ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijareeie.com

Vol. 7, Issue 7, July 2018

CAN Assisted Grid Synchronization of a Microgrid over Regeneration Energy Sources and Storage

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ABSTRACT: Microgrids are rising as an important constituent of big-scale clever grids. They are geared up with the controls essential for handling the operation in islanded or grid linked mode and serve the hundreds with easy, reliable, and unin-terruptible energy. Microgrid ought to be geared up with a robust grid synchronization (GS) algorithm with a purpose to allow a smooth transfer from islanded mode to grid tied mode. This receives even extra essential when the availability of the strength grid is irregular or the power grid is weak. This paper proposes a easy yet incredibly reliable GS method based on controller place community (CAN) conversation. The grid synchronizer block senses the three phase grid voltages, derives the section perspective (θ) the usage of synchronously rotating reference frame-based segment lock loop, and transmits this facts on the CAN community to all micro-assets (MS). The nearby controller associated with each MS receives the information with small but regarded and exact time latencies. This lets in every MS to energize simultaneously in synchronization with the grid, facilitating easy GS of all of the MS, minimizing the time required for GS of the whole micro grid. All the analytical, simulation, and hardware effects associated with this paper are provided. This new manage concept is validated with good sized MATLAB/Simulink simulation research

KEYWORDS: CAN micro-sources, GS algorithm, and Simulink simulation

I. INTRODUCTION

Micro grids are gaining sizable popularity as they possess all of the vital properties to constitute a primary constructing block of the envisioned smart grid. The damaging effects of high penetration of Renewable Energy Sources (RES) like sun PhotoVoltaic (PV), PEMFC(Proton Exchange Membrane Fuel Cells), wind, and so forth. On the steadiness of the prevailing grid community has been raising a firstrate difficulty. With the appearance of micro grids this trouble has subsided. Micro grids are capable of presenting at ease, uninterrupted, and excessive first-rate strength to the loads while facilitating Smooth integration of the RES. Black-start, Grid Synchronization (GS), balance, safety, and energy control during island mode of operation are a number of the essential troubles [1] with micro grids which are being considerably investigated. The default operating mode of micro grids is the "grid connected mode" in which they're tied up with the principle grid. Micro grids need to trade energy (import or export) with the number one grid that lets in you to balance the technology and nearby load demand. As in line with IEEE-1547-2003, an anti-islanding scheme has to de-energize the assets interior 2 s of the superiority of an islanding event [2]. Whereas as in step with IEEE1547.Four, the micro grid is authorized to maintain operation in island mode to supply uninterrupted power to the nearby masses furnished it meets the important voltage and frequency balance standards [3]. All trough this section, if the grid restores, then it's far relevant to switch again to the grid related mode. In order to transfer between the 2 strolling modes, it's miles vital to offer smooth and brief loose transition so that the hundreds do no longer experience any disturbance. Thus, there is a need to have the micro grid equipped with a robust transition management gadget comprising each islanding and GS schemes. For any smart grid implementation, communique among various automation components is crucial. Power measurement gadgets must speak to real-time manage components throughout the entire electricity technology, transmission and distribution spectrum. All automation additives have to

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connect with higher level Supervisory Control And Data Acquisition (SCADA) structures, and these SCADA systems should hyperlink to one another [10].All of those connections and linkages require open verbal exchange systems, regularly based totally on Ethernet and the Internet, particularly for brand spanking new installations and enhancements to present systems. First, open structures reduce purchase costs because communications hardware and software program primarily based on Ethernet and the Internet are a good deal much less expensive than their proprietary options. Second, set up is eased due to a massive familiarity with these types of systems amongst contractors. Third, present communications infrastructure can be used in many instances, dramatically lowering installation and different related costs [7-10]. Fourth, integration costs for connecting exceptional clever grid components are reduced due to the fact Ethernet used as a commonplace communications hardware protocol.. Fifth and remaining, on-going maintenance and operation costs are decreased because many inside the enterprise are familiar with Ethernet and the Internet [4]. Most of the present North American strength grid operates in a centralized way, with energy flowing from generation facilities to the grid for Transmission and Distribution (T&D) to the cease person. Substations are the brains of T&D systems, and connections among substations and technology centers are often restricted in phrases of bandwidth and actual-time overall performance [5-8]. These constrained connections make it difficult for utilities to balance technology and call for in actual-time, specifically with the arrival of renewable and disbursed power technology. Some renewable normally solar and wind power are difficult to deal with due to their inherent intermittent, unpredictable and broadly various energy output [1]. Distributed power sources are normally small scale strength era facilities, frequently renewable however in different instances conventional resources like fuel turbines and diesel mills. These resources are frequently now not underneath the direct control of the software, and their energy output varies broadly with very little relation to standard call for [10].

