A NOVEL APPROACH TO PARALLELING OF POWER CONVERTER UNITS WITH TRUE REDUNDANCY

F. Petruzziello P. D. Ziogas G. Joos

Department of Electrical and Computer Engineering
Concordia University
Montreal, Quebec, M3G 1M8
Canada

ABSTRACT

The demand for power supplies with expansion capabilities has prompted interest in modular power converters with built-in features for connection in parallel with two or more other units. This paper describes a new scheme which offers to a given unit frequency and phase synchronization with any number of units operating in parallel. The scheme is based on a Master/Slave configuration using a rotating priority window which provides random selection of a new master and therefore results in true redundancy. Compared to conventional methods of paralleling, the scheme requires fewer interconnections between individual units and offers increased reliability. System operation and implementation are described in detail and experimental results are given.

1 INTRODUCTION

In order to increase the power capability with standard power modules, reliable paralleling schemes are required. With the typical methods of implementation, as presented in Fig. 1 and Fig. 2, the operation of the individual units is dependent on the master control signals.[1][2][3][4]

Fig. 1 presents a scheme in which the selected master unit echoes the gating signals to all other units. If the system were comprised of three units, as presented in Fig. 1, the master unit would be required to echo two sets of gating signals. Therefore, with such an implementation the number of interconnections between units can become quite large. Also with such a scheme, if any slave unit were to fail the system would still be operational. A certain degree of redundancy is obtained by adopting this configuration.

Another scheme which also provides a reduced degree of redundancy is presented in Fig. 2. The individual units are arranged in a ring configuration. Consecutive units are used as repeaters for the gating signals generated by the master unit. Therefore the master unit is only required to generate two sets of independent gating signals, no matter how many units are in the ring. This reduces the number of interconnections required between units but in turn the level of redundancy is compromised. Only if the last unit in the ring were to fail would the system still be operational.

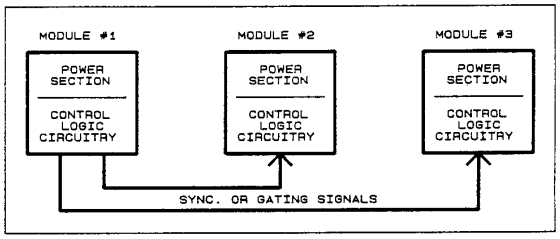

Fig. 1. Typical method of implementation #1 (echoing of gating signal configuration)

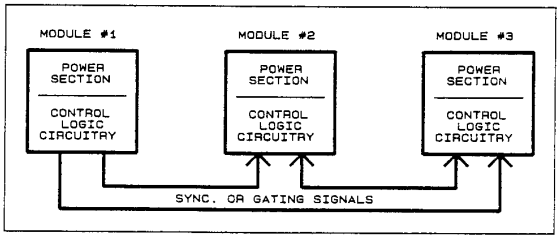

Fig. 2. Typical method of implementation #2 (ring configuration)

One major disadvantage with the above two configurations is that the reliability of the power supply is dictated to a large extent by the reliability of the master unit. If the master unit were to fail, the entire system would shut down. Therefore the level of redundancy provided may be inadequate in demanding situations. This paper proposes a novel Master/Slave configuration which provides increased reliability and, at the same time reduces the number of interconnections required between individual units as compared to the previous two methods.

The implementation of the proposed method is presented in Fig. 3, where each individual module has the capability of becoming a master if required. Each module is equipped with (n-1) inputs and one output, where n denotes the number of modules to be connected in parallel. An encoded

CH2873-8/90/0000-0808 $1.00