Annex 113A Description of cable clamp and test setup

(informative)

113A.1 Overview

This annex describes an example of a cable clamp and a representative methodology that should be used in the rejection of external EM fields test of 113.5.4.3, which is used to determine the sensitivity of the PMA receiver to external EM fields picked up by the MDI connector and the cabling and interconnect system. Variations of this methodology may also be useful for other testing as may be suitable for design and development purposes.

Description of Cable Clamp

As shown in Figure 113A-1 and 113A-2, the clamp is 300 mm long, 75 mm wide, 78 mm high with a center opening of 9.525 mm (0.375 in). The clamp consists of two halves that permit the insertion of a cable into the clamp.

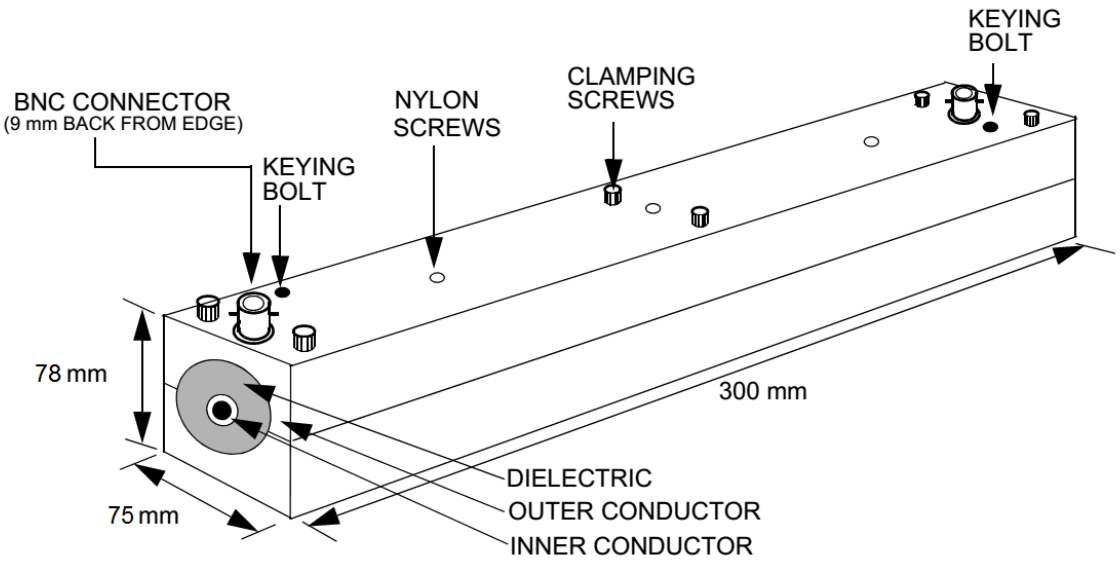

Figure 113A-1 - Cable clamp

The clamp has a copper center conductor and an aluminum outer conductor with a high density polyethylene dielectric. The following is a review of the construction and materials of the clamp:

a) Inner conductor - Copper tubing with an inner diameter of 9.53 mm (0.375 in) and an outer diameter of 12.7 mm (0.50 in).

b) Outer conductor - Aluminum bar that is 300 mm long and approximately 78 mm by 75 mm. The bar is milled to accept the outer diameter of the dielectric material.

c) Dielectric - High Density Polyethylene (Residual, TypeF) with dielectric constant of 2.32. The hollow cylinder has an outside diameter of 45 mm and an inner diameter that accepts the outside diameter of the copper inner conductor.

d) Connectors - BNC connectors are located 9 mm (0.39 in) from each end of the clamp and are recessed into the outer conductor. The center conductor of the connector is connected to the inner conductor as shown in Figure 113A-2.

e) Clamping screws - Six screws are used to connect the two halves of the clamp together after the cable has been inserted. Although clamping screws are shown in Figure 113A-1, any clamping method may be used that ensures the two halves are connected electrically and permits quick assembly and disassembly.

f) Nylon screws - Used to align and secure the inner conductor and dielectric to the outer conductor. The use and location of the screws is left to the manufacturer.

g) Keying bolts - Two studs used to align the two halves of the clamp.

