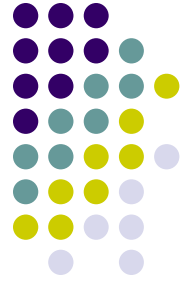




Smoothing Reactor and AC/DC Filter

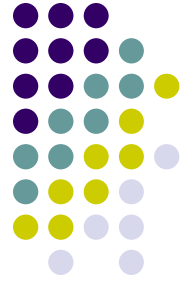
DC Smoothing Reactors



Smoothing Reactor - Purpose



- Connected in series in each converter with each pole
- Decreases harmonic voltages and currents in the DC line
- Smooth the ripple in the DC current and prevents the current from becoming discontinuous at light loads
- Limits crest current (di/dt) in the Rectifier due to a short circuit on DC line
- Limits current in the bypass valve firing due to the discharge of the shunt capacitances of the dc line.



DC Smoothing Reactor ratings

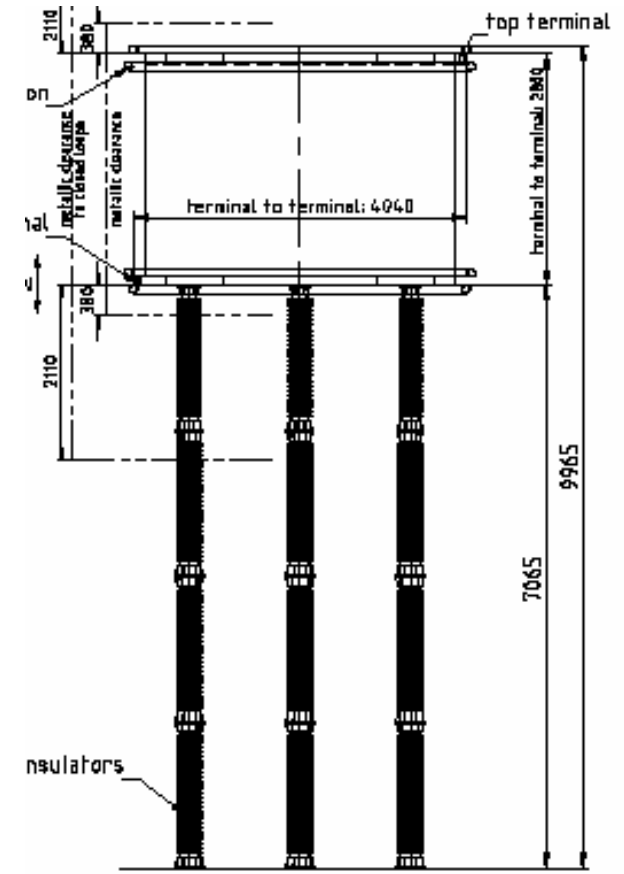
- Two Smoothing Reactors per pole
- Inductance - 125mH
- Nominal DC Voltage - 500KV
- Max DC Voltage - 515KV
- BIL - 950/1425KV

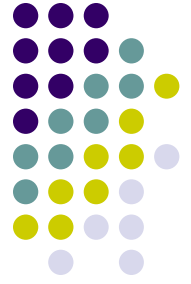
(Typical Value for 2000 MW \pm 500 KV Bipole HVDC Link)

DC Smoothing Reactor ratings

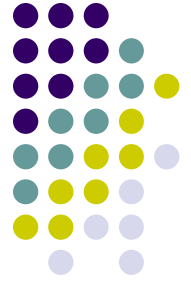
- Continuous current - 2000A
- Continuous Over load current - 2200A
- Type - Air Cored Dry type
- Forced Air cooling system
automatically controlled on Amb. Temp & DC current
- Location : Outdoor
- Total mass - 30 Ton
- Temperature Class - F

(Typical Value for 2000 MW \pm 500 KV Bipole HVDC Link)





HARMONIC FILTERS



HARMONIC FILTERS

- Conversion process generates – Harmonics
- AC side Harmonics- Current harmonics
 - Generated harmonics – $(12n \pm 1)$ harmonics
 - $n = 1, 2, 3, \dots$
 - Predominant harmonics – 11, 13, 23, 25, 35, 37
 - Additionally 3rd harmonics
- DC side Harmonics- Voltage harmonics
 - Generated harmonics – $(12n)$ harmonics
 - $n = 1, 2, 3, \dots$
 - Predominant harmonics – 12, 24, 36

