

Control Strategy for Inverter Based Micro Grid

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Abstract:

Micro Grid (MG) may be treated as a low voltage network of local distributed energy sources and local loads. Micro Grids (MG) are usually a small scale power supply networks with total installed capacities around a few hundred kilowatts to few megawatts. The main aim of micro grids are supplying power to remote place or village by utilizing the available local resources, where there is no grid connection and also micro grids can be designed for uninterruptable power supply with high quality power to sensitive loads in a certain area.

Micro Grid (MG) can be operated in two modes one is grid connected and another one is islanded mode. Each mode has its own control strategies. In this project islanded mode is mainly focused.

In previous method virtual output impedance method is used. By using this method the derivative of output current may amplify the magnitude of harmonic currents. Due to this power supply is interrupted and the power sharing among the inverters is not satisfactory.

To overcome above problem a new control technique is proposed. This method contains Second Order General Integrator (SOGI) and virtual output impedance. This method increases the impedance certainly and limits the circulating currents (harmonic currents) in the inverter. The main objective of this project is to limit the circulating currents (harmonic currents) in the inverter and proper power sharing among the inverters in islanded mode by using proposed control techniques.

The proposed method is simulated in MATLAB/SIMULINK environment.

I. INTRODUCTION

This chapter gives brief show of Appropriated Generation (DG), different methods used to generate electrical power and how to utilize DGs, how shielding the islanding of conveyed generation and different kinds of spread generation, benefits of flowed generation and facing technical challenges in scattered generation has gotten a handle on.

Preface to dispersed generation

As of now daily's interconnection of Dispersed Generations (DG) which works in agreed with electrical power association, and is currently changing the standard used to live with. Appropriated generation is gaining generally interest considering regular issues, filling in energy expenses and power plant advancement cost.

Scattered generations are close to nothing and a significant parcel of them use economical power sources like energy units, gas turbines, small scale hydro, wind turbines and electrical phenomenon. Various DGs use power electronic inverters, rather than turning generators. The inverters commonly have speedy current confining capacities for self security, and may not be harmed by out-of-phase reclosing. The operation of conveyed generation will get better the quality power in power system and this interconnection especially with pivot power stream might provoke a couple of issues like voltage and repeat deviation, harmonics, reliability of the power system and islanding phenomenon. Islanding is one of the most technical concerns related with the advancement of flowed generation related with utility associations. Islanding can be

characterized as a circumstance wherein a piece of the utility system contains both load and dispersed generation stays strengthened, even as being isolated from the rest of the utility system. Islanding acknowledgment is necessary component for grid-related not entirely settled in overall necessities and thoughts. Inverters commonly perform current control and fortitude power component and use inert screen for islanding area methods based on secretly assessed limits. Under islanding conditions, the size and repeat of the voltage on the variable at the reason in common coupling will overall float from the assessed grid values as a part of the power lopsidedness. It is prominent that distribution system really does at absolutely no point in the future have any unique power making source and does at absolutely no point in the future secure energy assuming that there should be an event of a shortcoming in transmission line.

However, with doled out appropriated generation this supposition that is at this point not significant. In latest action DG is supposed to separate the utilities from the grid in case of islanding. The hardships about islanding are:

- 1) Protection issues because a piece of the system stays keyed up while it isn't obvious.
- 2) Islanded system might be insufficiently grounded by the DG interconnection.
- 3) Brief reclosing ought to cause out of phase in the device.
- 4) Loss of the board over voltage and repeat within the system.
- 5) Outlandish transient stresses upon reconnection to the grid.
- 6) Awkward confirmation.

The approaches of islanding area are to check the DG output limit for the system and dependent upon the assessments close whether an islanding condition has happened from seeing of these limits. Islanding disclosure techniques can be secluded into remote and neighborhood techniques.

PROPOSED CONCEPT

Prologue TO PROPOSED Idea

A MG might be treated as a low voltage organization of neighborhood Dispersed Energy

Resources (DERs) and nearby loads. The power output of the DERs is controlled by a focal controller or a singular controller. Besides, MGs are typically a limited scale power supply networks with all out introduced limits around a couple hundred kilowatts to few megawatts. The fundamental point of MG is to power a remote spot or a town by using the neighborhood resources accessible, where there is no grid association and furthermore MG can be intended to give uninterruptible high quality power to delicate loads in a specific region. The component that makes MG a special power systems is that, although it very well may be worked in lined up with the grid and it tends to be naturally moved to islanded mode whenever its control systems identifies a shortcoming or unsettling influence in power quality from the grid. When the shortcoming is cleared or the unsettling influence vanishes, the MG can be resynchronized with the fundamental organization. The increment of MGs likewise lessens the load on conventional power generation plants and help in diminishing carbon foot in the climate.

