

## UK GTEM users group

Minutes of meeting held at Measurement Technology Ltd., Luton  
18 November 2009

Attendees:

First name	Last name	Organisation	code
Stuart	Bright	Echelon	SB
Andrew	Hicks	BEKA associates Ltd	AH
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 GTEMUG	RD
Howard	Chetwin	Measurement Technology Ltd	HC
John	Wombwell	EMC Hire Ltd.	JW
Kris	Cadman	Consultant	KC
Angela	Nothofer	University of Nottingham	AN

Apologies from:

Jim Duck (Megger Ltd.)  
Ivan Yallup (Landis+Gyr)

Logistical notes:

Planned arrivals at 10am for 10:30 start. Actual start about 11am due to parking problems, and getting a decent notebook PC. Meeting closed after 4pm, followed by MTL EMC lab visit.

### 1) Greeting by Chairman (JH)

Chairman opened the meeting, and thanked RD for his previous work in the role.

### 2) Introducing NPL as secretary

DK was present as representative of NPL, acting as secretary. The administration will be run through NPL's KT department, and the contact is currently Stuart Humphreys. The GTEM users group website is still maintained by HC as before. There is a link from NPL's 'club' page through to the GTEM UG page.

<http://www.npl.co.uk/networks-clubs/electromagnetics-network/rf-and-microwave-traceability-special-interest-group>

### 3) Minutes and actions from last meeting

DK reported that he had investigated the 'WaveCell' device which had been marketed by a company called Wave Control. The device had been presented at a university conference in Spain but the organisers told him that no presentations were available in electronic format. The company had not responded to emails. Must conclude this device is experimental and not a viable alternative to GTEMs at the moment.

RD asked whether Farquhar Galbraith will continue his contribution to the JTF meetings.

**Action:** JH to contact Farquhar

**Action:** AN to appoint SB as observer for next JTF meeting at Fort Lauderdale

General consensus that meetings be held away from London because travel to/from NPL can be difficult.

#### **4) Presentation by ZD - also available on the website**

An overview of TDR was given. The peak in  $Z_0$  corresponds to the join with the resistive panel. The  $S_{11}$  also has a maxima at a characteristic frequency where the resistor performance finishes and the RAM performance begins. Ideally  $S_{11}$  should be better than 20dB return loss.

RD - made point that free-space impedance is important, not just coax characteristic  $Z_0$ . In response ZD said that the free-space impedance is inextricably linked with reflection from cell.

ZD then described how CST was used to model the GTEM, with particular focus on the resistive panel, and the current distribution on the panel. Ben loader (NPL) has done a previous analysis of current distribution on the resistive plate (Title: 'The longitudinal field in the GTEM 1750 and the nature of the field termination', now available on the website).

Three types of cable bundle were described, which will be used to remove excess cable length: common mode, differential mode, and meander. These bundles will be inside the test volume of the GTEM (as part of EUT), rather than on the floor because the standards suggest keeping cables away from floor, although in practice the cables need to exit the GTEM somehow.

ZD explained how the correlation algorithm between OATS and GTEM assumes component dipole gains, whereas some bundles may have higher gains.

There followed a discussion on whether the  $S_{11}$  maxima reinforce the measured emissions, and should this be taken into account, by some correction. The  $S_{11}$  may have some correlation with the  $E_{0y}$  which is used for the OATS correlation, so it was recommended that  $E_{0y}$  be calibrated across the frequency band, rather than use a fixed value.

JW - Were any comparisons done between OATS and GTEM with these bundles as part of the EUT test volume? What consideration given to larger cables like GPIB? AN explained this had not been covered but the plan would be to do this.

ZD showed that putting the bundle in the EUT test volume reduced difference in emissions between different termination loads.

#### **COMMENTS**

AN - agreement between OATS and GTEM is often worse than comparison between different GTEM cells.

RD - Tian Loh (NPL) has done work on emissions above 1GHz. Does this overlap with this work? Though we think this work did not use cables.

