



Photovoltaic Telecommunications Power Installations Morningstar's Controllers Deliver Solar Success

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Overview

From its origins in telegraph and semaphore communications, the telecommunications industry has been at the forefront of technological progress—to the point of a telecom company, Bell Laboratories, inventing the solar cell in 1954.

Today, it's fitting that solar photovoltaic (PV) systems successfully power thousands of communication installations worldwide in remote locations and harsh conditions far from any utility grid. These installations are for applications ranging from remote wireless telecom towers to security outposts, from marine vessels to military installations, and from far-off weather stations to various out-of-the-way industrial outposts.

Today's telecom infrastructure consists of Base Transceiver Stations (BTS) which include microwave sites, cellular base stations, repeaters, relay stations, VSAT sites and two-way radio networking stations. Because these BTS sites are typically in remote, isolated areas—from mountain tops to desert regions—they have traditionally relied on diesel or propane generators for on-site power. But generators have profound disadvantages for this purpose: they are expensive to own and operate between fuel transportation and maintenance costs, have limited life-spans, and between noise and emissions are not environmentally-friendly. Rising fuel costs, increasing fuel theft and regular

maintenance requirements including regular overhauls have increased the overall operational costs of these remote fossil-fuel-powered generators to where they are increasingly less practical and cost-effective for powering Base Transceiver Station (BTS) sites.

The proliferation of BTS sites for telecommunications combined with the increasing challenges of delivering on-site power is behind the demand for cleaner, greener technologies among mobile carriers and other operators. In both the number of installations and powering requirements of each, the Information and Communication Technology



(ICT) sector's growth is surging, driven partially by the explosive growth in mobile phones and cellular networks. According to *GigOm3*, as of YE 2012 there were over six billion cell phone subscriptions in the world, and cell phone penetration in developing countries reached over 80%. (Currently, 600 million cell phone users live in communities where there is no electrical grid). Future mobile subscriber growth will be driven by demand among currently "unconnected" populations in developing countries, particularly those in rural areas.

For communications providers, the ultimate goal is to establish self-sustainable mobile networks with higher efficiency and profitability, to help them stay competitive in a lower Average-Revenue-Per-User (ARPU) environment. As such, mobile carriers are looking to PV and PV/Hybrid (PV + a secondary energy

source) power solutions to achieve their business objectives.

Morningstar – The Telecommunication Industry's Solar Controller of Choice

Morningstar is the world-leading supplier of solar charge controllers to the communication Industry, with many thousands of units in operation across on all seven continents. Since 1993, over four million Morningstar's products have been installed in off-grid PV power systems in well over 100 countries, helping power a variety of industrial, commercial, consumer and mobile applications. Whether the power systems are PV-only or PV/Hybrid, Morningstar controllers, inverters and accessories are getting the job done when utility power is unavailable, unreliable or cost-prohibitive.

Morningstar's controllers and inverters are renowned for their thermal, mechanical and electronic circuitry design, high quality and outstanding reliability, as well as long operating life and dependable performance. Morningstar's advantages for system designers include:

1. Smarter digital design with faster, more agile processing on-board
2. Internals laid out for performance, not economics
3. "Over-spec" components
4. Superior, "fanless" thermal design—no moving parts or fans to fail, and no parasitic loads to compromise efficiency
5. Dedicated engineering center with advanced R&D facilities, test lab, EMI and environmental chambers, full-thermal modeling
6. Products built in fully automated world-class ISO 9001 facilities
7. Quality Control— 100% functional testing of every product, using the latest computerized test equipment and processes



The result is a hardware failure rate less than 0.4%, a critical advantage in mission-critical installations.

Morningstar’s manufacturing facilities are CNS 15506, ROHS and REACH compliant. They are also classified as Class I sites and certified to the international management standards ISO 14001, OHSAS 18001 and ISO 9001. Morningstar products undergo rigorous testing and receive a number of telecom and safety specific certifications, including (but not limited to):

- CE, RoHS and REACH
 - IEC 62093
 - UL 1741 / CSA C22.2 No. 107.1-01 Listing
- EMC Compliance (Immunity, Emission and Safety)
 - FCC Title 47 (CFR), Part 15 Subpart B for Class B Device (Meeting U.S. & International Radio Frequency Radiation Interference Limitations)

Morningstar’s flagship, industry-leading TriStar and TriStar MPPT solar charge controllers are environmentally optimized and engineered with extensive electronics’ protection, conformal coating and tropicalization features. Their very advanced and amply-proven thermal, mechanical and electrical design is based on no moving parts and no fans to fail or compromise efficiency— just a few of the reasons why TriStar and TriStar MPPT controllers have proven themselves as “the perfect choice for the varied geographic and extreme climate conditions found at many remote telecom sites.”

