Application Note

Glowlink Model 3010
Uplink Power Control System

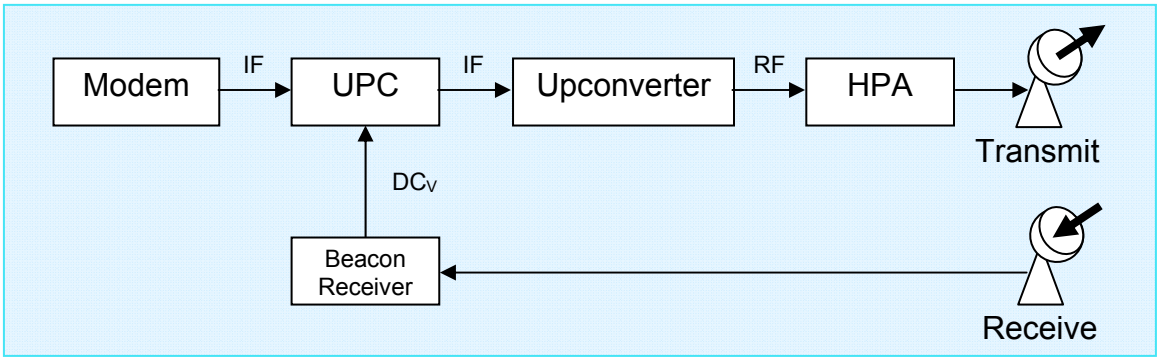
Glowlink's Model 3010 Uplink Power Control (UPC) system is a new generation of digital UPC which builds on recent advances in digital signal processing (DSP) technology, offering a dramatic performance improvement over more traditional, largely analog systems. The Model 3010 introduces powerful DSP features like Transponder Compression Avoidance™, that eliminate the risk of UPC saturating a transponder. This feature, enabled by Glowlink's patented Transponder Operating Point (TOP™) and SmartClamp™ technologies, regulates power adjustments when transponder compression is detected. The result is a powerful, system solution that provides power adjustments which are effective and safe.

The Model 3010 includes a Windows™ based graphical user interface (GUI) with set-and-forget power control operations that streamline system use and maintenance. In addition to providing setup and control functions, system operations can be viewed graphically and even exported into a Microsoft Excel™ worksheet at the click of a button for additional performance analysis.

The advanced technological features, unmatched quality, and unparalleled service, make the Glowlink Model 3010 an easy choice for uplink power control. As an added benefit, the Model 3010 can be integrated with Model 1000 Spectrum Monitoring System for carrier monitoring applications.

