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Standards for Power Electronic Components and Systems

EPE 14 ECCE Europe

Dr Peter R. Wilson

Session Outline

- "Standards for Power Electronic Components and Systems"
  - Peter Wilson, IEEE PELS Director of Standards
- "Uncertainty calculations of power measurements"
  - Ben Kemink, Yokogawa
- "Mechanical power >measurement and uncertainty"
  - Jyri Niinistö, HBM,
- "Calorimetric & electric measurement"
  - Rahul Kanchan, Senior Scientist at ABB Corporate Research Center,

Significance of standards

- In 2013 >50% of ALL IEEE Standards are managed by three IEEE Societies:
  - IAS, PELS and PES
  - Plus significant numbers in IES and DEIS
- Each society also has a standards Chair who co-ordinates
  - But the activities are *driven* by the technical committees

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Standards rely on volunteers

To get involved contact me:
prw@ecs.soton.ac.uk

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The IEEE Standards Association

- Coordinates Standards Activities
- Provides a collaborative environment (ICP)
  - Tools
  - Contacts
  - Links to Industry
- Strategic View of Standards
  - Cross Society View

Standards in Power Electronics – where next?

- Wide Band Gap Devices
  - SiC, GaN etc…
- Transformers (ETTT)
- Power Modules
- LED and Lighting
- Electrification of Transportation
- Low Voltage DC (“DC in the home”)
- Power Electronic Systems

Source: travelwellworldwide.com

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Standards for Power Electronic Components and Systems

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University of Southampton, UK

IEEE PELS Director of Standards

IEEE Std 1573

- IEEE Recommended Practice for Electronic Power Subsystems:
  - Parameters, Interfaces, Elements, and Performance

Scope

This recommended practice provides a technical basis for implementation of **electronic power subsystems**.

It is intended for **electronic systems engineers and integrators**, **electronic power subsystem designers** and **integrators**, as well as **power element manufacturers and suppliers**.

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IEEE 1573 – range of operation

- Power: Up to 20kW
- Voltage: Up to 600V
  - DC
  - AC (Single Phase)
  - AC (Three Phase)
- Frequency: DC to 1kHz
  - Although internal operating frequencies of internal signals may be much higher than 1kHz

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IEEE 1573 Purpose

- To provide a systems engineering approach to acquisition, adaptation, and integration of electronic power subsystems.
- To facilitate and promote a modular approach to element or subsystem integration.
- To enable effective communication between the end users of power electronics and their manufacturers or suppliers.
- To ensure better Electronic Power Subsystem design

"Strive for perfection in everything you do. Take the best that exists and make it better. When it does not exist, design it."

