

Influence of Modulation Method on Using LC-Traps with Single-Phase Voltage Source Inverters

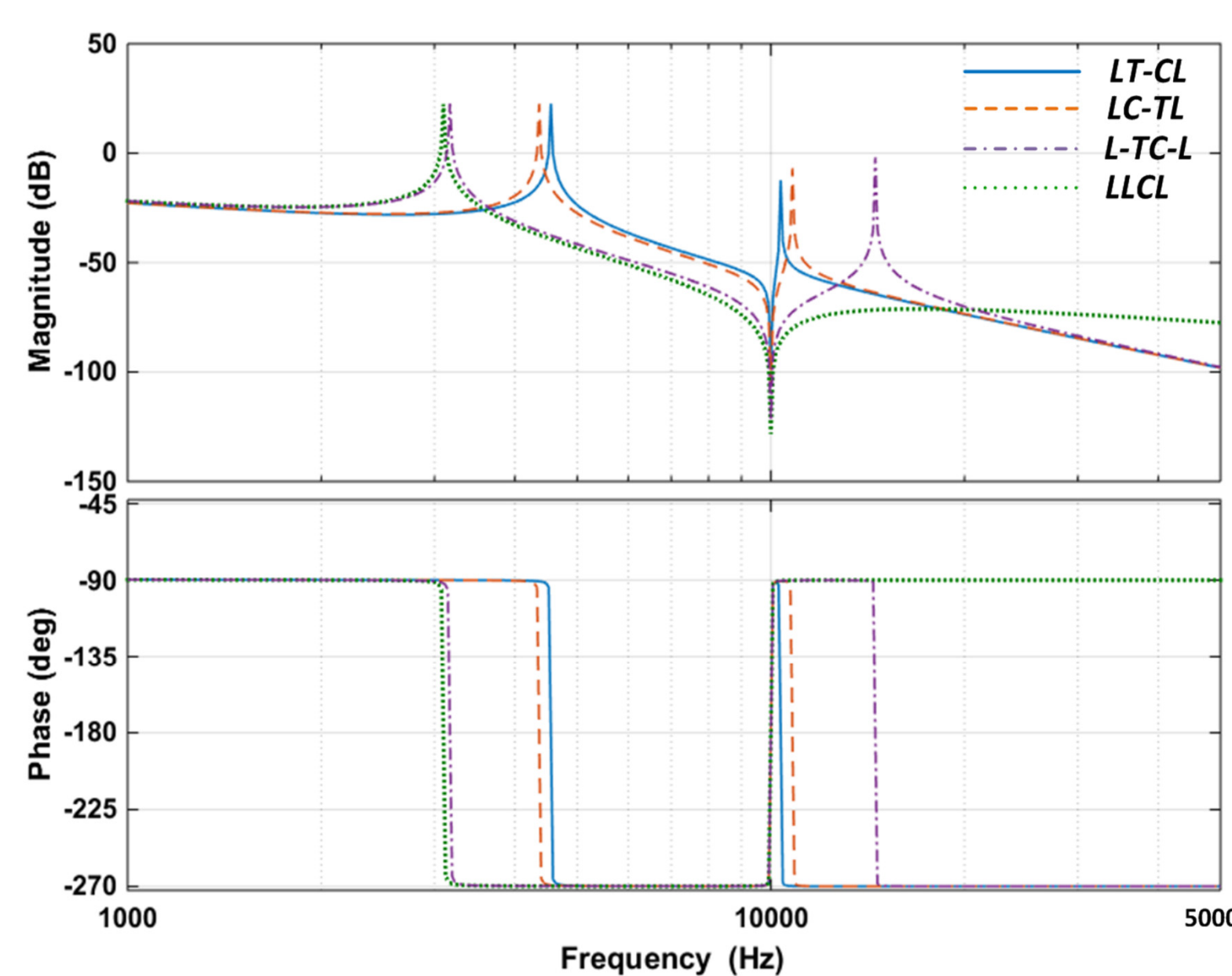
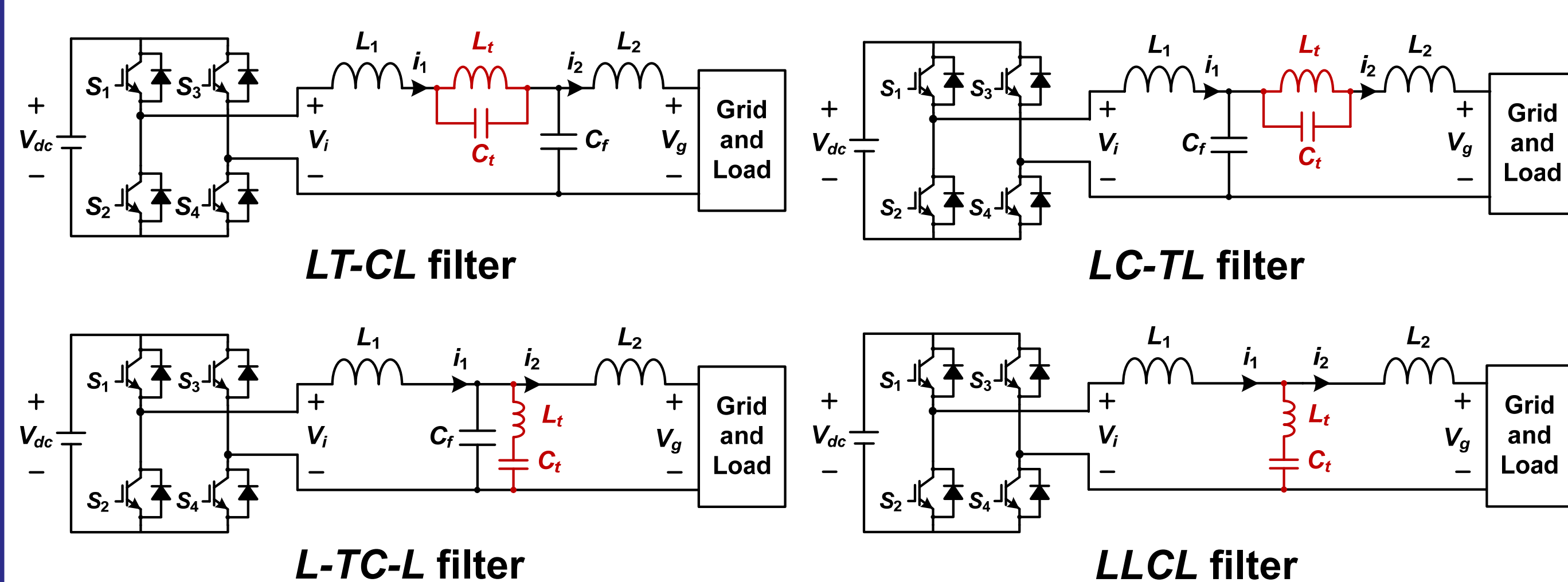
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Abstract—This paper investigates the influence of modulation method on using the LC-traps with single-phase VSIs. Two-level (bipolar) and three-level (unipolar) modulations that include Phase Distortion (PD) and Alternative Phase Opposition Distortion (APOD) strategies are analyzed. Harmonic filtering performances of four LC-trap-based filters with different locations of LC-traps are compared. It is shown that the use of parallel-LC-traps in series with the filter inductors, either grid- or converter- side, has a worse harmonic filtering performance than using series-LC-trap in the shunt branch. Simulations and experimental results are presented for verifications.

