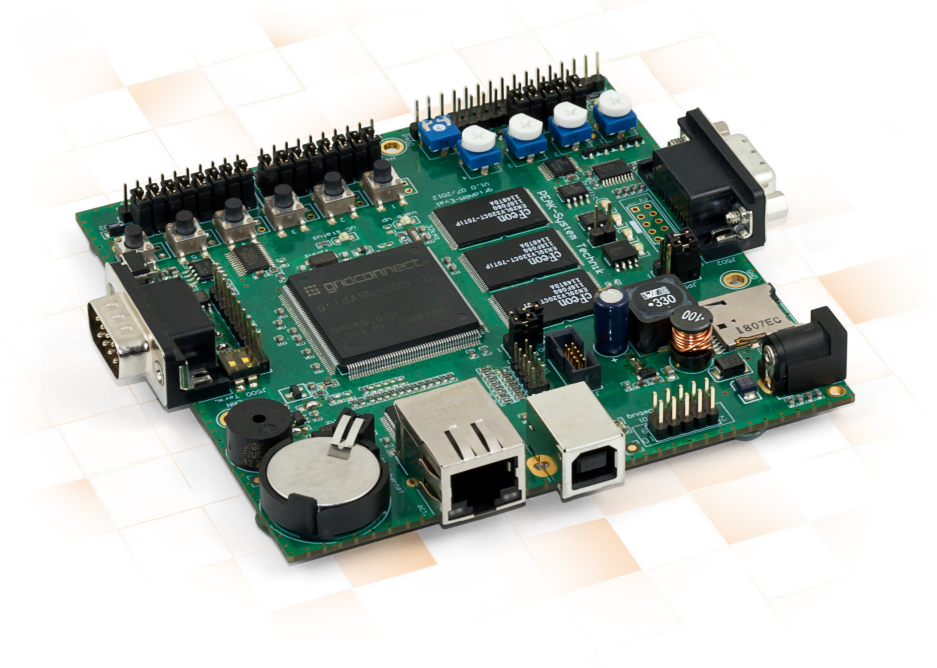
PEAK-gridARM Eval Board

Linux-based Development Platform for the gridARM™ Microcontroller

Hardware Manual



Document version 1.1.1 (2014-03-03)

Products taken into account

Product Name	Model	Part number
PEAK-gridARM Evaluation Board		IPEH-004051

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Contents

1 Introduction

Grid Connect[1] has developed the ARM7™ microcontroller gridARM™ as SoC solution aiming for embedded applications in the field of industrial communication. The PEAK-gridARM evaluation board is a Linux-based development platform for the gridARM microcontroller. It has connectors for Gigabit Ethernet, High-speed CAN, USB 2.0, RS-232, SPI, and I^2C. Digital and analog inputs of the evaluation board are manipulated by push buttons and potentiometers. The microcontroller state as well as the states for supply and data traffic are indicated by LEDs. A Board Support Package (BSP) for Linux gives access to the hardware resources of the PEAK-gridARM evaluation board.

The gridARM™ microcontroller by the U.S. company Grid Connect is distributed in Europe exclusively by PEAK-System.

This manual describes the evaluation board's hardware and first steps with it. Please refer to the following documents for further information:

- PEAK-gridARM Evaluation Board - Linux BSP - User’s Guide: developer documentation of the Board Support Package for Linux
- gridARM - Hardware Data Sheet[2]: documentation about the microcontroller

[1] http://gridconnect.com

[2] http://gridconnect.com/media/documentation/grid_connect/gridARM_Hardware_DS.pdf

1.1 Properties at a Glance

- ARM7 gridARM microcontroller (80 MHz)
- Linux operating system (version 2.6.36)
- 4 MByte NOR flash with 16-bit data bus access
- 8 MByte NOR flash with 32-bit data bus access
- 64 MByte SDRAM with 32-bit data bus access
- I^2C EEPROM for device configuration
- 4 MByte SPI flash
- Memory card slot for additional memory capacity
- Real-time clock (RTC) with battery
- Two alternative JTAG sockets
- Push button for hardware reset
- Voltage supply via USB or an external power supply unit (8 - 30 V)
- Dimensions: 110 x 110 mm
- Additional HD44780-compatible text display can be connected, availability on request

Communication

- Gigabit Ethernet (10/100/1000 Mbit/s)
- High-speed CAN channel (ISO 11898-2) with bit rates up to 1 Mbit/s
- Connection via D-Sub, 9-pin (in accordance with CiA® 102)
- NXP CAN transceiver PCA82C251
- USB 2.0 Full-speed (USB Device Port)
- Two RS-232 ports for debugging and terminal access

- SPI bus (1 MHz) for two external extensions
- I²C bus (400 kHz) for external extensions

Inputs and outputs

- 8 digital inputs, occupied with 6 push buttons, an RTC alarm, and memory card detection
- 8 digital outputs, occupied with 7 LEDs and a buzzer
- 5 analog inputs, occupied with 4 potentiometers
- Optional use of I/O ports with external wiring via jumpers
- LEDs for µC status, supply, CAN, and RS-232

1.2 Prerequisites for Operation

- PC with USB port for the power supply, alternatively, DC source 8 to 30 V with barrel connector

Optionally for development:

- RS-232 port at the PC and null-modem cable (D-Sub 9 f-f) for terminal access
- Linux operating system recommended for the PC

1.3 Scope of Supply

- PEAK-gridARM Evaluation Board
- USB connection cable (type B)
- Flat ribbon cable for RS-232 debugging port to D-Sub 9 m

- Software and documentation
  - µClinux-dist development environment and toolchain
  - Board Support Package (BSP) for Linux with sources and binaries
  - Hardware manual with circuit diagrams, BSP user guide (both PDF)

2 Startup Procedure

The chapter describes the startup of the PEAK-gridARM Evaluation Board by applying a supply voltage. The startup process can be observed on a PC via a serial connection.

Afterwards, the setup of the date and time is described.

Note: This startup procedure is referring to the Linux image being present in the memory at delivery of the evaluation board.

In addition to the scope of supply you need:

- PC with USB port for the voltage supply
- RS-232 port at the PC
- null-modem cable (D-Sub 9 f-f)
- terminal emulation program

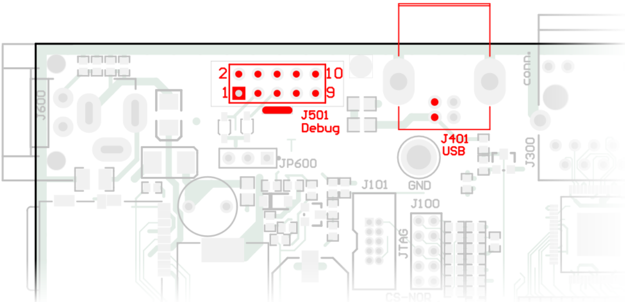
2.1 Starting the Board

Attention! Electrostatic discharge (ESD) can damage or destroy components on the PEAK-gridARM Evaluation Board. Take precautions to avoid ESD when handling the board.