Disadvantages of Harmonics



- Over heating and extra losses in generators
- Over heating and extra losses in motors
- Instability in the converter control
- Interference with telecommunication systems
- Over voltages due to resonance

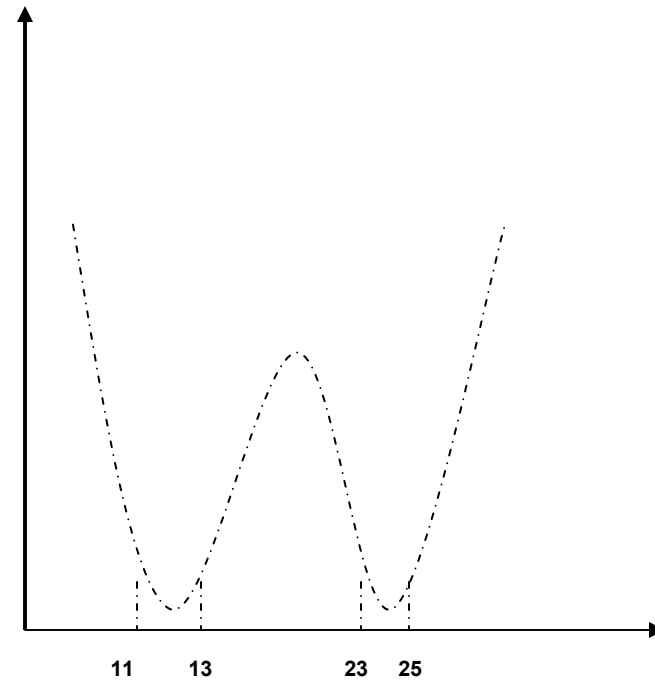
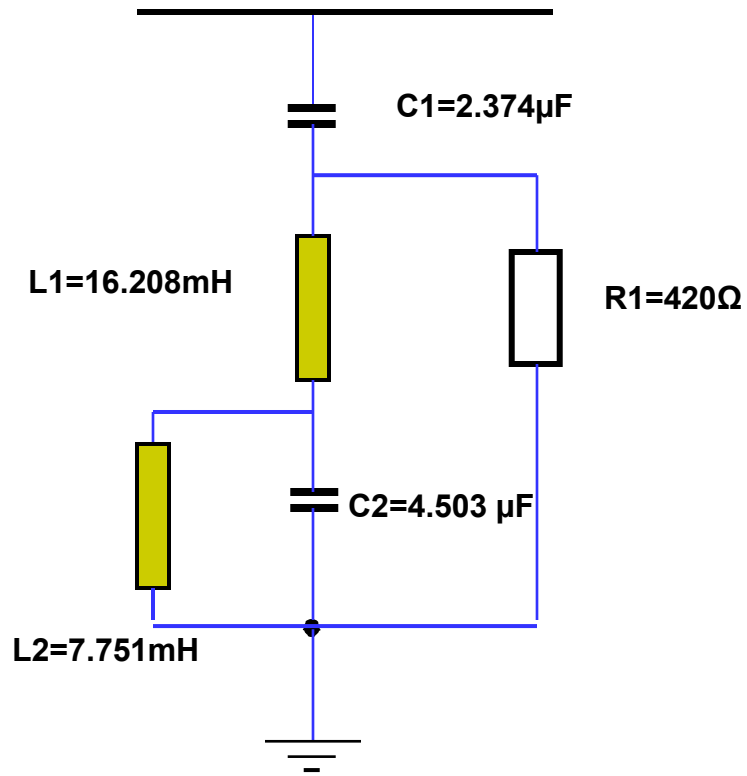


AC Filters – (For A TYPICAL 2500 MW ,±500 KV Bipolar project)

ITEM		A	B	C
Filter sub bank		DT 12/24	DT 3/36	Shunt C
Rating (3 ph., 400 kV)	MVAr	120	97	138
No.of 3 phase Banks	-	8	4	5
HV-Capacitor C1	μF	2.374	1.85	2.744
HV-Reactor L1	mH	16.208	5.444	1.602
HV-Resistor R1	ohms	420	300	-
LV-Capacitor C2	μF	4.503	3.759	-
LV-Reactor L2	mH	7.751	204.2	-
LV-Resistor R2	ohms	-	1500	-

