Multi-Spectral Camouflage Incorporating Insulation, Diffusion & Active Avoidance Techniques

(Expanded Topically From Previous Title "Cryogenically Derived Insulation For Thermal Stealth And Electronics Integration" & Inclusive Thereof)

By:

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&

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Forward By:

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US Army ARDEC, Joint Services Small Arms Program

Topic:

“Leveraging Advanced Commercial Technology To Achieve Military Goals”

Case Study: Commercial Electronics Innovation Transformed

Contents:

Introduction:

Theme:

1) Night vision devices have radically decreased in all SWAP-C factors.

2) They are commercially available now at extremely low cost worldwide.

3) These include IR CCD cameras, thermal imagers, I-Squared, others.

4) While not “MIL-STD”, the trend is immediately toward higher resolution.

However, ***even the lowest resolution passive devices pose a threat*** to US superiority in night operations…

Historical Overview Of Individual Weapon Night Vision Sights:

Innovative, Effective For The Times, But Short Ranged, Bulky And Heavy…

Active Night Vision Devices, Top Row: WW-II German "Vampir" Sight With Infrared Searchlight And Battery Pack. Bottom Row: US M-3 Carbine With IR Sight And Infrared Searchlight And Battery Pack.

Historical Overview Of Individual Weapon Night Vision Sights:

Smaller And Smaller, More Capable, Greater Range And Frequency Coverage…











US Passive Night Vision Devices: Clockwise From Far Left: PVS-2 Gen-1, PVS-4 Gen-2, PVS-17C Gen-2, UNS "Clip On" I-Squared Gen-3, PVS-10 , FLIR Thermal Sight, PVS-24 Gen-4, KAC "FIST" Gen-4, Night Vision Depot "COTI" Thermal Clip On Fusion Sight Available For Commercial Sale As Of This Presentation.

The Problems:

Current Commercial Night Vision & Thermal Systems:

Advancing Rapidly, Inexpensive, Widely Available And In Many Cases Superior To MIL-STD…

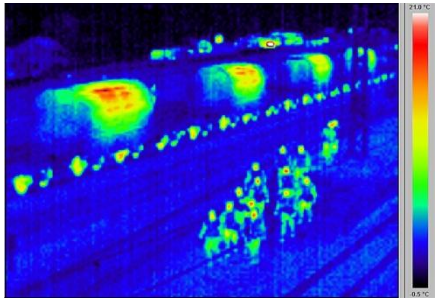
Clockwise From Top Left: Argus Inspection Camera (Note Handprint), FLiR Lepton, FLiR One Cell Phone Thermal Imager, FLiR Neutrino 2 Miniature Cooled Thermal, Raytheon Minature Thermal Imager, FLiR Commercial Hunting Sight, Sofradir Atom Thermal (Note Quarter, Tiny Sensor, B&W Image), FLiR Remote Link Inspection Camera With Bluetooth Connectivity.

The Problems:

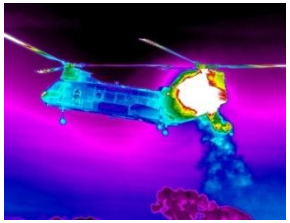
Current Commercial Night Vision & Thermal Systems:

Well Funded Commercial, Scientific And Consumer Efforts Produce This Imagery…





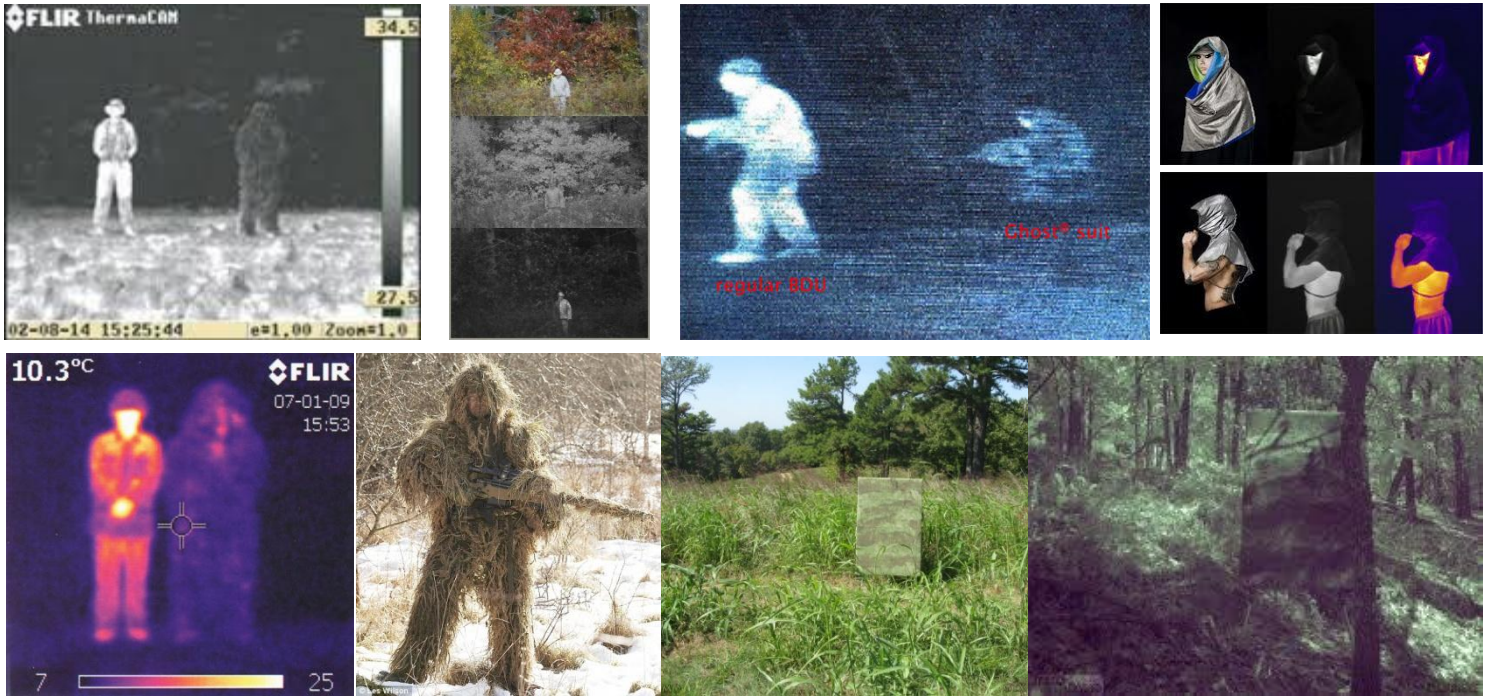





Clockwise From Upper Left: ATN Thor Rifle Sight, FLiR Lepton Thermal Core, FLiR One Lepton Based Cellular System & Currently Available Cell Phone Sight App, FLiR Low Resolution Inspection Camera Image, 120x80 Pixel Thermal Hog Hunting Scene, FLiR Neutrino 2 Cooled Thermal, Teppo-Jutsu Gen 2 I-Squared, Armasight Thermal, Long Range 120x180 Pixel Thermal Hog Hunting (Note Long Range Detection Without Identification In Low Resolution Imagery).

