REVISING MP-4, THE FCC COMPUTING DEVICE TEST PROCEDURE

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Abstract

The Federal Communication Commission uses the procedure MP-4 (1983) entitled "FCC Methods of Measurement of Radio Noise Emissions from Computing Devices" [1] to determine the radio frequency (RF) interference potential of personal computers and other types of computing devices (now called digital devices). Since MP-4 was written in 1983, it is quite evident that it should be updated to include industry and Commission experience gained over the last six years. In addition, Part 15 has been revised and the related test procedures, such as MP-4, need to be updated to reflect the recent changes to the FCC Rules [2]. This paper looks at the Commission rule making process, the issues raised by the parties interested in digital device testing, and the Commission reasoning behind the decisions in the revision of test procedure MP-4.

Background

Computers and similar digital devices, unless properly designed and manufactured, produce electromagnetic emissions (EME) which emanate from the cabinet and interconnecting cables. These emissions may cause harmful radio interference that disrupts the reception of radio and TV signals on nearby receivers. To address this interference concern, the Commission, in 1979, codified Subpart J of Part 15 of its Rules to limit the interference potential of digital devices [3]. To assist manufacturers in testing such equipment to determine compliance with the new rules, the Commission adopted MP-4 in 1983.

MP-4 sets forth uniform methods for measuring both radiated and line conducted EME from large and small digital devices to determine compliance with the technical requirements in Part 15. Specifically, it describes the environment, instrumentation, and conditions for testing digital devices. MP-4 was the outgrowth of the work of the Accredited Standards Committee on Electromagnetic Compatibility (C63) and the Computer Business and Equipment Manufacturers Association (CBEMA).

C63 is a voluntary standards making organization accredited by the American National Standards Institute (ANSI) with the Institute of Electrical and Electronics Engineers, Inc. (IEEE) as its secretariat. C63 consists of representatives from a wide variety of concerned industry, trade, government and professional organizations which, when previously known as the Radio Electrical Coordinating Committee of the ANSI, was responsible for developing the C63.4 test standard entitled "Methods of Measurement of Radio-Noise Emissions

from Low Voltage Electrical and Electronic Equipment in the Range 9 kHz to 1 GHz" for measuring the interference potential of electronic devices.

CBEMA is a trade organization of forty-five manufacturers and vendors of computer, office equipment and information services. CBEMA has been a participant in the development of the limits and methods of measurements for digital devices since 1976.

Factors Influencing MP-4 Revision

In the fall of 1986, the Commission's laboratory started a pre-grant sampling program on personal computers. In this program, all personal computers were tested for compliance before being issued equipment authorization by the Commission. This had not been done since 1981. The results of this sampling project were startling. Over 60 % (108 of 176) of the personal computers tested at the FCC laboratory between August of 1986 and February of 1987 were found to be non-compliant. What was even more startling was the fact that these computers were the same engineering prototypes that had been tested for compliance by a manufacturer or an independent test laboratory. Tests on the same device by two different laboratories should yield the same results unless there are problems with the test procedure or its implementation. This sampling program led us to believe that MP-4 needed revision to clarify certain portions to enable better repeatability of EME measurement results.

The Commission also desired to make changes to MP-4 to incorporate our experience in testing digital devices over the last several years. Simultaneous with the sampling project, the Commission began revising MP-4 (1983) through committee work within the Office of Engineering and Technology (OET). Until a revised test procedure could be developed and released, OET embarked on an education program to inform computer manufacturers and independent test laboratories how FCC testing was performed on personal computers. A Public Notice was released in the fall of 1986 which detailed a number of guidelines to be followed when testing personal computers. In addition, a seminar was held at the FCC laboratory which featured staff engineers demonstrating the testing of a personal computer system for compliance. These efforts produced positive results because the compliance rate of personal computers started to rise, albeit very slowly.

In July of 1987, the Commission released a revised MP-4 which provides a more comprehensive explanation of how the FCC Laboratory tests personal computers and

¹ The views expressed are those of the authors and do not necessarily reflect the views of the Commission.