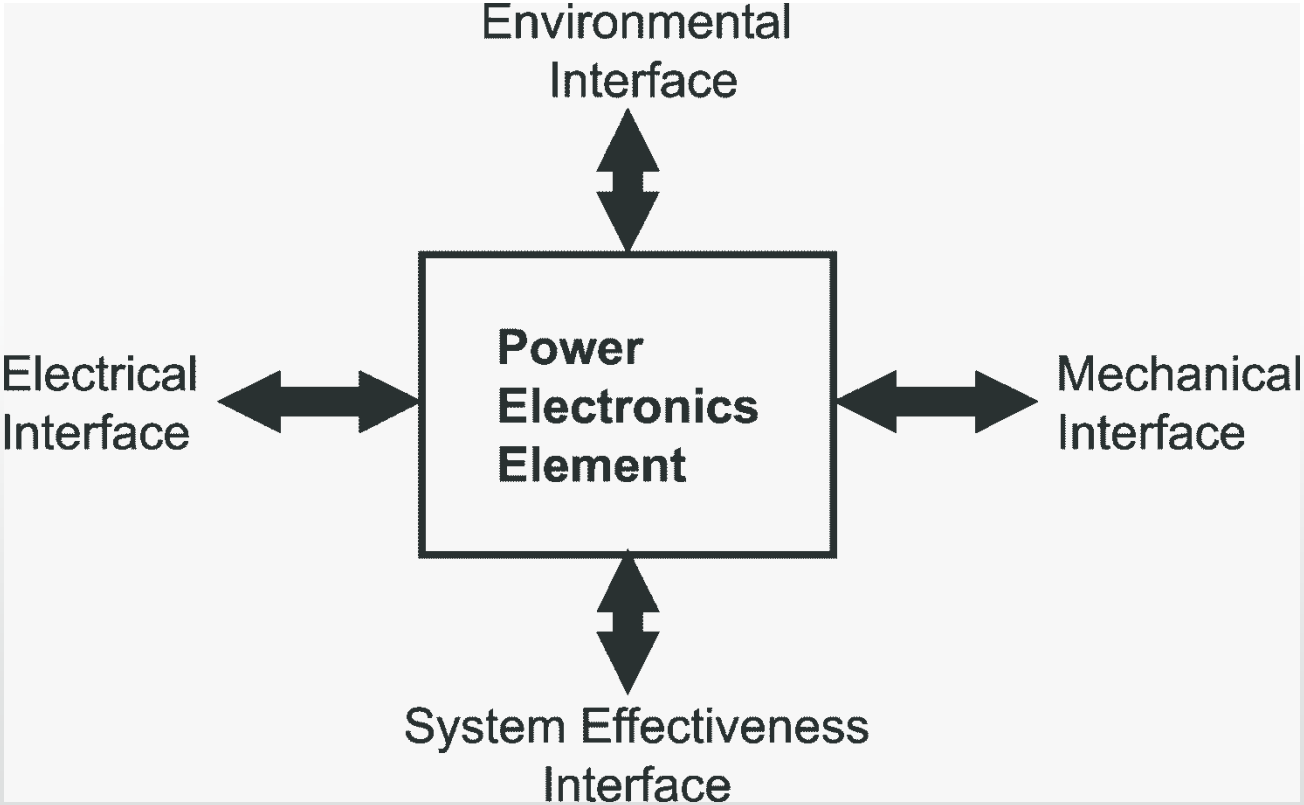
– Sir Henry Royce

IEEE 1573 Structure

- The standard is designed to explain how power electronic systems can be designed taking into account all the necessary considerations such as:
  - Interfaces
  - Requirements
  - Architecture considerations
  - System Interactions
- Approaches and definitions for testing are defined to ensure compatibility between components suppliers, designers and system integrators

Interfaces

- For example, how to handle aspects of interfaces are defined in IEEE 1573



Interface Considerations - example

Electrical	Mechanical	Environmental	System effectiveness
Input voltage range	Dimensions	Operating temperature range	Reliability
Input frequency range	Thermal interface	Storage temperature	Life expectancy
EMI/EMC	Structural requirements	Humidity	Regulatory requirements
Input voltage/frequency transients	Mounting	Shock	Component quality
Output voltage and current	Power dissipation	Vibration	Configuration management
Efficiency	Center of gravity	Salt spray	Derating
Control and status signals	Cooling medium	Explosive atmosphere	Component/product obsolescence
Dynamic load and signal requirements	Weight	Radiation	Quality assurance
Overcurrent/overvoltage protection		Sand and dust	Safety

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Requirements Definition

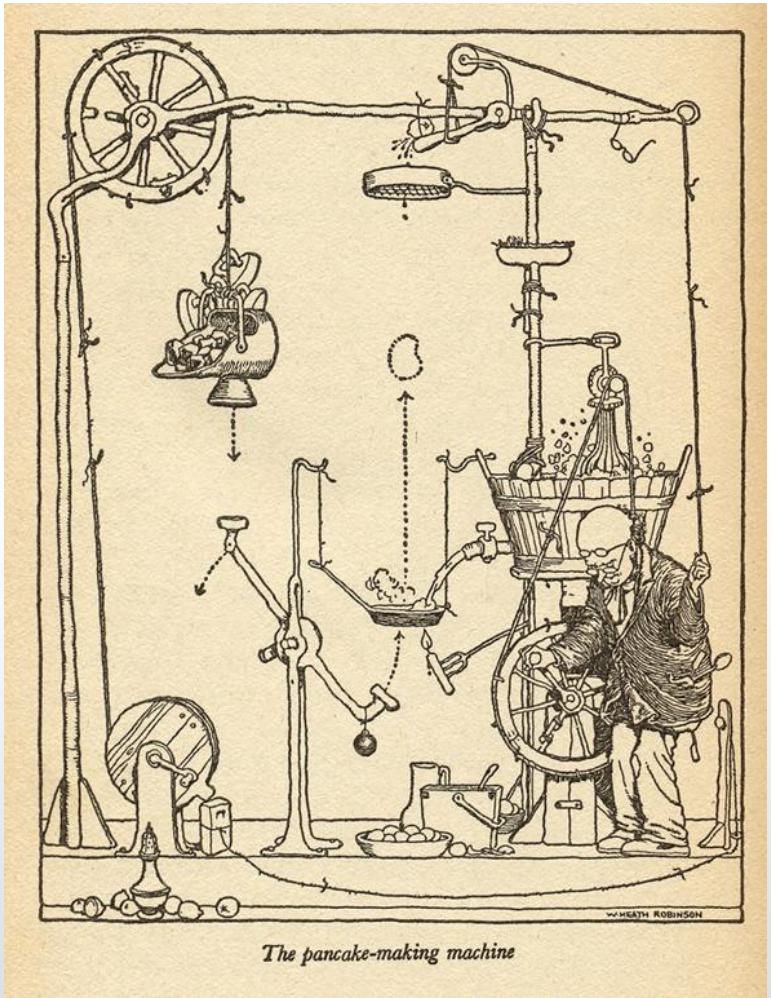
- This is the process of identifying application, interface, and regulatory requirements and constraints.
  - Defining requirements clearly is a primary task for successful completion of subsystem development.
  - The requirements definition generally results in a specification for the electronic power subsystem.

