Prototyping Testing Plan

Project: Open Strom Smart Meter

Object: CPU Board PCB

## Introduction and Project Overview

### The goal of Open Strom Smart Mete project is to develop the necessary hardware and software for acquisition ,monitoring and disaggregation estimation of the energy parameters for electrical home and business appliances

## Project Sub-Systems Being Tested

### Figure 1.1 is a high level block diagram showing all of the components that need to be tested.

Battery Charger

Power Supply

5.0V, 3.3V

Current/Voltage Sensor

**STPM 34**

Ch1

Relay Switch

Ch1

SPI

Main Microcontroller

PIC 32MX975F512H

SPI

Current/Voltage Sensor

**STPM 34**

Ch10

Relay Switch

Ch10

Tx,Rx

MMI

SPI

Ethernet

Circuit

LAN 8720

WiFi Module

ESP 8266 WROOM

ZigBee Module

MRF24J40MA

Fig .11

## Test Strategy

### . Table 1.1 is an abbreviated version of the specifications that will be filled in as tests are carried out.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Engr. Spec. # | Specification (description) | Pass criteria | Units | Measured | Pass/Fail |
| **Hardware** | |  |  |  |  |
| Test1 | Power Supply 5.0V | ±0.5% | Volt |  |  |
| Test2 | Power Supply 3.3v | ±0.05% | Volt |  |  |
| Test3 | PIC32MX759F512H | works |  |  |  |
| Test4 | RelaySwith1-10 | Switch On/Off | Volt | 4.75V-5.25v |  |
| Test5 | SPI2 BUS Sensors | works |  |  |  |
| Test6 | SPI3 BUS ZigBee | works |  |  |  |
| Test7 | Current Sensors 1-10 | works | Volt | ±0-300mV |  |
| Test8 | Voltage Sensor 1-10 | works | Volt | ±0-300mV |  |
| Test9 | STPM34 | works |  |  |  |
| Test10 | Ethernet | works |  |  |  |
|  |  |  |  |  |  |

Table 1.1: Specification test sheet

## Prototype reference documents

The prototype is real PCB named SM-CPU board Rev.0.3 with the following reference documents:

- Schematics – CPU-board-Sheet1-multi.schDoc;

-CPU-board-Sheet2-multi.schDoc;

-CPU-board-Sheet1-multi.schDoc;

-BOM – BOM-CPU-board-multi.xls;

### Equipment required for testing follows:

### Oscilloscope with probes 100MHZ two channels;

* Voltage Digital Multimeter 6 Digit;

### DC Voltage supply 12V/ 3Amps;

### DC Current supply 1- 20mAmps;

### ICD -3 debugger/programmer;

### PicKit2-programmer (optional);

## Steps of testing

### **Power Supply test step 5.0V - Test1**

* + - 1. Power Supply – 5.0V (PS5.0V)

Populate components that build the PS5.0V – see List of components

1.4.1.2. List of components

- Terminal Block – TB1-1, TB1-2, P1,P2,P3;

- IC – U1;

- Capacitors – C1, C2, C3, C4, C5, C6;

- Resistors – R1, R2, R5, R6, R8;

- Inductor – L1;

- Diodes – D1, D2;

- Solder components to the board

Connect external PS 12V/3Amps to the terminals TB1-1, TB1-2 .

1.4.1.3 Measurement of PS5.0V

- use TP1 -5.0V located on the header P2-21 and GND located on the P1-5

- the measured voltage should be in the rate of +5.25V- 4.75V;

- D3 should light up;

1.4.1.4. Measurement PS5.0V under a load

- between P1-2 and P1-5 connect load resistor 5 Ohms/5W;

- The measured value of PC5.0V should be in the range of 4.75V – 5.0V;

- D3 should light up;

-mark in the Table 1.1 that Test1 was passed;

**1.4.2 . Power Supply test step 3.3V – Test 2**

Populate components that build the PS3.3V – see List of components

1.4.2.1. List of components

- IC – U1;

- Capacitors – C8, C9, C7, C10;

- Resistors – R14, R17, R18, R19, R20;

- Inductor – L2;

- Diode- D5, D7;

1.4.2.2. Measurement of PS3.3V

- use TP2 3.3V on the header P1-1;

- use GND on the header P1-5;

- measure voltage between TP2 and GND;

- the measured value should be in the range 2.8V - 3.4V ;

1.4.2.3. Measurement of the PS3.3V under a load

- between P1-1 and P1-5 connect load resistor 5 Ohms/5W

- the measured value should be in the rate of 2.8V – 3.4V ;

- D7 should light up;

-mark in the Table 1.1 that Test2 was passed

1.5. **Microcontroller pic32mx795F512H test step – Test 3**

1.5.1. Populate all of the components to the PCB without Wifi Module M2

1.5.2. Check power supply of microcontroller pic32mx

- between microcontroller (uC) GND’s pins 9,25,41 and Vdd’s pins 26,38,10,57 the voltage should be in the range 2.8V -3.4V;

1.5.3. Download TestCPU01.hex file

- connect ICD 3 debugger or PicKit2 to header P1.

