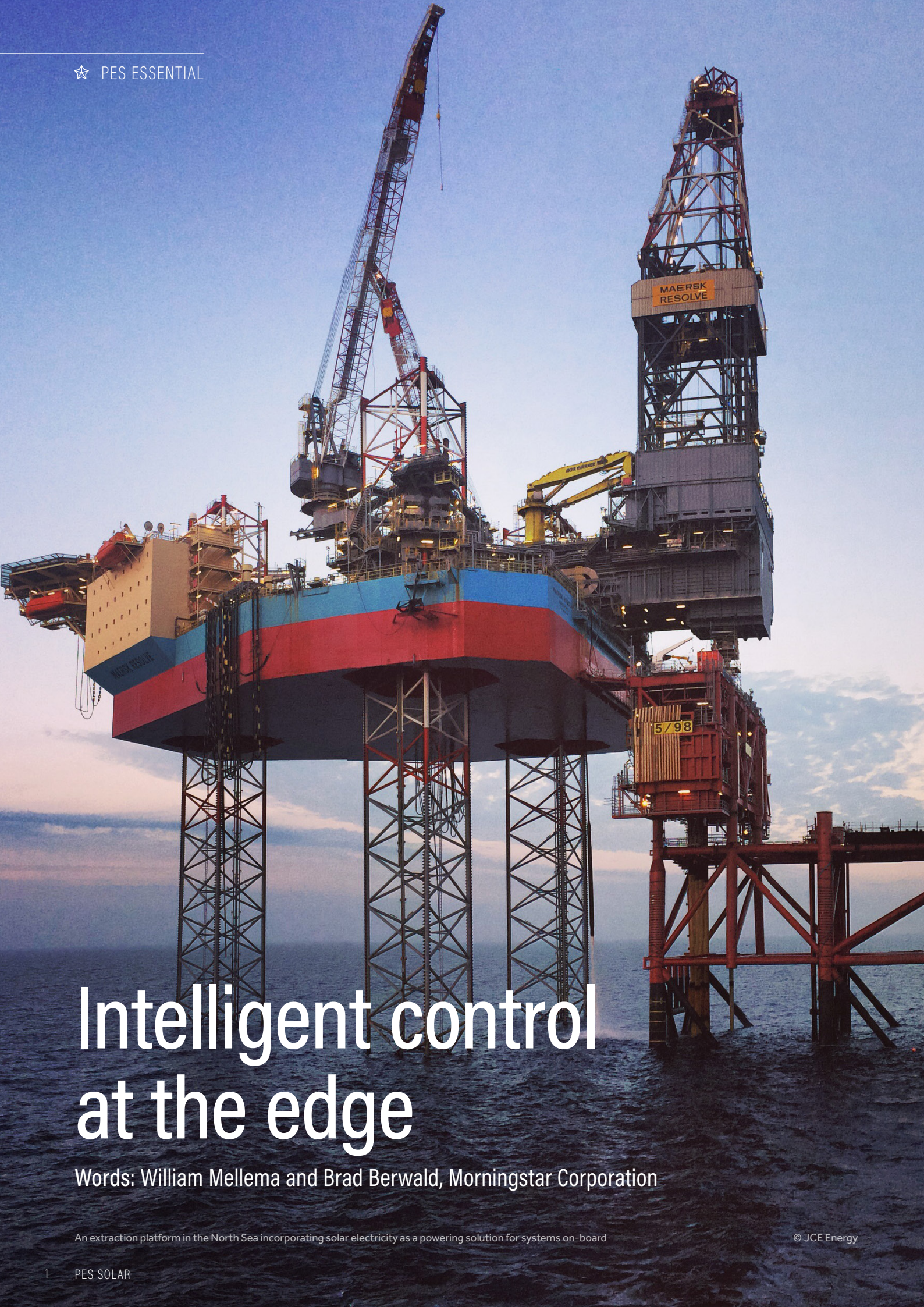


Intelligent control at the edge

Words: William Mellema and Brad Berwald, Morningstar Corporation

An extraction platform in the North Sea incorporating solar electricity as a powering solution for systems on-board

Managing remote power systems is a challenge, but an increasingly necessary one. Fortunately, there are new hardware and software technologies emerging that will allow solar electric system optimization in the field while reducing downtime, without being on-site.

