MMnet1001

Minimodule with ARM9 microprocessor and Ethernet

User's Manual

REV 0.5 (2008-10-10)

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Contents

1. Introduction

MMnet1001 is a universal minimodule intended for use with “big” operating systems like Linux or Windows CE. It is equipped with fast ARM9 microprocessor running 200MHz or 400MHz clock, 64MB of RAM memory, 1GB of Flash memory, 100Mbit Ethernet, USB ports, onboard power supply and other peripherals. Microcontroller’s port are led to two pin headers. Thanks to use BGA packages and multilayer printed circuit board all of this could be placed on a small area. Module is a complete, independent microprocessor system, it just requires to connect power supply and Ethernet cable and you can login to Linux system. MMnet1002 can work standalone or can be connected with extension boards in form of a sandwich.

The **MMnet1001** minimodule can be also used in didactic laboratories of informatics colleges and universities, and can be also used to build circuits realizing thesis projects.

Features

MMnet1001 minimodule:

- Complete, ready to use microprocessor system
- Fast ARM926-EJ AT91SAM9260 (AT91SAM9G20) microprocessor with **210MHz (400MHz)** clock
- Up to **64MB** SDRAM memory and up to **4GB** NAND Flash
- **Ethernet** PHY 10/**100Mbit** interface with magnetics and RJ45 connector
- Place for 4MB DataFlash memory
- 2 x **Host USB** 2.0 Full Speed
- RS232 interface
- USB 2.0 Full Speed Device
- Two LED diodes: „Power Supply” and „User”
- Module supply voltage: 3.3V
- 2 x 40 terminals with 0.1" (2.54mm) pitch, fitting every prototype board
- Small dimensions: 100mm x 70mm
- Module is delivered with Linux system, sample applications and development environment

2 The module

Block diagram

A block diagram of MMnet1001 minimodule is shown on the image below:

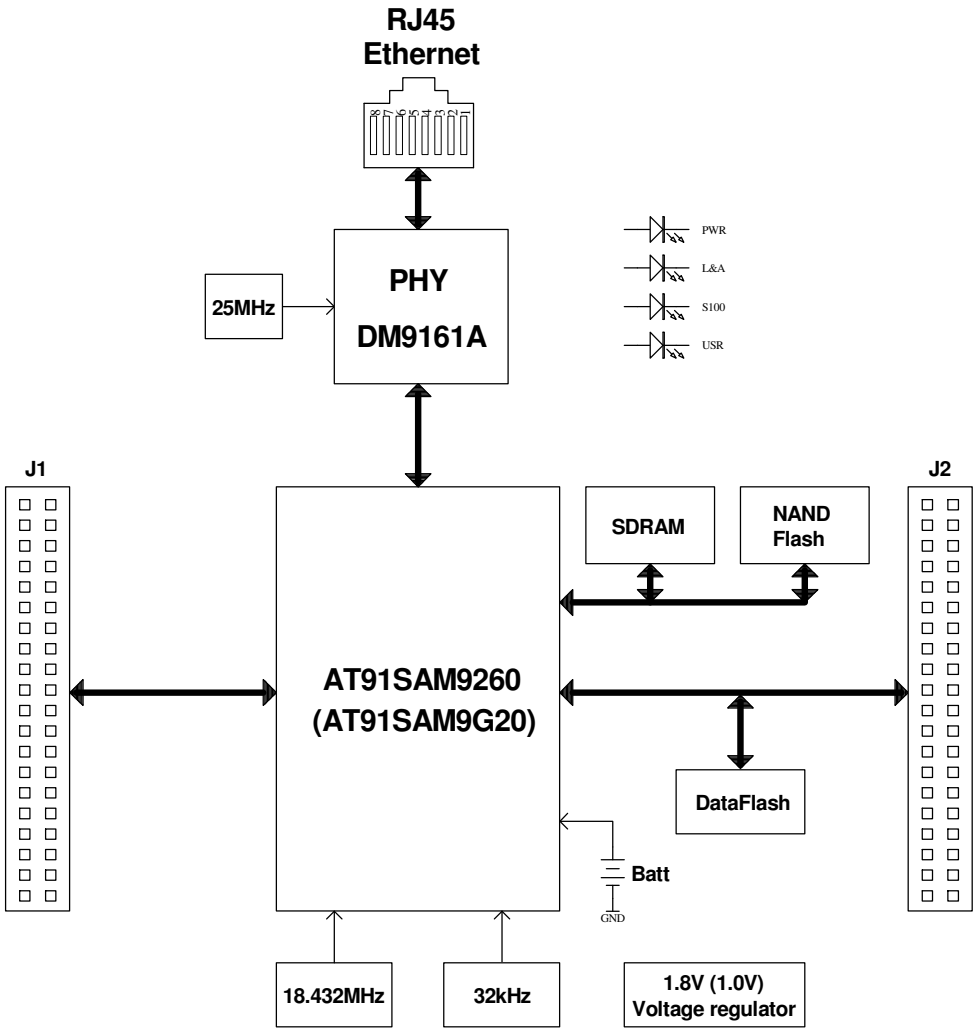


Figure 1 MMnet1001 block diagram.

Module configuration

Minimodule can be ordered in different configurations with use of selector:

MMnet1001–Ax–Bx–Cx–Dx–Ex–Fx–Gx

In place of x should be used value from table:

Parameter	Description
A	1 – AT90SAM9260 2 - AT91SAM9G20
B	8 – 8MB 16 – 16MB 32 – 32MB 64 – 64MB
C	0 – without NAND Flash memory 1 – 1GB 2 – 2GB 4 – 4GB
D	0 – without DataFlash memory 1 – 4MB
E	0 – Battery socket not mounted (R53 mounted) 1 – Battery socket mounted (R53 not mounted)
F	0 – RJ45 connector not mounted 1 – RJ45 connector mounted
G	0 – Ethernet PHY (DM9161) not mounted 1 – Ethernet PHY (DM9161) mounted

For example: MMnet1001–A1–B64–C1–D0–E1–F1–G1

Terminals layout

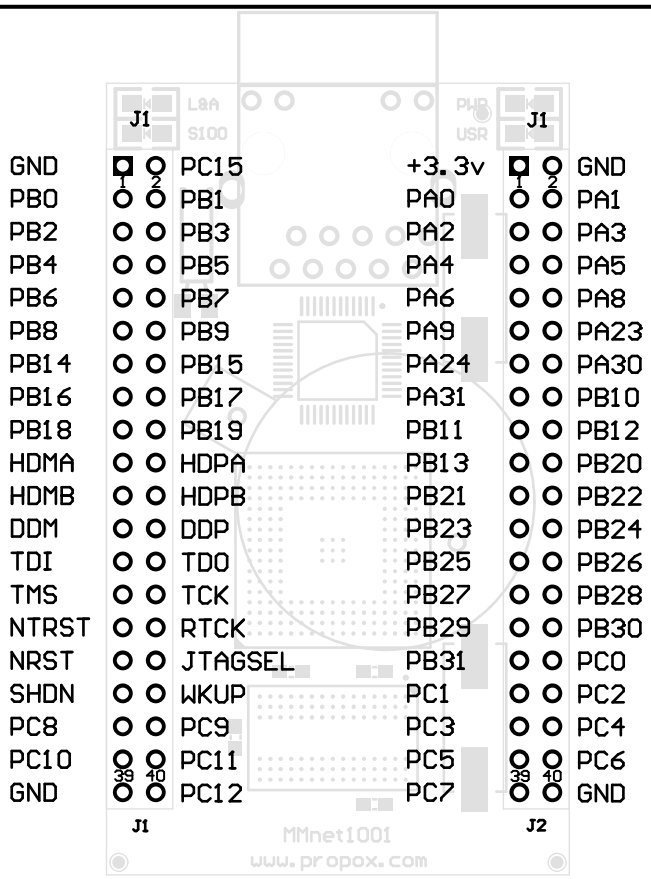


Figure 2 Terminals layout – top view.

