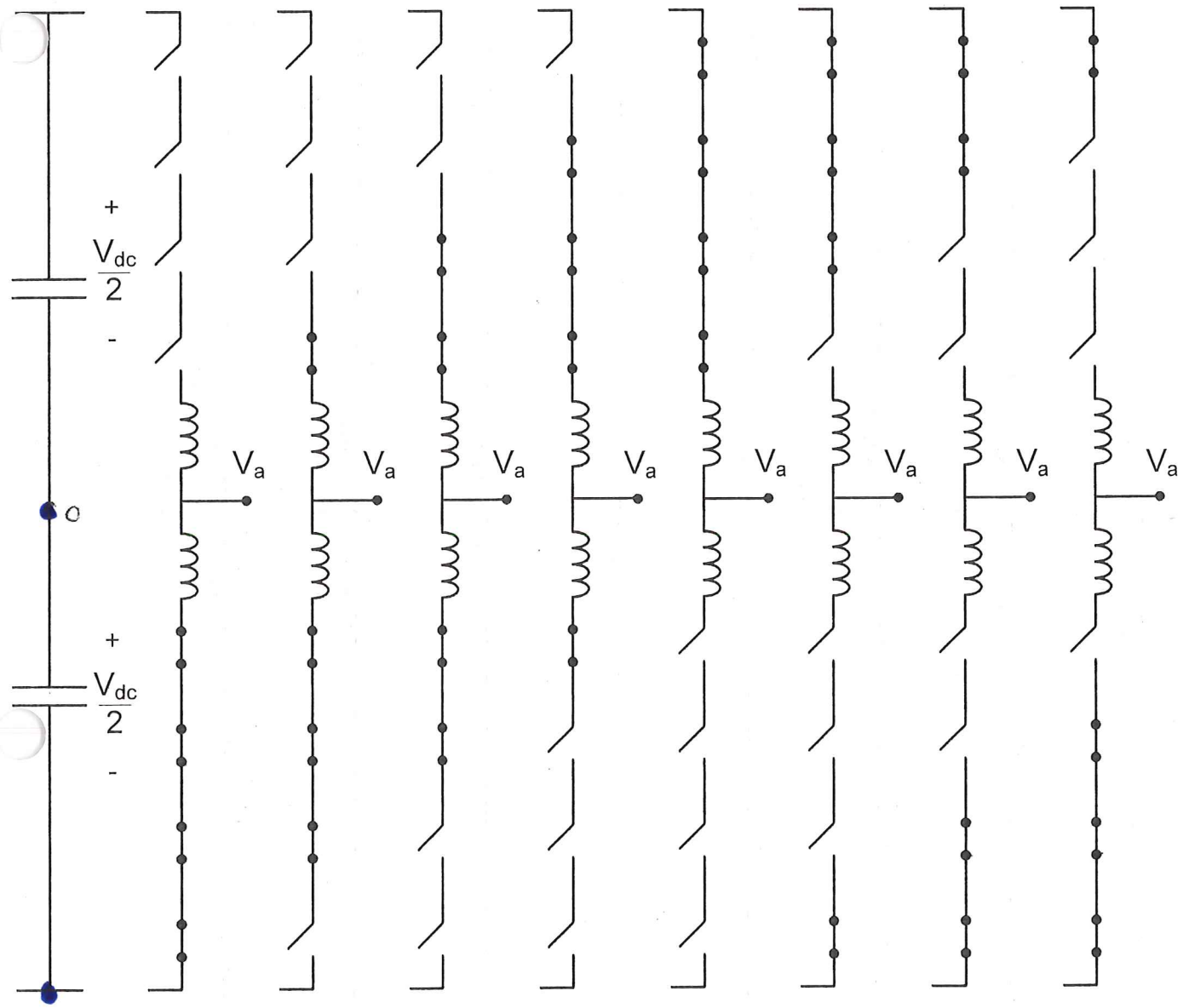
