



**EPSMA TC2 2015  
Technical Committee Meeting  
2 November 2015**

**Held at Heathrow Hotel Bath Road, London**

## EPSMA Technical Committee Meeting 2<sup>nd</sup> November 2015

Date: Monday, 2 November, 2015  
 Time: 11:30pm to ~ 16:30pm  
 Venue: The Oakmont Room, Heathrow Hotel, The Grove, Bath Road, Sipson, West Drayton, Middlesex, UB7 0DG, United Kingdom, [Tel: +44 \(0\)20 8759 7777](tel:+442087597777)  
 EPSMA: Paul Conway: +44 7814183450 (mobile)

11:30	<b>Arrival for sandwich lunch.</b>	All
12:00 - 12:20	<b>Open meeting, introductions and brief review of agenda</b>	Paul
12:20 - 12:45	<b>General TC status review</b> <ul style="list-style-type: none"> <li>• Update on current and possible future TC members status.</li> <li>• Brief review of projects and actions</li> <li>• Approval of TC1-15 minutes</li> </ul>	Paul Paul TC1-15 Attendees
12:45 - 13:15	<b>Safety of Low-Voltage Switch Mode Power Supplies'</b> (The new standard IEC 61204-7, 2 <sup>nd</sup> edition: proposed in 22E/142/NP). <ul style="list-style-type: none"> <li>• Review of the current status of the IEC 61204-7, 2<sup>nd</sup> edition which takes account of IEC62477-1.</li> <li>• Discussion: IEC61204-7 Ed 2 CDV (Committee Draft for Vote) vote results and comments due Friday 18<sup>th</sup> September 2015.</li> </ul>	Paul Paul / All
13:15- 13:30	<b>EPSMA Guideline 'Harmonic Current Emissions Guidelines to the standard EN 61000-3-2'</b> <ul style="list-style-type: none"> <li>• Based on EN 61000-3-2:2006; needs update to IEC 61000-3-2:2014</li> </ul>	All
13:30- 14:00	<b>EPSMA Guideline 'CE MARKING GUIDANCE FOR POWER SUPPLIES'</b> <ul style="list-style-type: none"> <li>• Review update to meet 2014 directives mandatory in April 2016.</li> </ul>	DH
14:00 - 14:15	<b>Refreshment break – coffee and pastries</b>	All
14:15 - 14:45	<b>Accurate Efficiency Measurements – Working Group Session</b> <ul style="list-style-type: none"> <li>• Working Session – review the contents and invite up-issue if expertise is offered to add more detail on methods or additional issues.</li> </ul>	Hubert, Vlad
14:45 - 15:15	<b>Developments in GAN</b> <ul style="list-style-type: none"> <li>• Francesco will make a short presentation.</li> </ul>	Francesco
15:15 - 15:45	<b>EPSMA Website</b> <ul style="list-style-type: none"> <li>• EPSMA web improvement to make the title and keyword of the publications more relevant to search engines.</li> <li>• Accurate Efficiency Measurement report to be added to the list of publications on the public page.</li> <li>• TC to recommend improvements that could be passed to MC for approval.</li> </ul>	Paul All
15:45 - 16:00	<b>Review of other areas of interest – Reports from monitoring “champions”</b> <ul style="list-style-type: none"> <li>• <b>Energy Efficiency/Savings</b> External Power Supplies (19.03.2014)</li> <li>• <b>Energy Efficiency/Savings</b> Battery Charging Systems (2012_09_03)</li> <li>• <b>Future Trends in Semiconductors</b> Any new topics?</li> <li>• <b>Photo Voltaic</b> - Any update since presentation on PV-applications?</li> <li>• <b>HVDC Systems for Telecom</b> Need new champion to keep a watch of development of ETSI EN 301605 to report developments to the TC.</li> <li>• <b>ROHS and WEEE</b> - Any update since re-issue Nov 2012?</li> <li>• <b>IPC9592</b> Any developments affecting members?</li> <li>• <b>International Standards</b> – Any developments affecting members?</li> </ul>	Jarmo Armin Francesco All (Previously Markus) All (Previously Andreas)  All All
16:00 – 16:15	<b>Other?</b> <ul style="list-style-type: none"> <li>• Do any EPSMA TC publications need update?</li> <li>• Any new subjects for possible publications or as presentations to the TC. E.g. the smart grid segment: smart meters, smart appliances, energy storage, International Standards and Directives?</li> </ul>	All
16:15 - 16:30	<b>Summary of actions from the meeting.</b> <b>Set next meeting and adjourn</b> Propose Monday 9 May 2016, at Siemens, Nuremburg. Annette has reserved a large meeting room. Hotel reservation - IBIS in Steinbuehler Strasse has no discount vacancies. Possibly we can stay at <a href="http://www.nuernberg-bestwestern.de">www.nuernberg-bestwestern.de</a> Note: PCIM is being held from 10th May to the 12th May 2016	Paul Paul

