

# Thermal Imaging History

- Thermal Imaging technology originally developed for military applications.
- 1950-1960 Single Element Detectors (Line Images)
- 1970 Philips and English Electronic Valve (EEV) developed Pyro-Electric tube. **FIRST NAVY THERMAL IMAGER**
- 1978 Raytheon developed Barium Strontium Titanate (BST). **CURRENT NAVY THERMAL IMAGERS (ISG-K90 Talisman)**
- Late 1980's Microbolometer technology developed.

# Navy Thermal Imagers

- EEV



Legacy

- ISG-K90 Talisman



Replacement

# Sensor Types

## Past Technology

- **Pyroelectric Vidicon (Tube Technology)**
  - Produced 1982 to 1998
    - TGS (Triglycine Sulfate, the sensing material)
      - could not tolerate high heat loads
    - Whiteout when pointed to a fire, unable to reset
    - Low sensitivity, lack of scene detail
    - Sensor permanently damaged when subjected to heat
    - Unable to resolve movement and direction of thermal energy (very important)



EEV P4428 NFTI, the original Navy Firefighting Imager

# Sensor Types

## Present

- **BST**

- Produced 1998 to Present

- BST Target – can tolerate high heat loads without damage
- No whiteout when pointed to a fire
- High sensitivity – very good scene detail
- Image constantly being refreshed (30+ per second)
- Sensor not damaged when subjected to heat
- Resolves movement and direction of thermal energy

Thermal Current



# Sensor Types

## Present

- **BST**
  - Reliability is unparalleled
  - Thousands in use in military systems such as:
    - USN Replacement Thermal Imagers
    - Bradley Fighting Vehicle
    - DVE for HUM-V
    - Light Weight Weapons Sites

Thermal Current



# Sensor Types

Present



- **Microbolometer**

- Produced 2000 to Present
- Available in Amorphous Silicon (Asi) and Vanadium oxide (Vox).
  - Chemical makeup of sensing material of the chip
- High dynamic range.
- Allows for reduced unit size
- Sensor has a shutter which refreshes image.
  - Think of your eye's iris and pupil
  - Causes image to freeze while being refreshed

# Navy Thermal Imagers

- Legacy Imager (EEV)
  - Developed with 1970's technology.
  - Entered Fleet service circa 1987 (Post USS STARK)
    - Requirement for thermal imaging capability identified during investigation.
  - No longer manufactured.
    - Spare parts no longer available.
  - Battery performance poor
  - Subject to “whiteout”, user can not restart or clear lens
  - Cumbersome
- Need for COTS replacement identified late 1990's.

# Navy Thermal Imagers

- ISG-K90 Talisman
  - USN conducted technical evaluation of 7 manufacturers against 27 requirements during 1998-1999. Live Fire testing conducted aboard EX USS SHADWELL. K-90 deemed superior.
  - BST Sensor with **DIGETEK** technology.
    - Microbolometer Quality with Reliability of BST.
  - Total weight = 4 pounds
  - Uses Nickel Metal Hydride (NiMH) batteries which significantly increases battery life (5 hours) and are rechargeable.



# Navy Thermal Imagers

- ISG-K90 Talisman (cont'd)
  - DIGITEK provides:
    - **AUTOMATIC VARIABLE SENSITIVITY SYSTEM:** Ultra-high resolution in hot firefighting environments.
    - **AUTOMATIC ACTIVE COOLING:** Improves camera's endurance in hot environments by adding a special Smart Turbofan that automatically cools critical electronics.
    - **AUTOMATIC SCALE EQUALIZATION:** The Scale Equalization system continually measures and analyzes the environment's temperatures, then takes the highest temperatures and truncates them to avoid whiteout, while concurrently boosting the brightness of colder objects to allow firefighters to look directly into a fire, yet not lose clarity of other objects around, and in front of the fire.
    - **DIGITAL IMAGE PROCESSING:** Incorporates new algorithms to take control of the sensor's output and funnels it through a bank of digital image processors to "sharpen" the image..
    - **HIGH CLARITY CRT DISPLAY:** Replaces the standard CRT monitor with a newer, higher performing CRT monitor for even better image reproduction, and better reliability in hot environments.

