

## Submission Guideline

# The 2016 International Future Energy Challenge (IFEC'16)

A student competition sponsored by the  
The Institute of Electrical and Electronics Engineers (IEEE)

July 30<sup>th</sup>, 2015



## Summary of Competition and Proposal Requirements

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### General Information

**Competition Title:** 2016 International Future Energy Challenge (IFEC) Student Competition

**Topic:** High Power Density AC-DC Converter

**Period of Competition:** May 4<sup>th</sup>, 2015 to July 20, 2016

**Challenge Program Awards:** There will be a Grand Prize of \$10,000 and three additional awards granted at \$1,000, \$3000 and \$5,000 each.

**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 categories such as Best Undergraduate Educational Impact, Best Innovative Design of Power Electronics Converters, etc.

### 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 2016 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:** Each university is limited to support only one team.

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 the 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 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 qualifying reports. These teams are invited to present their progress to the panel at IEEE APEC conference on March 20-24, 2016, in Long Beach, USA. Feedback will be given to the team to improve the system. The team will be invited to a competition event in July of 2016. A Final Report will be due at the competition event.

**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 are limited to advisory role in the team. The up limit of graduate student participants is **two for each team**.

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 2016 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 the competition 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 2016 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.

<b>Language</b>	Proposals must be written in English.
<b>Length</b>	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.
<b>Authors</b>	Proposals are to be prepared by the student team in collaboration with the faculty advisors.
<b>Signatures</b>	Proposals must be signed by all authors of the proposal (or the student team leader) and the faculty advisor.
<b>Letter of Support</b>	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.
<b>Preliminary Team Data</b>	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 by close of business on **October 15, 2015** for full consideration.

**Proposal Submission** The electronic copy of the proposal in PDF format must be sent to Topic Chair and Co-Chair via email, with a copy to the IFEC'16 chairman below:

**General Chair:**

**Jin Wang**, Associate Professor  
Department of Electrical and Computer Engineering  
The Ohio State University  
Columbus, Ohio, 43210-1272, U.S.A.  
Tel: 1-(614)-688-4041, Fax: 1-(614)-292-7596  
Email: [wang.1248@osu.edu](mailto:wang.1248@osu.edu)

**Topic Chair and Co-Chair:**

**Yaow-Ming Chen**, Professor  
Department of Electrical Engineering  
National Taiwan University  
No. 1, Sect. 4, Roosevelt Rd.  
Taipei, 10617, Taiwan  
Tel: 886-(2)-33663667, Fax: 886-(2)-33669881  
Email: [ntuymchen@ntu.edu.tw](mailto:ntuymchen@ntu.edu.tw)

**Huang-Jen Chiu**, Professor  
Department of Electrical and Computer Engineering  
National Taiwan University of Science and Technology  
43, Keelung Rd., Sec. 4  
Taipei, Taiwan 10607  
Tel: 886-27376419, Fax: 886-27376424  
Email: [hjchiu@mail.ntust.edu.tw](mailto:hjchiu@mail.ntust.edu.tw)

**Information** The volunteer Organizing Committee for the 2016 International Future Energy Challenge maintains a web site at <http://www.energychallenge.org/>. The site will include the most recent schedule and rule updates, frequently-asked questions, details about judging and scoring, and other team information. It should be checked regularly.

**Time Schedule**

Oct. 15, 2015	Proposals Due
Sept. 22, 2015	IFEC' 16 Information Session at ECCE2015
Dec. 1, 2015	Proposal reviewing results collected
Dec. 15, 2015	Schools informed of acceptance into the competition
Mar. 15, 2015	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).
Mar. 20-24, 2016	Workshop at APEC 2015, Long Beach, CA, USA
Mar. 30, 2016	Finalists notified (Selection is based upon likelihood of deliverable hardware, quality of design, and likelihood of success in meeting all the challenge objectives).
Jul. 6, 2016	Topic A Final reports and working units due (Final reports are limited to 50 single-column pages total, including all diagrams, attachments, and appendixes)
Jul. 18-20, 2016	Final competition

## High Power Density AC-DC Converter Specification

Input Voltage  $V_{in}$ : 90~264 Vac

Input Current  $I_{in}$ : 15 A (**max**)

Input Frequency  $f_{ac}$ : 47~63 Hz

Input Power Factor PF: >0.95 @20% load

Input Current Harmonic  $I_{THD}$ : <2% @100% and 50% load

Input Inrush Current  $I_{inrush}$ : <60Amax @264Vac

Output Power  $P_{out}$ : 1.3 kW (**max**)

Output Voltage  $V_{out}$ : 400 Vdc

Output Voltage Ripple  $V_{out,p-p}$ : 5 Vdc

Hold-Up Time  $T_{hold}$ : 12 ms ( $V_{out}>360Vdc$  @100% load)

Power Density: >1 W/cm<sup>3</sup>

Efficiency  $\eta$

$P_{out}$	10%	20%	50%	100%
115 Vrms	92%	94%	96%	92%
230 Vrms	92%	96%	98%	96%

EMI Requirement: CISPR CLASS A (Shall have a minimum of 3dB margin)

Maximum AC Leakage Current: 3.5 mA @240 Vrms

**Note: The AC-DC converter will be tested in an environmental chamber @65<sup>0</sup>C full load for 10 minutes**

**More detailed explanation of the specification will be provided in the final Request for Proposal, which is to be uploaded by Aug. 15<sup>th</sup>.**



**ATTACHMENT I**

**2016 INTERNATIONAL FUTURE ENERGY CHALLENGE  
PRELIMINARY TEAM INFORMATION FORM**

Submit with Proposal

NAME OF UNIVERSITY:

CORRESPONDING ADDRESS (PLEASE INCLUDE NAME):

TELEPHONE:

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.]**

To:

**Yaow-Ming Chen**, Professor  
Department of Electrical Engineering  
National Taiwan University  
No. 1, Sect. 4, Roosevelt Rd.  
Taipei, 10617, Taiwan  
Tel: 886-(2)-33663667, Fax: 886-(2)-33669881  
Email: [ntuymchen@ntu.edu.tw](mailto:ntuymchen@ntu.edu.tw)

Dear International Future Energy Challenge Coordinator,

Our university has organized a student team to participate in the 2016 International Future Energy Challenge. Our proposal 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 December 15, 2015. 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 2016 International Future Energy Challenge.

Sincerely,

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