Factors outside the Commission also influenced the revision of MP-4 (1983). In the spring of 1987, CBEMA submitted to the Commission a proposal for a new measurement procedure to replace MP-4. CBEMA argued that its proposal was a more practical and repeatable measurement procedure than MP-4. CBEMA further stated that its proposed revision was needed to help resolve industry disputes, and to adjust the measurement procedure in accordance with digital device industry demands. The major points of the CBEMA proposal were:

- (1) Specifying a preferred test method, but permitting alternative test methods.
- (2) Establishing fixed antenna distances for radiated emission testing (3 meters for Class B, 10 meters for Class A).
- (3) Establishing a standard test site.
- (4) Requiring site attenuation measurements for both horizontal and vertical antenna polarizations.
- (5) Preferring the use of broadband instead of dipole antennas for radiated emission measurements.
- (6) Limiting the maximization of equipment under test (EUT) emissions.
- (7) Relaxing the FCC limits for "clicks" (short duration emissions).
- (8) Establishing minimum reporting requirements.

In response to the CBEMA proposal and our desire to update and improve MP-4 (1983), the Commission issued a Public Notice on August 4, 1987, inviting comments on the CBEMA proposal and the Commission revised test procedure known as MP-4 (1987). A total of 24 parties filed comments, and 14 parties filed reply comments in response to the Public Notice.

Due to the number of parties interested in revising MP-4 and the important issues concerning the suitability and effectiveness of our measurement procedure for digital devices, the Commission decided to revise MP-4 via a formal rule making action. This process has the advantage of recording and explaining concerns regarding a proposal and providing an explanation of the ultimate decision on each issue.

All U.S. Government agencies must follow the Administrative Procedure Act (APA), 5 USC Sections 551-559, when adopting new rules or proposing to change existing rules. These procedures are codified into the FCC Rules in Part 1, 47 CFR Part 1. In brief, the APA requires that the Commission or any other government agency notify the public of any proposed changes to their regulations and give interested parties sufficient opportunity to comment.

The first step in this process is typically a Notice of Inquiry (NOI) or a Notice of Proposed Rule Making (NPRM). The NOI or NPRM is the process where the government agency notifies the general public of any proposed changes to its regulations. All rule making documents are published in the Federal Register for the purpose of

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giving official notice of any proposed action.

Once the proposal is published or released, the public is given an opportunity to file their comments or concerns with the agency initiating the rule making. A period is also provided for the public to file reply comments to support or counter comments made on the rule making. For rule makings involving technical standards, the comment period is normally seventy-five days and the reply comment period is thirty days.

If there were serious objections to the proposal, the agency may vacate the proceeding or issue a modified proposal in a second NPRM. Assuming that the comments can be accommodated, the agency may adopt the proposed rules in a document called a Report and Order (R&O). Any R&O will be published in the Federal Register because new rules typically become effective thirty days after publication in the Federal Register.

Individuals who believe that the issues raised in their comments were not adequately addressed may file a Petition for Reconsideration of the agency action taken in the R&O within thirty days of publication. This petition is placed on public notice to allow time for comments from interested parties. An agency must reply to or act on a Petition for Reconsideration. It cannot be ignored. After the agency's response to the Petition for Reconsideration, the party that filed the petition still has the right to ask for a Court review of the adopted regulation if they believe the facts in the case warrant it.

General Docket Number 89-44

After receiving all the comments to the Public Notice requesting comments on the CBEMA proposed test procedure and MP-4 (1987), the Commission adopted an NPRM, proposing substantial changes to MP-4 (1983). The proposed test procedure was designated TP-5 to avoid confusion with the old test procedures since the new procedures will take into account the new Part 15 Rules adopted in General Docket 87-389. TP-1 through TP-4 had been reserved for measurement procedures for other devices mentioned in the completely revised Part 15 Rules. TP-5, the proposed replacement procedure for MP-4, was released in a Notice of Proposed Rule Making in General Docket No. 89-44 on March 7, 1989.

