EV CONTROLLER

SOFTWARE REQUIREMENTS SPECIFICATION

Contact:

Tom Snoblen
Snoblen & Associates
1218 City Drive
Ann Arbor, Michigan 48103
734-665-7366

Revision History

DOCUMENT	DATE	COMMENTS
EV Controller -0100	2 June 2000	Original release.

TABLE OF CONTENTS

1. Introduction

This is the Software Requirements Specification (SRS) for the EV Controller project.

1.1 Purpose

The purpose of this SRS is to specify the requirements for development of the software to control the operation of an electric traction motor.

1.2 Scope

This document shall contain all the requirements for the EV Controller software.

1.3 Definitions, acronyms, and abbreviations

EV Electric Vehicle
SRS Software Requirements Specification
PWM Pulse Width Modulation

1.4 References

The following documents form a part of this specification to the extent specified. In the case of conflict between a cited document and this specification, this specification shall be considered a superseding document.

Data Sheets

Maxim MAX110/MAX111 19-0283 Rev 3 3/96 data sheet
Intel 8752 Manual

2. Overall description

This section describes general factors that affect the product and its requirements. Items presented in these subparagraphs are **not** requirements but provide **background information** for the requirements specified in section 3.

2.1 Product perspective

This document describes the software for the whole traction system.

2.2 Product functions

The EV Controller Software shall perform the following:
Measure pedal position
Measure battery current
Measure battery voltage
Generate a PWM signal between 0-100% at ~2000Hz
If the software enters a failure mode it must turn the PWM off (0%).

2.3 User characteristics

None.

2.4 Constraints

The platform for this software is an 8752 base processor board running on an 11.05 MHz clock. The code is to be written in “C”.

3. Specific requirements

The following paragraphs specify the software requirements of the EV Controller in sufficient detail to enable designers to design the system to satisfy these requirements, and testers to validate that the designed system satisfies the requirements.

3.1 External interface requirements

3.1.1 User interfaces

3.1.1.1 LCD Display

The LCD shall display % modulation, battery current, battery voltage, % modulation, and battery charge.

3.1.1.2 Pedal

The pedal position set the desired speed of operation full down shall be 100% on full up 0%

3.1.1.3 LED

An LED is provide for debugging purposes and as an indicator that the processor is running normally. During normal operation the LED should blink at a 2-second rate

3.1.2 Hardware interfaces

3.1.2.1 LCD

The LCD uses the standard LCD 14-pin interface and command set
Data is on port 0
Control lines are on port 2
Data/Reg bit 3
Enable bit 2
R/W bit 1

3.1.2.2 AtoD

Communication with the 4 channel AtoD is by a three wire serial buss:
Select line Port 2, bit 5
Clock Line Port 2, bit 4
data line out Port 2, bit 6
data line out Port 1, bit 1
The data format is described in Maxim data sheet.

3.1.2.3 Pedal

The pedal interface consists of a positioner and an up and down switch. The up switch defines 0% modulation and the bottom switch defines 100% modulation.

Phase 1 port 1 bit 5
Phase 0 port 1 bit 6 (also int pin)

The down switch connects to port 1 bit 3.

The up switch connects to port 1 bit 2.

3.1.2.4 RS-232

The RS-232 interface provides a communications path to collect data from the controller. It shall report %modulation, battery voltage, battery current, battery state of charge, abs pedal position and current limit status.

The RS-232 hardware is internal to the 8752 see its data sheet for more information

3.1.2.5 PWM

The PWM output is used to drive the traction motor. The pulse width may vary between 0 and 100% depending on pedal position and current limiting.

The PWM output is at port 2 bit 7

3.1.2.6 LED

The LED is connect to port 2 bit 0 of the 8751

3.1.2.7 Ignition

This input indicates that the vehicle is turned on.
Port 1 bit 0.

3.1.2.8 Switches

Port 1 bits 6 and 7 are connected to switches. There are no requirements for the uses of the switches.

3.1.3 Software interfaces

None

3.1.4 Communications interfaces

RS232 Port – Transmit only no handshaking, 9600baud, N, 1
It shall report %modulation, battery voltage, battery current, battery state of charge, abs pedal position and current limit status. The data shall be in ASCI format and comma delimited. Each data packet shall end in a carriage return and line feed.

3.2 Functional requirements

3.2.1 Function Pedal Monitoring

The following paragraphs define the processing associated with the Pedal Position Monitoring..