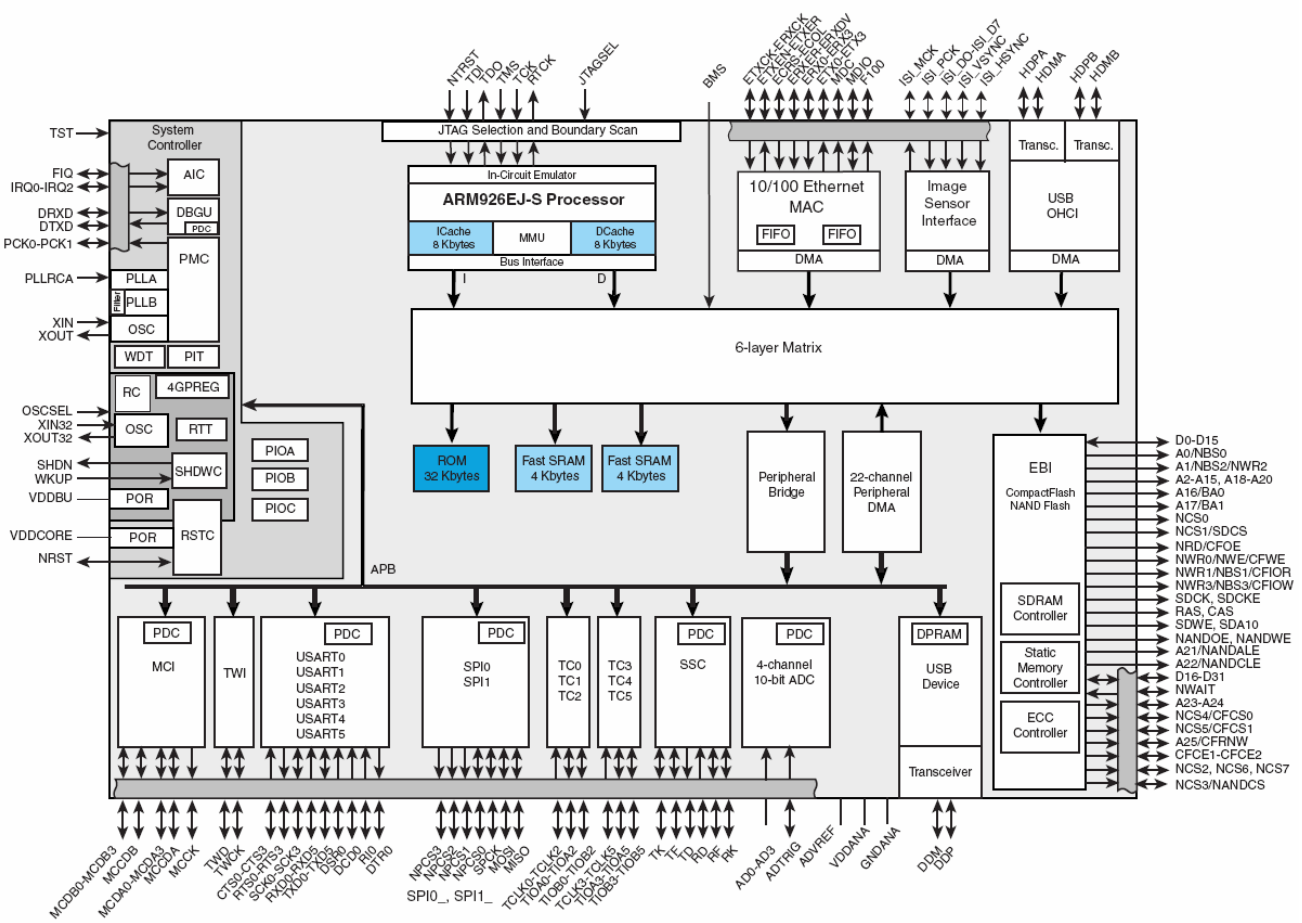
Name	J1		Name	Name	J2		Name
GND	1	2	PC15/NWAIT [IRQ1]	+3.3V	1	2	GND
PB0/SPI1_MISO [TIOA3]	3	4	PB1/SPI1_MOSI [TIOB3]	PA0/SPI0_MISO [MCDB0]	3	4	PA1/SPI0_MOSI [MCCDB]
PB2/SPI1_SPCK [TIOA4]	5	6	PB3/SPI1_NPCS0 [TIOA5]	PA2/SPI0_SPCK	5	6	PA3/SPI0_NPCS0 [MCDB3]
PB4/TXD0	7	8	PB5/RXD0	PA4/RTS2 [MCDB2]	7	8	PA5/CTS2 [MCDB1]
PB6/TXD1 [TCLK1]	9	10	PB7/RXD1 [TCLK2]	PA6/MCDA0	9	10	PA8/MCCK
PB8/TXD2	11	12	PB9/RXD2	PA9/MCDA1	11	12	PA23/TWD [ETX2]
PB14/DRXD	13	14	PB15/DTXD	PA24/TWCK [ETX3]	13	14	PA30/SCK2 [RXD4]
PB16/TK0 [TCLK3]	15	16	PB17/TF0 [TCLk4]	PA31/SCK0 [TXD4]	15	16	PB10/TXD3 [ISI_D8]
PB18/TD0 [TIOB4]	17	18	PB19/RD0 [TIOB5]	PB11/RXD3 [ISI_D9]	17	18	PB12/TXD5 [ISI_D10]
HDMA	19	20	HDPA	PB13/RXD5 [ISI_D11]	19	20	PB20/RK0 [ISI_D0]
HDMB	21	22	HAPB	PB21/RF0 [ISI_D1]	21	22	PB22/DSR0 [ISI_D2]
DDM	23	24	DDP	PB23/DCD0 [ISI_D3]	23	24	PB24/DTR0 [ISI_D4]
TDI	25	26	TDO	PB25/RI0 [ISI_D5]	25	26	PB26/RTS0 [ISI_D6]
TMS	27	28	TCK	PB27/CTS0 [ISI_D7]	27	28	PB28/RTS1 [ISI_PCK]
NTRST	29	30	RTCK	PB29/CTS1 [ISI_VSYNC]	29	30	PB30/PCK0 [ISI_HSYNC]
NRST	31	32	JTAGSEL	PB31/PCK1 [ISI_MCK]	31	32	PC0/ AD0 [SCK3]
SHDN	33	34	WKUP	PC1/ AD1 [PCK0]	33	34	PC2/ AD2 [PCK1]
PC8/NCS4/CFCS0 [RTS3]	35	36	PC9/NCS5/CFCS1 [TIOB0]	PC3/ AD3 [SPI1_NPCS3]	35	36	PC4/A23 [SPI1_NPCS2]
PC10/A25/CFRNW [CTS3]	37	38	PC11/NCS2 [SPI0_NPCS1]	PC5/A24 [SPI1_NPCS1]	37	38	PC6/TIOB2 [CFCE1]
GND	39	40	PC12/IRQ0 [NCS7]	PC7/TIOB1 [CFCE2]	39	40	GND

Detailed description of ports can be found in microcontroller datasheets www.atmel.com.

AT91SAM9260/(AT91SAM9G20) microcontroller

- 32-bit ARM926EJ core running up to 210MHz (400MHz)
- DSP Instruction Extensions and JAVA acceleration
- Memory Management Unit (MMU) allows to run Linux or Windows CE®
- 8kB (32kB) Data Cache and 8kB (32kB) Instruction Cache
- Two 4kB (16kB) Internal SRAM, Single-cycle Access at Maximum Matrix Speed
- External Bus Interface (EBI) supports SDRAM, Static Memory, ECC-enabled NAND Flash and Compact Flash
- USB 2.0 Full Speed (12 Mbits per second) Device Port
- USB 2.0 Full Speed (12 Mbits per second) Host and Double Port
- Ethernet MAC 10/100 Base T
- Image Sensor Interface
- Reset Controller
- Advanced Interrupt Controller
- RTC with battery backup
- Periodic Interval Timer, Watchdog Timer, Real-time Timer
- 10-bit A/D converter
- DMA controller
- MultiMedia Card/SDCard/SDIO controller
- Synchronous Serial Controller (supports I2S)
- 6 USARTs + 1 DBGU port
- 2 SPI interfaces
- TWI interface
- TWI interface
- JTAG interface

More info on AT91 microcontrollers can be fund at manufacturer site: http://www.atmel.com/



Ethernet PHY

The minimodule is equipped with DM9161A Ethernet PHY and RJ45 connector with integrated magnetics.

DM9161A features:

- Fully compatible with IEEE 802.3/IEEE 802.3u 10Base-T/100Base-TX, ANSI X3T12 TP-PMD 1995
- Supports MDI/MDI-X auto crossover (Auto-MDI)
- Supports Auto-Negotiation IEEE 802.3u
- Full-duplex or half-duplex mode
- Low power consumption
- Low power modes