The past decade has seen tremendous growth in solar electric systems being used to power remote applications and systems. One example is in the oil and gas extraction industry, where a global network of well over three million miles of pipelines and 65,000+ extraction sites, with over 9,000 of them off-shore, means that the vast majority of operations are far from any electrical grid.

Expanding the solar frontier

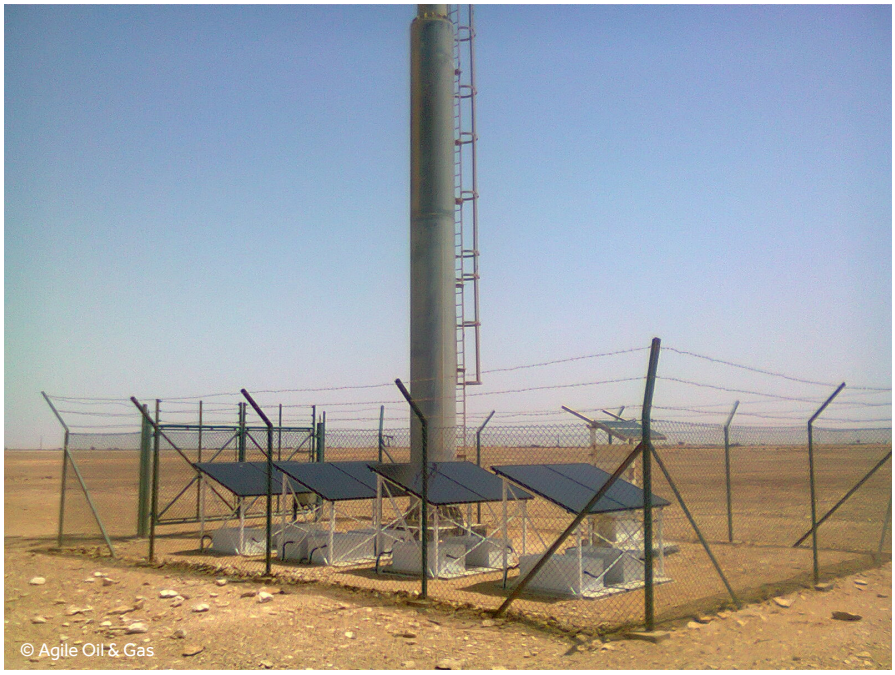
Yet today's critical 'digital oilfield' technologies and systems found along those pipelines and at these sites all have one thing in common: they require electricity to function. Solar electric modules are growing like weeds along pipelines for that reason.

Another prime example is telecommunications. In the developed world, vital tower repeater networks are often in remote, relatively inaccessible locations. And in the developing world, the need for rapidly-expanding telecom services is creating networks that are bypassing the 'copper wire stage' and resulting in an explosion of wireless internet service providers (WISPs) relying on many thousands of small, remote systems to meet the demand for connectivity.

The case for smarter solar devices and systems

The development of modern and hybrid powering systems that are reliable, effective, efficient and more affordable has firmly established solar as a most valuable player (MVP) with these and other rapidly expanding industrial applications. As these solar electric remote powering solutions are pushed further into more remote, inaccessible and often environmentally-hostile locations, it is creating the need for power conversion and control devices that can make decisions independently, manage system dynamics autonomously, and take action when necessary, to minimize down-time and interruptions along with sometimes very costly service calls

More recently, remote industrial system designers are able to work from an energy palate that includes solar, fuel cells, gensets, and other auxiliary off-grid charging sources, and sometimes even leverage grid power if available, to work in tandem with them. The typical powering system schemes that resulted usually consisted of discrete components wired together to



A solar-powered desert extraction site

A scalable telecommunications system in Latin America

A solar powered wireless internet service provider installation

meet the requirements, which added a lot of complexity with the potential for miscommunication and outright failure. Connectivity and communication between components were often poor or even non-existent. And collecting all the system information necessary to ensure smooth operation was difficult and clumsy, because it was beyond the means of any one user interface or software tool for more seamless operability.

