**MIDDLE EAST TECHNICAL UNIVERSITY**

**DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING**

**EE400 – SUMMER PRACTICE REPORT**

**Student Name:** Göksenin Hande Bayazıt

**Student ID Number:** 2093441

**Summer Practice Company:** AVL Research and Engineering, Turkey

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**Supervisor:** Elif Pınar Kesik

**Supervisor’s Contact Information:**

**E-Mail:** pinar.kesik@avl.com

**Phone:** +90 216 498 7950

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**INTRODUCTION**

**DESCRIPTION OF THE COMPANY**

1. **COMPANY NAME**

AVL Research and Engineering (AVL Araştırma ve Mühendislik San. Tic. Ltd. Şti)

1. **COMPANY LOCATION**

AVL is a global company originated in Graz, Austria.

AVL has two facilities in İstanbul: AGM-2, where I have performed my summer practice, and AGM-1.

AGM-1: AVL Research and Engineering Turkey HQ

Akpınar Mahallesi Tuna Caddesi Ballıca Sokak No: 1 34885 Sancaktepe, İSTANBUL

Phone: +90 216 498 7950

Fax: +90 216 498 7956

AGM-2: Abdurrahman Gazi Mahallesi Atatürk Caddesi ByOffice Kat: 6 34920 Sultanbeyli, İSTANBUL

Tel: +90 312 210 18 57-58

Fax: +90 312 210 18 57-58

1. **GENERAL DESCRIPTION OF THE COMPANY**
   1. **ORGANIZATIONAL STRUCTURE**

The company consists of three main departments: Mechanical Design, Software – Electronics and Calibration. These main departments ……

* 1. **NUMBER OF EMPLOYEES**

By the end of August 2017, there are more than 140 employees, where more than 100 of them are engineers (mostly electrical, electronics, mechanical, computer, control systems engineers).

* 1. **MAIN AREA OF BUSINESS**

AVL is the world's largest independent company for the development of powertrain systems with internal combustion engines as well as instrumentation and test systems.

AVL is active in the following areas of business:

* **Powertrain Engineering**

AVL Powertrain Engineering is an expert partner to the global automotive and mobility industry for the development of innovative powertrain systems. From diesel engines to electric drives, from alternative fuels to control software, from transmissions to batteries, we have been working in partnership with companies all over the world for more than 60 years. Unique synergies with AVL Instrumentation and Test Systems and AVL Advanced Simulation Technologies enable the development of highly creative, mature and application-specific solutions for our customers in order that they meet their future market challenges.

* **Instrumentation and Test Systems**

The need for CO2 reduction, the increasing complexity of new powertrain systems, and a requirement to achieve the highest possible level of process efficiency - along with the need to quickly launch new models - are some of the key challenges facing the automotive industry now and for the foreseeable future.

* **Simulation**

Powerful multi-dimensional simulation platforms developed on the basis of AVL's engineering knowledge guide you to practical, application oriented solutions.

AVL is providing a set of comprehensive simulation tools in a flexible and open environment enabling multi-disciplinary solutions as integral part of your powertrain development process. Fully validated state-of-the-art physical simulation models embedded in application specific simulation methods enable virtual prototyping on component and system level for most efficient combination of simulation, design and testing.

1. **HISTORY OF THE COMPANY**

|  |  |
| --- | --- |
| 1946 | Prof. Dr. Hans List started up as an independent engineer. |
| 1948 | A team of diesel engine construction experts headed by Prof. Dr. Hans List got together to set up IBL ("Ingenieurbüro List" or List Engineering). |
|  |  |
| 1951 | IBL became AVL - "Anstalt für Verbrennungskraftmaschinen", Prof. Dr. Hans List (or Institute for Internal Combustion Engines). |
|  |  |
| 1960 | AVL initially became involved in engine instrumentation for its own purposes, manufacturing such instruments as quartz pressure transducers, monitoring and control units, instruments for engine indicating etc. So it was that the group's second division - AVL Engine Instrumentation - was born. |
| 2007 | AVL introduces the i60 series of Emission measurement systems. Setting a new industry standard in usability, accuracy and reliability.  AVL expands electronics portfolio: With the newly tailored „Powertrain Software Strategy" AVL is looking to increase their focus on the area of calibration software for powertrain control units which includes for example engine, transmission, hybrid and exhaust gas after-treatment control.  AVL takes over Le Moteur Moderne. As a local contact for the French automobile industry, LMM will represent the global AVL engineering network and will also integrate services from the global tech centers of AVL. |
| 2008 | AVL amplifies its activities in the fields of application and software development in Germany and founds the wholly owned subsidiary "AVL Software and Functions GmbH" in Regensburg.  AVL presents its new image: kaleidoscope pictures which are intended to symbolize the unique business of AVL and a new logo guarantee a new strong brand image of the globally present company.  60 Years of Innovation: Providing an essential and continuous contribution to the developments in the automotive industry on the basis of technical innovations, that characterizes the high-tech company AVL for the previous 60 years. |

**WORK CONDUCTED AT AVL**

1. **DESIGN OF A DC/DC CONVERTER**

Automotive manufacturers increase the electrification in vehicle powertrains in the form of hybrid electric vehicles and electric vehicles. As the vehicles with these type of architectures are based on high voltage battery systems, the number and need of switched mode power supplies have also increased further, compared to the vehicles with conventional powertrains.

One of the projects that I was involved in was the design and manufacturing of a device that can be connected between the Engine Control Unit (ECU) and the battery of a vehicle which can simulate the possible failures of the battery (e.g. short circuit and open circuit cases between different channels of the ECU).

As the device is between two buses with different voltage and current levels (and also, as the different subsystems of the device operate with the different voltage and current levels), numerous switched mode power supplies (SMPS) are needed to be used. One of those necessary SMPS’s is the one with the following specifications:

* 9-36 VDC input voltage range
* 24 VDC output voltage
* 5 ADC output current
* 120 W output power
* High efficiency
* Compatibility with automotive standards

Because of the limited time due to the schedule of the project, a DC-DC converter module which can be seen on Figure 1 and whose datasheet is accessible by the link given in References is bought. However, as buying these modules is costly, I was given the task of designing a DC-DC converter which has the same specifications.

Figure 1: DC-DC Converter, RSD-60G-24



To satisfy the given requirements, a buck-boost converter topology had to be used obviously, as the input voltage range is wide that it can be both below and above of the output voltage. Initially, I started my design with a conventional buck-boost converter circuit topology, which is indicated in Figure 2, without including a controller. However,

**CONCLUSION**

**REFERENCES**