*Lunch and coffee breaks included*

*19:00: Social/meal – the MC will join us at the TC social/meal to be held in the Smith Grill in the same Heathrow Hotel as our TC in the Oakmont Room. Buffet Meal with Bar.*

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**Present at the meeting:**

<b>Name</b>	<b>Company</b>	<b>Tel No.</b>	<b>Mail address</b>
<b><u>TC Members</u></b>			
Arthur Jordan (AJ)	Vicor UK	+44 7768 461870	<a href="mailto:AJordan@vicr.com">AJordan@vicr.com</a>
Dave Collins (DC)	Artesyn	+353 87 6470711	<a href="mailto:david.collins@artesy.com">david.collins@artesy.com</a>
Dominique Hessmann (DH)	Delta Energy Sys.	+49 7641 455 315	<a href="mailto:dominique.hessmann@delta-es.com">dominique.hessmann@delta-es.com</a>
Hubert Schoenenberger (HS)	PULS	+49 89 9278 184	<a href="mailto:Hubert.Schoenenberger@pulspower.com">Hubert.Schoenenberger@pulspower.com</a>
Francesco Di Domenico (FD)	Infineon	+43 51777 3424	<a href="mailto:Francesco.DiDomenico@infineon.com">Francesco.DiDomenico@infineon.com</a>
Jarmo Minkkinen (JM)	Salcomp	+358201875424	<a href="mailto:jarmo.minkkinen@salcomp.com">jarmo.minkkinen@salcomp.com</a>
Milos Luptak (ML)	Bel Power	+421 918392880	<a href="mailto:milos.luptak@psbel.com">milos.luptak@psbel.com</a>
Paul Conway (PC)	EPSMA	+44 7814183450	<a href="mailto:conwaypk@googlemail.com">conwaypk@googlemail.com</a>
Vlad Grigore (VG)	Efore	+358 9 4784 6579	<a href="mailto:vlad.grigore@efore.fi">vlad.grigore@efore.fi</a>
<b><u>MC Member (Part time)</u></b>			
Paul Lee (PL)	Murata (secretariat)	+44 1908 619820	<a href="mailto:Paul.lee@fsmail.net">Paul.lee@fsmail.net</a>
<b><u>Apologies (TC Members):</u></b>			
Armin Wegener (AW)	FRIWO	+49 2532 81301	<a href="mailto:wegener@friwo.de">wegener@friwo.de</a>
Bernhard Grub (BG)	XP-Power	+49 151 12748545	<a href="mailto:bgrub@xppower.com">bgrub@xppower.com</a>
Christian Augesky (CA)	Siemens	+43 51707 29745	<a href="mailto:christian.augesky@siemens.com">christian.augesky@siemens.com</a>
Jürgen Schneider (JS)	Texas Instruments	+49 8161 80 3652	<a href="mailto:j-schneider1@ti.com">j-schneider1@ti.com</a>

*Note 1: In the following minutes, any actions are indicated in blue after the respective item.*

### **Open meeting, introduction and review of agenda**

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PC opened by welcoming the TC members to the EPSMA's 2<sup>nd</sup> TC meeting in 2015 and thanked everyone for making the effort with difficult travel - many flight cancellations at Heathrow and other UK and European airports due to fog.

PC briefly introduced two new members who joined the TC soon after April 2015;

Arthur Jordan, Vicor UK and Dave Collins, Artesyn.

As two members had not yet arrived due to flight delays, the members introductions were postponed until everyone had arrived.

The agenda was presented and there were no new items requested however some agenda items were postponed to later in the afternoon until everyone was present.

### **General TC status review**

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The membership status, Appendix 1, was reviewed.

The status of actions is as follows.

**Action:** PC early 2016 to encourage Diarmuid Hogan, Head of R&D at Excelsys, to join the TC. He had asked to defer membership for a year during 2015.

