

# Domestic EMC Requirements For ISM Equipment

CLARK VITEK  
CKC Laboratories, Inc.

## INTRODUCTION

In the United States, industrial, scientific, and medical (ISM) equipment is subject to different EMC regulations than other types of devices that use RF energy. This is primarily for two reasons: to recognize the need for certain types of ISM equipment to generate and use high levels of RF energy, and to address the increased potential for such devices to cause interference. Part 18 of the Federal Communication Commission (FCC) regulations specifically addresses these concerns for ISM equipment. In order to avoid excessive testing, or testing to the wrong standard, it is important to understand the differences between FCC Part 18 and FCC Part 15, which is the primary EMC standard for information technology equipment (ITE).

## U.S. REQUIREMENTS: ISM REQUIREMENTS VS. ITE REQUIREMENTS

In the United States, the EMC requirements for ISM equipment are provided by Part 18 (CFR 47) of the FCC regulations. The requirements are similar to those for RF devices in the more commonly understood FCC Part 15 for ITE. However, a few important differences between the Part 15 requirements and the Part 18 requirements do exist. One common misbelief is that a piece of equipment that meets the FCC Part 15 requirements automatically satisfies FCC Part 18. The following information on the two specifications shows that this statement is not necessarily true.

**The limits of FCC Part 15 do not generally apply to ISM equipment.**

## FCC PART 18: ISM EQUIPMENT RADIATED EMISSIONS

The FCC Part 18 radiated emissions requirements for ISM are broken into four frequency groups:

- Prohibited bands,
- Allocated ISM frequencies,
- ISM frequencies that exceed allocated bandwidth tolerances, and
- Other frequencies.

The requirements of each of these groups must be satisfied in order to be in full compliance with Part 18 requirements.

*Prohibited Bands.* ISM equipment is prohibited from operating within specified bands (Table 1).

*Allocated ISM Frequencies.* ISM may operate on any frequency above 9 kHz that is not prohibited. However, at specified frequencies the ISM equipment is permitted unlimited radiated energy for FCC Part 18 compliance (Table 2).

FREQUENCY BAND
490 - 510 kHz
2170 - 2194 kHz
8354 - 8374 kHz
21.4 - 121.6 MHz
156.7 - 156.9 MHz
242.8 - 243.2 MHz

**Table 1.** FCC Part 18 : Prohibited Operating Frequencies (reference CFR 47, paragraph 18.303).

*ISM Frequencies that Exceed Allowed Bandwidth Tolerances.* Any ISM frequency that exceeds the above bandwidth tolerances must meet a Part 18 radiated emissions limit of 25  $\mu\text{V}/\text{m}$  at a distance of 300 meters. This requirement can be satisfied by meeting a radiated emissions limit of 57.5 dB $\mu\text{V}/\text{m}$  at a test distance of 10 meters. This requirement is relaxed if the equipment generates more than 500 watts of RF power (reference CFR 47, paragraph 18.305b).

*Other Frequencies.* Other frequencies must meet an FCC Part 18 radiated emissions requirement of 15  $\mu\text{V}/\text{m}$  at a distance of 300 meters. This can be satisfied by meeting a limit of 44.3 dB $\mu\text{V}/\text{m}$  at a test distance of 10 meters. This limit is relaxed if the equipment generates more than 500 watts of RF power (reference CFR 47, paragraph 18.305b).

It is important to note that in order to properly perform a Part 18 test to satisfy all of the above requirements, some information about the equipment under test (EUT) must be known. This is because different ISM equipment may make use of different operating frequencies allowed under allocated ISM frequencies, and because some of the limits can be relaxed based on the operating power.

## FREQUENCY RANGE FOR RADIATED MEASUREMENT TESTS

The frequency range for the FCC Part 18 radiated emissions tests is based on the lowest and highest frequencies that are generated in the device. Table 3 summa-

*Continued on page 122*

ISM Frequency	Tolerance
6.78 MHz	±15.0 kHz
13.56 MHz	±7.0 kHz
27.12 MHz	±163.0 kHz
40.68 MHz	±20.0 kHz
915 MHz	±13.0 MHz
2,450 MHz	±50.0 MHz
5,800 MHz	±75.0 MHz
24,125 MHz	±125.0 MHz
61.25 GHz	±250.0 MHz
122.50 GHz	±500.0 MHz
245.00 GHz	±1.0 GHz

**Table 2.** FCC Part 18 : Allocated ISM Frequencies, No Part 18 Limit (reference CFR 47, paragraph 18.305a).

izes the frequency bounds of the test.