Commercial Night Vision Camouflage Technology:

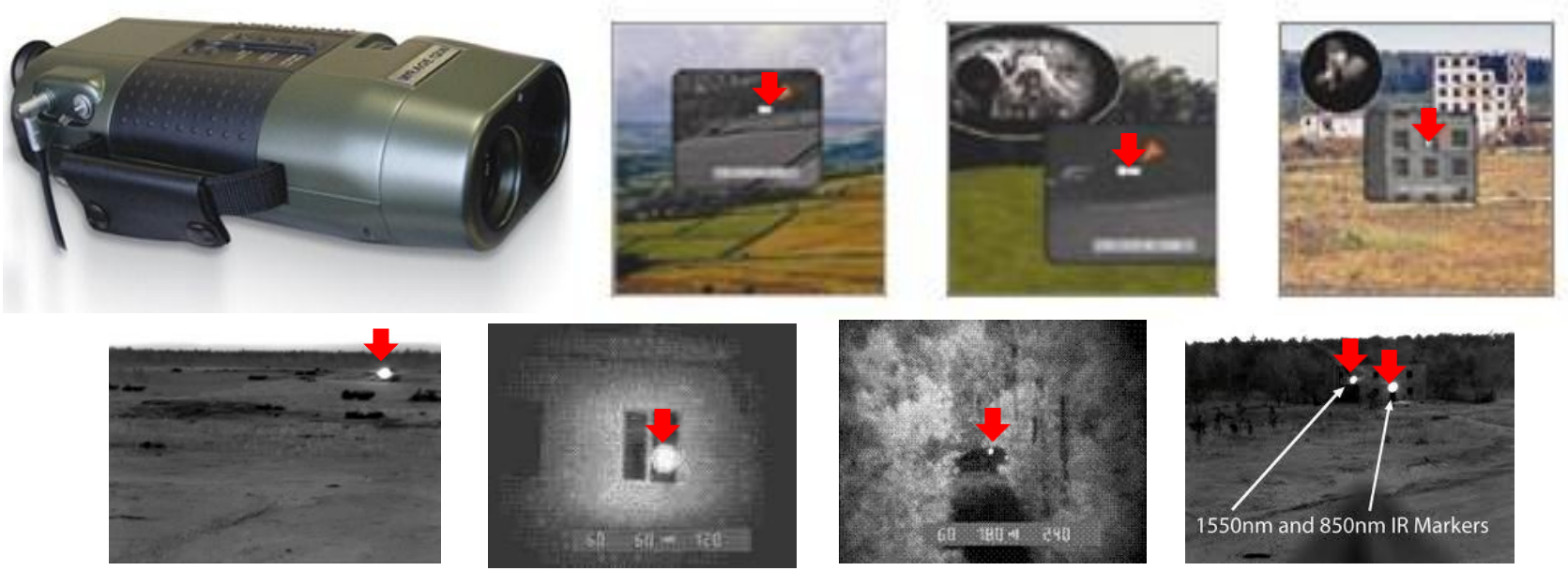
Note: Majority Work In A Single Frequency, Frequently Becoming More Detectable In Others…



Clockwise From Top Left: SoldierSystems.net photo, UVR Defense Tech, Blucher Systems, GizMag.net photos, Greyops VIS/IR, British MOD Traditional Ghillie Suit, Raven Aerostar/W.L. Gore Nemesis Thermal Attentuation.

The Problems:

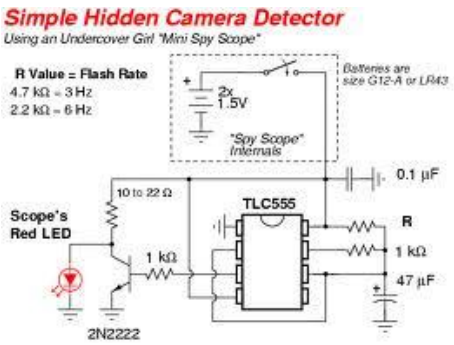
The Mirage Optic Detection System (1 of 4) from Torrey Pines Logic:



Clockwise From Top Left: Torrey Pines Mirage-1500 Long Range Optical Detector, Finding Observation Teams, Same Image Close Up, Finding Snipers, Finding Target Markers, Finding More Snipers, Finding Cameras, Finding Rangefinders…Can Locate Any "Stacked" Optical Device With>1 Lens By Reflection.

The Problems:

Commercial Hidden Optic Detectors:



Clockwise From Upper Left: OCD Canada LR Optics Detector, Public Area Camera Detector Circuit, Counter-Spy Shop RF & Hidden Camera Sweep Kit, Home-Made Red LED Flashlight & Cardboard Camera Detector, Combined RF/Camera Detector, Detector Image Of Three Hidden Cameras (One In Upper Picture Frame, Two In Lower Frame & Photo).

