

CARL COOPER

P.O. Box 4860
Incline Village, NV, 89450
(775) 831-6123
(775) 831-5305 fax
videoengr@sbcglobal.net

February 14, 2012

Mr. Russ Minick
Executive V.P. Residential Products
Generac Power Systems, Inc.
P.O. Box 8
Waukesha, WI 53187

Via Express Mail EO 908 418 424 US

RE: New Product Inquiry

Dear Mr. Minick,

Please allow me to introduce myself. I am an electrical engineer and have worked as an inventor for several decades. I believe one of my inventions would generate excellent sales with your company and I would like to explore potential opportunities with you in that respect.

While in the process of addressing some backup power issues with my home I discovered some problems which appear to me to be fairly common in residential and small business applications. As you are well aware there is little need, and less customer interest in paying for, a backup generator large enough to service the potential maximum load which the residence or business site can present to the grid. Accordingly a generator which is much smaller than one which has that maximum capability can be utilized if overloading that smaller generator can be prevented. This is a problem which Generac partially solves with its Nexus Smart Switch and DLM Module series of products.

As you are also likely aware Generac's Nexus and DLM products offer some guarantee of protection against long term overloading of a backup generator, but they do so by less than ideal backup protection. As just one example, waiting until the generator is overloaded to the point of slowing down and then disconnecting a load is undesirable as it causes significant power frequency variations. If the threshold speed for disconnecting the load is adjusted to a relatively small power frequency change then false tripping is a problem. I believe my invention provides quite significant improvement in performance.

February 14, 2012

I have attached a summary of my invention for your review. Please take a look, discuss with your sales people and let me know if Generac has any interest in marketing such a product line. I can be reached at the phone number or email address above.

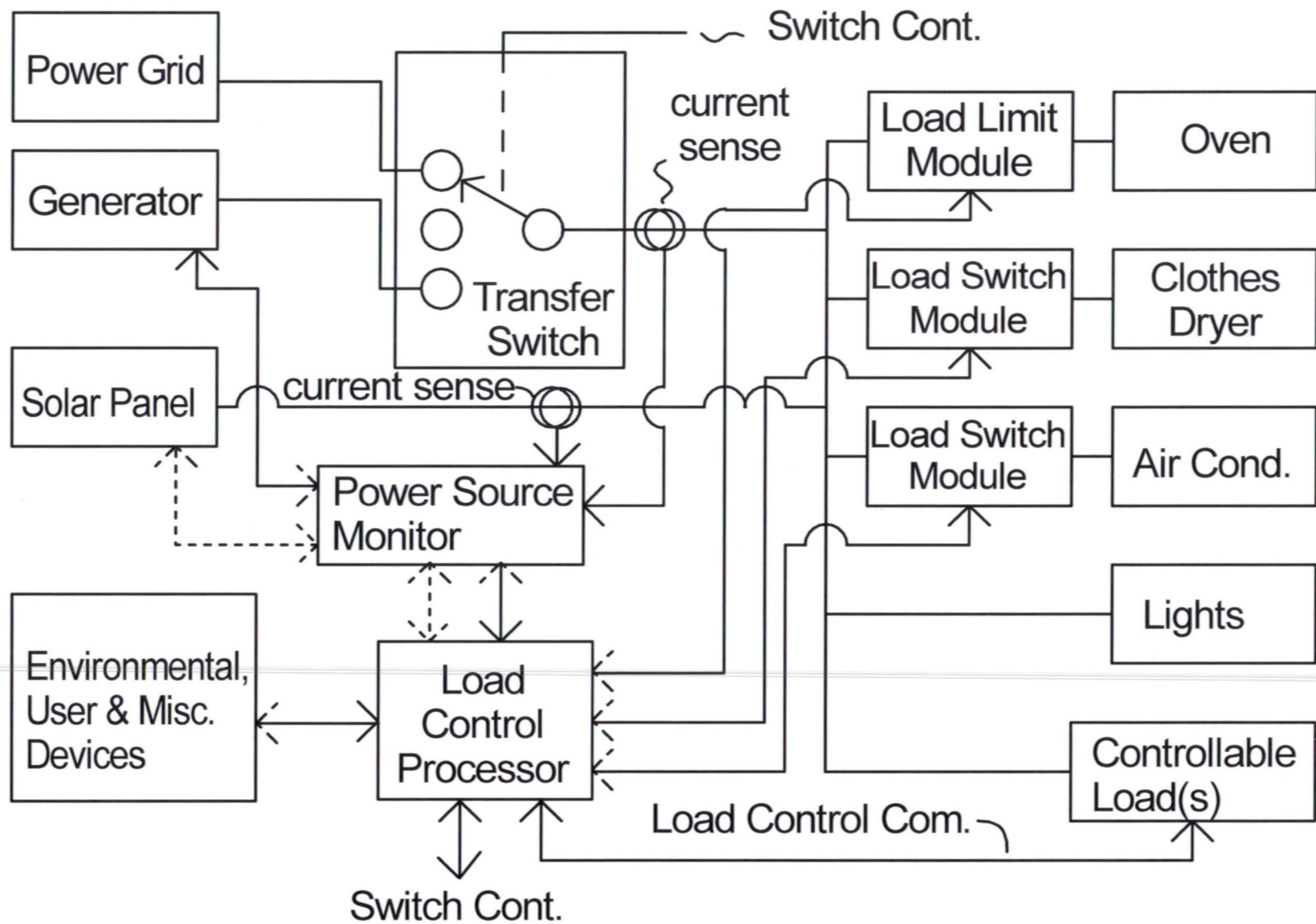
Thank you very much for your time.