Inverter based MG assumes a basic part in making the system more dependable and more coordinated with different kinds of DERs. A MG with a legitimate control technique can give fitting and play admittance to the Miniature Sources (MS). The block graph of inverter based MG is shown in Fig 4.1. The basic boundaries that are expected to be controlled in a MG are dynamic power dispatch of different miniature sources, power sharing among the inverters, voltages and the recurrence of the system.

MG has to working modes, grid associated mode and the other, islanded mode. When it is associated with grid, control procedure should have the option to make inverters to siphon the set worth of dynamic and responsive powers and here steady current control or PQ control can be carried out. During islanded mode, control technique should control the voltage and recurrence of the MG notwithstanding the dynamic and receptive powers and here p-f and Q-V hang methods track down their application. This hang method is more

reasonable for high and medium voltage grids due to their inductive nature.

For low voltage grids, particularly MGs, where the sources are resistively coupled, control method inverse to conventional hang methods work all the more precisely however there are issues connected with security, and just, voltage control is achieved yet no power dispatch and legitimate control over power sharing among the inverters is mind boggling. To resolve these issue, circuitous operations of conventional hang or virtual impedance circle methods might be utilized.

In this project an original control technique which utilizes virtual impedance circle method and Second Request General Integrator (SOGI) in conjunction with circuitous operation of conventional hang method is proposed.

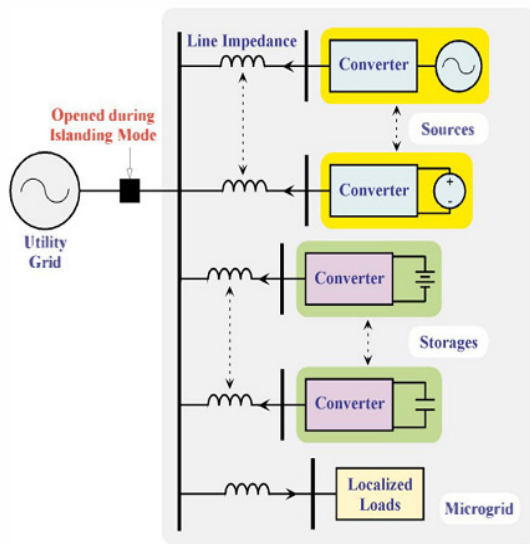


Fig Structure of Micro grid

MG IN GRID CONNECTED MODE

There are different deep rooted control methods to control the inverters in a MG when it is working in grid associated mode [2], [3]. By and large, either of steady current control or PQ control is utilized. These two methods are momentarily made sense of beneath.

In this control method [2], inverters are compelled to infuse steady current output. The block graph of this control is shown in the underneath Fig 4.2. Furthermore, its controller is shown in Fig 4.3.