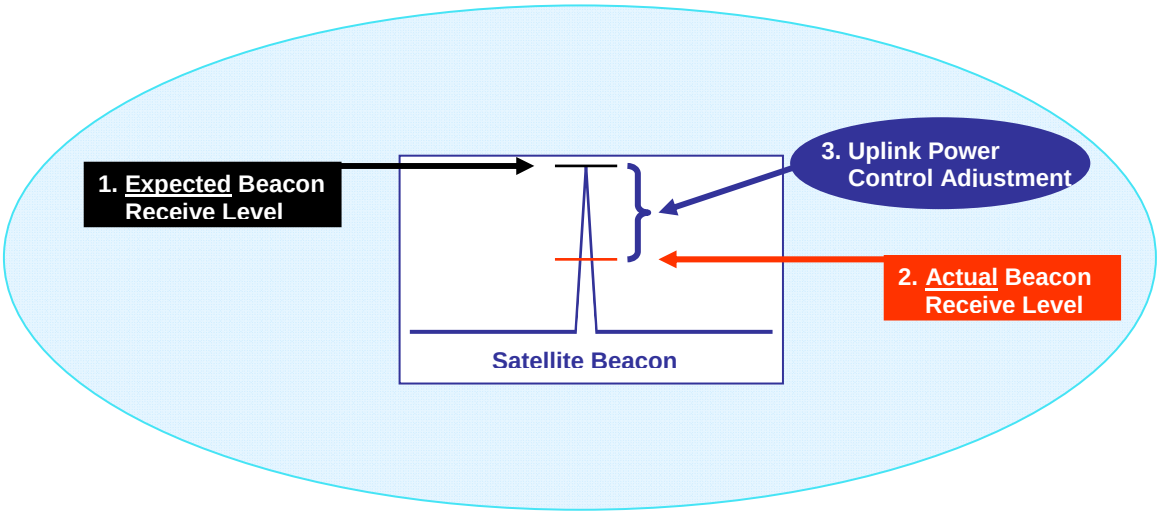
The Uplink Power Control

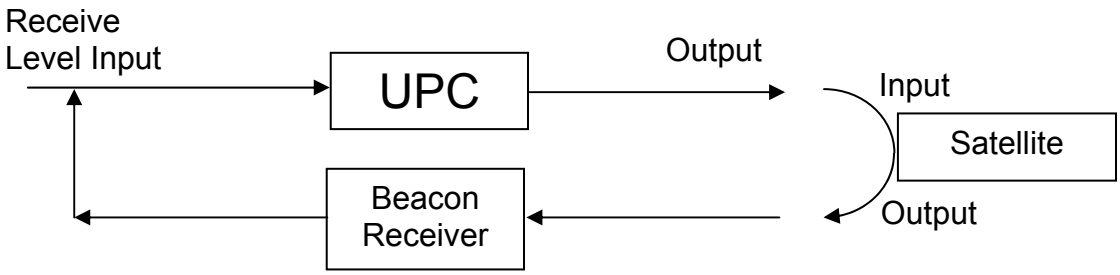
Uplink power control systems are typically installed with the transmit equipment prior to the upconverter units to adjust the upconverter input signal levels as power management is dictated by an external beacon signal indicator such as a beacon receiver.



Open Loop Power Control

UPC systems are often designed to adjust uplink signal power based on changes in the beacon receive level – a power measurement usually monitored by an external, customer-supplied beacon receiver. This type of control is commonly referred to as "open loop" power control.





Errors Associated with Beacon-Based Control

Unfortunately, in an open loop power control system, the impact of any erroneous power adjustments is not provided to the UPC system as feedback, so the system can not recognize and correct for such erroneous power control decisions. Therefore, key to effective open loop power control is the ability to make precision adjustments and avoid any erroneous adjustments caused by errors in the beacon measurement.

As an example, most traditional UPC systems require calibration between the beacon receiver's received signal *power* level and the dc *voltage* it generates that is in turn input to the UPC. This need for calibration introduces a source of power control error that can deteriorate over time as these receivers are generally analog based.

Making matters worse, use of an external beacon receiver is susceptible to a number of other factors that can result in erroneous power adjustments. These include:

1. Beacons are often used to transmit telemetry data from the satellite to ground stations. When the reference beacon modulates, the beacon receiver may interpret this as an increase in signal level whereby causing the UPC to reduce transmit power below nominal.

2. Since satellite beacons are often operated at the same frequencies, transitioning satellite beacons may come into view of the beacon receiver, and if the beacon from the repositioning satellite is higher in power, the traditional UPC system will reduce service carrier power below nominal until it completes its flyby.

3. Not all satellites provide telemetry or UPC beacons in the user's downlink beam. When satellites do provide useable beacons, they can be located at opposite ends of the satellite spectrum with respect to the user's operational band, and can introduce significant frequency scaling errors limiting the accuracy of the UPC system.

