**CHARGING STATION FOR ISO / IEC 15118 PROTOCOL**

**A PROJECT REPORT**

***Submitted by***

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***of***

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# BONAFIDE CERTIFICATE

Certified that this project report **“CHARGING STATION FOR ISO / IEC 15118 PROTOCOL”** is the bonafide work of “**JIZTOM FRANICS K (311113106022) and NIVAS GOKUL M (311113106040)”** who carried out the project work under my supervision.

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# ABSTRACT

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CHAPTER I

1. INTRODUCTION

In this chapter a short summary of this work is described. In addition, the task description as well as to overview of the following chapters and their contents are given.

## SHORT VERSION

The present project work serves to set up a working model for the current standardization of the vehicle to grid communication according to ISO / IEC 15118 along with the HMI display running on raspberry pi platform.

The built-up working model consists of two interconnected EVACharge SE boards and a Raspberry Pi with a 7” inch screen for the display. .

The software used is derived from an existing stack and adapted for a defined application of ISO / IEC 115118. A dummy state model is used to test the veracity of the code.

According to the ISO, variable parameters are listed as macros and documented, so that a change is possible at any time. If parameters are selected so that the resulting requirements can no longer be met by the respective other subscriber, a fault message is output.

The HMI is configured to choose the language and allows the user to have smooth transition for payment and charging the vehicle. Additional option to fully charge and also timed charging with full receipt details of the charge is displayed at the end of the process.

## TASK

The main task is to implement a basic working model of the car charging station with the HMI interfaced into the system. It involves the study of the basic working of the ISO 15118 protocol and defining the possible working structure of the Charging station.

The task involves the design of the communication mechanisms and processes between the main processor of an electric vehicle supply equipment (EVSE) – or called charging station - and a computer that runs the HMI on that EVSE (HMI), and the electric vehicle to be charged (EV)

The targets to be achieved:

* Analyse the requirements of ISO 15118 and IEC 61851 based on the work of the references.
* Design, discuss and finalize the state machine and the communication process between EVSE and HMI together with a German student (Raphael Scholz)
* Learn about UML as a description language for state machines and communication sequences
* Use TCP/IP communication between the Raspberry pi and EVSE to send information between HMI and EVSE.
* Write Software program based on C language to interface the HMI and the EVSE as a backend process.
* Implement the entire task to a fully functional final product.

## CHAPTER OVERVIEW

CHAPTER II

1. LITERATURE SURVERY

**REFERENCES**

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CHAPTER III

1. PROBLEM STATEMENT / OBJECTIVE

## INTRODUCTION

The European Union is looking forward to reduce the no. of oil based vehicles by 40% and replace them with electric vehicles by 2025. This allows countries to reduce their carbon footprint and also improve the pollution crisis which some of the cities are facing worldwide.

This new idea on implementing results in another growing concern, i.e. the power required to charge the newly added electric cars. If all the cars are charged simultaneously it will result in a blackout due to overdraft of available power. This is not an acceptable scenario.

This led to the realization of ISO/IEC 15118 which focus on how to distribute the power rather than on how to increase the speed of charging. The main idea is to integrate the smart grid into the charging station and make a platform on which all types of standard AC or DC charging can be done. The OpenV2G project is the community project which focuses on developing the codes for the integration of the smart grid with the Charging Station.

Once implemented, it may increase the time required to charge the electric vehicles but allows to reduce the possibility of potential blackout and also integrate all forms of renewable energy sources into the system.

## OBJECTIVE

The car charging station based on ISO/IEC 15118 has already been implemented and communication between the EVSE and EV is done using Green PHY (powerline communication).Now the next objective is to integrate an HMI to the system which allows the user to interact and charge the vehicle.

Conditions to be followed:

1. Another platform should be used to run and interface the HMI as the EVSE has enough processes to run.
2. The EVSE should be a client and should have the code modified in minimal invasive method.
3. The three devices should simultaneously run when the specified conditions are satisfied.
4. Should satisfy all the state and event condition as mentioned in the OpenV2G project.

CHAPTER IV

1. METHODOLOGY

This chapter provides an overview of work and information to which the project is worked up. These include, inter alia, the former way of loading a vehicle as well as the previous exchange of information and the different vehicle connectors used for loading of electric vehicles. Further more information on this work is a study work, which is describes the ISO 15118 accurately and a dissertation of Dr. Marc Mültin which is engaged in the electric vehicle as a "flexible consumers and energy storage device in the smart home".