Four LC-Trap-Based Filters

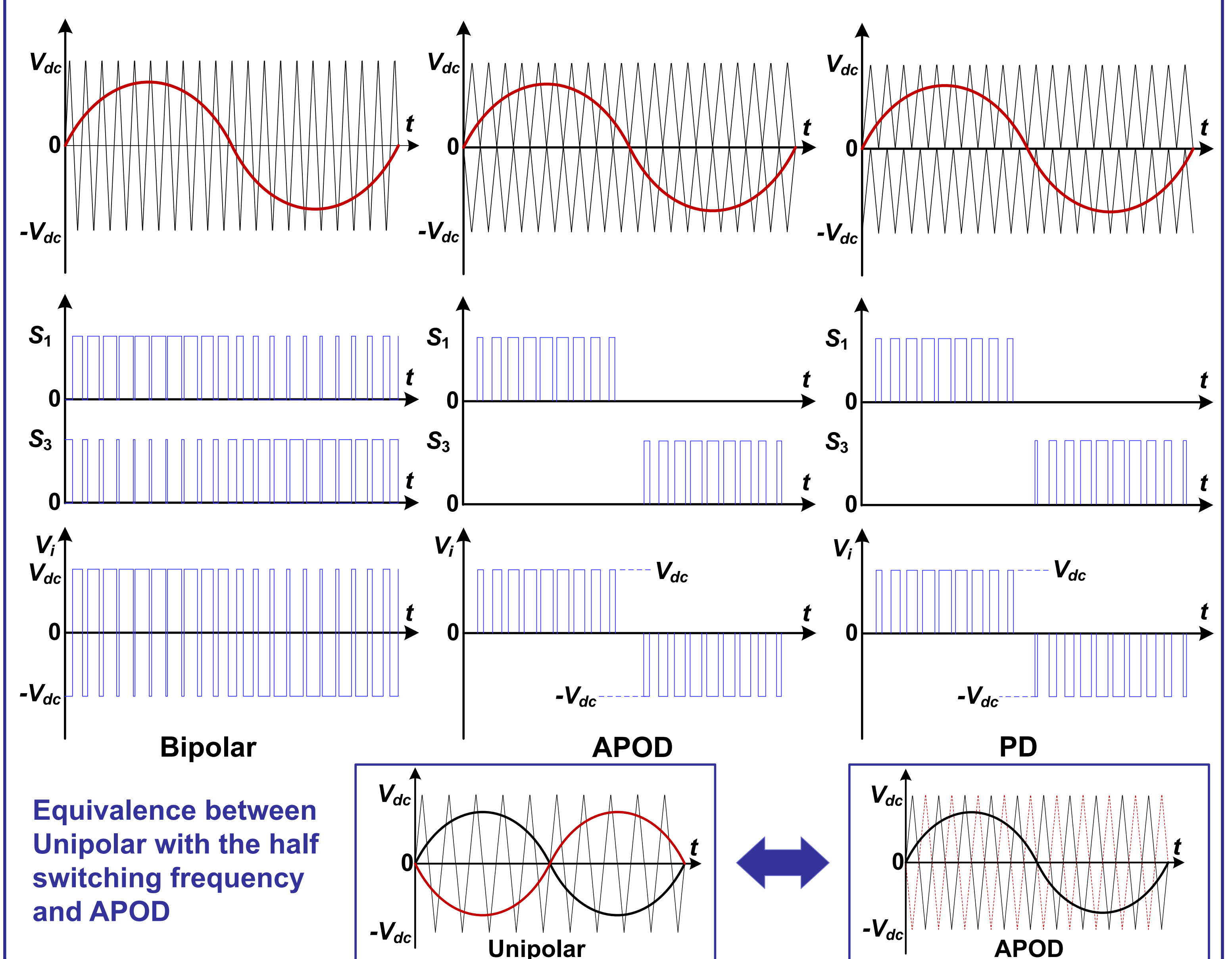


Filter Parameters	
Filter inductor L_1	1.5 mH
Filter inductor L_2	0.7 mH
Filter capacitor C_f	2.5 μ F
Trap inductor L_t	100 μ H
Trap inductor L_t (LLCL)	50 μ H
Trap capacitor C_t	2.5 μ F
Trap capacitor C_t (LLCL)	5 μ F

