Request for Proposals (RFP)

The 2013 International Future Energy Challenge (IFEC'13)

A student competition sponsored by the

The Institute of Electrical and Electronics Engineers (IEEE)

July 9, 2012

Summary of Competition and Proposal Requirements

General Information

Competition Title: 2013 International Future Energy Challenge (IFEC) Student Competition

Topic Areas:

(A) Highly efficient grid-tied microinverter for photovoltaic panels

(B) Low power off-line light-emitting diode (LED) driver with long lifetime.

Period of Competition: February 15, 2011 to July 31, 2013

Challenge Program Awards: In each of the two topic areas there will be a Grand Prize of $10,000 and three additional awards granted at $1,000, $3000 and $5,000 each. The IFEC awards include the following for each of the two topic areas (See IEEE Awards Manual)

- Grand Prize $10,000
- Outstanding Performance Award $5,000
- Best Engineering Achievement Award $3,000
- Best Innovative Design of Power Electronics Converters Award $1,000

Prize requirements: US$10,000 will be awarded as Grand Prize for highest score among entries in each topic area meeting all minimum requirements as confirmed through reports and hardware tests. The remaining prizes will be awarded to the teams who have scored the highest in each of the categories: Outstanding Performance, Best Undergraduate Educational Impact, and Best Innovative Design of Power Electronics Converters.

Intellectual Property and Use of Prize Money:

The International Future Energy Challenge does not restrict the use or protection of inventions or other intellectual property produced by participating teams. There are no special licenses or rights required by the sponsors. However, the Final Test Events in July 2013 will include public disclosure of each team's technology. Teams interested in securing protection for their inventions should be aware of this date when making arrangements.

The prizes provided to schools are intended to benefit the team members and student team design project activities. There is a Letter of Support (Attachment II) required for submission with the proposal and it should outline the plans of the school in the event that a prize is received.

Outside Support:

Individual schools should solicit project funding from companies, foundations, utilities, manufacturers, government agencies, or other sources. There is no limitation for the sources of project funding.

Eligibility Information:

- **Eligible schools must:** have an accredited or similarly officially recognized engineering program (through the Accreditation Board for Engineering Technology (ABET) or equivalent); be a college or university with engineering curricula leading to a full first degree or higher; have the support of the school's administration; establish a team of student engineers with an identified faculty advisor; demonstrate the necessary faculty and financial support commitments; and demonstrate a strong commitment to undergraduate engineering education through their proposal.

- **University Eligibility Limit: <u>Each university is limited to one topic area; each school can support only one team.</u>**

To confirm eligibility, potential participating schools must submit a Letter of Support (Attachment II) together with a Preliminary Team Information Form (Attachment I) when they submit the proposal.

How to Participate: Participation is on a proposal basis. Those schools that are interested must submit a proposal before the proposal deadline. Proposals will be judged by a distinguished panel of volunteer experts from the IEEE and from industry. Schools with successful proposals will be notified two months after the proposal deadline. Student teams will then carry out the work and prepare hardware prototypes and reports. Deadline for the progress reports and qualification reports are also listed in the attachment and will be posted on the IFEC website. The reports will be judged by a similar expert panel. The panel will select a group of teams as Finalists based on the progress and qualifying reports. These teams are invited to present their progress to the panel at IEEE APEC conference on March 17, 2013, in Long Beach California, USA. Feedback will be given to the team to improve the system. The team will be invited to a competition event in July of 2013. A Final Report will be due at the competition event.

Please be aware that each of the two topic areas of the 2013 International Future Energy Challenge will be judged separately, against a separate specification set. Each team proposal must address a single topic area.

Judging Panels

Experts from IEEE Power Electronics Society (and others to be announced) and representatives from manufacturers, national labs, independent test labs, utilities, and R&D engineers.

Judging

Student team project results will be judged based on cost effectiveness, performance, quality of the prototype and other results, engineering reports, adherence to rules and deadlines, innovation, future promise, and related criteria. Each aspect of judging will be scored according to a point list and test protocol.