## IEC 62196: VEHICLE PLUG

Connector types and charging modes of electric vehicles are defined by the International Electrotechnical Commission in IEC 62196 (Wiki\_plug, 2016),

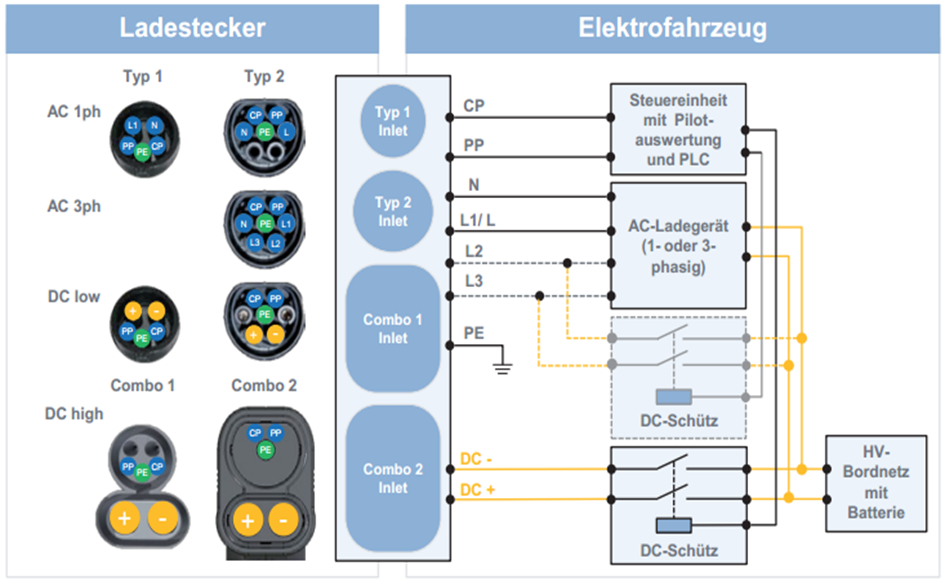
The second part of the standard was published in 2011 and includes different types of connectors. This includes three of the most popular at this time charging plug.

Figure 4.1 CAR CHARGING PLUG MODELS

The Type 1 charging plug, which in Figure 2.1 is shown, takes its specification of the SAE J1772. This was first published in 1996 by the Society of Automotive Engineers and has since been expanded and maintained by this. The disadvantage of this connector type is found in the contacts since these do not allow a three-phase charging with alternating current.

Type 2 of the standard charging plug is the currently the most built-up type of charging plug systems and found in figure 2.1. The plug finds its origins through a collaboration of the connector manufacturer Mennekes with the power company RWE and the carmaker Daimler. The naming of the Mennekes plug thus receives this by its manufacturer.

|  |  |  |
| --- | --- | --- |
| abbreviation | Contact | function |
| CP | Control pilot | Control signals charging station🡪electric vehicle |
| PP | Proximity pilot | Check the presence of a charging cable |
| N | Neutral | For AC charging |
| L1, L2, L3 | Current-carrying phases | For AC charging with a (L1 / L) or three (L1, L2, L3) Phases |
| PE | Protective Earth | protective conductor |
| DC +/- | Current-carrying phases | For DC charging |

Table 4.1 PIN details of IEC 62196

The third plug-in type plugged into the standard, the EV Plug Alliance, was defined by a consortium led by French and Italian companies. Due to the low demand, the further production of the plug was discontinued.

For all defined types of connectors as defined in Type 1 Signal contacts CP (Control Pilot) and PP are (Proximity pilot) included which allow charging to IEC 61851.

* 1. **IEC 61851**

The IEC 62196 is an international standard for a number of types of plugs and charging modes for electric vehicles and of the International Electrotechnical Commission maintained (IEC). The standard is valid in Germany as a DIN standard DIN EN 62196. It consists of several parts which have been passed in succession. The third part was published in June 2014. In June 2015, the standardization process for part 4 (light- weight electrical connections) began.

The standard adopts the IEC 61851 definition for a signal pin that switches the charging current - the charging station remains de-energized until an electric vehicle is connected. During the charging process, the vehicle cannot be put into operation.

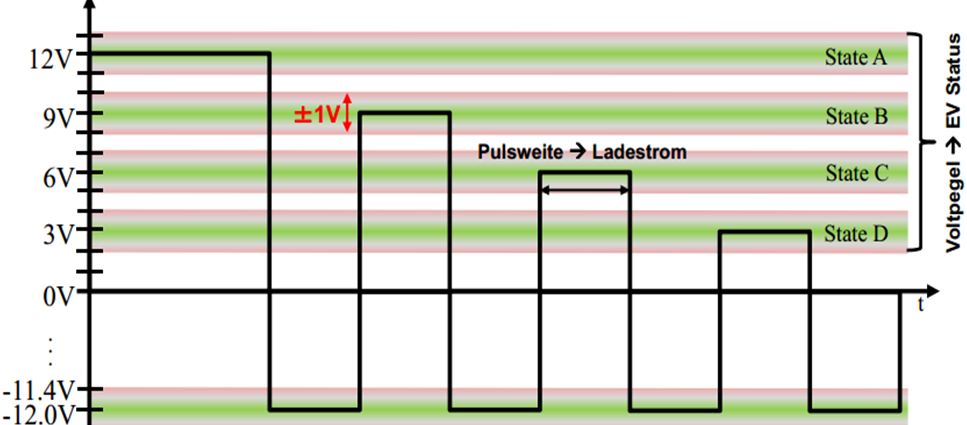
Prior to the definition of a charging process according to ISO / IEC 15118, the charging parameters required for the charging process were defined using a PWM signal according to IEC 61851. The signals of the Control Pilot (CP), Protective Earth (PE) and Proximity Pin (PP) contacts described in section 2.1 are required to determine the parameters required for loading.

