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ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER PICATINNY ARSENAL, NJ

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

UWB Radiating Using Explosive Pulse Power from M4 Rifle

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Agenda

- Objective
- Background
- System Components
- Future Work

Objective

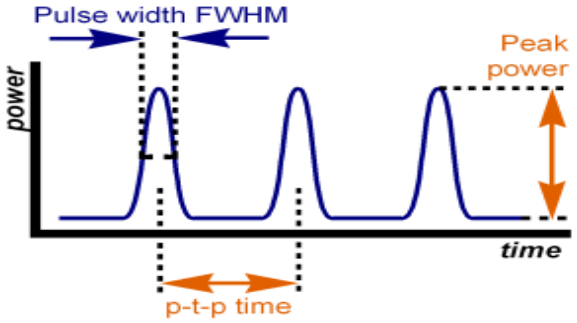
- To develop a portable directed energy system or weapon
- Utilize M4 rifle and blank ammunition to increase explosive pulse power output
- Determine maximum standoff distances that UWB (Ultra wideband) pulse affects electronic devices under test
- Determine far field EMP (electromagnetic pulse) beam width and elevation

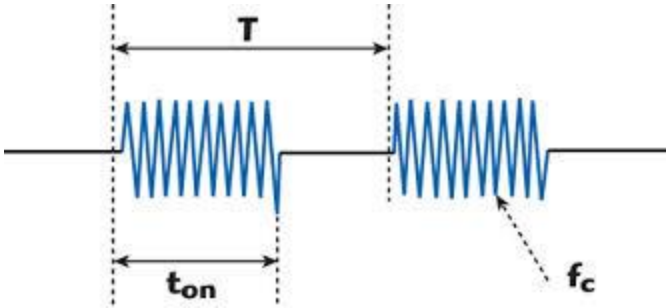
Background

- Most directed energy systems or weapons need to be towed

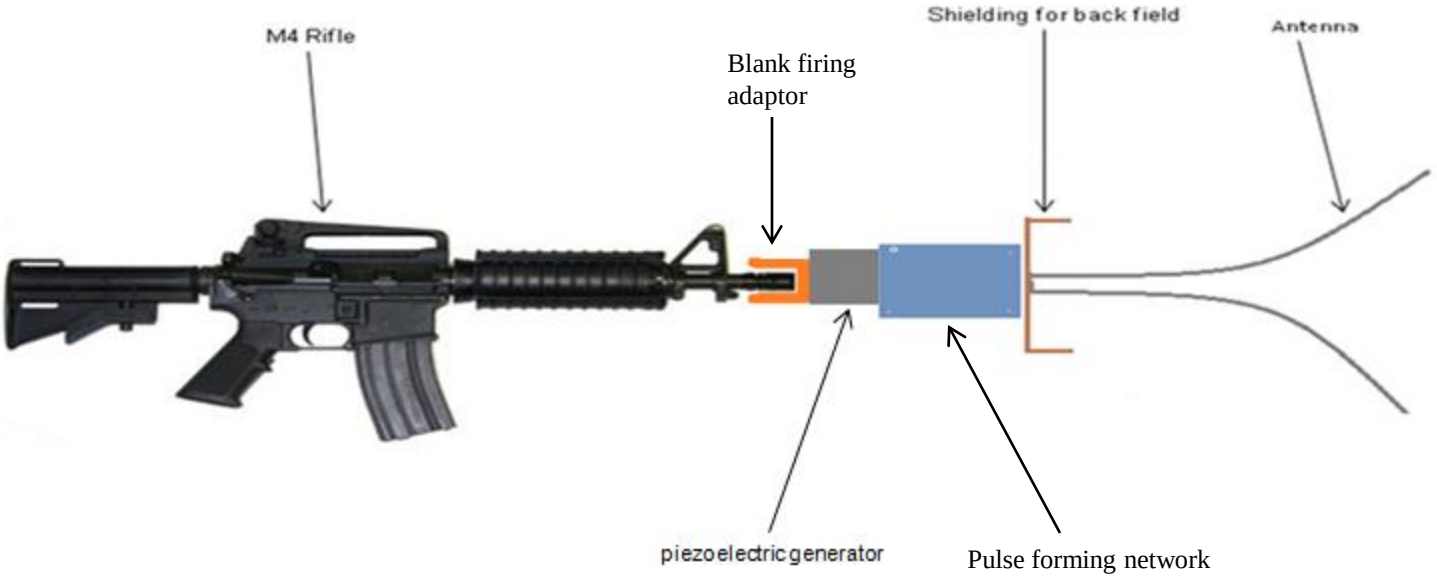
- Directed energy defeats electronic threats by high magnitude of coherent EMP or lower magnitude high rep rate coherent EMP.