Candidate Weapon: The Remington MK21 Precision Sniper Rifle

Game Changing Accuracy & Versatility In A Single Weapon System…

Above: Top Image Remington MK21 PSR In SOCOM Configuration, Below: Selected PSR Accessories
Remington Defense Photos

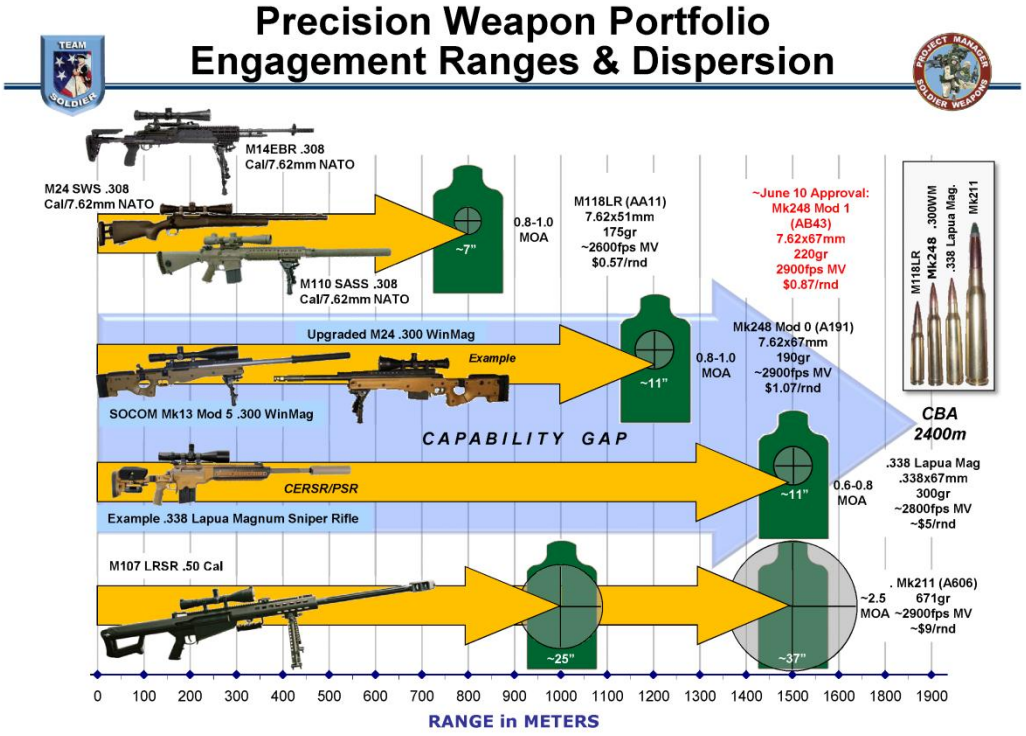
Candidate Weapon: The Remington MK21 Precision Sniper Rifle

Visually Stealthy, Deployable, Powerful…

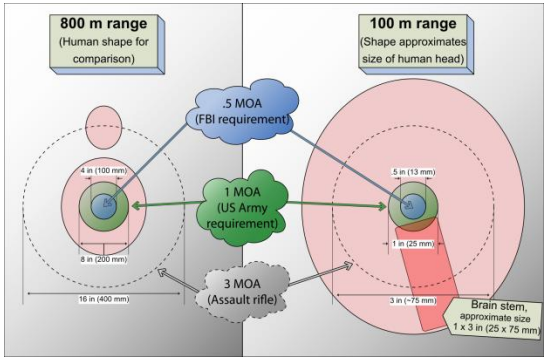
Clockwise From Upper Left: Earth Tone Coloration, Field Deployment Kit, Comparison Of Available Rounds. Remington Defense Photos

Candidate Weapon: The Remington MK21 Precision Sniper Rifle

Filling The Precision Engagement Capability Gap…And Evolving Ever Greater



caliber	.308W	.300 WM	.338 LM	.338 LM
round	175 gr	190 gr	250 gr	300 gr
v1 in m/s	784.5	830.5	903.6	807.0



Clockwise From Upper Left: Army Engagement Range & Dispersion, SAR Chart Of PSR Ammunition, Wikipedia Effect Of Accuracy vs. Range At 100 & 800m Distance From The Firing Position…Sub-MOA Is Essential At Extended Range.

Blocking Light From Illumination Passively & Actively:

Goals:

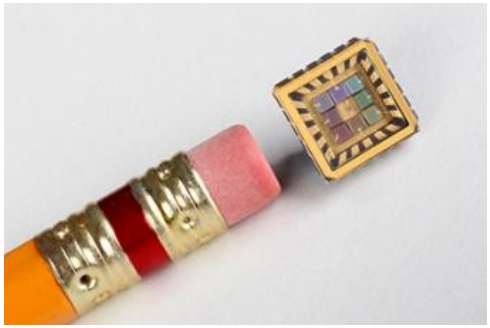
1) Prevent Laser Optic Locator From Revealing Shooter Position

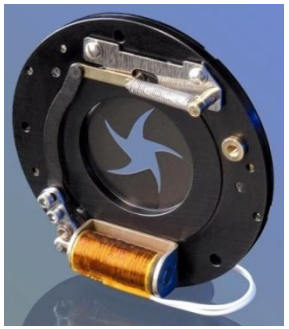
2) Protect The Operator From Dazzling Or Blinding Lasers

3) Blocking Light Selectively To Allow Continuous Viewing Even When Under Direct Attack From High Power Lasers

Example: PixelTeq Multi-Band Light Detector Shutter Counter-Measure:

Goal: Eliminate Soldier Illumination Detection Deficit & React Instantaneously

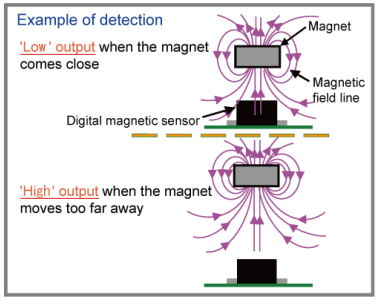


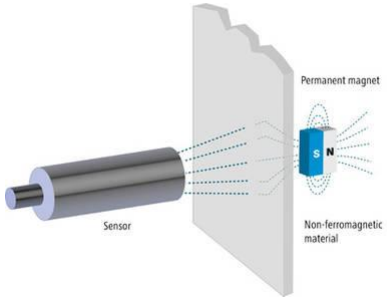


Left To Right: PixelTeq Selective 8-Band Light Detector Connected To Reaction Circuit For: 4x5 Camera Shutter (Melles Griot), Nidec/Copal Shutter Aperture Example, Thorlabs 1” Shutter System.

