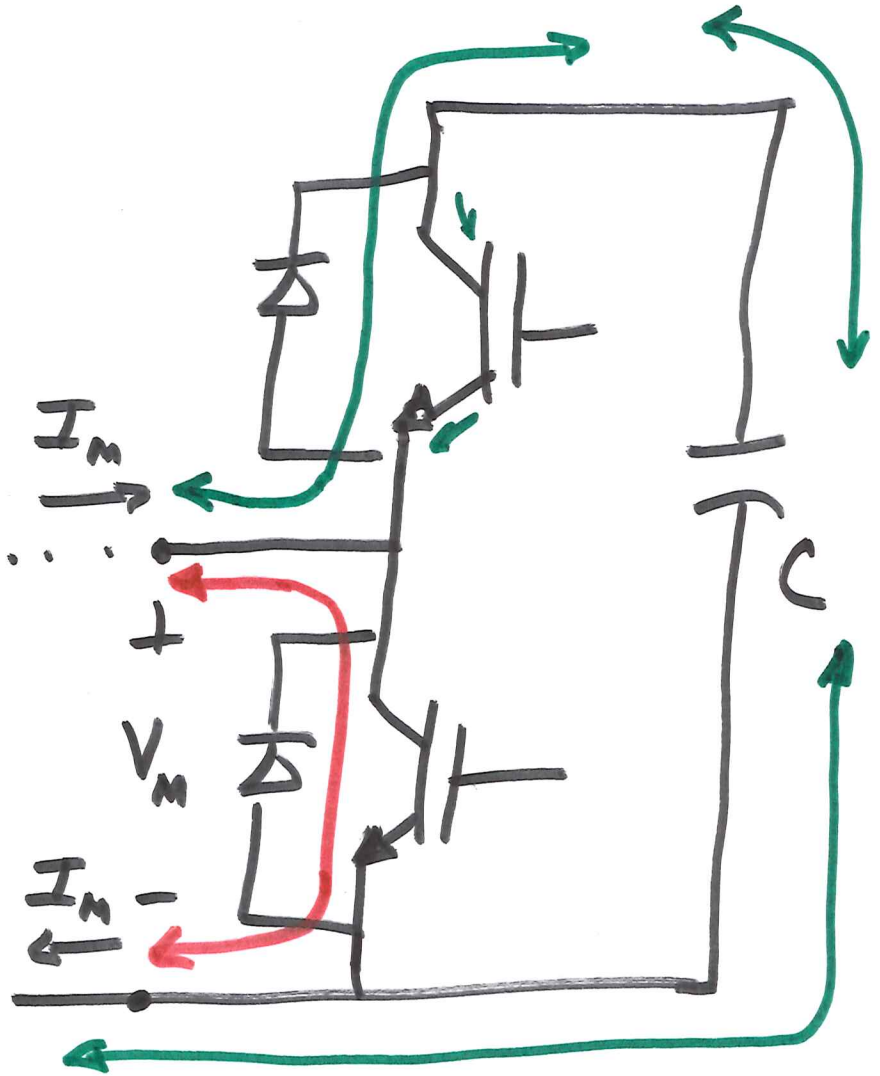
