

GALE Wind Inverters



Gale Wind Inverters Versus Solar Inverters

Diversified Technology, Inc.'s Gale Series of wind turbine inverters are variable input voltage and frequency, high power inverters developed specifically to serve the wind power market. When combined with a tower-mount wind turbine, Gale Series inverters take the variable electric power generated and create pure sine, clean filtered power that can be sold to the utility. DTI designed its Gale Series to comply with standards set for grid-tied operation, safety and electromagnetic compatibility including: UL 1741 and CSA C22.2 No. 107.1-01.

Many so called "wind inverters" on the market were designed as solar inverters and their application for wind power is an after thought. DTI's Gale Series was designed from the beginning to meet the specific needs of the wind power market including many features that either can not be implemented on a solar inverter or require additional, complicated external circuitry.



DTI's Green Power Technology for Wind Inverters

Built-in rectification and DC boost circuitry

The Gale inverters accept 3-phase variable AC directly from the wind generator and do not require an external input conditioner or DC rectifier.

Once the input is rectified in the Gale inverter, it is conditioned in a boost circuit that increases the DC voltage high enough for the output to be shaped into a smooth sine wave to match the grid voltage. This allows the inverter to export power from a very low input voltage.

Wide input voltage range

The Gale-12 can operate from 30VAC input up to 400VAC input and the Gale-6 operates up to 470VAC input. This high input voltage means that the braking or external dump loads to dissipate excess input power isn't needed.

This very low input voltage allows the inverter to begin exporting power in very light wind conditions. Usually the programmable cut-in voltage is set to 60VAC and the cut-out voltage is set to 30VAC. This is to allow some hysteresis so that when the inverter starts pulling current from the generator and the input voltage drops, it does not instantly go below the cut-out voltage and start an oscillation.

Input over voltage protection

Gale inverters sense the input voltage and automatically disconnect from the input to protect themselves if exposed to an over voltage condition. External input overvoltage protection is required for solar inverters that were not designed for quickly changing and extreme wind conditions.

In many cases the Gale inverter will not trip off even at its rated maximum input voltage. The inverter actually senses several internal voltages and currents to determine if it needs to trip off for self preservation. The amplitude and time of the over voltage event as well as thermal and output conditions will affect how much overvoltage the inverter will accept. The Gale inverter works hard to produce every watt it can for you during the most profitable weather conditions.

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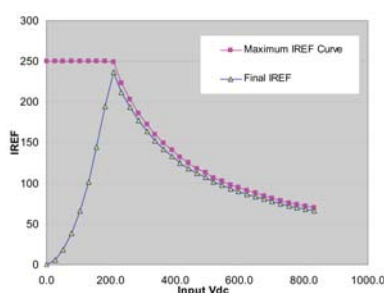
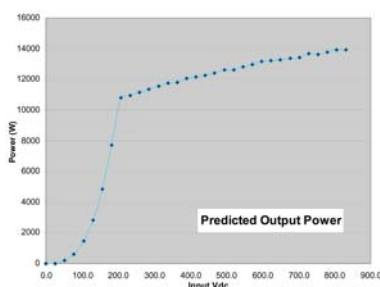
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Initialization and pre-charge from the grid

The inverter will initialize and sync to the grid after a five minute countdown from when the grid is connected. Then it will sit in a low power “waiting for wind” state ready to start exporting power almost instantly as soon as there is enough input voltage. Some solar inverters power their control electronics from the input. They will not start their initialization process until there is a considerable amount of input power. This may take several minutes. Sleeping this way makes sense for a solar inverter not to use power until the sun comes up. But for a wind application, by the time they are up and ready to export power to the grid, the wind gust may have stopped. The wind can gust any time of day, so you want your inverter to be ready for it.

Power curve

For solar panels, **maximum power point tracking (MPPT)** is the automatic adjustment of inverter input load to achieve the greatest possible power harvest, during variations of light level, shading, temperature, and photovoltaic module characteristics. Compared to changes in wind speed, solar input variations occur gradually. For wind applications, MPPT is useless because by the time the inverter adjusts to a given input condition it will have changed. Some solar inverters allow this feature to be turned off and operate in “constant voltage mode” but this is not ideal either since turbines have their own “power curve” that relates wind powered turbine torque to inverter loading. If the inverter puts too much load on the turbine the blades can stall. If it puts too little load on the turbine, energy is wasted. DTI's Gale inverters have a 32 point power curve table that can be configured for each turbine model. It relates the voltage of the input to the current drawn into the inverter. The Gale inverter can efficiently react almost instantaneously to rapidly changing input conditions.

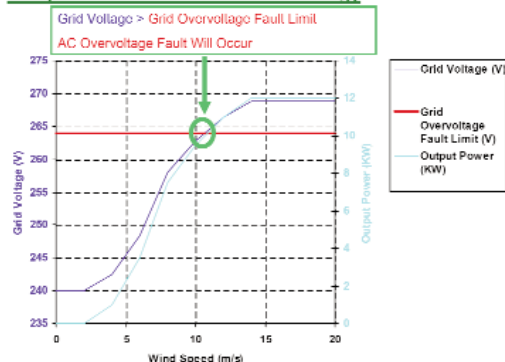


Graphs from the DTI power curve calculator tool

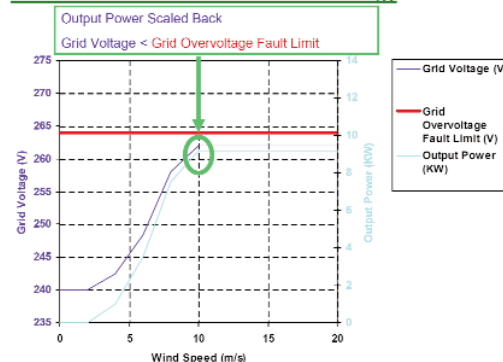
Soft Grid

DTI's Soft Grid Technology allows the inverter to continue to produce the maximum amount of power even during wind gusts that would otherwise cause over voltage on the grid. This is useful in rural locations during light local grid loading conditions. This maximizes profits for the operator while preventing annoying system resets.

Competitor without Soft Grid Technology



DTI's GALE Series with Soft Grid Technology



Thermal Throttling

While Gale inverters are rated for continuous full power operation up to 45°C (113°F), they are capable of surviving and producing reduced power up to 60°C (140°F). They include built-in thermal sensing, and will reduce output power or shutdown automatically if temperatures exceed safe operating conditions.

Fuses

Gale inverters are protected on their output grid connection with internal high speed fuses, with fuses on the input as well for the Gale-6. Because these fuses are included in the inverter, they are not required in an external box. Lower cost disconnect switches are still needed at the turbine and the distribution panel. Gale inverters monitor current on their input and output connections and will open their input and output contactors, which prevents the fuse from blowing in most cases.