IEEE EMC Society Standards Development Committee Recommendations on the Resolution of Specific Comments Provided by Balloters of the P1775 BPL EMC Standard

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P1775 text: 7.2.2.3.1 AC ports (conducted emissions) - The test setup and procedures in CISPR 16-2-3 and ANSI C63.4 shall be used. **The transmit BPL function shall be disabled unless national regulation specify that conducted limits apply to the carrier current emissions.**

Balloter Comment: This Clause states that the BPL signal shall be disabled before conducted emissions testing is done on the AC port, unless national regulation specifies that conducted limits apply to the carrier-current emissions. This is in STARK contradiction to the requirements of CISPR 22, the most applicable international standard that applies to conducted emissions. The premise that unless a nation had the foresight to specifically state that conducted emissions limits don't apply to BPL devices, they will be presumed not to apply to BPL devices is entirely backwards. If this outrageous premise is allowed in an IEEE standard, every manufacturer of every technology can state that if the rules don't specifically mention that technology, they can test their products by turning them off, too.

Balloter's proposed resolution: This Clause must be in full and complete harmonization with CISPR 22. The text must be changed to indicate that unless national regulation exempts BPL signals from conducted emissions limits, the BPL signal must be operated at its maximum operating level to make conducted emissions measurements.

P1775 proposed/approved resolution status: Disagree.

P1775 proposed/approved rebuttal #1: The scope of CISPR 22 does not include carrier current systems. Although this standard is widely cited in this draft, there are also international and national exceptions to the conducted emission limits of CISPR 22 - such as CISPR 11 and FCC Part 15 for carrier current systems. The referenced clause does not preclude the application of CISPR 22 conducted emission limits where national regulations so specify.

P1775 proposed/approved rebuttal#2: This draft standard assesses coupler port interference potential by means of radiated emissions. It does not preclude conducted emission tests if specified in national regulations.

Discussion: The proposed rebuttal #1 by P1775 is not factual. Although there is work within CISPR to revise CISPR 22, in its present form, CISPR 22 does apply to BPL devices and in that standard, the BPL function must be enabled during conducted emissions tests. The outcome of possible revisions to CISPR 22 is not at all certain. The statement in the rebuttal #2 is also not correct – the standard does not specify that testing shall be done at the maximum level **or as required** by national regulations. It states that testing shall be done at the maximum level **if** required by national regulations.

The Swedish national committee submitted a document to CISPR SC I which was discussed at the CISPR SC I WG3 meeting in Lyon last month. It was distributed as CISPR/I/310/INF. WG3 discussed this paper and came to the unanimous conclusion that Edition 3 and Edition 5 treat PLT in the same fashion. PLT

devices must be tested with the port active and sending data. This is consistent with the requirement for any other ports or peripheral devices when testing to CISPR 22. The EUT must be configured in a typical fashion and operating as intended. The only thing Edition 5 adds to the party (and actually was added in Edition 4) is the flow chart in Figure C.6 (Figure C.5 of Edition 6) which clearly shows the for telecommunications ports utilizing the mains port the limits in Tables 1 or 2 apply and that an AMN (what we call a LISN in the US) shall be used.

SDCom proposed resolution: To be provided by Pettit.

P1775 text: Clause 7.2.2.3.2: "the BPL coupler port is not subject to conducted emissions measurements."

Balloter Comment: "the BPL coupler port is not subject to conducted emissions measurements."

Balloter's proposed resolution: Change text to: ""the BPL coupler port is also subject to conducted emissions measurements."

P1775 proposed/approved resolution status: Disagree.

P1775 proposed/approved rebuttal: This draft standard assesses coupler port interference potential by means of radiated emissions. It does not preclude conducted emission tests if specified in national regulations.

Discussion: This is a comment similar to the first comment above regarding the standard being in disagreement with CISPR 22.

SDCom proposed resolution: Change the text to: "Unless national regulations specify that conducted emissions limits do not apply to BPL or carrier-current devices, the BPL coupler port shall be subject to conducted-emissions testing."

P1775 text: Balloter comment on Figure 9.