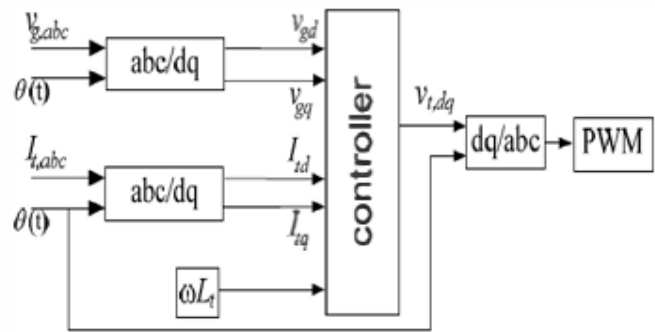


Fig Block diagram of Constant Current Control

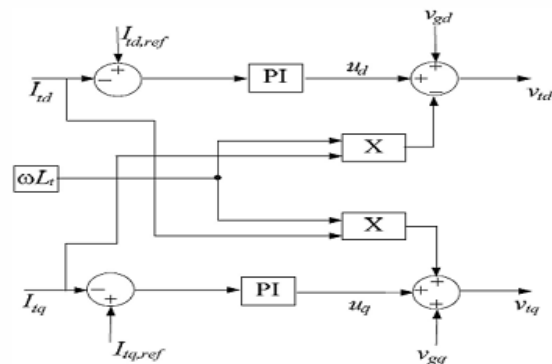


Fig Block diagram of Controller

The steady current control estimates the load voltage V_{gabc} and the inverter current I_{gabc} and moves them to dq outline. The converter amounts I_d and level of intelligence are then contrasted and reference DC amounts $I_{td, ref}$ (dynamic power set point) and $I_{tq, ref}$ (responsive power set highlight) acquire mistake signals. The blunder signals are then applied to Corresponding Fundamental (PI) controllers to address the mistakes and characterized the reference voltage signals V_{td} and V_{tq} . These reference voltages are again changed to three phase amounts and are given to the pulse generator to generate pulses for the inverter.

Generally, this cycle powers the inverter to infuse the characterized currents and simultaneously it directs the voltage at the association point as estimated from the grid side.

PQ Control Method

The block outline of PQ [3] control is shown in Fig 4.4. The control construction of this sort hushes up like the steady current control. The main contrast

between the two controls is the directed boundaries and they reach a similar resolution, which is output power control, in this control type managed boundaries are the dynamic and receptive powers rather than the current.

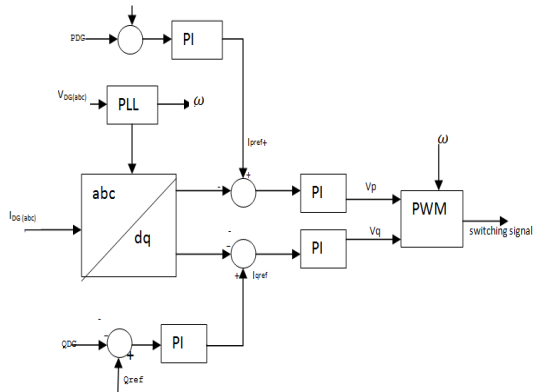


Fig Block diagram of PQ Control

Active and reactive powers are measured at the output terminal of the inverter and then compared with the reference values to obtain the errors. These error signals are then applied to two PI controllers in order to obtain $I_{d,ref}$ and $I_{q,ref}$. The rest of the process is similar to the constant current control technique shown earlier in Fig 4.2 and Fig.

RESULTS & ANALYSIS

This topic describes the Matlab/Simulink results and analysis of micro grid and summary.
MATLAB/SIMULINK RESULTS

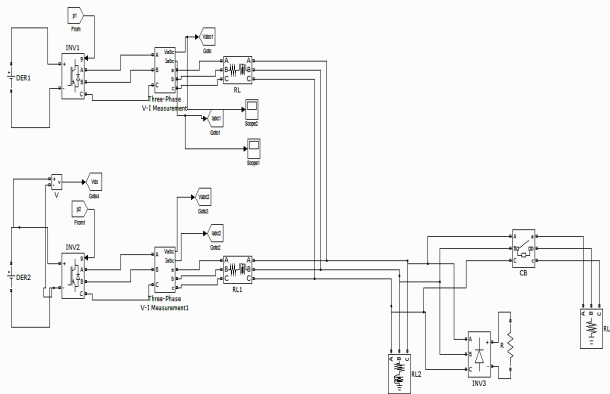


Fig Block diagram of tested micro grid structure in simulink

Fig 5.1 shows that it has two DER units interfaced by two inverters, inverter-1 and inverter-2 respectively and are connected through distribution system. In this system there are two critical loads, in which one is nonlinear load and another one is RL load and there it is a noncritical load, which is on/off with help of through a circuit breaker, which operates based on the situation of micro grid.

