

Customer

A manufacturer of automated power supply monitoring and control systems.

Objective

Create a hardware and software platform for a data hub to be used in the automated power supply monitoring and control network. The hub should interact with data acquisition and transmission equipments network over a PLC (Power Line Communications) and communicate with the master controller using TCP/IP over various wired or wireless connections. Emphasis is placed on reliability and fault tolerance. Further production of various modified versions of the unit based on the designed platform should be provided.



Solution

CPU board

The digital platform was developed based on System-on-Chip Atmel AT91RM9200. The hardware platform comprises SDRAM Micron MT48LC16M16 16M x 16bit, 8Mb FLASH memory Atmel AT45DB642D, NAND FLASH Samsung K9F1208U0B, FRAM Ramtron FM25L256. The physical level of wire Ethernet 10/100 Mbit interface for communication with the master controller was based on PHY Ethernet National Semiconductor DP83848 chip.

The wireless interface for communication with the master controller was based on the GSM/GPRS module of Wavecom GR64 modem. Additional FULL UART TI TL16C550DIPT chip was used to connect GSM/GPRS modem to the CPU.

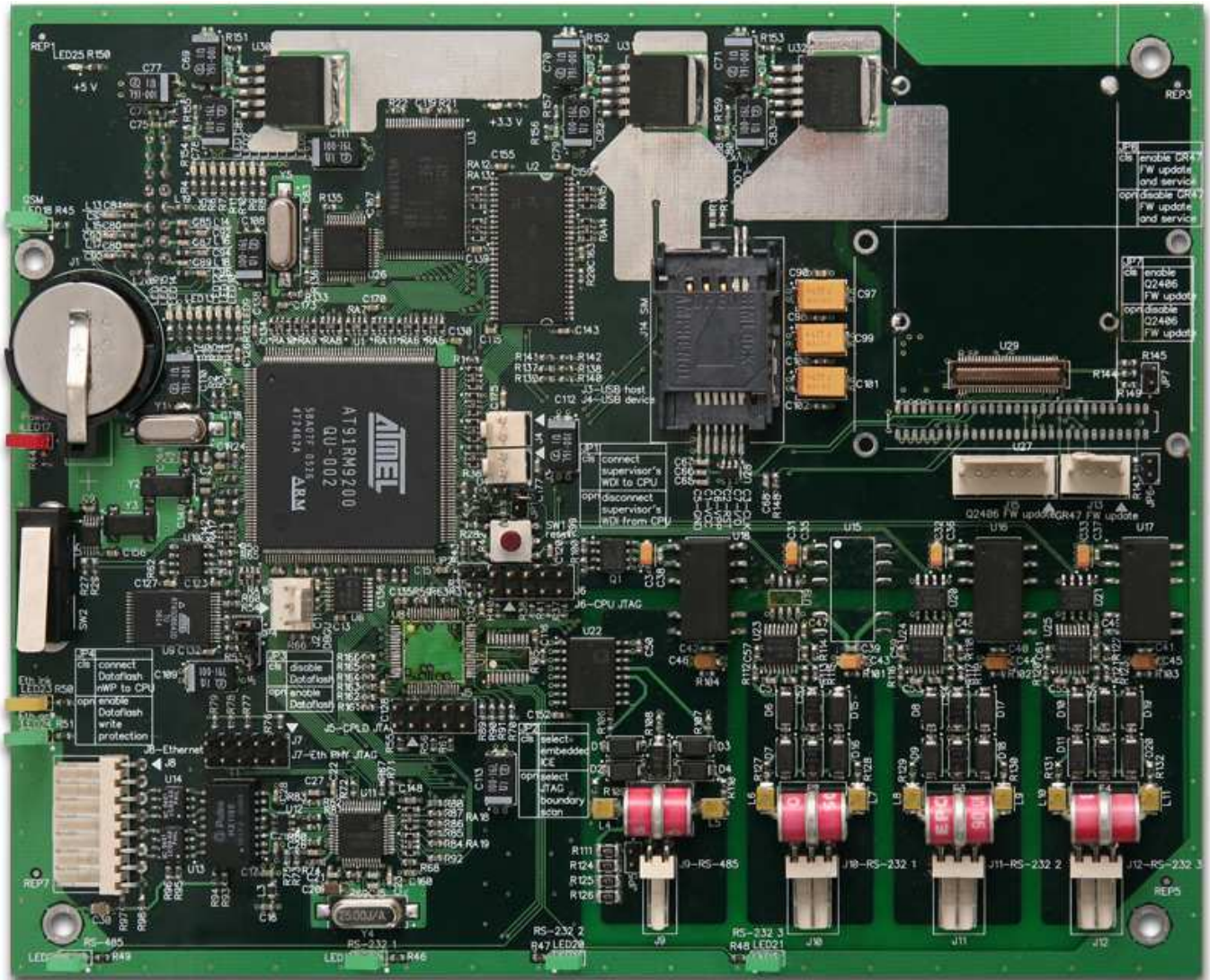
RS-485, RS-232 interfaces were installed to connect with the data collection and transmission equipment. Separate protective galvanic isolation circuits based on DC/DC transducers (Aimtec AM1/2L and AD ADUM1201) were implemented in either of RS-485 and RS-232 channels. A case opening sensor was installed on the board. A case open event registration circuit that worked when the unit was de-