Proposals

Proposals will be judged on the quality of plans, the likelihood that a team will be successful in meeting the International Future Energy Challenge objectives, technical and production feasibility and degree of innovation. Other key criteria are evidence of the school's commitment, capability, experience, and resources to implement their design over the one-year span of the competition. Commitment to excellence in undergraduate education is important, and acceptable proposals will involve undergraduate students as the primary team members. Teams are limited at minimum 4 members. Interdisciplinary teams are encouraged. Graduate students are not excluded, but the limit of participants is as follows:

Number of Team Members	Maximum Graduated Students

4 – 5 Members	1 Graduated Student
6 – 10 Members	2 Graduated Students
11 – 15 Members	3 Graduated Students
More Then 15	4 Graduated Students

The impact on undergraduate education is a critical judging criterion. **Proposals are limited to 12 double-spaced pages total, including all diagrams, attachments, and appendixes.** Schools that are invited to participate in 2013 International Future Energy Challenge are expected to adhere to the basic plans described in their proposals. Approval of the competition organizers must be sought for significant changes in plans or engineering designs. **Only one proposal will be considered for each school. Proposals must be submitted electronically in PDF format.**

A. Proposal Objectives

Respondents should express their ideas and plans relevant to their interested topic area. The project should include the construction and operation of a complete hardware prototype. The proposal must address both technical and organizational issues for each phase of the prototype's development and testing. It must contain a realistic project budget, along with a plan to secure the necessary funding. The educational goals, including any course credit provided for work related to the 2013 International Future Energy Challenge, and how the project relates to other efforts within the school and at the regional or national level should be addressed. A Letter of Support from an official of the school confirming a commitment to participate in the competition, and stating the type(s) and level of support for the team's participation in the competition should be attached, and is not counted toward the 12-page limit. Refer to the attachments at the end of this document for a sample.

B. Administrative Considerations and Limitations

This section describes the limitations placed on the proposal. Compliance is mandatory.

Language Proposals must be written in English.

Length Proposals are limited to 12 single-sided double-spaced pages of text, figures, and appendixes. The page size must be 8.5" x 11" or A4 and the font size must be no smaller than 10 point. Margins should be at least 25 mm. The Preliminary Team Information Form (Attachment I in this RFP), Support Letter (Attachment II in this RFP) from the school, government entities, or private sector organizations will not count in the proposal length.

Authors Proposals are to be prepared by the student team in collaboration with the faculty advisors.

Signatures Proposals must be signed by all authors of the proposal (or the student team leader) and the faculty advisor.

Letter of Support Proposals must be accompanied by a letter of support from an appropriate Dean, Department Chair, or other authorized school official. The letter must confirm the school's commitment to participate. It must also state the type(s) and value of support from the institution. School support should match the value of cash and in-kind support from the team's principal sponsors. Additional letters of support from other team sponsors are optional. A sample letter is provided as Attachment II.

Preliminary Team Data Submit one copy of the Preliminary Team Information Form (Attachment I) with the proposal, then an updated copy with the progress reports to the address below. This form does not count in the 12-page limit.

Due Date

All proposals must be received at the address below by close of business on **September 15, 2012** for full consideration. A non-mandatory letter of intent is preferred by June 15, 2012.

Proposal Submission

The electronic copy of the proposal in PDF format must be sent to the respect topic chairs via email, with a copy to the IFEC'13 chairman below:

General Chair: Chris Mi, Ph.D, Fellow IEEE
Associate Professor, Electrical and Computer Engineering
Director, DOE GATE Center for Electric Drive Transportation
University of Michigan – Dearborn
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Tel: (313) 583-6434, Fax: (313) 583-6336
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Information

The volunteer Organizing Committee for the 2013 International Future Energy Challenge maintains a web site at http://www.energychallenge.org/. The site will include the most recent schedule and rule updates, frequency-asked questions, details about judging and scoring, and other team information. It should be checked regularly.