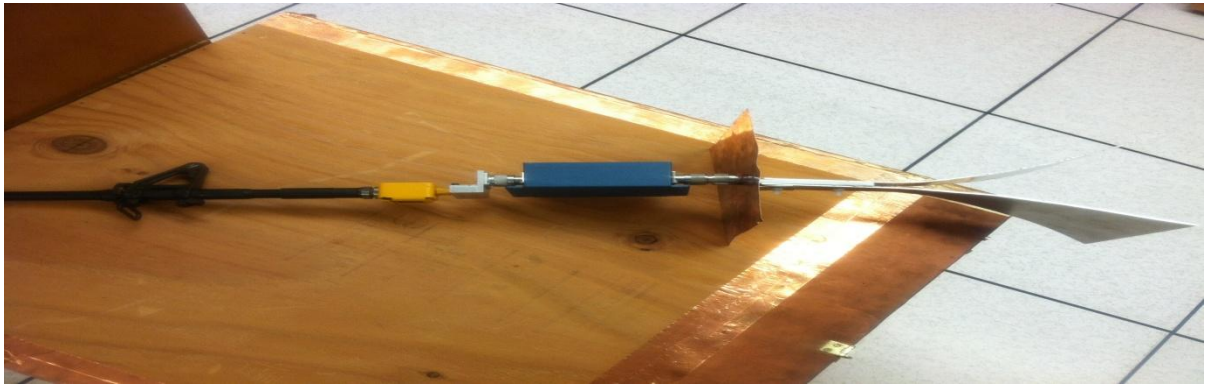
- Bipolar RF (radio frequency) pulses and Gaussian pulses are commonly used in directed energy systems. This project is using Gaussian pulses.





System Components

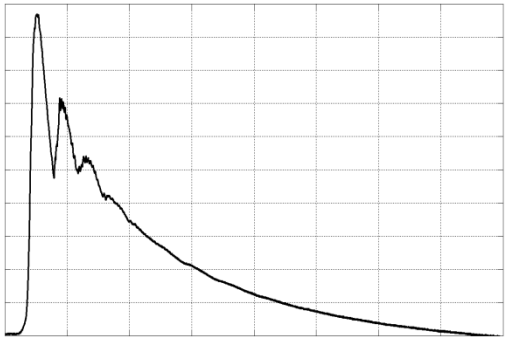


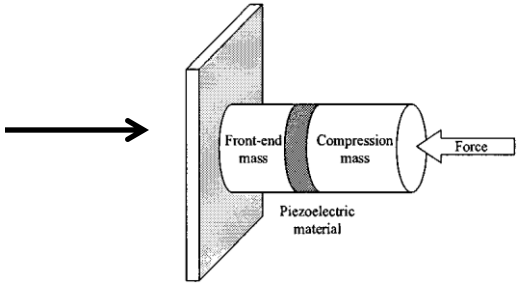


System Components

- Blank Rounds used to exert force onto a linear piezoelectric generator or PEG
- Working with Noliac to fabricate custom PEG
- Calculated results using Noliac solid and stacked PEG on DTIC (Defense Technical Information Center)

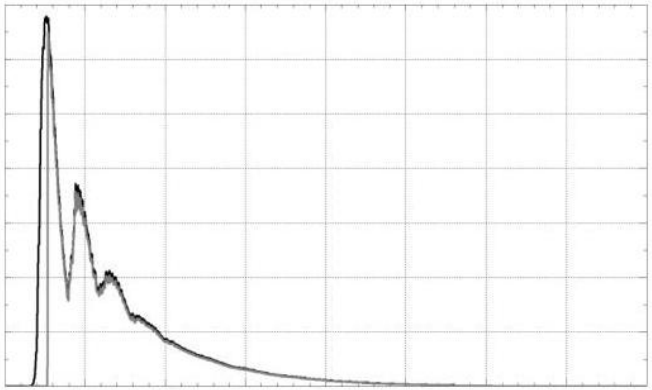
$$W_e = \frac{V}{2} k_{33}^2 s_{33}^D P^2 \qquad C = \frac{\varepsilon_r \varepsilon_0 An}{t} \qquad U = \sqrt{\frac{2W_e}{C}}$$