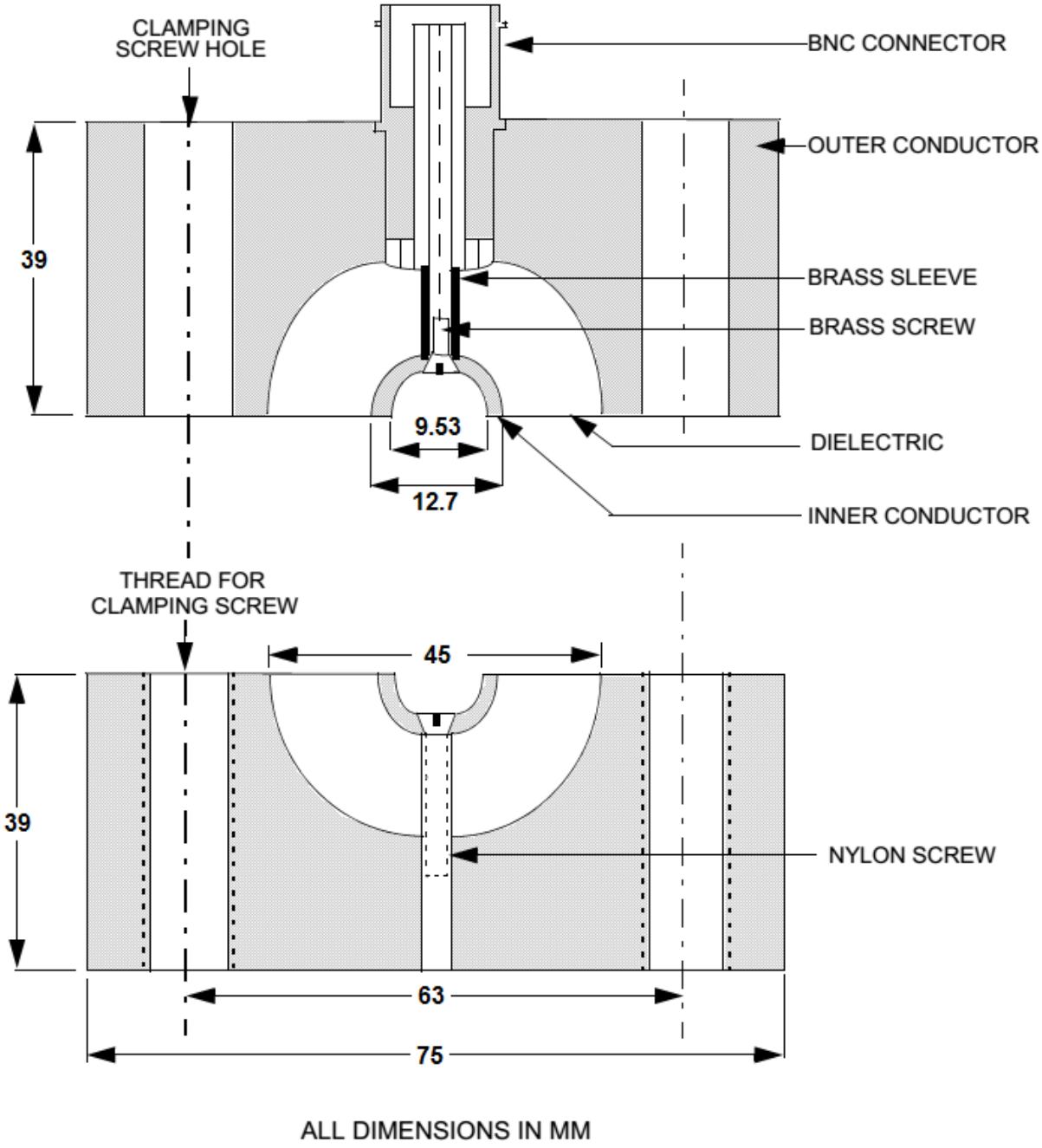

Figure 113A-2 - Cross-section of cable clamp

As shown in Figure 113A-2 the inner conductor on the bottom half of the clamp extends slightly (~ 0.1mm) above the dielectric to ensure there is good electrical connection with the inner conductor of the top half of the clamp along the full length of the conductor when the two halves are clamped together.

~~The electrical parameters of the clamp between 80 MHz and 2 000 MHz are as follows:~~

~~a) Insertion loss: < 5 dB~~

~~b) Return loss: >20.0 dB (1 MHz-520 MHz), >20.5 – 50log30(f/500) dB (520 MHz-2 000 MHz)~~

113A.~~1~~ 2 Cable ~~clamp~~ Clamp ~~validation~~Measurement

In order to ensure the cable clamp ~~described above~~ is operating correctly, the following ~~test~~ validation procedure ~~is~~s are provided. Prior to conducting the ~~following~~ these test~~s~~ ~~shown in Figure 113A-3~~, the clamp should be ~~tested~~ measured to ensure the insertion loss and return loss are as specified ~~above~~below. The electrical parameters of the clamp are measured between the source connections and without installed cabling to verify proper operation and so that the Insertion Loss results can be used for testing. Measurement results should meet the following:

a) Insertion loss: < 1 dB below 500 MHz, < 3.5 dB below 1000 MHz, < 15 dB below 2000MHz

b) Return loss: > 7 dB below 500 MHz, > 3.5 dB below 1000 MHz, > 1 dB below 2000 MHz

113A.3 25/40G Setup Validation

Thi~~s~~e cable clamp validation test procedure uses shielded cabling that meets the specifications of 113.7.

