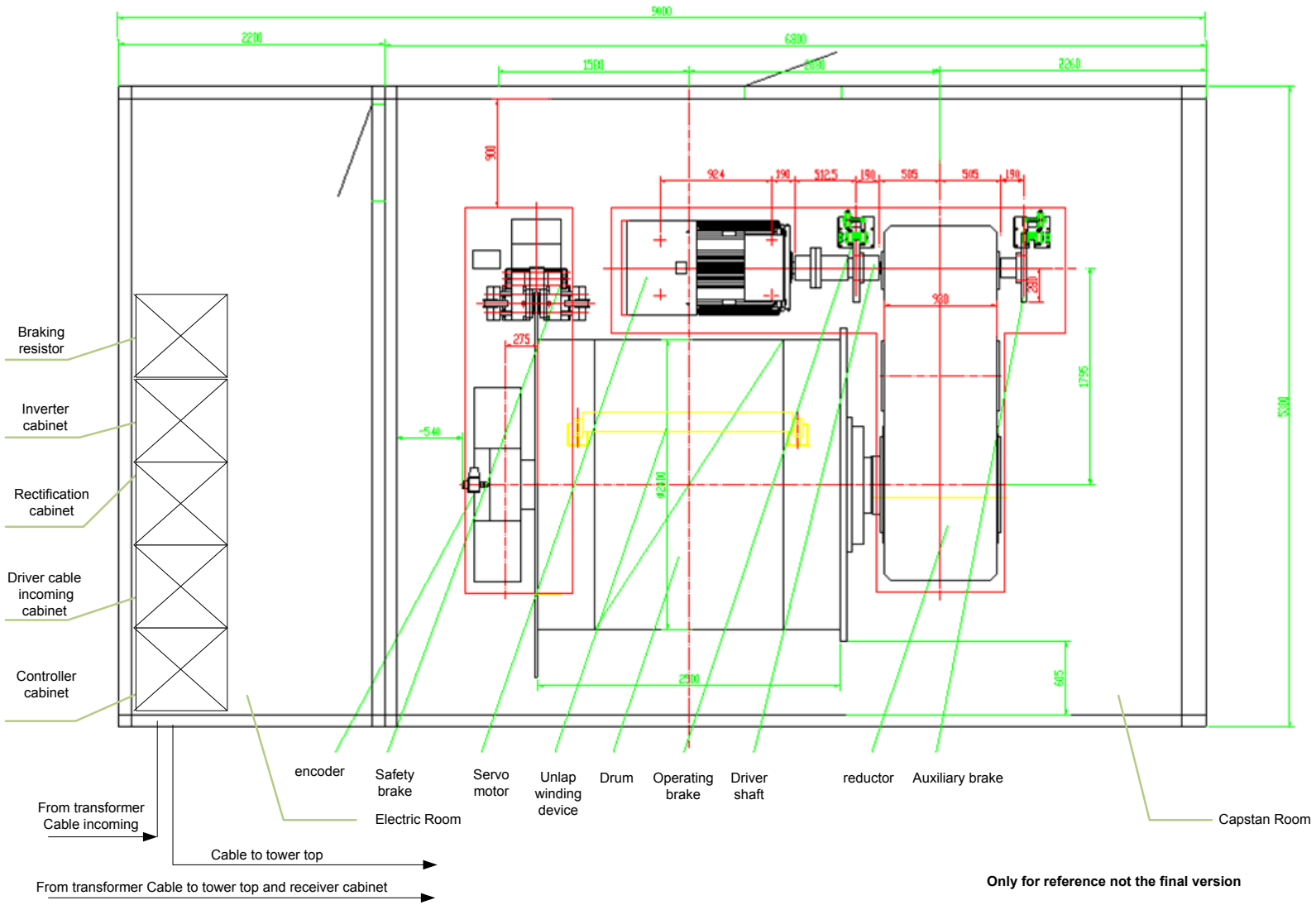
d: isolation for signal and Filter for power supply

