ABSORBING CLAMP FOR CISPR INTERFERENCE MEASUREMENTS

CISPR are the French initials for "International Special Committee on Radio Interference" (See the section on Professional Societies) or "Comité International des Perturbations Radioelectriqués." The measurement of conducted interference is covered by CISPR Publication 2.[1] According to this regulation, interference at frequencies below 30 MHz should be measured in terms of *interference voltage* using a radio-interference measurement receiver in conjunction with an artificial supply network while interference measurements in the 30 to 300 MHz (or 1000 MHz) range should be carried out in terms of *interference field strength*, using a specified measurement setup.

The interference field-strength measurement method laid down for the 30 to 1000 MHz range requires that all measurements be carried out on a site which is free from any extraneous interference (located, if possible, outside built-up areas), or in a screened absorptive chamber.

Since the conventional test methods are rather complicated, the CISPR has been looking for a suitable method which does not call for measurements in an interference-free environment. After several methods had been considered, it was finally decided to specify–for interference measurements in the 30 to 300 MHz range on AC-powered appliances–a method involving the use of an absorbing clamp (Figure 1). Recommendations to this effect are contained in a supplement to CISPR Publication 2, Section 4.1.3. The absorbing clamp was developed by Jean Meyer de Stadelhofen (PTT, Switzerland).[2] and is manufactured and distributed by Rohde & Schwarz.

Principle of Operation

The principle of operation relies on the fact that the interference energy produced by appliances, whose physical size is small in comparison with a wave-length at the frequency considered, is largely carried or radiated by the power cable.[3] The new absorbing clamp contains a ferrite absorber which encircles the power cable and reflects a resistive RF load ($\approx$100 to 250Ω) into the supply cable carrying the interference. RF interference currents passing into the absorber flow through an RF current transformer located at the input of the absorber, are measured by means of a radio-interference test receiver (Fig. 2). To eliminate false readings due to any interference already carried by the AC-supply system, it is essential that the absorber be capable of suppressing any such AC-supply derived noise (if this is considerable, then it may be necessary to interpose an additional ferrite absorber between the AC-supply socket and the absorbing clamp).

In such a test setup there is normally no matching between the impedance of the interference source, the power cable and the absorber, and consequently reflections and standing waves exist along the AC-supply cable. To carry out a valid measurement it is necessary to slide the MDS clamp (which is fitted with rollers) along the cable until the meter on the test receiver indicates a maximum. Under these conditions the input impedance of the absorber is matched, via the "transformer" formed by the power cable, to the impedance of the interference source, which thus delivers maximum power.

By using suitably proportioned absorber elements and turns ratio on the current transformer, it was possible to make the dB (μV) meter indications of the test receiver equivalent to dB (pW). Higher accuracy can be obtained by use of the calibration and frequency-correction curve supplied with each absorbing clamp. The method of calibration (Fig. 3), and the measurement setup to be used for selection of the ferrite rings, are specified in the CISPR publication.

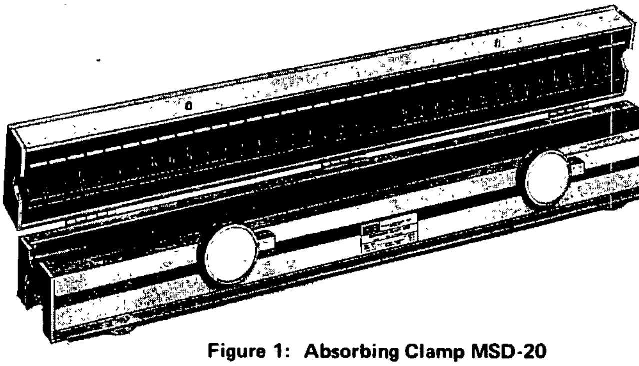

Figure 1: Absorbing Clamp MSD-20

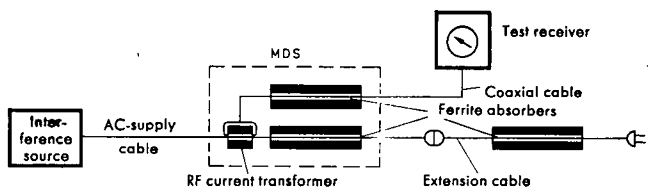

Fig. 2 Interference power measurement by use of absorbing clamp.