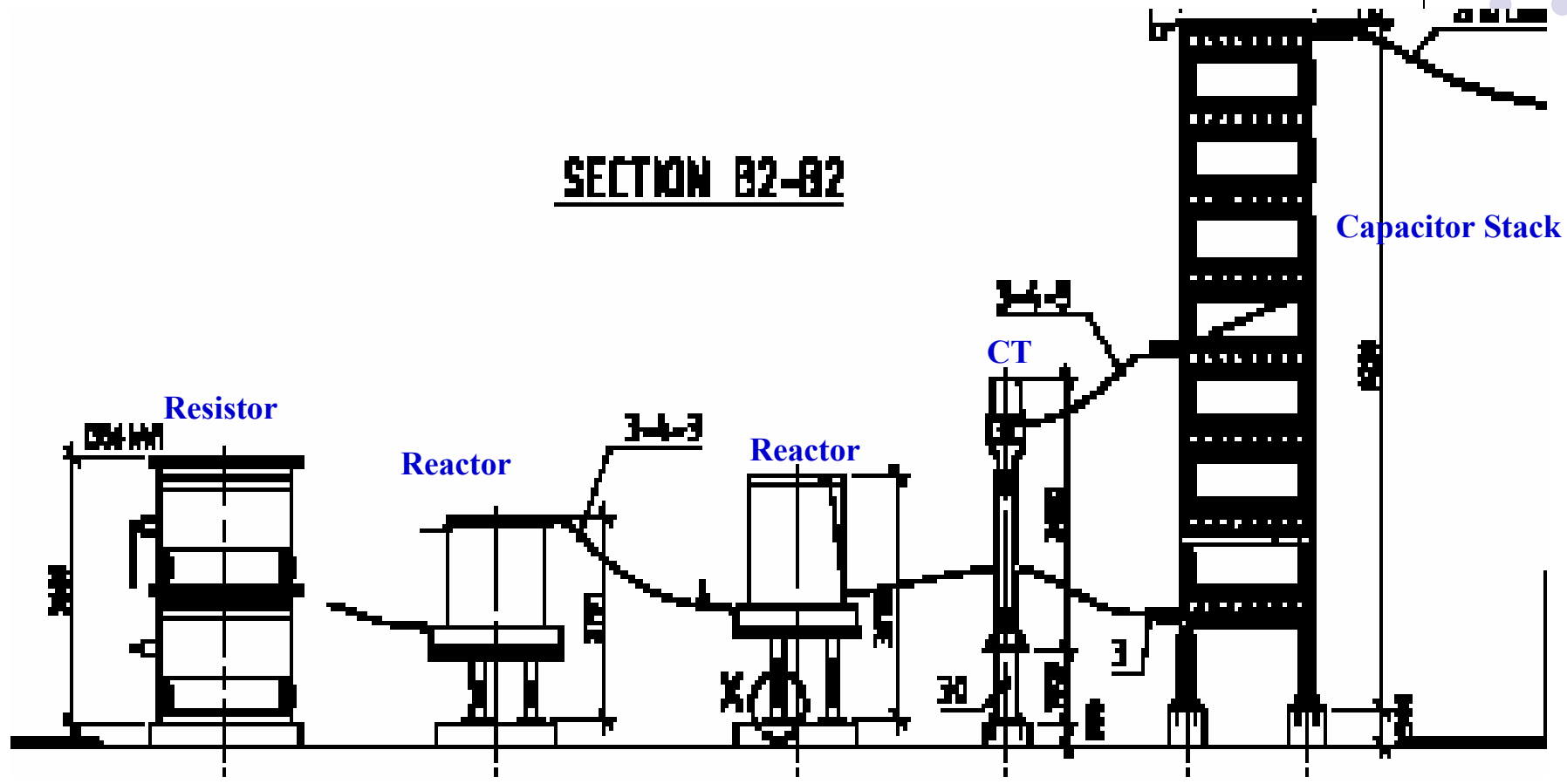
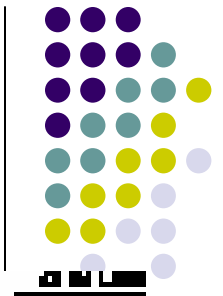