Chair for Topic (A) Highly efficient microinverter for photovoltaic panels:

Prof. Jin Wang
Ohio State University
Department of Electrical and Computer Engineering
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205 Dreese Lab
2015 Neil Ave, Columbus,
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Chair for Topic (B): Low power off-line light-emitting diode (LED) driver with long lifetime

Dr. Junming Zhang and Prof. Mark Dehong Xu

Zhejiang University

College of Electrical Engineering

zhangjm@zju.edu.cn

Hangzhou, Zhejiang

China

Topic B is co-sponsored by IEEE PELS Beijing Chapter.

(Add details of Beijing chapter, chair person, address, contact info, etc.)

IEEE PELS Beijing Chapter is one of the branches of IEEE PELS, and was established in 1994 by the IEEE Headquarter, and founded in April of 1995 in Beijing. Registered PELS members in 2011 are 286.

Chairman——Prof . Zhengming Zhao, email address: zhaozm@tsinghua.edu.cn

Treasurer—— Prof. Qongling Zheng,

Academy—— Prof. Mark Dehong Xu

Membership——Prof. , Jingjun Liu

Secretary—— Mr . Zhihua Wang

Time Schedule

Calendar Events

April 9, 2012	Request for proposals (RFP) posted.
Sept 15, 2012	Proposals Due
Sept 16, 2012	Optional Workshop at ECCE 2012 Raleigh, NC, USA
November 1, 2012	Schools informed of acceptance into the competition.
November 15, 2012	Progress reports due (Progress reports are limited to 10 double-spaced, single-column pages total, including team organization, school support along with basic diagrams, design, any simulation results, any preliminary experimental results, attachments, and appendixes).
January 15, 2013	Qualification reports due (Qualification reports must include preliminary experimental results. It is limited to 25 single-column pages total, including all diagrams, attachments, and appendixes).
February 15, 2013	Finalists notified (Selection is based upon likelihood of deliverable hardware, quality of design, and likelihood of success in meeting all the challenge objectives).
March 17, 2013	Workshop at APEC 2013, Long Beach, California, USA
July 18, 2013	Topic A Final reports and working units due (Final reports are limited to 50 single-column pages total, including all diagrams, attachments, and appendixes).
July 18-19, 2013	Topic A Final competition. (dinner on July 17)
July 29, 2013	Topic B Final reports and working units due
July 29-30, 2013	Topic B Final competition (dinner on July 28)

Calendar Events

2013 International Future Energy Challenge

Organizing Committee

General Chair: Prof. Chris Mi – University of Michigan-Dearborn

Topic A Chair: Prof. Jin Wang – Ohio State University

Topic B Chair: Dr. Junming Zhang, Zhejiang University

Topic B Co-chair: Prof. Mark Dehong Xu, Zhejiang University

Webmaster: Faete Jacques Teixeira Filho – Eaton Corp.

IEEE Inter-Society Associate: Donna Florek – IEEE

Treasurer: Jason Lai, Virginia Tech University

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Competition Description

Scope: An international student competition for innovation, conservation, and effective use of electrical energy. The competition is open to college and university student teams from recognized engineering programs in any location. Participation is on a proposal basis.

Introduction: In 2001, the U.S. Department of Energy (DOE), in partnership with the National Association of State Energy Officials (NASEO), the Institute of Electrical and Electronics Engineers (IEEE), the Department of Defense (DOD), and other sponsors, organized the first Future Energy Challenge competition. The objective was to build prototype, low-cost inverters to support fuel cell power systems. This competition was originally open to schools in North America with accredited engineering programs. The 2001 Future Energy Challenge focused on the emerging field of distributed electricity generation systems, seeking to dramatically improve the design and reduce the cost of dc-ac inverters and interface systems for use in distributed generation systems. The objectives were to design elegant, manufacturable systems that would reduce the costs of commercial interface systems by at least 50% and, thereby, accelerate the deployment of distributed generation systems in homes and buildings. Final events were conducted at the National Energy Technology Laboratory (NETL) in Morgantown, WV, USA. Speakers from IEEE, DOE, and DOD introduced the competition and interacted with students during the event week. Hardware was tested with an experimental fuel cell at the NETL site. The 2001 Challenge was a success, and is now the first in a biannual series of energy-based student team design competitions.

