What is claimed is:

1. A photovoltaic grid-connected control device, comprising a controller, and a voltage converter, an inverter and a low-pass filter that are cascaded in sequence, wherein:

an input terminal of the voltage converter is configured to be connected to a photovoltaic device;

an output terminal of the low-pass filter is configured to be connected to a grid, wherein a filter capacitor of the low-pass filter is configured to be connected in parallel with a noncritical load; and

the controller is configured to control a switch driving signal of the inverter to adjust power of the noncritical load, so that a grid-connected active power output from the low-pass filter tracks a grid-connected active power reference value P_{g_ref}.

2. The photovoltaic grid-connected control device according to claim 1, wherein the controller is configured to:

control the switch driving signal of the inverter based on the grid-connected active power reference value P_{g_ref}, a first voltage signal v_g and a first current signal i_g at the output terminal of the low-pass filter, a second voltage signal V_{bus} and a voltage reference value V_{bus_ref} on a DC bus side of the inverter, and an inductor value

L_t of the low-pass filter.

3. The photovoltaic grid-connected control device according to claim 2, wherein the controller is configured to:

obtain a voltage component in a αβ coordinate system based on the grid-connected active power reference value P_{g_ref}, the first voltage signal v_g, the first current signal i_g, the second voltage signal V_{bus}, the voltage reference value V_{bus_ref}, and the inductor value L_t of the low-pass filter;

obtain a feedforward component of grid voltage v_f according to the first voltage signal v_g and a feedforward function $G_{ff(s)}$; and

obtain the switch driving signal according to the voltage component in the αβ coordinate system and the feedforward component of grid voltage v_f.

4. The photovoltaic grid-connected control device according to claim 3, wherein the controller is configured to:

obtain a first current component I_d and a second current component I_q in a dq coordinate system according to the first voltage signal v_g and the first current signal i_g;

obtain a first reference voltage value V_{d_ref} and a second reference voltage value V_{q_ref} in the dq coordinate system according to the second voltage signal V_{bus}, the voltage reference value V_{bus_ref},

and the grid-connected active power reference value P_{g_ref};

obtain a first voltage component V_d and a second voltage component V_q in the dq coordinate system according to the first current component I_d, the second current component I_q, the first reference voltage value V_{d_ref} and the second reference voltage value V_{q_ref}, and the inductor value L_t of the low-pass filter; and

obtain a α voltage component v_α and a β voltage component v_β in the αβ coordinate system according to the first voltage component V_d and the second voltage component V_q.

5. The photovoltaic grid-connected control device according to claim 4, wherein the controller is configured to:

input the first voltage signal v_g to a phase locked loop (PLL) to obtain an amplitude V_g, a phase θ, and a fundamental frequency ω of grid-connected voltage;

obtain a β current component i_{g_β} in the αβ coordinate system based on the β voltage component v_β, and the first voltage signal v_g; and

obtain the first current component I_d and the second current component I_q in the dq coordinate system according to the first current signal i_g, the phase θ, and the β current component i_{g_β}.

6. The photovoltaic grid-connected control device according to

claim 4, wherein the controller is configured to:

input the first voltage signal v_g to a phase locked loop (PLL) to obtain an amplitude V_g, a phase θ, and a fundamental frequency ω of grid-connected voltage; and

obtain the first current component I_d and the second current component I_q in the dq coordinate system according to the first current signal i_g and the phase θ.

7. The photovoltaic grid-connected control device according to claim 4, wherein the controller is configured to:

perform proportional integral (PI) control on a difference between the voltage reference value V_{bus_ref} and the second voltage signal V_{bus}, the result of which passes through a limiter and a holder to obtain a second reference current I_{q_ref} in the dq coordinate system;

perform PI control on a difference between the second reference current I_{q_ref} and the second current component I_q, the result of which passes through a limiter to obtain the second reference voltage value V_{q_ref};

divide the grid-connected active power reference value P_{g_ref} by the amplitude V_g, the result of which passes through a limiter and a holder to obtain a first reference current I_{d_ref} in the dq coordinate system; and

perform PI control on a difference between the first reference current I_{d_ref} and the first current component I_d, the result of which passes through a limiter to obtain the first reference voltage value V_{d_ref}.

8. The photovoltaic grid-connected control device according to claim 4, wherein the controller is configured to:

according to the first current component I_d and the inductor value L_t of the low-pass filter, obtain a first voltage value V_{dt} corresponding to the inductor in the dq coordinate system;

perform a difference operation between the second reference voltage value V_{q_ref} and the first voltage value V_{dt} to obtain the second voltage component V_q;

according to the second current component I_q and the inductor value L_t of the low-pass filter, obtain a second voltage value V_{qt} corresponding to the inductor in the dq coordinate system; and

add the first reference voltage value V_{d_ref} to the second voltage value V_{qt} to obtain the first voltage component V_d.

9. The photovoltaic grid-connected control device according to any one of claims 1 to 8, wherein:

the low-pass filter is an LCL type low-pass filter;

the inverter is a single-phase inverter or a three-phase

inverter; or

the voltage converter is a Boost converter.

10. A photovoltaic grid-connected control system, comprising:

the photovoltaic grid-connected control device according to any one of claims 1 to 9; and

a photovoltaic device.

