Bedea with new test procedure

EMC of passive CATV components with Triaxial Cell *

In order to guarantee the coexistence of wireless services with telecommunication networks for television signals, sound signals and interactive services, limit values are necessary for ingress as well as for radiation. This applies also to passive wideband equipment for coaxial cable networks according to IEC 60728-4 in the frequency range from 5 MHz up to 3 GHz, respectively 3,5 GHz

The standards of the EN 50117 and EN 50083 series specifies limit values for screening effectiveness of cables and passive equipment as well as appropriate test procedures.

Whereas the EN 50117 series requires the Triaxial test procedures according to IEC 62153-4-3 and IEC 62153-4-4 (EN 50289-1-6), EN 50083-2 specifies different test procedures, depending on the frequency range.

- 5 MHz to 30 MHz
  Coupling unit-method,
- 30 MHz to 1000 MHz
  Absorbing clamp-method, (EN 55013)
- 950 MHz to 3500 MHz
  Substitution-method.

For evaluation or qualification or manufacturing control of a passive device according to EN 50083-2, e.g. in the range from 5 MHz to 1.500 MHz three different costly test procedures with three different costly test equipment are needed.

With the triaxial test procedure, which was extended by the Triaxial Cell, one can measure transfer impedance and screening attenuation of cables, connectors and passive equipment from DC up to 4 GHz (12 GHz depending on the size of the tube or the cell) with one test setup.

In this way effort and costs for evaluation or qualification of EMC behaviour of passive components can be reduced considerably.

Beside the requirements of EN 50083-2 on passive equipment, there are further specifications of users and network operators which differ from the requirements of table 1 in the frequency range as well as in the specified limits. E.g. for a CATV tap-off for laying underground, a network operator specifies a screening attenuation of ≥ 90 dB in the range of 5 MHz to 862 MHz and ≥ 85 dB in the range of 862 MHz to 1200 MHz. Approval and manufacturing control of components fulfilling these limit values can be achieved by measurement with Triaxial cell.

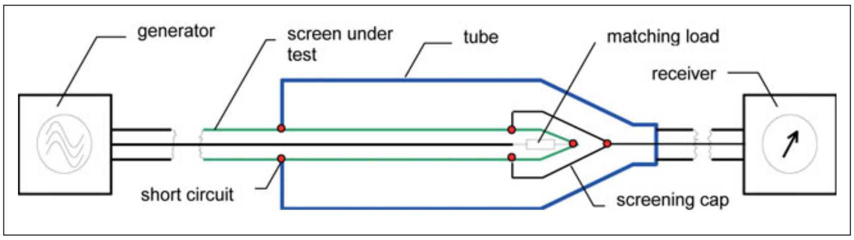

Figure 1: Principle test set-up to measure transfer impedance and screening attenuation

Frequency range MHz	Limit value		Test procedure
Screening attenuation	Class A	Class B	
5 to 30	≥ 85 dB	≥ 75 dB	Coupling unit-method, EN 50083-2
30 to 300	≥ 85 dB	≥ 75 dB	Absorbing clamp - method, EN 55013
300 to 470	≥ 80 dB	≥ 75 dB	
470 to 1 000 a)	≥ 75 dB	≥ 65 dB	
950 b) to 3 500	≥ 55 dB	≥ 50 dB	Substitution-method, EN 50083-2

a) For equipment with an upper frequency limit of 1 000 MHz, the absorbing clamp method is used up to 1 000 MHz.
b) For equipment with a lower frequency limit of 950 MHz, only the substitution method is used.

Table 1: Screening classes of passive equipment according to EN 50083-2

Frequency range MHz	Limit value			Test procedure
Transfer impedance	Class A+	Class A	Class B	Triaxial method
5 to 30	≤ ~~0,9~~ mΩ/m	≤ ~~2,5~~ mΩ/m	≤ ~~5~~ mΩ/m	IEC 62153-4-3
Screening attenuation	2,5 mOhm/m	5 mOhm/m	15 mOhm/m	
30 to 1 000	≥ 95	≥ 85	≥ 75	IEC 62153-4-4
1 000 to 2 000	≥ 85	≥ 75	≥ 65	
2 000 to 3 000	≥ 75	≥ 65	≥ 55	

Table 2: Screening classes of CATV – cables according to EN 50117-2-4 and EN 50117-4-1

Triaxial method

The triaxial method is one of the classic procedures to determine the screening effectiveness of RF-cables and connectors. With one test set-up one can measure transfer impedance as well as screening attenuation respectively the coupling attenuation in case of balanced devices.