e:Well to earth

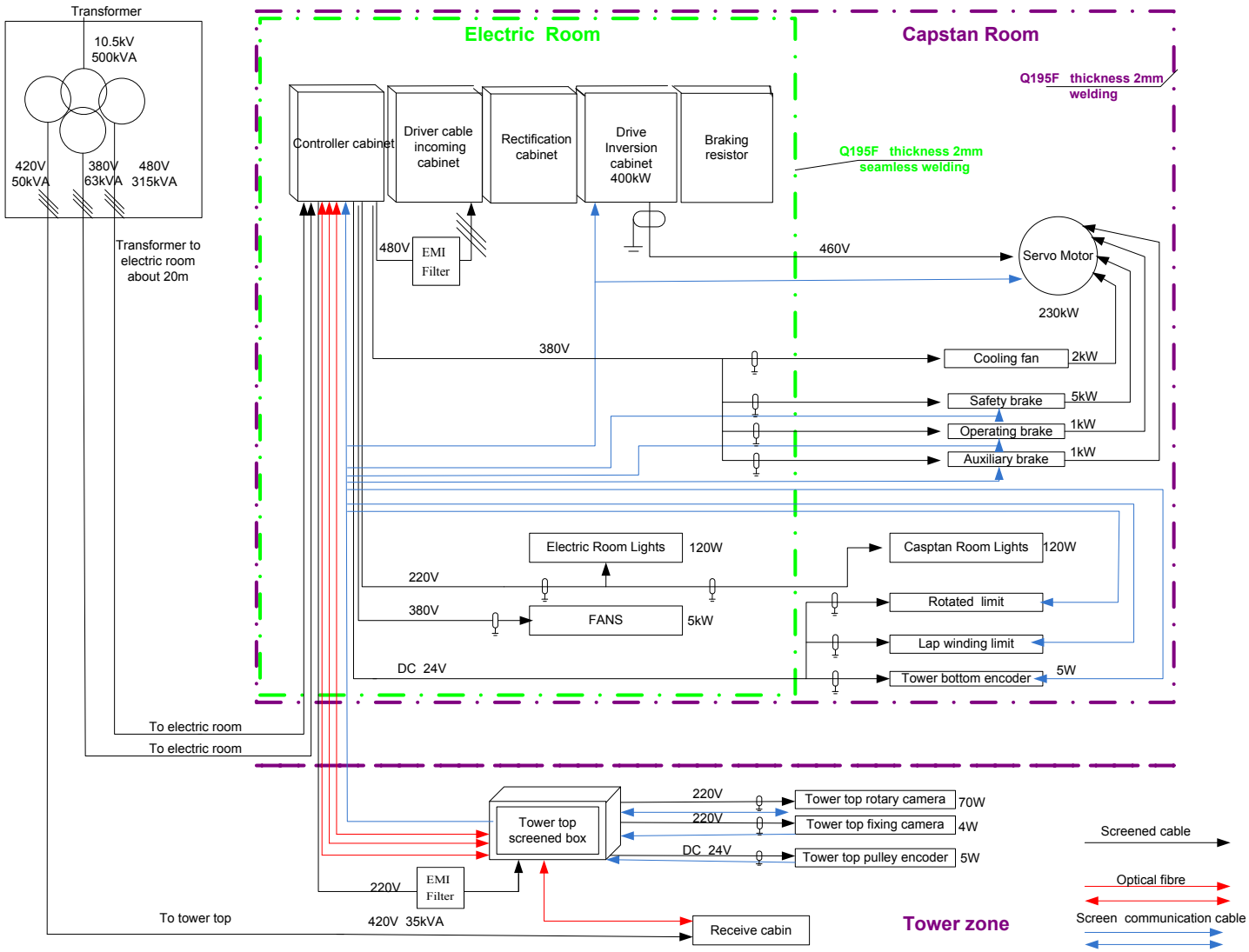
Part 2: (1) Cable suspension control system architecture

FAST focus cabin is suspended and driven by six cables that run over six towers and then connected to capstans on ground. A coarse position control can be realized by adjusting lengths of the cables. Each capstan includes servo motor, reducer, drum , switches, and control system, and etc.

There are two schemes of control systems on the cable suspension design. One scheme is to use the Siemens system that there is one controller at the root of each 6 tower. The other scheme is to use the ABB system, which means that only one control will be used to control the total 6 capstans. The information provided by the company that the EMI of controller is satisfied to the FCC C1 standard (about 47dBuV/m), which the rough calculation implies that at least 70 dB additional attenuation factor is needed (the distance to the feed is at least 100 meter). The figures listed below are the control design based on Siemens system. Shielded cabinet of the electrical instruments with 90 dB attenuation factor has been proposed in the electric room which is located in the capstan room. However, since we are not quite sure the EMI from the other electric instruments, we are thinking to shield the electric room with low attenuation factor, such as 40 or 50 dB. However, we are still not sure if it is necessary to shield the whole capstan room which includes the electric room. Do you think it is necessary? And Which control scheme of cable suspension system do you prefer according to EMC?



Only for reference not the final version


Transformer
10.5kV
500kVA
420V
50kVA
380V
63kVA
480V
315kVA
Transformer to electric room about 20m
Electric Room
Capstan Room
Q195F thickness 2mm welding
Q195F thickness 2mm seamless welding
Controller cabinet
Driver cable incoming cabinet
Rectification cabinet
Drive Inversion cabinet 400kW
Braking resistor
480V
EMI Filter
460V
Servo Motor
230kW
380V
Cooling fan
2kW
Safety brake
5kW
Operating brake
1kW
Auxiliary brake
1kW
Electric Room Lights
120W
220V
380V
FANS
5kW
DC 24V
Casptan Room Lights
120W
Rotated limit
Lap winding limit
Tower bottom encoder
5W
To electric room
To electric room
Tower top screened box
220V
Tower top rotary camera
70W
220V
Tower top fixing camera
4W
DC 24V
Tower top pulley encoder
5W
220V
EMI Filter
To tower top
420V 35kVA
Receive cabin
Tower zone
Screened cable
Optical fibre
Screen communication cable

(2) Potential RFI sources of cable suspension system

Kind of Devices	Power	Main frequency	Quantity	Position	Which we need pay more attention to?
Servo motor	280KW	0~50Hz	6	Capstan room	
Driver	7.2KW	150MHz	6	Electric room	
Controller	10W	450MHz	1	Electric room	
Industrial TV	70W	50Hz	6	Tower top	
Industrial TV	5W	50Hz	6	Tower top	
Industrial TV	5W	50Hz	6	Capstan room	
Switch power suppl	5.3W	100Mbps	8	Electric room	

Our means:

a: Divide different EMC region

b: Install ventilator with shield cover

c: Be well grounded

d: Shielding lines