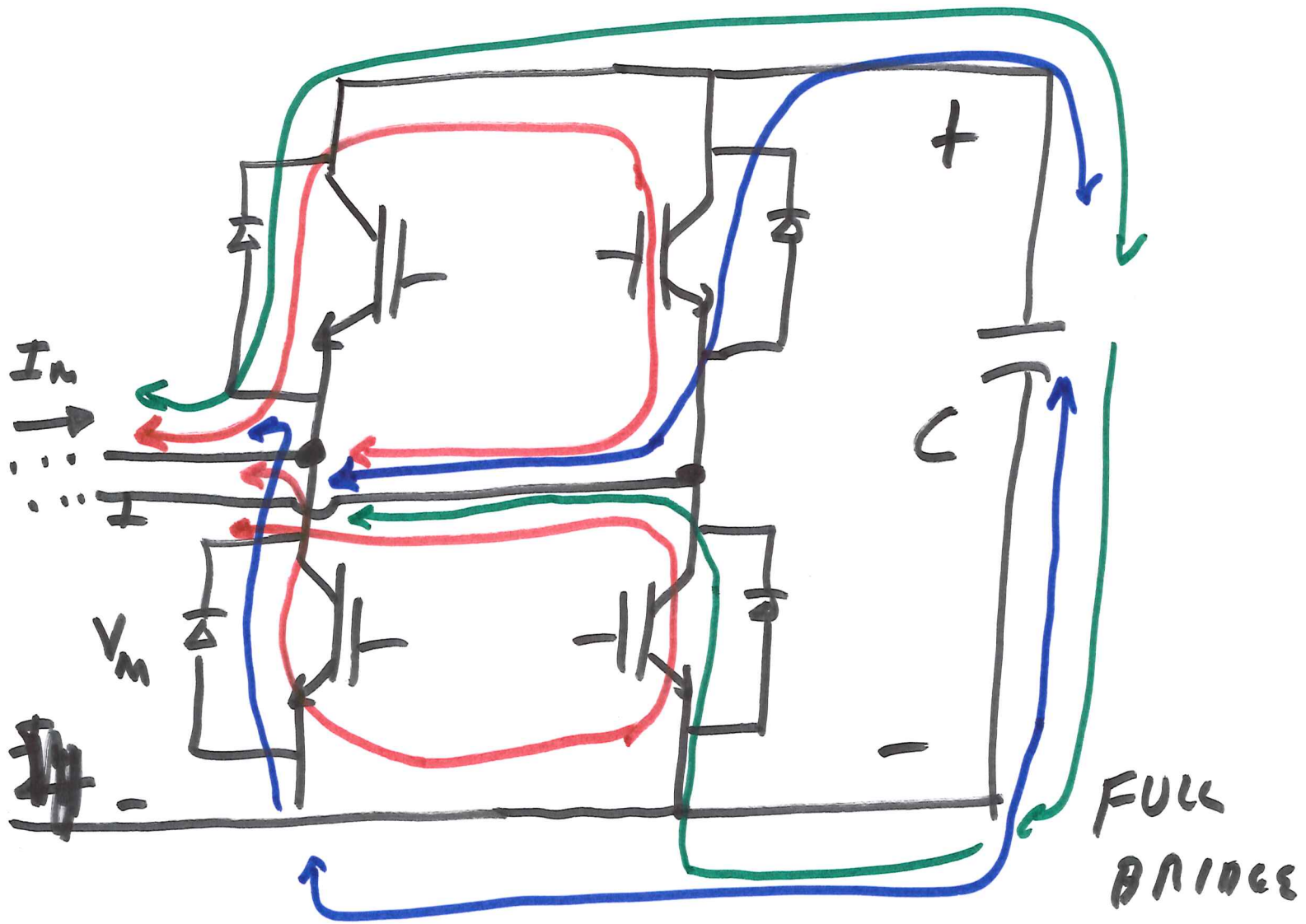
ECE 404-TD / 504-TD