Figure 4.2 VOLTAGE DIVIDER STATES

For charging the vehicle, both communication subscribers are first connected to one another. A 1 kHz signal with 12V is generated on the CP contact from the side of the charging column. The pulse width of the signal indicates which maximum power can be provided by the charging column. In this case, 10% max. 10A, 25% 16A, 50% max. 32A and 90% quick charge (Wiki\_Stecker, 2016).

On the vehicle side, resistors are connected between CP and PE or PP and PE. Different charging states are indicated by different switchable levels of the voltage between the CP and PP contacts, as shown in Figure 2.2. Please note that the negative voltage value is permanently -12V, and only the positive values change. A definition of the individual states is Table 2.2.

|  |  |  |
| --- | --- | --- |
| Level | State | Condition Description |
| 12 ± 1 V | State A | Electric vehicle is not connected |
| 9 ± 1 V | State B | connected electric vehicle, not charging Ready |
| 6 ± 1 V | State C | connected electric vehicle, ready to charge |
| 3 ± 1 V | State D | connected electric vehicle, ready for loading, ventilation needed |
| 0 ± 1 V | State E | Network problem, PP Short to earth |
| -12V | State F | Vehicle unavailable Error |

Table 4.2 IEC 61851 STATES EXPLAINED

Lastly, a vehicle-side resistance between the PP and the PE contact indicates the maximum possible charging current of the electric vehicle. The greater the resistance used, the lower the maximum charging current. Specifically, for a 1.5kΩ resistor, a maximum charging current of 13A, a maximum of 20A with a resistance of 680Ω, at 220Ω the maximum charging current 32A and 63A is at 100Ω.

## ISO 15118

The International Organization for Standardization (ISO) and the International Electronic Commission (IEC) in 2009 started to describe the standardization of a "digital IP-based communication protocol" between electric vehicle and charging station( Mültin, 2014), This should be a "plug-and-charge" mechanism for authentication, authorization, accounting, and for load control, so that needed to load enable parameters are stored in the vehicle and the user both communication parties must connect only. The individual communication Content will be the level of tension control pin signal from Chapter2.2 correspondingly Figure 2.3 assigned

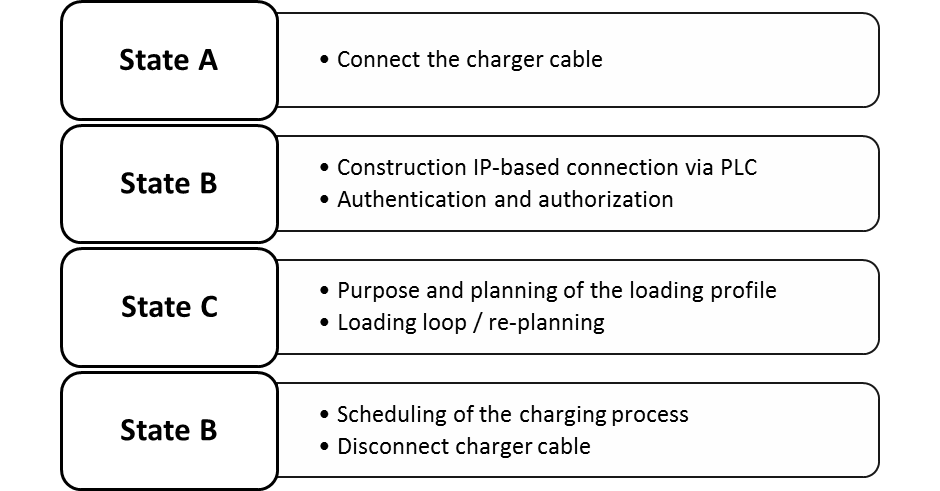


Table 4.3 ISO 15118 STATES WORING DETAILS

The full schedule of communication stacks for AC or DC charging an electric vehicle according to ISO / IEC 15118 can be found in Figure 7.1 to Figure 7.4, an overview of the variables contained in the messages within the AC communication stack is described together with an overview of the ISO / IEC 15118 in a previous study, work (Barth, 2015)