12/24 Double Tuned Filter - 120 MVAr

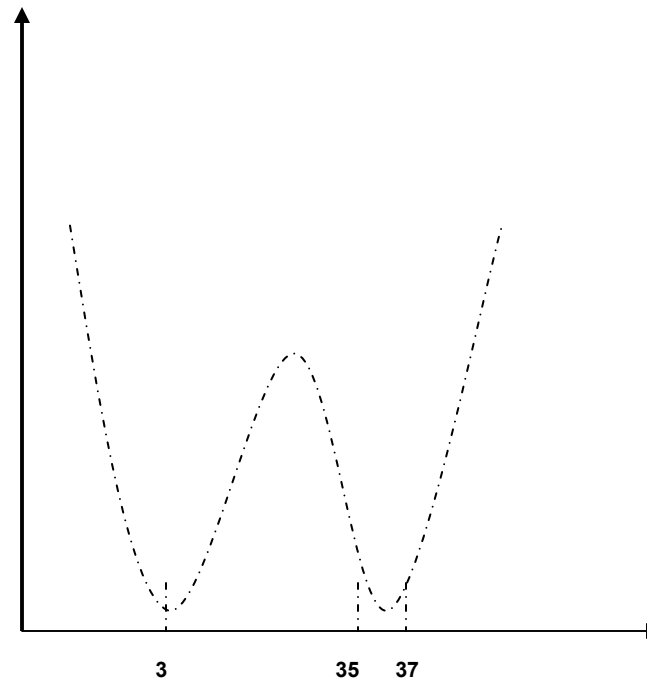
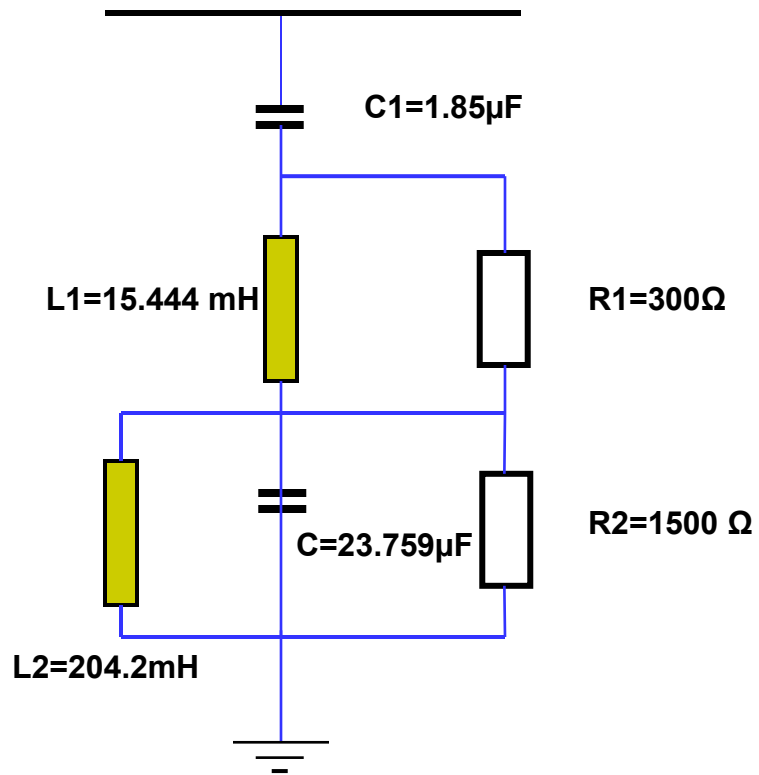