The Glowlink Alternative

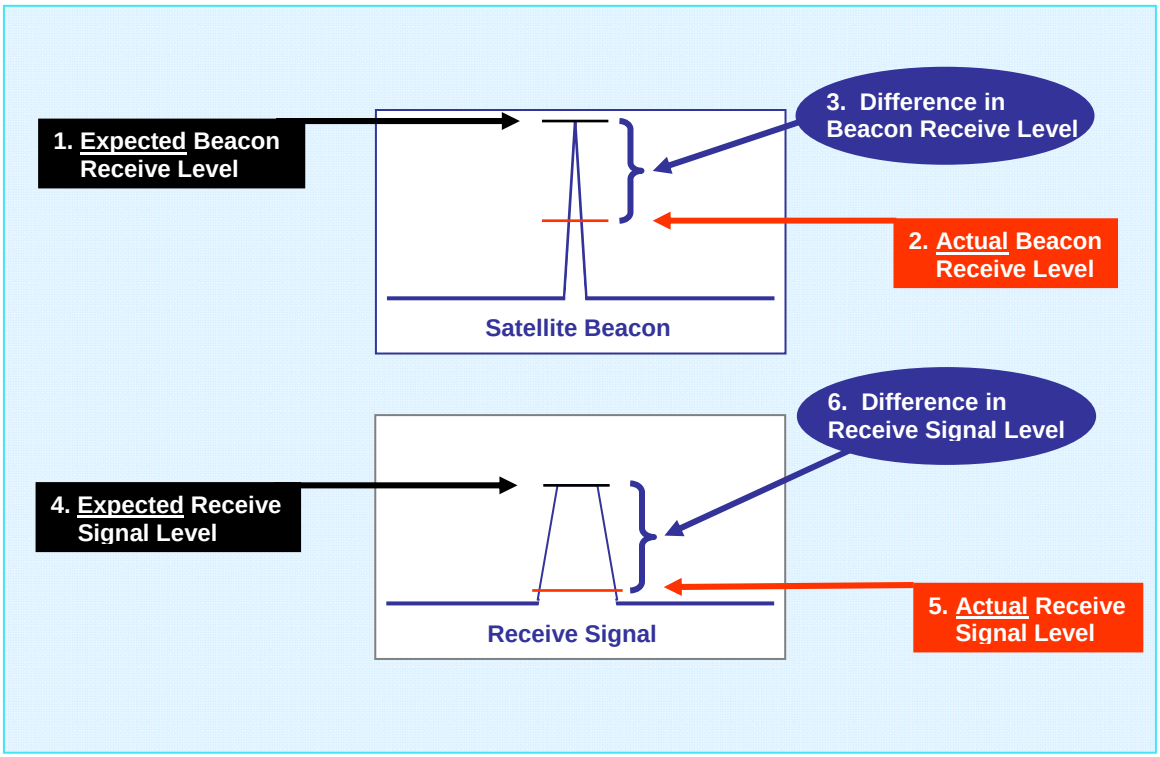
To address these problems, the Model 3010 has a built-in beacon receiver designed specifically for monitoring beacon and pilot signals. This built-in beacon receiver combines DSP-based, precise beacon monitoring with advanced signal processing tuned for UPC operations to make accurate power control decisions. It also eliminates the need for calibration and the corresponding errors that introduces. The result is a system that provides effective, safe open loop power control.

An open loop UPC system asks only one question before making adjustment:

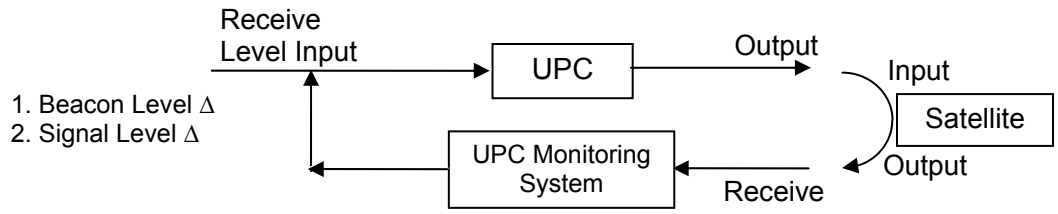
1. Is the beacon reference carrier being received at the expected level?

Closed Loop Power Control

Some UPC systems can provide an additional layer of UPC system management by observing the power controlled signals in conjunction with the satellite reference carrier to update the power control adjustments. This type of power control is often referred to as "closed loop" power control.



The combined uplink power control adjustment is a function of both the open loop beacon power measurement, and the closed loop signal measurement. The intended receive signal is used as the "loopback" reference.



The Glowlink Alternative

Key to closed loop power control is the precise, accurate, and timely monitoring of the loopback carrier. Included in the Model 3010 are signal processing algorithms directly from Glowlink's DSP-based carrier monitoring systems. These algorithms are designed to provide continuous, rapid, and highly accurate monitoring of the loopback carrier that quickly verify the effect of power control adjustments and then refine those adjustments to maintain proper carrier receive levels.