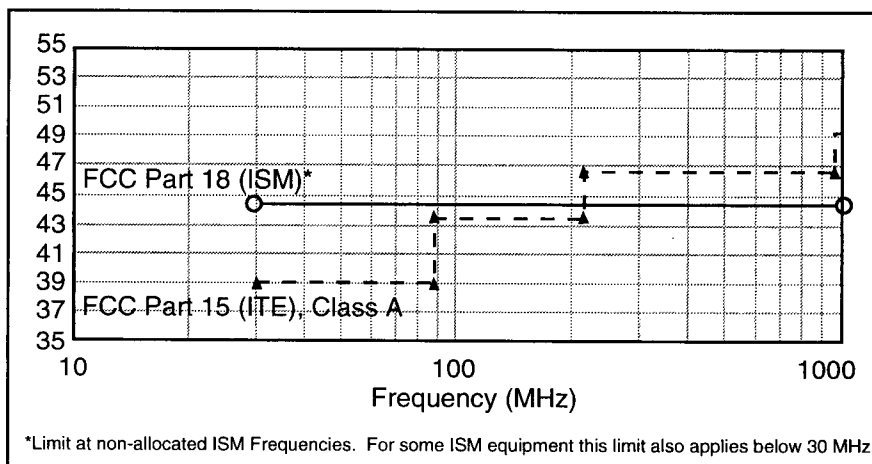
It is very important to note that unlike FCC Part 15, which specifies that measurement shall not be made "below the lowest frequency for which a radiated emission limit is specified" (CFR 47, paragraph 15.33b), FCC Part 18 does not make this statement in reference to radiated measurements. This means that radiated measurements should be performed below 30 MHz to demonstrate compliance with the requirements for ISM frequencies that exceed allowed bandwidth tolerances and other frequencies given in Table 1, and to verify compliance with the prohibited bands.

#### FCC PART 15, CLASS A RADIATED EMISSIONS REQUIREMENTS

Figure 1 shows a comparison of the FCC Part 18 limit to the Part 15 Class A limit for a test performed at 10 meters. Note that although the Part 15, Class A limit is substantially tighter from 30 MHz to 230 MHz, above 230 MHz the FCC Part 18 limit is lower for some types of emissions (referred to above as other frequencies). Note that although this comparison is made for a 10-meter test distance, the actual Part 18 specified test distance

Frequency Band in Which the Device Operates	Lowest Frequency	Upper Frequency
Below 1.705 MHz	Lowest frequency generated in device, but not below 9 kHz	30 MHz
1.705 to 30 MHz	Lowest frequency generated in device, but not below 9 kHz	400 MHz
30 to 500 MHz	Lowest frequency generated in device or 25 MHz, whichever is lower	Tenth harmonic, or 1000 MHz, whichever is greater
500 to 1000 MHz	Lowest frequency generated in device or 100 MHz, whichever is lower	Tenth harmonic
Above 1000 MHz	Lowest frequency generated in device or 100 MHz, whichever is lower	Tenth harmonic, or highest detectable emission

**Table 3.** FCC Part 18: Frequency Range of Radiated Measurements (reference CFR 47, paragraph 18.309).



**Figure 1.** Comparison of Limits for ISM and ITE (30 MHz - 1 GHz).

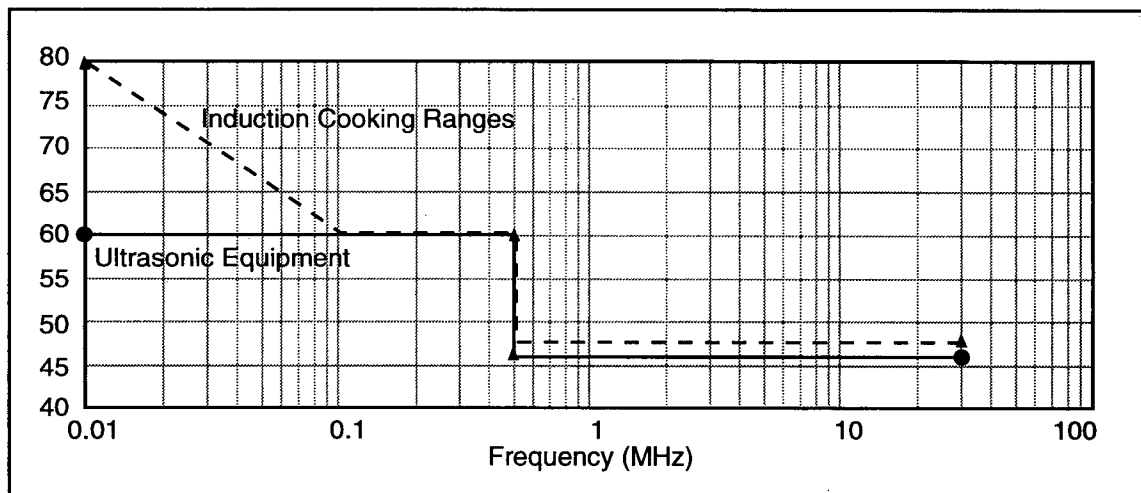
varies between 30 and 1600 meters depending on the type of ISM equipment.