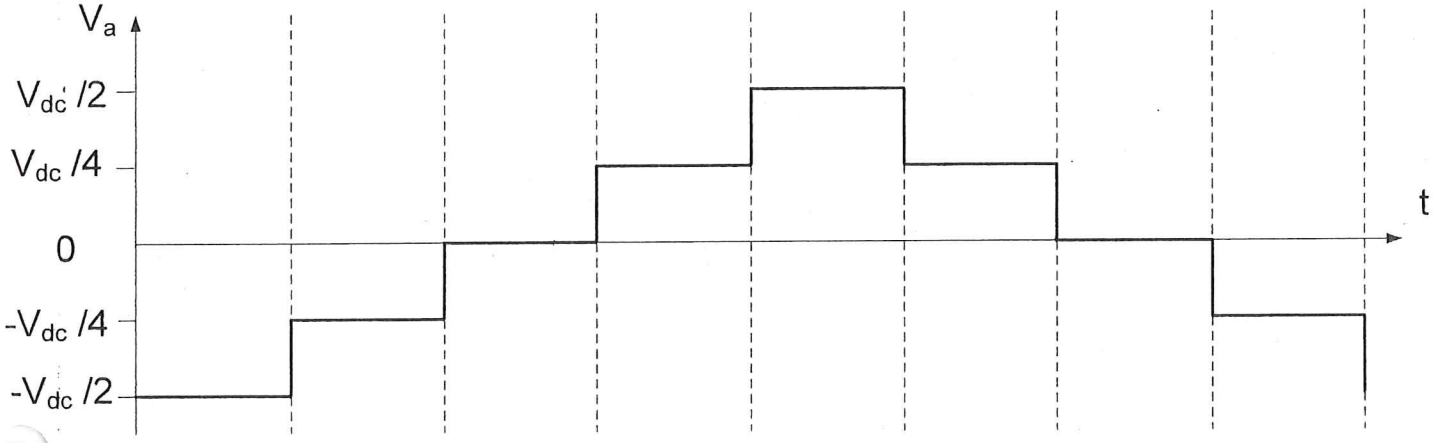