JW - These measurements are essentially checking that the EUT does not interfere with other equipment, although there should be interest in improving device with regard to nuisance interference.

RM - Historically OATS is the baseline test, although it has flaws. Higher modes are not captured, and no GTEM arrangement can replicate the OATS environment.

JW - Comment that 95% of EMC now done in chambers, OATS mainly used as reference.

RD - The measurement of EUT box and cables cannot be separated into component parts, which is the main issue.

RM - suggested that we ignore bundles and require manufacturers to make short leads for testing. This would not be popular and may affect repeatability between GTEMs.

JW - noted that Hewlett Packard provided cables with ferrites and stated that the unit would only pass EMC if these cables were used.

#### **5) DK discussion on round robin**

There was a discussion on how best to implement a round robin comparison between labs. A separate proposal will be written and circulated for comments. In general this would be a comb generator in a small box (30cm cube approx.) to be tested from 30MHz to 1GHz. RM agreed to manufacture a variable termination suitable for this frequency band. Termination values (Ohms) will be 0, 50, 150, 300, and open circuit. The target will be to have mid-Jan 2010 as start date.

#### **6) IEC committee work**

JH - EMC directive will be amalgamated into one omnibus directive to harmonise the enforcement.

AN summarised the current activity in the JTF on GTEM standards. This will be made available as a separate addendum to the minutes.

DK - passed on copies of related comparisons being done by European labs. One covered use of absorbing clamps in anechoic rooms, and the other covered conduction measurements with a CDN (no results were available at the time).

#### **7) Leakage from GTEM seals**

JW explained how he had measured emissions from the GTEM septum with the door open and closed. The resulting shielding indicated possible problems with GTEM shielding (30dB).

We are used to chambers having 90dB or better, but GTEMs may be compromised after moves or adjustments. MIL285 cannot be used because of difficulty putting antenna inside cell. Hence just measure emission from cell with door open/closed. Can use E-field sniffer probe to find weak points. Copper tape may be used to seal suspect joins, and the contact finger strips around the door can be replaced. The access panel for cable should also be checked.

## 8) Performance verification of GTEM

HC explained there was a suspected problem with the MTL GTEM after a move. TDR suggests large change in  $Z_0$ , so what is causing this ?

There are 4 tests which ETS use to verify GTEM cells:

- calibrated CNE source
- TDR
- VSWR ( $S_{11}$ )
- Fwd power for given field strength.

The CNE is calibrated at 3m through a gold standard held by another test house, and this can be used to test emissions from the GTEM, using the OATS algorithm. The uncertainty in the calibration can be large due to the number of steps in the traceability chain.

Careful choice of BW and frequency step are required to capture the maximum energy from the source. JW comments that you can leave the receiver on Maxhold to gather best signal.

Deep dip in emission at 108MHz, and relatively small deviation around 900MHz.

AN - commented you could test CNE straight into spectrum analyser to check nothing wrong with the source.

Some measurements were discussed where the CNE was moved about a 5 point grid in the test volume. Also, the configuration of the resistive panels was altered to try improve the performance. RD said the current distribution was highest on the edge, so the resistors need to be configured accordingly.

The TDR showed a 7 Ohm bump in  $Z_0$  around the join with the resistor panels. The  $Z_0$  also continued level after this point, which contrasted with some TDR data which ZD had presented in which the  $Z_0$  fell rapidly.

The pros and cons of using factor files were discussed.

The fwd power tests corroborate the features observed in the other tests.

DK made comment that you can model the CNE box in software such as CST (available from CST.com), then directly measure output power of real device so that radiated performance may be predicted more precisely than currently possible with a long calibration traceability chain.

## 9) AOB

DK asked whether there was interest in improving field uniformity above 1GHz. Ben Loader at NPL is planning to work on this. There is some interest from those who use CISPR22.

## 10) Next meeting

Wed 19th May 2010  
Again at MTL Luton