**Department of Electrical and Electronic Engineering**

2021 Third Year Industrial Group project Brief

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| **Name of Company** | Intel |
| **Contact Details** of company representative/supervisor(s) | Name: Josh Levine  Email: [joshua.levine@intel.com](mailto:joshua.levine@intel.com)  Tel: 07795 800974 |
| **Introduction to Company** | Intel Programmable Solutions Group (PSG), formerly Altera, is the FPGA division of Intel. Local engineering contacts are based in Marlow, near High Wycombe, Buckinghamshire. |
| **Project Description**  Describe the problem to be solved by the project team giving as much details as possible. | Advanced power converter  As transport is electrified, attention will switch from fuel consumption to electrical energy consumption and the efficiency and cost of power converters. Many power converters are controlled either by fixed function chips (ASICs) or microcontrollers with limited control update rates. FPGAs are unique in enabling custom digital control at very high frequencies, giving potential benefit by reducing the size and cost of passive components required to stabilize voltage or changing from traditional PWM switching waveforms to other methods to reduce switching losses. This may be an advantage in heavily used high voltage electric vehicle charging stations.  Intel FPGA has:   * a published DC-DC controller reference design for a single-phase converter * a related two-phase converter design that is used in the control of a motor kit * prototype designs that need to be implemented on FPGA or optimized   The aim of this project is to create a new higher performance power converter reference design. Work includes:   * Using the existing DC-DC controller reference design to understand the operation of the converter (the converter is implemented in Intel DSP Builder so can be simulated and modified in MATLAB/Simulink) * Maximizing the FPGA clock frequency that can be used for generating PWM waveforms. * Reducing the FPGA resource usage by optimizing the fixed-point signal formats. * Simulating in more detail the interface to external sensors and transistors * Simulating the external sensors and ADCs * Considering different control algorithms to the existing PI + PWM control, to improve efficiency while limiting worst case voltage error * Extending the design from DC input to single or 3-phase AC input to simulate electric vehicle charging. * Implementation on FPGA, using SignalTap to acquire signals in real time from the FPGA. |
| **Commercial/Industrial context** for project | An improved design would be published and promoted to Intel’s customers for use with Intel FPGAs. |
| **Challenges** – technical and professional | Some understanding or interest in modern switch mode power converters would be an advantage, electronic circuit modelling skills, control system design knowledge and appreciation of FPGA chips and digital logic. |
| **Roles/Expertise/Skills required** i.e. any particular skills that would be essential/desirable | There is some freedom in how roles are defined. The team could brainstorm some issues but also work independently on different aspects in an agile way, for example one person could work on interfacing while another works on the control algorithm and another works on reducing FPGA resource use. |
| **Resources** available:  £ in excess of £500  Personnel  Equipment | Intel DSP Builder licenses and FPGA development kits will be provided as required. An Intel engineer will be available for weekly meetings to guide the project, potentially using a tool like Trello for project management. |