



## Technical Note

**Primus Wind Power** Engineering Department – Lakewood, CO

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Re: Lithium Ion Battery Integration with AIR Wind Turbines

The AIR Family of off grid, battery charging micro turbines are horizontal axis, upwind turbines designed for DC applications. AIR turbines are voltage specific (12/24/48V) and must be connected to a battery for the turbine to operate and charge with direct current (e.g. - DC). If the battery is disconnected, the turbine will exhibit open circuit behavior, which is characterized with repeated spin acceleration and shut down of the turbine provided sufficient wind resource. This condition will not damage the turbine if left for a short period of time, but the turbine must be shut down (in particular during strong winds) using a Stop Switch if no battery connection is present for a longer period of 24 hours or more. Shutting down the turbine during extended periods of time where there is no battery connection will prevent unnecessary mechanical and electrical wear on the turbine and specifically the electrical circuit board. The failure to properly shut down the turbine during extended periods of time where there is no battery connection will void the 5-year limited warranty on the circuit board.

Most Lithium Ion battery systems use a BMS (battery management system) to control the operation, safety and function of the battery. The BMS is designed to disconnect the battery when it detects a problem of over voltage (typically from overcharge with a normal threshold of 15.6-16.5 volts for a 12V battery). This BMS disconnect can occur in under voltage situations as well (typically from overload or undercharge with a normal threshold of 8-9 volts). Over temperature can also be a factor (typically from an overcharge or overload at high temperatures with a normal threshold of 170F degrees to 180F degrees internal temperature) that will cause a BMS disconnect. These situations causing a BMS disconnect are unusual and if the balance of system components are properly installed, it should not occur often, if at all. However, if Lithium-Ion batteries are to be used with the AIR turbine, then the BMS and battery bank that is used must be sufficiently sized and operated to handle the various over-voltage, under-voltage and over-temperature environments that can be created. Furthermore, the AIR turbine must be installed with the Stop Switch that is included with all Marine AIR units or that can be purchased as a Wind Control Panel or single Stop Switch for land applications (see reference page). Once installed, and if a disconnection between the BMS and the AIR turbine occurs, then this Stop Switch must be manually toggled to the STOP/OFF position. This will avoid the open circuit issues from either BMS disconnection (as described above) or other conditions such as an open circuit breaker/fuse or a poor/loose wire connection. **WARNING** - if each of these requirements and precautions for use of Lithium-Ion batteries with the AIR turbine are not observed and performed, damage will occur to the Lithium Ion battery and/or AIR turbine, including its circuit board. When the battery connection is re-established, you must then toggle the switch back to RUN and the AIR turbine will automatically restart and begin normal operation.

When using Lithium Ion batteries, Primus Wind Power requires that a minimum 300 amp per hour battery bank be connected to the wind turbine. Smaller battery banks may damage the battery due to potential high output voltage of the turbine in 30+ MPH winds or turbulent wind. **Warning** - installation and use of the required minimum battery bank and BMS is essential for safe operation of the system.

Questions on this Technical Note should be directed to Primus Wind Power Technical Support at:

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