The closed loop system asks two questions before making adjustment:

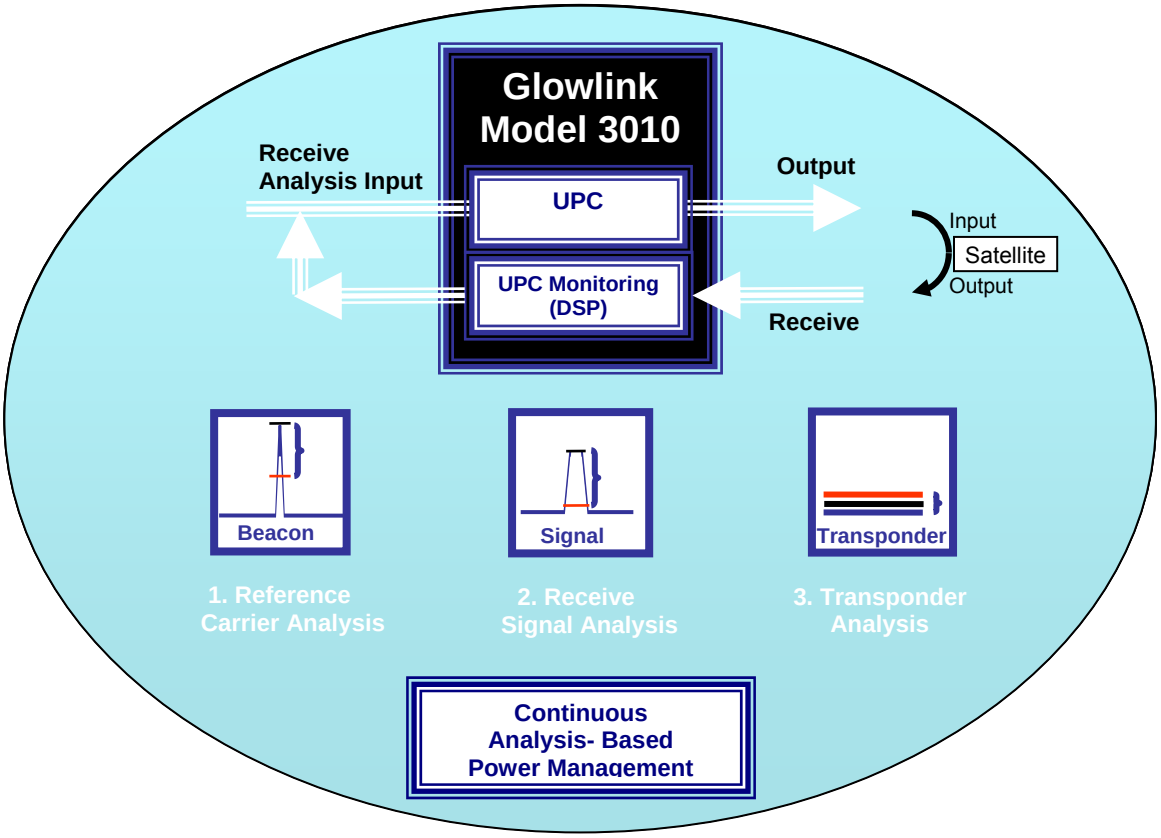
1. *Is the beacon reference carrier being received at the expected level?*
2. *Is the intended receive signal being received at the expected level?*

Glowlink's Approach to Effective Power Control

Glowlink takes the traditional open/closed loop solution for UPC to a new level by introducing accurate, safe and effective control. Central to an effective and safe control is the Glowlink Transponder Compression Avoidance™ feature.

Glowlink Model 3010
Transponder Compression Avoidance™

Available with the Model 3010 is the Transponder Compression Avoidance™ feature[†] to prevent transponder compression/saturation problems. This feature continuously monitors the transponder operating state and, if it detects the transponder undergoing compression or is on the verge of saturation, will automatically regulate any impending power adjustment. This feature is enabled by Glowlink's groundbreaking Transponder Operating Point (TOP™) technology, and SmartClamp™ technology, resulting power adjustments which are effective and safe.



[†] Model 3010 optional feature

With the Transponder Compression Avoidance™, safety limits to the power control adjustment range can be relaxed without worrying about overdriving the transponder. This is especially important for operations at Ku bands and above where fade depths are more severe. The SmartClamp™ dynamically regulates the adjustment range based on the transponder state, thus preventing the UPC from further compressing, or worse, saturating the transponder.