Do the following to start the evaluation board and to observe the startup process:

1. Place the board on a flat, clean, and dry surface.
2. Plug the supplied flat ribbon cable onto the double pin header “J501 Debug” on the board. The strand marked red

must be on the side of pins 1 and 2 of the double pin header.



RS-232 Debug (J501, left), USB (J401, right)

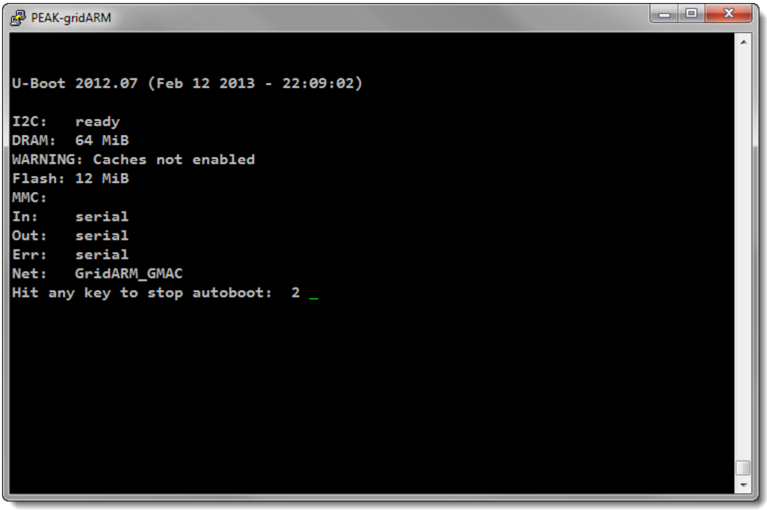
3. Use a null-modem cable (not included in the scope of supply) in order to connect the RS-232 port of the PC with the flat ribbon cable.
4. On your PC, start a terminal emulation program that establishes a connection to the evaluation board via the RS-232 interface (e.g. COM1 in Windows or ttyS0 in Linux). For this use the following connection parameters:
   - 38,400 bit/s
   - 8 data bits, no parity, 1 stop bit (8N1)
   - No hardware or software handshake
5. Use the supplied USB cable to make a connection between the powered-on PC and the "J401 USB" connector on the board.

   This establishes the voltage supply of the board.

Note: If you use another USB cable instead of the supplied one, it may happen that a cheap version doesn't have an appropriate wire cross section for proper voltage supply. Possibly, the evaluation board does not start then.

Startup Sequence

At delivery, the PEAK-gridARM Evaluation Board is supplied with the U-Boot bootloader and with a Linux image with Kernel 2.6.36, both being started in succession.



U-Boot bootloader with 3-second countdown
until the automatic Linux boot sequence

```
PEAK-gridARM

U-Boot 2012.07 (Feb 12 2013 - 22:09:02)

I2C:   ready
DRAM:  64 MiB
WARNING: Caches not enabled
Flash: 12 MiB
MMC:
In:    serial
Out:   serial
Err:   serial
Net:   GridARM_GMAC
Hit any key to stop autoboot:  0
## Booting kernel from Legacy Image at 20000000 ...
   Image Name:   Linux-2.6.36
   Created:      2013-02-22   7:33:02 UTC
   Image Type:   ARM Linux Kernel Image (uncompressed)
   Data Size:    3704352 Bytes = 3.5 MiB
   Load Address: 20008000
   Entry Point:  20008000
   Verifying Checksum ... _
```

Start of the Linux boot sequence

```
PEAK-gridARM
gridarm_i2c gridarm_i2c: gridARM i2c bus driver.
mmc_spi spi0.1: SD/MMC host mmc0, no WP, no poweroff, cd polling
lcd-gpio GPIO Panel driver v0.2.0 loaded
gridarm_adc gridarm_adc: device registered irq=11 clk=5000000
TCP cubic registered
NET: Registered protocol family 17
can: controller area network core (rev 20090105 abi 8)
NET: Registered protocol family 29
can: raw protocol (rev 20090105)
can: broadcast manager protocol (rev 20090105 t)
input: gpio-keys as /devices/platform/gpio-keys/input/input0
rtc-m41t80 0-0068: setting system clock to 2013-08-09 12:58:52 UTC (1376053132)
eth0: Link now 100-FD
IP-Config: Guessing netmask 255.0.0.0
IP-Config: Complete:
     device=eth0, addr=77.0.0.0, mask=255.0.0.0, gw=255.255.255.255,
     host=77.0.0.0, domain=, nis-domain=(none),
     bootserver=255.255.255.255, rootserver=255.255.255.255, rootpath=
Freeing init memory: 1432K
starting pid 30, tty '': '/etc/rc'
gridarm_can gridarm_can: BRP=10 SJW=1 PROP_SEG=6 PHASE_SEG1=7 PHASE_SEG2=2
gridarm_can gridarm_can: writing GA_BR: 0x00090561
starting pid 50, tty '/dev/ttyS0': '/bin/sh'
/ # _
```

Bottom: Linux prompt after the finished boot sequence

After a successful boot sequence, the µC status LED on the evaluation board blinks with the rhythm of a heartbeat signal (blink - blink - pause).

Tip: The pre-installed Linux image is provided with several demo scripts. One starts automatically after the boot sequence and activates the seven LEDs at the digital outputs one after another. More information about the scripts in section 2.3 on page 14.

At the Linux prompt (current path with number sign #), you can now enter and execute commands.

2.2 Setting Date and Time

We recommend to check the system date and time and to correct it if needed after the first start.

Check the date and time by entering the following command at the Linux prompt:

```
date
```

Note the time zone in the output. The default is UTC (Coordinated Universal Time). Accordingly, you must then specify the new time for this time zone.

If required, enter a new time with the following two commands. This sets the system time in a first step and then applies the set time to the real-time clock.

```
date YYYY-MM-DD hh:mm[3]
hwclock --systohc
```

[3] YYYY: year, MM: month, DD: day, hh: hour, mm: minute
Alternatively, you can enter only the time with hh:mm.

Even after disconnecting the supply voltage, the real-time clock stays in function, because it is supplied by the button cell.

2.3 Demo Scripts

At delivery, the Linux image is provided with several demo scripts that illustrate the access possibilities to the periphery.

The scripts are located in the `/home/peak/demo/` directory.