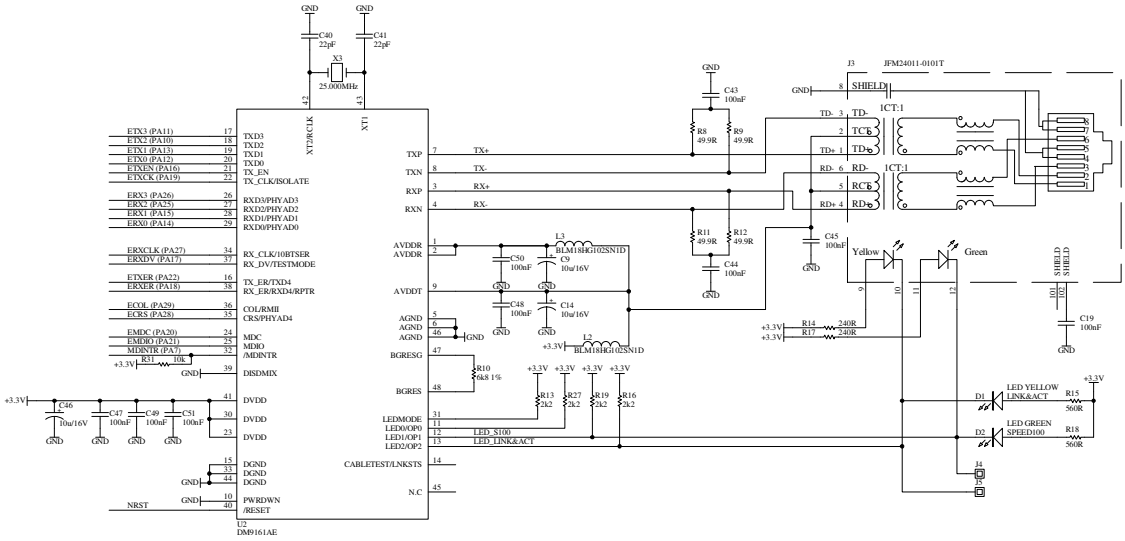
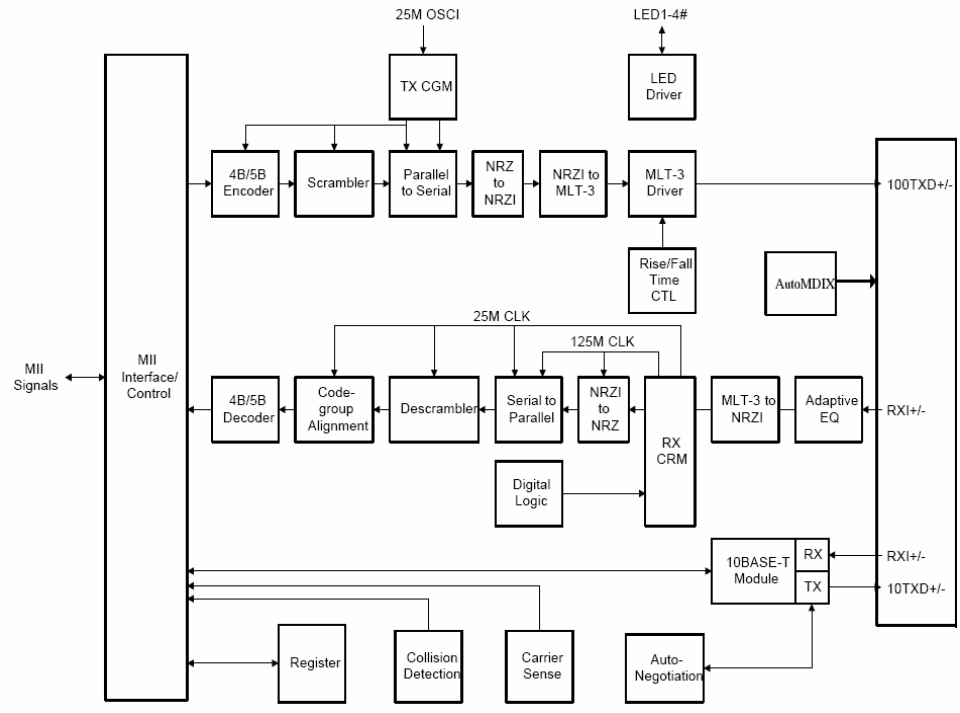


Figure 3 Implementation of Ethernet interface in MMnet1000.



DM9161A documentation can be fund on manufacturer site: http://www.davicom.com.tw

USB Device Interface

AT91SAM9260 (AT91SAM9G20) contains USB 2.0 full-speed device interface. Signals of this interface are brought to J1 connector. On drawing below is presented how to connect USB mini B socket to module. If Vbus voltage is connected to PC5 pin (through voltage divider) it is possible to detect if module is connected to bus.

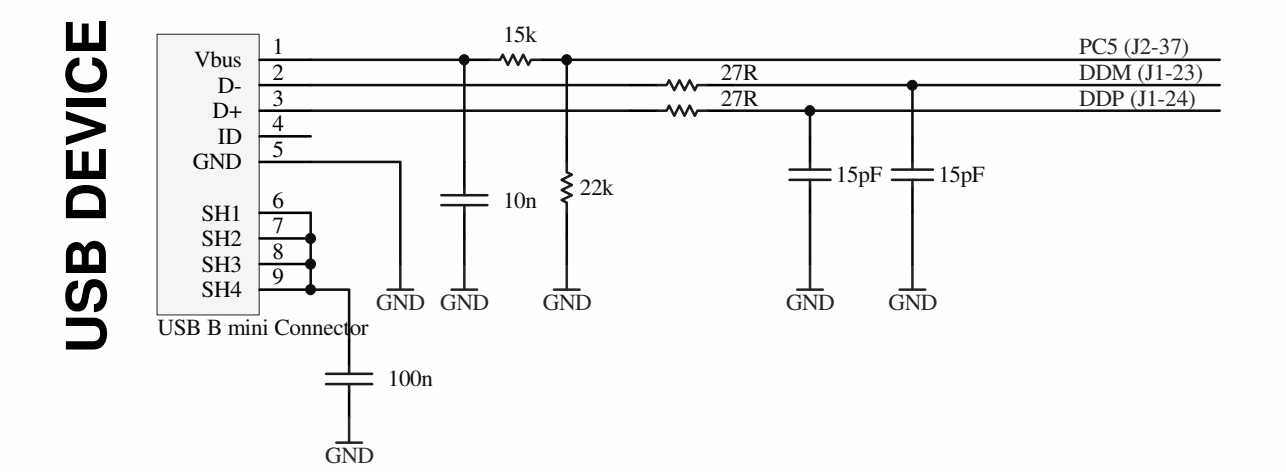


Figure 4 Connection of USB device socket to module.

USB Host Interface

AT91SAM9260/AT91SAM9G20 microcontrollers have USB Host interface with two ports compliant with USB 2.0 specification (Full Speed and Low Speed). Signals of this interface are brought to J1 connector. On drawing below is presented how to connect double USB A socket to module. Because USB Host supply power to connected devices, it is necessary to provide 5V voltage with 0.5A current capability to connector.

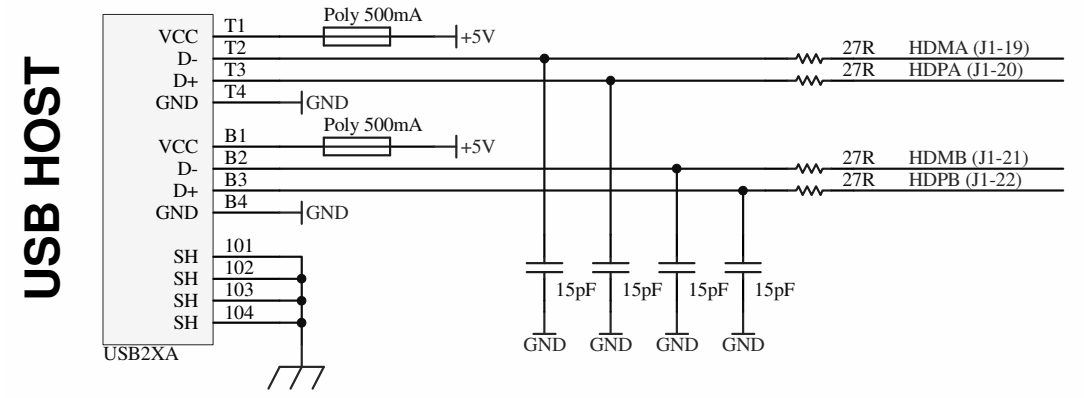


Figure 5 Connection of USB hot socket to module.

AT91SAM9260/AT91SAM9G20 microcontrollers has seven USART ports which can be used to connect the minimodule with a PC computer other equipment equipped with a RS-232 port. UART0 have full modem lines, UART 1, 2, and3 have two modem signals: RTS and CTS, and ports UART4, 5 and DBGU only TXD and RXD lines. Drawings below show example of use UART0.

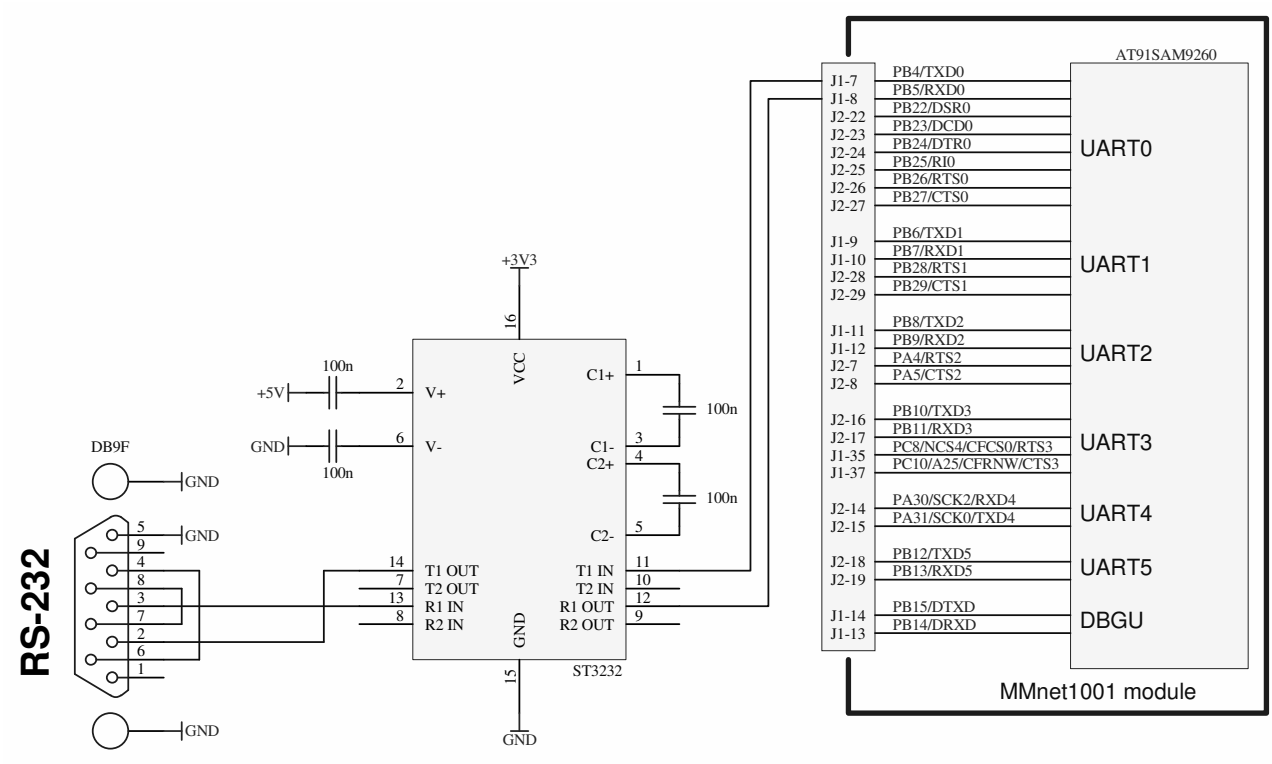


Figure 6 Example of UART0 use as DCE.