Sincerely,

A handwritten signature in dark ink, appearing to read 'Carl Cooper', with a long horizontal flourish extending to the right.

Carl Cooper

Enc. Load Control Description



Load Control System

J. Carl Cooper
Feb. 1, 2012

Load Control Description

Feb. 1, 2012, J. Carl Cooper

(775) 831-6123

videoengr@sbcglobal.net

This document is an overview background and description of a non-confidential but proprietary product design and is made available solely in respect to discussing potential business relationships pertaining thereto and should not be considered to be any transfer or release of any intellectual property rights related to the product or its capabilities.

In small backup power systems such as those used in a home it is often desirable to utilize a generator which is only capable of providing power for part of the maximum possible load which can be presented. Obviously some mechanism for limiting the load presented to the generator is necessary to prevent overload. With current technology this limit is usually hard wired, that is, only certain higher priority loads are connected to the backup generator and those lower priority loads which are not connected simply go without power. In other systems certain lower priority loads are connected but are immediately disconnected after the generator is overloaded. The detection of overload in such systems is performed by detecting the frequency of the AC power and in particular detecting when the frequency drops below a preset limit. This frequency drop corresponds to the engine of the generator being unable to maintain full speed because of the overload. Neither of these systems is capable of a high degree of utilization of the power available from the generator, in the first low priority loads are never powered and in the second a low priority load may be powered part of the time but when it is disconnected after an overload it will not be reconnected until after a time delay which is unrelated to the generator's ability to power that load at that later time.

Recognizing the above faults, an improved Load Control system and its devices have been designed. As part of controlling the load presented to the generator it is desirable to connect some or all loads according to a priority. It is also preferred to alert the home owner that power is not available to power one or more particular device(s) and allow the home owner to decide what to turn off (or leave off) in order to have the device (and possibly several others) turned off shortly after it is turned on. If loads are available that may but do not need to be connected and operated, it may be desirable to wait and operate them when the generator is operating well below its optimum capacity or efficiency. By waiting an increase in the efficiency of the operation is achieved with the added benefit of avoiding having to disconnect loads when the generator is operating at or somewhat below its maximum capability when an unexpected additional load is applied. Thus different modes of operation may be assigned to the backup system by the user with the user selecting priority of connection of the loads and the system

automatically connecting and disconnecting loads to best achieve the priority based modes of operation. Very importantly, the priority may be changed by the user if needed. For example to cook a meal which has already been started when the grid power goes off. The load priority may be changed automatically in response to environmental or other conditions. For example lights are more important at night than in the daytime and heating is more important when it is cold outside than when it is hot.

Short term large loads may be allowed in that many engine driven alternator systems are designed to permit short term increases in power output above the maximum power that can be continuously delivered. An overload can cause a departure from specifications for the power output from the generator such as a deviation of AC power voltage or frequency for longer than a specified time period, a loss of power such as from a tripped circuit breaker, or damage such as overheating or exceeding mechanical stress limits. A small deviation in power frequency may be acceptable but tripping a breaker usually is not. With the present Load Control system the home owner can decide which overloads are permissible and which are not and the system will then automatically prevent an undesired overload from happening (as compared to ending an overload after it has happened) and reduce or eliminate the risk of unwanted total loss of power to one or more loads.