Glowlink's Model 3010 asks three questions before making adjustment:

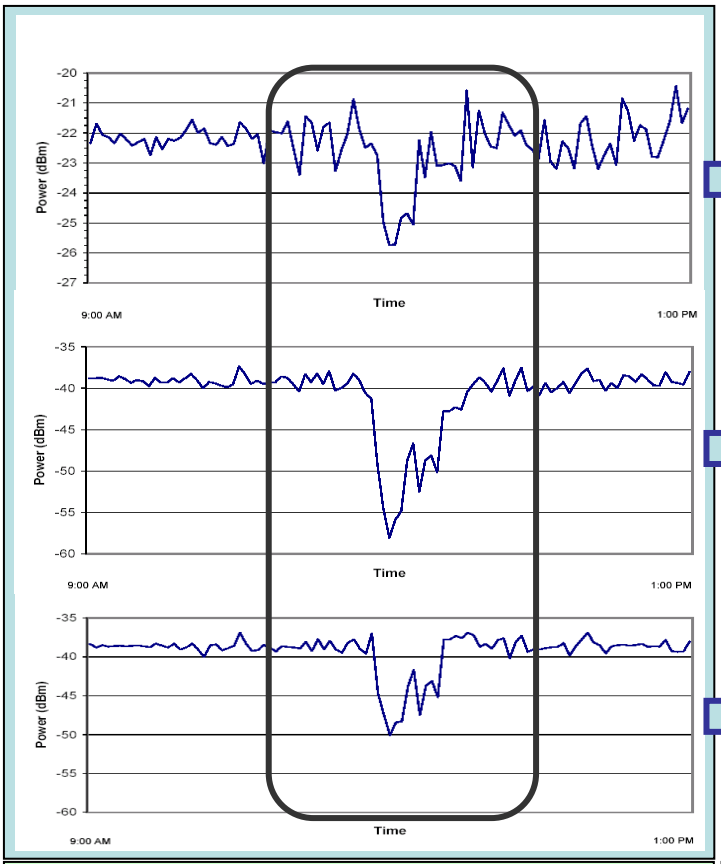
1. *Is the selectable reference carrier being received at the expected level?*
2. *Is the intended receive signal being received at the expected level?*
3. *Is the transponder already suffering from compression?*

Field Performance Data

Glowlink's advanced uplink power control system technologies have been proven in extreme atmospheric attenuation conditions, and have been exceptionally safe, accurate, and responsive. The Model 3010 is particularly effective in Ku and Ka-bands due to its ability to process instantaneous adjustments within its 32dB power adjustment range.

The following plots are from actual field data taken using Glowlink's UPC technology. The data groups all follow the same basic layout: The first plot provides the beacon receive levels to indicate the degree of atmospheric attenuation in each plot. The second plot identifies the atmospheric impact to the receive signal in the absence of uplink power control. The third and final plot in each group demonstrates the effectiveness of the uplink power control configuration. The four scenarios included are: Deep Rain Fade, Slow Power Drift, Scintillation Bursts, and Uncorrelated Fades (between beacon and receive signal frequencies).

The resulting conclusion is that the effects of atmospheric attenuation can be dramatically dynamic, and therefore require constant, rapid open and closed loop DSP-based analysis for accurate and responsive uplink power control. Glowlink's Model 3010 combines these capabilities with other powerful safety and ease of uses features for your UPC solution.