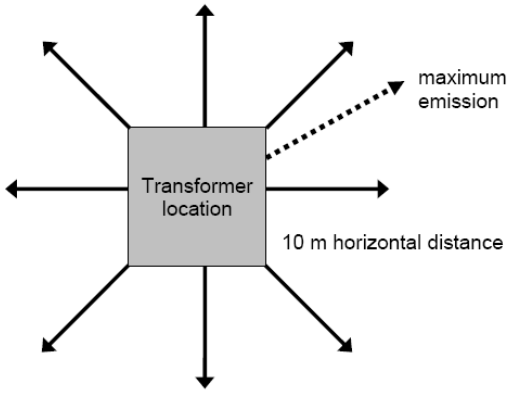

Figure 9 -- Example of geometry for measurements at 8 positions (45°) around the perimeter of an in-ground power transformer

Balloter Comment: Figure 9 shows that 8 compass points around the radiating transformer should be tested. This is not in harmonization with the requirements of ANSI C63.4, a normative reference to the standard. C63.4 requires that 16 cardinal points be measured. It is also not in self harmonization with Clause 7.2.1, which requires 16 points around a building carrying a BPL signal.

Balloter's proposed resolution: Change figure and text to show 16 compass points, in compliance with C63.4.

P1775 proposed/approved resolution status: Disagree.

P1775 proposed/approved rebuttal: Extensive testing experience indicates that field strength around an underground installation can be generally characterized with fewer than 16 points. The draft provides for additional measurements to identify the maximum emission. Experience indicates that a similar simplification does not apply to measurements around dwellings.

Discussion: The requirements in C63.4 to test 16 radial points is based on decades of experience over a wide range of DUTs. The premise that this group, with no more expertise than having hired testing companies to make measurements, has a better body of knowledge about general testing requirements than the hundreds of people involved in C63 over decades is simply wrong.

SDCom proposed resolution: Change figure and text to show 16 compass points, in compliance with C63.4.

P1775 text: Clause 6.1 (c). **If required by national regulations**, *in-situ* testing shall be performed by **configuring the EUT to operate at its maximum-possible level,** using software and firmware designed for such testing. **If national regulations stipulate testing at maximum possible signal power**, any controllable signal attenuation shall be minimized. It will then be necessary to determine what device settings and configuration would permit it to operate at the specified emissions limits and report those settings and the test measurements that were used to determine them. The measurement of

attenuation or power settings could be done in a laboratory environment, using the methods for making conducted emissions measurements described in this standard

Balloter Comment #1: Point c). It should not be allowed that equipment be tested at one operating condition, but then operated in a condition that exceeds the tested emission level. If the equipment is effectively adjustable by the end-user, then the full range of adjustments should be tested.

Balloter Comment #2: Sub clause (c): The requirement to test the device at its maximum possible operating level *only* if required by national regulation is contrary to good EMC practice.

Balloter's proposed resolution: The text must be changed in several places (7.4(d), for example), to require that the equipment be tested at its maximum power level, not, as the text implies, turned down until it passes in the configuration being tested.

P1775 proposed/approved resolution status: Disagree.

P1775 proposed/approved rebuttal: BPL system power is programmable to accommodate different components and regulations. **Testing shall be at the maximum power level or according to national regulations.**

Discussion: The rebuttal misrepresents what the standard says. The standard says that if national regulations require it, the DUT must be operated at its maximum level. The rebuttal says that the standard says that testing shall be at the maximum possible level, or according to national regulations. This misrepresentation will be misleading during the recirculation ballot.

SDCom proposed resolution: Change text to be less ambiguous and to require that unless national regulations permit a device to be tested at less than its full operating power, it should be tested at its maximum operating level. Change text to: "If *in-situ* testing is required by national regulations, it shall be performed by configuring the EUT to operate at its maximum-possible level, using software and firmware designed for such testing. If national regulations stipulate testing at other than maximum possible signal power, any controllable signal attenuation shall be minimized. It will then be necessary to determine what device settings and configuration would permit it to operate at the specified emissions limits and report those settings and the test measurements that were used to determine them. The measurement of attenuation or power settings could be done in a laboratory environment, using the methods for making conducted emissions measurements described in this standard."