"Unless in communicating with it one says exactly what one means, trouble is bound to result."

-Alan Turing, about computers

Requirements Definition

- Over specification can be a limiting factor leading to problems (delays, technical issues)
  - This can be mitigated by the use of standard terminology and techniques to provide an **appropriate** level of specification



The pancake-making machine

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IEEE 1573 : In Summary

- IEEE 1573 provides a framework to enable best practice in the design of Electronic Power Subsystems
- IEEE 1573 provides standard terminology and definitions to enable suppliers, designs and integrators to communicate effectively
- IEEE 1573 provides a basis for designing Electronic Power Subsystems using a systems engineering approach

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FLICKER AND IEEE PAR1789

Recommended Practices of Modulating Current in High Brightness LEDs for Mitigating Health Risks to Viewers

Chair IEEE PAR1789

Brad Lehman (speaker)
Northeastern University
lehman@ece.neu.edu

Vice Chair IEEE PAR1789

Michael Poplawski
Pacific Northwest National Lab

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Vision: *Bring together a community of lighting environmental psychologists, medical researchers, lamp designers, LED driver designers, and LED lamp users to openly discuss concerns for LED lighting.*

There is a need to create a community where experts among the above different fields can communicate.

Suggest a recommended practice, not a standard. Representation on IEEE P1789 from ENERGY STAR, CIE and NEMA may later incorporate findings into standards if deemed necessary.

IEEE Standards Association has a unique open process that MUST involve all interest groups including academics, national labs, industry, customers… (current membership is ~50 with around 25% academics, 25% government labs, 50% industry/consulting)

International participation from members and from standards groups

IEEE PAR 1789 - PURPOSE

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IEEE PAR 1789 - PURPOSE

- Describe some possible health risks, such as headaches, eye strain and epileptic seizure, associated with low frequency modulation of High Brightness LEDs in different applications
- Provide recommended practices to aid design of LED driving systems to modulate at safe frequencies for their particular applications in order to protect against the described health risks.

http://grouper.ieee.org/groups/1789/

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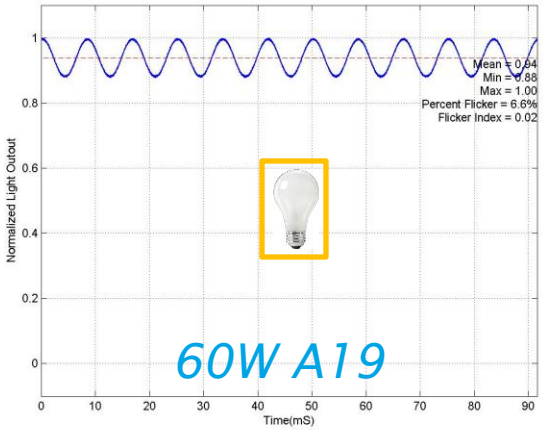