II. IMPLEMENTATION

Architecture

CAN is a multi-master serial bus preferred for connecting Electronic Control Units [ECUs] also called nodes. Two or extra nodes are required on the CAN community to talk. The complexity of the node can range from a easy I/O tool as much as an embedded laptop with a CAN interface and sophisticated software. The node can also be a gateway allowing a trendy computer to communicate over a USB or Ethernet port to the gadgets on a CAN community. All nodes are related to each different thru a two wire bus. The wires are a hundred and twenty Ω nominal twisted pair.

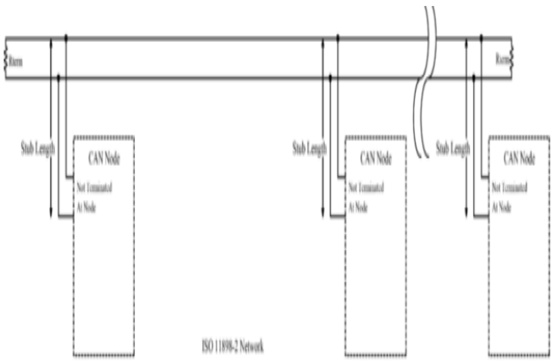

Fig:-1 CAN network

High speed CAN signaling drives the CAN high wire towards 5V and the CAN low wire towards 0V when transmitting a dominant (0), and does not drive either wire when transmitting a recessive (1). The dominant differential voltage is a nominal 2V. The termination resistor passively returns the two wires to a nominal differential voltage of 0V. The dominant common mode voltage must be within 1.5 to 3.5V of common and the recessive common mode voltage must be within +/-12 of common.

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IMPLEMENTATION

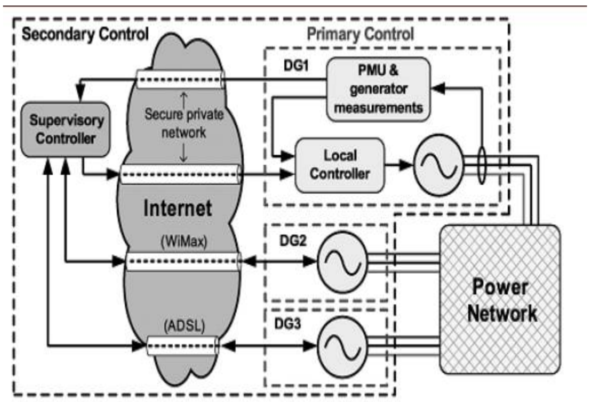

Fig:-2 Power Network

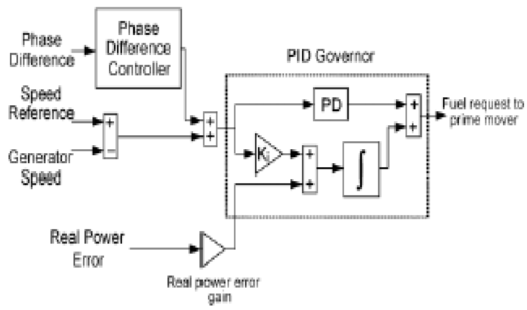

Fig:-3 circuit diagram

Island Control

As there may be massive distance between DG, a appropriate supervisory manage machine is proposed that could function efficiently using IP communications and relatively gradual statistics replace prices, of the order of several seconds.