CMC/TI AR-15, AR-10 Pattern Rifle Digital Drop In Trigger & Sensor:

Goal: Control Weapon Electronics With Trigger To Minimize Movement





Clockwise From Top Left: TI LDC-1000 Direct Inductance-To-Digital Sensor, CMC Trigger With LDC-1000, CMC Drop In Trigger Design, CMC Installation, LDC-1000 On Trigger Cartridge, Baumer Photo, Toshiba Photo (Magnetic Principles)

Example: Kent Optronics “Intelligent Glass” Counter-Measure

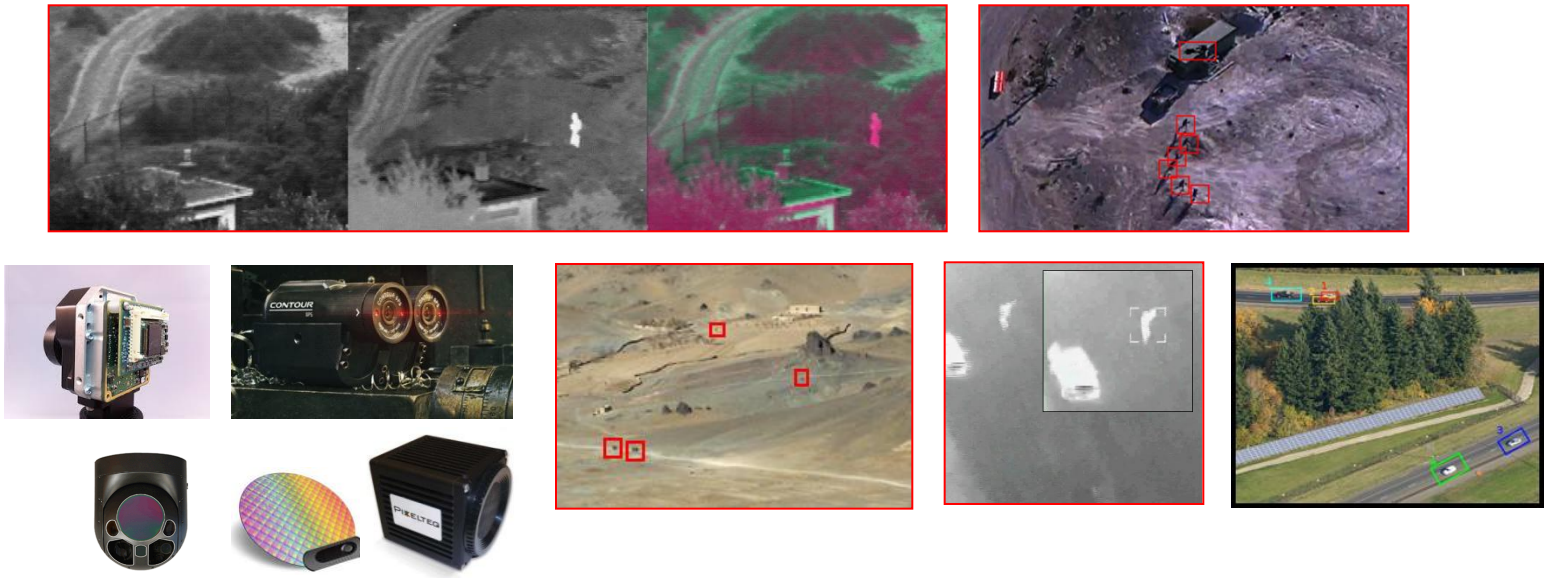
Goal: Provide Solid State “Shutter-Type” Concealment & Protection For Users

- Nano-Wire Embedded LCD Display, >90% Clear With Optical Coatings
- Compares With Commercial Optic Clarity When Used As A Lens Filter
- Able To Black Out The Filter Surface In <10ms For Laser Protection

Above: Intelligent Glass By Dr. Le Li, Kent Optronics LLC, Phone: 845-897-0138, e-Mail: leli@kentoptronics.com

SightLine Video Based Optical Detector/MTI/Tracker Counter-Measure:

Goal: Increased Situational Awareness & Target Engagement Efficiency

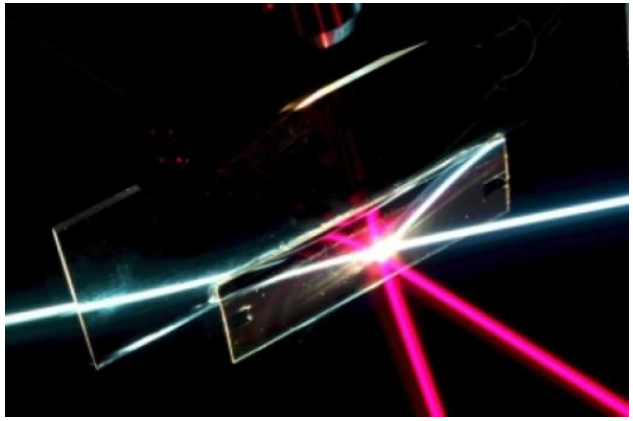


http://www.sightlineapplications.com/index.html

Clockwise From Top Left: Sightline Multi-Image Overlay, Kestrel UAS Image, Sightline Automobiles, Sighltine PIP Magnified Combined Tracker, Kestrel UAS Image, PixelTeq 4 Band NIR-SWIR, Twin Gunmetal LLC/REPLAY Stereo EOD, FLIR MX-10 Three Camera Bay, FLiR Quark/Sightline Board.

Example: MIT “One-Way Selective Glass” Counter-Measure:

Goal: Selectively Block Specific Light Frequencies In One Direction Only



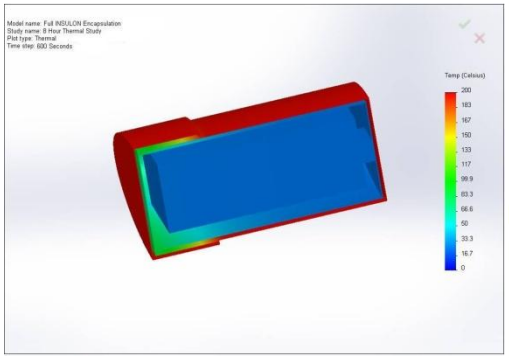
“Optical Broadband Angular Selectivity”

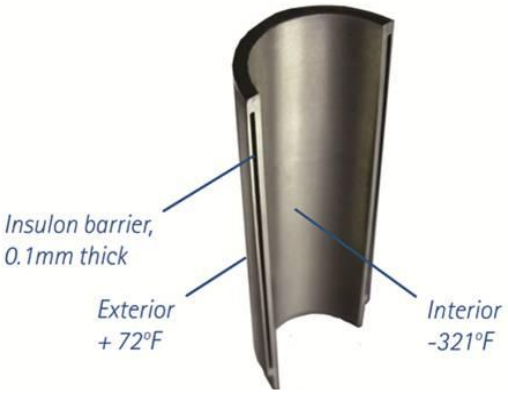
Journal Reference: Optical Broadband Angular Selectivity. Science, 2014; 343 (6178): 1499 DOI: 0.1126/science.1249799
1.Y. Shen, D. Ye, I. Celanovic, S. G. Johnson, J. D. Joannopoulos, M. Solja i .