2.3.1 LEDs at the Digital Outputs (led_demo, led_switch)

During boot, the `led_demo` script is started automatically. It activates the seven LEDs at the digital outputs one after another.

Do the following to stop the script:

1. Enter the following command:
   `ps`

   All currently running processes are listed.
2. Note the PID (process number) of the
   `/bin/sh demo/led_demo` entry.
3. Enter the following command:
   `kill -9` *`PID`*
   Replace PID with the previously noted number.

Using the `led_switch` script, you can **influence each LED**. It is called with parameters:

`led_switch` *`led`* `[on|off]`

led: `cpu, yellow:1, yellow:2, yellow:3, yellow:4, green:5, green:6, red:7`

Example (activating the yellow LED 3):

```
/home/peak/demo # ./led_switch yellow:3 on
```

2.3.2 Push Buttons at the Digital Inputs (btn_demo)

During boot, the `btn_demo` script is started automatically. On pressing button 1 or 2, it reacts with the transmission of a CAN message onto a connected CAN bus.

In the demo script, no function is assigned to the other four buttons.

You can stop the execution of the script according to the instructions in the previous subsection 2.3.1.

2.3.3 CAN Communication (can_demo)

During boot, the `can_demo` script is started automatically. It shows incoming CAN messages from a connected CAN bus in the debug terminal.

You can stop the execution of the script according to the instructions in the previous subsection 2.3.1.

To **transmit single CAN messages manually**, use the following command:

```
cansend can0 ID#Data
```

Example (CAN ID 12F, data bytes 45 67 89 AB):

```
/ # cansend can0 12F#456789AB
```

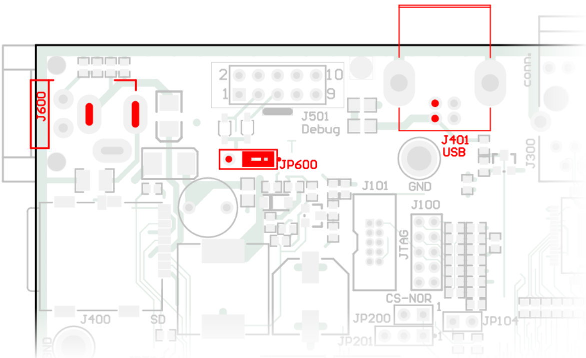
The Data Length Code (DLC, here: 4) is automatically determined from the number of given data bytes.

3 Elements on the Board

Attention! Electrostatic discharge (ESD) can damage or destroy components on the PEAK-gridARM Evaluation Board. Take precautions to avoid ESD when handling the board.

3.1 Supply Socket

The PEAK-gridARM Evaluation Board can either be supplied via the USB port (setting at delivery) or the supply socket. The supply path is determined by the jumper JP600.



Supply socket J600 (left), USB port J401 (top), jumper JP600 (center) for selection

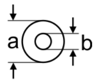
Jumper position JP600	Supply Eval Board via…
JP600 2-1*	USB port
JP600 3-2	Supply socket

* Setting at delivery

Important note: Never connect all three pins of the JP600 jumper together. The microcontroller and the USB interface of a connected PC can otherwise be destroyed by overvoltage.

For the supply socket, a DC source with barrel connector is needed (not part of the scope of supply), e.g. an AC adaptor.

Supply voltage:
12 V DC (8 - 30 V possible)



Diameter of barrel connector:
a = 5.5 mm, b = 2.1 mm;
minimum length: 11 mm

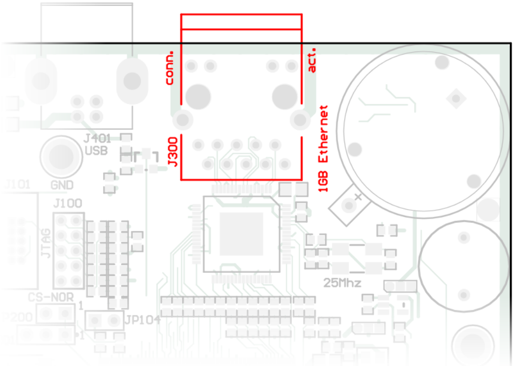
3.2 USB

The USB interface supports the USB 2.0 standard (UDP) with bit rates up to 12 Mbit/s (Full Speed).

With a USB connection to a PC, the **power supply** of the evaluation board can be taken on (setting at delivery). Alternatively, it is possible to use the separate supply socket (see section 3.1 on page 16).

3.3 Gigabit Ethernet

The Ethernet interface can be operated with 10 Mbit/s, 100 Mbit/s, and 1 Gbit/s. On the connector housing, there are two LEDs that indicate an established connection and transfer activity.

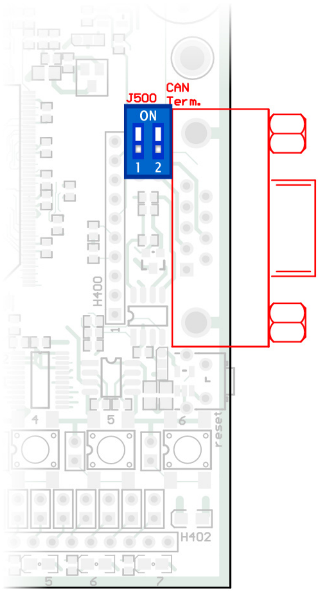


Ethernet connector

Besides basic communication purposes, the Ethernet interface can also be used for a firmware update.

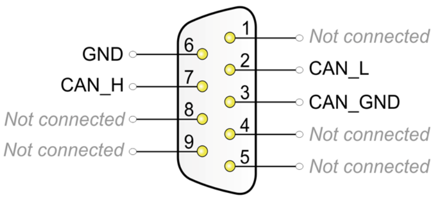
3.4 CAN

The CAN interface supports the two CAN formats 2.0A (Standard) and 2.0B (Extended). The NXP PCA82C251 transceiver leads out a High-speed CAN bus (ISO 11898-2), that allows bit rates up to 1 Mbit/s.



D-Sub CAN port J500 and switch block for the CAN termination

The bus is connected to the 9-pin **D-Sub** port. The pin assignment for CAN corresponds to the specification CiA® 102.

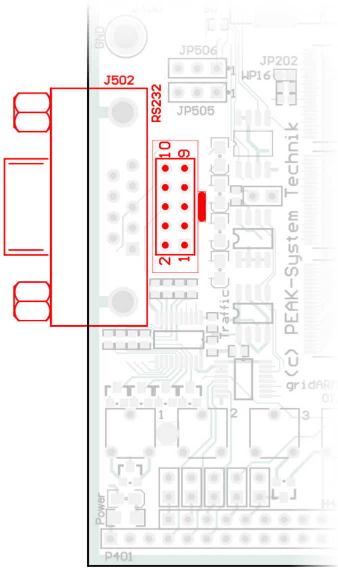


Assignment of the D-Sub port for CAN,
GND and CAN_GND are connected at delivery.