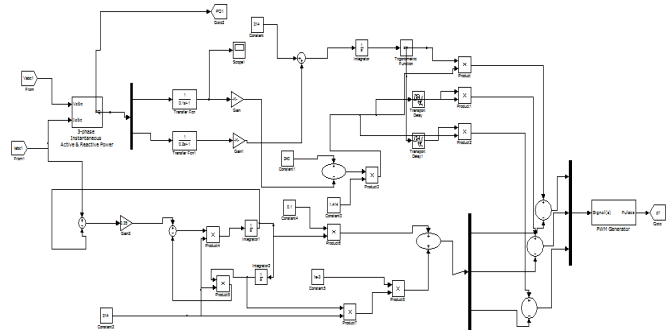


Fig Simulink circuit of the proposed control strategy

Fig 5.2 shows the simulink circuit of the proposed control technique, in this circuit the voltages are given to three phase quick dynamic and responsive power block. This gives the genuine and responsive power, these genuine and receptive powers are changing over completely to voltage and recurrence through change circuit, the voltage is associated with PI controller circuit. This PI controller remedies the mistake signals and will give voltage signals. The voltage signs will be phase shift to 00, 1200, 2400 and these are associated adding circuit and another circuit, voltage is provided to second request general integrator. This output is associated with virtual impedance. This will give the output outcome as three phase voltage signals. These voltage signals are utilized for pulse generation to set off the inverter.

Output results:

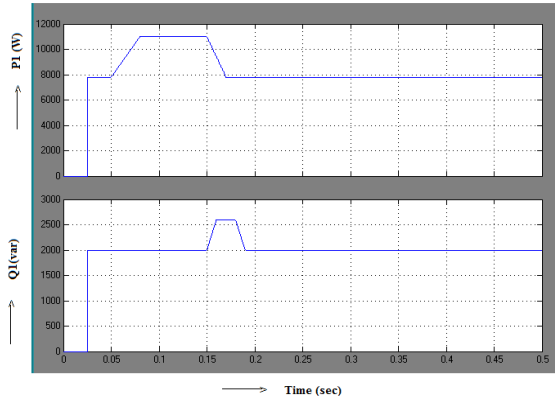


Fig Real & reactive power of the inverter-1

Fig shows the real and reactive power of inverters. When the load is connected between the time 0.5sec to 0.15sec, real power demand is increasing and reactive power is decreasing. When the load is removed the real power is decreasing and reactive power is increasing in the inverter 1.

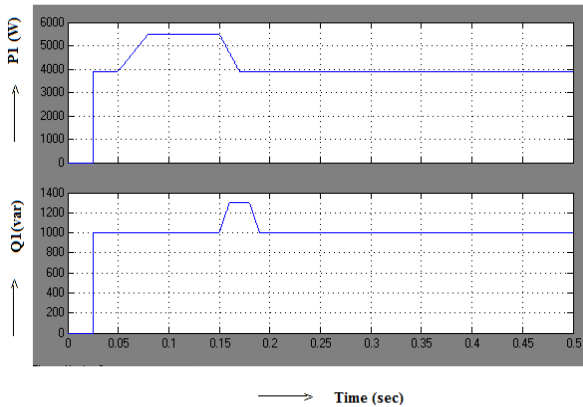


Fig Real & reactive powers of inverter-2

Fig 5.3 shows the real and reactive power of inverters. When the load is connected between the time 0.5sec to 0.15sec, real power demand is increasing and reactive power is decreasing. When the load is removed, the real power is decreasing and reactive power is increasing in the inverter 2. This means proper power sharing between inverter 1 and inverter 2 has done.

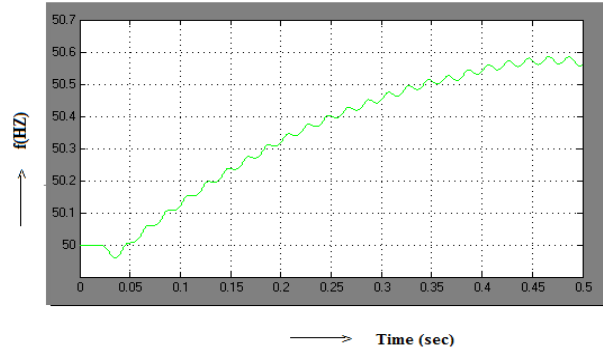


Fig Frequency of the inverters

Fig 5.5 shows the frequency of the inverters; here the inverter frequency is stable in 50.55 Hz.

