**Developments on Control Board and DSP software**

1. DC bus voltage measurement from each module
2. Phase current measurement from each module
3. Position and speed measurement from encoder
4. Motor speed control
5. Phase current control for each module
6. Balancing of DC bus voltages
7. Waveform synthesizing with PWM for low harmonic content
8. DC bus overvoltage protection
9. Phase overcurrent protection
10. Short circuit protection (?)
11. Advanced techniques (fault detection, operation under fault etc.)



Fig. 1. General control block diagram



Fig. 2. Speed and voltage controllers

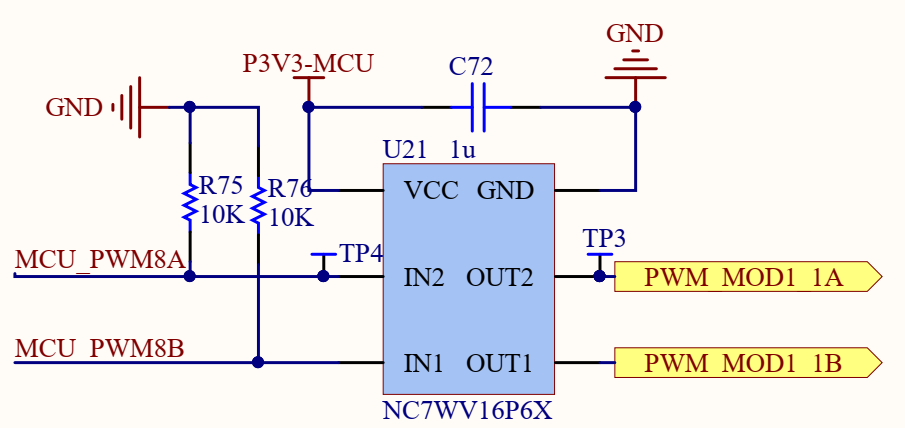


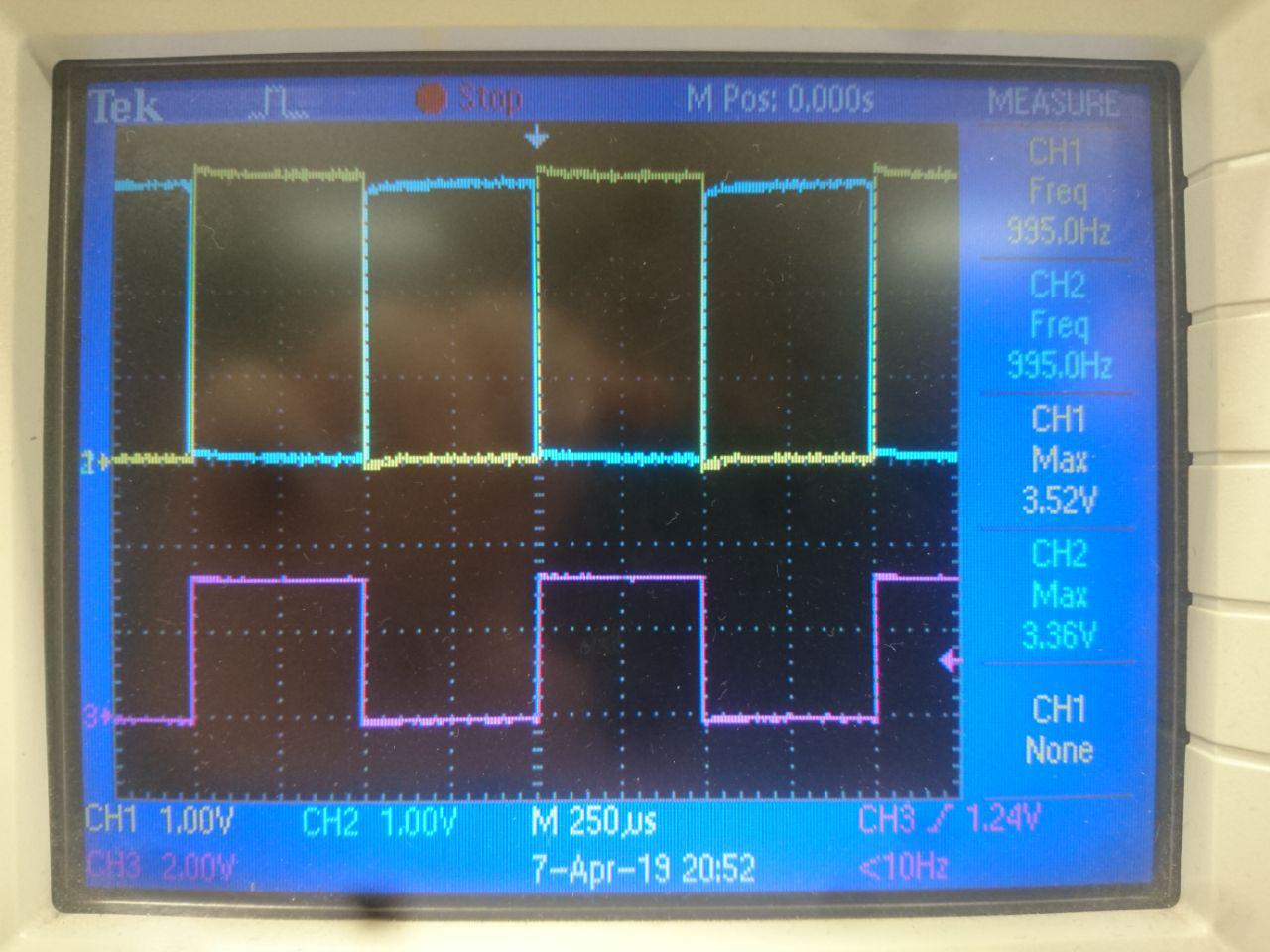
Fig. 3. Current controller



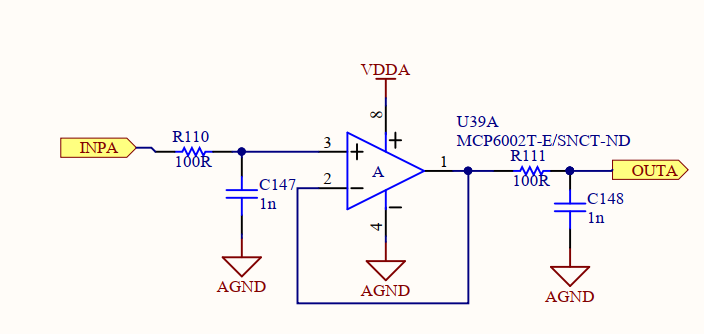
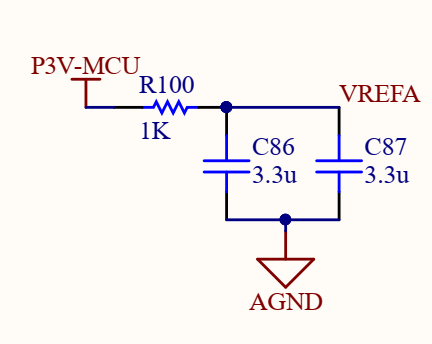
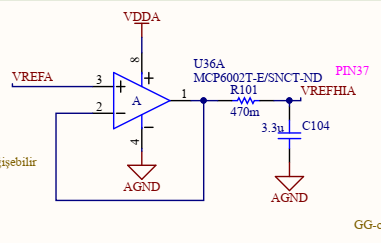
Fig. 4. Control system timing

