Flexible Synchronous Regulation of Power Electronic Blocks of Transformer-Based Photovoltaic Stations

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Keywords: voltage source inverter, photovoltaic station, pulsewidth modulation (PWM), voltage synchronization, spectral analysis

Abstract. Photovoltaic (PV) systems are very popular sources of renewable electrical energy [1]. Voltage source inverters (VSI) are the main workhorses of PV installations, providing controlled conversion of dc voltage from PV strings into the required ac voltage for energy consumers [2]. To ensure synchronization and symmetry of basic voltages of PV inverters at increased power levels, an original strategy and scheme of synchronous modulation have been developed for regulation of inverters of some promising structures of systems [3, 4].

Basic conception. Modification of algorithms of synchronous modulation of signals of dual VSIs of the corresponding configurations of transformer-based PV systems, based on smooth regulation of switching frequency of VSIs, subject to equivalence of switching losses in each VSI, improves the spectral composition of winding voltage of the power transformer.

Fig. 1 presents dual-inverter-based PV installation supplied by two strings of PV panels with the operating dc voltages V_L (lower voltage) and V_H (higher voltage) [2]. So, to assure equal switching loses it two VSIs, the VSI feeding by the lower voltage V_L should be functioning at higher switching frequency $_{Fsw\text{-}higher}$, and VSI feeding by the higher voltage *VH* should be functioning at lower swit-ching frequency $F_{sw\text{-}lower}$:

$$V_L F_{sw\text{-}higher} = V_H F_{sw\text{-}lower} \quad (1)$$

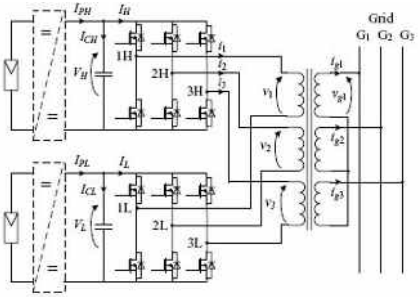

Fig. 1. Two-VSI-based topology of grid-tied PV system with power transformer

Simulation results and conclusion. Table presents results of calculation of *Total Harmonic Distortion* (*THD)* factor ($THD = (1/V_{1_1})\sqrt{\sum_{k=2}^{100} V_{1_k}^2}$) of the winding voltage V_1 of system as function of modulation index *m* of VSIs for two PWM schemes (V_L = *0.8Vh*, $F_{sw\text{-}lower}$=*1.2kHz*, $F_{sw\text{-}higher}$ =*1.5kHz*), which shows advantage of the using of discontinuous synchronous PWM (DPWM) for PV system, if *m>0.5*.

Table. *THD* factor of the winding voltage V_1

m_L=m_H	0.3	0.4	0.5	0.6	0.7	0.8	0.9
CPWM	0.15	0.17	0.20	0.23	0.27	0.31	0.35
DPWM	0.24	0.22	0.20	0.18	0.17	0.17	0.18

References

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