Lab 3: Three-Phase Fully Controlled Bridge

EE595S

Fall 2005

S.D. Sudhoff

1

Objectives

- Write a macro to simulate a 3-phase bridge inverter, including conduction losses
- Compare performance of sine-triangle (w/3rd) and space vector modulation strategy when inverter feeds a balanced 3-phase RL Load

2

Comments on Conduction Loss

- Transistor voltage drop

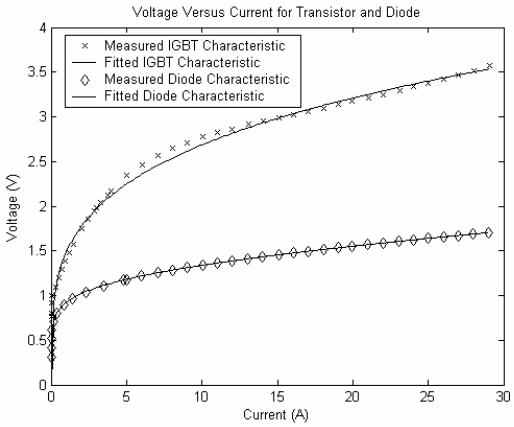
$$v_{sw} = a_t\left(\frac{i_{sw}}{i_{bt}}\right) + b_t\left(\frac{i_{sw}}{i_{bt}}\right)^{c_t}$$

- Diode forward voltage drop

$$v_d = a_d\left(\frac{i_d}{i_{bd}}\right) + b_d\left(\frac{i_d}{i_{bd}}\right)^{c_d}$$

3

Motivation for Assumed Form*



*Brant Cassimere, S.D. Sudhoff, Brandon Cassimere, M. Swinney, "IGBT and PN Junction Diode Loss Modeling for System Simulations," 2005 International Electric Machines and Drives Conference, San Antonio, Texas, May 15-18, 2005

4

Bridge_CL

- MACRO DEFINITION

```
Bridge_CL(z,sa,sb,sc,vin,ia,ib,ic,var,vbr,vcr,iin, &
          par_at,par_bt,par_ct,par_ibt, &
          par_ad,par_bd,par_cd,par_ibd)
```

5

Notes

- You will be studying both sine-triangle (w/3rd) and space-vector modulation strategies, with the inverter feeding an RL load
- All files needed (CSL, CMD, and macros), except for the bridge, are on the course web site
- Invert1.csl is set up for sine-triangle (w/3rd). You will need to set the numbers which are of form XX.X
- Invert2.csl is set up for space-vector. You will need to set the numbers which are of the from XX.X

6

Study 1

- Your inverter feeds an RL load
  - The fundamental voltage should be 230 V, l-l, rms at 60 Hz (this is the voltage you will provide).
  - At 230 V, l-l, rms, the RL load consumes 10 kVA at 0.9 pf. You will need to compute R and L.
  - Set the dc voltage to 23% higher than minimum needed (forgetting about conduction drops). You will need to compute this.

7

Study 1

- Compare the two modulation strategies in terms of input power, output power, inverter loss, and total harmonic distortion

8

Study 2

- The results for study 1 are for one load at one operating point. Design a sequence of studies to see if the trend you found holds up during different conditions. (Vary voltage level, or kVA of the load, or Power Factor, etc)

9

Deliverables

- All code *.csl, *.cmd, and all of your macros
- Do not include my macros
- Results from studies
- 1-2 Paragraph commentary on studies. Discuss points of interest

10