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High-power microwave (HPM) / E-Bomb

High-power microwave (HPM) sources have been under investigation for several years as potential weapons for a variety of combat, sabotage, and terrorist applications. Due to classification restrictions, details of this work are relatively unknown outside the military community and its contractors. A key point to recognize is the insidious nature of HPM. Due to the gigahertz-band frequencies (4 to 20 GHz) involved, HPM has the capability to penetrate not only radio front-ends, but also the most minute shielding penetrations throughout the equipment. At sufficiently high levels, as discussed, the potential exists for significant damage to devices and circuits. For these reasons, HPM should be of interest to the broad spectrum of EMC practitioners.

Electromagnetic Pulse (EMP) and High Powered Microwave (HMP) Weapons offer a significant capability against electronic equipment susceptible to damage by transient power surges. This weapon generates a very short, intense energy pulse producing a transient surge of thousands of volts that kills semiconductor devices. The conventional EMP and HMP weapons can disable non-shielded electronic devices including practically any modern electronic device within the effective range of the weapon.

References

- [E-Bomb Frequently Asked Questions \(FAQ\)](#) by Dr Carlo Kopp
- [The Electromagnetic Bomb - a Weapon of Electrical Mass Destruction](#) By Carlo Kopp [Aerospace Power Chronicles](#) -- This paper discusses aspects of the technology base, weapon delivery techniques and proposes a doctrinal foundation for the use of such devices in warhead and bomb applications.
- [High Power Microwaves: Strategic and Operational Implications for Warfare](#) By Eileen M. Walling, February 2000 [Occasional Paper No. 11, Center for Strategy and Technology, Air War College]
- Holzman, Robert, and Neil Munro. "Microwave Weapon Stuns Iraqis." *Defense News* 7 (13 April 1992): 1, 52.
- [Hardening Your Computing Assets](#) By Carlo Kopp, [Asia/Pacific Open Systems Review](#) February 1997 [PDF 83 Kb]

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The effectiveness of an EMP device is determined by the power generated and the characteristic of the pulse. The shorter pulse wave forms, such as microwaves, are far more effective against electronic equipment and more difficult to harden against. Current efforts focus on converting the energy from an explosive munitions to supply the electromagnetic pulse. This method produces significant levels of directionally focused electromagnetic energy.

Future advances may provide the compactness needed to weaponize the capability in a bomb or missile warhead. Currently, the radius of the weapon is not as great as nuclear EMP effects. Open literature sources indicate that effective radii of "hundreds of meters or more" are possible. EMP and HPM devices can disable a large variety of military or infrastructure equipment over a relatively broad area. This can be useful for dispersed targets.



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A difficulty is determining the appropriate level of energy to achieve the desired effects. This will require detailed knowledge of the target equipment and the environment (walls, buildings). The obvious counter-measure is the shielding or hardening of electronic equipment. Currently, only critical military equipment is hardened e.g., strategic command and control systems. Hardening of existing equipment is difficult and adds significant weight and expense. As a result, a large variety of commercial and military equipment will be susceptible to this type of attack.

The US Navy reportedly used a new class of highly secret, non-nuclear electromagnetic pulse warheads during the opening hours of the Persian Gulf War to disrupt and destroy Iraqi electronics systems. The warheads converted the energy of a conventional explosion into a pulse of radio energy. The effect of the microwave attacks on Iraqi air defense and headquarters was difficult to determine because the effects of the HPM blasts were obscured by continuous jamming, the use of stealthy F-117 aircraft, and the destruction of Iraq's electrical grid. The warheads used during the Gulf War were experimental warheads, not standard weapons deployed with fielded forces.