Multi-purpose data acquisition controller

energized and a high precision real time clock (RTC) with an integrated battery with extended service life were set on the board too.

In addition, CPLD Xilinx XC9572XL was installed on the board in order to implement simple logical functions.



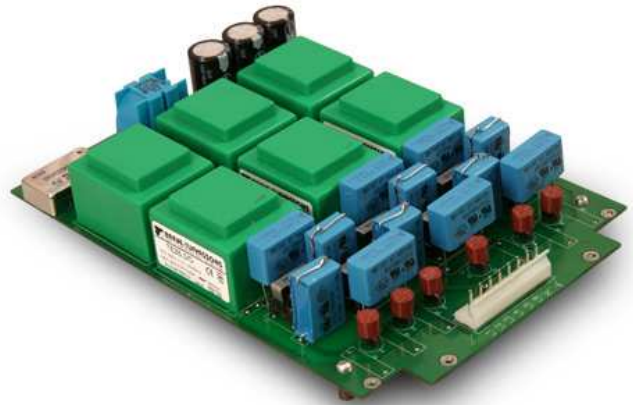
Main features and specifications:

- CPU module PCB dimensions: 180x145 mm
- Power supply PCB dimensions: 215x145 mm
- Ethernet 10/100 Mbit
- Internal connector for USB 2.0 host/device
- 1 x RS485
- 3 x RS232



Power supply

Power was supplied to the board from a power supply unit designed by us. The unit uses 6 input lines 220 V. It provides the power continuously when at least one of the 6 input voltages is available. In addition, the power supply unit was able to accumulate the amount of energy sufficient to support correct shutdown of the consumer equipment within 5 seconds.



Design

The package was based on the OEM solution produced by OKW. Its design is in compliance with the standard specifications (GOST) applicable to the electronic components used in the automated control systems - dust and moisture protection class IP65. Modular design application allowed simplifying the assembly process and improving the serviceability of the unit.