The cable under test (CUT) is prepared with a connector at one end and with a matching load at the opposite end. The CUT is set into the tube and short circuited at the generator side with the tube. The device under test or the inner system is fed with RF-energy by the generator. Due to the leaking screen (EM)-energy couples into the outer system and an EM wave is travelling in both directions. At the short circuit, the wave is totally reflected, so that the receiver

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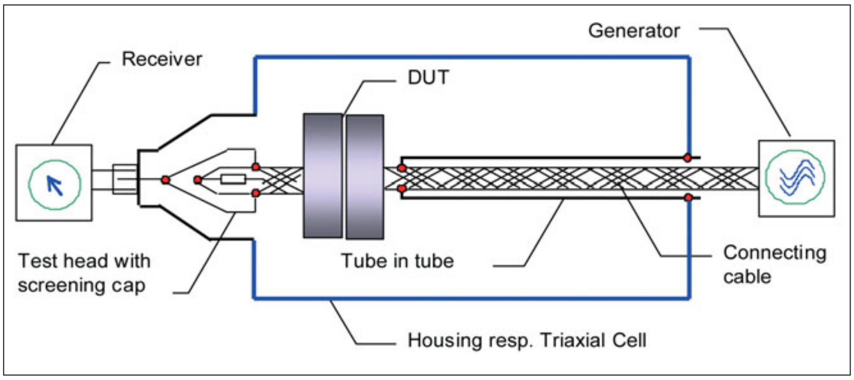

Figure 2: Principle depiction of the Triaxial cell to measure transfer impedance and screening attenuation components with tube in tube according to IEC 62153-4-7

136-er Cell				750-er Cell				1000/150/150-er Cell			
a	b	c	f/GHz	a	b	c	f/GHz	a	b	c	f/GHz
136	136	99	2,17	750	250	250	0,87	1000	150	150	1,41

Table 3: Resonance frequencies of different Triaxial Cells

measures the superposition from both waves respectively from near- and far end coupling.

The logarithmic ratio of the input power P_1 to the received power P_2 at the receiver is the screening attenuation a_S at high frequencies respectively the transfer impedance in the lower frequency range. The transfer impedance Z_T is calculated by the voltage ratio U_2/U_1, the length l of the CUT as well as the characteristic impedance Z_1 by:

$$Z_T \cdot l \approx Z_1 \cdot \left|\frac{U_2}{U_1}\right| \quad (1)$$

where U_1 is the input voltage U_2 is the received voltage.

The screening attenuation is related to the standardised impedance Z_S of the outer system of 150 Ω to:

$$a_s = 20 \cdot \log\left(\left|\frac{U_2}{U_1}\right|_{\max}\right) + 10 \cdot \log\left(\frac{2 \cdot Z_s}{Z_1}\right) \quad (2)$$

where Z_1 is the characteristic impedance of the CUT and Z_S is 150 Ω.

Triaxial Cell

The Triaxial Cell was designed to test larger connectors and assemblies. The principles of the Triaxial test procedures according to the IEC 62153-4-x series can be transferred to rectangular housings. Tubes and rectangular housings can be operated in combination in one test set-up.

The screening effectiveness of connectors, assemblies or other devices can be measured in the tube as well as in the Triaxial Cell. Test results of measurements with tube and cell correspond well.

Figure 3: Different designs of Triaxial Cells of the CoMeT System

Cut off frequencies, higher order modes

The housing respectively the triaxial cell is in principle a cavity resonator which shows different resonance frequencies, depending on its dimensions. For a rectangular cavity resonator, the resonance frequencies can be calculated according to equation (3).

$$f_{MNP} = \frac{c_0}{2}\sqrt{\left(\frac{M}{a}\right)^2 + \left(\frac{N}{b}\right)^2 + \left(\frac{P}{c}\right)^2} \quad (3)$$

where

M,N,P

number of modes (even, 2 of 3 > 0)

a,b,c

dimensions of cavity [mm]

c_0

velocity of light in free space

For dimensions of the Triaxial cells of 136/136/99 mm, 750/250/250 mm and 1000/150/150mm the first resonance frequencies are given in table 3. Since the device under test is placed inside the cavity, the resonance frequencies during the test may differ from the calculated frequencies.

Comparative measurements of transfer impedance and screening attenuation of cables with tubes and with Triaxial cells showed the same results up to the first resonance frequencies.

Above the first resonance frequencies of the cells, deviations of the maximum values of the curves within 3 dB were measured. The behaviour of the cells above the first resonance frequencies and the location of the device under test in the cell are under further study.

Measurements on network components

The screening attenuation of the CATV tap-off of fig. 4 of Intica Systems in Passau, Germany, frequency range from 5 to 1500 MHz, was optimised with the Triaxial cell. The component is already approved by different network operators.

The complete system of tap-off, contact bushes and KES-plugs show a screening attenuation of > 95 dB up to 1 GHz according to class A+ of EN 50117 after optimisation.

In the range of 1 GHz to 1.5 GHz a value of > 85 dB was measured.