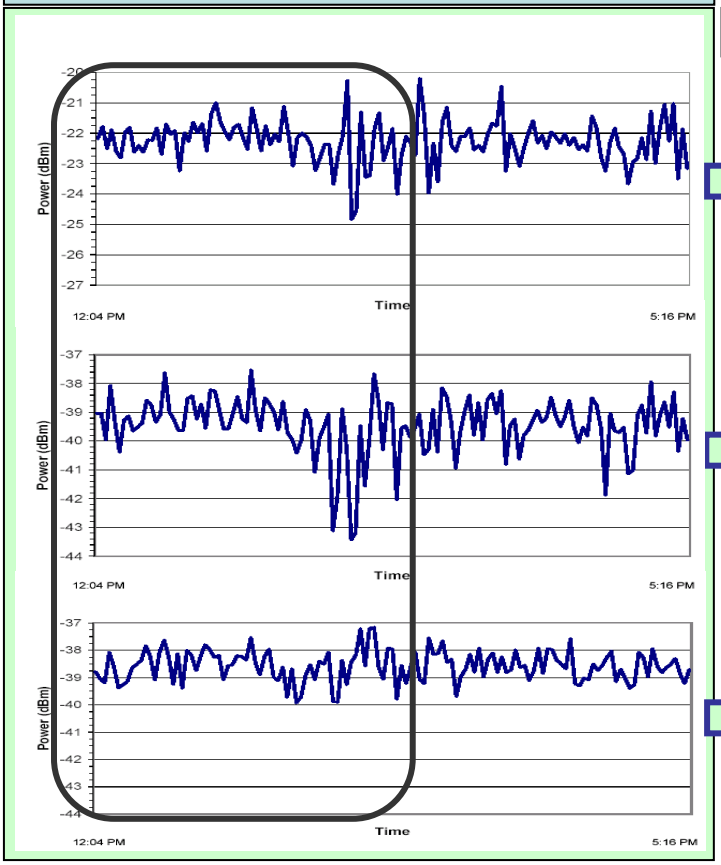


Deep Rain Fade

Satellite Beacon Only Recorded ~ 4dB Fade

Signal Receive Level Recorded ~ 18dB Fade Without UPC

With UPC Signal Receive Level Recovered ~8dB (HPA limited)

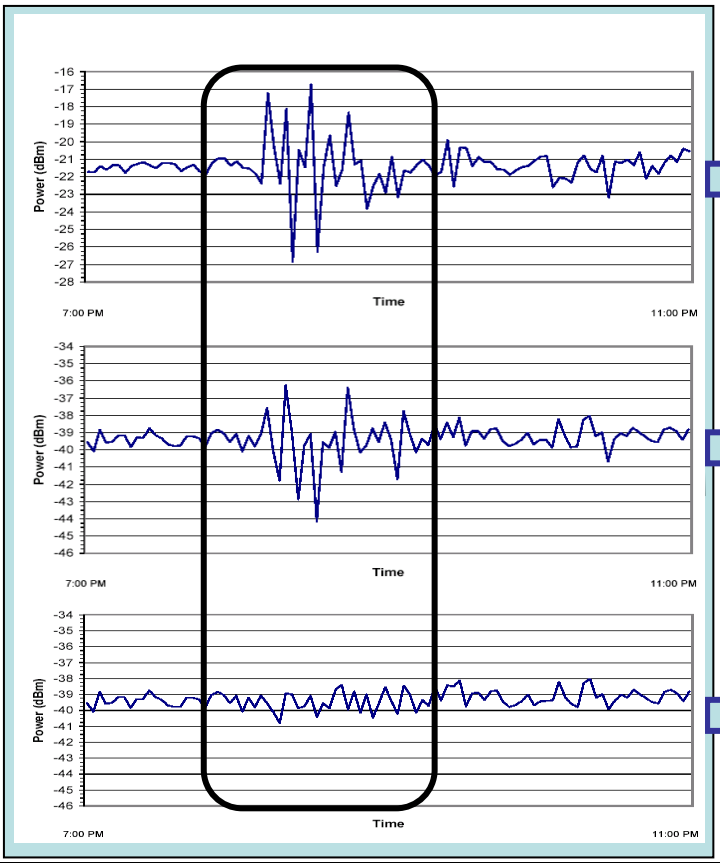


Slow Power Drift

Satellite Beacon Receive Drift

Signal Receive Drift Without UPC

Power Drift Corrected and Fluctuations Reduced With Combined Open and Closed Loop Power Control