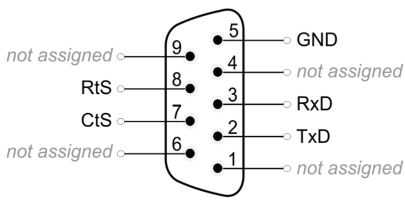
If the evaluation board is connected to the end of a CAN bus and this end isn't yet terminated, the **CAN termination** (120 Ω) available on the board can be activated. This is done by setting both switches of the switch block J500 to ON.

3.5 RS-232 Terminal

Via RS-232 (V.24 levels), the D-Sub port J502 provides a terminal access for administrative purposes. With a D-Sub extension cable (9-pin m-f, 1:1), a connection to a PC can be established. Alternatively, the RS-232 signals can be accessed via the pin header field J503 (not equipped).



RS-232 port J502 (D-Sub 9-pin),
J503 (pin header field not equipped) alternatively



Assignment of the D-Sub connector for RS-232 Terminal

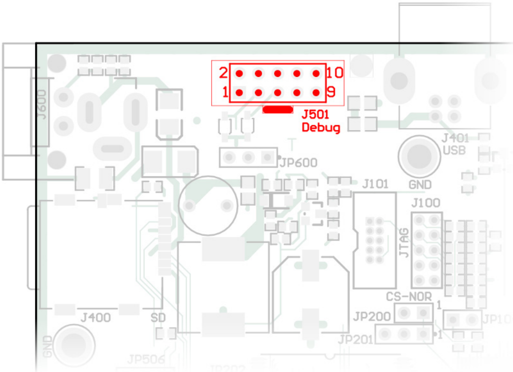
Function	Pin at J503
RxD	3
RtS	4
TxD	5
CtS	6
GND	9

3.6 RS-232 Debug

Via RS-232 (V.24 levels), the double pin header J501 provides debugging access. At delivery, the evaluation board is configured to route output of the bootloader and of the Linux environment and to receive input via this interface (see also 2.1 *Starting the Board* on page 9). For further information about debugging, see the Hardware Data Sheet of the gridARM microcontroller.

For a connection, the provided flat cable can be used. The connection to the PC is then done with a null modem cable (D-Sub 9 f-f).

Two LEDs can be used for the traffic indication for RxD and TxD. For the corresponding configuration, see 4.5 *Assigning Traffic LEDs* on page 35.

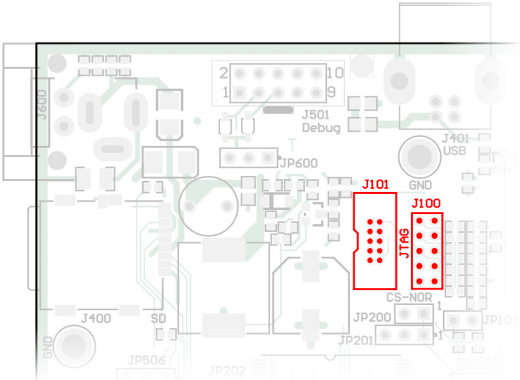


RS-232 port for debugging purposes.

Function	Pin at J501
RxD	3
TxD	5
GND	9

3.7 JTAG

For the development at the microcontroller, a JTAG interface with two connection possibilities is available. J100 is a 10-pin double pin header, J101 a 10-pin header socket with 1.27-mm grid.

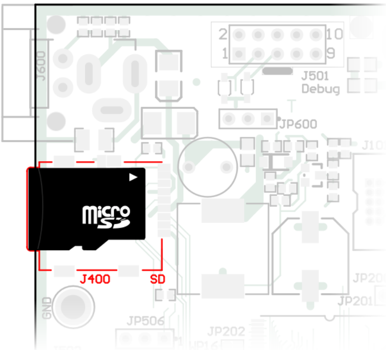


JTAG ports J100 (double pin header) and J101 (header socket)

Function	Pin at J100	Pin at J101
GND	1, 2	3, 5, 9
µC Reset	3	none
3.3 V	4	1
TCK	5	4
TMS	6	2
TDO	7	6
TDI	8	8
RTCK	9	none
TRST	10	10

3.8 microSD™ Slot

Among others, the microSD card can be used for system updates. It is connected to the gridARM microcontroller via the SPI bus.



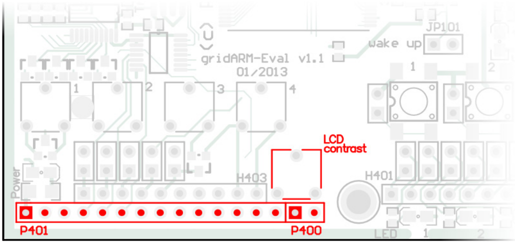
microSD slot J400

Note: A plugged-in microSD card blocks the communication with further devices that are connected to the SPI bus (e.g. internally connected: 4 MB Flash-ROM). Remove the microSD card in order to allow the communication with further devices again.

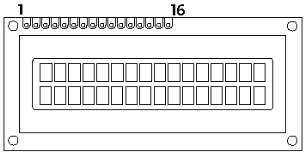
3.9 Text Display Connector

At P400 and P401, a HD44780-compatible LC text display can be connected. The pin assignment of such a display fits to the one on the evaluation board.

The LCD contrast can be adjusted with the corresponding potentiometer.



Pin headers P400 and P401 for a text display
and potentiometer for contrast adjustment

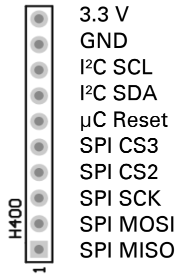


Connector pins of a text display

Pin at text display	Pin at P400/P401	Name	Level	Function
1	P401-1	Vss	GND	Ground
2	P401-2	Vdd	5 V or 3.3 V	Supply
3	P401-3	Vo	0 - 1.5 V	Contrast voltage
4	P401-4	RS	High/Low	Register Select
5	P401-5	R/W	High/Low	High: read, Low: write
6	P401-6	E	High	Enable
7	P401-7	D0	High/Low	Data 0 (LSB)
8	P401-8	D1	High/Low	Data 1
9	P401-9	D2	High/Low	Data 2
10	P401-10	D3	High/Low	Data 3
11	P401-11	D4	High/Low	Data 4
12	P401-12	D5	High/Low	Data 5
13	P401-13	D6	High/Low	Data 6
14	P401-14	D7	High/Low	Data 7 (MSB)
15	P400-1	LED+	5 V or 3.3 V	LED background light +
16	P400-2	LED-	GND	LED background light -

3.10 I^2C/SPI

Via the pin header H400, the signals of the communication busses I^2C and SPI can be accessed directly. The pin header is not equipped at delivery. The pins have the following functions:



Assignment of the connector H400 for I^2C and SPI

Attention! The pins are directly connected to the microcontroller and not protected. Incorrect use can cause damage to the microcontroller.