Impedance Graph

12/24 Double Tuned Filter - Sectional view

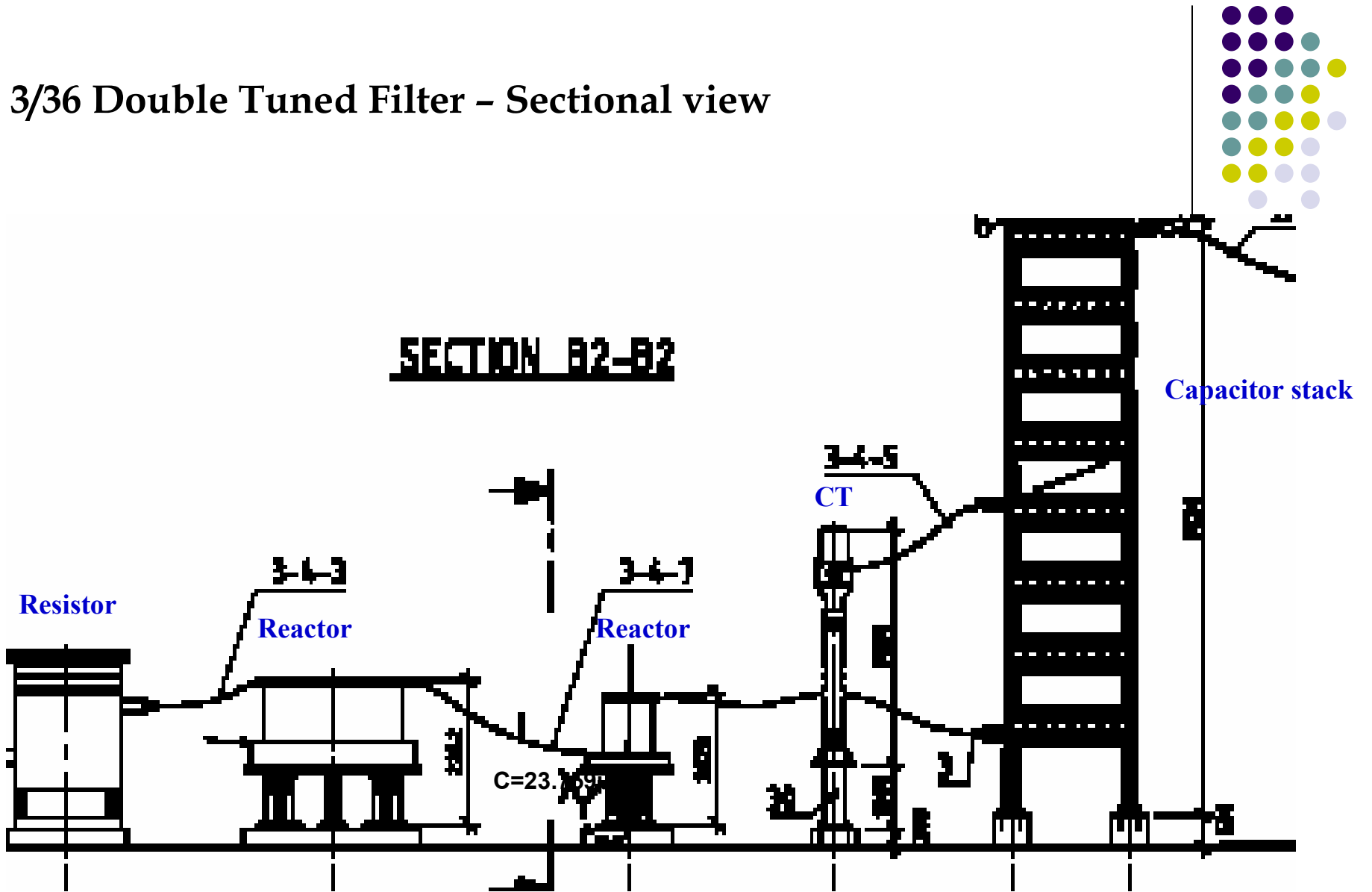


3/36 Double Tuned Filter - 97 MVAr

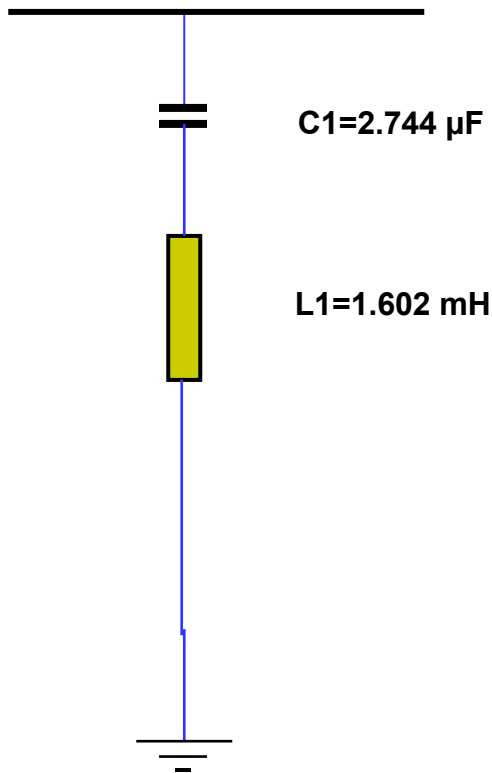


Impedance Graph

3/36 Double Tuned Filter - Sectional view

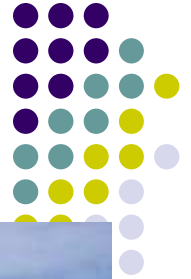


Shunt Capacitor – 138 MVAr

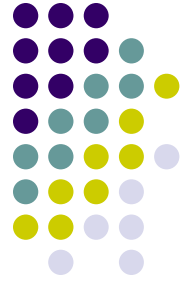


- No harmonic filtering
- Supplies MVAr to the grid
- Switched into the circuit for voltage control purpose
- Capacity – 138 MVAr