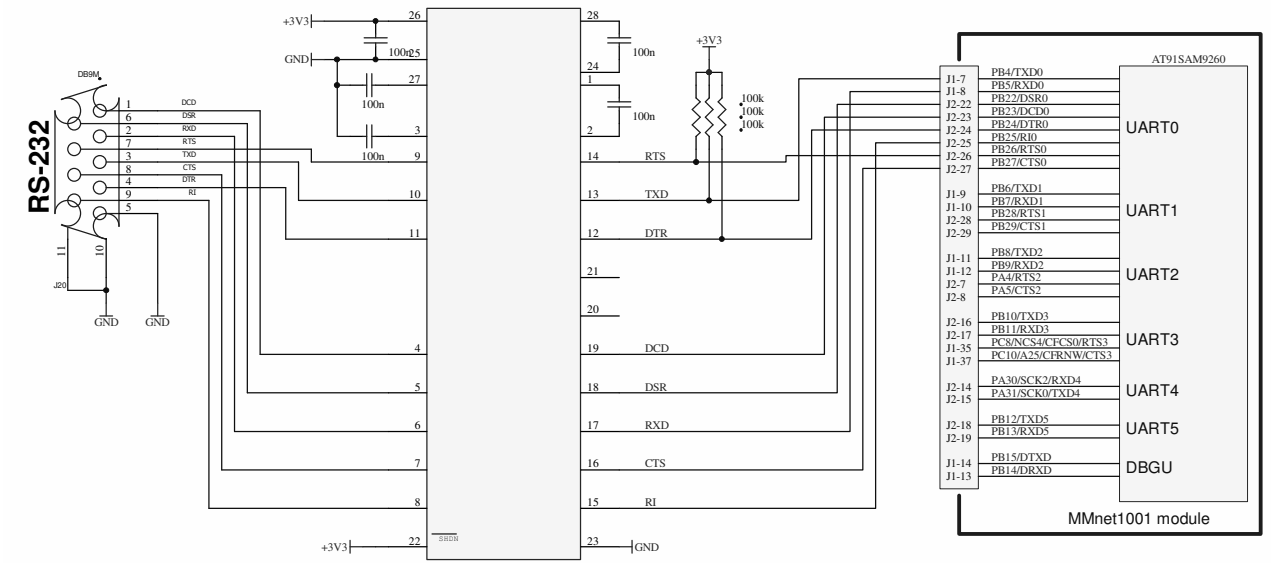


Figure 7 Example of UART0 use as DTE.

NAND Flash memory

The minimodule can be equipped with NANDFlash memory with capacities from 128MB to 4GB, as standard, 1GB memory is available.

AT91SAM9260/AT91SAM9G20 microcontrollers can boot from NANDFlash memory, so entire operating system including file system can be placed in this memory.

Memory is connected directly to system bus, so high read/write speed can be achieved (dependent on used memory).

Content of memory can be protected from accidental deletion by soldering R49 resistor (it is not mounted by default).

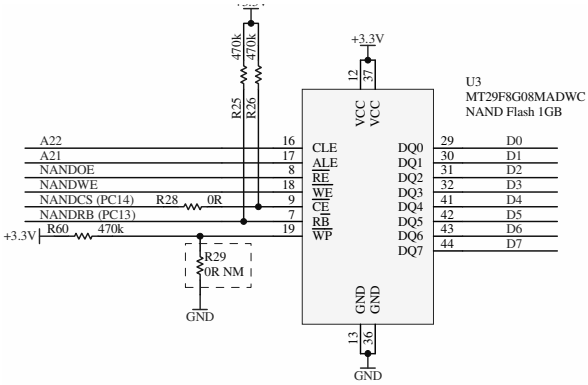


Figure 8 NAND Flash memory.

A detailed description of NANDFlash memories can be found on Micron web page: www.micron.com.

SDRAM memory

Module by default is equipped with 64MB SDRAM memory. For reduce cost when ordering higher quantities, lower capacity memory can be mounted (8, 16 or 32MB). Memory is connected to system bus with 100MHz (AT91SAM9260) or 133MHz (AT91SAM9G20) clocking.

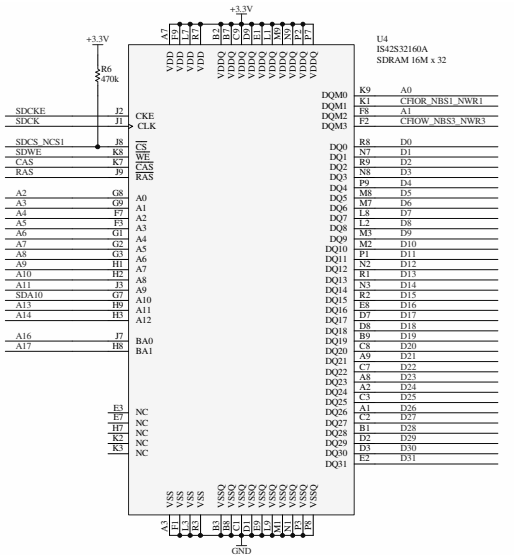


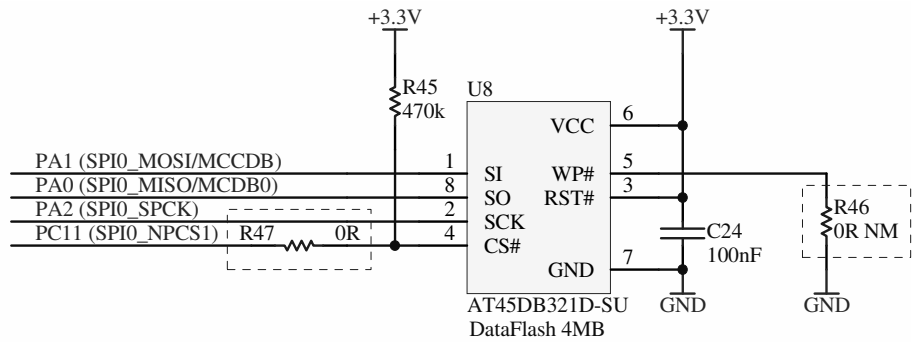
Figure 9 SDRAM memory.

DataFlash memory

The minimodule can be equipped with serial DataFlash with up to 32 Mb capacity.

AT91SAM9260/AT91SAM9G20 microcontrollers can boot from DataFlash memory, so entire operating system including file system can be placed in this memory.

Memory is connected to microcontroller's SPI interface and is activated by low logic level on #CS pin. If there is such need (for example when restoring broken bootloader), DataFlash can be deactivated by unsoldering R47 resistor. Content of memory can be protected from accidental deletion by soldering R46 resistor (it is not mounted by default). Such possibility can be useful in system which do not need software upgrade.



A detailed description of DataFlash memories can be found on Atmel's web page: www.atmel.com.

Programming/debugging of module can be done through JTAG interface.