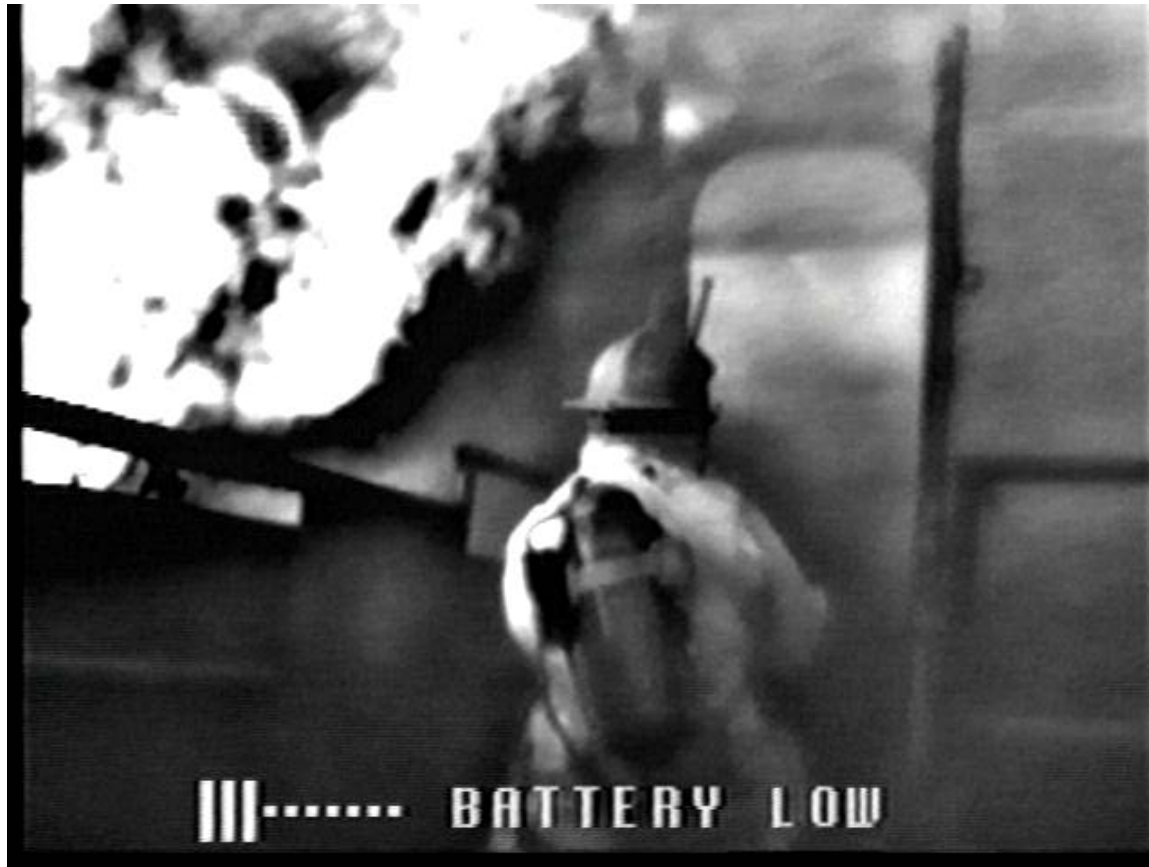
# Thermal Imager Cost Offsets

- Cost Offsets
  - ISG manufactures the K-90, including all components used in the image processing core. This guarantees lifetime part support.
  - ISG has provided the US Navy with component level repair training and provides annual refresher training. This training has been supplied to the Navy at no cost. These sites are established at Norfolk and San Diego.
  - The organic Navy repair capability for the cameras reduces ownership costs in parts, labor and shipping.
  - ISG is expanding the training and certification to include carriers which will significantly enhance the organic Carrier Strike Group repair capability and readiness level at no cost to the Navy.

# Navy Thermal Imagers



# Navy Thermal Imagers



# Navy Thermal Imagers

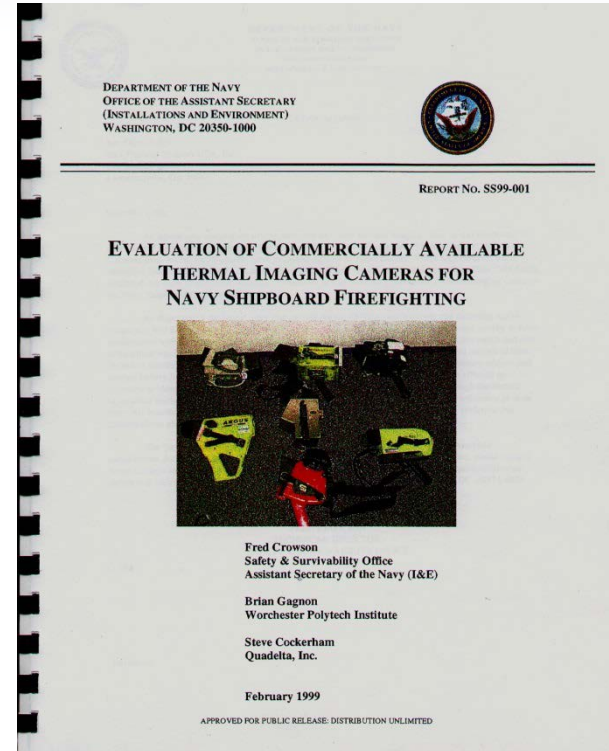


# Other Users

## NATO and other US users of K-90 Talisman

- Singaporean Navy
- Greek Navy
- Hellenic Navy
- Hong Kong Navy
- Turkish Navy
- German Navy
- Navy Of Portugal
- Australian Navy
- New Zealand Navy
- Spanish Navy
- US Air Force
- US Coast Guard