On the evaluation board, the I^2C bus internally connects the following peripherals with 400 kbit/s:

- System EEPROM (256 byte)
- Buzzer
- microSD card detection
- Real-time clock (RTC)
- RTC alarm input
- 7 freely available LEDs (see 3.11 on page 27)
- 6 freely available push buttons (see 3.11 on page 27)

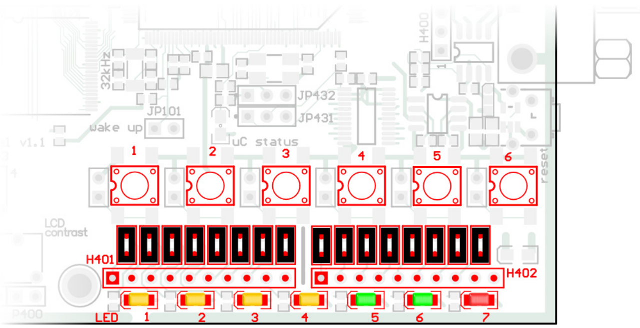
On the evaluation board, the SPI bus internally connects the following peripherals:

- microSD card
- 4 MByte flash ROM

3.11 Digital inputs and outputs

The I²C bus connects six push buttons, the detection of a microSD card, and the RTC alarm as digital inputs, and furthermore, seven LEDs and a buzzer as digital outputs. They can be disconnected separately from the inputs and outputs by opening the interconnected jumpers.

The inputs can be directly accessed via the pin header field H402, the outputs via H401.



Push buttons for digital inputs, LEDs for digital outputs,
jumpers for disconnection,
pin header fields H401 and H402 for direct access

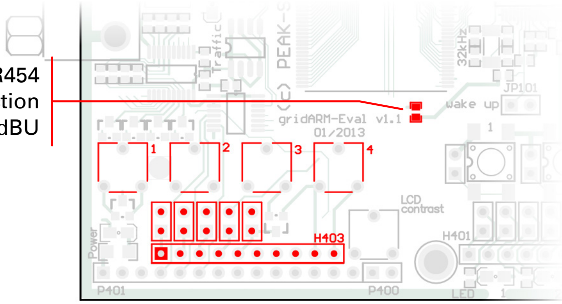
3.12 Analog Inputs

Five analog inputs are directly led out from the gridARM microcontroller. The reference voltage is 3.3 V. Four of the analog inputs are equipped with potentiometers.

A direct access to the analog inputs is provided by the pin header field H403. To do this, the potentiometers must be separated from the inputs by opening the interconnected jumpers.

Analog input 5 can optionally be used for measuring the VddBU voltage (button cell). To do this, the solder field R454 (see figure below) must be shortened by a solder jumper.

Solder field R454
for connection
µC AD4 to VddBU



Potentiometers for four analog inputs,
jumpers for disconnection, solder field R454,
pin header field H403 for direct access

Pin at H403	Function
1	Analog input 1 (µC AD0)
2	Analog input 2 (µC AD1)
3	Analog input 3 (µC AD2)
4	Analog input 4 (µC AD3)
5	Analog input 5 (µC AD4)
6	Not used
7	Not used
8	Not used

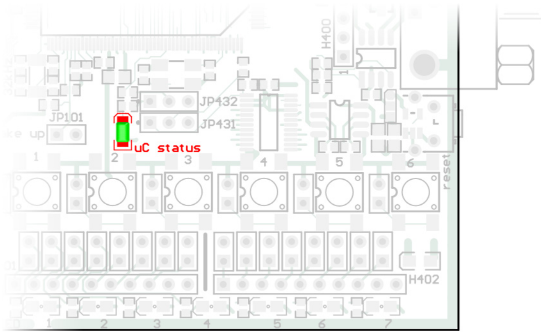
Pin at H403	Function
9	GND analog (at delivery connected to GND)
10	3.3 V analog

Attention! The pins are directly connected to the microcontroller and not protected. Incorrect use can cause damage to the microcontroller.

Note: The gridARM microcontroller is also available in a BGA package with **eight** analog inputs.

3.13 Status LED Microcontroller

At delivery, the “µC status” LED is connected to port PA15 of the gridARM microcontroller and it is freely programmable. For example, it can be used as heartbeat indicator.



Microcontroller status LED

If the LED doesn't react when controlled by Port PA15, this may be due to the jumper configuration (see 4.4 *Using Microcontroller LED or USB Detection* on page 34).

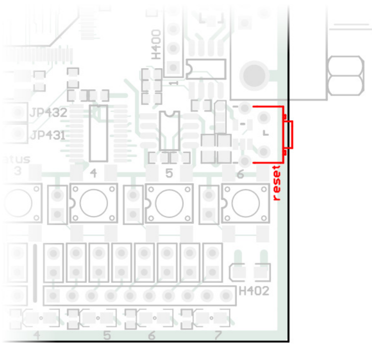
3.14 Real-Time Clock

The real-time clock is connected to the gridARM microcontroller via the I²C bus. It is buffered by the button cell if no supply voltage is applied (JP429 set to 3-2).

The alarm signal of the real-time clock can be read via the I/O module at the I²C bus (IO_B7).

3.15 Reset Push Button

Pressing the reset push button initiates a reboot of the PEAK-gridARM Evaluation Board.



Reset push button

4 Configuration

On the PEAK-gridARM Evaluation Board, several hardware functions can be configured:

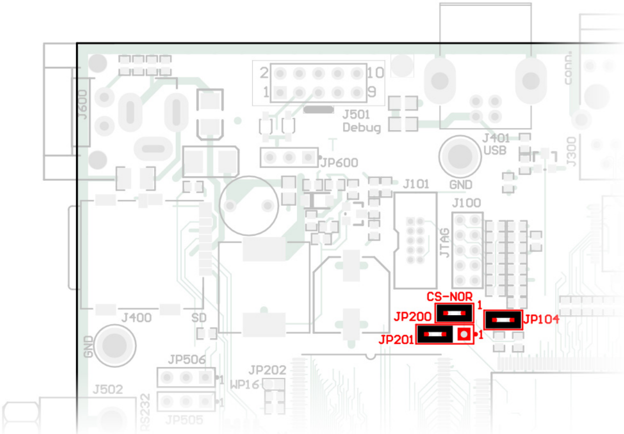
- Selecting the Boot Flash (below)
- Activating the Write Protection for the System EEPROM (on page 32)
- Using I/O Interrupt or microSD™ Card Detection (on page 33)
- Using Microcontroller LED or USB Detection (on page 34)
- Assigning Traffic LEDs (on page 35)
- Replacing the Button Cell for the Real-Time Clock (on page 37)

4.1 Selecting the Boot Flash

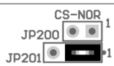
On start of the microcontroller a bootloader is loaded from either the 16-bit or the 32-bit NOR flash. This is determined by the jumpers JP200 and JP201.