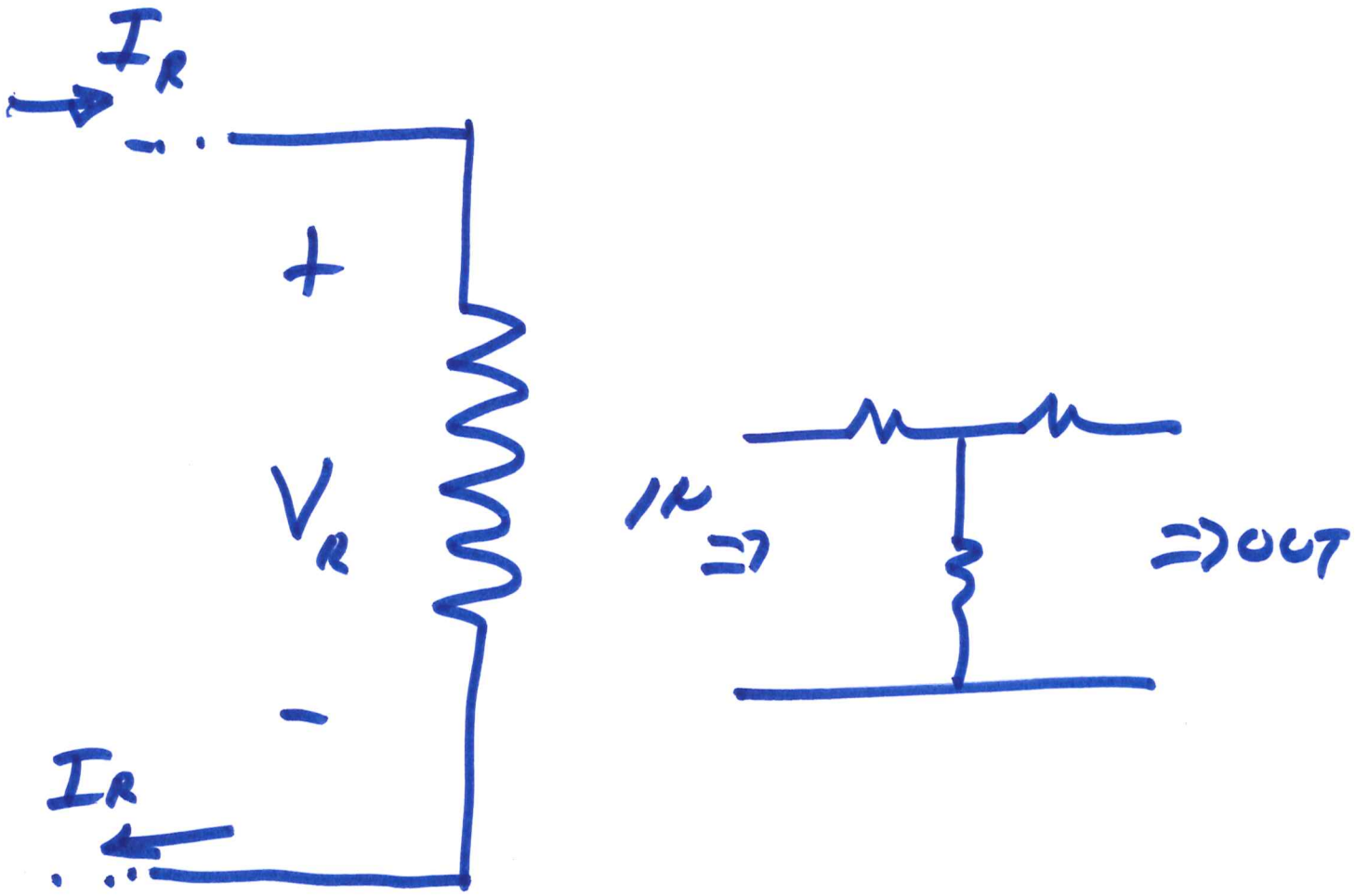
ST: T&D APPLICATIONS OF VOLTAGE SOURCE CONVERTERS

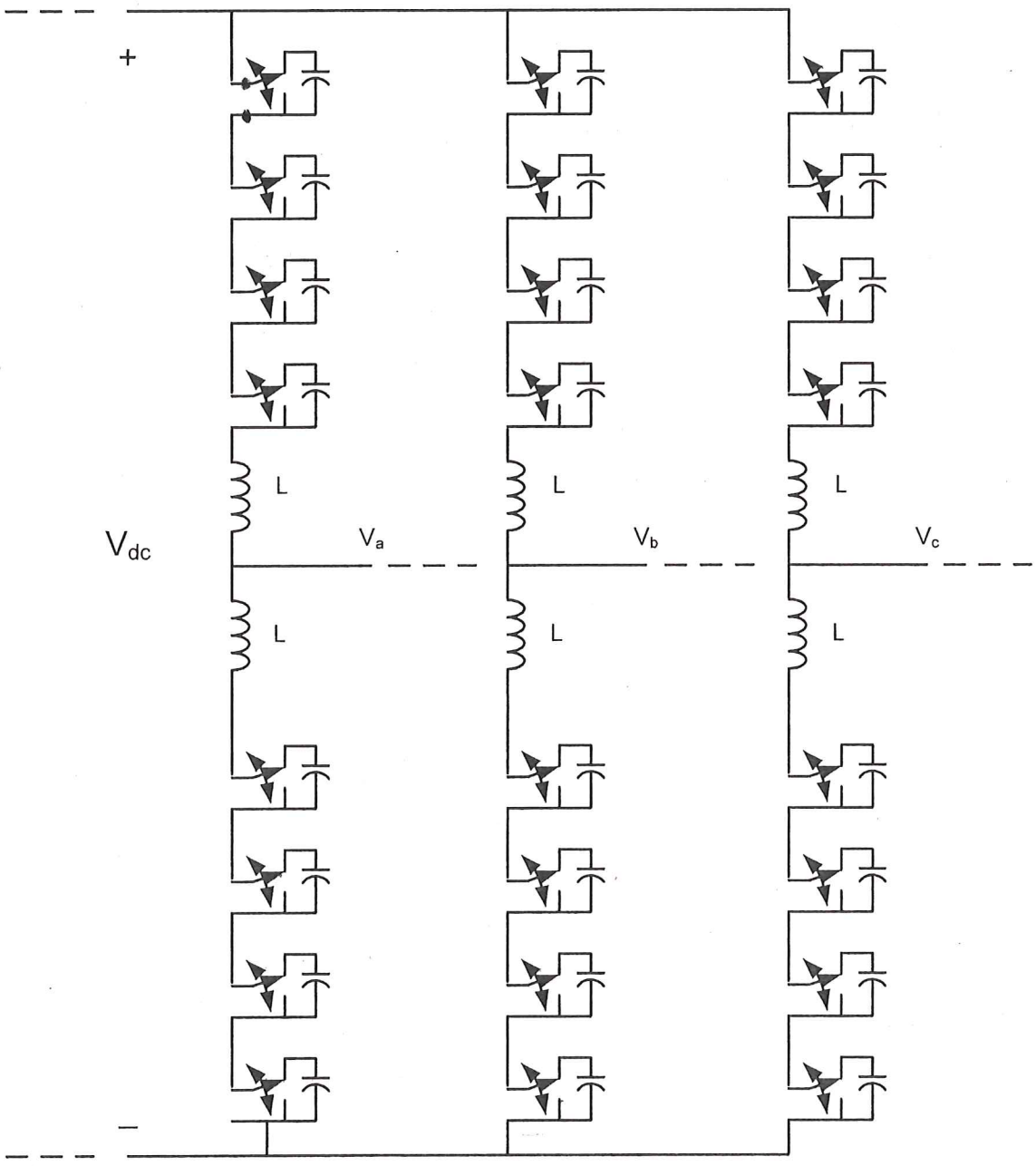
SESSION no. 17

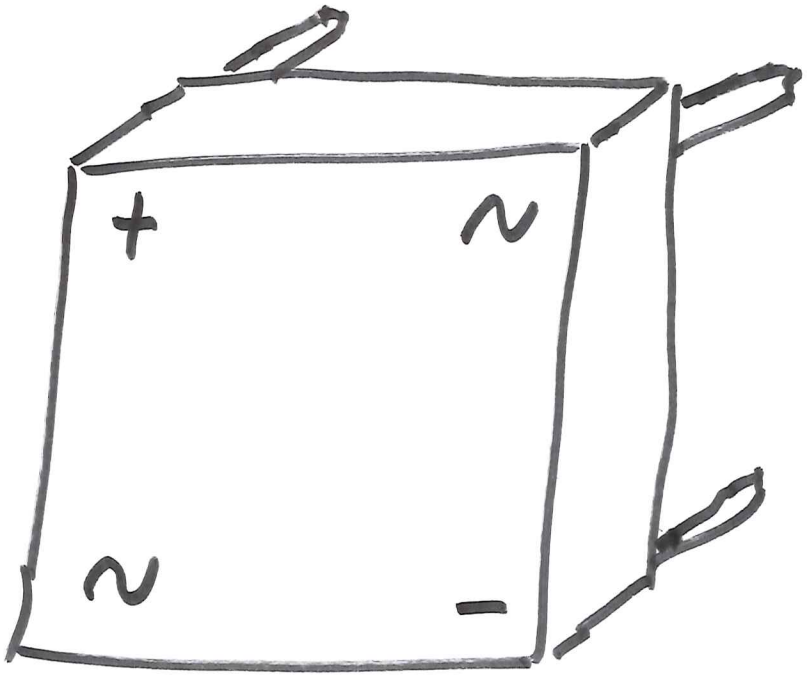


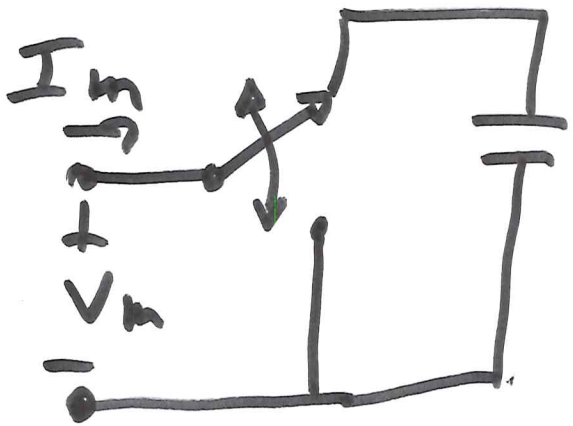
HALF BRIDGE


+
I_M
C
V_M
−
FULL
BRIDGE


I_R
+
V_R
−
I_R
IN
OUT

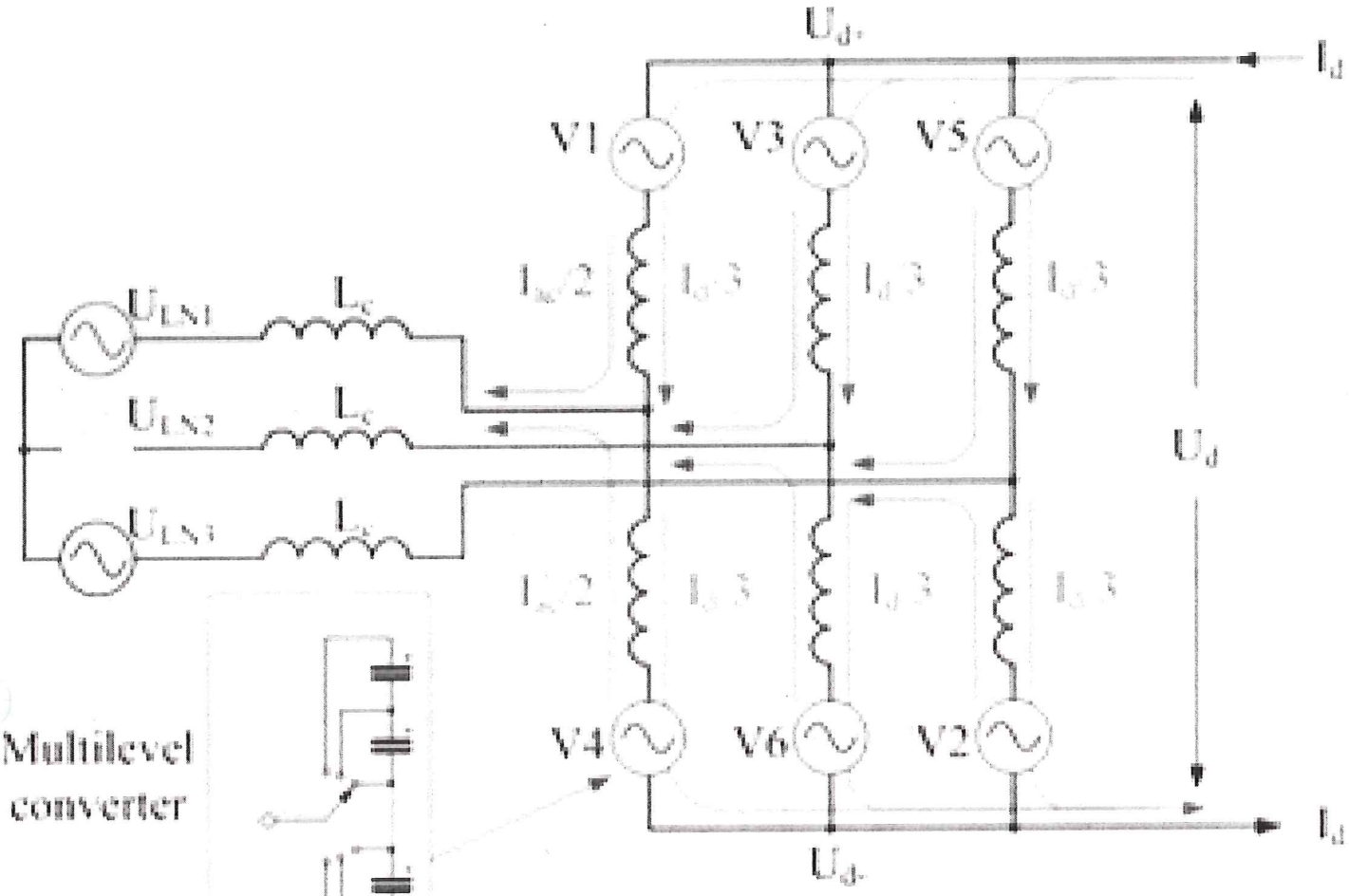

+
L
L
L
V_{dc}
V_a
V_b
V_c
L
L
L
–



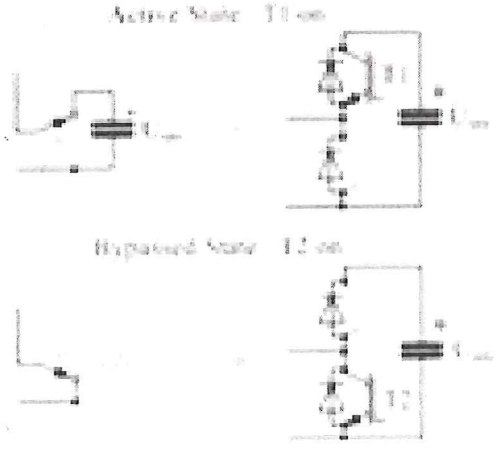


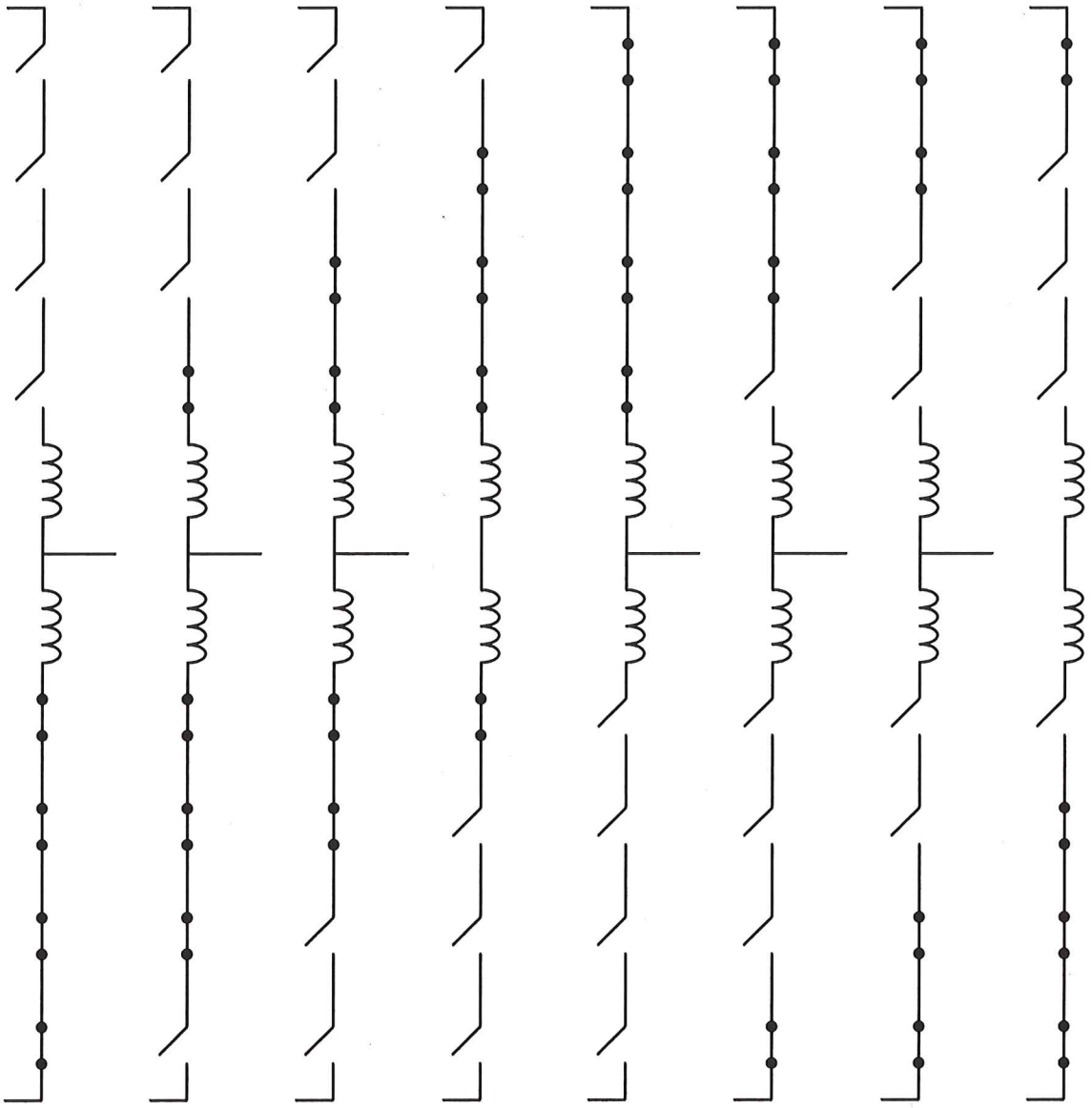