Solar takes an integrated approach

The next step is developing charging and control components that integrate all vital functions into one platform, providing single-point access for both real-time and logged system data as well as system control. The ideal product would enable on-site access using mobile apps or a state-of-the-art web app, and provide remote access through Ethernet integration and accommodate control/communication protocols such as SNMP and SCADA. Most importantly, it could provide meaningful metrics for busy system operators who are often managing multiple site deployments, sometimes entire fleets of systems in the field.

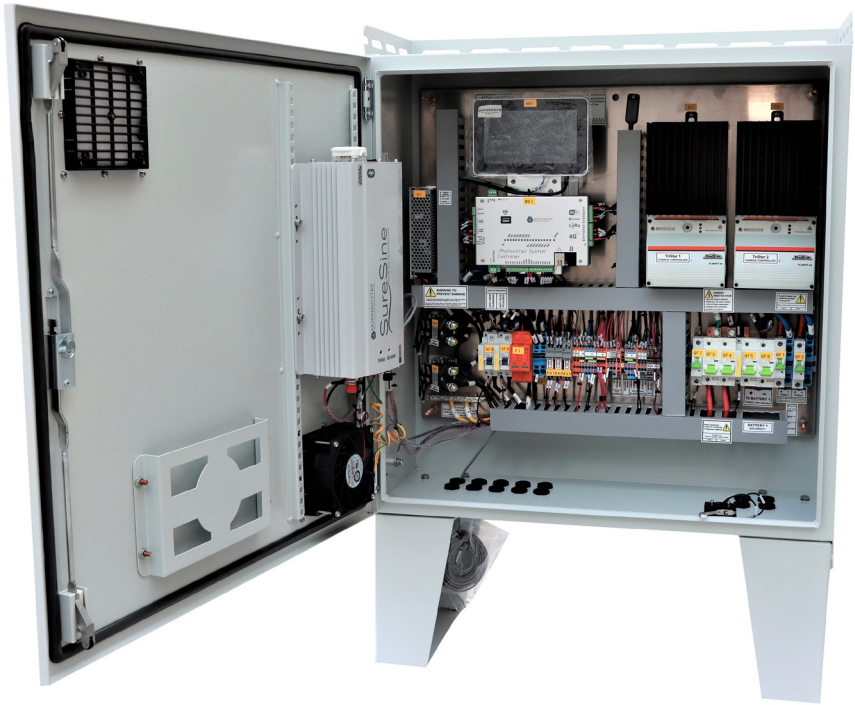
This, along with additional features and capabilities, is what Morningstar envisioned in creating its innovative new GenStar MPPT™ fully-integrated solar DC charging system. GenStar is a 'solar controller on steroids' in a sense, it combines the functions of a charger with everything required for intelligent control and hybrid system management to maximize energy storage and extend system 'autonomy' or the ability to deliver electricity in low solar conditions, something important in remote systems. By leveraging system information to make smarter auxiliary charging source usage decisions on-site, GenStar saves fuel.

Solar electric systems exist to power loads, and intelligent control of loads and charging sources is extremely important, especially in remote industrial systems. Toward that end GenStar is capable of sophisticated prioritization of loads and charging sources, choosing from a wide menu of real-time values, instead of relying just on voltage or battery state of charge (SOC) data, like conventional controllers, to make better on/off decisions.

All loads and charging sources in the system are monitored and controlled centrally, whether they are connected via proprietary MS-CAN, through dry contact, or the GenStar's own integrated load output.