The test hardware consists of the following:

a) Transmitter/Receiver – A link partner system, configured for the data rate being evaluated, with the transmitter disabled.

b) Breakout Fixture – A passive fixture with ~~a modular jack~~an MDI connector jack input and individual outputs for each of the 8 signal wires. Wires of pairs not being measured should be terminated to the ground plane with a 50 Ω resistor.

c) Balun - ~~3~~ 4 ports, laboratory quality with a 100 Ω differential input and a 50 Ω single-ended, unbalanced output:

Insertion Loss (100 Ω balanced <-> 50 Ω unbalanced): <4dB (1 MHz-~~3~~ 2 000 MHz)

Return Loss: >~~30dB~~ 15dB (~~1~~ 3 MHz-~~3~~ 2 000 MHz)

Common-Mode Rejection: >~~60dB~~ 50dB (1 MHz-200MHz), >~~30dB~~ 40dB at ~~3~~ 2 000 MHz

Common-Mode Return Loss > 8 dB (1 MHz-2 000 MHz)

d) 50 Ω Resistor terminations for the unmeasured conductors

e) Test cable – A 30m, 4-pair 100 Ω plug terminated shielded cable that meets the requirements of 113.7; for example, ~~S/FTP~~ Category 8 balanced cable.

~~e~~f) Chokes (5) - Wideband Ferrite Material:

~~Inner diameter: 8.7 mm to 10.15mm~~

Impedance: 175 Ω @ 100 MHz, 275 Ω @ 250 MHz, 375 Ω @ 500 MHz, 400 Ω @ 1 000 MHz

~~f~~g) Ground plane - Copper sheet or equivalent large enough to span the equipment interface under test and the clamp, including the portion of the cable between the equipment and the chokes.

~~g~~h) Signal generator capable of providing a sine wave signal of 80 MHz to 2 000 MHz.

~~h~~i) Signal Sensor & Measurement System - Oscilloscope, power meter or spectrum analyzer with at least ~~4~~ 2 000 MHz bandwidth

~~i~~j) Receiver

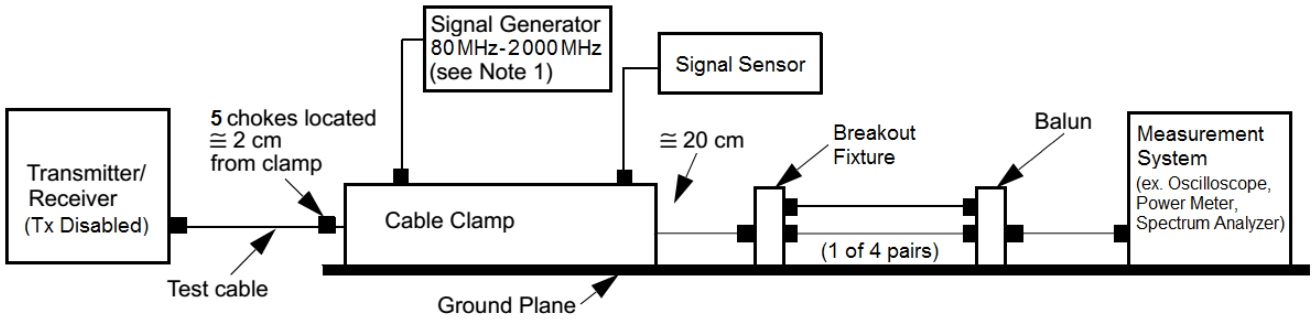

Figure 113A-3 - Cable clamp validation test configuration

[Commenter's input: Is there a Note 1?]

With the test cable inserted in the cable clamp, a signal generator with a 50 Ω output impedance is connected to one end of the cable clamp and a signal sensor with a 50 Ω input impedance is connected to the other end.

The signal generator shall be capable of providing a sine wave signal of 80 MHz to 2 000 MHz. The output of the signal generator is adjusted for a signal power of 6dBm at 80 MHz on the signal sensor. The remainder of the test is conducted without changing the signal generator voltage. The cable pairs not connected to the balun are terminated in a resistor network. ~~It is very important that t~~The cable clamp, breakout fixture and balun must have ~~good~~ direct low inductance contact with the ground plane. The chokes~~, which~~ are placed on the cable, located next to each other~~, are located~~ approximately 2.0 cm from the clamp. The cable between the clamp and the balun should be positioned straight to the breakout port and not in contact with the ground plane except where the plug shield contacts mate to the breakout.~~It is recommended that t~~The cable between the transmitter and the cable clamp should be

installed either in a linear run or wrapped randomly on a cable rack. The cable rack should be at least 3 m from the cable clamp.

