Recommended American Standards for Electromagnetic Exposure

Summary: This recommendation focuses on a specific loophole in current standards of electromagnetic exposure that is being exploited by specific foreign-built consumer grade electronics to express a comprehensive approach to ensuring operating safety for the end-user consumer in the United States. Current standards mainly focus on intentional electromagnetic radiators such as smart phones at cellular frequencies or tablets at Wi-Fi frequencies. These intentional radiators are combined with a charger or AC/DC adapter which adhere to a poorly defined and poorly enforced FCC Class B standard for unintentional radiation. The integration of foreign manufactured components into the final consumer product sidesteps individual component testing. Foreign electronics manufacturers intentionally alter the electromagnetic signals emanating from components to prevent accurate measurements from foreign accredited testing laboratories that are selectively testing to low standards. With the recent technological shift to faster switching semiconductors and burst mode charging capability combined with poor end-user habits, emanations from cheap foreign handheld consumer electronics with biologically unsafe signatures create a health risk to Americans.

Issues with power adapters, converters, and chargers:

- Foreign-built power adapters undergo no direct accreditation process because they are combined with end-user equipment.
- End-user equipment is required to use a foreign accreditation laboratory that focuses on intentional radiators such as smart phone communication signals and issues a "Supplier's Declaration of Conformity (SDoC)" on unintentional radiators such as power adapters.
- Foreign-built power adapters exploit standards-testing limitations. Actual field levels exceed measured field levels due to switching frequency manipulation.
- Emanation of maximum electric fields occurs at the consumer grade handheld device which is problematic for smart phones and tablets when connected to the charger.
- Emanation of magnetic fields occurs where the adapter is connected to AC power, such as a wall outlet or extension cable. US household 3-conductor Romex wiring presents an ideal radiator compared to industrial environments with armored AC wiring layouts.
- Chargers often use a burst mode to charge the batteries that randomly align electromagnetic emanations with biological processes.
- Burst mode is comprised of random events that vary over the charge status of the battery, from a dead battery to low charge level to high charge level to full battery. Accreditation labs do not test across all of these possible variations.
- Accreditation labs do not measure near fields of the chargers.

- Recent introduction of gallium-nitride semiconductors creates electrical transients that increase electromagnetic radiation compared to slower, older electronics.
- Current accreditation test equipment is incapable of accurately measuring the electromagnetic radiation of gallium-nitride based chargers.

This report makes the following recommendations:

- Update standards to include peak transient electromagnetic, electric, and magnetic field levels.
- Shift compliance testing to a US-based accredited laboratory.
- Ensure all components included with consumer grade electronics undergo compliance testing.
- Do not allow component manufacturers, mainly of power converters or chargers, to defer compliance to the integrator.
- Ensure that compliance testing is conducted during all possible states of electric, magnetic, and electromagnetic radiation.
- Provide recommendations on the use of consumer grade electronics equipment.

RFI Questions: This report focuses on the electromagnetic aspects posed with modern consumer grade electronics. Though the original "request for information" places emphasis on the observational biological effects of electromagnetics, this author focuses on modern nuances of electromagnetics that deviates from the radio-frequency traditional experimental approach. This report is initially keyed to the RFI questions, as applicable.

2. Author's credentials: Retired after 29 years as a Senior USG RF-Electromagnetics Engineer overseeing safety on the design, engineering, and usage of RF, Electromagnetics, and Electronics systems. 5 years as a research scientist in this specific area, from theoretical scientific proposals, through electrical engineering/antenna design/invention, through infrastructure coordination, to laboratory experimentation.

5. Prior to considering health effects of human exposure to RF/EMF, the review team should note that there is no complete understanding of electromagnetics in American academia. The American approach to electromagnetics is mentally locked into the design of microwave engineering systems such as communications systems or power transfer topologies like microwave ovens. As American academia considers bio-effects of electromagnetics, the quantum approach is generally taken which provides an abstract, limited perspective of biology. American academia and the federal government should invest in modern test equipment that allows electromagnetics to be studied and measured in the time-domain.

5p. Peak instantaneous electric, magnetic, and electromagnetic fields should be measured around all components of consumer grade test equipment. Laboratory observations indicate

that the derivative of the electric field is significant (rise time, fall time) for radiating electromagnetic signals from an antenna as well as coupling into and interfering with electronic systems, an FCC concern. A standard should be considered for measuring the time-domain (temporal) electromagnetic field to ensure the first-time-derivative of the electric field is below a specific level.

8. Sensors and detectors would be designed, fabricated, and distributed to industrial work areas where electromagnetic exposure is a concern. There is no current standard on sensing time-domain electromagnetic field levels. 2026 equipment to study time-domain electromagnetic fields in laboratory environments is inaccurate and extremely expensive, which makes these methodologies cost-prohibitive to mass distribution to schools, homes, and industrial worksites.

9. Electronics consumers have an expectation of safety when purchasing electronics and would have difficulty/frustration dealing with FCC emanation classes. Options for society:

- Measuring environments where large groups congregate
- In place monitoring systems for industrial sites
- Individual worker dosimetry tags
- Educating on best practices:
    - Avoiding handheld usage while charging
    - Avoid using extension cords placing AC/DC converters close to the body
- Distancing WiFi access points to prevent close access

16. Electromagnetics is naturally impactful with transients, and with the traditional American focus of reducing electromagnetics to the frequency domain and skipping to quantum, this produces the biggest gap. Modern consumer grade electronics are emanating electromagnetic radiation in this gap in scientific understanding. Sensors and detectors needed to measure electromagnetic fields for future compliance are currently in the pioneering phase of development.

18. References: Sole source based on a career of research and observation in this area.

Conclusion: With recent developments of technology expanding into new areas but with the diversification of observed health effects, now is the ideal time to consider adapting American standards for electromagnetic radiation. Past negative-findings laboratory reports were based on a very limited 1960's perspective of electromagnetics. Investing in modern equipment to update scientific knowledge-base would give policy-makers confidence in understanding this threat to the health of the American people.

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