JTAG is a four-lead interface permitting the takeover of control over the processor's core. The possibilities offered by this interface are, among others: step operation, full-speed operation, hardware and software breakpoints, inspection and modification of contents of registers and data memories. The method of connecting the JTAG connector to the minimodule is shown in the drawing:

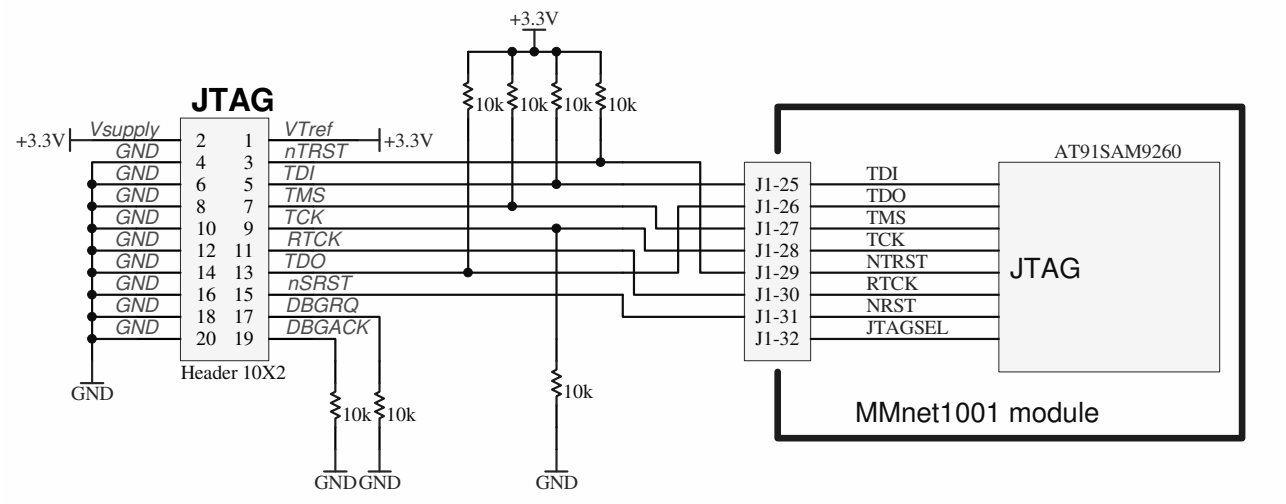


Figure 10 Connection of JTAG interface to MMnet100.

JTAG interface can also work In boundary scan mode, to enable his mode high logic level (1.8V) should be connected to JTAGSEL pin. In JTAG mode JTAGSEL pin can be left unconnected.

WARNING: voltage higher than 1.8V an JTAGSEL pin can damage microprocessor !

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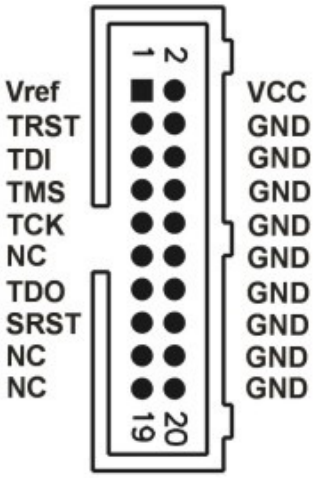


Figure 11 JTAG connector.

Pin description	
TCK	Supply voltage to the emulator
TDI	Target voltage sense
TDO	Tap RESET, RESET signal for JTAG chain
TMS	Test Data Input, data signal from debugger to target
TRST	Test Mode Select, mode select signal from emulator to target
SRST	Test Clock, clock signal from emulator to target
VCC	Test Data Output, data signal from target to debugger.
Vref	Target RESET signal
GND	Ground

JTAG programmer/debugger may be found on page:
- ARMCable I: http://www.propox.com/products/t_122.html

LED diodes and „SAMBA" jumper

MMnet1001 module contains four LED diodes: Power supply LED, two LED's for Ethernet , and user LED connected to PC15 pin.

To PC15 pin JP1 „SAMBA" jumper is also connected. When this jumper is closed, it is possible to enter SAMBA bootloader in case when software upgrade is needed and it can't be done from operating system level.

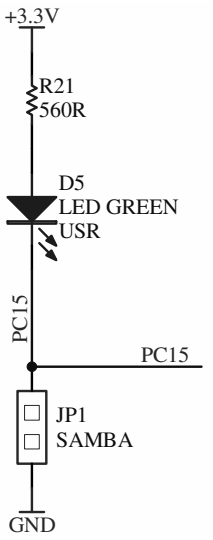


Figure 12 USR LED diode and SAMBA jumper.

Battery backup

AT91SAM9260 (AT91SAM9G20) contain RTC clock and 16 bytes of memory with battery backup possibility. CR2032 battery can be mounted don module if necessary, if not, R53 resistor should be mounted instead.

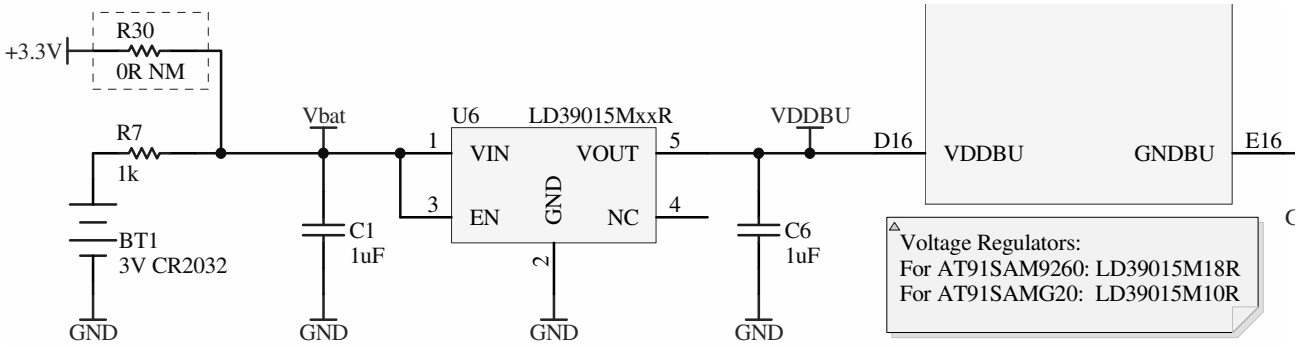


Figure 13 Battery backup power supply.

Power supply

MMnet1002 require external power supply in range 8 – 40V DC or 8 – 24V AC. Supply voltage can be led to standard connector 2.1mm/5mm or to „terminal block" type connector (chosen while ordering). Power can be also supplied through J12 connector (only DC in this case).

3.3V and 5V voltages are generated by onboard switching regulators that ensures high efficiency and low heat generation. Output current capability of 3.3V supply is 1A, where 0.5A should be reserved for module and remaining 0.5A can be used to supply devices connected to module (through J1, J2 and J12 connectors). 5V power supply can also deliver 1A and is intended to supply devices connected to USB bus. This voltage can also be used to supply devices connected to J1, J2 and J12 connectors provided that USB devices are not used or require less power than maximum.

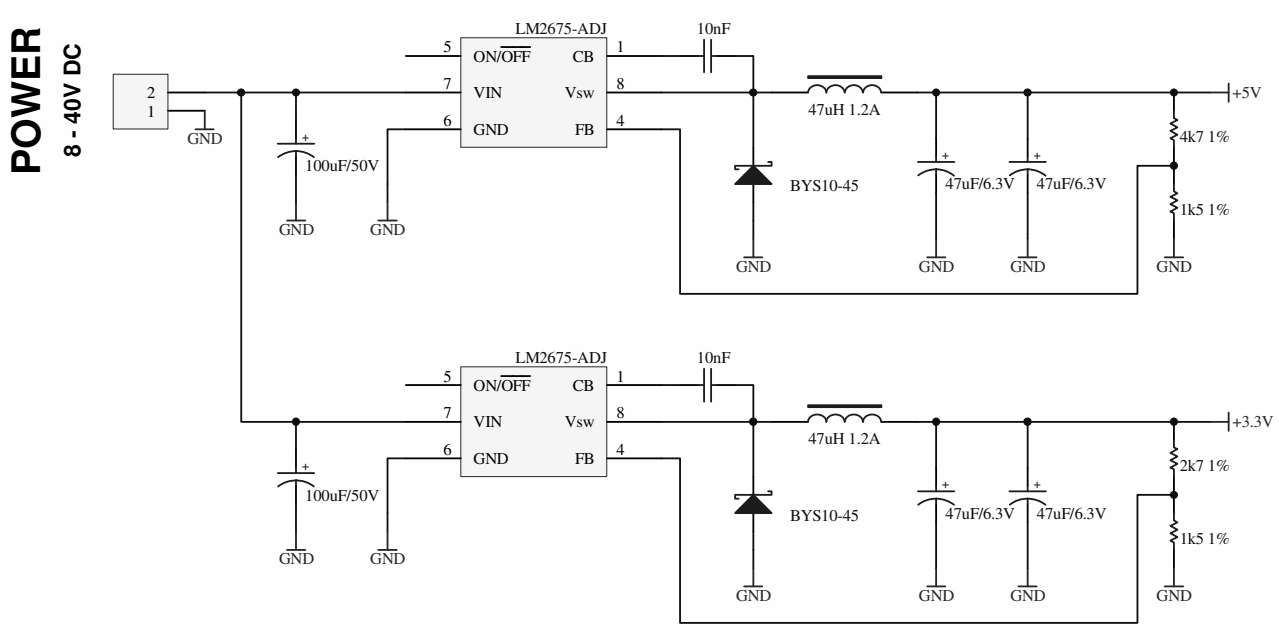


Figure 14 Example of Power supply for MMnet1001.

Placement of configuration resistors

Below are grouped functions of resistors and their placement is presented:

Resistor	Default	Function
R28	Mounted	When this resistor is unsoldered NAND Flash memory is disabled.
R47	Mounted	When this resistor is unsoldered DataFlash memory is disconnected from SPI bus.
R29	Not mounted	When this resistor is mounted NAND Flash memory is protected from writing data.
R46	Not mounted	When this resistor is mounted DataFlash memory is protected from writing data.
R30	Not mounted	If battery is not mounted on the module, this resistor should be mounted.
R21	Mounted	When this resistor is unsoldered USR LED diode is disconnected from PC15 pin.