3.2.1.1 Introduction

Pedal position used with current liming to determine the percentage of PWM. When the pedal is pressed it moves a quadature optical encoder, this enables the processor to determent the direction of motion. The pedal additionally triggers two position switches. One at the unpressed position this is used to determent the zero modulation position. the other switch is at the full on position and determines the 100% modulation position.

3.2.1.2 Inputs

Phase 0 (generates an interrupt).
Phase 1
Top Switch
Bottom Switch

3.2.1.3 Processing

When the top (unpressed) switch is open the pedal position shall be 0. This requirement has highest piority.

When the bottom switch is closed the pedal position shall be the maximum value for the pedal.

When between the switches the pedal value shall increase with downward motion and decrease with upward. The interrupt of phase zero indicates a new pulse and phase 1 determines the direction.

After the bottom switch is closed the value of encoder counts from the top to bottom switch shall be used to scale the pedal position from 0 to maximum pedal value. Before the bottom switch is closed an estimate value shall be used.

3.2.1.4 Outputs

A scaled variable indicating the pedal position.

3.2.2 Function Running Analog to Digital Converter

The following paragraphs define the processing associated with the AtoD converter.

3.2.2.1 Introduction

The AtoD converter provides battery voltage and battery current for the current limiting function and the charge monitoring function.

3.2.2.2 Inputs

Data is read with a 4 wire serial interface

3.2.2.3 Processing

Initialization and calibration shall occur at powerup and when ever needed while the program is running.

The software shall alternate between measuring current and voltage.

Voltage rang is 0-100v. Out of bound voltages are errors

Current range –1000 to +1000 Amps Out of bounds readings are errors

There shall be a calibration constant for both voltage and current.

3.2.2.4 Outputs

This routine shall maintain the current and voltage variables.

3.2.3 Function PWM generation and Current Limit

3.2.3.1 Introduction

The percentage PWM determines the power to the motor. The current limit limits the maxim power to motor

3.2.3.2 Inputs

Present Pedal Position 0-100%
Current reduction a constant
Current Limit a constant
Battery Current

3.2.3.3 Processing

PWM shall equal Percent Pedal Position except when Battery Current is greater than Current Reduction Constant.

When Current Reduction Constant is less than Battery Current PWM shall not be increased.

When Battery Current is greater than Current Limit PWM shall be decreased by 50%

If the Pedal Position should become invalid PWM shall be set to 0.
Lost of AtoD function the PWM shall be set to 0

Lost of ignition the PWM shall be set to zero

PWM frequency output shall be ~2000Hz. 0 to 100% modulation.

3.2.3.4 Outputs

PWM

3.2.4 Function Battery Charge Monitoring

3.2.4.1 Introduction

Using data provide by the AtoD this function shall record the energy flow into an out of the battery.

3.2.4.2 Inputs

Battery Current
Battery Voltage

3.2.4.3 Processing

Battery Current * Battery Voltage = Power
Sum of Power/time = Charge

3.2.4.4 Outputs

Charge Value

4. Qualification provisions

Section	Requirement	Qualification
3.1.1.1	LCD Display	Demonstration
3.1.1.2	Pedal	Demonstration
3.1.1.3	LED	Demonstration
3.1.2.4	RS-232	Demonstration
3.1.2.5	PWM	Test
3.2.2	Function Running Analog to Digital Converter	Test
3.2.3	Function PWM generation and Current Limit	Test
3.2.4	Function Battery Charge Monitoring	Test

5. Appendices

I/O MAP

PORT	BIT	Function
0	0	i/o Bit 0 of the LCD data/reg input
	1	i/o Bit 1 of the LCD data/reg input
	2	i/o Bit 2 of the LCD data/reg input
	3	i/o Bit 3 of the LCD data/reg input
	4	i/o Bit 4 of the LCD data/reg input
	5	i/o Bit 5 of the LCD data/reg input
	6	i/o Bit 6 of the LCD data/reg input
	7	i/o Bit 7 of the LCD data/reg input
1	0	input Ign
	1	input from the AtoD data
	2	input from upper pedal switch
	3	Input from lower pedal switch
	4	input Position encoder ph1
	5	input Position encoder ph0
	6	input SW2
	7	input SW1
2	0	Output LED
	1	Output LCD R/W
	2	Output LCD select
	3	Output LCD data/reg
	4	Output AtoD clock
	5	Output AtoD Select
	6	Output AtoD data

	7	Output PWM
Int		input phase 0