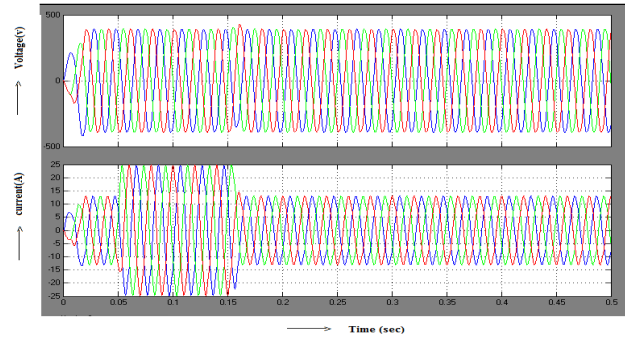


Fig Output voltage & current of inverter-1

Fig 5.6 shows the output result of voltage and current of inverter, where the circuit breaker is closed at the duration of 0.05 sec to 0.15 sec when the load is connected. The inverter current raises to 25 A in inverter 1 and voltage is constant.

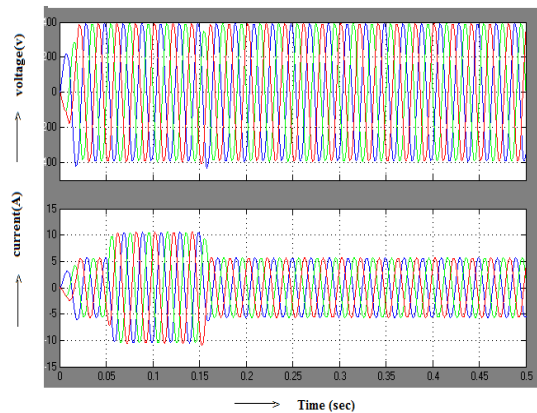


Fig Output voltage & current of inverter-2

Fig 5.7 shows the output result of voltage and current of inverter, where the circuit breaker is closed at the duration of 0.05 sec to 0.15 sec when

the load is connected. The inverter current raises to 10 A in inverter 1 and voltage is constant.

By seeing these results when critical or non critical loads are connected, the inverters share the current properly so that there is no effect on the inverters operation by using the second order general integrator with virtual impedance method. The circulating currents in the inverter 1 and inverter 2 share accordingly. So that the inverters are not affected by the circulating currents and inverters work effectively.

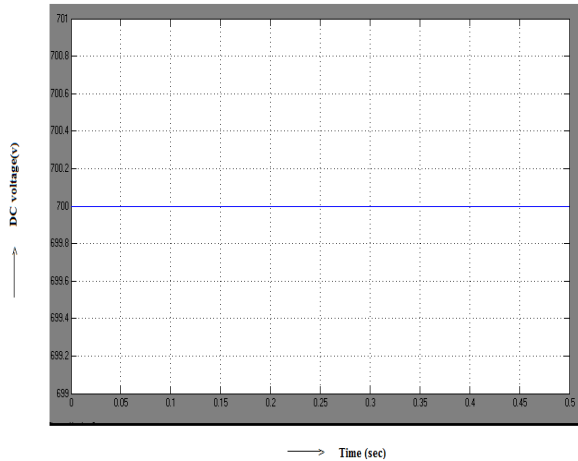


Fig DC bus voltage of the inverters

Fig 5.8 shows dc supply voltage of inverter 1 and inverter 2. The dc input voltage is given to inverters in simulink circuit.

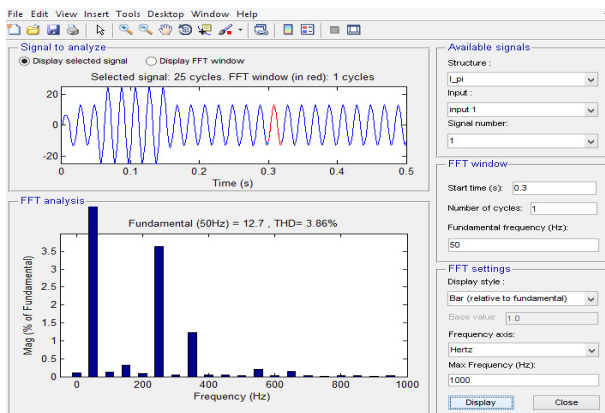


Fig THD analysis results of circulating current

Fig 5.9 shows the total harmonic distortion results of the circulating current. Using the controlling techniques we can limit the circulating currents within the acceptable value.

CONCLUSION

The virtual impedance circle with SOGI control method can successfully enhance the power sharing capacity of inverters and this technique restricts the flowing currents in the inverters actually. This sort of control method can be utilized for the MGs which are situated at country or remote spot.

In future utilizing the fluffy rationale controller the inverters are control the successfully, power sharing and breaking point the circling currents actually, and achieve better complete harmonic distortion.

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