**PWM generation:**

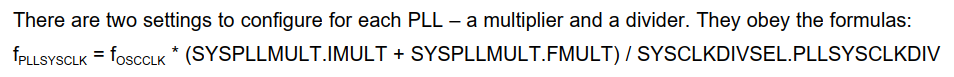


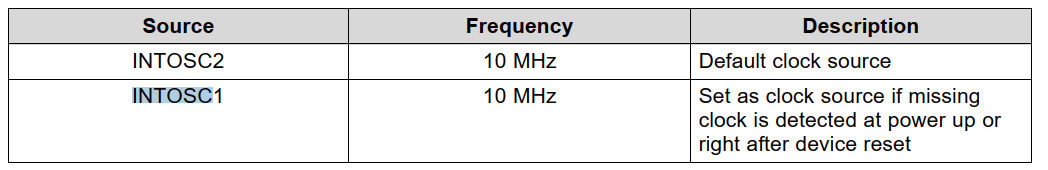


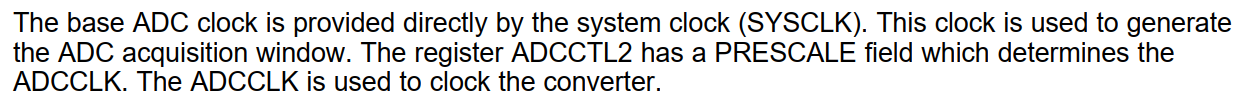
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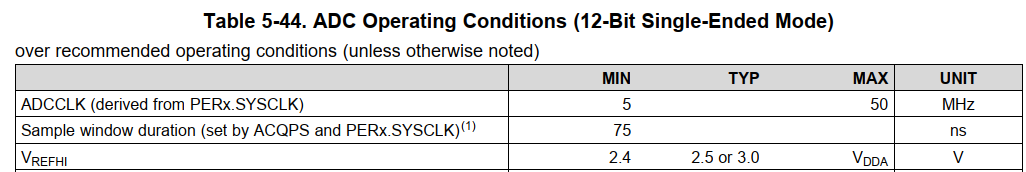
  