**Action:** PC to chase-up a reply from AW to let us know, in view of his poor attendance over recent years, whether he will regularly attend future TC's or whether he wishes someone else to represent FRIWO on the TC.

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## Brief review of projects and actions

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The previous minutes were viewed by the TC both to review the accuracy of the minutes and to review projects and actions.

The status of projects are summarised in the minutes below with any new actions.

## Approval of TC1-15 Minutes

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The previous minutes of TC1-15 held 27 April 2015 at Siemens AG, Gleiwitzer Str. 555, 90475 Nürnberg, were approved by VG with no changes requested by the TC.

## Introductions by Members of MC and TC

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Later in the meeting, when everyone had arrived, members briefly introduced themselves by name, position, company and job responsibilities.

## Energy Efficiency/Energy savings

*[Jarmo Minkkinen (EPS) and Armin Wegener (BCS)]*

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### General Requirement of Energy Efficiency for External Power Supplies

*[Jarmo Minkkinen (Author)].*

Jarmo informed the TC that new regulations affecting the no load power of EU External PSU's may be mandatory in 2017. Jarmo said these were very challenging as it seemed they were based on limits set by the USA for 110V mains and the same limits would apply to 220V mains. E.g. a 250W PSU is required to not exceed 0.21W no load current. A European Commission organization had written an Explanatory Note accompanying the updated working document on the Review of Regulation (EC) No 278/2009 regarding External Power Supplies. This is from the web page below sent by Jarmo after the meeting:

<http://www.eup-network.de/product-groups/drafts-regulations/>

Associated Working documents are at these links:

Lot 7 [external power supplies](#) (review of regulation 278/2009), [explanatory note](#), [review study](#) (2012), [additional study](#) (2014).

Jarmo mentioned that the measurement method written by CENELEC is defined in EN50563: 2011: 'External a.c. - d.c. and a.c.- a.c. power supplies – Determination of no-load power and average efficiency of active modes'.

Jarmo will update the database for External Power Supplies when official decisions have been made and new rules have been introduced in the European Official Journal.

**Action: JM** to keep a watch of the EPS standards and update the database when these change.

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## Energy Efficiency Standards for Battery Charging Systems

[Armin Wegener (Author)]

Armin was not at this TC and had been asked for an update but none was received. At the May 2014 TC Armin explained then that the Californian CEC Energy Star is still voluntary and the DoE new revision that may affect BCS was in discussion about limits.

**Action:** **AW** to keep a watch of the BCS standards and update the database when these change.

## EPSMA Guideline 'Harmonic Current Emissions'

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An enquiry to the EPSMA secretariat asked 'Are there any changes or new rules for the EN 61000-3-2 standard?'

This is the subject of EPSMA Guideline 'Harmonic current emissions - Guide from the EPSMA' dated November 2010.

It is based on EN 61000-3-2: 2006 and the IEC store shows that a more recent version IEC 61000-3-2:2014 exists: <https://webstore.iec.ch/publication/4149>

The TC reviewed the content of the guideline and PC asked whether anyone was willing to update it to the latest IEC 61000-3-2:2014.

PC explained that EPSMA documents now include acknowledgements of the authors in the cover page.

Milos Luptak offered to champion the project and both Arthur Jordan and Dave Collins offered to support him with this. It was agreed that the draft would be ready for comment by 31 January 2016.

**Action:** **ML** to champion the update of 'Harmonic Current Emissions' supported by **AJ** and **DC**

**Action:** **PC** to ask the secretariat, **PL**, for the latest MS Word original of Guideline 'Harmonic Current Emissions - Guide from the EPSMA' dated November 2010 and send it to **ML**.

## EPSMA Website

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The TC reviewed the EPSMA web to see what improvements might be made, for example to make the title and keyword of the publications more relevant to search engines.

TC comments about the site included that it takes a while to get content added and many news releases are very old giving the site an appearance that it is not kept up to date. The TC felt EPSMA could increase revenue if it improved the website.

To test a web search, the TC attempted a Google web search of 'Accurate Efficiency Measurements'. The search was abandoned after it did not locate the latest white paper within the first few pages. Other searches were more successful showing EPSMA guidelines early in the search.

The EPSMA Forum previously available to members was briefly discussed. As this had not been much used by members and was not seen as being of much use, previous actions were

closed. It is unlikely that the Forum will be re-instated with the web update unless a special need arises.

