UK GTEM users group

Minutes of meeting held at Measurement Technology Ltd., Luton

29 June 2010

Attendees:

Name	Organisation	code
Stuart Bright	Echelon	SB
George Vassila	ETS	GV
Jonathan Hamilton	Megger Ltd	JH
Sean Saint	Measurement Technology Ltd	SS
Steve Cobb	EC Compliance Ltd	SC
Richard Marshall	Richard Marshall Ltd	RM
Zaid Muhi-Eldeen Al-Daher	University of Nottingham	ZD
David Knight	NPL	DK
Roger Dixon	Past chairman of GTEM UG	RD
Howard Chetwin	Measurement Technology Ltd	HC
John Wombwell	EMC Hire Ltd.	JW
Angela Nothofer	University of Nottingham	AN
Ian Alderman	Past secretary of GTEM UG	IA
Michael Davies	HMGCC	MD
Richard Neyton	Apollo Fire Detectors	RN

1) Chairman's welcome

Meeting started with introductions around the room. It was noted that Ian Alderman had sent apologies for last meeting, however this did not appear in the minutes.

2) Round robin progress, DK

Initially the draft round robin schedule was presented to give the group an overview of the aims, then a discussion document was presented to invite comments from the members. Both documents are available on the user group website. RD mentioned that he had contributed to a proposed annex to CISPR32, along with JW and HC.

The aim of the round robin exercise was cited as to produce a standard proposal for testing EUTS with cables – possibly for inclusion in 61000-6-20. RD suggested that a satisfactory conclusion to the project could be that an error margin of ±6dB is ok for GTEM use.

Action: RD or HC to supply their draft CISPR32 Annex, which was written to include TEM cells in the multi-media emission standard. COMPLETE 30/6/2010

Some measurements had been completed at NPL and Nottingham, so this data was used to demonstrate various issues with the round robin. In order to normalise the data for different sized GTEM cells, it was proposed that the data be transformed into total radiated power, using the expression from 61000-4-20, just using single voltage measured (1-D case).

It was proposed that the EUT and wires be positioned at the same height (0.45m) regardless of GTEM size, thus it would be low in large GTEMs and high in small GTEMs. The assumption being that movement within the test volume should produce less variation than cable routing effects. Also, it has been shown that EUT height affects the emission below 300 MHz, so it is

important to remove this parameter. Previous work has shown that an exit impedance of between 150Ω and 300Ω produces best repeatability.

During the discussion it was stated that the definition of the EUT needs to be clear, and also the definition of the exit from the test volume. To manage excess cable the side bundle could be used, either within the test volume or at ground level.

There followed a discussion on where the EUT finished, and where the cable exit began. It is crucial to decide how much cable is bundled within the test volume and how much is managed outside the test volume, but still within the GTEM cell. The position of the bundle needs to be precise to get repeatable results. In particular it was shown that:

- If the bundle outside the volume is not near the floor there could be large resonances (these were damped by addition of ferrites)
- If the bundle is within the test volume there are similar resonances. If cables are part of the EUT then their position should be defined carefully.

RD also mentioned that Tian Lo while at NPL had established that in excess of 1GHz emissions would only manifest if the EUT was rotated. AN also confirmed that cable variations were always in the sub 1GHz range.

NPL used RM's CDN to demonstrate the improvement of cable management above the same situation with no cable management at all. It is intended to provide a long (3m+) length of cable for the round robin so individual labs may demonstrate their cable management schemes.

Although the 3-D transform has been used to get equivalent 10m OATS radiated field from GTEM emissions, using 3 EUT rotations, this works best for small EUTs without wires. Previous work with EUT and wires has shown that the transform works reasonably below 300 MHz, where most of the radiation is generated by the wires, however this breaks down at higher frequencies. It is proposed we add a section to the round robin schedule in which each lab rotates the EUT and simply records the maximum emission.

DK confirmed that he would add a cable layout option to the round robin so that the cables are at the critical angle and the EUT is rotated through 3 orientations to maximise results.

GV volunteered to do some complete radiation pattern tests on the ETS OATS, and this could be compared to the maximum signals achieved from the GTEM cells.

RM commented that the twisted pair of wires should be taped together. This will be specified in the round robin schedule.

HC showed a polystyrene jig which holds their test devices in 3 orientations, with the excess cable wrapped in a fixed path around the jig, and then leaving the GTEM suspended at fixed height.

3) ZD to present the simulation work

The difference between measured and theoretical field factor (e_{0Y}) was presented. This has some correlation with the measured S11 which has characteristic resonances and at high frequency the magnitude can be above -20dB.