The U-Boot bootloader can only be loaded from the 16-bit NOR flash.

If jumper JP104 is open (port BMS receives High signal), the bootloader contained in the gridARM microcontroller is started instead of an external one.



Jumpers JP200, JP201, and JP104

Jumper setting JP200 and JP201		NOR flash selection
	closed* 3-2*	16-bit at CS0 and 32-bit at CS2
	open 2-1	32-bit at CS0

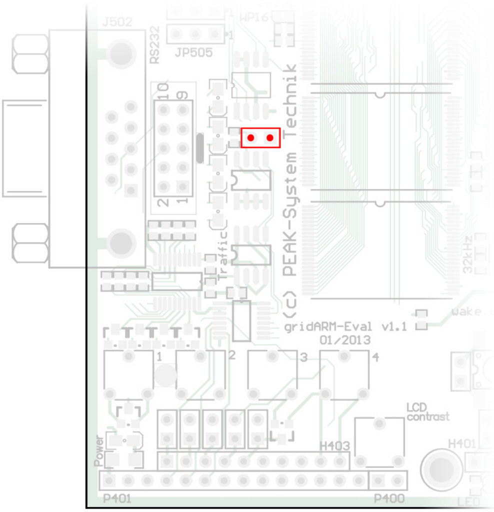
Jumper setting JP104		Bootloader
	open	Internal of the gridARM µC
	closed*	From external flash (CS0)

* Setting at delivery

4.2 Activating the Write Protection for the System EEPROM

The system EEPROM (256 Byte, I²C connection) can be write-protected with jumper JP430. In case of a microcontroller-internal boot, it contains the boot order in the first 128 bytes. If using the U-

Boot bootloader (setting at delivery), the system EEPROM is not needed and therefore completely available to the user.



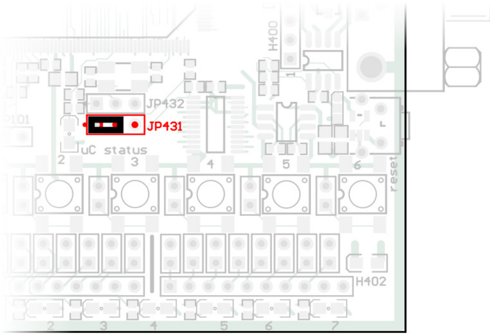
Jumper JP430

Jumper setting	Write protection
open*	deactivated
closed	activated

* Setting at delivery

4.3 Using I/O Interrupt or microSD™ Card Detection

Usually, the detection of a inserted microSD card is done via the I/O module at the I²C bus (IO_B6). If required, the PA02 port at the gridARM microcontroller can be used alternatively for this purpose. To do so, jumper JP431 must be set over. In that case, the interrupt line is disconnected from the I/O module and an interrupt signal is not available anymore.



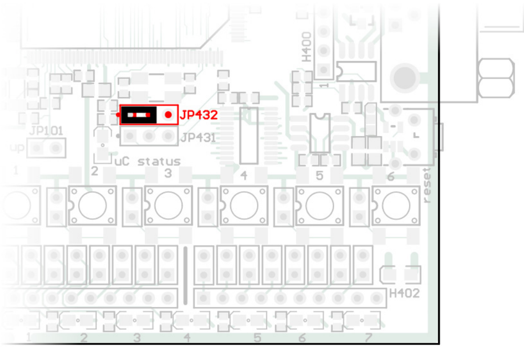
Jumper JP431

Jumper setting	Port PA02 connected to
JP431 1-2*	Interrupt I²C I/O
JP431 2-3	microSD card detection

* Setting at delivery

4.4 Using Microcontroller LED or USB Detection

Port PA15 of the gridARM microcontroller is assigned to the "µC Status" LED (D407) at delivery. Alternatively, port PA15 can be used as input for detection of a plugged USB cable at the evaluation board (not useful if supply is done via the USB port). To do so, jumper JP432 must be set over.



Jumper JP432

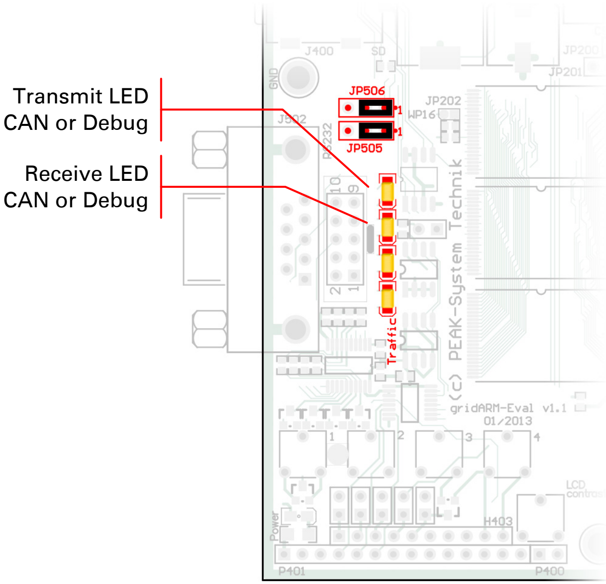
Jumper setting		Port PA15 connected to
JP432	1-2*	"µC Status" LED
JP432	2-3	USB detection

* Setting at delivery

4.5 Assigning Traffic LEDs

Two of the four traffic LEDs can be assigned either to the CAN communication or to the communication via RS-232 Debug. This is done with the jumpers JP505 and JP506.

The remaining two traffic LEDs are permanently assigned to the communication via RS-232 Terminal.



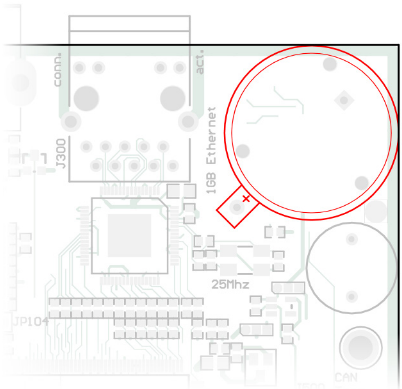
Jumpers JP505 and JP506 and traffic LEDs

Jumper setting		Traffic indication for…
JP506 JP505	2-1* 2-1*	CAN Tx CAN Rx
JP506 JP505	3-2 3-2	RS-232 Debug TxD RS-232 Debug RxD

* Setting at delivery

4.6 Replacing the Button Cell for the Real-Time Clock

The real-time clock (RTC) used by the evaluation board or the timer as part of the gridARM microcontroller are supplied by a button cell of the IEC type CR 2032 (3 V), as long as the evaluation board is turned off.