Decisions can also be aimed at efficiency. One substantial consideration which can be utilized is the cost of providing power from the grid vs. cost from the generator. If power can be obtained from the electric utility or elsewhere at lower cost during certain times, for example during the night, the Load Control can be utilized to control loads in a manner to best take advantage of the lower cost power. This can be done while still ensuring that the devices presenting the loads are available for use at other times if needed. Such use can include the device's intended function or use by a home owner, or as a load to improve generator efficiency. For example a battery charger for charging an electric or hybrid vehicle can charge the battery to a given level such as half full, immediately upon being connected. This will ensure the vehicle is quickly available for use. The remainder of the charging from half to full charge can be delayed until lower price electricity is available. The delay of the remaining charge can also be used to boost an under-utilized generator such as a backup generator closer to its optimum output for improved efficiency.

Most backup generators are controlled in order that they are operated periodically, with or without a load, for example 30 minutes every week. This helps to keep fluids circulating, bearings lubricated, moisture dried, etc. to improve reliability. The delay of operating a load can be coordinated with exercising or maintenance of the generator to provide a load for exercising without wasting power. A load such as a vehicle battery charger can be delayed until an

upcoming scheduled exercising at which time the battery is charged. Alternatively the battery can be charged at a convenient time by rescheduling the exercising.

The Load Control can also be configured to allow selection of a power generator to power one or more loads from among a plurality of available power sources, for example a load can be powered from a low cost source such as photovoltaic solar cell panels, a wind turbine, fuel cell or powered from the utility company power if there is insufficient sun and wind or if more power is needed than the solar panel, wind turbine and/or fuel cell can provide. The Load Control allows efficient matching of a total load made up of individual loads to one or more power sources without overloading the power sources. The Load Control will allow sizing of generators to accommodate less than the maximum possible load and can prevent overloading of the generator by preventing a load from being connected which would otherwise immediately cause an overload, or lead to a future overload, as a result of being connected. The operation, and in particular the prevention of overloads, is achieved by the intelligent connection and disconnection of individual loads as well as the control of the load presented by connected individual loads.

Most commercially available generators are well characterized for operations under various conditions and the maximum available output power is known for any particular set of such conditions. The Load Control may sense one or more of the various conditions which affect that maximum available output power and use those conditions along with the characterization of the generator to determine precisely what that maximum available short and long term available output power is at a given time. For example a load may be permissible for a short duration but not for a long duration because the generator's cooling system is not capable of proper cooling for the long term load. The size of an impermissible long term load will likely change with changes in the ambient temperature. With this information the Load Control can select loads to be connected to the generator to power the maximum number of desired loads and/or to operate nearer to maximum generator output or achieve optimum efficiency while at the same time ensuring that the generator will not be overloaded instantly or during the duration of any particular load connection.

The Load Control utilizes intelligent timing for connecting and disconnecting loads to one or more power sources in order that the total load on any one power source is kept at or below the maximum output capability of that source, or alternatively at or near an optimum efficiency level, which may be at or below the maximum capability. The decision making process used by the Load Control for connecting a particular load to the generator is responsive to the capability of the source and the type of load to be connected, the priority or importance of the load to be connected, the timeliness of the load connection, environmental parameters which affect the

power source and load and the input of one or more persons desiring to use devices presenting particular loads.

The system which achieves the performance described above consists of a controller module and individual sensing and control modules which communicate with the control module. A simplified version of the system is shown in the attached drawing showing a typical installation having the following components.

Power Grid. The utility power grid which is subject to loss of power or power fluctuations (e.g. brownouts) and supplies power where the cost of the power varies from time to time.

Generator. A backup generator which may be started by the load control or otherwise when needed, typically an engine driven alternator.

Solar Panel. A solar panel which may be utilized to convert sunlight to cheap power for the various loads via controlled connection to the output of the transfer switch (e.g. a local power buss).

Environmental, User & Misc. Devices. User interface, e.g. an iPad or computer type display with interactive software, Environmental Sensors e.g. for home & outdoor such as temperature, sunlight, humidity, wind, generator operating conditions, Misc. Devices e.g. vehicle battery charger and battery, communications (e.g. telephone, internet, wireless).

Transfer Switch. A typical transfer switch or an improved version having multiple throws and an off selection where neither the power grid or any generator is connected.