Based upon USN acceptance  
Report.



Questions?

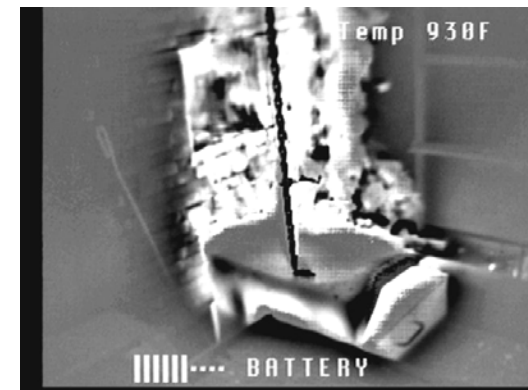
**BACKUP**



# DIGITEK

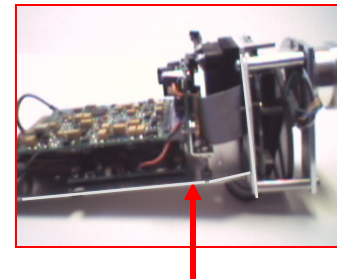
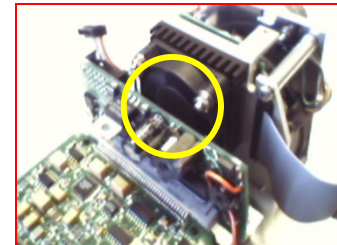
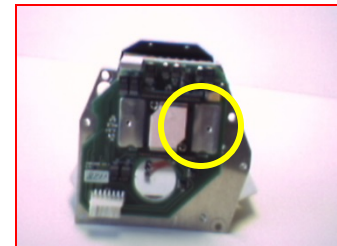
- **Automatic Variable Sensitivity**

- Automatic Gain
  - adjusts the brightness for best image clarity
- Automatic Offset
  - Adjusts the contrast for best image clarity relative to the brightness
- Automatic “Cat-Eye” Iris
  - prevents the sensor from being blinded by very hot objects.



# DIGITEK

- **Automatic Auxiliary Cooling**
  - **Thermoelectric Stabilizers**
  - **Smart Turbo-Fan**
  - **Heat Collector**



# DIGITEK

- High Efficiency Lens System
  - **Custom Designed** By ISG specifically for the K-90 Talisman.
  - **Hard Coated Germanium** for extra reliability and strength.
  - **Two Element Aspheric Design** for superb performance, better transmission and better image quality.

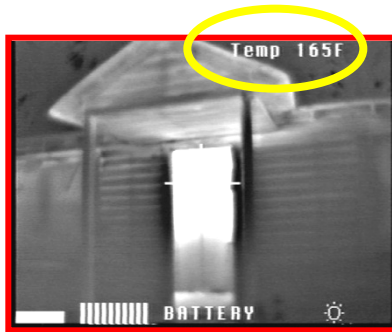
# DIGITEK

- Digital Image Processors
  - Special Customized Electronic signal processing To “Clean-Up” The Image