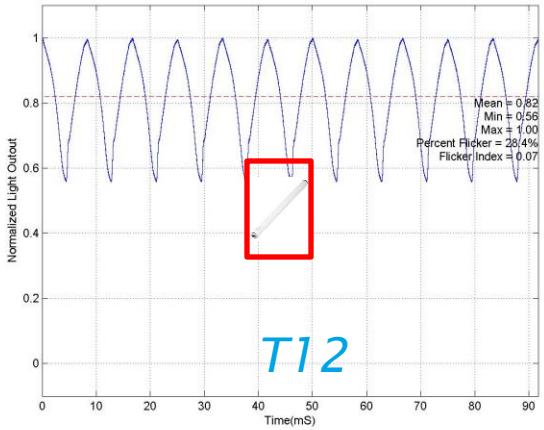

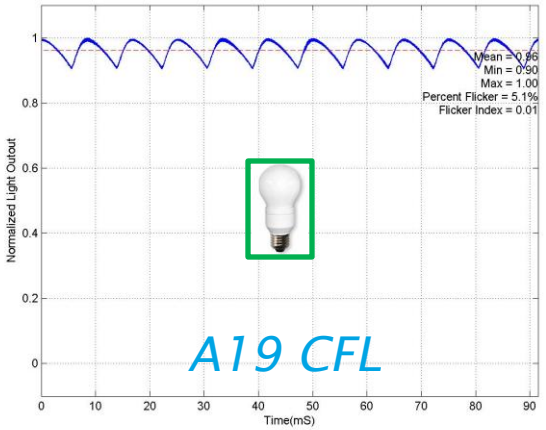

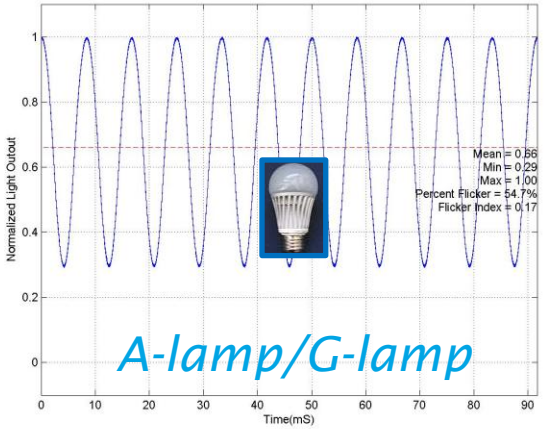

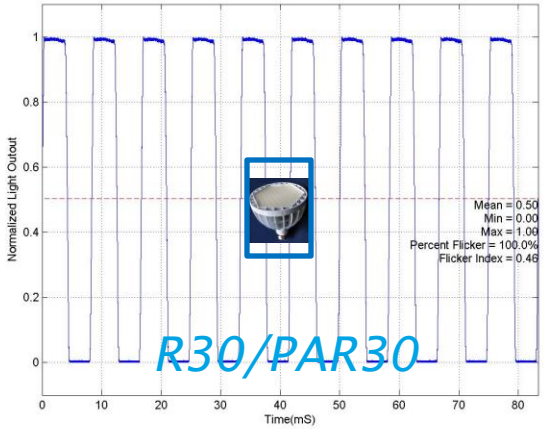

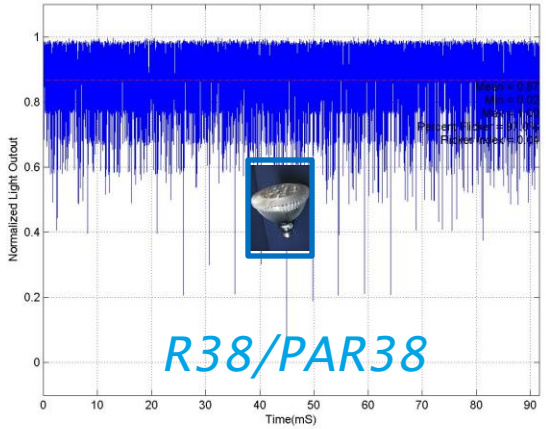

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Status-Timelines

MAJOR Developments : **3rd Revision Hazard Analysis Draft Report (30 pages)**.

- **Has been released** to general PAR1789 membership
- Gives low-risk levels for flicker
- Report development led by same authors that developed the European Union Commission's policy on consumer product recall

Writing draft recommended practice report (~ 50 pages written)

- Portions of recommended practices have been proposed by members already
  - Visible flicker to be avoided
  - No effects levels understood
  - Low risk levels proposed (controversial)
- Discussions on the 70Hz – 1000Hz range for flicker recommended practices still to be formalized in writing