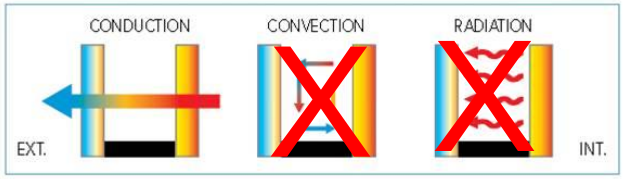
Abstract: Light selection based purely on the angle of propagation is a long-standing scientific challenge. In angularly selective systems, however, the transmission of light usually also depends on the light frequency. We tailored the overlap of the band gaps of multiple one-dimensional photonic crystals, each with a different periodicity, in such a way as to preserve the characteristic Brewster modes across a broadband spectrum. We provide theory as well as an experimental realization with an all–visible spectrum, p-polarized angularly selective material system. Our method enables transparency throughout the visible spectrum at one angle—the generalized Brewster angle—and reflection at every other viewing angle.

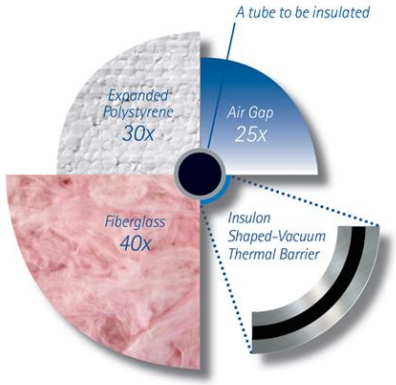
http://www.sciencedaily.com/releases/2014/03/140327142447.htm

Concept Group, Inc. INSULON Thermal Barrier Technology:





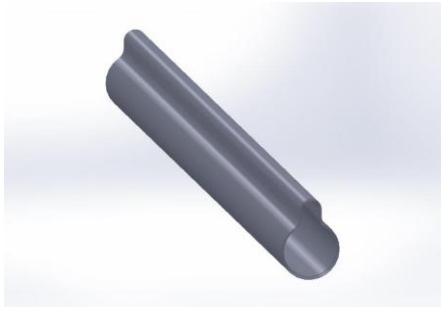


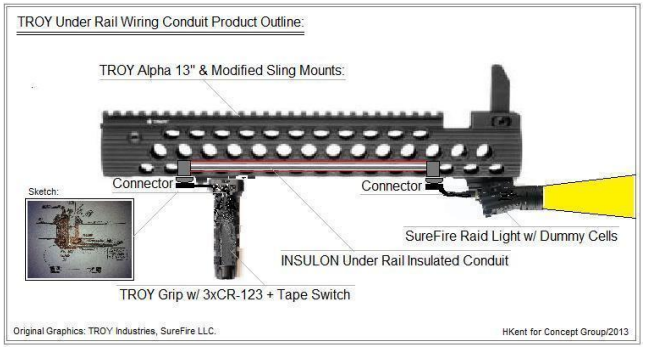


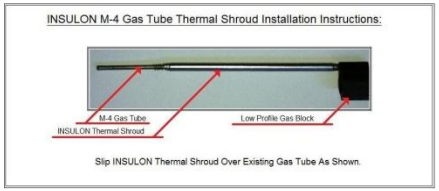
Clockwise From Upper Left: INSULON Enclosure 8-Hour Thermal Test, INSULON Original Cryogenic Application, INSULON Cryo-Surgical Tube Test, INSULON Insulation Equivalency, Chart Showing Reduced Convection & Radiation Due To Micro-Polished Internal Surfaces & High Earth Orbit Vacuum Levels, INSULON High Temperature Application.

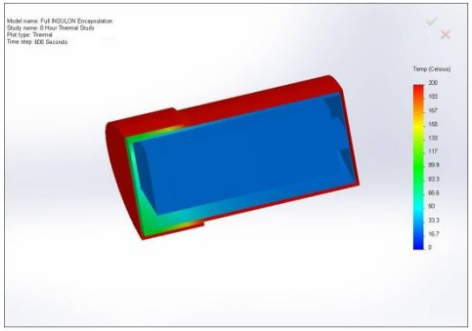
Concept Group, Inc. INSULON Thermal Barrier Technology:

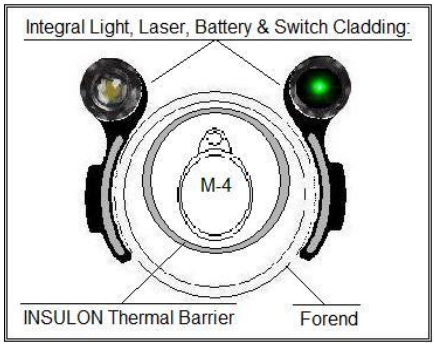
Goal: Allow Batteries, Wiring & Sensitive Electronics To Coexist With Firearm Heat