Col. William G. Heckathorn, commander of the Phillips Research Site and the deputy director of the Directed Energy Directorate of the Air Force Research Laboratory, was presented the Legion of Merit medal during special retirement ceremonies in May 1998. In a citation accompanying the medal, Col. Heckathorn was praised for having provided superior vision, leadership, and direct guidance that resulted in the first high-power microwave weapon prototypes delivered to the warfighter. The citation noted that "Col. Heckathorn united all directed energy development within Army, Navy and Air Force, which resulted in an efficient, focused, warfighter-oriented tri-service research program." In December of 1994 he came to Kirtland to become the director of the Advanced Weapons and Survivability Directorate at the Phillips Laboratory. Last year he became the commander of the Phillips Laboratory while still acting as the director of the Advanced Weapons and Survivability Directorate.

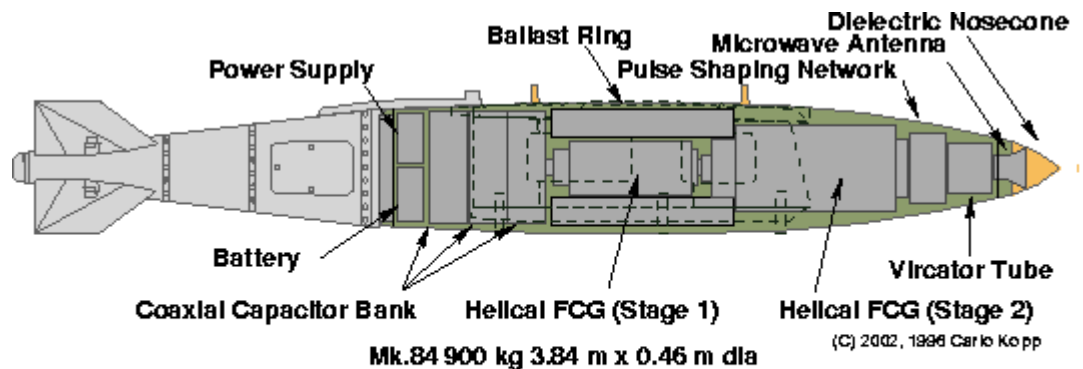
As with a conventional munition, a microwave munition is a "single shot" munition that has a similar blast and fragmentation radius. However, while the explosion produces a blast, the primary mission is to generate the energy that powers the microwave device. Thus, for a microwave munition, the primary kill mechanism is the

microwave energy, which greatly increases the radius and the footprint by, in some cases, several orders of magnitude. For example, a 2000-pound microwave munition will have a minimum radius of approximately 200 meters, or footprint of approximately 126,000 square meters.

Studies have examined the incorporation of a high power microwave weapon into the weapons bay of a conceptual uninhabited combat aerial vehicle. The CONOPS, electromagnetic compatibility and hardening (to avoid a self-kill), power requirements and potential power supplies, and antenna characteristics have been analyzed. Extensive simulations of potential antennas have been performed. The simulations examined the influence of the aircraft structure on the antenna patterns and the levels of leakage through apertures in the weapons bay. Other investigations examined issues concerning the electromagnetic shielding effectiveness of composite aircraft structures.

Collateral damage from E-bombs is dependent on the size and design of the specific bomb. An E-bomb that utilizes explosive power to obtain its damaging microwaves will result in typical blast and shrapnel damage. Ideally, an E-Bomb would be designed to minimize and dissipate most of the mechanical collateral damage. Human exposure to microwave radiation is hazardous within several meters of the epicenter. However, there is a relatively low risk of bodily damage at further distances.

Any non-military electronics within range of the E-bomb that have not been protected have a high probability of being damaged or destroyed. The best way to defend against E-bomb attack is to destroy the platform or delivery vehicle in which the E-bomb resides. Another method of protection is to keep all essential electronics within an electrically conductive enclosure, called a Faraday cage. This prevents the damaging electromagnetic field from interacting with vital equipment. The problem with Faraday cages is that most vital equipment needs to be in contact with the outside world. This contact point can allow the electromagnetic field to enter the cage, which ultimately renders the enclosure useless. There are ways to protect against these Faraday cage flaws, but the fact remains that this is a dangerous weakpoint. In most circumstances E-bombs are categorized as 'non-lethal weapons' because of the minimal collateral damage they create. The E-bomb's 'non-lethal' categorization gives military commanders more politically-friendly options to choose from.



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