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TI Based Night Vision System

K. Vinod Kumar Reddy¹, K. Rojamani²

¹UG Student [ECE], Krishna University College of Engineering & Technology, Machilipatnam, AP, India ²Assistant Professor, Dept of ECE, Krishna University College of Engineering & Technology, Machilipatnam, AP, India

Abstract: Night vision system is a cooled TI based integrated day/night sight. This is highly useful to Army and Navy for effective engagement of targets. Weather proof and withstand shocks and vibrations. It is provided with electronically generated reticle. A thermal picture is captured by an IR-sensitive detector. The output electrical signal is converted to a video signal. The processed signal is translated to at TV picture on which the various temperatures and emissivity appear as different brightness's. This technology operates by capturing the upper portion of the infrared light spectrum, which is emitted as heat by objects. Hotter objects emit more of this than cooler objects.

Keywords: TI, IR, PSCB

1.Introduction



Every object naturally emits electro-magnetic radiation. Radiation intensity depends on object temperature and emissivity. Peak wavelength of radiation is inversely proportional to object temperature. Temperature of the sun is 5890°K, and its peak wavelength is about 0.5 μ m. Standard room temperature is 296°K (23 C), and its peak wavelength is between 8 to 13 μ M.



2.Infra - Red Radiation

$$M_{\lambda} = C_1 \lambda^{-5} \left[\exp\left(C_2 / \lambda T\right) - 1 \right]^{-1} \left[W(\mu m)^{-1} (cm)^{-2} \right]_{\text{Where}}$$

M_{\lambda} - Spectral Radiant Existence [W (\mumber)^{-1}(cm)^{-2}]

T- Absolute Temperature [K°] C_1 - 1st radiation Constant = 3.74×10^4 [W (cm)²] C_2 - 2nd radiation Constant = 1.44×10^4 [µm K]

 λ - Wavelength [µm]

3.Planck's Law for Spectral Radiant Emittance



4. Operation Principle



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Collects the radiation from the target and projects it on the detector/detectors.

5.Scanners

The function of the scanner in a FLIR is to scan the image formed by the optical system in the plane of the detector (array) in such a way that the detector dissects the image sequentially and complementally.

Different types of scanners

- Serial scanning
- Parallel scanners
- Staring doesn't need scanning

Staring with random access (electronically)

6.Parallel Scan

Systems are much better in performance: The overall Thermal Sensitivity of a system is proportional to the square root of the Effective Number of Detectors (the number of detector elements multiplies by the scan efficiency). The effective number of detectors in parallel scan systems is typically a factor of 2-10 larger than in serial scan systems. These systems are Mechanically Much Simpler than serial scan systems, the scan velocities being lower by a factor of 200-400. These systems are Compatible with the trend toward staring arrays, where mechanical scanning is completely abolished.

7.Detectors

Characteristics:

Responsivity - The gain of the detector expressed in volts (or amperes) of output signal per Watt of input signal

D*- The detector output signal-to-noise ratio, for one Watt of input signal, (normalized to a unit detector area and a unit electrical bandwidth).

Electrical frequency, Optical wavelength, Detector area, Detector noise measurement bandwidth, Distribution of irradiance on the detector with wavelength.

8.Spectral Response of various IR detector



9. Technical Data Performance Characteristics

• Spectral Sensitivity - 8 μm - 10.5 μm,

Fields of View (FOV)

- Narrow (H x V) 4.0° x $2.5^{\circ} \pm 10\%$
- Wide (H x V) 13.6° x $8.5^{\circ} \pm 10\%$

FOV Change - Manual

Focus Change - Manual

Focus Range

- 100 m to infinity in the NFOV
- 20 m to infinity in the WFOV

Reticles

• Electronically generated reticle with different patterns for WFOV and NFOV.

Video Out

• CCIR type B, 625 lines, 50 fields per second

Operating Time

• 2 hours with Standard NiMH battery (continuous operation at room ambient temperature).

Ready Time

- From OFF Mode ≤ 8 minutes
- From STBY Mode ≤ 45 sec

Power Consumption

- ON Mode 21W
- STBY Mode 8W

Power Source

• Option A - Attachable, rechargeable power pack.

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- Option B Attachable, disposable power pack.
- Option C External AC/DC adapter.

Environmental Conditions

- Storage Temperature $-35^{\circ}C \div +70^{\circ}C$.
- Operating Temperature $-30^{\circ}C \div +55^{\circ}C$.

10. Block Diagram



11. PSCB Block Diagram



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12. Stimulation Results









13. Conclusion

Through night vision system we can see the object in dark environment. We have seen four generation of these devices and seen different ranges. Initially this device was used by military but now it also available for civilians. The innovation and implementation of night vision system has a great impact on automotive session such as saving many lives from death reducing accidents at night. Finally, we have seen that use of night vision system. We find that night vision device is used in the presence of ambient light or in case of cloudy weather. There are many types of night vision system available in the market but in all these devices one things is common: they produced green light. So, in overcast and cloudy whether the performance of night vision devices decreased means the detection range is decreased compared to ambient light such as moonlight or starlight.

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