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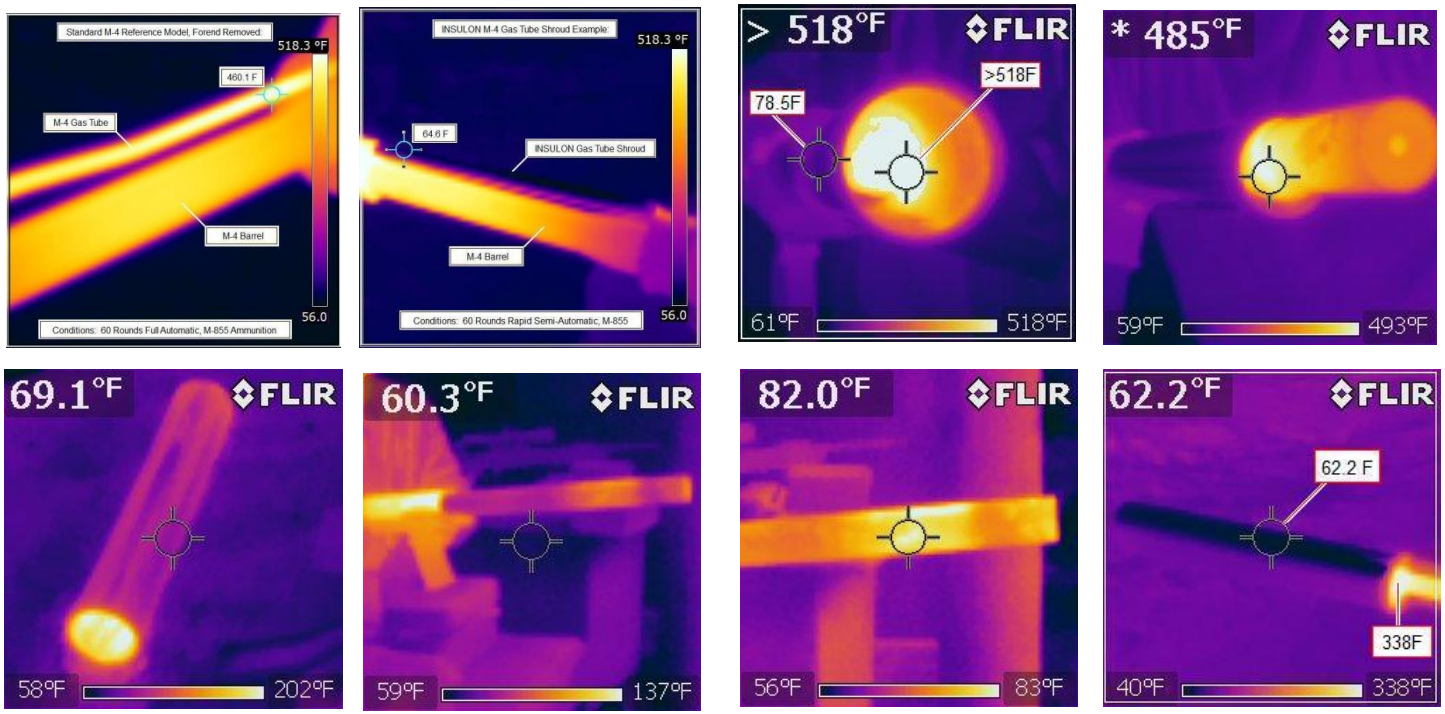
Concept Group, Inc. INSULON Thermal Barrier Technology:

Goal: Eliminate High Temperature “Point Sources” & Diffuse Thermal Signature



Clockwise From Top Left: Bare M-4 Gas Tube After Firing, INSULON Gas Tube Shroud After Firing, INSULON Sound Suppressor Shrouding Effect, Same View INSULON Retracted, Side View Of Previous, Early Heavy Wall INSULON With Point Source Elimination, Full Frame Of Previous, INSULON Tube After 15 Minutes With Suppressor Inside.

Remington MK 21 Based Example:

Above: Remington MSR M-2010 US Sniper Rifle With LR-UNS, Storm Rangefinder, AAC Suppressor; Original Concept Art Showing Shrouded Suppressor, Barrel & Muzzle For Signature Reduction Of Thermal & Flash Effects.

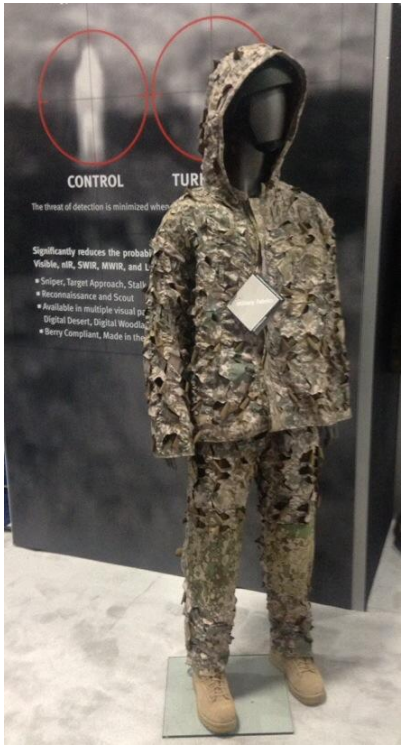
Commercial IR Camouflage Technology:

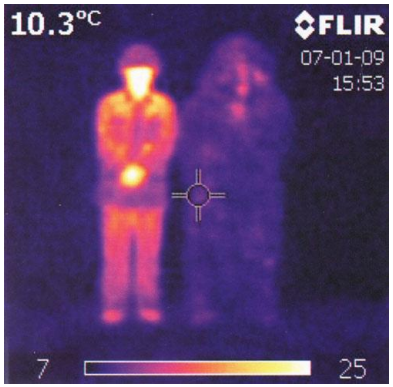
Goal: Minimize IR Reflection With NIC Proprietary Ceramic Camouflage Coating

Clockwise From Upper Left: Two Rifle Seen In IR Gen III, NIC Ceracoat IR In Brown & Green Camouflage Pattern, Barrel With Dark Grey IR Coating, Action Section, Difference Between Scope & Action, Entire Rifle Non-Reflective.

