grid to which a voltage source device is connected, a detector to detect a state quantity of the distribution grid, a power conversion device, and a grid control unit. The power conversion device inputs or outputs a power for changing the state quantity to the distribution grid. The grid control unit calculates a power command value for the power conversion device from a deviation between the state quantity obtained from an output of the detector and a control target of the state quantity such that a drooping characteristic for compensating for the deviation is provided. The grid control unit performs control computation having a predetermined frequency characteristic, with the deviation as an input and the power command value as an output. The frequency characteristic is defined such that a first control gain value in a first frequency range including direct current is set corresponding to a slope of the drooping characteristic and a second control gain value in a second frequency range including higher frequencies than the first frequency range is set to be lower than the first control gain value.

[0009] According to another aspect of the present disclosure, a control device of a grid system including a distribution grid to which a voltage source device is connected includes a deviation computation unit and a control computation unit. The deviation computation unit calculates a deviation between a state quantity of the distribution grid and a control target of the state quantity, based on an output of a detector provided in the distribution grid. The control computation unit generates a power command value for a power conversion device for inputting or outputting a power for changing the state quantity to or from the distribution grid. The control computation unit performs control computation having a predetermined frequency characteristic, with the deviation as an input and the power command value as an output, such that a drooping characteristic for compensating for the deviation calculated by the deviation computation unit is provided. The frequency characteristic is defined such that a first control gain value in a first frequency range including direct current and a target value of a grid frequency of the distribution grid is set corresponding to a slope of the drooping characteristic and a second control gain value in a second frequency range including higher frequencies than the first frequency range is set to be lower than the first control gain value.

ADVANTAGEOUS EFFECTS OF INVENTION

[0010] According to the present disclosure, even when the control gain value in the first frequency range including direct current is set to be high in order to ensure the slope of the drooping characteristic, the control gain in the second frequency range with higher frequencies can be reduced, so that grid stabilization control having a predetermined drooping characteristic can be implemented without impairing the control

CLAIMS

[Claim 1] A grid system comprising:

a distribution grid to which a voltage source device is connected;

a detector to detect a state quantity of the distribution grid;

a power conversion device to input or output a power for changing the state quantity to or from the distribution grid; and

a grid control unit to calculate a power command value for the power conversion device from a deviation between the state quantity obtained from an output of the detector and a control target of the state quantity such that a drooping characteristic for compensating for the deviation is provided, wherein

the grid control unit performs control computation having a predetermined frequency characteristic, with the deviation as an input and the power command value as an output, and

the frequency characteristic is defined such that a first control gain value in a first frequency range including direct current is set corresponding to a slope of the drooping characteristic and a second control gain value in a second frequency range including higher frequencies than the first frequency range is set to be lower than the first control gain value.

[Claim 2] The grid system according to claim 1, wherein

the state quantity is a grid voltage effective value of the distribution grid, and

the grid control unit calculates the power command value such that the power conversion device outputs, to the distribution grid, a reactive power in a current phase advance direction or a current phase delay direction in accordance with the deviation of the grid voltage effective value and the control target value.

[Claim 3] The grid system according to claim 2, wherein when an absolute value of the deviation is smaller than a reference value, the grid control unit calculates the power command value such that the reactive power output from the power conversion device to the distribution grid becomes zero.

[Claim 4] The grid system according to claim 2 or 3, wherein

the power conversion device is connected to a power storage element and capable of

inputting/outputting an active power and the reactive power to/from the distribution grid, and

the grid control unit generates the power command value to limit an output amount of the reactive power in accordance with an input/output amount of the active power by charging/discharging of the power storage element, such that an apparent power input/output to/from the power conversion device is equal to or lower than a limit value.

[Claim 5] The grid system according to claim 1, wherein

the state quantity is a grid frequency of the distribution grid, and

the grid control unit calculates the power command value such that the power conversion device inputs/outputs an active power to/from the distribution grid in accordance with the deviation of the grid frequency and the control target.

[Claim 6] The grid system according to claim 5, wherein when an absolute value of the deviation is smaller than a reference value, the grid control unit calculates the power command value such that the active power input/output between the power conversion device and the distribution grid becomes zero.

[Claim 7] The grid system according to any one of claims 1 to 6, wherein the second frequency range includes a response frequency of the power conversion device.

[Claim 8] A control device of a grid system including a distribution grid to which a voltage source device is connected, the control device comprising:

a deviation computation unit to calculate a deviation between a state quantity of the distribution grid and a control target of the state quantity, based on an output of a detector provided in the distribution grid; and

a control computation unit to generate a power command value for a power conversion device for inputting or outputting a power for changing the state quantity to or from the distribution grid, wherein

the control computation unit performs control computation having a predetermined frequency characteristic, with the deviation as an input and the power command value as an output, such that a drooping characteristic for compensating for the deviation calculated by the deviation computation unit is provided, and

the frequency characteristic is defined such that a first control gain value in a first frequency range including direct current is set corresponding to a slope of the drooping characteristic and a second control gain value in a second frequency range including higher frequencies than the first frequency range is set to be lower than the first control gain value.

[Claim 9] The control device according to claim 8, wherein

the state quantity is a grid voltage effective value of the distribution grid, and

the control computation unit calculates the power command value such that the power conversion device outputs, to the distribution grid, a reactive power in a current phase advance direction or a current phase delay direction in accordance with the deviation of the grid voltage effective value and the control target value.

[Claim 10] The control device according to claim 9, wherein when an absolute value of the deviation is smaller than a reference value, the control computation unit calculates the power command value such that the reactive power output from the power conversion device to the distribution grid becomes zero.

[Claim 11] The control device according to claim 8, wherein

the state quantity is a grid frequency of the distribution grid, and

the control computation unit calculates the power command value such that the power conversion device inputs/outputs an active power to/from the distribution grid in accordance with the deviation of the grid frequency and the control target.

[Claim 12] The control device according to claim 11, wherein when an absolute value of the deviation is smaller than a reference value, the control computation unit calculates the power command value such that the active power input/output between the power conversion device and the distribution grid becomes zero.

[Claim 13] The control device according to any one of claims 8 to 12, wherein the second frequency range includes a response frequency of the power conversion device.

[Claim 14] The grid system according to any one of claims 1 to 7, wherein

the frequency characteristic is defined such that (i) a third frequency range in which a phase lag is 90 degrees is provided between the first frequency range and the second frequency range, and (ii) the phase lag approaches 0 degrees with increase of a frequency in a frequency range including higher frequencies than the third frequency range.

[Claim 15] The grid system according to any one of claims 1 to 7, wherein

the frequency characteristic is defined such that (i) a third frequency range in which a control gain decreases with increase of a frequency is provided between the first frequency range and the second frequency range, and (ii) the second frequency range includes a frequency range in which the control gain is constantly maintained with increase of the frequency.

[Claim 16] The control device according to any one of claims 8 to 13, wherein

the frequency characteristic is defined such that (i) a third frequency range in which a phase lag is 90 degrees is provided between the first frequency range and the second frequency range, and (ii) the phase lag approaches 0 degrees with increase of a frequency in a frequency range including higher frequencies than the third frequency range.

[Claim 17] The control device according to any one of claims 8 to 13, wherein

the frequency characteristic is defined such that (i) a third frequency range in which a control gain decreases with increase of a frequency is provided between the first frequency range and the second frequency range, and (ii) the second frequency range includes a frequency range in which the control gain is constantly maintained with increase of the frequency.