To continue and expand the 2001 success, the 2003 International Future Energy Challenge (IFEC) was organized as a worldwide student competition. The 2003 IFEC had two topics, a revised topic on fuel cell power conditioning, and a topic for high-efficiency motor drive systems suitable for home appliances. Major sponsors included three IEEE societies, DOE, and DOD. Fuel cell inverter events were again held at NETL. Motor system events were held at Advanced Energy in Raleigh, NC, USA.

The 2005 IFEC had two topics. The inverter topic was revised to incorporate photovoltaic sources and grid interaction, while the motor topic was revised only slightly. Major sponsors included three IEEE societies and DOD, with more modest sponsorship from DOE. Inverter events were held at the National Renewable Energy Laboratory (NREL) in Golden, CO, USA. Motor events were held at MPC Products in Skokie, IL, USA.

The 2007 IFEC had two topics. An integrated starter/alternator and a Universal battery charger system were chosen as the two topics. Major sponsors included IEEE Power Electronics society, and Power Supply Manufacturer Association (PSMA). The final competitions were held at MPC Products in Skokie, IL and Texas Instrument in Richardson, TX.

The 2009 IFEC, similar to the previous editions, had two topics. The Integrated Starter/Alternator-Motor Drive for Automotive Applications topic was repeated, a new topic, the Power Wind Turbine Energy Maximizer was included. Major sponsors included IEEE Power Electronics society, Industrial Electronics Society, MPC Products, Monash University, IEEE Power Electronics Society, IEEE Industrial Electronics Society, and Power Sources Manufacturers Association (PSMA). The final competitions were held at Illinois Institute of Technology in Chicago, IL, USA, and in Monash University, VIC, Australia.

The 2011 Competition also had two topics. Topic A, chaired by Professor Chris Mi of the University of Michigan-Dearborn, focused on low cost lithium ion battery chargers. The final competition was held on July 22-23. Virginia Tech University of USA won the Grand Prize and the Outstanding Performance Award, Seoul Tech Won the PSMA Best Engineering Achievement Award, University of Kassel of Germany won the IEEE IES Best Innovative Design of Power Electronic Converters Award, and National Taiwan University of Science and Technology won the Best Undergraduate Educational Impact Award. Topic B was focused on Low Power Induction Motor Drive System Supplied from a Single Photovoltaic Panel for an Emergency Water Treatment Device Maximizer. Federal University of Maranhao win the Grand Prize and Outstanding Performance Award as well as the Best Technical Presentation Award; Cologne University of Applied Sciences won the PSMA Best Engineering Achievement Award; Federal University of Mato Grosso do Sul won the IEEE IES Best Innovative Design of Power Electronic Converters Award; and Consortia of UT-Dallas and Texas Christian University won the Best Undergraduate Educational Impact Award. Sponsors of this year's competition include

IEEE Power Electronics Society, IEEE Industrial Electronics Society, and Power Sources Manufacturers Association (PSMA).

2013 Topics and Descriptions: The 2013 competition addresses two broad topic areas:

TOPIC A: Highly efficient microinverter for photovoltaic panels.

TOPIC B: Low power off-line light-emitting diode (LED) driver with long lifetime.

Detailed specifications, system requirements, and test procedures for each of the two topics are attached and will also be announced through the IFEC Web page.

Topic A

Highly efficient microinverter for photovoltaic panels

Vision

- Reduce the manufacturing cost to less than $0.1/Watt for residential photovoltaic inverter;
  - Encourage the development of technologies to reduce the cost of inverters (power processors) that are designed for domestic energy sources.
  - Encourage the utilization of highly efficient emerging wide bandgap power semiconductor devices.
  - Incorporate practicality, potential manufacturability, and affordability into the competition assessment process.
  - Improve engineering education and foster practical learning through the development of innovative team-based engineering solutions to complex technical problems.