Raven Aerostar / W.L. Gore "***Nemesis***" Thermal Camouflage Technology:

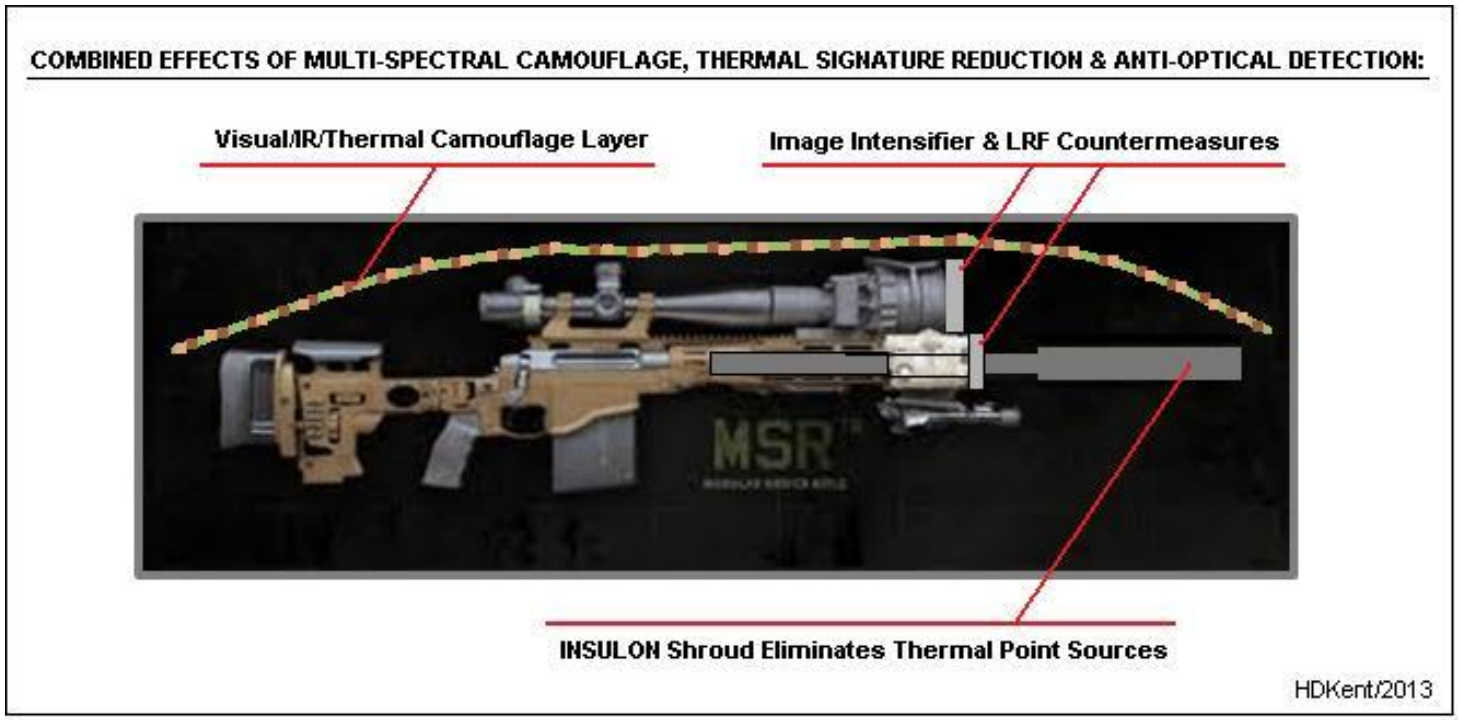
Goal: Attenuate Human/Rifle Thermal Signature To Reduce Enemy Thermal Detection Range





Clockwise From Top Left: Nemesis Camouflage, Full Profile, SoldierSystems.net Photo, Greek Military Test Standard Uniform + IR Camouflage + Thermal Ghillie Suit, ca. 2009 Glowtrade Standard Uniform + Thermal Ghillie Suit.

Combined Passive & Active Effects Of Counter-Measures:



Conclusions:

- Commercial Technology May Be Co-Opted For Military Purposes
- Any Adversary In The Future Will Have Advanced Detection Devices
- There Is An Increased Need For Multi-Spectral Signature Reduction
- A Combined Approach Of Multiple Technologies Will Be Required
- Both Passive & Active Countermeasures Must Be Considered To Address The Emerging Array Of Threats

Credits:

POC: Howard D. Kent, CEO, Phone: 818-314-8636, e-Mail: HDKent@socal.rr.com

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With Special Thanks To:

Remington Defense

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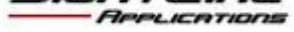


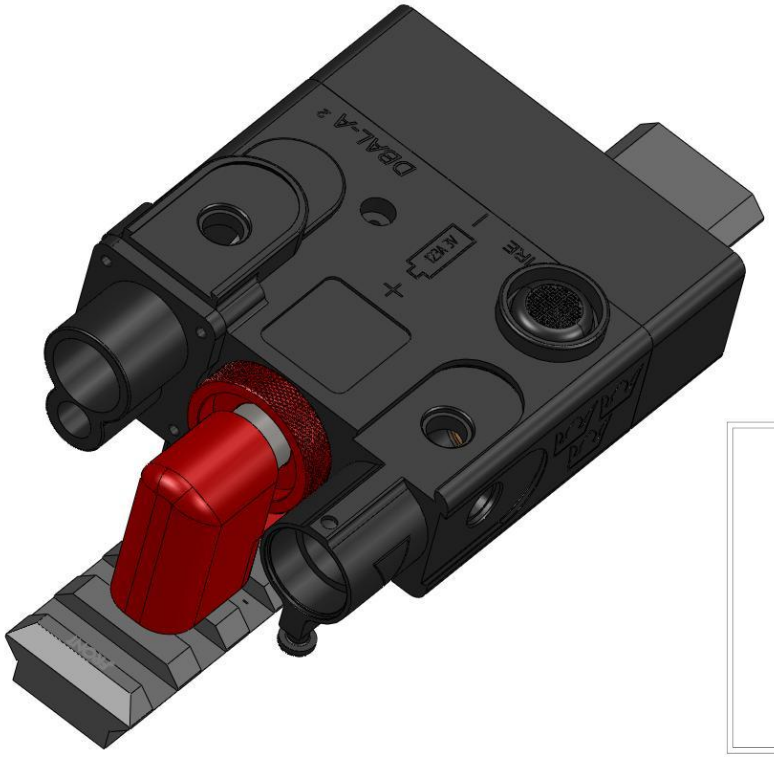
&
Dr. Jeffrey Widder, PhD.