P1775 text: Clause 7.2.2.3.1: "The transmit BPL function shall be disabled unless national regulation specify . . ."

Balloter Comment: "The transmit BPL function shall be disabled unless national regulation specify . . ."

Balloter's proposed resolution: Change the text to say: "Emissions shall be measured with the port disabled and also with the port enabled."

P1775 proposed/approved resolution status: Disagree.

P1775 proposed/approved rebuttal: This draft standard assesses coupler port interference potential by means of radiated emissions. It does not preclude conducted emission tests if specified in national regulations.

Discussion: This is a comment similar to the first comment above regarding the standard being in disagreement with CISPR 22.

SDCom proposed resolution: Change the text to say: "Unless national regulations specify that conducted emissions limits to not apply to BPL or carrier-current devices, conducted emissions shall be measured with the BPL signal and port disabled and also with the BPL signal and port enabled.

P1775 text: Clause 6.1(g): When frequencies below 30 MHz are measured, an active or passive magnetic loop shall be used. Field strength in dBμA/m shall be converted to dBμV/m by adding 51.5 dB according to the formula dBμV/m = dBμA/m + 51.5 dB. See CISPR 16-1-4 *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-4: Radio disturbance and immunity measuring apparatus – Ancillary equipment – Radiated disturbances.* **The magnetic loop antenna shall be at 1 meter height with its plane oriented vertically and the emission maximized by rotating the antenna 180 degrees about its vertical axis.** When using active magnetic loops, care shall be taken to prevent ambient signals from overloading the spectrum analyzer or antenna pre-amplifier. High ambient signals may create overload which should be addressed by the use of a band stop or band pass filter.

Balloter Comment: Sub clause (g): In this section, the measurement of the magnetic field is not complete. Although good EMC practice calls for the measurement of X, Y and A axes and an RSS calculation to be done on the result to get the total actual field strength, this section of the document measures only the RSS of two of the three axes. This is not in good harmonization with the procedure in Annex A, which appropriately requires that all three axes be measured and the square root of the sum of the squares of the results be taken as the actual value. This is a good example of the way that the document has drawn heavily on US FCC regulations and FCC test procedures, even when those procedures are not in accorance with good EMC practice.

Balloter's proposed resolution: This Clause needs to require the measurement of all three axes, as described in Annex A.

P1775 proposed/approved resolution status: Disagree.

P1775 proposed/approved rebuttal: ANSI C63.4 specifies rotation in the vertical axis only. CISPR 16-2-3 allows either the same approach as ANSI or measurement in 3 orthogonal axes for "maximum disturbance field strength from lines arranged in any direction…" This draft employs the more burdensome 3-axis approach only in the infrequent situations where extrapolation is needed.

Discussion: In the draft standard, the test antenna is rotated only with the loop oriented vertically. In C63.4, the rotation of the test antenna (a biconical antenna above 30 MHz) is from a horizontal to a vertical polarization, so it the provisions of C63.4 should *not* be the justification for not also orienting the loop antenna horizontally. The provisions do so are described in Annex A and in CISRP 16-2-3.

SDCom proposed resolution: The methodology for doing a root sum square of measurements made in 3 axes described in Annex A for extrapolation measurements only should be incorporated into Clause 6.1(g).

P1775 text: New text proposed for Annex F (how to identify and resolve interference – informative).

Balloter Comment: This is to add to the new F.3 subclause proposed in a separate comment

Balloter's proposed resolution: When evaluating BPL emissions using complainant's receiver, complainant's antenna will be used.

P1775 proposed/approved resolution status: Disagree.

P1775 proposed/approved rebuttal: Widely-accepted measurement methods are documented. Calibrated antennas and receivers are sufficient for the purpose.

Discussion: Calibrated antennas and most EMC measurement equipment (receiver, spectrum analyzer) are far less sensitive that typical HF communications antennas and equipment. The rebuttal is technically inaccurate.

SDCom proposed resolution: Add text to Annex F: When evaluating interference using a complainant's receiver, the receiver's normal antenna should be used. Measurements of field strength, if needed, should be made using calibrated antennas and receivers.