$$I_m = \pm I$$

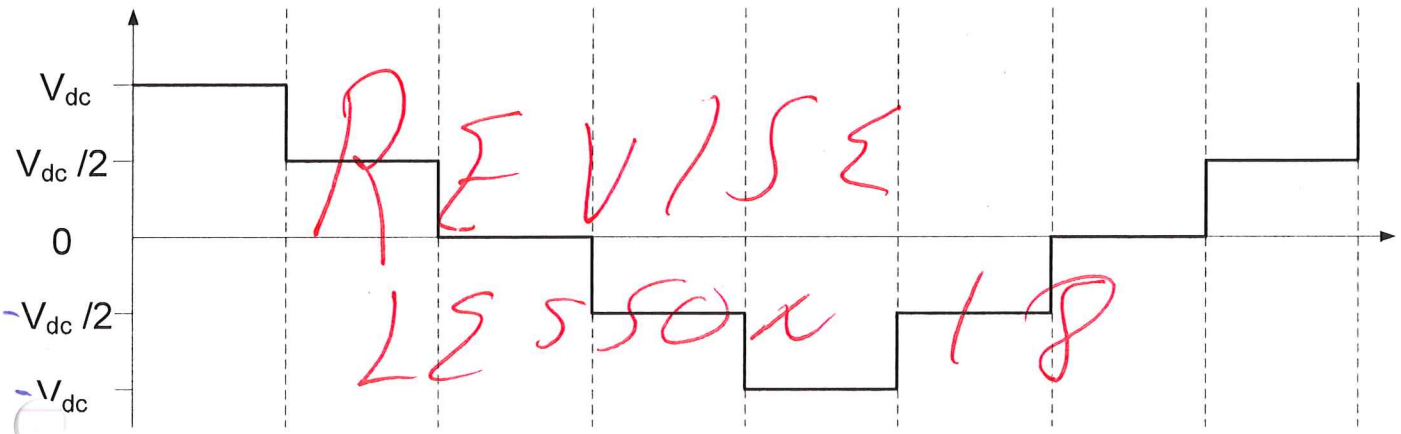
$$V_m = \begin{cases} V \\ 0 \end{cases}$$



Multilevel converter







REVISE
LESSON 18

ECE 404 / 504

T & D Applications of Voltage Sourced Converters

Lesson 17

Multilevel (Chain Link) converter

References: papers by Marquardt 2003, 2004, 2008,

Wikipedia article:

HVDC Converters ... good graphics

Review: 2-level converters; 6 switches (3 phase), 8 switching states; six-step waveforms (old) ... Pulse Width Modulation (PWM) current technology; High switching frequency and the filtering action of the load (or inserted filters) gives a sinusoidal output current; switches can mitigate faults nearby; issues include switch losses, EMI, harmonics, voltage limits

Multilevel converters...neutral point clamped inverter

***Many switching states (27 for a 3-level converter..._____ for a 4-level converter...); Stepped or PWM output possible, often a combination thereof; high switching frequency and the filtering action required at the load to get nearly sinusoidal current; switches can mitigate faults nearby; As a percentage of total power processed, switching losses can be less than a similar 2-level converter; higher voltage levels at the load are possible; new problem of balancing the dc voltages on the capacitors.**

We now look at a converter that has become attractive the past few years, often for projects that the utilities find appropriate: Multilevel Modular Converter (MMC), also known as the Chain Link Converter.

Marquardt et al proposed this converter in 2003. First employed in a commercial project, the Trans Bay Cable, in San Francisco-Oakland in 2010.

How does it work?

- **Modular**
- **Multilevel**
- **Converter**

Bidirectional voltage and current

Multilevel: it works by having exactly half of the modules in each phase supporting the DC voltage.