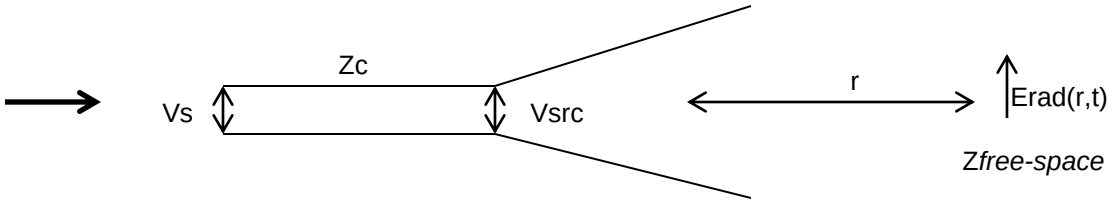




System Components

- Adding a spark gap to the output of the PEG as the pulse forming network.
- Spark gap will increase the rise time to sub-nanoseconds.
- TEM (transverse electromagnetic) horn antenna is used as the radiator for the EMP
- The back copper plate is for attenuation of back fields
- Transient calculations are used to determine the far field strength of the EMP



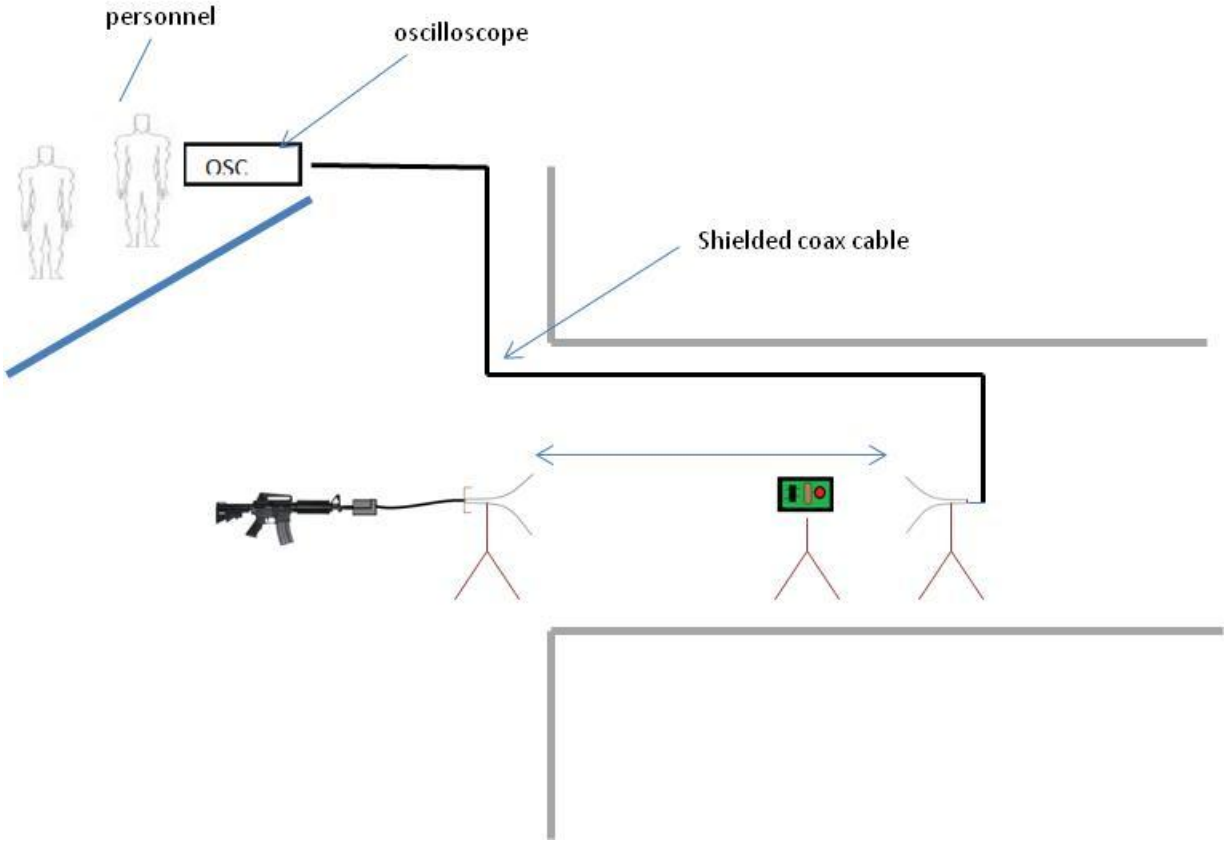


$$E_{rad} = \frac{h_{eff}}{2\pi cr}\left(\frac{Z_{free-space}}{Z_c}\right)\left(\frac{dV_{src(t)}}{dt}\right)$$

System Components

- Two TEM horn will be used for field testing

- Electronics device in far field to determine disruption level to electronic threat.



Future Work

- In the process of conducting far field transient test at ARDEC facilities
- Improve design of TEM horn antenna for higher transient gain in the far field
- Collaborate with Noliac to develop solid or stacked PEG designs that will increase pulse power output
- Investigating performances with higher caliber blank ammunitions
- Government personnel can contact DTIC online Journal for calculated and measured results