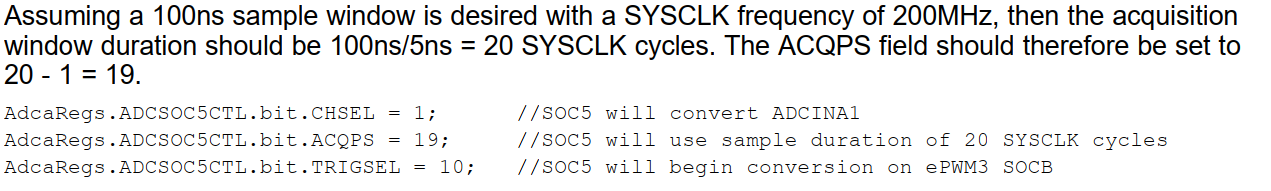
**Control system timing:**

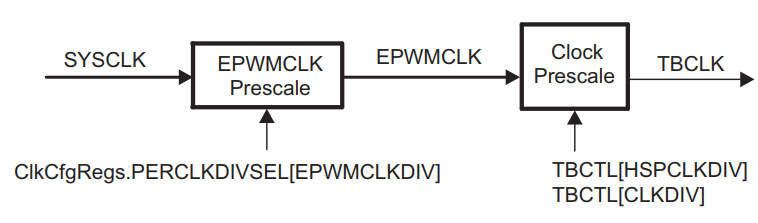


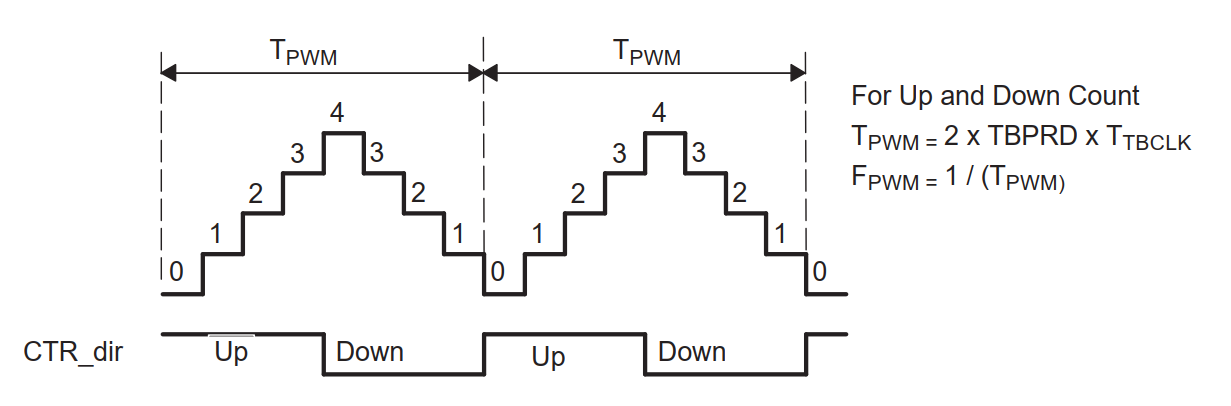