P1775 text: Page ii: Introduction. See balloter comment below.

Balloter Comment: Page ii: Introduction: Though stated as not being part of the standard, the Introduction borders on opinion which may or may not concur with those among interested observers. Statements such as "In 2004, the regulatory uncertainty in the USA ended..." could easily be arguable, especially in light of more recent court rulings on the matter.

Balloter's proposed resolution: Consider eliminating the Introduction altogether, perhaps keeping only the final paragraph as it is the only portion germaine to the creation of this standard. Otherwise the introduction will create unnecessary controversy and debate that may slow the progress of the standard.

P1775 proposed/approved resolution status: Disagree.

P1775 proposed/approved rebuttal: The introduction is not part of this draft standard; it describes the history of carrier current systems.

Discussion: If the introduction is not a part of the standard, this could present an opportunity for the EMC Society to add its position on any unresolved provisions in the standard that it does not believe are technically correct and justified.

SDCom proposed resolution: A determination of how the introduction can be changed should be made after the final version of the document is prepared and through the IEEE ballot and (possible) appeals process.

P1775 text: Annex A – Measurement of decay of field strength with distance. See appended Annex A. See also proposed FCC regulation, based on Annex A, below.

39. Under this plan, which as indicated above is based on a concept under consideration in the IEEE P1775/D2 effort, entities conducting measurements would be allowed to determine an extrapolation factor specific to the site by fitting a straight line to measurements of field strength in dBμV/m vs. logarithmic distance in meters from the nearest conductor carrying BPL emissions, where the extrapolation factor would be taken as the slope, *n*, of that line. The slope *n* any point on the straight line is μV/m would be:

$$n = (\log E_1 - \log E_2)/(\log D_2 - \log D_1)$$

where E_r is the measured field strength at distance D_r

The field strength at any distance D along the best straight line fit is estimated from the value of *n* as:

$$\log E_r = \log E_2 + n(\log D_2 - \log D_r)$$

40. The extrapolation factor would be derived from a best fit straight line fit determined by a first-order regression calculation from measurements for at least four lateral distances from the overhead line, at no less than 3 meters from the lateral plane and differing from each other by at least 3 meters. Additional provisions of this procedure are set forth in the proposed modifications to our Access BPL measurement procedures in Appendix C. If these measurements allow a straight line to be calculated or drawn with reasonable fit (the minimum regression coefficient would be 0.9), the best straight line fit would be used to calculate field strength at the 30 meters standard measurement distance in the rules according to the equation above. If the four measurements do not fall near any straight line or negative slope, measurements at a new distance would be added until a reasonable straight line is indicated. In addition, measurements that obviously show a "null" would be ignored. Parties employing site specific extrapolation values would be required to provide a record of the measurements under the above procedure and to submit those measurements and their derivation of the *in situ* values with any measurements in certification applications or other compliance

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Balloter Comment: This Annex makes reference to CISPR (16), which is a start, but it fails to present a complete model including specific characterization of how field strength depends on distance, and it fails to deal with field strength as a function of height and frequency.

Balloter's proposed resolution:

P1775 proposed/approved resolution status: Disagree.

P1775 proposed/approved rebuttal: In-situ environmental conditions vary substantially. The distance correction factor is derived from several in-situ measurements and will be more accurate than generic model.

Discussion: Annex A is the most important parts of this document, especially with respect to technical accuracy. This procedure is being considered by the FCC for adoption into the rules, which will have probable world-wide implications and have ripples into FCC rules applying to other measurements and technologies. The issues dealing with extrapolation in the near field has been worked on by the EMC community for decades, and the premise that all we had to do was turnt it over to the BPL industry is unsupportable. Following very vague references in CISPR 18, Annex A outlines how to make measurements of 4 points in situ and determine that "actual" extrapolation.

