RF Safety in the Film & Video Production Environment

Final Report

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Background

This project was undertaken to examine the Radio Frequency Radiation (RFR) exposure issues associated with the use of camera back wireless video transmitters in the Film & Video Production Environment.

Excessive RFR Exposure could pose a health hazard to the Cinematographer. Maximum Permissible Exposure limits are prescribed by the Federal Communications Commission (FCC). We examine the operational workflow of the Cinematographer against the FCC exposure guidelines.

RF Safety in the Workplace

The FCC's policies with respect to environmental RF fields are designed to ensure that FCC-regulated transmitters do not expose the public or workers to levels of RF radiation that are considered by expert organizations to be potentially harmful. Therefore, if a transmitter and its associated antenna are regulated by the FCC, they must comply with provisions of the FCC's rules regarding human exposure to RF radiation.

Camera back wireless video transmitters are regulated by the FCC and subject to the limits detailed RFR exposure guidelines contained in the FCC OET 65 document.

The RF Environment

The FCC radio frequency exposure requirements found in 47 CFR 1.1310 define the 'controlled' and 'uncontrolled' environments. The controlled, or occupational environment, is the working environment of the Cinematographer where there is knowledge of the use of RF devices. The uncontrolled environment is that of the general public where there is no knowledge of the existence of RF devices.

The RFR exposure level varies between the environments.

RF Exposure Variables

Human exposure to radio frequency energy is influenced by:

- The field intensity of the transmission source
- The operating frequency of the RF device
- The amount of time someone is exposed
- Whether the environment is 'controlled' or 'uncontrolled’

The Typical Camera Back Transmitter

Transmitters are commonly mounted to the rear of the video camera and have a small antenna mounted to a short mast. The transmitters are FCC Certified under Part 15 and operate in the unlicensed 2.4 or 5.8 GHz bands with a maximum power output level of 1 W.

Basis of the Safety Analysis

The transmitted field intensity and safe operating distance can be determined from the technical characteristics of the transmission system as detailed in the Part 15 Certification filing providing:

- The equipment has not been modified in any way which would change its Certified characteristics.
- The proper antenna is affixed to the transmitter and the RF power output level is properly set.
- There is no external equipment connected to the transmitter which would increase the transmitter power level.

Unconditionally Compliant Exposure

There is no time limit for exposure to an RF field at an unconditionally compliant field intensity level. Unconditional compliance is found at a distance from the antenna which does not exceed the MPE level.

Unconditional compliance is the desired condition for all television and film operations utilizing wireless video transmission systems.

Safe Distance for the Typical ¼ W Transmitter

The calculation shows that the MPE of 5 wW/cm^2 (controlled environment) occurs at a distance of 2.5 cm (0.98 in.) from the antenna. Therefore, at a distance greater than 2.5 cm from the antenna, the operator can never exceed the allowed MPE. **Any distance greater that 2.5 cm from the antenna under Controlled conditions is <u>Unconditionally Compliant</u> with the FCC RFR Exposure Guidelines.**

$$r = \sqrt{\frac{400}{4\pi \bullet 5.0}}$$

Where:
r = 2.5 cm (0.98 in)
EIRPmW = +26 dBm (23 + 3) = 400 mW
Pd= Power density 5 mW/cm2

FULL MOTION VIDEO

Worst Case Scenario

The calculation shows that the MPE of 1 wW/cm^2 (uncontrolled environment) occurs at a distance of 12.6 cm (5 in.) from the antenna. Therefore, at a distance greater than 12.6 cm from the antenna, the operator can never exceed the allowed MPE. **Any distance greater that 12.6 cm from the antenna under Uncontrolled conditions is <u>Unconditionally Compliant</u> with the FCC RFR Exposure Guidelines for a worst case (1 W) transmitter.**

$$r = \sqrt{\frac{2000}{4\pi \bullet 1.0}}$$

Where:
r = 12.6 cm (5 in)
EIRPmW = +33 dBm (30 + 3) = 2000 mW
Pd= Power density 1 mW/cm$_2$

Conclusion

The key to RFR safety in the Film and Television production environment is identification and mitigation of the potential RF hazard. Knowing that radio frequency energy is being transmitted on the set and knowing how to maintain safety around the transmitters can minimize exposure to unsafe levels of radio frequency radiation.

Maintaining an Unconditionally Compliant distance from the camera back wireless video transmitter puts the Cinematographer out of danger at all times with respect to exceeding the MPE for the transmitter energy.

Recommendations

- All wireless camera back video transmitters must be FCC certified for Part 15 and comply with the following:
  - The transmitter has a legible FCC ID number on the manufacturer's product tag affixed to the unit.
  - The transmitter has not been modified in any way from its original state as delivered by the manufacturer.
  - All transmitter cabling is in good condition and properly attached.
- The operator should have a clear understanding of the requirements for operating the equipment to maintain unconditional compliance with the MPE limits.
- The operator should review the RF Safety Statement provided by the manufacturer for the particular transmitter prior to operation of the transmitter.

Recommendations – continued

- When the “unconditionally compliant” condition cannot be met, the operator should mitigate the exposure danger by observing the time limit for RFR exposure so as not to exceed the MPE.
- When a wireless video transmitter is used that is not certified under FCC Part 15 and requires a Special Temporary Authorization (STA) from the FCC, the operator should understand the potential for RFR exposure and take precautions to not exceed the MPE during the course of work.
- The operator should be aware of the RF environment to understand what other transmitters may contribute to the total exposure to RFR.
- Cinematographers should receive specialized training regarding the identification and mitigation of RF Safety issues in the workplace.

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