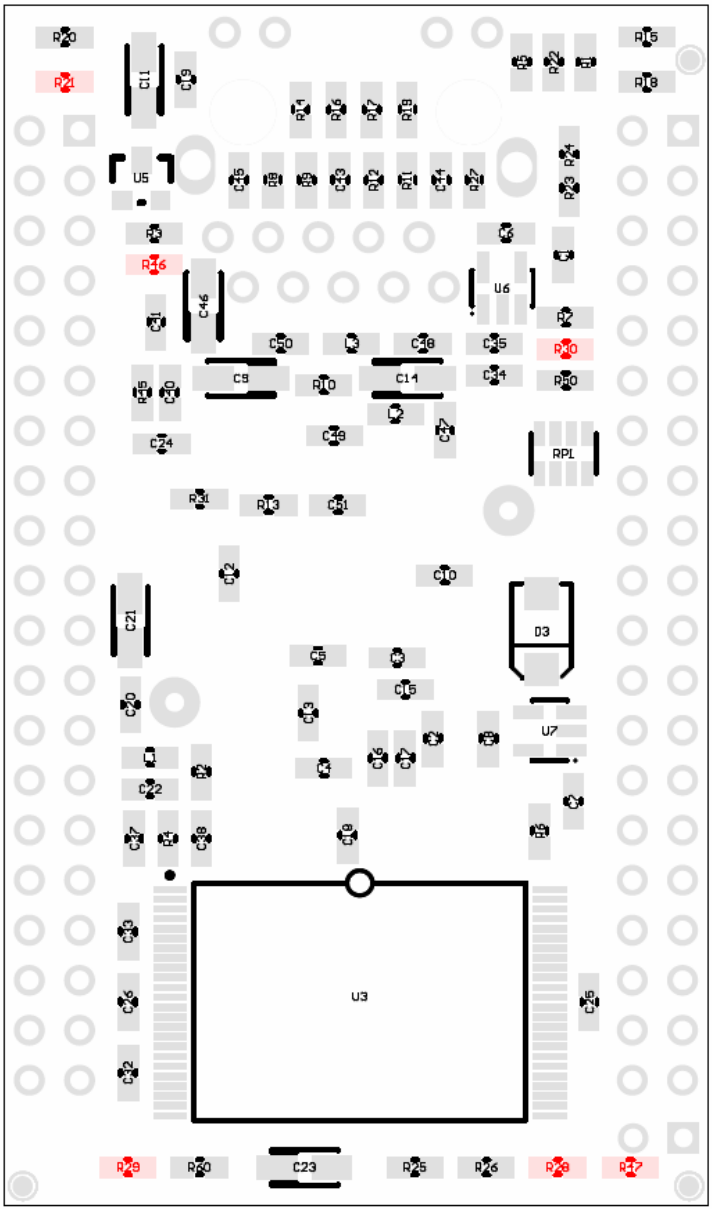


Figure 15 Placement of configuration resistors on bottom side of the board.

3 Specifications

Microcontroller	AT91SAM9260 / AT91SAM9G20
NAND Flash memory	1GB by default
SDRAM memory	64MB by default
DataFlash memory	Up to 4MB
No. of digital I/O	Up to 60
No. of analog inputs	Up to 6
Ethernet	10/100 Mb/s Auto-MDIX, onboard RJ45 connector
Power supply	3.3V
Maximum power consumption	1.5W
Dimensions	36x61mm
Weight	ok. 25g
Operating temperature range	-20 – 85ºC
Humidity	5 – 95%
Connectors	RJ45 (Ethernet) Two 2x40 headers

4 Technical assistance

In order to obtain technical assistance please contact support@propox.com . In the request please include the following information:

- number of the module version (e.g. REV 1)
- setting of resistors
- a detailed description of the problem

5 Guarantee

The MMlpc213x minimodule is covered by a six-month guarantee. All faults and defects not caused by the user will be removed at the Producer's cost. Transportation costs are borne by the buyer.

The Producer takes no responsibility for any damage and defects caused in the course of using the MMlpc213x module.

6 Assembly drawings

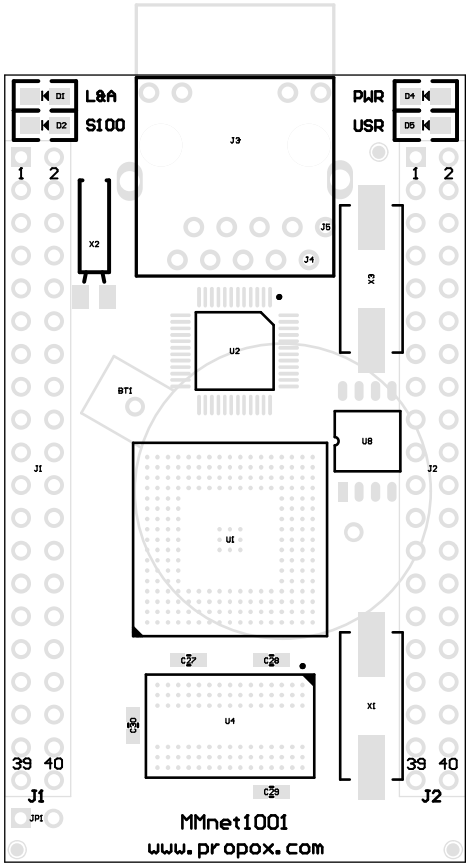


Figure 16 Assembly drawing – top layer.

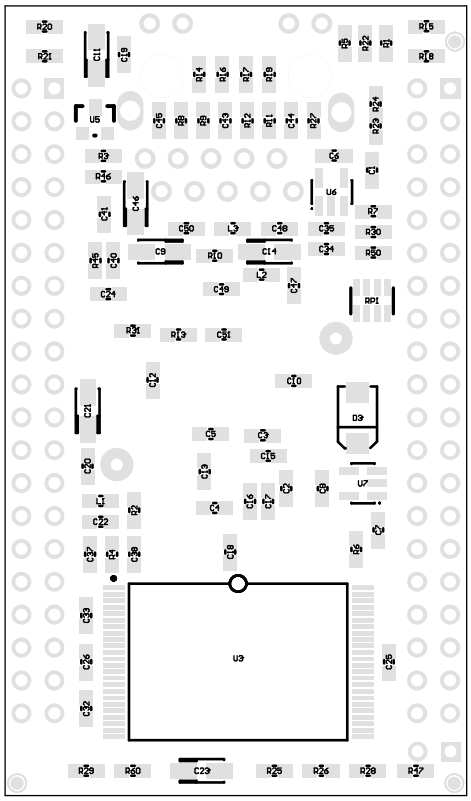


Figure 17 Assembly drawing – bottom layer.