Goals

Construct an inverter that will:

- Reduce the manufacturing cost to less than $0.1/Watt for microinverter;
- Achieve maximum efficiency;
- Achieve minimal size and weight requirements;
- Minimize cooling requirements; and,
- Demonstrate the performance and benefits of wide bandgap semiconductors if such devices are utilized in the circuit.

Background

The main goal of the Topic A is to develop low-cost power processing systems that support the rooftop photovoltaic (PV) installations to provide non-utility and ultra-clean electricity. Currently, the cost of power electronics in PV system is around $0.3/Watt. To achieve the goal of $1.5/watt installed PV systems by 2020, a price point that allows the solar energy competing with conventional electricity in the United States, the cost of the power electronics needs to be reduced to $0.1/Watt.

This dramatic cost reduction can be achieved through innovations in circuit topologies, optimizations of circuit parameters, improvements of cooling strategies, and possible implementations of highly efficient wide bandgap (WBG) devices.

Wide bandgap devices, such as Silicon Carbide (SiC) Metal Oxide Field Effect Transistors (MOSFET) and Gallium Nitride (GaN) Heterostructure Field Effect Transistor (HFET), are expected to have lower on-resistance, higher switching frequency and higher junction temperature than their Silicon (Si) based counterparts. The lower power loss and higher junction temperature can bring in the size and cost reduction in the cooling system, whereas the higher switching frequency can result in smaller passive components.

At this time, SiC MOSFETs from CREE and GaN HFET from EPC are already available in the market. For the Topic A competition, all the teams are encouraged to use active wide bandgap devices in their circuits. The competition has negotiated limited sample supplies from the device manufacturers. A full list of sample devices will be released before Jan. 2013.

Inverter Specifications

The inverter proposed will be judged against a set of objectives, requirements and characteristics given below.

- The inverter design concept should target a 500 VA (peak) power generation system.
- The inverter shall be able to work in both grid-tied and standalone modes.
- Modular or scalable circuit topologies are highly encouraged.
- Galvanic isolated is not required but preferred.
- Utilizations of wide bandgap (WBG) devices are encouraged.
- ***A programmable dc power supply will be provided at the competition test site as the only power source to the inverter.*** No auxiliary power supply for control and sensing units will be provided.

Scoring will be set up such that improvements beyond the minimums are beneficial to the team, with significant weight on energy efficiency, circuit scalability and demonstration of the advantages of the WGB devices.

Teams who adopt wideband gap devices and achieve higher efficiency and size reduction will receive bonus points. New circuit topologies and control strategies that fully utilize benefits of wide band gap devices are encouraged. Simply substituting Silicon devices in traditional circuits with wideband gap devices is less encouraged.

Design Item	***Minimum*** **Target Requirement 500 VA System**
1. Manufacturing cost	Less than US$0.1/W for the 500 VA design in high-volume production. A brief cost analysis in the report is required.
2. Complete package size	A convenient shape with volume less than 1 Liter.
3. Complete package weight	Mass less than 2 kg.
4. Output power capability –	500 VA continuous, total (500 VA continuous @ displacement factor 0.7, leading or lagging, max.)
Current limit (short circuit)	Unit shall shut down if the output current exceeds 110 % of maximum rated value. Teams may select either to continue supplying current or to shut down for currents >100% and <110%.
5. Auxiliary control power	No auxiliary power supply will be provided.
6. Output voltage	240 V nominal (single phase).
7. Output frequency	60 Hz nominal.
8. Output voltage harmonic quality	Output voltage total harmonic distortion (THD): less than 5% when supplying a standard nonlinear test load (Test Considerations to be provided later).
9. Output voltage regulation quality	At standalone mode, output voltage tolerance no wider than ±6% over the full allowed line voltage range, from no-load to full-load.