11. A control method of the photovoltaic grid-connected control device according to claim 1, comprising:

obtaining a first voltage signal v_g and a first current signal i_g at an output terminal of the low-pass filter, and a second voltage signal V_{bus} on a DC bus side of the inverter;

generating the switch driving signal of the inverter according to the first voltage signal v_g, the first current signal i_g, and the second voltage signal V_{bus}; and

controlling the switch driving signal of the inverter to adjust power of the noncritical load, so that the grid-connected active power output from the low-pass filter tracks the grid-connected active power reference value P_{g_ref}.

12. The control method according to claim 11, wherein generating the switch driving signal of the inverter comprises:

generating the switch driving signal of the inverter based on the grid-connected active power reference value P_{g_ref}, the first voltage signal v_g and the first current signal i_g at the output terminal of the low-pass filter, the second voltage signal V_{bus} and a voltage reference value V_{bus_ref} on the DC bus side of the inverter, and an inductor value L_t of the low-pass filter.

13. The control method according to claim 12, wherein generating the switch driving signal of the inverter comprises:

obtaining a voltage component in a αβ coordinate system based on the grid-connected active power reference value P_{g_ref}, the first voltage signal v_g, the first current signal i_g, the second voltage signal V_{bus}, the voltage reference value V_{bus_ref}, and the inductor value L_t of the low-pass filter;

obtaining a feedforward component of grid voltage v_f according to the first voltage signal v_g and a feedforward function $G_{ff(s)}$; and

obtaining the switch driving signal according to the voltage component in the αβ coordinate system and the feedforward component of grid voltage v_f.

14. The control method according to claim 13, wherein obtaining the voltage component in the αβ coordinate system comprises:

obtaining a first current component I_d and a second current

component I_q in a dq coordinate system according to the first voltage signal v_g and the first current signal i_g;

obtaining a first reference voltage value V_{d_ref} and a second reference voltage value V_{q_ref} in the dq coordinate system according to the second voltage signal V_{bus}, the voltage reference value V_{bus_ref}, and the grid-connected active power reference value P_{g_ref};

obtaining a first voltage component V_d and a second voltage component V_q in the dq coordinate system according to the first current component I_d, the second current component I_q, the first reference voltage value V_{d_ref} and the second reference voltage value V_{q_ref}, and the inductor value L_t of the low-pass filter; and

obtaining a α voltage component v_α and a β voltage component v_β in the αβ coordinate system according to the first voltage component V_d and the second voltage component V_q.

15. The control method according to claim 14, wherein obtaining the first current component I_d and the second current component I_q in the dq coordinate system comprises:

inputting the first voltage signal v_g to a PLL to obtain an amplitude V_g, a phase θ, and a fundamental frequency ω of grid-connected voltage;

obtaining a β current component i_{g_β} in the αβ coordinate system based on the β voltage component v_β, and the first voltage signal v_g;

and

obtaining the first current component I_d and the second current component I_q in the dq coordinate system according to the first current signal i_g, the phase θ, and the β current component i_{g_β}.

16. The control method according to claim 14, wherein obtaining the first current component I_d and the second current component I_q in the dq coordinate system comprises:

inputting the first voltage signal v_g to a PLL to obtain an amplitude V_g, a phase θ, and a fundamental frequency ω of grid-connected voltage; and

obtaining the first current component I_d and the second current component I_q in the dq coordinate system according to the first current signal i_g and the phase θ.

17. The control method according to claim 14, wherein obtaining the first reference voltage value V_{d_ref} and the second reference voltage value V_{q_ref} in the dq coordinate system comprises:

performing PI control on a difference between the voltage reference value V_{bus_ref} and the second voltage signal V_{bus}, the result of which passes through a limiter and a holder to obtain a second reference current I_{q_ref} in the dq coordinate system;

performing PI control on a difference between the second

reference current I_{q_ref} and the second current component I_q, the result of which passes through a limiter to obtain the second reference voltage value V_{q_ref};

dividing the grid-connected active power reference value P_{g_ref} by the amplitude V_g, the result of which passes through a limiter and a holder to obtain a first reference current I_{d_ref} in the dq coordinate system; and

performing PI control on a difference between the first reference current I_{d_ref} and the first current component I_d, the result of which passes through a limiter to obtain the first reference voltage value V_{d_ref}.

18. The control method according to claim 14, wherein obtaining the first voltage component V_d and the second voltage component V_q in the dq coordinate system comprises:

obtaining a first voltage value V_{dt} corresponding to the inductor in the dq coordinate system according to the first current component I_d and the inductor value L_t of the low-pass filter;

performing a difference operation between the second reference voltage value V_{q_ref} and the first voltage value V_{dt} to obtain the second voltage component V_q;

obtaining a second voltage value V_{qt} corresponding to the inductor in the dq coordinate system according to the second

current component I_q and the inductor value L_t of the low-pass filter; and

adding the first reference voltage value V_{d_ref} to the second voltage value V_{qt} to obtain the first voltage component V_d.

19. A controller, comprising:

a memory; and

a processor coupled to the memory, the processor configured to, based on instructions stored in the memory, carry out the control method according to any one of claims 11 to 18.

20. A non-transitory computer-readable storage medium on which computer program instructions are stored, which when executed by a processor implement the control method according to any one of claims 11 to 18.