HARRIS

TECHNOLOGY TO CONNECT, INFORM AND PROTECT™

The Next Generation of Covert Antennas

A New Design Increases Flexibility and Maximizes Performance

Harris Corporation

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THE NEED FOR HIGHER-PERFORMANCE, BODY-WORN ANTENNAS

As the capabilities of tactical radios continue to deliver greater advantages to the warfighter, the need for advanced antennas to complement these powerful devices grows as well.

Progress has been made in recent years to reduce the size of antennas, increasing their flexibility, and providing support for wider frequency bands. Of particular interest to Special Operations Forces (SOF) is the ergonomic and performance innovation in the area of covert Body-Worn Antennas (BWAs).

Covert BWAs provide a much higher degree of safety than traditional tactical radio antennas, which protrude from the vest, making the warfighter a more obvious target.

In addition, since covert BWAs are worn very close to the body and below the head, they are less likely to hinder the agility and movement of warfighters, or impede rapid access to weapons and other essential devices.

While today's marketplace offers a myriad of covert BWA options, most have significant limitations. These can include a cumbersome connection process, loss of signal strength due to body proximity and mounting, and performance and reliability issues because the antenna was not designed at the outset for integration with high-performance radios.

Because of these limitations, warfighters must create their own workarounds. For example:

- **Rolling the antenna down when not in use – sometimes 10 to 20 times a day**
- **Fixing it under the shoulder pad so it doesn't interfere with a parachute opening**
- **Stuffing it between the back and rear ballistic plate while boarding a helicopter, impacting signal strength**
- **Using the 30-512 short whip, which is not suited for FM communications**

Some antennas require manual adjusting for optimal operation on the desired frequency. This can require a depth of communications expertise few warfighters possess.

Combat experience indicates that users are resigned to tolerating reduced performance in exchange for some measure of increased safety. But a new approach to the design of these antennas may eliminate such a trade-off.

This paper examines specific covert BWA capabilities that meet the mission needs of the SOF community. It also discusses a new approach to their design – one emphasizing flexibility, ease of connection, and consistency of performance across multiple frequency bands without signal loss.

Antenna Design Starts with the Radio

Today, the term “body-worn” is used interchangeably to describe virtually any antenna attached to a body vest. Covert antennas are worn in such a manner and are nearly invisible from a distance.

The larger picture, essential to any discussion of BWAs, is that antennas and radios must work together as a body-worn *system*. As a result, the best foundation for antenna design is a meaningful understanding of the unique communications challenges facing the warfighter and a “total system” approach to solving them.

This method, used by Harris Corporation’s engineers to innovate tactical radios, has been employed to create a new generation of covert BWAs. These new antennas specifically complement Harris radios, yet also work with those of other manufacturers. By fully understanding the customer *and* the radio technology, Harris designs to specific battlefield needs.

How to Evaluate Covert Antennas

Today’s warfighter carries more equipment than ever before. From displays, batteries and End User Devices, to weapons and ammunition, every piece of real estate on the vest must be maximized. As a result, ergonomics is driving an intense interest in several aspects of BWAs.

Low-Profile Design

First is the need for low-profile design, so that the antenna doesn’t become a target for enemy fire even when worn over the shoulder. This is also essential when on the move, to ensure warfighters don’t have to spend time manipulating the antenna when quickly entering aircraft and ground vehicles. In addition, the design and mounting of the antenna must ensure zero obstruction of other equipment in high-stress situations.

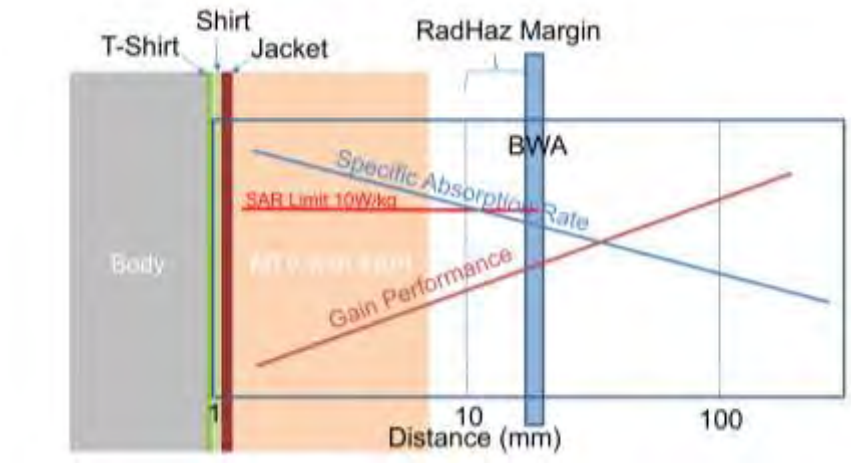
Proximity to the Body and Electronic Equipment

BWAs, by their name and nature, are worn close to the body. However, if the antenna is attached too closely, the proximity results in signal absorption and shadow effects that can impact the strength of the transmission. A too-close connection can also pose potential radiation hazards to the user.