The differential-mode and common-mode voltage outputs of the balun and breakout fixture should meet the limits shown in Table 113A-1 over the frequency range 80 MHz to 2 000 MHz for each cable pair.

Table 113A-1 - Common- and differential-mode output voltages

Frequency (f)	**Common-mode voltage**	**Differential-mode voltage**
80-250 MHz	<1.07 – 0.6 (f-80)/170 Vpp	<22 mVpp (-29 dBm)
250MHz-2 000 MHz	<470mVpp (-2.6dBm)	<22mVpp

[Commenter's input: It's position here makes it unclear if this correction applies above or below or both. Also, earlier submissions indicated doing the correction based on measurement with the cabling and choke. Also power correction is called into question based on Moffitt initial chamber comparison submission. All this needs to be resolved.] NOTE - ~~Prior to conducting the validation test~~As per 113A.1 the cable clamp should be tested without the cable inserted to determine the variation of the signal generator voltage with frequency at the output of the clamp. The signal generator voltage should be adjusted to 6dBm at 80 MHz on the signal sensor. When the frequency is varied from 80MHz to 2 000 MHz, the measured power should not vary more than ±10%. If the power varies more than ±10%, then a correction factor must be applied at each measurement frequency.

113A.~~2~~ 4 25/40G Test ~~Setup~~

~~Up to~~ 30 meters of cabling that meets the specification of 113.7 is connected between two 40GBASE-T PHYs and inserted into the cable clamp. The cable should be terminated on each end with an MDI connector plug specified in 113.8.1. The clamp. cabling, and choke positioning should be the same as the 113A.2 Validation, and the Transmitter/receiver under test should be positioned where the breakout was originally. The clamp should be located a distance of ~20 cm from the receiver port. ~~It is recommended that the cable between the transmitter and the cable clamp be installed either in a linear run or wrapped randomly on a cable rack. The cable rack should be at least 3 m from the cable clamp. In addition~~As with the validation, the cable clamp and ~~40GBASE-T~~Transmitter/ receiver under test should be placed on a common ground plane and the ground of the receiver should be in direct low inductance contact with the ground plane. The chassis grounds of all test equipment used should be connected to the ground plane. ~~No connection is required between the ground plane and an external reference.~~ A signal generator with a 50Ω impedance is connected to one end of the clamp and measurement equipment with a 50Ω input is connected to the other end of the clamp. The signal generator shall be capable of providing a sine wave signal of 80 MHz to 2 000 MHz. [Commenters input: adjusted needs a clear explanation] The output of the signal generator is adjusted for a signal power not to exceed 6 dBm

at the signal sensor to simulate an external electromagnetic field of approximately 3 V/m. The signal influence over data received from the far end transmitter is assessed by the manufacturer.

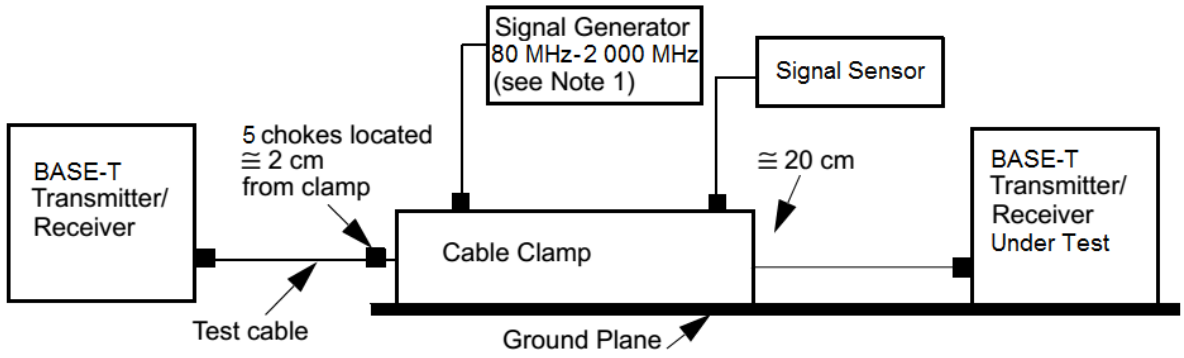

Figure 113A-4 - Cable clamp test configuration

[Commenter's input: Is there a Note 1?]

113A.5 2.5/5/10G Setup Validation and Test

For testing the sensitivity of 2.5/5/10GBase-T receivers, Annex 40B may be used at extended frequencies as described in 55.5.4.3 Common-mode noise rejection. Alternatively the clamp described in 113A.1 may also be used, but the Setup Validation and testing is done with suitable unshielded cabling, and currents are induced directly onto the cabling pairs.

[Commenters note: How different will the clamps behave and what parameters must be outlined?]