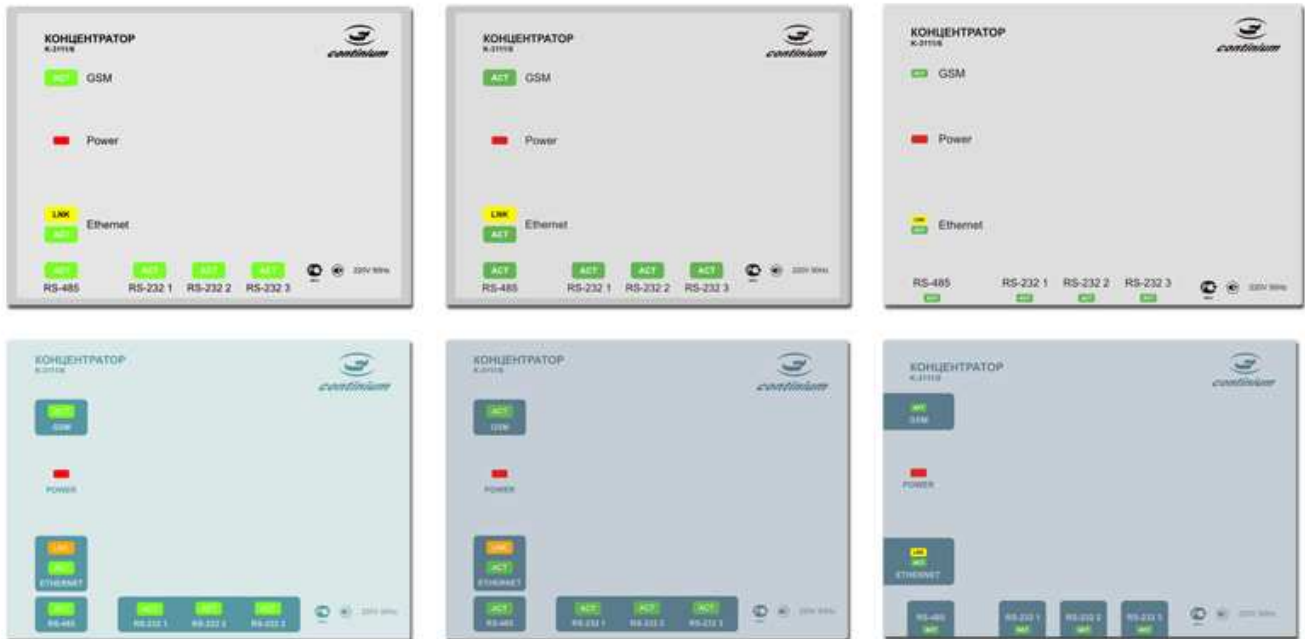




Multi-purpose data acquisition controller

The internal components, the exterior appearance, and the placement of external connectors were designed. Separate Ethernet, RS-485, RS-232 interfaces connectors, external GSM aerial, and power terminals 220 V connectors that meet the IP65 requirements were placed on the side panel of the hub. The unit was adopted to be mounted using a DIN rail.

Our designer proposed 6 stickers featuring various layouts and colors of symbols and icons.



Software

A board support package (BSP) based on initial boot loader U-Boot and Linux kernel 2.6.21 was developed for the AT91RM9200 board. Support of SDRAM Micron MT48LC16M16, Ethernet transceiver DP83848, and 64 Mbit NAND Flash Samsung K9F1208U0B was added. A Linux driver for FRAM memory connected to the SPI interface of the CPU was developed. Some of these modifications and corrections were integrated in the main Linux kernel branch.

Main functions of the software:

- Hub management over the Web-interface
- Different access rights for user groups (operator, administrator)
- Interworking with PLC modems over RS-232, support of Yitran's proprietary protocol IT800D Host Interface Command Set
- Monitoring the status of units in the data collection and transmission network
- Communication with the data acquisition and transmission equipment
- Fault tolerance improvement due to spooling the readouts and events in the nonvolatile quick access FRAM



- Communication with the master controller using TCP/IP over Ethernet, GSM/GPRS, or direct connection over RS-232.

Web-interface supports the following functions:

- Review and edit the list of subordinate equipment
- Set the tariff schedules for various types of meters
- Review the log of events occurring in the hub and its subordinate units
- Review the list of readouts transmitted to the hub from its subordinate units
- Download the events and readouts lists to a PC
- Archiving and removing past events and readouts
- Access to the system parameters and settings of the OS

hub management [Help Index](#)

Tariffs list

Type: [0034](#) (id: 4)
Type: [0041](#) (id: 3)
Type: [1234](#) (id: 111)
Type: [0001](#) (id: 1)

[Add new tariff](#)

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Archive events

Source: Type: Priority, starting from: Index, up to: (0 - all)

Confirm archivation

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View device info

S/N: 2025
Registration mode: 2
Type: 1
Data 1: undefined
Data 2: undefined
Internal Id: 2
Net address: 1234
Registered: 1

Meters

No	Info	Registered at	Deleted at
1	0003,0001,198169,1	2006-08-08 20:00	
2	0004,0001,198163,1	2006-08-08 20:00	

Certification tests

The hub passed certification tests in compliance with GOST under the following sections:

- EMC
- Interference immunity
- Industrial radio-frequency interference
- Immunity to ESD
- Immunity to nanosecond pulse interference
- Immunity to high energy microsecond pulse interference
- Immunity to dynamic changes of voltage in the power supply circuit (voltage falls or interrupts)
- Electrical safety (the hub meets class I requirements of protection against the electric shock hazard).



Benefits

- OS Linux and ANSI C application ensures the possibility to use the software code in other hardware platforms. The product doesn't use any proprietary solutions that would require royalty or subscription fees
- The Web-based user interface permit's to configure the unit remotely and view the work results from any PC using an Internet browser. There is no need to install additional software
- High level of fault tolerance
- Protection class IP65 of the case
- The modular design makes it easy to produce various modified versions based on the developed platform



Technologies	Embedded Linux, JFFS2, u-boot, CGI,
Programming languages	C, bash, VHDL
Interfaces	Ethernet 10/100 Base-T, RS-232, RS-485, GSM/GPRS, SPI, PLC
Development tools	ISE8.1, PCAD GNU Toolchain (gcc, gdb), valgrind, IDE Eclipse
Project management tools	dotProject, MSProject, CVS
Labor input	190 man-days
Project completion period	6 month