TriStar MPPT controllers incorporate the advanced TrakStar solar output tracking algorithm, which is how they achieve an unprecedented 99% conversion efficiency rate. They deliver more usable renewable electricity and consuming less in the process, reducing overall system operating costs and help maximize energy harvest.

In fact, the TriStar MPPT delivers the industry’s best-in-class energy production at higher ambient temperatures; it simply will not reduce power or turn off at higher temperatures. As a result, batteries maintain a higher state-of-charge (SOC) resulting in improved battery health and longer life, which, by protecting one of the system’s most costly components, lowers operational costs and capital expenditures. A higher SOC means:

- Better PV system autonomy and better QoS for the system’s subscribers (equating to fewer customer service calls)
- Higher system uptime and less system maintenance (equating to fewer truck rolls)

Communications

TriStar MPPT controllers are the industry’s *only* solar controllers with open communication protocols and true Ethernet-enabled functionality, allowing extensive system networking, monitoring and communications.

TriStar MPPT controllers use the open MODBUS™ protocol (an open and free communications protocol widely used in industrial automation, allowing networking of up to 247 devices on a single data link) and are equipped with an on-board RS-232 serial communications port. Furthermore, the 60-Amp TriStar MPPT controller (model TS-MPPT-60A) is equipped with on-board EIA-485 and Ethernet to enable open/flexible serial communications and TCP/IP networking, respectively. As a result, there are no proprietary network hardware issues or software compatibility issues to resolve, nor any requirements for external gateways. This enables developers to use proven and readily-available code to speed development time and lower costs. Also, for telecommunication applications that require Simple Network Management Protocol (SNMP) monitoring of deployed systems, the TS- MPPT-60A controller behaves as an SNMP agent and will send a report (trap notification) on alarm or fault events to a central

management server.

The TS-MPPT-60A's open, built-in PC or remote communication capabilities include:

- Communication Ports/Interfaces: Ethernet, EIA-485, RS-232 and MeterBus™ (for flexible communications)
- Protocols: MODBUS RTU and MODBUS TCP/IP™, HTTP, SNMP v2 (for system networking and monitoring) and SMTP
- Data Logging: up to 200 days of daily data

The TriStar MPPT controller network (using Morningstar's MSView™ Software, EIA-485 communications port and MODBUS protocol) can scale to 247 devices on a single data link, enabling support for large daisy-chain installation—ideal for a medium-sized telecom site installation.

PV/Hybrid Installations

Morningstar's Relay Driver and TriStar MPPT controllers makes it possible to build a /Hybrid installation where the PV can work in concert with a wind or hydro-based power system, or even with a diesel or propane-based generator power system. This type of system can be sized and installed as the primary source of power for a remote telecom site, and the hydro, wind and/or generator-based systems can supplement tPV output should "days of autonomy" be insufficient for the installation's powering needs.

Summary

Ever-increasing fuel prices and high operational costs are two of the key drivers for mobile network operator (MNO) service providers turning to renewable energy as a solution. Their ultimate target is to establish a self- sustainable mobile network with higher efficiency and profitability to help them stay competitive in a low ARPU environment.

Since 1993, Morningstar's products have been helping provide stand-alone, solar electric power to many industrial system installations around the world, in applications including telecommunications, oil and gas, railroad, security and instrumentation.



Morningstar's TriStar and TriStar MPPT controllers are proven, preferred solutions for scalable telecommunication sites located in remote areas where grid electricity is either non-existent or unreliable, and in areas with wide-ranging geographic and climatic challenges; e.g.,

- Environmentally-extreme regions such as:
 - Deserts (plagued by hot, dust-laden winds and strong sandstorms)
 - Sub-Tropical Climates (characterized by hot, humid summers and generally mild to cool winters)
 - Tropical Rainforests (typically hot and wet throughout the year since rainfall is both heavy and frequent)
 - Cold Terrains (extending to glacial, tundra and alpine environments)
- Marine Locations with Corrosive Salt Air
- Remote locations, such as mountaintops, sea platforms, and wilderness areas

In addition, Morningstar components are

- Compact – with smaller overall form-factors and improved thermal design, Morningstar components better fit the typically limited space available for installing PV power electronics in a remote telecom site, particularly inside communications towers.
- Renowned for quality and reliability – With the industry’s longest operating life (more than twice the industry average) and equipped with open communication protocols to enable remote and/or local monitoring of the installations’ daily operations, Morningstar components are uniquely qualified to minimize the need for any service calls and consequently lower overall maintenance costs.

Morningstar solar controllers and accessories enable power network modernization of remote communication sites. They help provide the business benefit of using solar energy to power the installation and better manage operational and maintenance costs , efficiencies, and increase environmental friendliness. They are proven to work in both PV-only and PV/Hybrid installations.



Left top: telecommunications repeater station at McEvoy Lake, Canada, in winter



Left bottom: the installation's power bay with an array of Morningstar 600V charge controllers