**Action: PC** to ask the new secretariat, Paul Lee, whether improvements could be made to improve the search 'ranking' of EPSMA publications. Also to add the Accurate Efficiency Measurement report title to the list of publications on the public page and include a synopsis of the paper on the web. The Excel tool to calculate errors also needs to be added separately as it was not included with the pdf of the original MS Word version with the embedded tool.

**Post Meeting:** Paul Lee offered at the AGM on 3/11/15 to improve and update the website.

## **IEC 61204-7 edition 2.0 'Safety of Low-Voltage Switch Mode Power Supplies'**

### **Background**

EPSMA TC has been following progress with development of IEC 61204-7 edition 2.0.

There have been presentations on the subject to the TC in May 2013, May 2014 and April 2015 by Holger Laible, Chairman of IEC SC22E committee tasked with producing edition 2 of IEC61204-7. Also Thierry Pelikan of TDK Lambda made a presentation to the TC on the subject in May 2013 and April 2015.

PC informed the TC that Holger Laible has agreed to update us on IEC 61204-7 edition 2.0 at the next TC at Siemens, Nuremberg on Monday 9 May 2016. Holger expects by then that the standard will be 'finished'.

The current status is that IEC SC22E did complete all comments on the IEC 61204-7, 2<sup>nd</sup> Ed. during the meeting in Rosslyn and they are planning to go FDIS\* by the end of this year.

**\* Final Draft International Standard (FDIS)** (*The FDIS is circulated to the National Committees for a two-month voting period.*)

The TC discussed the concerns of this new standard being finalised and the transition from UL/EN 60950 to UL/EN 62368; potentially three standards for products to be assessed to and increased costs and certification times.

Dominique mentioned that Delta had sent a product for assessment to both '60950' and '62368' and the report contains a comparison between the standards.

This was considered very helpful to share with EPSMA if Delta agrees.

**Action: DH** to send the '60950' and '62368' comparison report to share with the TC if agreed by Delta.

**Continuing Action: PC** to keep contact with Holger Laible, Chairman of IEC 22E committee, and Thierry Pelikan\* so as to keep the TC up to date with developments.

\* Thierry Pelikan, TDK-Lambda France SAS. Member of EPSMA MC. Member of French mirror TC22X (Cenelec) and TC22 (IEC).

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## EPSMA Guideline 'CE MARKING GUIDANCE FOR POWER SUPPLIES'

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### Background

A recommendation for update of the CE MARKING GUIDANCE FOR POWER SUPPLIES was made November 2014 by Dominique.

This guideline, issued in 2005, refers to directives that have been updated for a long time. Also new LVD & EMC directives published in 2014 will be mandatory April 2016.

Dominique said the CE process is needed at Delta and offered to update it with some help. Clemens Klemm (Siemens) and Michael Raspotnig (PULS) offered to support the update. DH felt it could be completed before the end of 2015.

### Progress

Dominique has revised some of the paper but is experiencing problems with interpretation of the application and meaning of the standards.

Some TC acknowledged they too experienced difficulties in interpretation of the standard. Examples were discussed included:

'Is the brand owner, manufacturer or OEM required to add the CE Mark?'

Dominique had other questions and the TC offered to help with these.

### Actions

**PC** to forward the Word version of the pdf web copy to DH, CK and MR.

**Action Complete.** These were sent 3 May 2015.

**DH** to Champion the CE Marking project to issue the draft update by April 2016 with the assistance of CK and MR.

**DH** to send the TC questions about the interpretation of CE Marking requirements to meet the latest applicable directives including LVD, EMC and RoHS.

## **Accurate Efficiency Measurements**

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*[Hubert Schoenenberger(Champ), Vlad Grigore and previously Andi Stiedl]*

This paper was released to the EPSMA web on 21 June 2015.

It is hoped that the report will be up-issued in the future if expertise is offered to add more detail on described measurement techniques or to add other methods.

The TC was shown the contents of the paper and Hubert made a short presentation to show the evolution of the project, the changes to the structure from the original specification and ideas for improvement:

- Add 3phase AC-DC power conversion
  - Real power, apparent power, power factor
  - symmetric / asymmetric power feeding
- Add measuring methods for
  - DC-AC conversion
  - AC-AC conversion

- Improve team communication. (e.g. contents of the current report were not discussed/reviewed in the team)
  - discussion with new team members is essential

The TC also considered moving the calculations to an annexe.