Power Source Monitor and Load Control Processor. The Power Source Monitor is preferred to be a separate module because of its need to monitor the power source(s) outside the home but may be part of the Load Control Processor. The Power Source Monitor may be installed at the backup power source and monitors its operating parameters and conditions which may affect its operation, for example such as ambient temperature. The Load Control Processor is the computing unit of the system and may be part of the user interface (e.g. iPad) which is preferred to be located in the home but may also be part of other equipment. The Load Control Processor receives information about the various components of the system, receives user input, inputs from various monitors and sensors (including a time clock) and controls the Transfer Switch, Generator and Loads according to various pre-programmed parameters and those inputs.

Load Modules. Modules which communicate with the Load Control Processor and which may provide information about the load, the load's environment and/or operate to permit control of the load. Load Modules include Load Limit Modules and Load Switch Modules.

Load Limit Module. Load limit modules limit the load presented by various devices by e.g. current limiting, power factor adjustment and/or time modulation of current. Load Limit Modules may include load condition sensors such as voltage, current and power factor sensors and the type of load operation for communication to the Load Control Processor.

Load Switch Module. Load Switch Modules switch power to loads on and off. Load Switch Modules may include load condition sensors such as current sensors and the type of load operation for communication to the Load Control Processor.

Controllable Load(s). These are loads which may be controlled directly without the need for a Load Module. Examples include electronically controlled devices such as heating and air conditioning systems, vehicle battery chargers, light dimmers and internet and wirelessly controlled appliances.

The communications between the various system components may be wired or wireless but for ease of installation are preferred to be via bidirectional wireless data links, for example such as via IEEE Std. 802.1X. For those elements which communicate in one direction the associated receiver or transmitter circuitry may be omitted.

At installation each device is mounted and connected at its location such as the Power Source Monitor being connected to the Generator at the Generator and Load Modules being connected either at the load or at the breaker location for the load. When the system is connected the installer programs the load type and load specific parameters for each load, and power source type and source specific parameters for each power source. For example if a 30 Kw Generator is installed the information about its maximum current output vs. internal (and/or ambient) temperature curve and allowed frequency variation is programmed in the Load Control Processor. Similarly for an air conditioner the starting and running currents vs. outdoor and indoor temperatures, as well as the head pressure bleed time are programmed.

Priorities for various environmental conditions are also programmed. For example an electric oven will receive a high priority if it is already in use when grid power fails, the assumption being that it is being used to prepare food. The environmental conditions for the oven may be obtained by the Load Limit or Load Switch Module directly from the oven's operating system, or inferred by measuring its current draw, or the Load Control Processor may communicate directly with the oven. As an example if the current is very low it may be assumed the oven is not being used, and if the current is a first amount it may be assumed the oven is being used for baking and if it is a second, higher amount it may be assumed the oven is in a self-cleaning mode. The installer can then assign a priority for baking and possibly a second priority for self-cleaning. Alternatively the installer can simply identify the Load Limit Module as being connected to control an oven and the Load Control Processor can learn about the oven

operation by monitoring current demand information provided from the Load Limit Module and comparing that demand against a set of preprogrammed generic or brand specific oven characteristics.

In operation the Load Control Processor operates to intelligently manage loads in response to the inputs from its various sensors in further response to the home owner's inputs and its previous programming. When Grid power is available the Processor mainly operates to minimize power costs, such as by controlling the timing of connection of high current devices such as vehicle battery chargers to operate during the time of lowest power cost while still maintaining adequate battery charge for expected and unexpected usage. When power from the Grid fails the Load Control Processor operates to start the generator (or ensure the generator is running) and then connects and disconnect loads according to priority, inputs and programming while at the same time ensuring that connecting a load will not overload the generator. It is preferred that at all times the home owner has the opportunity to interact with the Load Control Processor in order to facilitate any out of the ordinary power needs the home owner may want. For example the home owner may choose to turn off an air conditioner or vehicle charger for 30 minutes in order to allow normally low priority clothes dryer to be used. As another example the home owner may want to limit the current supplied to an oven (causing the heating element to be on for longer periods of time) to allow an air conditioner to be used.

Printed Domestic Labels

Transaction #: 223130698

Charged to: VISA *****8228

Labels Included: 1

Print Date/Time: 2/14/12 3:16:41 PM CST

	Delivery Address	Package Info	Service	Price
1 of 1	RUSS MINICK, V.P. GENERAC POWER SYSTEM PO BOX 8 WAUKESHA, WI 53187-0008	Ship Date: 02/14/12 Value: \$100.00 Weight: 0lbs 3oz From: 89451	Express Mail Flat Rate Env Signature Required Label Total	\$17.75 \$17.75

Express Mail® Label Number: **EO 908 418 424 US****Domestic Order Total: \$17.75**