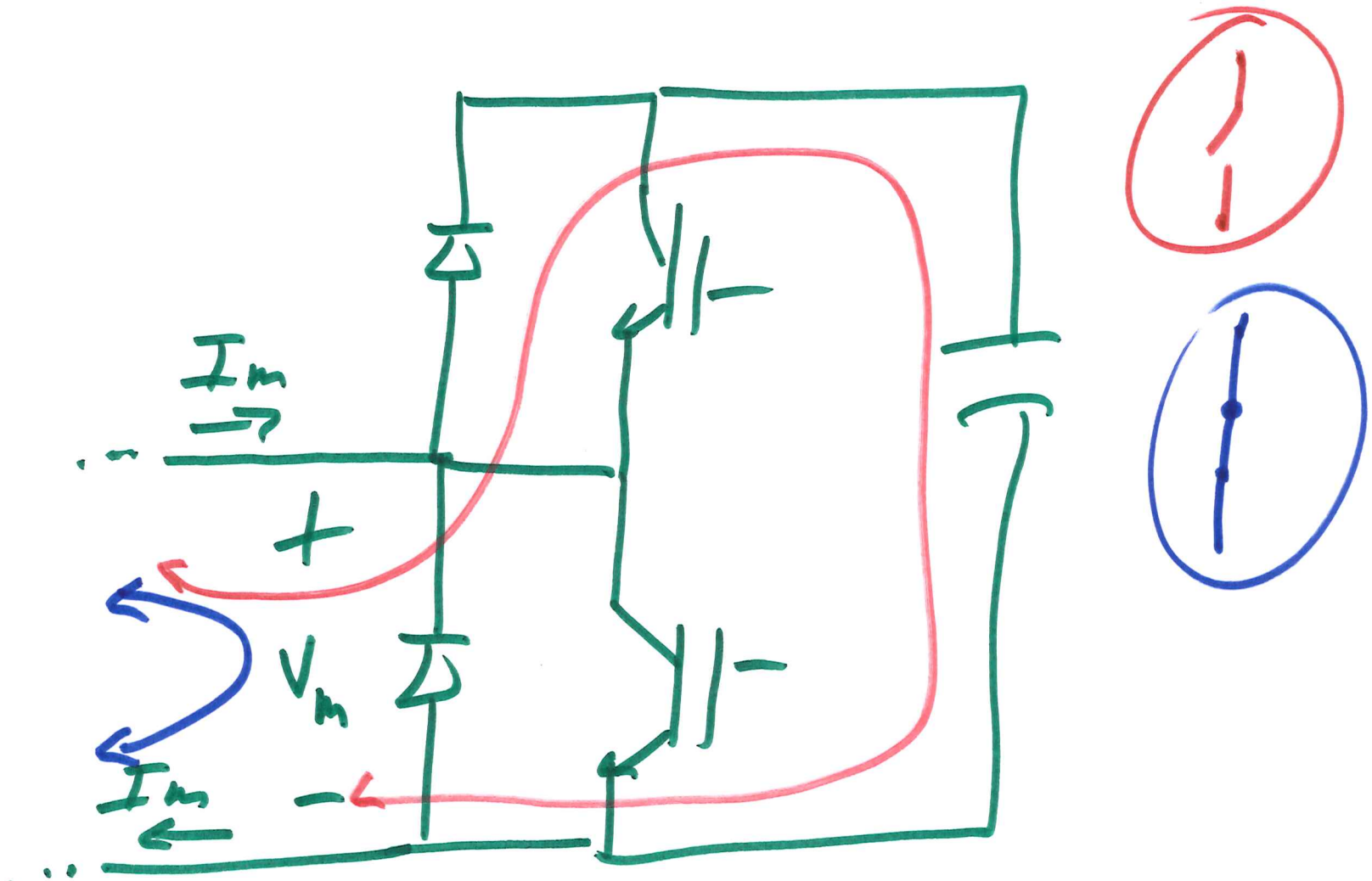
ECE 404-TD / 504-TD