The purpose of the paper was discussed to decide the intended audience e.g. for EPSMA members or customers to understand the pitfalls of efficiency measurements. Paul Lee asked the TC's opinion on whether the report should be freely available or EPSMA only or to be purchased by non-EPSMA members. Pros and cons were discussed and Paul Lee took these to the MC AGM next day to make a decision.

The paper is to be circulated to the TC to consider options for a revision and seek volunteers to work on its revision.

#### Actions

**PC** to send the finished report to the secretariat to circulate it to the MC for a 3 week opportunity to comment and approve it for issue to EPSMA web with a press release.  
**Action Complete.** The paper was released to the EPSMA web on 21 June 2015.

**PC** to send the MS Word version of the report to the TC to consider options for a revision and seek volunteers to work on its revision.

#### Other areas of interest

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##### Future Trends in Semiconductors

*[Jürgen Schneider, Francesco Di Domenico]*

Francesco gave an interesting presentation on developments of GaN by Infineon.

Some key points included:

- GaN functions to 100kHz and has low  $R_{DS\ on}$  at high voltage.
- GaN costs are high but reducing.
- Low  $Q_{RR}$  (Reverse recovery charge).
- P-GaN developed to have positive threshold and normally-off (GaN is normally-on).
- GaN has very linear  $C_{OSS}$  (Output capacitance).
- Very high efficiencies in PFC - predicted to be 95.5%.
- Infineon GaN products are undergoing formal qualification.

**Action: FD** to send an edited version of the presentation for circulation to the TC and MC.

##### Photo Voltaics

*[Previously Markus Hallenberger]*

Markus is no longer a member of the TC. The TC was previously asked who would like to champion this area but there were no volunteers.

At the November 2014 TC, AS commented that this area is interesting and it was felt that there would be resurgence in adoption of PV.



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## Electric Lighting – LED applications

[Armin Wegener]

Armin was not at this TC.  
No new comments from the TC.

## High Voltage DC Systems for Tele - Datacom and Data Handler Applications

[Andreas Stiedl (Previously Anders Petersson)]

[Background;

At the November 2011 TC, Anders said that Inteltec, The International Telecommunications Energy Conference, held October 2011, probably revealed details on the subject. Also ETSI is looking into this area and obstacles foreseen are e.g. Infrastructure/Fuses/Security issues.

A driving application for the higher voltage is Blade Servers.

At the November 2012 TC, AP said there is a new draft to cover HVDC:

ETSI EN 301605: 'Environmental Engineering Earthing and Bonding of 400VDC Data and Telecom ICT Equipment'.

There is also ETSI EN 300132-3-1 V2.1.1 2012-0: 'Environmental Engineering.'

The TC previously decided that we should keep a watch of development of ETSI EN 301605.

AS commented at the November 2013 TC that demand for HVDC is coming from customers especially for power back-up. AS also explained that lightning strikes at outstations is a problem to HVDC when it results in arcing that is difficult to stop as there is no zero crossing as with AC power.

At the November 2014 TC, AS commented that interest seems to have decreased within equipment racks as distances are short and DC power losses in wiring are low. HVDC is used for outside installations and Data Centres where longer distances are involved. Problems with HVDC are lightning, as mentioned earlier, also corrosion.]

At the November 2015 TC, Arthur Jordan said he may be interested in working on this as Vicor are looking into HVDC.

Vlad commented that Eltek has new products for HVDC and the EU has granted money to universities for work on the Microgrid.

Action:

- **PC** to find a new champion for this evolving technology.
- **AJ** to consider what he might offer towards an HVDC paper.

## Adoption of IPC9592

– Full or selective compliance? What are our customers asking for?

The TC was asked whether any members were aware of any issues regarding IPC9592.  
There were no new issues reported.

## International Standards

The TC was asked whether they knew of any developments affecting members.  
There were no new issues reported.

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## NEW PROJECTS

*[To be formally approved/ assigned]*

The TC reviewed all TC publications, Appendix 2, to remind members of projects completed and to consider whether any released projects need revision.

The review/update of the two Database EPS and BCS recorded earlier in the minutes is ongoing.

Three TC Publications are now subject to revision as detailed earlier in these minutes:

- Harmonic Current Emissions
- CE MARKING GUIDANCE FOR POWER SUPPLIES
- Accurate Efficiency Measurements

No other new project ideas were generated at the TC.