Multiple-Set Control

In a a couple of-set isochronous frequency or section controlled island, using a single set to carry out the master manipulate is simpler to put into effect than a multiple-set control choice, and does not, to the identical quantity, rely upon communications, ok controller layout and cautious tuning. However, multiple-set manage has a few benefits: greater manage options are to be had, all DG in the island can reply to disturbances as one set or inside the most appropriate manner, following a disturbance all turbines reply to govern phase difference, and following the loss of a generator there could be a quicker go back to strong synchronous islanded operation. In schemes with many DG appearing primary proportional, imperative, by-product (PID) control capabilities, size errors can reason the control structures of each generator to conflict. The solution is an accurate dimension of variables mixed with communications among units. Typically that is to be had for DG in near proximity to one another, in the identical constructing as an instance. A comparable scheme might be carried out the use of modern communications techniques, and a secondary manipulate loop as in to facilitate a couple of-set segment distinction manipulate and cargo sharing.
The controller used at each DG The phase and frequency references are taken from the reference power system, a location on the main network, which may be used to allow synchronous operation of several adjacent islands. Data are collated from all DG at the supervisory controller before the load set-point for each DG is calculated and transmitted

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periodically to the DG. Thus, as well as permitting load sharing, this set-point can prevent control errors causing wind-up in the integral functions of the DG governors.
An enhanced governor with additional control inputs can be used to improve the response. It was shown in that a governor with supplementary inputs [13] could significantly improve the phase control by reducing the frequency deviation.

III. EXPERIMENTAL RESULTS

Simulation results

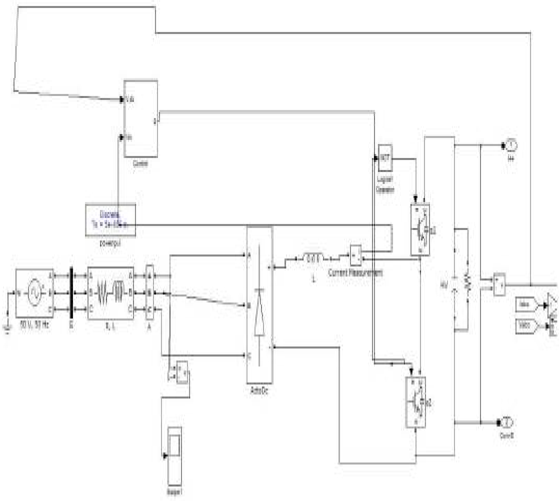

Fig:-4 NM13_2ldctodc

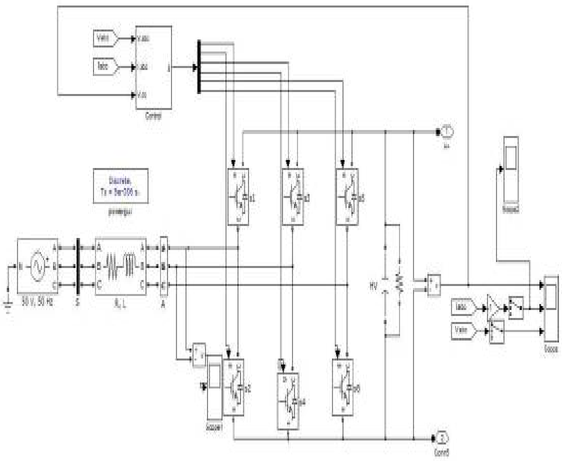

Fig:-5 NM13_2lrectifer_pwmen

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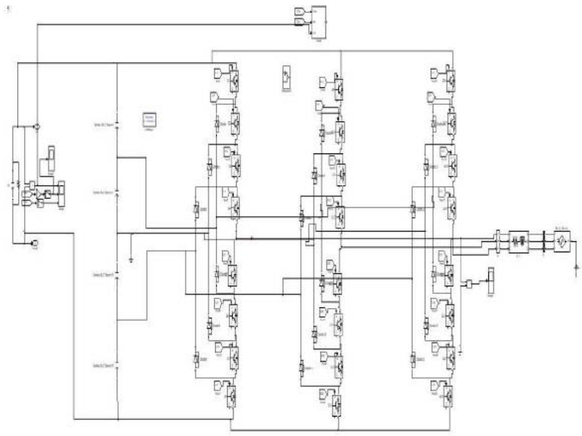