#### CONDUCTED EMISSIONS

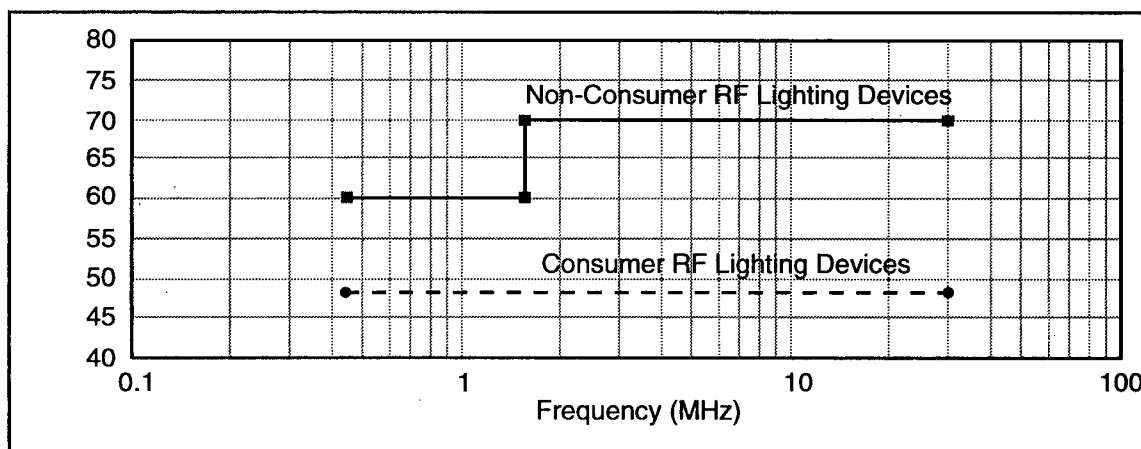
FCC Part 18 requires conducted emission measurements only for the following types of ISM equipment: ultrasonic equipment, induction cooking ranges manu-

factured after February 1, 1980, and RF lighting devices. Figures 2 and 3 show the limits for these types of devices.

The devices discussed here are the only types of ISM equipment which must be tested for conducted emissions; there is a wide range of ISM equipment that is not subject to Part 18 conducted requirements. However, it is pru-



**Figure 2.** FCC Part 18 Conducted Emissions Limits — Ultrasonic Equipment and Induction Cooking Ranges (5  $\mu$ H LISN).



**Figure 3.** FCC Part 18 Conducted Emissions Limits — RF Lighting Devices (50  $\mu$ H LISN).

dent for a manufacturer to attempt to meet the conducted emissions levels of FCC Part 15, Class A as a minimum internal quality requirement. This limit is the same as shown above for non-consumer RF lighting devices, except for a slightly different transition frequency of 1.6 MHz for the Part 18 devices versus 1.705 MHz for Part 15 devices. FCC Part 18 does state that "ISM equipment shall be designed and constructed in accordance with good engineering practice with sufficient shielding and filtering to provide adequate suppression of emissions outside [the ISM allocated] frequency bands." (CFR 47,

paragraph 18.109). Further, ISM equipment is always subject to the FCC's general requirements that it does not cause a disturbance to any authorized radio service (CFR 47, paragraph 18.111) and that the end user is required to take any corrective measures necessary.

### CONCLUSION

ISM equipment must meet the technical requirements of FCC Part 18 to be marketed and sold in the United States. Because ISM is covered under FCC Part 18 as a stand-alone requirement, the limits of FCC Part 15 do not generally

apply to ISM equipment. Meeting the requirements of FCC Part 18 requires knowledge of the EUT, as some of the ISM requirements are tailored specifically to the EUT's operating power and frequencies, and to the specific subtype of ISM equipment.

---

**CLARK VITEK** is an EMC engineer with CKC Laboratories, Inc. He received his BSEE degree from the University of California, Davis in 1992. He has worked on many EMC design projects, both military and commercial, and is presently active in helping customers meet new guidelines for EMC. (800) 500-4362.