Button cell for the real-time clock

A new button cell lasts several years. If the real-time clock indicates an unexpected time, take out the button cell and measure its voltage. This should be around the nominal 3.0 Volts. If the measured voltage is lower than 2.5 Volts, you should replace the button cell with a fresh one.

Afterwards, the real-time clock must be set again.

5 Technical Specifications

Power supply	
Supply voltage	12 V DC nominal, 8 - 30 V possible
Current consumption (at 12 V)	U-Boot idling: 100 mA Linux kernel idling: 150 - 180 mA
Buffer battery for the real-time clock or VddBU	Button cell CR 2032, 3 V

gridARM microcontroller	
Processor	ARM7TDMI® 32-Bit
Voltages	Core: 1.3 V; I/O: 3.0 V
Clock frequency	80 MHz
On-chip memory	256 KByte masked ROM (Grid BIOS, boot code) 160 KByte SRAM
Interrupt handling	Advanced Interrupt Controller (AIC)
Manufacturing	130-nm technology
Packages	QFP 208-pin or BGA 225-pin, RoHS
Further technical specifications	See data sheets for the gridARM microcontroller[4]

Gigabit Ethernet	
Bit rates	10 Mbit/s, 100 Mbit/s, 1 Gbit/s
Phy	Micrel KSZ9021RLI (RGMII, MDIO/MDC)

CAN	
Specification	ISO 11898-2, High-speed CAN 2.0A (Standard format) and 2.0B (Extended format)
Bit rates	up to 1 Mbit/s
Transceiver	NXP PCA82C251
Termination	120 Ω, switchable on board

[4] http://gridconnect.com/media/documentation/grid_connect/GRIDARM_DS_01.pdf
http://gridconnect.com/media/documentation/grid_connect/gridARM_Hardware_DS.pdf

SPI Serial Flash ROM	
Size	4 MByte
SPI modes	0 and 3
Chip Erase Time	35 ms (typical)
Sector/Block Erase Time	18 ms (typical)
Byte Program Time	7 µs (typical)

Parallel Flash ROM	
Size	4 MByte, 16-bit 8 MByte, 32-bit
Interface	Common Flash Interface (CFI)
Access time	70 ns

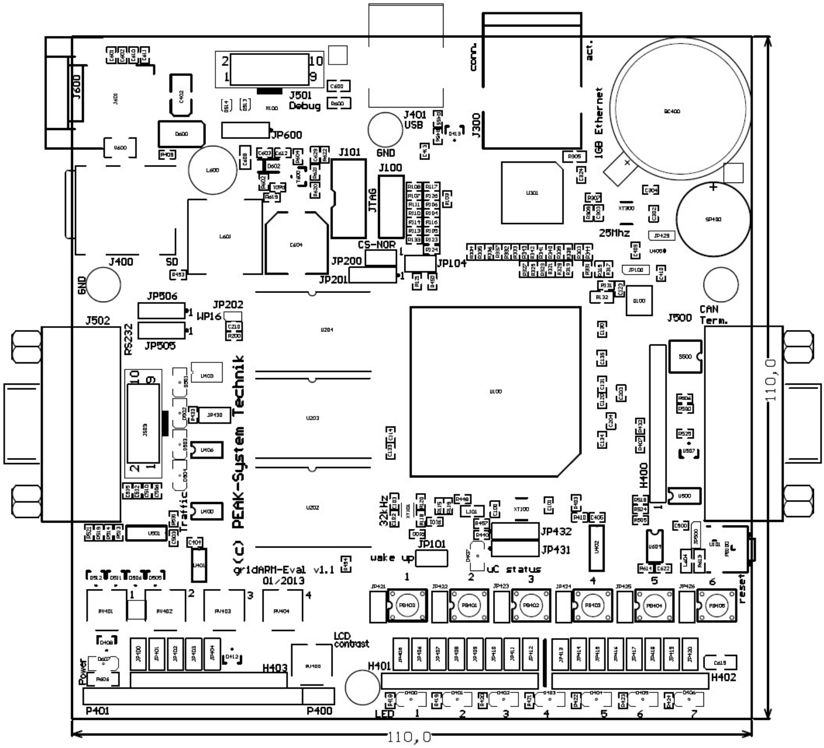
SDRAM	
Size	64 MByte, 32-bit
Organization	4 Mbit x 16 I/O x 4 bank
Timing	166 MHz 3-3-3 PC166
Cycle	6 ns

I/O	
Digital inputs (via I²C)	8: 6 push buttons, microSD card detection, RTC alarm
Digital outputs (via I²C)	8: 7 LEDs, 1 buzzer
Analog inputs	5: 5 potentiometers, 1 alternative for voltage measurement of the button cell
All I/Os	Also direct access possible

Measures	
Size	110 x 110 mm (L x W) See also dimension drawing Appendix A on page 40
Weight	125 g