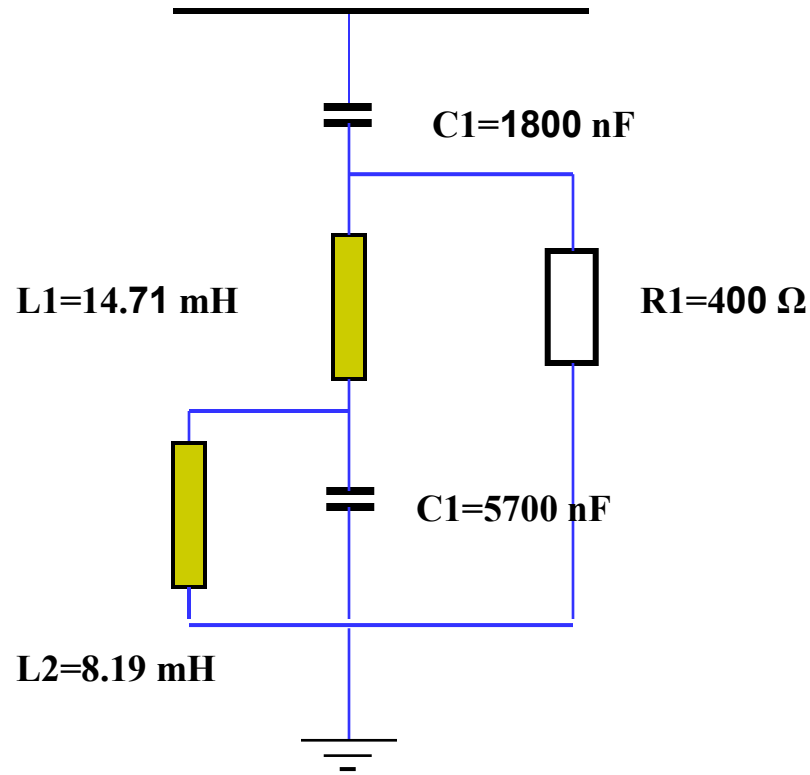
Shunt Capacitors-Voltage Improvement



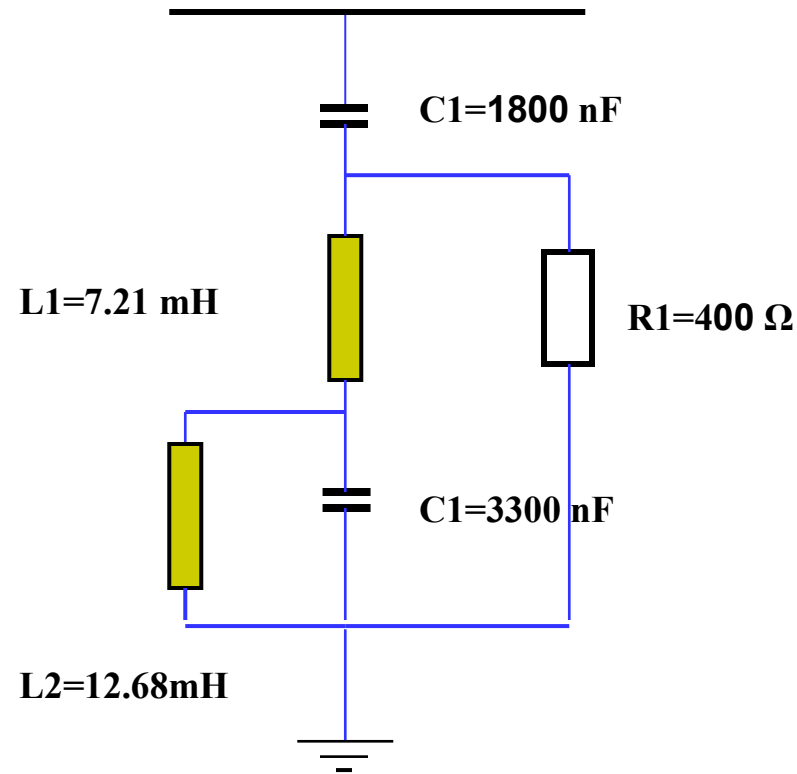
DC Filter

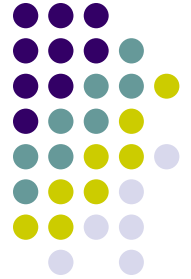


DC Filter 12/24



DC Filter 12/36





THANK YOU