TP-5 didn't resemble MP-4 in many aspects. First, it provided individual sections which described general test requirements and separate test procedures for table-top and floor-standing devices. Previously, MP-4 contained this information throughout the document not in one section and there was no distinction between the type of EUT by size or classification for testing purposes. Second, MP-4 provided step-by-step instructions for setting up and testing digital devices for compliance with the FCC Regulations. MP-4 contained most of this information but it was not organized in the same manner. Third, TP-5 proposed the use of a separate line impedance stabilization network (LISN or mains network) for the EUT and a separate LISN for the peripheral equipment to isolate line conducted EME from peripheral equipment from those from the EUT. Lastly, changes were made to TP-5 in order to harmonize more with the test procedures in CISPR Pub. 22 [4] by (1) proposing a test table height of 80 centimeters for testing; (2) proposing a 2 meter by 2 meter ground plane for conducted emissions testing; and (3) proposing that the measurement antenna height above ground be varied between 1 and 4 meters regardless of the measurement distance used.

TP-5 also differed from MP-4 in several important areas regarding the testing of personal computers. TP-5 defined a typical minimum system which was to be used for testing any personal computer or related peripheral. This minimum system would consist of a computer, keyboard, monitor and one or more peripheral devices, such as a printer or modem. Second, it fixed the location of the components of the minimum system in the test set-up. No longer would moving components around be required to maximize emissions. Instead, only the interface cable positions would be varied to maximize emissions. Third, TP-5 specified the operating conditions to be used to maximize emissions when testing. Each emission was to be maximized by varying the mode of operation, clock speed and software programming. In addition, a program was to be used to send a constantly repeating line of "H"s to all peripherals in the minimum system. Fourth, TP-5 also specified the operating conditions for the monitor used in a personal computer minimum system. TP-5 proposed that the monitor contrast control be set to maximum, the brightness control be set to raster extinction and, for character display on color monitors, the color white was to be used instead of testing all possible combinations of colors. These changes were intended to standardize the testing to insure the repeatability of measurements when testing a personal computer or related peripheral.

Finally, TP-5 contained a section to address the special issues of testing Class A digital devices which for the most part consist of floor-standing devices or a combination of floor-standing and table-top equipment. The following is a summary of the proposed instructions

for testing floor-standing devices: (1) the conducting wall for floor-standing equipment was deleted for line conducted tests on large systems, provided a conducting floor was utilized; (2) a ground plane was recommended for radiated measurements of large equipment but not required; (3) the minimum horizontal distance from the LISN to the EUT was changed from 0.8 to 1.0 meter; (4) the power cables and the interconnecting cables between the EUT and system components were required to be elevated above the metal ground plane by at least 25 centimeters; and (5) a preferred method was indicated for the routing of interconnecting cables to remotely located peripherals. These changes were proposed to stabilize conditions which affect the repeatability of test results on large digital devices.

Comments and reply comments on the TP-5 proposal, after several extensions, were due on July 7, 1989, and September 6, 1989, respectively. A total of 41 parties, consisting of individuals, trade associations, computer manufacturers and independent test laboratories, filed comments in this proceeding. Sixteen parties filed reply comments. In our review process, we separated the comments into 75 different issues before summarizing these comments.

Comments Requiring Rule Changes

An overriding issue mentioned by most parties commenting on TP-5 dealt with whether the Commission should harmonize the FCC Rules and TP-5 with CISPR Publication 22. Besides the fact that CISPR Pub. 22 will be mandatory in 18 countries, particularly in Europe in the near future, many parties provided strong arguments for changing TP-5 to harmonize with Pub. 22 where there are inconsistencies. To harmonize TP-5 with Pub. 22 would reduce the burden of multiple tests and make the USA more consistent with worldwide practices.

Unfortunately, exactly what the statement "harmonize with CISPR Pub. 22" means is not clear. We suspect that the parties want the Commission to adopt both the limits and methods of measurement in CISPR Pub. 22. We believe that TP-5 is, in general, in agreement with CISPR Pub. 22, but that the latter lacks sufficient detail essential for repeatable measurements. It was our desire to provide the necessary detail to help improve repeatability.

A few parties recommended that the Commission adopt the ANSI test procedure C63.4 instead of TP-5. C63.4 is a consensus procedure developed by a cross section of industry and government representatives. Harmonization of TP-5 to such voluntary industry standards would ease the Commission's burden of providing guidance to industry by adopting an existing standard rather than writing a new one. Several parties believe draft 8 of C63.4, which is currently undergoing revision by ANSI, provides the additional detail which they want to see in a test procedure for digital devices.