11. Input voltage	18-40 VDC, operational 60 V max. no operation
12. Maximum input 120 Hz current ripple	Small peak-peak value is desired.
13. Overall energy efficiency	Higher than 95% for 250 W resistive load with minimal efficiency degradation up to peak power and down to minimum power. Additional scoring points will be awarded for efficiencies higher than 95%.
14. Protection	Over current, over voltage, short circuit, over temperature, and under voltage. No damage caused by output short circuit. The inverter must shut down if the input voltage dips below the minimum input. IEEE Std. 929 is a useful reference.
15. Safety	The final rules will contain detailed safety information. No live electrical elements are to be exposed when the unit is fully configured. The system is intended for safe, routine use in a home or small business by non-technical customers. Industry safety standards will be required, such as UL 1741-2000.
16. Grid and source interaction	The inverter is intended as grid-tied system which can be also operated as a standalone unit during islanding mode.
17. Communication interface	No communication interface is required. However, simple display that shows the operation status of the converter is suggested.
18. Storage temperature range (suggested)	–20 to 85 °C.
19. Operating ambient temperature range	The inverter will be tested at room temperature.
20. Other ambient (suggested)	Humidity less than or equal to 95% up to 25 °C Less than or equal to 75% at temp. above 25 °C up

	to 40 °C
21. Enclosure type (suggested)	NEMA 1
22. Cooling	Natural convection
23. Shipping environment	Can be shipped by conventional air or truck freight.
24. Acoustic noise	No louder than conventional domestic refrigerator. Less than 50 dBA sound level measured 1.5 m from the unit.
25. Lifetime	The system is expected to function for at least sixteen years with routine maintenance when subjected to normal use in a 0°C to 40°C ambient environment. A brief analysis of lifetime in the report is required.
26. Technical report	Design, simulation, experiment results, lifetime analysis, and cost study.
27. Galvanic isolation	Galvanic isolation of the system is not required but preferred.
28. Test condition	A temperature stress test will be added. The test temperature will be 65 degree C.

Teams who adopt wideband gap devices and achieve higher efficiency and size reduction will receive bonus points. New circuit topologies and control strategies that fully utilize benefits of wide band gap devices are encouraged. Simply substituting Silicon devices in traditional circuits with wideband gap devices is less encouraged.

Final Competition Prototype Testing

A detailed test protocol will be presented to the teams prior to the competition. The teams can expect two stages of testing. The first being a preliminary test on a dc power supply with an ac load, and if the inverter passes, then the inverter will be tested in the grid-tied mode. Prototypes should be fully functional and meet the minimum requirements. Ability of adjusting power factor from 0.7 to 1 (both leading and lagging) and smooth transition between operation modes will be considered for extra points. The key judging criteria will be efficiency, possible demonstration of the advantages of the wide bandgap devices, and cost.

Topic B

Low power off-line light-emitting diode (LED) driver with long lifetime

Objectives

- Encourage development of equipment based of power electronics principia for emerging solid state lighting technology;
- Provide more efficient and environment friendly lighting solution with high reliability and low cost;
- Give opportunity to students work on a multiple subject challenge that involves energy processing and efficiency;
- Achieve hardware solution that includes practicality, manufacturability, and affordability;
- Develop a project with acceptable levels of performance, reliability, and safety.

Goals

Develop an off-line LED driver supplied from universal AC input. The input should have high power factor to avoid any potential pollution to the grid. Also, the conventional electrolytic capacitor for energy storage in the circuit should be eliminated to improve the reliability of the LED driver. Some characteristics need to be achieved.

- Maximum efficiency of the driver with AC input;
- High power factor low input current THD;
- No electrolytic capacitor in the power stage (E-capless);
- Isolated output.
- Wireless dimming function

Background

It is estimated by the International Energy Agency that more than 19% of electrical energy demand globally is used for lighting, so there is a significant impact in replacing inefficient light sources such as incandescent lamps with more energy efficient solutions. With the rapid development in high brightness LED technologies, both the efficacy (light output per watt in) and the cost of phosphor converted white LEDs (WLED) have improved significantly. The solid-state lighting (SSL) technology based on LED is a promising alternatives for future lighting application.