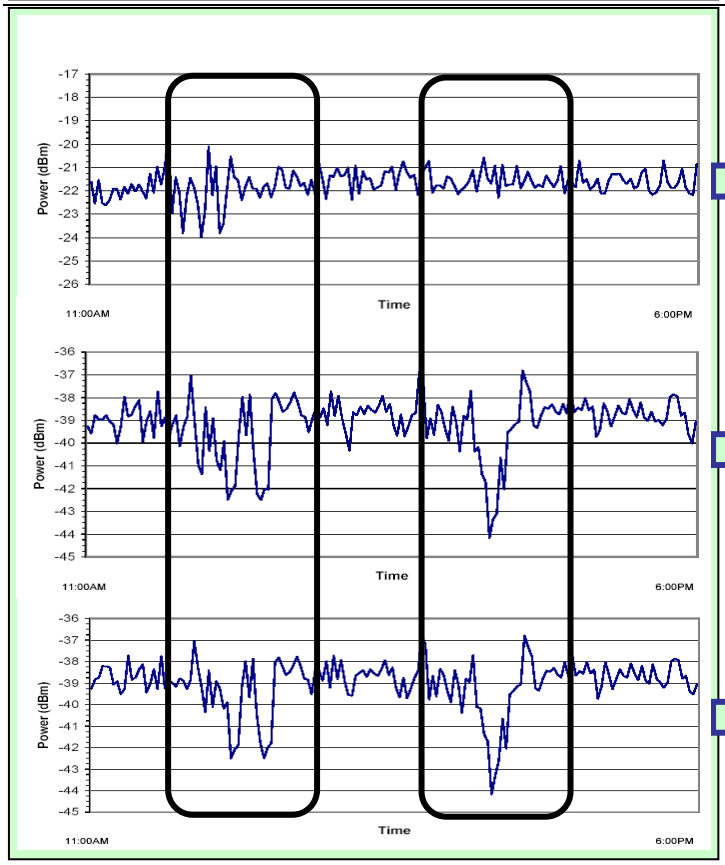


Scintillation Bursts

Scintillation Event Observed by Beacon Signal

Loosely Correlated Scintillation Seen By Signal Receive Levels Without UPC

Signal Receive Level Fluctuations Reduced With Combined Open and Closed Loop Power Control



Uncorrelated Fades

Satellite Beacon Receive Level Largely Unaffected

Signal Receive Level Severely Degraded Without UPC

Signal Receive Level Severely Degraded Using Only Open Loop UPC

Features and Benefits

Model 3010 Features	Benefits
Built-In Beacon Receiver	No calibration required (e.g., Voltage to Power calibration) Direct savings on UPC implementation Reference signal selectability
Digital Signal Processing Technology	Advanced monitoring and control Real-time, safe, continuous, and accurate Powerful safety features with TOP™ and SmartClamp™
Transponder Compression Avoidance™	Uses Transponder Operating Point (TOP™) to measure transponder linearity/compression providing the baseline for SmartClamp™
SmartClamp™	Prevents power control adjustments from overdriving transponder thresholds; extremely valuable in multi-carrier environments
Flexible Architecture	1-4 independently controlled channels Software based solution allows for future enhancements can be integrated with Model 1000 Spectrum Monitoring System
Ku and Ka-band Tested	Algorithm performance and responsiveness proven in rapidly changing environments; 32 dB Dynamic power adjustment range
Failsafe Path	Provides signal continuity in case of power outage to system
Windows™ Based GUI	Easily integrated and operated within your operational environment
Adjustment History Reporting	Provides detailed reporting on power control history is an easy to read graphical format
Data Analysis	Single click imports power control data to Excel for analysis
Service and Support	Available software and hardware maintenance programs ensure system is continuously supported, maintained, and updated.

Does Your Broadcast Need the Glowlink Model 3010?

Do any of these apply to your application? If so, you should consider a Glowlink Model 3010.

Application Parameters	Need a 3010
Service is critical	Yes
Cost of service outage is high	Yes
Uplink site located in moderate to heavy rain fade region	Yes
Poor look angle	Yes
Smaller fade margins are desired or required	Yes

About Glowlink

Glowlink Communications Technology, Inc. is a premier solutions provider of satellite monitoring, interference detection and power control systems for satellite communications networks.

Glowlink's core values are founded upon technology innovation, world class quality, and above all, outstanding service. Glowlink is NOT a "Box and Manual" operation, and strives for 100% customer satisfaction for each and every customer.

Glowlink actively participates in and supports many industry organizations, and remains firmly committed to the charter of interference free satellite communications by providing the highest quality satellite communications products.

The Glowlink brand is growing as industry leading organizations continue to choose our products for their primary enterprise systems. Please stop by our website to get more information on the Model 3010 and the rest of our leading edge product suite.

www.glowlink.com

Glowlink Related Patents

With respect to the Glowlink product(s) described in this document, the following patents may apply:
United States Patent No(s): 8,004,459; 7,667,640; 7,663,547; 7,639,761; 7,466,767; 7,120,392; 6,549,755; New Zealand Patent No(s): 529266; 533787, Singapore Patent No(s): 100422; 105251, Australia Patent No(s): 2002340512; 2003213579, Europe Patent No(s): 1393472, Canada Patent No(s): 2446301, China Patent No(s): ZL02812548.7, Hong Kong Patent No(s): 1066941.

Other U.S. and International Patents Pending