This methodology has not been demonstrated to be accurate in a complex EMC environment. As just two examples, note the graphs shown below. The first is a bird's eye view of the H field from an overhead power line, from a method-of-moments calculation of an antenna model of an overhead line in Allentown, PA, developed by the NTIA. Note that the way that field strength varies with distance at different points along the line varies tremendously from point to point, even being different in most cases on one side of the line than it is on the other. The premise that 4 points can be measured in this environment to determine the "real" extrapolation is flawed.

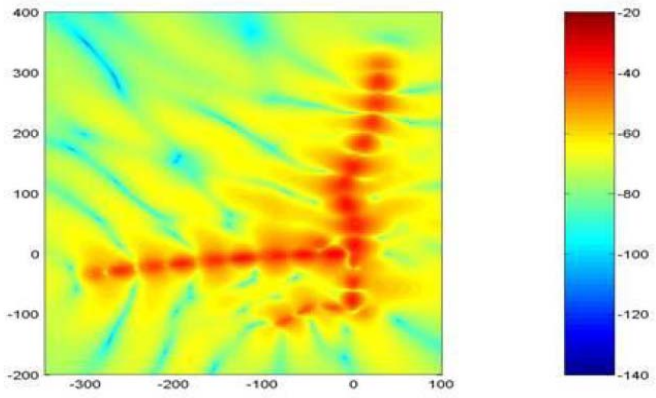

Figure 1 -- This shows a bird's eye view of the field strength from an overhead power line, as modeled by the NTIA. The color scale shows relative dB of the magnetic field at 1 meter height. Note that the field strength decays at different rates from each of the maxima along the line. The decay also typically shows a skew from perpendicular. It is not possible to find a real extrapolation from a measurement of any reasonable number of points in this environment.

The second figure below is from a graph provided to the FCC by Current Technologies, one of the BPL manufacturers. It shows the measurements Current made of the field strength vs distance from an overhead power line. Note that one would obtain a different "real" value for extrapolation from any

four set of points chosen from these data. A standard based on such a wildly varying set of results is insufficient and premature.

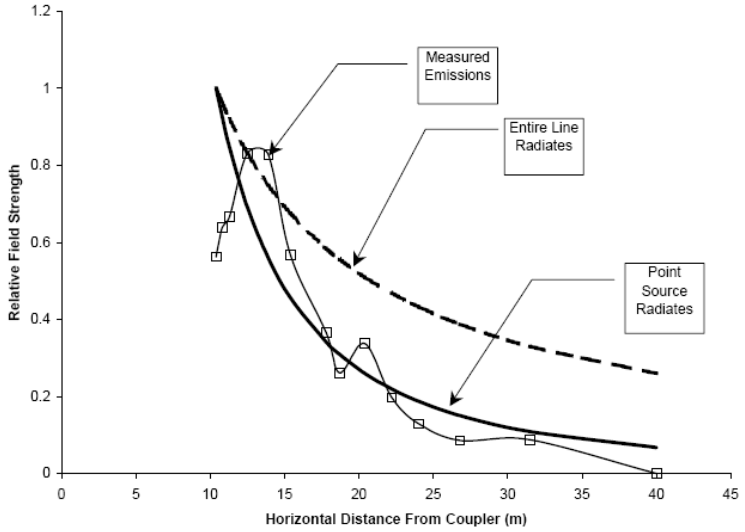

Figure 2 -- This graph shows reported measurements of the decay of BPL signals from an overhead line vs distance. The "entire line radiates" line is intended[1] to show a 20 log decay of field strength vs distance and the point source radiates is intended to show a 40 log decay rate[2]. Note that any set of four points will give a dramatically different extrapolation calculation than any other set of four points. The premise that one can determine actual extrapolation from these data, based on BPL-industry measurements, is technically flawed and unsupportable.

SDCom proposed resolution: Delete Annex A from the standard pending more complete work to characterize how such measurements can be made reliably in the very complex in-situ environment near large radiators. To address the statements about what distance extrapolation factor should be used in the absence of national regulations, the Working Group should either develop and justify a conservative extrapolation factor or use the methods described in C63.12 or any of a number of other standards that specify that extrapolation within the wavelength / 2pi region shall be presumed to be 40- or 60-dB/decade (for H and E fields respectively) and 20 dB/decade beyond that region.