Several commenting parties favored a relaxation of the digital device limit for "click", short duration or transient emissions. These parties argued that because of their intermittent nature, emissions of short duration do not have the same interference potential as continuous emissions, therefore, emissions of short duration should have their measured levels of interference reduced before comparison to the prescribed limit. The amount of the reduction should be related to the rate of occurrence over a given time period and the duration of the particular emission.

Issues concerning changes to the emission limits for digital devices go beyond the intended scope of an NPRM for revising a measurement procedure. However, it is noted that several petitions for reconsideration of the Report and Order in General Docket No. 87-389 have been filed requesting changes to the digital device emission limits in Part 15 of the FCC Rules [2]. It was recommended that issues involving changes in the digital device emission limits and harmonization with CISPR be handled in those petitions.

Comments on Technical Issues

Most of the commenting parties applauded the Commission proposal to test the EUT in one fixed configuration without requiring the EUT configuration to be varied to maximize emissions. However, there were a few parties who opposed this on the grounds that the test results were not repeatable if the EUT was set up in an arbitrary manner. These parties requested more guidance on how to set up the EUT and how to determine the configuration for testing.

Most of the parties who offered comments on TP-5 recommended that individual emissions not be maximized since this increases the time and costs for performing compliance testing. Various parties proposed alternative methods to maximizing individual emissions. Although some were rather interesting, it is doubtful that any repeatable results could be obtained without requiring some cable manipulation to maximize emissions as proposed in TP-5.

The Commission's proposal in TP-5 to continue to use the tuned dipole antenna as the reference antenna between 30 and 1000 MHz elicited many comments. The parties supporting and opposing the tuned dipole as the reference antenna were almost equally divided. Those parties opposing the tuned dipole argue that certain broadband antennas are equally acceptable for making EME measurements especially below 80 MHz where tuned dipole antennas have mutual coupling effects with the ground plane. Parties who support the tuned dipole as the reference antenna base their support on the premise that its characteristics are well known. However, they continue to support the Commission position of permitting other antennas to be used for measurements provided those results are traceable to the results obtained with a tuned dipole. Of those parties who support the tuned dipole, several further recommend a tuned dipole only be used for measurements down to 80 MHz. They propose using a dipole tuned to 80 MHz for measurements on frequencies between 30 and 80 MHz since this is the approach used in CISPR Pub. 22.

Many parties strongly recommend that the Commission replace OET Bulletin 55 with the site qualification requirements in ANSI C63.4. ANSI C63.4 requires both horizontally and vertically polarized site attenuation measurements whereas OET Bulletin 55 only requires horizontally polarized site attenuation measurements. Proponents of C63.4 say it was developed over a period of four years by industry experts and truly represents a consensus of test laboratories and manufacturers of equipment subject to Part 15. It is a critical test of the sites qualifications because most anomalies show up in vertical not horizontal site attenuation measurements. Those parties who support C63.4 site qualification requirements also urge the Commission to allow test sites sufficient time to comply with the vertical site attenuation requirements since this may require modification of a test facility which was qualified using OET Bulletin 55 procedures.

Most parties commenting on TP-5 oppose the Commission's proposal to elevate interface cables and power cords of floor-standing digital devices 25 centimeters above the ground plane. They state that this is unnecessary, costly, arbitrary, unworkable, not typical, not technically justifiable, and not consistent with other standards. One party commented that a study performed by them indicated that elevating interface cables and power cords above the ground plane had no effect on emission levels. Another party noted that ground planes can become illuminated by EUT emissions and yield false field strength levels. Their recommendation was to leave this requirement as an option. A third commenting party considered elevating interface cables and power cords a fair tradeoff even if it increased emission levels as long as it eliminated the requirement to manipulate interface cables to maximize emissions. This change was proposed to stabilize EME measurements by eliminating the capacitive coupling between interface cables and power cords and the site ground plane.

A number of the commenting parties were not in favor of the Commission's proposal to require the use of a separate LISN for the EUT and additional LISNs for the peripheral equipment when making line conducted emission measurements, particularly for floor-standing equipment. These parties argue that multiple LISNs powered from the same branch circuit may exceed that circuit's current capacity. The problem is further complicated by remote peripherals, sometimes located 100 feet or more away from the EUT, which must be powered from the same branch circuit. Parties who typically test small table-top equipment also oppose this proposal because it will add unnecessary costs to the line conducted test set-up to purchase additional LISN(s). Many of these parties favor powering the EUT and peripheral equipment from one LISN since this is the manner in which the equipment is typically used.