Designing for mission-critical applications

Long-term reliability and dependability are both essential aspects of remote power



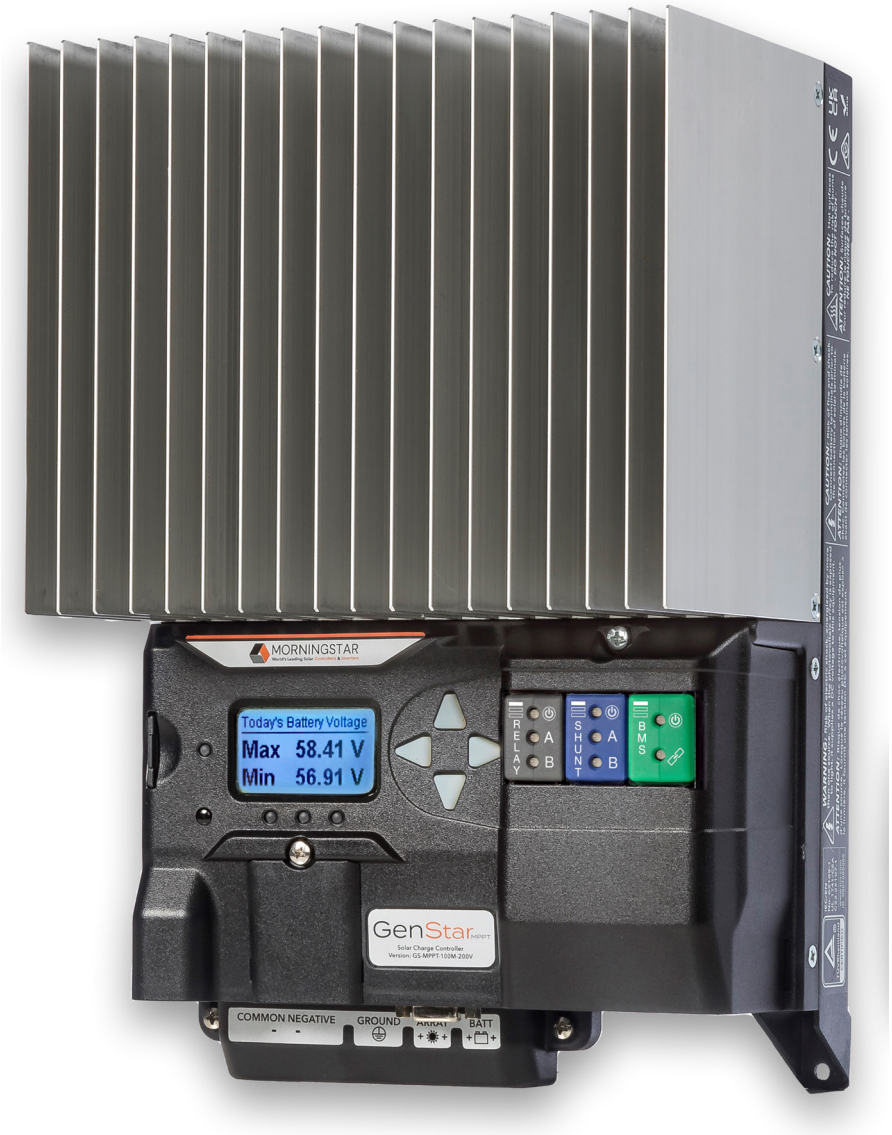
A small rural remote telecom powering system with solar charging and power conversion components on-board, in an enclosure

systems. Whether a system is operating at a mountaintop telecom site, a desert oilfield, or an off-shore gas extraction platform, any maintenance visits are extremely costly in terms of access, downtime and even safety, the fewer, the better. GenStar is engineered to reduce and even eliminate the need for regular servicing.