## Any other Business

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There was no new business from the TC.

## Next meeting

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The next TC meeting will be on Monday 9 May 2016, at Siemens, Gleiwitzer Str. 555, 90475, Nuremberg.

Annette has reserved a large meeting room.

Hotel reservation - Possibly we can stay at [www.nuernberg-bestwestern.de](http://www.nuernberg-bestwestern.de)  
Annette will confirm rates for the nights of Sunday 8 to Tuesday 10 May 2016.  
(IBIS in Steinbuehler Strasse has no discount vacancies.)

Note: PCIM is being held from 10th May to the 12th May 2016

The EPSMA MC will be the next day, Tuesday 10 May, at the PCIM if a room is able to be secured. The MC is to be arranged by the secretariat.

## Actions

**PC** to send invitations with a spreadsheet and an Outlook Meeting Invitation.

**All** to put the next TC meeting date in their calendar and please reply to the invites promptly to make it easier for planning catering and reservations etc.

## Adjourn

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The meeting was concluded at ~16:30 with thanks to all members for attending.  
Later at 19:00 we met for a social/ buffet meal with some of the MC in the Smith Grill in the same Heathrow Hotel as our TC meeting.

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## Appendix 1

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### TC Member Status, October 2015

#### A total of 12 members from 6 countries:



- Armin Wegener – FRIVO, Germany. (1/5)\*
  - Arthur Jordan – Vicor, UK. (1/1)
  - Bernhard Grub – XP-Power, Germany. (2/5)\*
  - Christian Augesky – Siemens, Austria. (1/2)\*
  - Dave Collins – Artesyn, Ireland. (1/1)\*
  - Dominique Hessmann – Delta Energy Systems, Germany. (3/5)\*
  - Francesco Di Domenico – Infineon, Austria. (2/2)\*
  - Hubert Schoenenberger – PULS, Germany (4/5)\*
  - Jarmo Minkkinen – Salcomp, Finland. (1/2)\*
  - Jürgen Schneider – Texas Instruments, Germany. (5/5)\*
  - Milos Luptak – Bel Power Solutions, Slovakia. (1/1)\*
  - Vlad Grigore – Efore, Finland. (2/2)\*
- **Andreas Stiedl left the TC in April 2015 when he left Artesyn. He works for Huawei and has applied to the secretariat to join EPSMA. Has membership been approved?**
  - **TDK Lambda has been invited to provide a TC member. Thierry Pelikan attended the TC in May 2013 and April 2015.**
  - **Diarmuid Hogan, Head of R&D at Excelsys, wishes to postpone joining the TC until 2016.**
- \* Key: (x/n) = (Member # from each country / Number of members from same country)

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## Appendix 2

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### EPSMA Publications – Public (Accessible to the general public as a free download)



- Power Factor Correction - Guide from the EPSMA (November 2010)
- Thermal Measurements of Power Converters – How and Why? (March 2009)
- Guidelines to Understanding Reliability Prediction (June 2005)
- WEEE Decision Tree Guidelines (Nov 2012)
- RoHS Decision Tree Guidelines (Nov 2012)
- CE-Marking on Power Supplies - Guidance from the EPSMA (April 2005)  
N.B. This is now to be marked on [www.epsma.org](http://www.epsma.org) as 'Outdated'.
- The Status of Lead-Free Electronics and its Impact on Power Electronics (Feb 2003)

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### EPSMA Publications – Members (Not accessible to general public but some may be purchased)



- AC-DC Power Supply Safety Guidelines for Medical Applications (November 2009)
- AC/DC Power Supply Safety Guidelines for Railway Applications (Nov 2008)
- AC-DC Power Supply Safety Guidelines for Power in Hazardous Locations (Jan 2008)
- AC-DC Power Supply Safety Guidelines for DIN Rail Supplies (Sept 2006)
- Energy Efficiency Database: Energy Efficiency No-load Consumption for EPS (Updated 19 March 2014)
- Energy Efficiency Database: Energy Efficiency BCS (Updated 3 Sept 2012)
- HDPUG Applications Guidelines for Board Mounted Power Supplies (Feb 2007)
- DC Power Supply Safety Guidelines for Telecom Applications (Final, 3rd September 2012)
- Lead-free soldering – Concerns and Practices (Final issue 1F, 21 Feb 2012)
- Accurate Efficiency Measurements (Final, 2015-06-21)

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