As the LED is powered by DC current and its brightness is directly related to its forward current. An LED driver is required to convert the AC power of the grid to the DC power required by the LED lighting fixture, which is typically an AC/DC converter. A front-end PFC converter cascaded with a DC/DC converter is the most popular structure used for the LED driver. The PFC converter is used to meet the current harmonics requirement and the DC/DC converter achieves isolated output and output regulation. In this system, usually a bulky electrolytic capacitor (E-cap) is used as an energy storage component to balance the input power and DC output power. Though the LED itself has quite high efficiency and long lifetime, the E-cap in the LED driver has very short lifetime especially at high operating temperature, which limits the lifetime of the whole LED lighting fixture. It is preferred to replacing the E-cap with low film capacitor. However, the film capacitor usually has much low capacitance compared with E-cap in same physical size. Design of a LED driver with high power factor and does not use E-cap require creative solutions. In spite of many circuits from researches around the world has been proposed to address this issue, there still room for improvements.

General Requirements

Develop a LED driver with AC input and isolated DC output for indoor LED lighting applications. The LED driver should have high input power factor and constant DC output without bulky E-cap in the circuit. It must fulfill some specifications and functionalities as described below:

- High conversion efficiency to ensure energy saving;
- High input power factor;
- Isolated DC output for safety (Galvanic isolated from input side);
- No E-cap.
- Wireless dimming function, dimming range: 10%~100%, no flicker.

A more detailed design requirement is listed as follows. The prototype will be scored based on these requirements. The performance beyond the specifications will be highly considered, especially for the efficiency, prototype dimension and output performance. A programmable AC source will be provided at the competition test site as the only power source to the LED driver. No auxiliary power supply for control and dimming will be provided. The E-Load or LED load is available during the test.

Teams who adopt wideband gap devices and achieve higher efficiency and size reduction will receive bonus points. New circuit topologies and control strategies that fully utilize benefits of wide band gap devices are encouraged. Simply substituting Silicon devices in traditional circuits with wideband gap devices is less encouraged.

Design Item	***Minimum* Target Requirement**
1. Dimensions (w/o enclosure)	***As small as possible, height must below 1 inch.*** An estimated dimension for reference: L*W*H: 160*35*25.4 mm
2. Output voltage	24~32V (nominal 28V)
3. Output Current	700mA (constant)
4. Output Current ripple	<10%~30% (as small as possible)
5. Input	AC220V (rms) +/- 20%. 47~63Hz ***Universal input is a plus (90~265 RMS)***
6. Power factor	>0.9 @ nominal input and full load >0.85 @ nominal input and 20% load
7. Harmonics current	Compliance to EN6100-3-2, Class C
8. EMI	The LED driver is expected to meet the EMI requirement specified by EN55022 (CISPR22) Class B. It is preferred to include the EMI test result in the report.
9. Efficiency	>82% (worst case) (>80% for universal input design)
10. Wireless dimming function	10~100%, no flicker (remote control within 5m)

11. Protection	Output over voltage. No damage caused by output short circuit and open circuit.
12. Storage temperature range (suggested)	–20 to 85 °C.
13. Operating temperature	–20 to 50 °C. The LED driver will be tested at room temperature.
14. Cooling	Nature convection
15. Galvanic isolation	Galvanic isolation of the system is required Such as UL1310 class 2 Withstand voltage: I/P & O/P: 3KV AC (1 min)
16. Manufacturing cost	Less than US$3 in high-volume production. The cost for the key components should be considered.
17. Technical report	Design, simulation, experiment results, lifetime analysis, and cost study.
18. Test condition	A temperature stress test will be added. The test temperature will be 65 degree C.