The assumptions behind the GTEM to OATS transform are that the maximum power can be measured in the 3 orientations, since EUT depicted as 3 orthogonal dipoles. Also, the gain must be less than or equal to a dipole, which is not true for complex EUTs at high frequency which have larger gains (directivities).

Cables have been modelled as a coil inside the volume, using 50Ω termination. It was noted that this load did not match the EUT emissions as well as 150Ω, as shown by actual EUT measurements. Also, it was noted that the position of the coil in the test volume has to be carefully controlled for best repeatability, because of the potential resonances found for real EUTs with bundles inside the test volume.

An equation was derived which estimates EUT directivity from GTEM emissions, and it was shown that EUT directivity is much higher than dipole directivity.

In conclusion the best results in a GTEM are obtained by azimuth scan, recording maximum output power. There was general support for testing EUT using the maximum emission, and this ties in with comments made about the round robin.

RM made point that we need more CST modelling to look at case of 150Ω termination.

HC asked whether we need greater safety margin because the GTEM to OATS algorithm is under-estimating directivity. The answer is yes (AN), maybe only slightly greater margins.

JW asked whether the performance of ferrites would allow compact test ranges to be built. However, we believe ferrite performance is not great above 1GHz.

Zaid confirmed that his research period ends at the end of 2010. A student called Tong (surname not given) has been cited as his replacement. Future work will be determined when Tong has taken over from Zaid.

4) Appointment of new secretary

Howard Chetwin has volunteered to take on this role, with support for any difficult technical areas.

General dissatisfaction that NPL could not support the user group as resource for UK industry. DK explained difficulty with funding; since financial structure has changed at NPL many people have lost funding for standards committee work.

The NPL logo will be removed from user group papers.

5) News and AOB

<u>RM reports:</u>

- CISPRI on PLT has lapsed, and may re-start in Oct2010. In the meantime CENELEC are setting up a working party to look at PLT between 2 - 47 MHz.
- PLT is a growing problem. There are some devices which exceed CISPR22 limits.
- EMC Industry Association has launched a competition on detection of PLT emissions. Details may be found on their website.
- BT Vision's new PLT device, while still failing the EMC requirement is a reduced emission device.

Comments on previous minutes:

The comment on page 2 of previous minutes asks whether comparison between OATS and GTEM, with cable bundle inside test volume has been done. AN answered not yet.

Last comment on page 2 needs to be clarified. Previous work by Tian Loh (NPL) does not include wires which exit the test volume.

Item 6 on minutes mentions work done by German labs on similar cable issues. Action on DK to follow this up.

The minutes of last meeting were accepted with minor corrections.

Provisional next meeting date:

Tue 30th Nov 2010, to be held at MTL

News:

Philip Stott of AWE Aldermaston is retiring, and being replaced at AWE by Stewart MacManus.

JH announced he had enquiry from someone looking to buy 2nd hand GTEM. None available from members present.

JH announced a company seeking a systems integration engineer to fit control panels. Electrical knowledge of PLCs and Mechanical knowledge required. Contact him for details.

SB cannot attend JTF in Fort Lauderdale, so need another observer.

Farquhar Galbraith is no longer able to contribute to the group. Joe Wilkinson of EMC Centre(Paisley) Ltd is the person to contact now.
RM suggested thanking Farquar for his help.

JH stated that links with the EMC TLA have been re-established, and that the GTEM user group invitations will be circulated to the EMC TLA run by Dave Imeson.

Three new members have joined the GTEM User Group from Application Solutions where there is a GTEM750.

JW suggested an investigation on how many GTEM cells are in use.

JW suggested contacting Raymarine and TuV who both have a GTEM cell.

AN covers JTF matters:

There is a struggle to keep JTF going. The maintenance is split into 2 parts: editorial and technical. After FDIS there is a 3 year cooling off period, before maintenance may resume. This may be resumed earlier if an appeal is made.

AN will produce work plan for proposed standard for the next meeting.

6) HC resolves GTEM resonance problem

Recap on resonance at 108MHz which apparently reduces emissions by 20dB.

The cell was dismantled in Apr2009, and rebuilt. There are many small components which contribute to the whole performance.

Resistor board has been extensively checked. Ordering and alignment has been checked, and also the boards were checked for broken resistors.

There are 2 types of termination frame. One where the RAM is supported by a non-metallic frame (like NPL and Nottingham), and another where there is a metallic frame which has conductive straps to the cell walls (like MTL).

In the first type the resistor board is strapped directly to the back wall of the cell. In the second type the board is strapped to the metallic RAM support by some pieces of tape. By experimentation it was found that the location of this tape is crucial to cell performance. The whole assembly forms a RC circuit between the resistor board and the cell wall.

HC demonstrated significant improvement in emissions comparisons, and forward power calibration after the strap was correctly placed.