Fig:-6 NM13_3lrectifer_pwmen

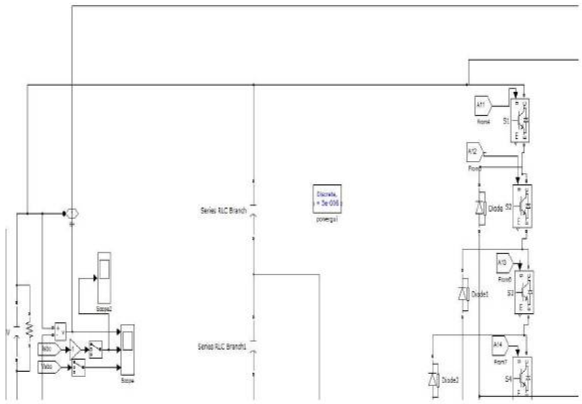

Fig:-7 NM13_5lrectifer_pwmen

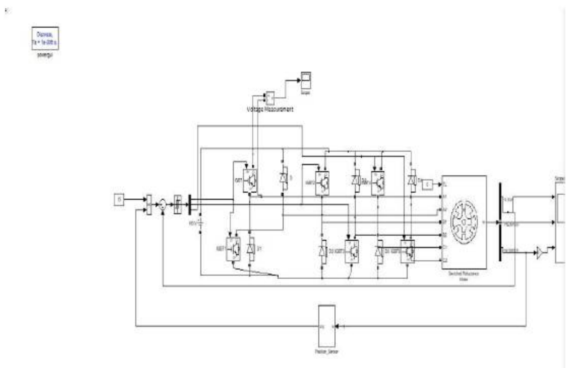

Fig:-8 NM53_WITH HYSTERSIS CONTROL

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Output Wave Forms

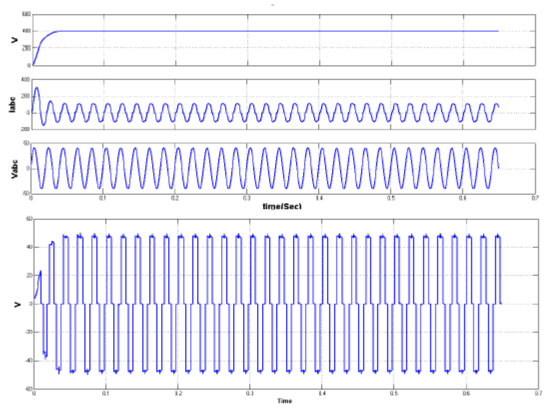


Fig:-9 Simulated output wave form for NM13_2ldctodc

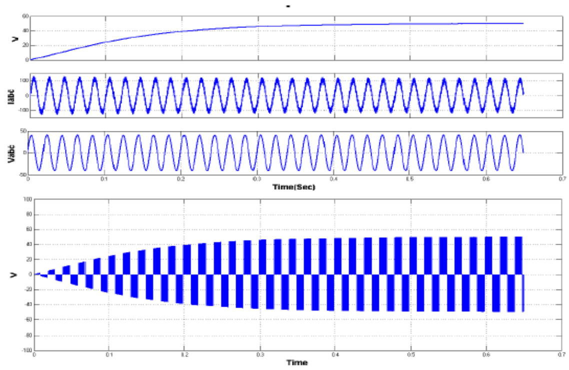
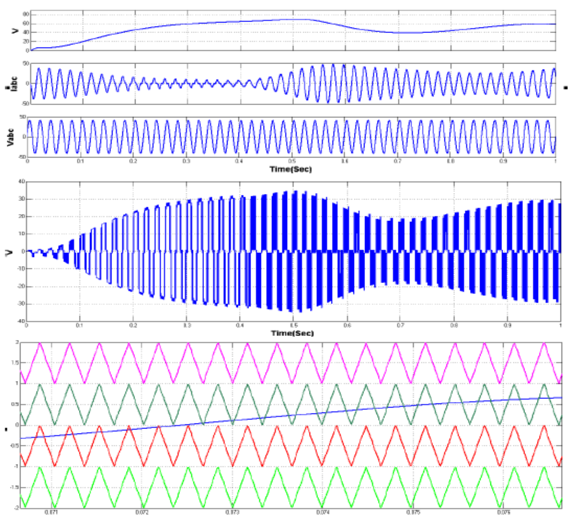