New resonance peak with LC-trap

Frequency responses of V_i -to- i_2 with LC-trap filters

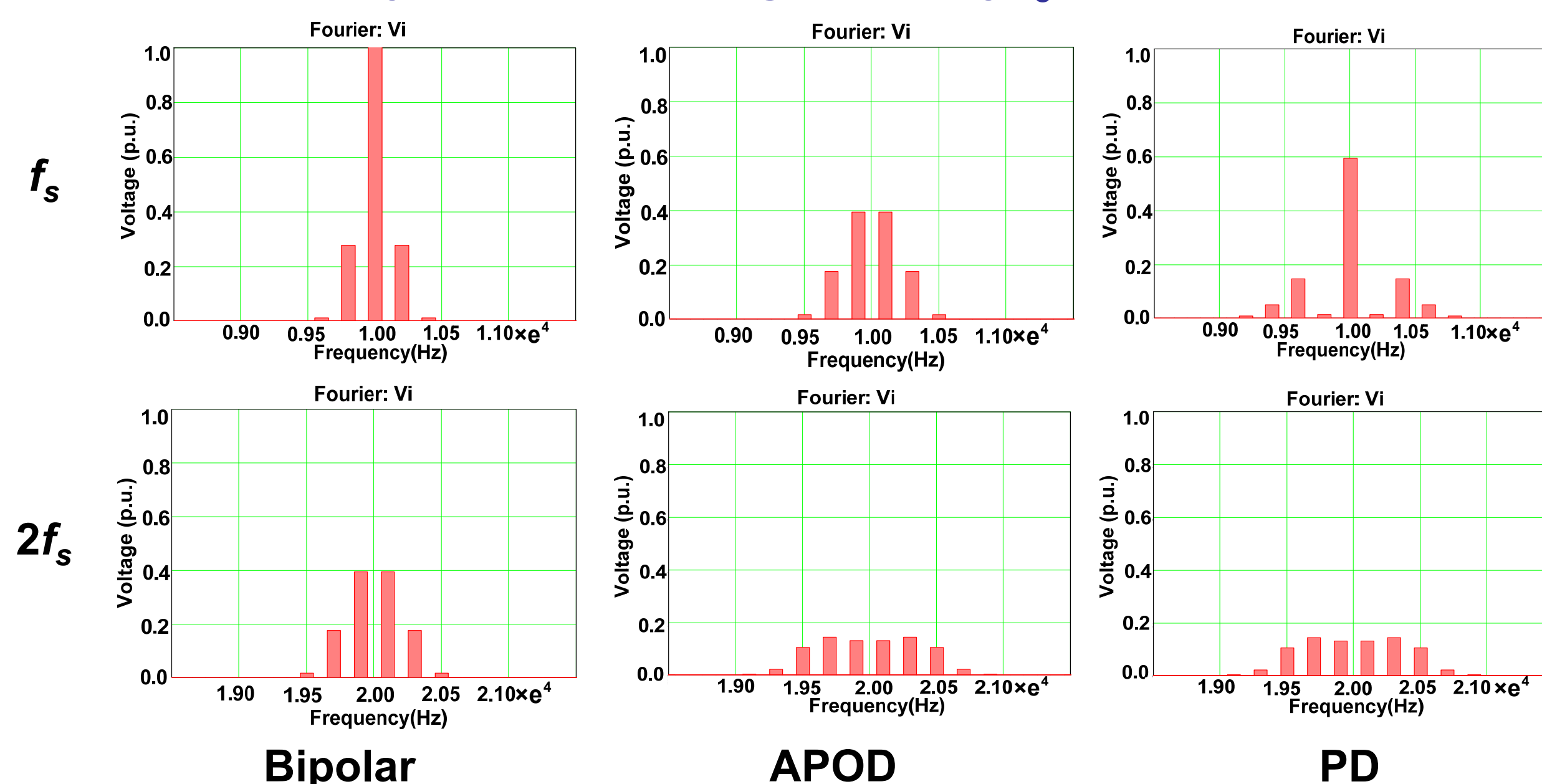
Three Modulation Strategies



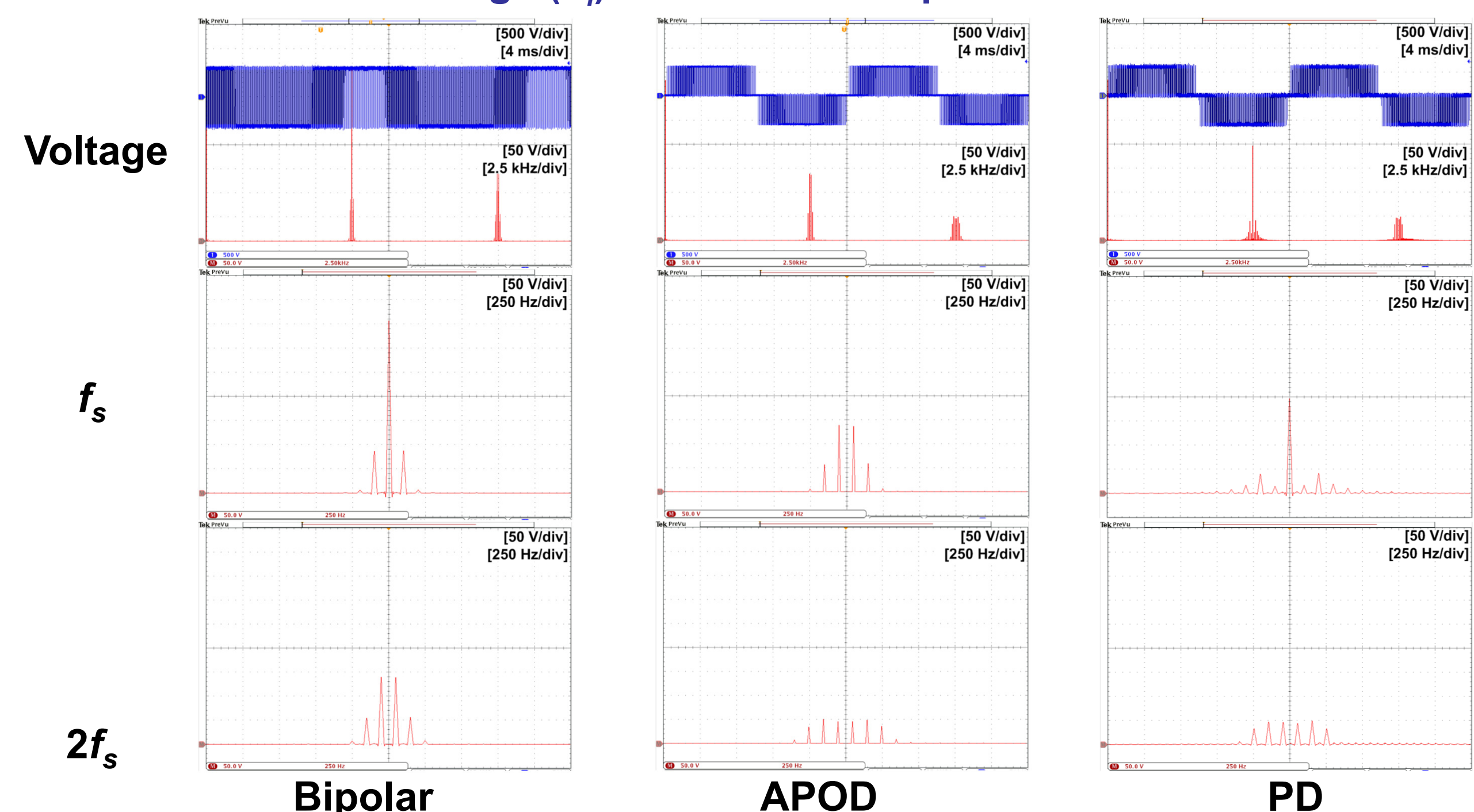
Harmonic Spectra of Inverter Voltage