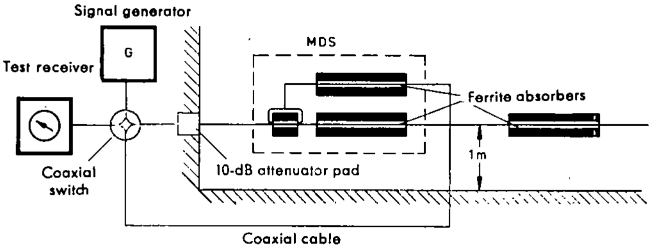

Fig. 3 Setup used to calibrate absorbing clamp.

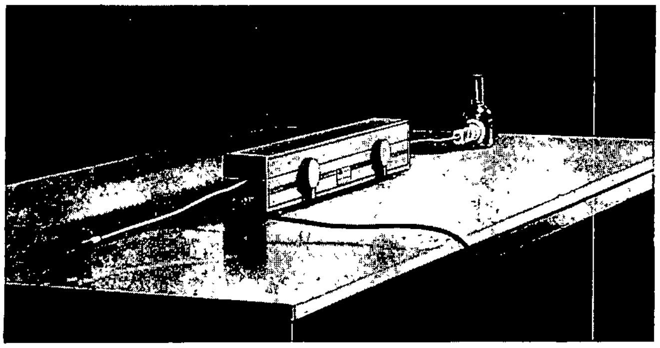

Figure 4. Interference measurement setup

Construction

The absorbing clamp MDS-20 consists of an oblong plastic case fitted with a hinged lid so that the cable to be measured can be inserted. Fitted inside the top and bottom halves of the case is a row of spring-supported ferrite half-rings which, when the hinged case is closed, form a closed magnetic circuit and thus an absorptive load for the RF current passing through the cable encircled by the rings (Fig. 1). The two rings nearest to the test item carry the secondary windings of the current transformer, the output of which is connected by coaxial cable to the output socket of the device, and from there to the input of the receiver. The internal cable is also fitted with ferrite rings in order to suppress any currents in the sheath.

Operation

To carry out a measurement, the test item is placed on a non-metallic surface, at least 70 cm above any possibly conducting surface and at least 40 cm from any other metallic objects (Fig. 4). The AC-supply cable of the test item should, if necessary, be extended to a length of at least $\lambda/2$ + 0.6m (where λ is the wavelength corresponding to the lowest test frequency to be considered) and should be kept straight and horizontal.

Test Procedure

To measure the interference (Figure 5) from an appliance 1 the latter is placed on an insulated surface (test table) so that it is at least 70 cm from a conducting floor or wall. Depending on the lowest interference frequency to be measured, the power cable is extended to a minimum length L_1. It is then laid out horizontally so that when the Absorbing Clamp 4 is closed around the cable it can slide easily to and fro. The converter end (green mark) of the Clamp should be directed to the appliance.

The procedure is then as follows:

a) Set the test receiver 5 to the appropriate frequency (e.g. lowest) and start the appliance.

B) Move the Absorbing Clamp away from the appliance until the greatest meter deflection on the receiver is reached. The Clamp should be held by the end away from the appliance.

c) Normally the maximum nearest to the appliance is measured, but with frequencies above 150 MHz this can often lie within the appliance itself. In this case, move the Clamp to the 2nd maximum (distance L_2) when a higher reading cannot be obtained with the Clamp as close to the appliance as possible.

d) Measure the interference intensity on the receiver's meter,

	Interference	Indication	Correc. with curve
Calibration in dB (μV):	dB (pW)	dB (μV)	+ dB
Calibration in μV:	dB (pW)	20 log EμV	+ dB

Special Cases

Measuring unstable or discontinuous interference signals. In these cases, the power cable is fed with a continuous and constant interference signal by inductive coupling from an auxiliary source. This enables the interference maximum to be determined. A convenient source is a battery-operated electric shaver with the suppression components removed. The auxiliary source 6 is placed approximately 15 cm from the power cable and 10 cm from the interfering appliance; the power plug of the appliance should be withdrawn. After the test receiver has been tuned to the appropriate frequency, the auxiliary interference source is switched on and the clamp is placed so that the maximum is obtained (at L_2). Then switch the auxiliary source off and the appliance on. Carry out the interference measurement as above.