- download the hex file TestCPU01.hex file;

- switch on/off power supply 12V to activate RESET-START ;

- measure frequency in TP6 and TP6 using 100Mhz oscilloscope;

- the rate of frequency should be 8MHZ +/- 2%;

- the LEDs D14,D15 should light alternatively with delay of 500ms;

-mark in the Table 1.1 that Test3 was passed

1.6. **Relays test step – Test 4**

1.6.1. Download the testRelays01.hex file by ICD-3 debugger

- switch on/off power supply 12V to activate RESET-START ;

- use the oscilloscope to measure the state on the header pins P2-2,

P2-4, P2-6, P2-8, P2-10, P2-12, P2-14, P2-16, P2-16, P2-20;

- the state on these pins should change alternately between 0.4v to 3.2V with the frequency of 10Hz.

**1.7. SPI-2 bus sensor test step – Test5**

1.7.1. Download the testSPI02.hex file by ICD-3 debugger

- switch on/off power supply 12V to activate RESET-START ;

- use the oscilloscope to view SPI signals as follows:

- TP7 - SCS;

- TP8 – SCL;

- TP9 – MOSI;

-TP10 – MISO;

1.7.2. The oscilloscope waveform should looks like as in the attached files:

- ;

- ;

1.7.2.1. If the real oscilloscope picture corresponds to the waveform in the files

Mark in Table 1.1 that the test was passed

**1.8. SPI-3 bus Zegbee test step – Test6**

1.8.1. Download the testSPI03.hex file by ICD-3 debugger

- switch on/off power supply 12V to activate RESET-START ;

- use the oscilloscope to view SPI signals as follows:

- TP11 SDO3;

- TP15 – SDI 3;

- TP14 – SCLK;

- TP17 – CS;

- TP12 – RESET;

1.8.2.1. If the real oscilloscope picture corresponds to the waveform in the files

Mark in Table 1.1 that the test was passed

**1.9. Current measurement test step – Test 7**

1.9.1. Connect DC current supply 1-20mA to the CPU board as follows:

- DC Current Supply active output to the P3-1;

- DC Power Supply GND to the P3-11/12/13;

- List of the test point (see the schematic document CPU-board-Sheet2-multi.SchDoc and CPU-board-Sheet3-multi.SchDoc :

- for Channel 1/2 :TP18 – U4-11; TP19 – U4-9; TP20 - U4-13; TP21- U4 -11;

- for Channel 3/4 :TP22 – U6-11; TP23 – U6-9; TP24 - U6-13; TP25- U6 -11;

- for Channel 5/6 :TP26 – U8-11; TP27 – U8-9; TP28 - U8-13; TP29- U8 -11;

- for Channel 7/8 :TP30 – U9-11; TP31 – U9-9; TP32 - U9-13; TP33- U9 -11;

- for Channel 9/10 :TP34 – U10-11; TP35 – U10-9; TP36 - U10-13;

TP37- U10 -11;

1.9.1.1. Apply the input current from the DC current Supply as is shown in

Table 2.1 and measure the voltage at the TP18

|  |  |
| --- | --- |
| DC Current Value(adjustable)  active output | Voltage value at TP18 (mV+-2%) |
| 0 mA | 0 mV +/- 2% |
| 40 uA | 7.48mV +/- 2% |
| 2 mA | 37.4mV +/- 2% |
| 4 mA | 74.8mV +/- 2% |
| 6 mA | 112.2 mV +/- 2% |
| 8 mA | 149.6 mV +/- 2% |
| 10 mA | 187 mV +/- 2% |
| 12 mA | 224.4mV +/- 2% |
| 14 mA | 261.8 mV +/- 2% |
| 16 mA | 299.2 mV +/- 2% |

Table 1.2

1.9.1.2. Connect DC current supply 1-20mA to the CPU board as follows:

- DC Current Supply active output to the P3-2;

- DC Power Supply GND to the P3-11/12/13;

1.9.1.2.1 Apply the input current from the DC current Supply as is shown in

Table 1.2 and measure the voltage at the TP20

1.9.1.3. Connect DC current supply 1-20mA to the CPU board as follows:

- DC Current Supply active output to the P3-3;

- DC Power Supply GND to the P3-11/12/13;

1.9.1.3.1 Apply the input current from the DC current Supply as is shown in

Table 1.2 and measure the voltage at the TP22

1.9.1.4. Connect DC current supply 1-20mA to the CPU board as follows:

- DC Current Supply active output to the P3-4;

- DC Power Supply GND to the P3-11/12/13;

1.9.1.4.1 Apply the input current from the DC current Supply as is shown in

Table 1.2 and measure the voltage at the TP24

1.9.1.5. Connect DC current supply 1-20mA to the CPU board as follows:

- DC Current Supply active output to the P3-5;

- DC Power Supply GND to the P3-11/12/13;

1.9.1.5.1 Apply the input current from the DC current Supply as is shown in

Table 1.2 and measure the voltage at the TP26

1.9.1.6. Connect DC current supply 1-20mA to the CPU board as follows:

- DC Current Supply active output to the P3-6;