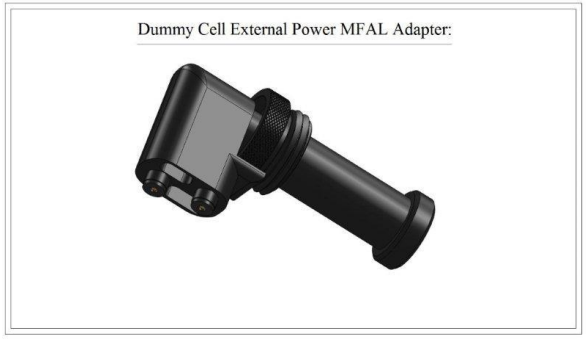
Battelle
The Business of Innovation

The ATK “RIPR” Powered Rail Attachment For The M-4:

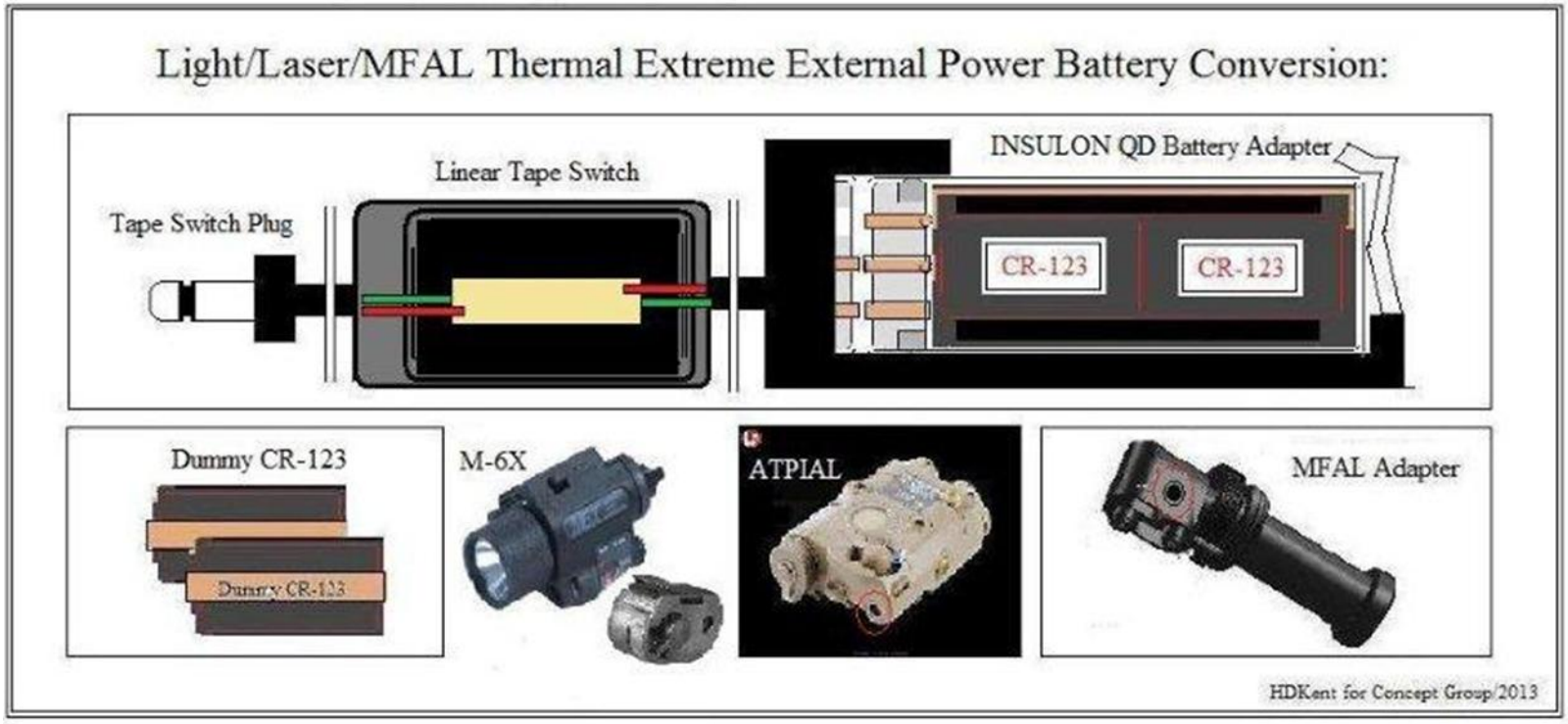
Patented 2008 By Howard D. Kent & Michael Malherbe

ATK RIPR Powered Rail Accessories, Laser Devices DBAL Example:

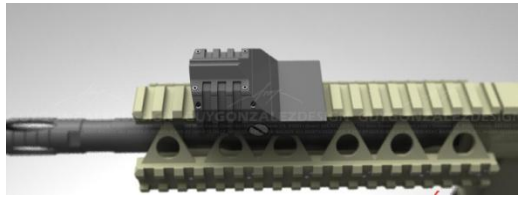


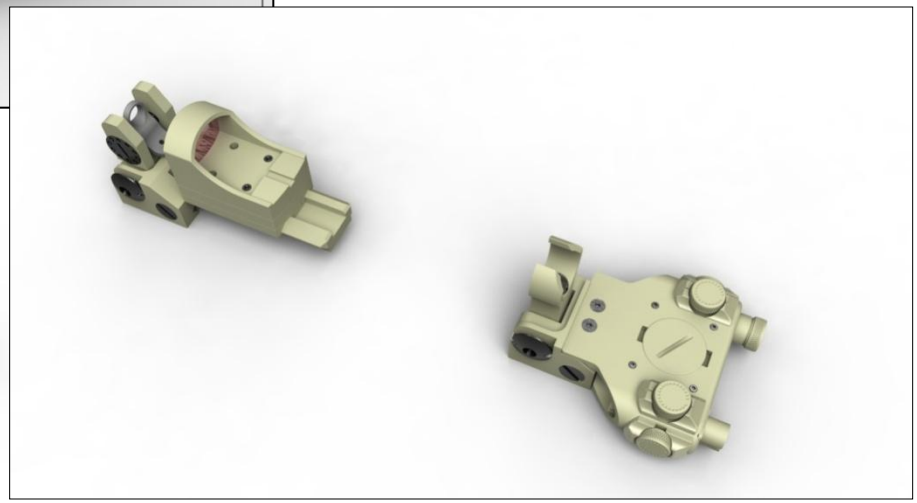


Conclusions:



ADG/Ballistic Opto-Mech Powered Rail Accessory Designs:





ADG With Col. Patrick Sheets' of **GC2IT**:

RM-FIST Concept: ***"Rifle Mounted-Fire Support Technology"***