Another Step Soon: Opening of Ballot

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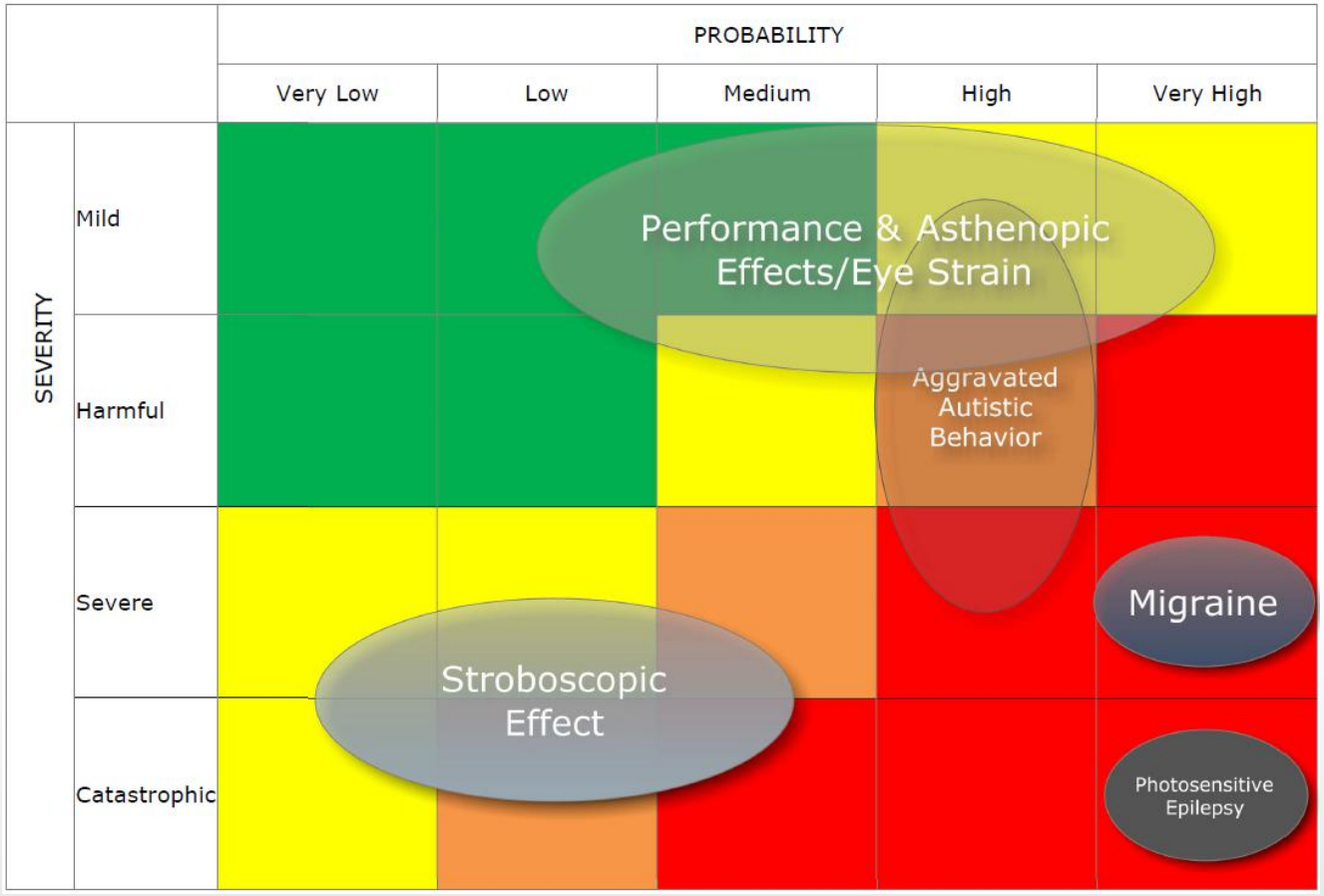

Table 2 Risk Levels

Risk Level	Color code
Low	
Medium	
Serious	
High	

Figure 1 Risk Matrix by Hazard. Greater opacity corresponds to greater certainty

G, Ryder, R. Altkorn, X. Chen, JA Veitch, M. Poplawski, Safety 2012, the 11th World Conference on Injury Prevention and Safety Promotion

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Conclusions

- IEEE PAR1789 Committee intends to provide a recommended practice for how to apply this information
- Designers need to understand and apply the new flicker metrics and risk matrix
- Third-party testing may be needed for interaction of dimmer and LED products

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Conclusions

- IEEE PELS is contributing to the ongoing development of standards in key areas
  - Power Electronic Components and Systems
  - LED Lighting
- New Areas require initiatives and working groups to drive them forward….
  - Electrification of Transport
  - Wide Band Gap Devices
  - DC in the Home
  - HVDC