- DC Power Supply GND to the P3-11/12/13;

1.9.1.6.1 Apply the input current from the DC current Supply as is shown in

Table 1.2 and measure the voltage at the TP28

1.9.1.7. Connect DC current supply 1-20mA to the CPU board as follows:

- DC Current Supply active output to the P3-7;

- DC Power Supply GND to the P3-11/12/13;

1.9.1.7.1 Apply the input current from the DC current Supply as is shown in

Table 1.2 and measure the voltage at the TP30

1.9.1.8. Connect DC current supply 1-20mA to the CPU board as follows:

- DC Current Supply active output to the P3-8;

- DC Power Supply GND to the P3-11/12/13;

1.9.1.8.1 Apply the input current from the DC current Supply as is shown in

Table 1.2 and measure the voltage at the TP32

1.9.1.9. Connect DC current supply 1-20mA to the CPU board as follows:

- DC Current Supply active output to the P3-9;

- DC Power Supply GND to the P3-11/12/13;

1.9.1.9.1 Apply the input current from the DC current Supply as is shown in

Table 1.2 and measure the voltage at the TP34

1.9.1.10. Connect DC current supply 1-20mA to the CPU board as follows:

- DC Current Supply active output to the P3-10;

- DC Power Supply GND to the P3-11/12/13;

1.9.10.1 Apply the input current from the DC current Supply as is shown in

Table 1.2 and measure the voltage at the TP36

1.10. **Voltage measure test step – Test 8**

1.10.1. Connect DC voltage supply to the CPU board as follows:

- DC Voltage Supply active output to the P2-1;

- DC Power Supply GND to the P3-11/12/13;

1.10.1.1. Apply the input voltage from the DC voltage Supply as is shown in

Table 2.1 and measure the voltage at the TP18

Table 2.1

|  |  |
| --- | --- |
| DC Voltage Value(adjustable)  active output | Voltage value at TP19 (mV+-2%) |
| 0 mV | 0 mV +/- 2% |
| 116mV | 116mV +/- 2% |
| 121mV | 121mV +/- 2% |
| 127mV | 127mV +/- 2% |
| 133mV | 133 mV +/- 2% |
| 139mV | 139 mV +/- 2% |
| 145mV | 145 mV +/- 2% |

1.10.2. Connect DC voltage supply to the CPU board as follows:

- DC Current Supply active output to the P2-3;

- DC Power Supply GND to the P3-11/12/13;

1.10.2.1. Apply the input current from the DC current Supply as is shown in

Table 2.1 and measure the voltage at the TP21

1.10.3. Connect DC voltage supply to the CPU board as follows:

- DC Current Supply active output to the P2-5;

- DC Power Supply GND to the P3-11/12/13;

1.10.3.1. Apply the input current from the DC current Supply as is shown in

Table 2.1 and measure the voltage at the TP23

1.10.4. Connect DC voltage supply to the CPU board as follows:

- DC Current Supply active output to the P2-7;

- DC Power Supply GND to the P3-11/12/13;

1.10.4.1. Apply the input current from the DC current Supply as is shown in

Table 2.1 and measure the voltage at the TP25

1.10.5. Connect DC voltage supply to the CPU board as follows:

- DC Current Supply active output to the P2-9;

- DC Power Supply GND to the P3-11/12/13;

1.10.5.1. Apply the input current from the DC current Supply as is shown in

Table 2.1 and measure the voltage at the TP27

1.10.6. Connect DC voltage supply to the CPU board as follows:

- DC Current Supply active output to the P2-11;

- DC Power Supply GND to the P3-11/12/13;

1.10.6.1. Apply the input current from the DC current Supply as is shown in

Table 2.1 and measure the voltage at the TP29

1.10.7. Connect DC voltage supply to the CPU board as follows:

- DC Current Supply active output to the P2-13;

- DC Power Supply GND to the P3-11/12/13;

1.10.7.1. Apply the input current from the DC current Supply as is shown in

Table 2.1 and measure the voltage at the TP31

1.10.8. Connect DC voltage supply to the CPU board as follows:

- DC Current Supply active output to the P2-15;

- DC Power Supply GND to the P3-11/12/13;

1.10.8.1. Apply the input current from the DC current Supply as is shown in

Table 2.1 and measure the voltage at the TP33

1.10.9. Connect DC voltage supply to the CPU board as follows:

- DC Current Supply active output to the P2-17;

- DC Power Supply GND to the P3-11/12/13;

1.10.9.1. Apply the input current from the DC current Supply as is shown in

Table 2.1 and measure the voltage at the TP35

1.10.10. Connect DC voltage supply to the CPU board as follows:

- DC Current Supply active output to the P2-19;

- DC Power Supply GND to the P3-11/12/13;

1.10.10.1. Apply the input current from the DC current Supply as is shown in

Table 2.1 and measure the voltage at the TP37

1.11. STPM 34 Test step - Test 8 (to be continued)

1.12. Ethernet test step – Test 9 (to be continued)

-