In addition, attaching data terminals, phones and computers to the radio creates RF noise that flows into the antenna port, affecting the radio’s sensitivity.

Harris has extensively studied these problems in conjunction with its radio development and testing programs. The result is a new antenna with a unique mounting technique that securely maintains the antenna one to two cm away from the body and uses ferrite beads to significantly reduce or eliminate RF current interference.

Distance From the Body is Critical to Performance



This diagram depicts the human body, clothing and armor. The Harris antenna (blue rectangle) can be varied from next to the Small Arms Protective Insert (SAPI) to any distance away from the body. The Specific Absorption Rate (SAR) of the human body is inversely proportional to the distance the antenna is away from the body, whereas the gain (or efficiency) is proportional to distance away from the body. The antenna must be far enough from the body to be past the SAR limit as set by the IEEE C95.1 standard, as a minimum. The maximum distance for a realistic case would be 100 mm.

Connection Method

How the BWA connects is important for a number of reasons, including performance, ergonomics and convenience.

Many BWAs still require the user to manually weave the antenna through multiple connection points – a cumbersome and time-consuming process not suited for quick-react situations. The weaving can also cause cancellation of radiated power, by creating a two-wire transmission line.

Figure 1. The Harris Dual-Band (UHF and L-band) Antenna is housed in cotton-like webbing that simplifies integration into the warfighter's kit.

Harris' new connector design uses an easy, clip-on technique that ensures the antenna is securely attached to the molles. A specialized device attaches to the antenna, enabling the user to quickly slide it through multiple molles at the same time. Once locked in, the antenna will not twist or come lose from the molles.

In addition to speed, the new connector provides flexibility, allowing the antenna to easily attach in the front or back depending on individual preference and needs. If necessary, the warfighter can easily reposition or access the antenna for troubleshooting potential communication problems.

On the rare occasion additional range/gain is required, the antenna element can be unclipped and extended up from the user's shoulder, or even removed and elevated.

Full-Spectrum Support and Mode Switching

Of particular challenge to SOF is the need to quickly switch between different transmission frequencies during a mission. In the past, this has required carrying multiple radios and antennas and moving between them as needs change. That's no longer the case.

Figure 2. Photos show Dual Band Antenna with the L-band section over shoulder (conformal) and vertical (performance deployment).

Under the SOF Tactical Communications (STC) program, Harris is providing a new, integrated two-channel, handheld radio combining communications, Intelligence, Surveillance and Reconnaissance capabilities. This lightweight radio enables SOF teams to communicate over multiple channels simultaneously, and has the ability to receive ISR full-motion video and signals-based threat information.

To maximize the effectiveness and achieve the full capabilities of a true body-worn system, a BWA should complement the capabilities of the STC radio.

The new Harris antenna is designed from the ground up to be a partner to the STC radio, providing consistency of performance over a wide range of frequencies. Its capabilities represent the largest spectrum of any covert antenna option available today, and the only UHF and L-band transmission in a single antenna. The antenna also has a unique, internal coupling innovation allowing the antenna to switch between transmission modes as needed.

Harris covert antenna features
225-450 + 1300-2600 MHz Dual-band Body Worn Antennas

- End feed (225-450 MHz); center feed (1300-2600 MHz)
- Antenna flexible strap, hangs from upper shoulder
- UHF and L-band included
- Extremely lightweight
- Can be raised to increase range (option)
- Can feed through molle, if desired

Summary

The issues surrounding antenna management, size and profile continue to grow as tactical radios evolve and missions become more complex. SOF applications in particular require high-performance, Body-Worn Antennas that support the capabilities of tactical radios.

In fact, the radio and antenna must work together in the field as a system – an integrated team – complementing and enhancing their capabilities to help ensure the best possible results for the warfighter and the mission.

As a global leader in the advancement of tactical radio technology, Harris has applied its understanding of battlefield operations and communications to design of the next generation of antennas that provide new capabilities at an affordable price point.

The company's patented solutions encompass both the design of the antenna structure, as well as how the unit delivers necessary bandwidth. They maximize performance of the radio while addressing the need for safety.

These antennas present a solution for the challenges and dangers users of covert and tethered antennas face every day – spectrum limitation, ergonomic deficiencies, and loss from body absorption. They are tested with Harris radios to ensure the highest levels of performance.

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