Fig:- 10 Simulated output wave form for NM13_2lrectifer_pwmen



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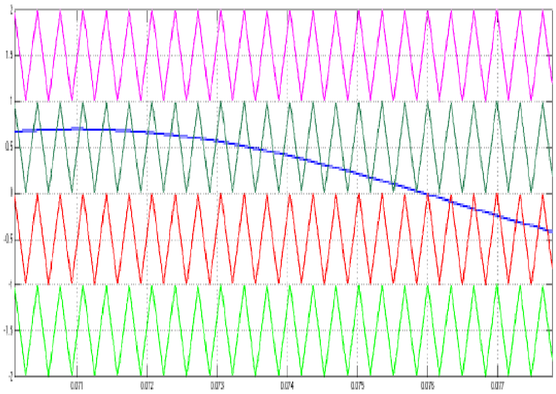

Fig:-11 Simulated output wave form for NM13_3lrectifer_pwmen

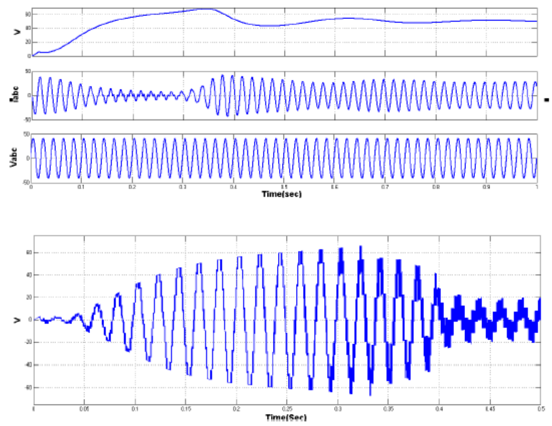

Fig:-12 NM13_5lrectifer_pwmen

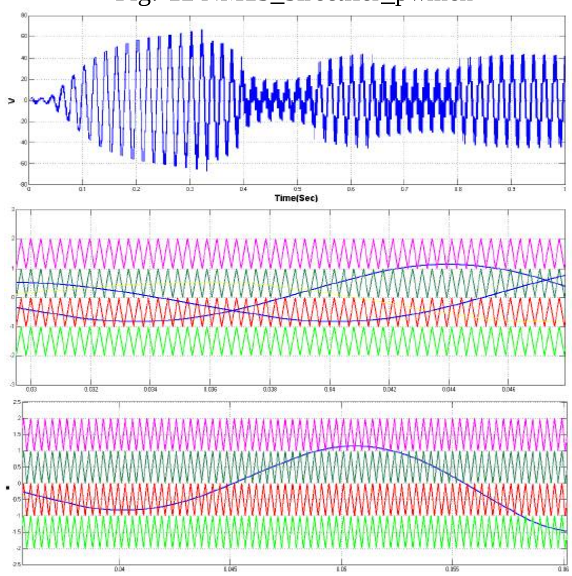

Fig:-13 Simulated output wave form for NM13_5lrectifer_pwmen

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IV. CONCLUSION

The mode transition control of a microgrid, dominated through RES is quiet complicated, especially while transitioning from islanded mode to grid linked mode. The non dispatchable nature of most of the RES makes the project more hard. In order to reduce the transition transients, it's miles vital to synchronize all the MS concurrently with the primary grid. This project has supplied a unique CCAGS scheme for microgrid application. The resultant transients observed during the transition section are very low. CAN communique participates effectively in presenting a fault tolerant, strong mechanism that ensures a easy switch of gadget manipulate from Grid Synchronizer to MMC for gadget management. Existing schemes of CAGS the usage of GPS, NTP, or PLC proposed within the beyond, add to the value of implementation. But CAN being suitable for the general microgrid manipulate operations, this venture shows that its use may be extended similarly to offer a sturdy GS scheme without a additional price.

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