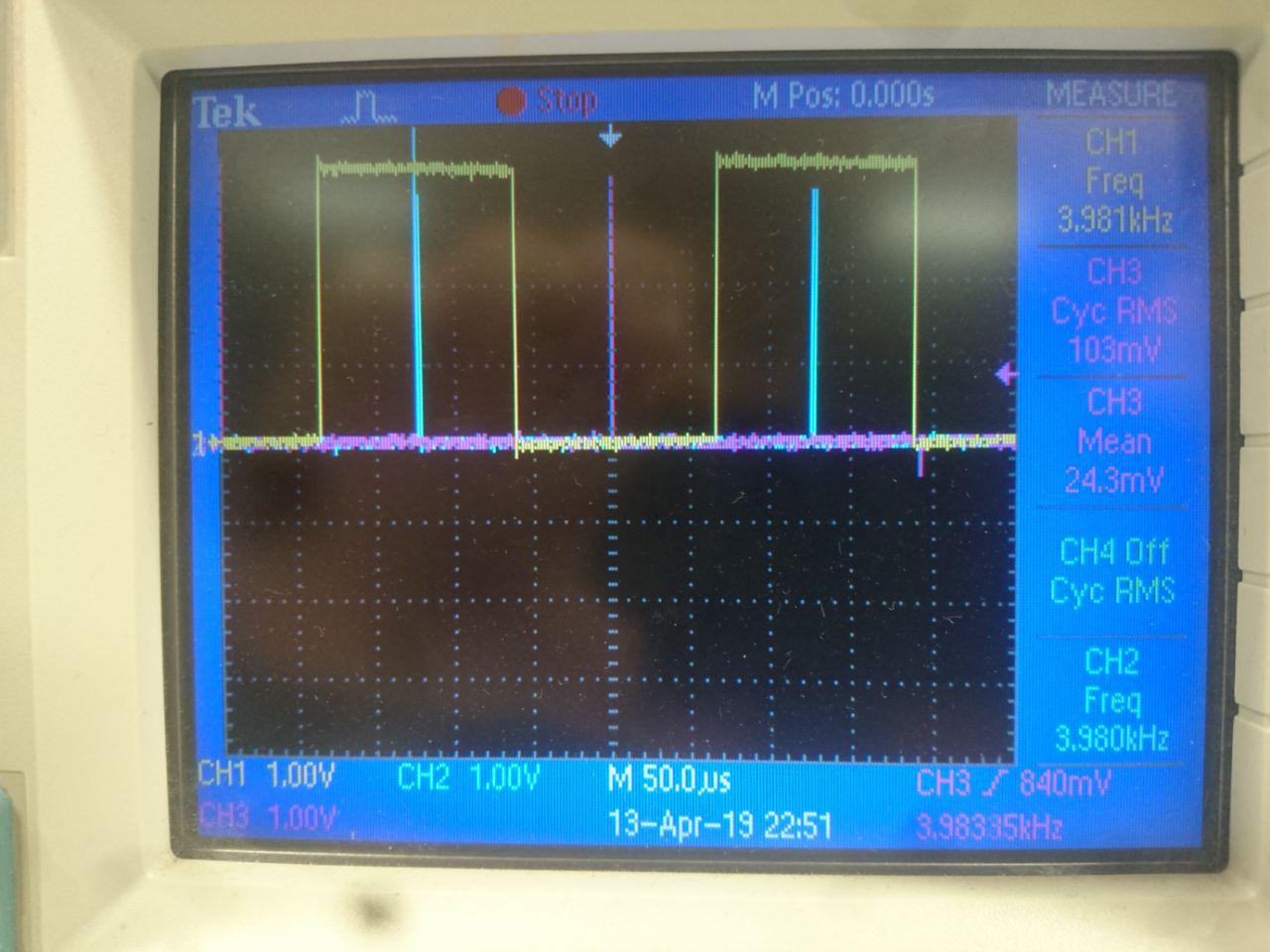




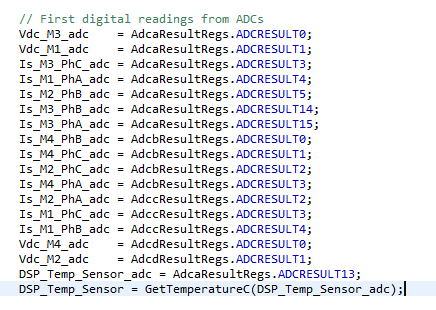
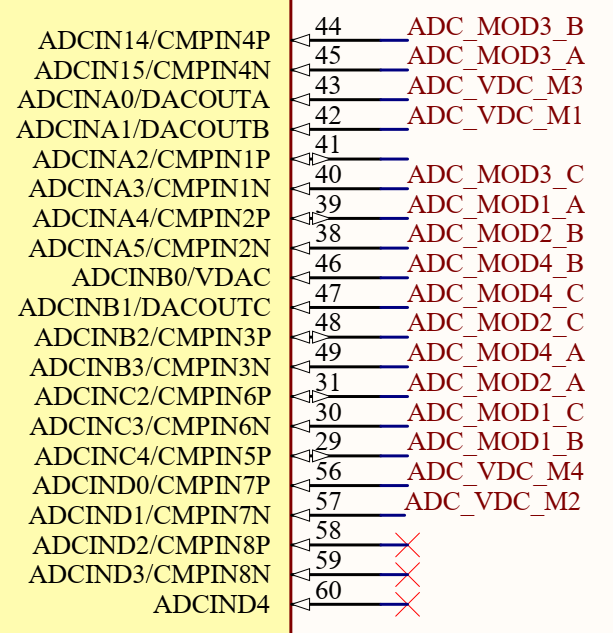