7 Dimensions

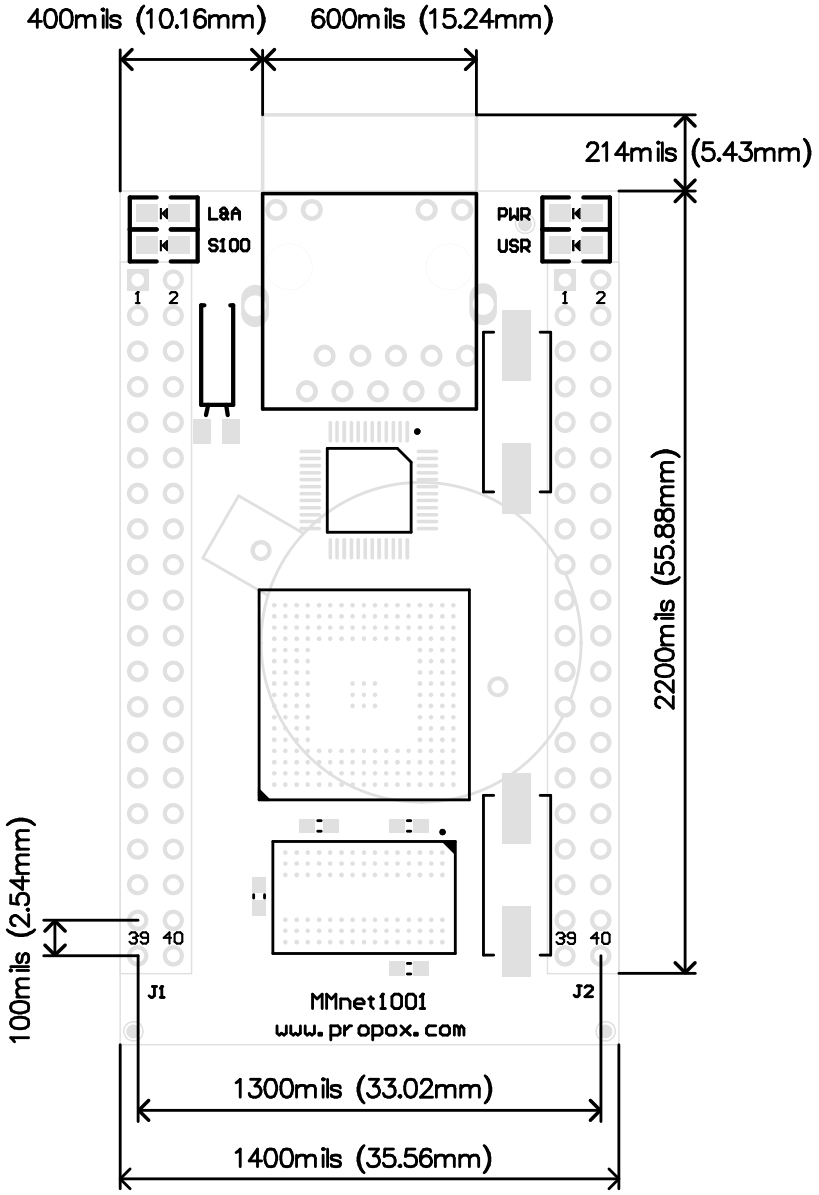
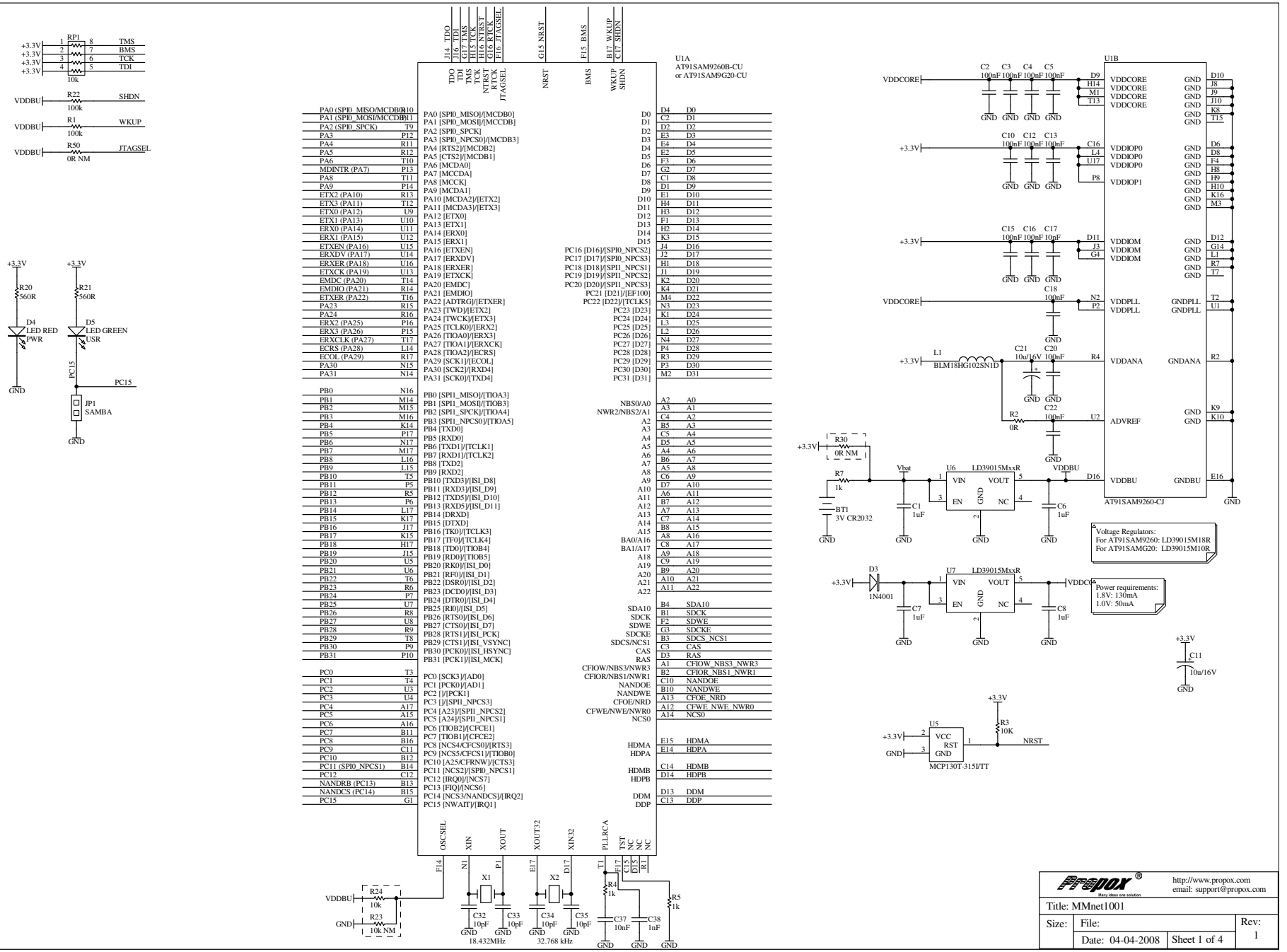


Figure 18 Dimensions – top view.

Figure 19 Dimensions – side view.