With these screening values, the device is useful for back channel applications as well as for requirements of the digital dividend and offers sufficient reserve for further services up to 1500 MHz.

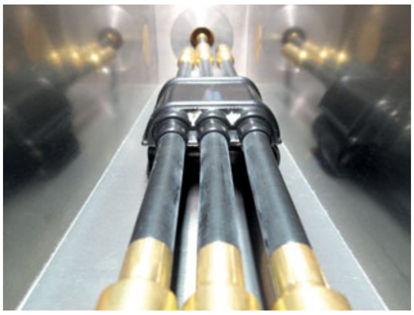

Figure 4: CATV tap-off with Triaxial Cell

In the same way as measuring splitters, one may measure e.g. TV-wall outlets with the Triaxial cell. With the "tube in tube" procedure according to IEC 62153-4-7, which may be applied together with the cell, one may connect the device under test direct by an additional RF-tight tube and minimise the influence of the connecting cables.

With the Triaxial cell one can measure transfer impedance and screening attenuation up to about 2 GHz (depending on the size of the cell) with one test set-up.

Beside the evaluation of screening effectiveness of communication cables, the triaxial method offers a useful and easy to handle tool to measure the screening effectiveness of passive components.

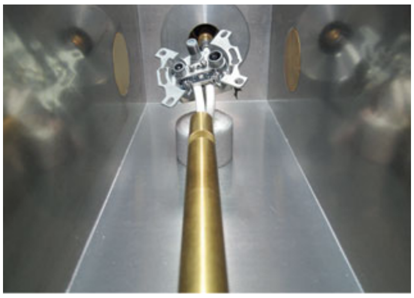

Figure 5: TV-wall outlet with Triaxial Cell and tube in tube

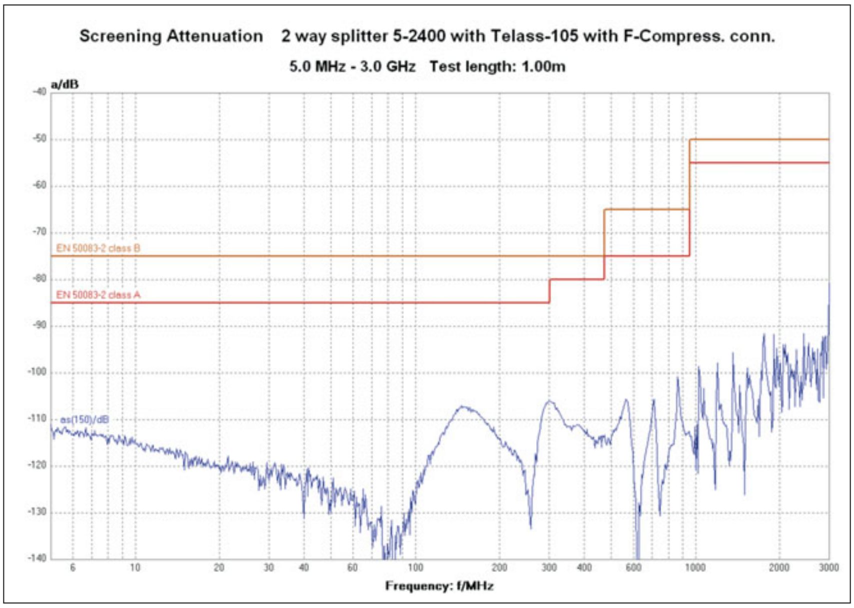

Figure 6: Screening attenuation of a two way splitter with triaxial cell

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Compared to the procedures of EN 50083-2 one can reduce effort and costs by using the triaxial method for evaluation, qualification and manufacturing control.

Additionally to numerous triaxial tubes, different component manufacturers as well as network operators already use Triaxial cells for evaluation and qualification. The use of the triaxial test procedure with the triaxial cell for passive components according to EN 60728-4 respectively EN 50083-2 should be discussed further by experts.

The test procedure with the Triaxial cell is under discussion as 62153-4-15, (46/454/CD) at international standardisation by IEC TC 46/WG 5.

Further information:
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Literature

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Arris introduces Ad Insertion clustering software

Arris has introduced new Cortex clustering software technology to be used with the Arris ConvergeMedia solution, utilizing the XMS Flex Distribution Platforms with Streaming Media Engine 5.3.1 and Ad Control Manager 3.0 software releases. Cortex gives operators the ability to consolidate their ad insertion infrastructure into centralized, resilient systems where the delivery infrastructure is both reliable and expandable. The technology will help cable operators cost-effectively grow capacity for HD expansions, improve operational efficiency, and preserve high run rates.

Cortex provides more fault tolerance than previous clustering techniques. It also contrasts with systems using external applications to provide fail-over resiliency. Cortex provides more granularity and flexibility in configuring the system and developing new capabilities. It is also more scalable since the intelligence is embedded in each node deployed.