Double Fourier analysis

Switching frequency $f_s = 10$ kHz

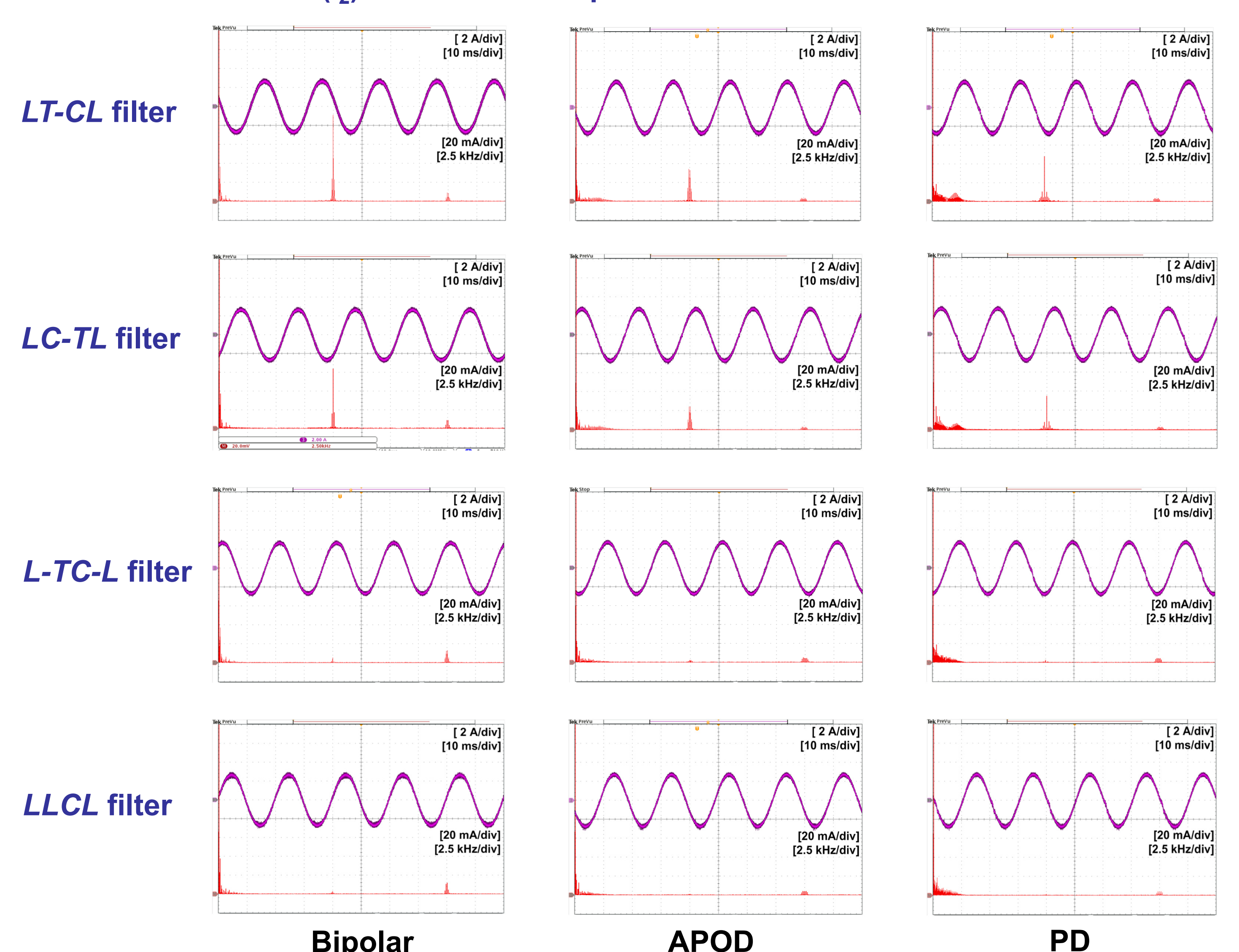


Measured inverter voltage (V_i) and harmonic spectra



Filtering Performance Comparison

Measured load current (i_2) and harmonic spectra



Conclusions

- Parallel-LC-traps in series with filter inductors yields worse filtering performance
- PD modulation method brings in more low-order harmonics
- New resonance peak added by LC-trap can be triggered by sideband harmonics