

# Electromagnetic Weapons as Means of Stopping Vehicles

## A Proposal of a Stationary Electromagnetic Device for Stopping Vehicles

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**Abstract** – The development of automobile technology is associated with the increase of application of electronic elements. One possible method to stop the vehicle is to disrupt the operation of electronic systems using a high power electromagnetic pulse. This article describes the design idea of a stationary generator of electromagnetic pulses that would be useful for stopping vehicles at checkpoints, at the entrances to the object and in front of sensitive infrastructure. An important aspect of the proposal is the effectiveness of the generator with respect to the electromagnetic immunity of vehicles.

**Keywords-direct** *energy weapons; car; vehicle; electromagnetic susceptibility; high power microwave; non-lethal weapons.*

### I. INTRODUCTION

Electromagnetic weapons are referred to as Directed Energy Weapons (DEW). These weapons use highly focused energy to damage targets. The energy could be delivered via electromagnetic radiation, sound, or subatomic particles. The DEW, which operate in the frequency range of 100 KHz - 1 GHz (Directed Energy Weapons - Radio Frequency DEWRF) and in the range from 1 to 300 GHz (microwave, DEWM) are devices designed to disrupt, degrade, or destroy electronic and electrical systems [1]. Automobiles contain a large number of electronic systems. Electromagnetic pulse (EMP) coupled into the electronic circuits of the vehicles can interfere with the operation of the electronic control unit [2]. Disruption of the function of the control unit may result in the engine stalling. This effect allows:

- Stopping the engine stationary or slow moving vehicles (e.g., vehicles used for bank robberies, drug-handovers, within the needs of detention persons or identification of criminals, or when the driver breached the traffic rules),
- Stopping speeding vehicles,
- Protection of convoys (reduce the risk of attack from other vehicles - collision, shooting) [3].

Only a few companies produce electromagnetic devices for stopping vehicles. These devices are used for the needs of police, army, special operations units or protecting of important events [4]. These electromagnetic weapons are very expensive. This article describes the design idea of a

stationary generator of electromagnetic pulses that would be useful for stopping vehicles at checkpoints, at the entrances to the object and in front of sensitive infrastructure. Initial ideas and design conditions of stationary electromagnetic system for stopping vehicles:

- The system will be used for stopping vehicles at the entrances to objects [5],
- Security personnel will use the system to stop suspicious vehicles [4],
- The system will be integrated with the access control system for use in security applications (this solution is missing),
- The system can be integrated with an alarm security system and video surveillance system (this solution is missing),
- The system can be activated automatically in response to a negative event (e.g., an attempt to break into the object, a vehicle in the vicinity of object, etc.),
- The power level of system will be set efficiently with a view of electromagnetic immunity vehicles,
- Possible inclusion of the system into a series of technical standards to complement alarm systems.

Project schedule should include:

- Analysis of design of contemporary DEW (USA, Germany, China, Australia, etc.),
- Comparison of contemporary devices and systems used for stopping vehicles,
- Analysis of the requirements of technical standards for electromagnetic immunity of vehicles,
- Selection of the type of generator of electromagnetic pulses (several solutions exist),
- The proposal the automatic generator control (main advantage of suggested approach),
- Simulation of the effects-similarly [4],
- Main goal-Creating a product prototype.

DEW basic description is given in Section 2. Contemporary electromagnetic systems for stopping vehicles are described in Section 3. Detailed information about the proposed system (use of alarm outputs of the access control system or cameras, detectors, wiring, etc.) will be addressed in our future work.

## II. DIRECT ENERGY WEAPONS

Electromagnetic weapons that operate in radio wave and microwave (DEWRF and DEWM) ranges use electromagnetic impulses. These weapons use two types of the generators: narrowband (HPM- High Power Microwave) and wideband (UWB- Ultra Wide Band). UWB weapons emit radiation in a wide frequency range, but with a low energy density. These devices are suitable where it is not possible to accurately identify the characteristics of the target- especially its working frequencies. HPM weapons emit pulses at the individual frequencies with very high power. The impact on the target is very effective, because the impulse resonates with the known frequency of the attacked device [1].