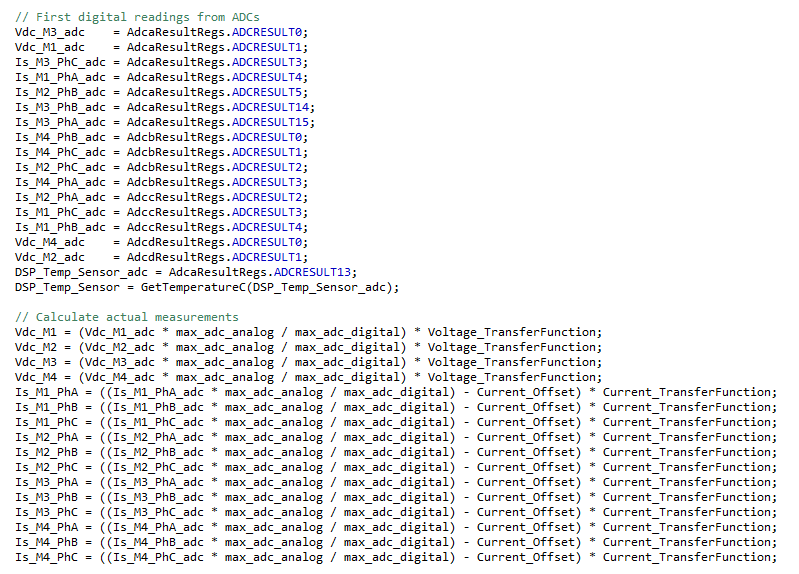




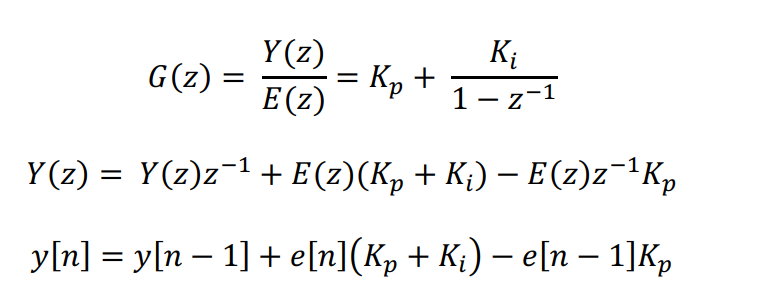
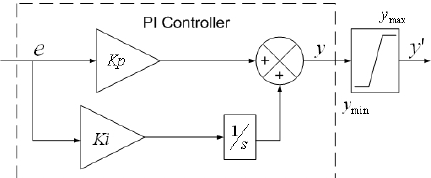


**ADC results**



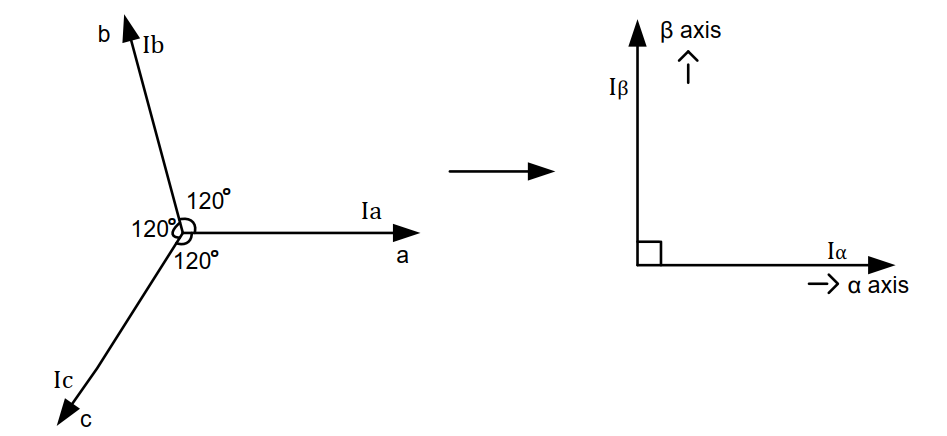
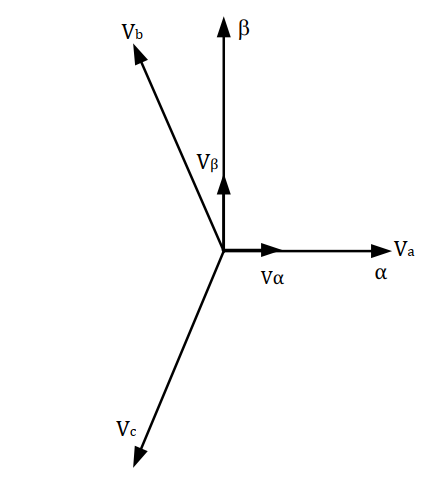


**PI controller:**



**Transformations:**

Clarke and Inverse Clark





Park and Inverse Park