8 Schematics


RP1
TMS
BMS
TCK
TDI
10k
R22
SHDN
100k
R1
WKUP
100k
R50
JTAGSEL
0R NM
D4
LED RED
PWR
D5
LED GREEN
USR
R20
560R
R21
560R
PC15
JP1
SAMBA
U1A
AT91SAM9260B-CU
or AT91SAM9G20-CU
PA0 (SPI0_MISO/MCDB0)
PA1 (SPI0_MOSI/MCCDB)
PA2 (SPI0_SPCK)
PA3 (SPI0_NPCS0)/[MCDB3]
PA4 [RTS2]/[MCDB2]
PA5 [CTS2]/[MCDB1]
PA6 [MCDA0]
PA7 [MCCDA]
PA8 [MCCK]
PA9 [MCDA1]
PA10 [MCDA2]/[ETX2]
PA11 [MCDA3]/[ETX3]
PA12 [ETX0]
PA13 [ETX1]
PA14 [ERX0]
PA15 [ERX1]
PA16 [ETXEN]
PA17 [ERXDV]
PA18 [ERXER]
PA19 [ETXCK]
PA20 [EMDC]
PA21 [EMDIO]
PA22 [ADTRG]/[ETXER]
PA23 [TWD]/[ETX2]
PA24 [TWCK]/[ETX3]
PA25 [TCLK0]/[ERX2]
PA26 [TIOA0]/[ERX3]
PA27 [TIOA1]/[ERXCK]
PA28 [TIOA2]/[ECRS]
PA29 [SCK1]/[ECOL]
PA30 [SCK2]/[RXD4]
PA31 [SCK0]/[TXD4]
PB0 [SPI1_MISO]/[TIOA3]
PB1 [SPI1_MOSI]/[TIOB3]
PB2 [SPI1_SPCK]/[TIOA4]
PB3 [SPI1_NPCS0]/[TIOA5]
PB4 [TXD0]
PB5 [RXD0]
PB6 [TXD1]/[TCLK1]
PB7 [RXD1]/[TCLK2]
PB8 [TXD2]
PB9 [RXD2]
PB10 [TXD3]/[ISI_D8]
PB11 [RXD3]/[ISI_D9]
PB12 [TXD5]/[ISI_D10]
PB13 [RXD5]/[ISI_D11]
PB14 [DRXD]
PB15 [DTXD]
PB16 [TK0]/[TCLK3]
PB17 [TF0]/[TCLK4]
PB18 [TD0]/[TIOB4]
PB19 [RD0]/[TIOB5]
PB20 [RK0]/[ISI_D0]
PB21 [RF0]/[ISI_D1]
PB22 [DSR0]/[ISI_D2]
PB23 [DCD0]/[ISI_D3]
PB24 [DTR0]/[ISI_D4]
PB25 [RI0]/[ISI_D5]
PB26 [RTS0]/[ISI_D6]
PB27 [CTS0]/[ISI_D7]
PB28 [RTS1]/[ISI_PCK]
PB29 [CTS1]/[ISI_VSYNC]
PB30 [PCK0]/[ISI_HSYNC]
PB31 [PCK1]/[ISI_MCK]
PC0 [SCK3]/[AD0]
PC1 [PCK0]/[AD1]
PC2 [J]/[PCK1]
PC3 [J]/[SPI1_NPCS3]
PC4 [A23]/[SPI1 _NPCS2]
PC5 [A24]/[SPI1 _NPCS1]
PC6 [TIOB2]/[CFCE1]
PC7 [TIOB1]/[CFCE2]
PC8 [NCS4/CFCS0]/[RTS3]
PC9 [NCS5/CFCS1]/[TIOB0]
PC10 [A25/CFRNW]/[CTS3]
PC11 [NCS2]/[SPI0_NPCS1]
PC12 [IRQ0]/[NCS7]
PC13 [FIQ]/[NCS6]
PC14 [NCS3/NANDCS]/[IRQ2]
PC15 [NWAIT]/[IRQ1]
TDO
TDI
TMS
TCK
NTRST
RTCK
JTAGSEL
NRST
BMS
WKUP
SHDN
D0
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
D13
D14
D15
PC16 [D16]/[SPI0_NPCS2]
PC17 [D17]/[SPI0_NPCS3]
PC18 [D18]/[SPI1_NPCS1]
PC19 [D19]/[SPI1_NPCS2]
PC20 [D20]/[SPI1_NPCS3]
PC21 [D21]/[EF100]
PC22 [D22]/[TCLK5]
PC23 [D23]
PC24 [D24]
PC25 [D25]
PC26 [D26]
PC27 [D27]
PC28 [D28]
PC29 [D29]
PC30 [D30]
PC31 [D31]
NBS0/A0
NWR2/NBS2/A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
A14
A15
BA0/A16
BA1/A17
A18
A19
A20
A21
A22
SDA10
SDCK
SDWE
SDCKE
SDCS/NCS1
CAS
RAS
CFIOW/NBS3/NWR3
CFIOR/NBS1/NWR1
NANDOE
NANDWE
CFOE/NRD
CFWE/NWE/NWR0
NCS0
HDMA
HDPA
HDMB
HDPB
DDM
DDP
OSCSEL
XIN
XOUT
XOUT32
XIN32
PLLRCA
TST
NC
NC
NC
R24
10k
R23
10k NM
X1
18.432MHz
X2
32.768 kHz
R4
1k
R5
1k
C32
10pF
C33
10pF
C34
10pF
C35
10pF
C37
10nF
C38
1nF
U1B
AT91SAM9260-CJ
VDDCORE
VDDIOP0
VDDIOP1
VDDIOM
VDDPLL
VDDANA
ADVREF
VDDBU
GND
GNDPLL
GNDANA
GNDBU
C2
C3
C4
C5
100nF
C10
C12
C13
C15
C16
C17
10uF
C18
C20
C21
10u/16V
C22
L1
BLM18HG102SN1D
R2
0R
R30
0R NM
R7
1k
BT1
3V CR2032
Vbat
U6
LD39015MxxR
VIN
VOUT
EN
NC
C1
1uF
C6
1uF
Voltage Regulators:
For AT91SAM9260: LD39015M18R
For AT91SAMG20: LD39015M10R
D3
1N4001
U7
C7
1uF
C8
1uF
Power requirements:
1.8V: 130mA
1.0V: 50mA
C11
10u/16V
U5
MCP130T-315I/TT
VCC
RST
R3
10K
NRST
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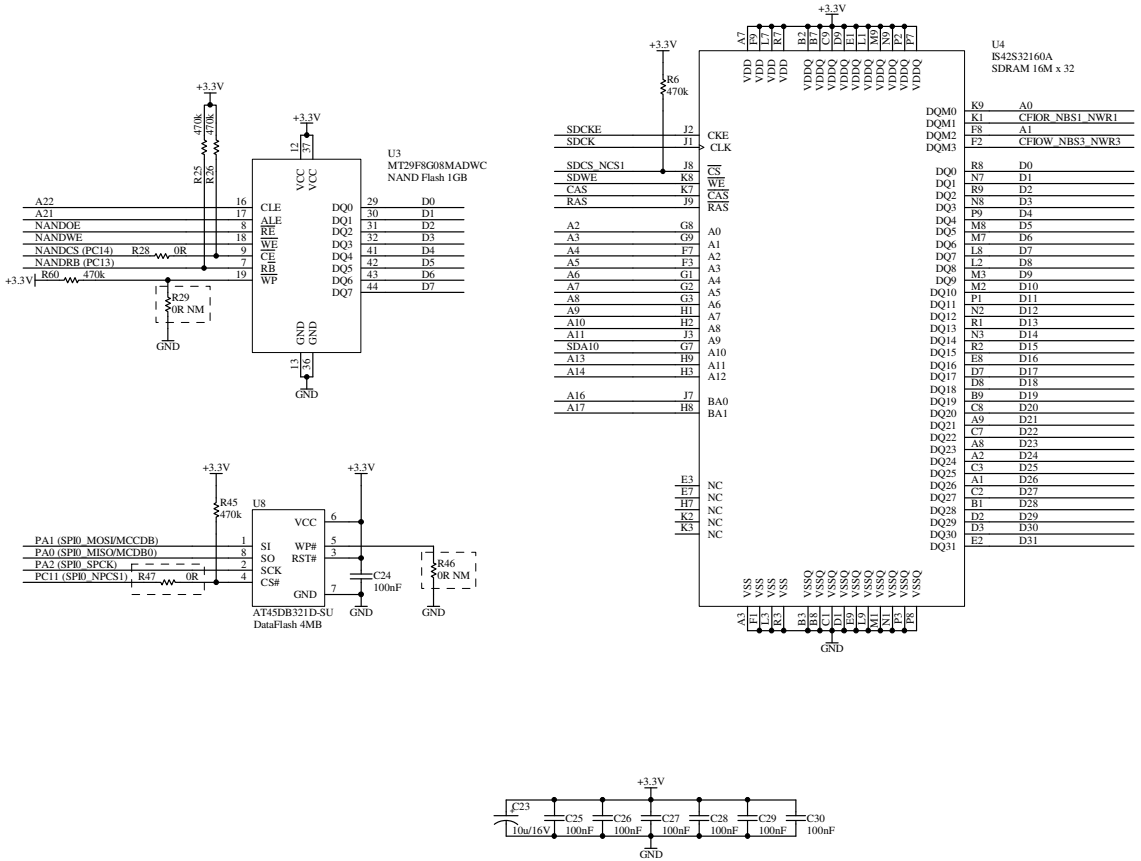

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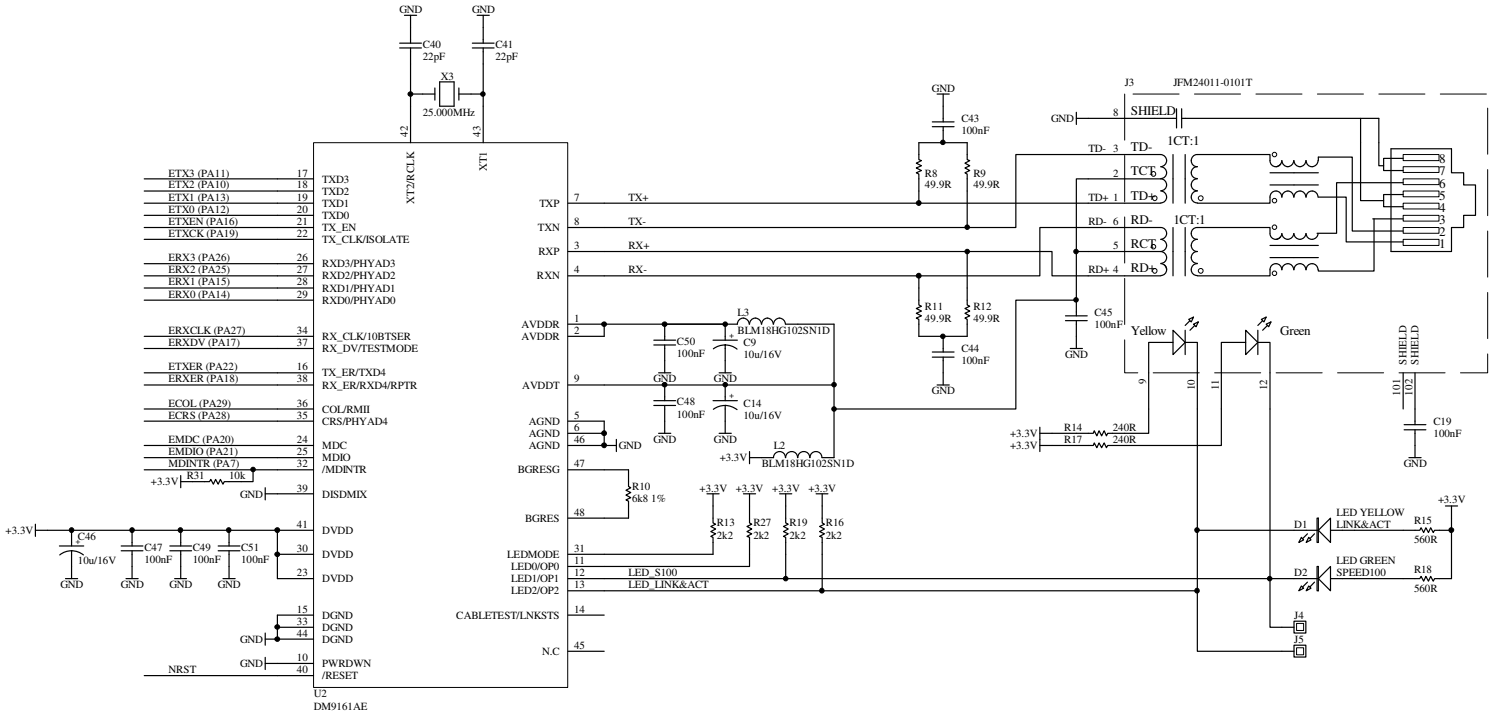

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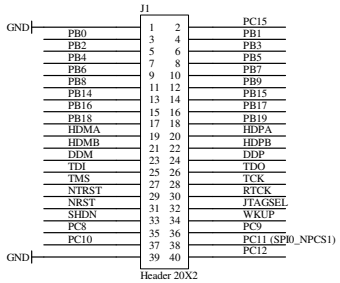
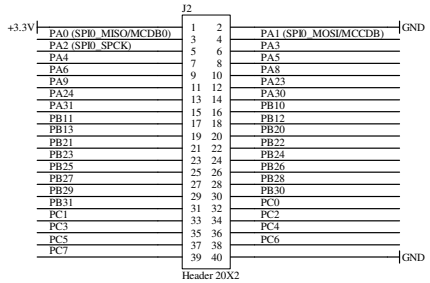
	Date: 04-04-2008	Sheet 3 of 4	





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