High-Power Microwave (HPM) electromagnetic energy can be produced as a near-instantaneous pulse created through special electrical equipment that transforms battery power, or powerful chemical reaction or explosion, into intense microwaves that are very damaging to electronics [2].

For the HPM systems some types of generators can be used like: MILO- Magnetically Line Isolated Oscillator, RKA-Relativistic Klystron Amplifier, TWT-Travelling Wave Tube, BWO-Back Wave Oscillator [3], MWCG-Cherenkov generator, Vircator-Virtual Cathode Oscillator, reltron, magnetron, gyrotron [4], etc. UWB Generator use as power component: special spark gaps, laser-activated semiconductor switches, quick switches for disconnecting circuits with inductance [4].

## III. CONTEMPORARY ELECTROMAGNETIC SYSTEMS FOR STOPPING VEHICLES

Figure 1 shows the system HPEMcarStop, which is produced by a company Diehl BGT Defence GmbH & Co., Roethenbach/Pegnitz, Germany [5]. The company produces HPEM (High Power Electro Magnetics) effectors in the form of systems with product names: HPEMcarStop and HPEMcheckPoint. System HPEMcarStop can be used, e.g., for activities by the police, army, special operations units or protection of important events (e.g., the Olympic Games).



Figure 1. The system HPEMcarStop (adapted from [5])

The system is designed so that EMP operates on the target vehicle from its front side; it means that the EMP generator is installed on a platform in the rear part of the

vehicle. HPEMcarStop was successfully tested with more than 60 different types of vehicles and allows stopping the target vehicle at a distance of 3 to 15 m with more than 75% success rate. HPEMcheckPoint is designed to the stopping of vehicles at checkpoints and in front of important objects (e.g., the critical infrastructure). It combines a system HPEMcarStop with another source HPEM, which is located on trailer.

Figure 2 shows the next system for stopping a car with the designation HPEMcase. This mobile system is used to influence command and data centers, computers, alarm systems control devices, surveillance installations, as well as all other kinds of electronics. Maximum peak radiated power is 365 MW and operating frequency 350 MHz [5].



Figure 2. The System for protecting buildings and persons HPEMcase (adapted from [5])

Other manufacturers, which produce similar devices are: the company Eureka Aerospace (Pasadena, California, USA, system RF Safe Stop) or British company e2v (Chelmsford, England, system HPEMS) [6] [7].

## IV. ELECTROMAGNETIC IMMUNITY OF AUTOMOTIVE TECHNOLOGY

During the research, it is necessary to analyze the requirements of the standards for electromagnetic immunity of automotive technology. Verification of Electromagnetic Compatibility (EMC) requirements is performed for automobiles, e.g., in compliance with European Directive 2006/28/ EC and with standards ISO 11451, 11452, 7637, CISPR 12, CISPR 25, SAE J1133, etc.

Vehicle manufacturers also use their own standards (e.g., BMW- GS 95002, Jaguar, Land Rover- CS2010JLR, Renault- 36.00.808, etc.). These standards are stricter than international standards. These standards contain information about the requirements of testing electromagnetic immunity (type tests, signal levels, etc.) for automotive components.

## V. CONCLUSION AND FUTURE WORK

An effective way to stop a vehicle is to disrupt the operation of electronic systems using high power electromagnetic pulses, which can be generated using electromagnetic weapons. We presented the idea to use a stationary generator of electromagnetic pulses for stopping vehicles at checkpoints and at the entrances to the object. An important aspect of the proposal is the comparison of

contemporary devices and systems used for stopping vehicles and analysis of the requirements of technical standards for electromagnetic immunity of vehicles. A novelty is the possibility of automatic generator control through integration with the alarm system. The output signal of the alarm system can trigger a HPM generator. The engine of vehicles within the radiation zone will stop and will not work as long as the HPM source is switched on. Another possibility is to use a camera system to identify the type of vehicle and its speed. This is one of the possible ways to adjust power of generator. It is not advisable to calibrate HPM generator for one type car. Suitable orientation of the antenna HPM generator is important, regardless of the car construction (cars with metalized windows and a full steel body or cars based on carbon fiber and aluminum). To achieve the best possible result (vehicle stop), target cars must be radiated from the front. Exposure time of HPM signals required to stop the vehicle is dependent on the vehicle type, construction, speed, etc.

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