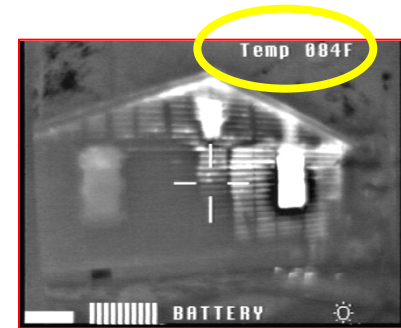


# Digital Direct Temperature Measurement

- On-screen Digital Temperature Display



**Useful Tactical  
Information for the  
Firefighters!**



**Allows for  
Identification of  
thermal load and  
flashover potential.**

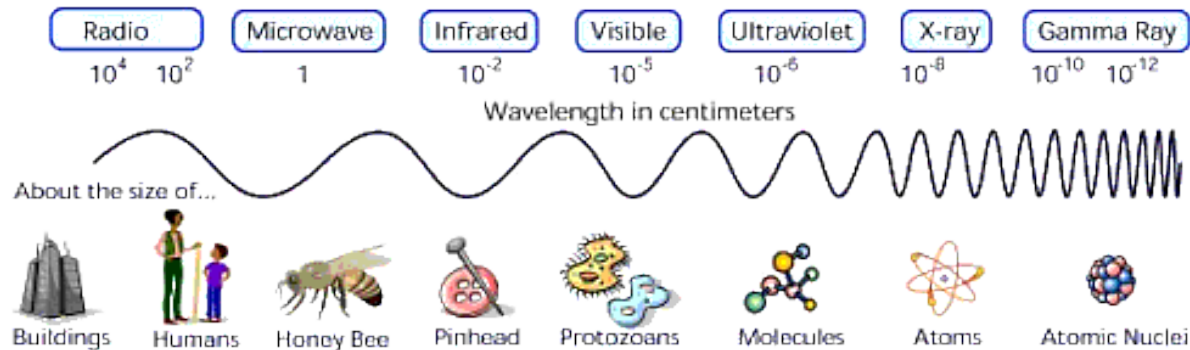


# Wavelengths Make The Difference

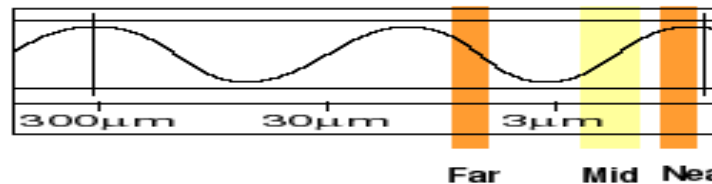
- Different Wavelengths mean different results:
  - Short Wave Infrared
  - Mid Wave Infrared
  - Long Wave Infrared
- Only one wavelength is suitable for firefighting applications – long wave infrared.

# Wavelengths Defined

- **Infrared light** lies between the visible and microwave portions of the electromagnetic spectrum. Infrared light has a range of wavelengths, just like visible light has wavelengths that range from red light to violet. "Near infrared" light is closest in wavelength to visible light and "far infrared" is closer to the microwave region of the electromagnetic spectrum. The longer, far infrared wavelengths are about the size of a pin head and the shorter, near infrared ones are the size of cells, or are microscopic.



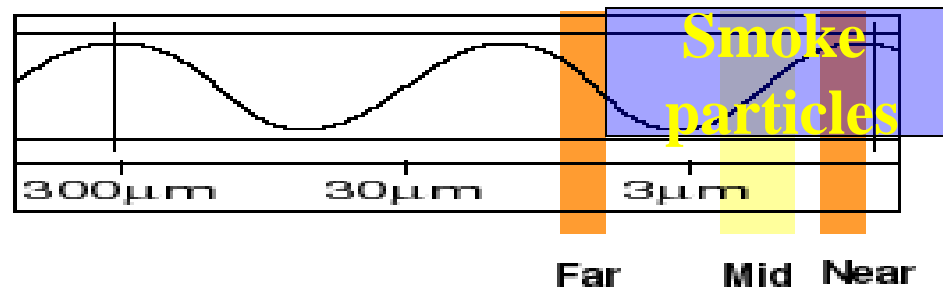
**Infrared Region of the Electromagnetic Spectrum**



# Wavelengths Defined

- **Far, Mid, and Short Wave Infrared:**
  - Smoke particles must be shorter than the shortest wavelength resolvable by the camera. In mid wave IR systems, the shortest wave sensed is typically 3 microns; in short wave IR, the shortest wave length sensed is typically 0.9 microns.
  - Far Infrared systems sense 7 to 14 microns. Smoke particles very rarely exceed 7 microns, therefore, transmission loss, due to smoke, is very rare in far infrared systems.
  - Camera transmission suffers material losses in shorter wave length systems. In effect, smoke interferes with the image clarity of short and mid wave systems.

Infrared Region of the Electromagnetic Spectrum





# Wavelengths Defined

- Only Far Infrared Works for Firefighting:
  - Furthermore, far infrared waves are thermal. In other words, we experience this type of infrared radiation every day in the form of heat! The heat that we feel from sunlight, a fire, a radiator or a warm sidewalk is infrared. The temperature-sensitive nerve endings in our skin can detect the difference between inside body temperature and outside skin temperature.
  - In firefighting, we must sense heat, therefore, the most appropriate wavelengths to sense to measure heat lie in the far infrared band.
  - Additionally, far infrared waves offer the best penetration through smoke without the interference from solar reflection inherent with mid infrared bands. Near IR does not nearly have enough smoke penetrating characteristics and therefore is not useful in firefighting conditions.