Final Competition Prototype Testing

A detailed test protocol will be presented to the teams prior to the competition. A programmable AC source will be provided at the competition test site as the only power source to the LED driver. No auxiliary power supply for control and dimming will be provided. The E-Load or LED load is available during the test. An efficiency/power factor (or harmonic current) test setup will be provided. The key judging criteria will be efficiency, dimensions and its electrical performance.

Funding Sources

IEEE and other sponsors provide the Challenge Award as well as the Program Awards.

Individual schools should solicit project funding from local, national, or international sources. There is no limitation for the sources of project funding.

ATTACHMENT I

2013 INTERNATIONAL FUTURE ENERGY CHALLENGE
PRELIMINARY TEAM INFORMATION FORM
TOPIC (X)
Submit with Proposal

NAME OF UNIVERSITY:

CORRESPONDING ADDRESS (PLEASE INCLUDE NAME):

TELPHONE:
FAX:
EMAIL:

FACULTY ADVISOR(S):

Name	Department	E-Mail

PRELIMINARY TEAM MEMBERS:

Name	Major Field of Study	Degree and Expected Graduation Date

ATTACHMENT II

LETTER OF SUPPORT

Submit with Proposal

[The letter below is a typical sample and should not simply be copied. Please send a letter with similar content on your university letterhead.]

For Topic (A) Highly efficient grid-tied photovoltaic inverter with wide bandgap devices:

To:

Prof. Jin Wang
Ohio State University
Department of Electrical and Computer Engineering
wang@ece.osu.edu
Columbus, Ohio
USA

For Topic (B) Low power off-line light-emitting diode (LED) driver with long lifetime:

To:

Dr. Junming Zhang and Prof. Mark Dehong Xu
Zhejiang University
College of Electrical Engineering
zhangjm@zju.edu.cnHangzhou, Zhejiang
China

Dear International Future Energy Challenge Coordinator,

Our university has organized a student team to participate in the 2013 International Future Energy Challenge. Our proposal for the topic ***(X)*** is enclosed. A Preliminary Team Participation Form is attached, listing our contact person, the faculty advisor(s), and some of the students who plan to be involved. The team will keep an eye on the Energy Challenge web site for detailed rules and other information. We understand that we will be notified whether we have been accepted to participate by August 1, 2012. If we are accepted, we agree to have our student team perform the design tasks and prepare the reports and hardware prototypes required for the competition. Our school is prepared to support the team with the following resources:

- A final year project course, ***XXX***, has been authorized to provide engineering students across several disciplines with the opportunity to include this project in their curricula. Laboratory space has been arranged for this course.
- A faculty advisor, Prof. ***XXX***, has been identified, and has been formally assigned to teach the project course and to advise the student team as a portion of his/her regular duties.
- A graduate student assistant has been identified to help manage the student team and to supervise direct laboratory activity. This student is supported with a Teaching Assistantship, which represents a funding commitment of our university of approximately ***$X.***
- The student team will be provided with an appropriate level of technician and machine shop support to assist them with package preparation and assembly. This assistance represents a funding commitment of approximately ***$X***, and we consider this as a matching commitment for any in-kind support received from external sponsors.
- In addition, we will provide limited funds to help secure special parts and equipment, with a total commitment of up to ***$X.***
- The student team will be encouraged to secure outside sponsorship. Our university strongly supports all these efforts, and will match any outside cash support 1:1 up to an additional total of ***$X***.

In the event that our school receives prizes from the competition, we are committed to using approximately X% of this money for scholarships for the student team members. The remainder of the funds will be added to our Team Design Program fund, which supports this and similar projects through sponsorship matching, travel funds for participation in competition events, and other direct costs of large team design projects. In the event that our team creates new inventions in the topic area, our university also provides the possibility of assisting with organization of a start-up company.

We understand the importance of student team projects in the engineering curriculum and look forward to our participation in the 2013 International Future Energy Challenge.

Sincerely,

(Head of Department, Dean of Engineering or similar school official)