ST: T&D APPLICATIONS OF VOLTAGE SOURCE CONVERTERS

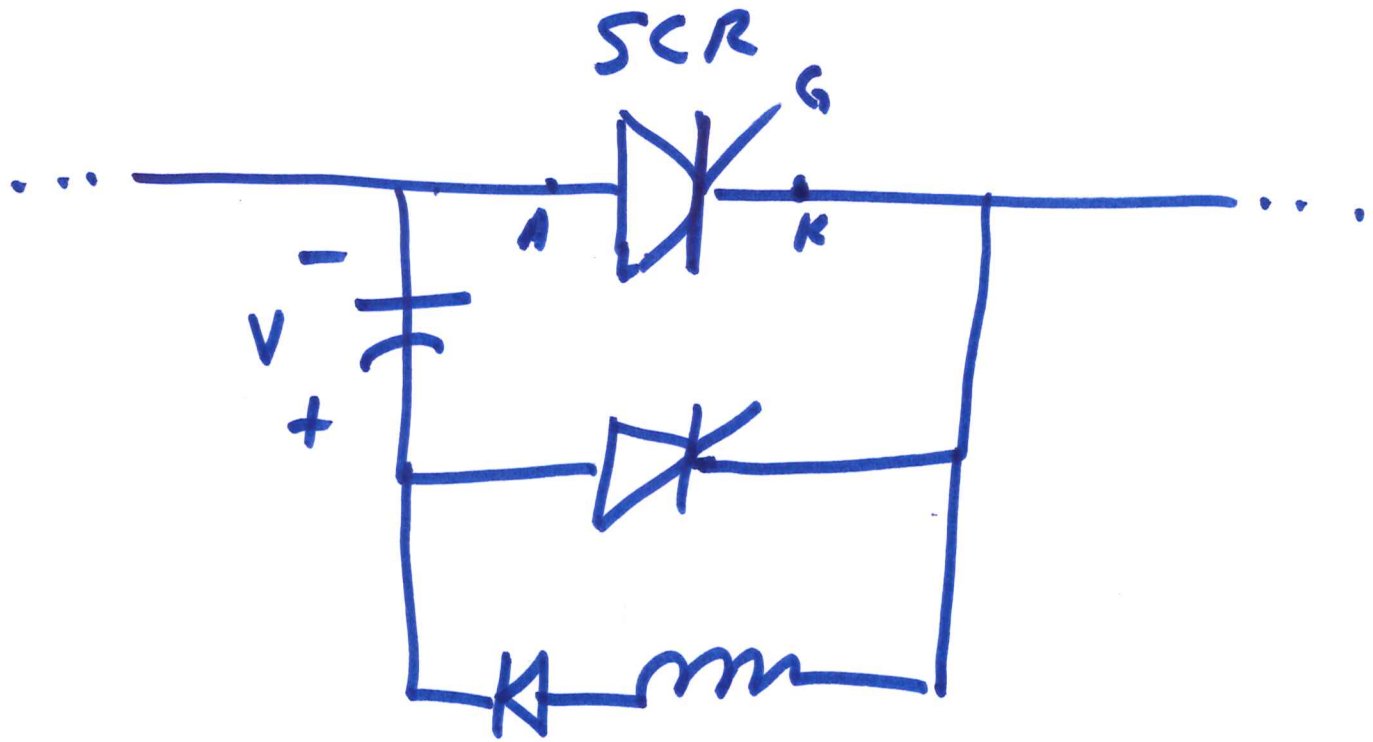
SESSION no. 18

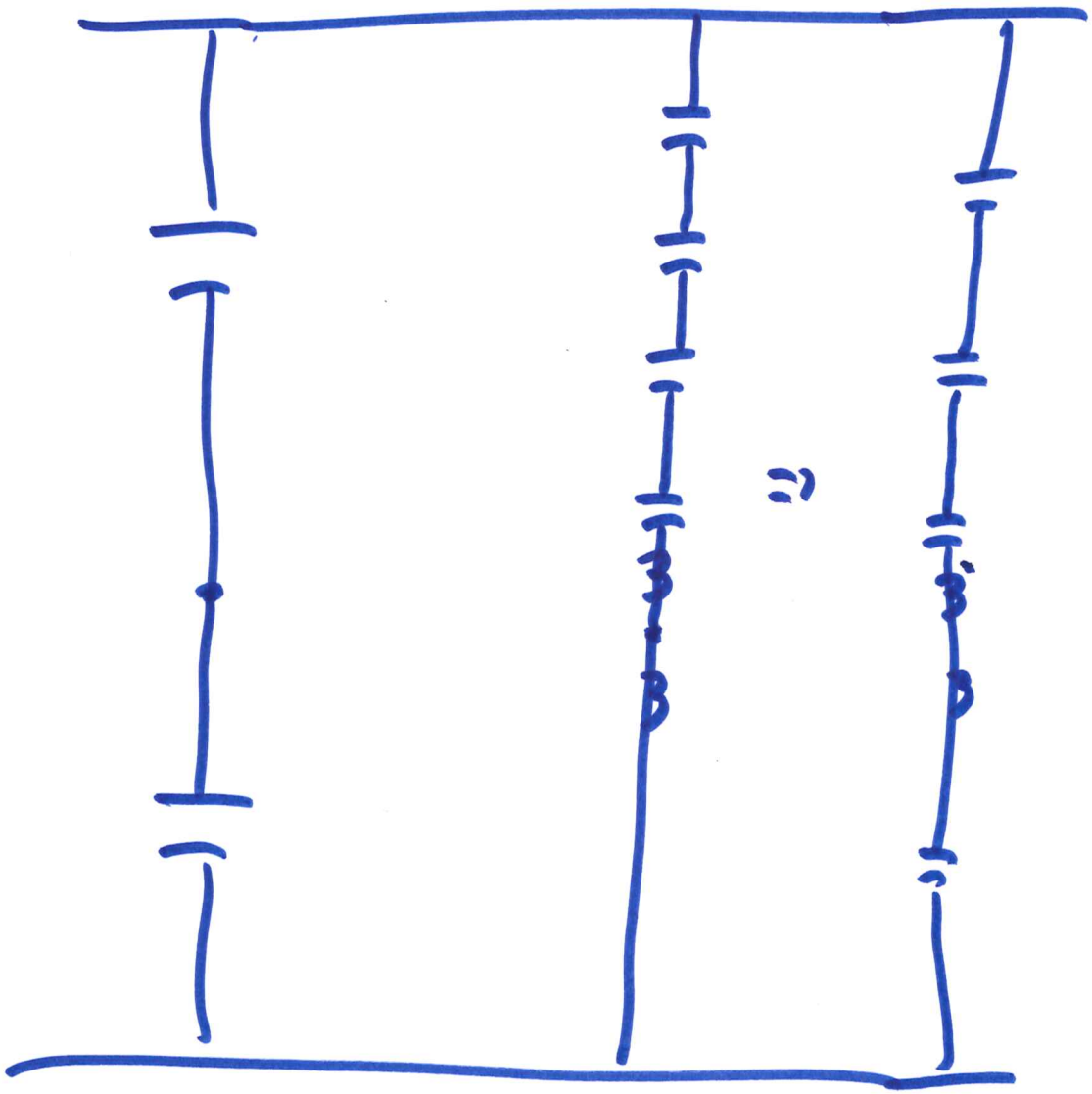

+
$\frac{V_{dc}}{2}$
-
o
+
$\frac{V_{dc}}{2}$
-
V_a
V_a
V_a
V_a
V_a
V_a
V_a
V_a


V_a
V_{dc} /2
V_{dc} /4
0
-V_{dc} /4
-V_{dc} /2
t


I_m
+
V_m
I_m
−

$$Q = C V$$


SCR
G
A
K
V
−
+



ECE 404 / 504

T & D Applications of Voltage Sourced Converters

Lesson 18

- Modular
- Multilevel
- Converter

Each switch module supports, in this case, Vdc/4.

Current flows in all switching modules all the time. There is really no such thing as an ON or OFF state here.

Force commutated switching device

Motor drives, power supplies: a switch that turns itself on or off in response to signals/commands.

Force commutated switching device: a switch with circuitry attached to turn it on or off; usually a thyristor (that cannot turn itself off)

The MMC is used to build a stepped voltage. Commercial versions use hundreds of steps. Advantages?

- MUCH higher voltages possible...300 steps, anyone?
- Harmonics? No significant harmonics before 300^{th}?

- Switching frequency? How often does each switch ~~switch~~ change state? At least once per fundamental frequency cycle.
- Slower switching…what's the advantage? Switching losses!!
  ☹ More devices
  ☹ They conduct ALL the time. All of them

2-3 level converters have losses of ~2% to 3%; MMC has <1% losses (half bridges; ~1.5% for full bridges) for similarly rated converters, as a practical observation.

- Fault protection? A lot of devices can protect against some pretty severe faults, even those right at the terminals.
- What is the current in each leg of the converter?
- What do the choke coils do for us? They keep the current essentially constant in the short term. They influence the high frequency current harmonics: switching and commutation. Noise and commutation transient reduction, which is periodic and hence harmonic in nature.
- No need for a DC bus capacitor; switching the little capacitors carefully stabilizes the voltage by itself.