Approximate measurements where space is confined. Lay the power cable of the interfering appliance in the Absorbing Clamp and gather the lengths of cable (on both sides of the Clamp), which cannot be stretched out, into bunches, taking care not to form a coil. Depending on the frequency, this method yields results 0 to 3 dB too high. If a power plug or line connector prevents the maximum from being found, two measurements are necessary with the plug respectively on the left and right of the Clamp. The true interference level is given by the higher values plus 2 dB.

Other Applications

Apart from measurements on interference sources such as small appliances, the Absorbing Clamp can also be used for evaluating suppression methods for ignition systems and the screening efficiency of coaxial cables. The principle of the clamp can also be used in reverse; for example, an interference signal can be fed into the antenna cable of a receiving equipment to check the sensitivity to interference fields.

References

1. Publication 2–Specification for CISPR Radio Interference Measuring Apparatus for the Frequency Range 25 to 300 MHz. First edition 1961, Bureau Central de La Commission Electrotechnique Internationale, Gineva, Switzerland.
2. Meyer de Stadelhofen, J.; Bersier, R.: Die absorbierende MeBzange–eine neue Methode zur Messung von Storungen im Meterwellenbereich. Technische Mitteilungen PTT 47 (1969) No. 3, pp. 96–104. Translation: The Absorbing Clamp–A New Method for Interference Measurements in the Range of Meter Wave Lengths. Technical Report PTT 47 (1969) (in German).
3. "News from Rhode & Schwarz" issue number 46, page 18.
4. Rohde & Schwarz data sheet 203422 "Absorbing Clamp, 30 to 300 MHz".

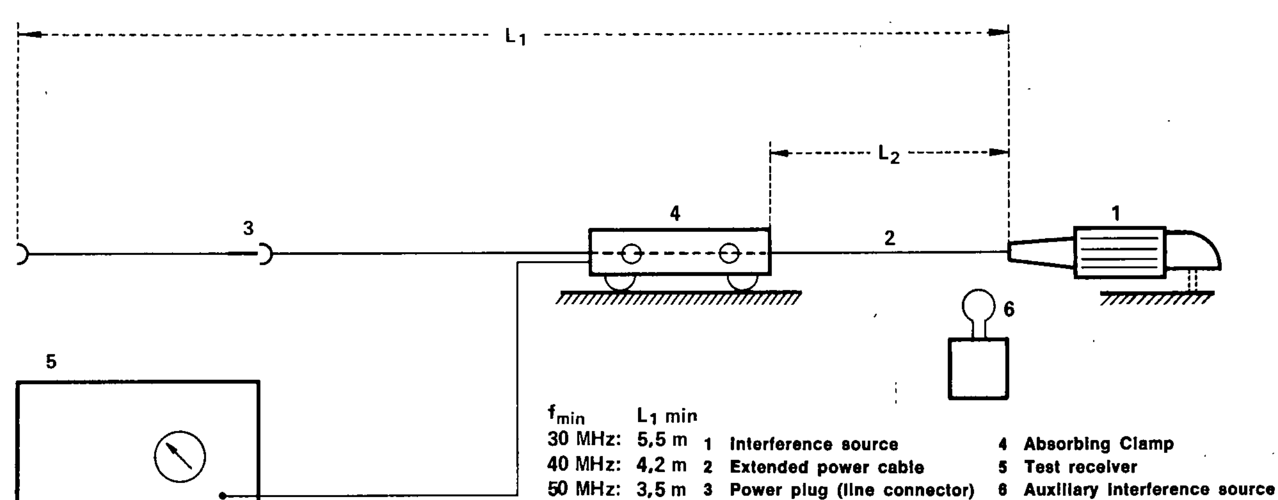

Figure 5. Interference measurement setup