Several parties urged the Commission not to adopt the requirement for radiated EME measurements above 1 GHz until test methods, site qualification requirements, and test equipment become readily available. Several parties recommend that the requirement for radiated measurements above 1 GHz be implemented over a 2 to 3 year period instead of made mandatory immediately. We believe that the regulations adopted in General Docket 87-389 provide for a gradual implementation of this requirement. Under the transition provisions of Section 15.37 of the Rules adopted in this docket, digital devices may be authorized under the former FCC Rules, which have no radiated emission limits above 1 GHz, until June of 1992.

This is only a brief summary of some of the major issues raised by concerned parties who filed comments in the TP-5 rule making. Time and space does not allow us to include more detailed information on these and some of the other issues raised. If the reader is interested, the comments in General Docket 89-44 may be reviewed by going to the Dockets Branch reference room, room 239, located at the Federal Communications Commission building at 1919 M Street, N.W., Washington, DC between the hours of 9:00 AM and 4:30 PM. Their telephone number is (202) 632-7569.

If you are located outside the Washington, DC area, you may use International Transcription Services, Inc. (ITS), the FCC copy contractor who performs research work on a fee-for-service basis to obtain this information. The telephone number of their office is (202) 857-3800.

Commission Decision on TP-5

After reviewing the comments and weighing the possible alternatives, the Commission staff decided to work with C63 to develop a voluntary consensus standard that would be acceptable to both the Commission and industry. Since C63.4 is very close to being acceptable to the Commission for testing digital devices, it would be in everyone's interest if we worked with C63 to resolve any differences, if possible. The C63.4 test procedure has the advantage of being a consensus standard, developed in conjunction with industry, and enhanced by electromagnetic interference (EMI) experts from all types of digital device manufacturers, test equipment manufacturers, government agencies, test laboratories, and concerned individuals.

Assuming these concerns are resolved, the staff is in a position to recommend to the Commission that it release a second NPRM proposing to adopt a voluntary industry standard for testing digital devices in lieu of proceeding with its own test procedure. As we go to press, C63.4 has been through 3 major editing sessions and draft 11 is out for ballot. We trust the balloting will produce a favorable document in the near future.

Summary

In this paper, we have explained how the rule making process works when the Commission regulations or test procedures require modification or updating. The process, although complicated and sometimes lengthy, provides all interested parties adequate time to express their concerns.

The comments received from all interested parties in a particular rule making are evaluated on an individual basis. Before any comment can be included in a proposed regulation, (1) it must have technical merit; (2) it must support the Commission objective of preventing interference to communications; and (3) it must be easy to implement and enforce. Unfortunately, many real world

situations dictate that we settle for a compromise where one of these items is sacrificed to expedite the process to meet an immediate need.

The factors affecting the revisions of MP-4 (1983) are many and complex. To the extent that industry, through C63, can resolve the technical considerations to achieve repeatable test results, we believe this has several distinct benefits. These include: (1) resolving complex technical issues with the industry that will be subject to them; (2) achieving a consensus standard rather than an arbitrary directive for performing tests; (3) obtaining industry willingness and support to control interference; and (4) using resources and expertise outside the Commission for resolving technical issues.

References

- [1] MP-4 was adopted by the Commission in 1981 as an Appendix to Part 15 of the Rules. In 1981, the Commission removed the Appendix from the Rules so it would be a separate test procedure. See Report and Order in General Docket No. 80-284, 46 FR 23240 (1981) and 48 FR 34748 (1983).
- [2] See Report and Order in General Docket No. 87-389, 54 FR 17710 (1989).
- [3] Subpart J of Part 15 of the Rules was adopted by the Commission in 1979. See Report and Order in FCC Docket No. 20780, 44 FR 59530 (1979).
- [4] See CISPR Publication 22 (1985) which contains the current European requirements for the measurement of RF interference voltages from information technology equipment as determined by the International Special Committee on Radio Interference (CISPR) of the International Electrotechnical Commission (IEC). The letters CISPR are the initials of the French committee title: Comité International Special des Perturbations Radioélectriques.