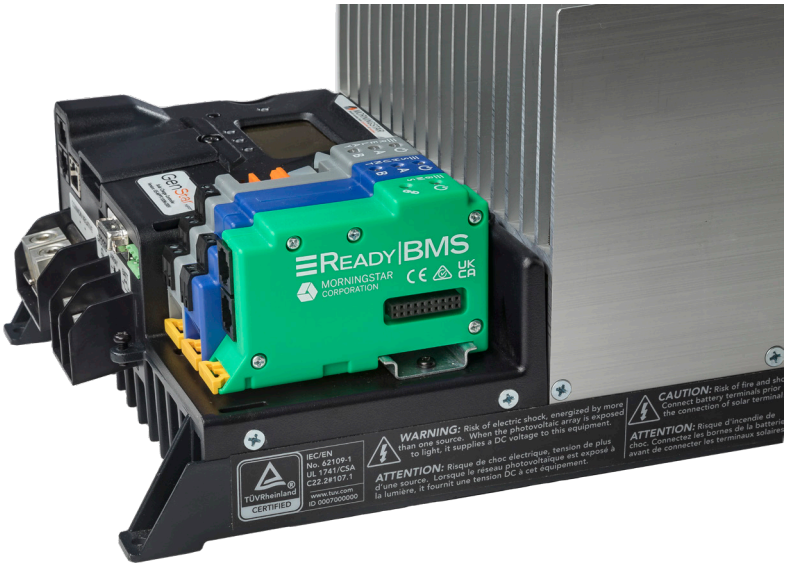
One example is its advanced thermal engineering which made it possible to remove the 'Achilles heel' of almost all other solar power conversion components: the cooling fan, which can be the single greatest weak point in a solar charging system for three reasons. First, because they have moving parts, fans inevitably fail. In fact many solar equipment manufacturers put more limited warranties on fans in their equipment for that reason. Second, fans will suck in dirt, dust and debris, compromising the reliability of the entire component by potentially causing overheating with that extra internal coating. And finally fans are a parasitic load. They require electricity to run, and they get that from the solar charging system. Removing the fan increases system efficiency.

Engineering for the future, with greater flexibility

The GenStar architecture is unique in that while it greatly expands system functions and options, at the same time it also reduces complexity and achieves greater simplicity. That's accomplished through an innovative and proprietary feature called a ReadyRail™, a built-in 'docking station', which enables a system installer to snap-in pre-configured ReadyBlocks™ and add key features when required. The technology represents a breakthrough in system design, prior to it, installers had to add outboard accessories with dongles and cables, increasing the chances of failure and compromising reliability and device compatibility, as well as causing costly increases in installation, set-up and programming time.



Morningstar's new GenStar MPPT fully-integrated solar DC charging system



Morningstar's unique ReadyBlock system, as installed on a GenStar MPPT system controller. With the blocks snapped-into place, key features are instantly accessible including closed-loop operation with lithium batteries

With Morningstar's ReadyRail technology, key features can be added to the GenStar MPPT at any time via a series of nap-in ReadyBlocks. These are auto-detected when the blocks are added. Once attached to the ReadyRail, their auto-detected presence initiates and enables the associated software functionality in the user interface. There is no additional power or communications, or software addressing, required to get the blocks to talk to the 'parent' component, the GenStar.

Measurements, data, and control provided by each block are seamlessly enabled in an intuitive way in the user interface. No custom programming is needed to get to the endpoint functionality users need in a DC

With GenStar in place in a system providing remote critical power, users are assured of significant gains in power optimization and system up-time, as well as extended energy storage life and a reduction in site maintenance visits with GenStar technology keeping the critical equipment up and running for them.

off-grid system, eliminating the configuration time that used to be necessary with add-on dongle-type accessories.

The ReadyShunt block provides battery/monitoring, key metrics including SOC, energy in/out in Amp hours, and current measurements for system sources and loads. A ReadyRelay block provides dry contact signaling and advanced load control. The ReadyBMS enables full communications and control, AKA 'closed loop operation', with lithium batteries. It is augmented by Morningstar's Energy Storage Partner program, which provides the data installers needed to seamlessly add the leading brands of lithium batteries to any system. This capability is one reason why the GenStar MPPT can boast 'lithium in its DNA' as a fully future-proofed system.

Enabling system operators to fully take control while keeping their distance

The new Morningstar technology represented by GenStar MPPT and the ReadyRail architecture is engineered to cover all the essential parameters that guarantee continuous, intelligent and 'hands off' operation of remote industrial systems: full visibility, logging history, and programmatic control. And GenStar's control topology ensures that there is no difficulty resetting and reconfiguring a system, which is vital in managing remote applications.

With GenStar in place in a system providing remote critical power, users are assured of significant gains in power optimization and system up-time, as well as extended energy storage life and a reduction in site maintenance visits with GenStar technology keeping the critical equipment up and running for them.

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