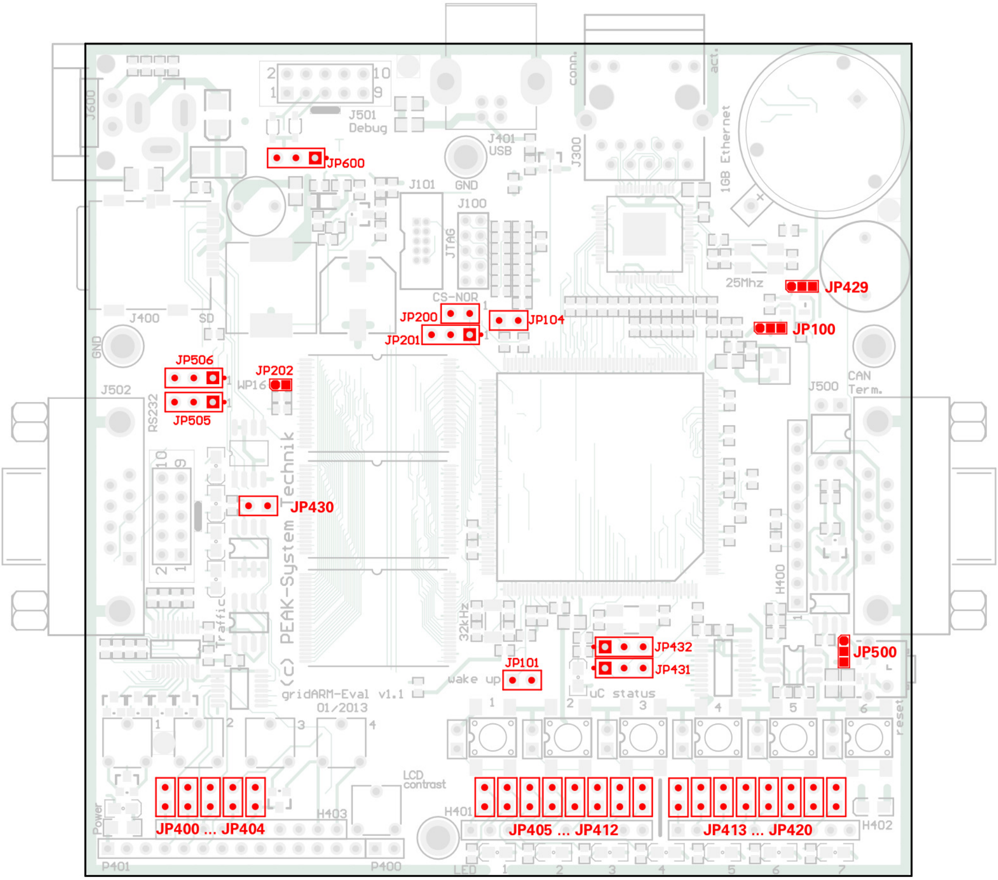
Environment	
Operating temperature	-40 - +85 °C (-40 - +185 °F)
Temperature for storage and transport	-40 - +100 °C (-40 - +212 °F)
Relative humidity	15 - 90 %, not condensing

Appendix A Dimension Drawing

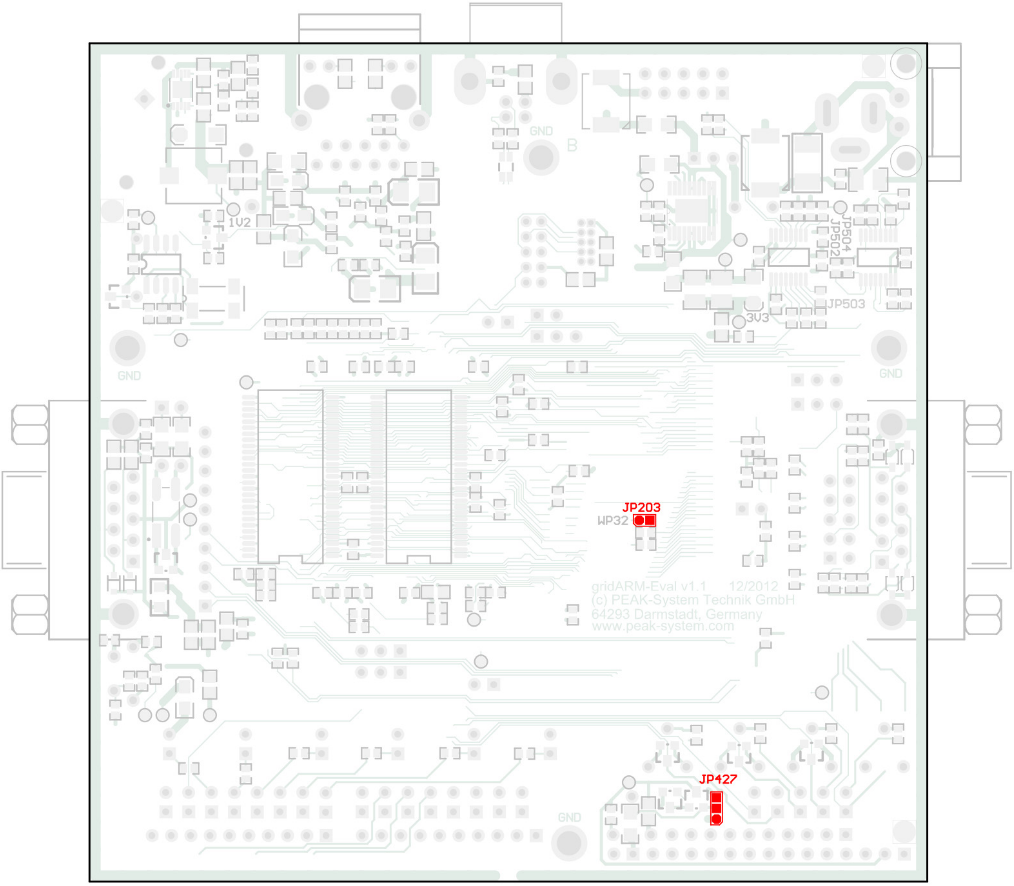


The figure does not show the original size.

Appendix B Jumpers Overview



Jumpers on the top side



Jumpers on the bottom side

Jumper	Setting	Function
JP100	1-2*	VddBU 1.2 V from the supply
	2-3	VddBU 1.2 V from the LDO/button cell (see JP429)
JP101	open*	Wake-up by switching between the two states
	closed	
JP104	open	Internal bootloader of the gridARM µC
	closed*	Boot from external flash (CS0)
JP200 + JP201	open + 1-2	32-bit NOR flash at CS0
	closed + 2-3*	16-bit NOR flash at CS0 and 32 bit NOR flash at CS2
JP202	open*	Boot block of 16-bit NOR flash writable
	closed	Boot block of 16-bit NOR flash write-protected
JP203	open*	Boot block of 32-bit NOR flash writable
	closed	Boot block of 32-bit NOR flash write-protected
JP400 - JP404	open	Analog inputs: external voltages on H403 pins 1 - 5 (0 - 3.3 V)
	closed*	Analog inputs: pots RV401 - RV404 (Do not apply external voltages!)
JP405 - JP411	open	Digital outputs A1 - A7: forwarding to H401 pins 1 - 7
	closed*	Digital outputs A1 - A7: LEDs D400 - D406 (Do not apply external voltages!)
JP412	open	Digital output A8: forwarding to H401 pin 8
	closed*	Digital output A8: beeper SP400 (Do not apply external voltages!)
JP413 - JP418	open	Digital inputs B1 - B6: external voltages on H403 pins 1 - 6 (0 - 3.3 V)
	closed*	Digital inputs B1 - B6: push buttons PB400 - PB405 (Do not apply external voltages!)
JP419	open	Digital input B7: external voltage on H402 pin 7 (0 - 3.3 V); tip: set JP431 to 2-3
	closed*	Digital input B7: microSD card detection via I²C I/O module
JP420	open	Digital input B8: RTC cannot trigger alarm
	closed*	Digital input B8: RTC alarm via I²C I/O module
JP427	1-2	Supply LC display 3.3 V
	2-3*	Supply LC display 5 V

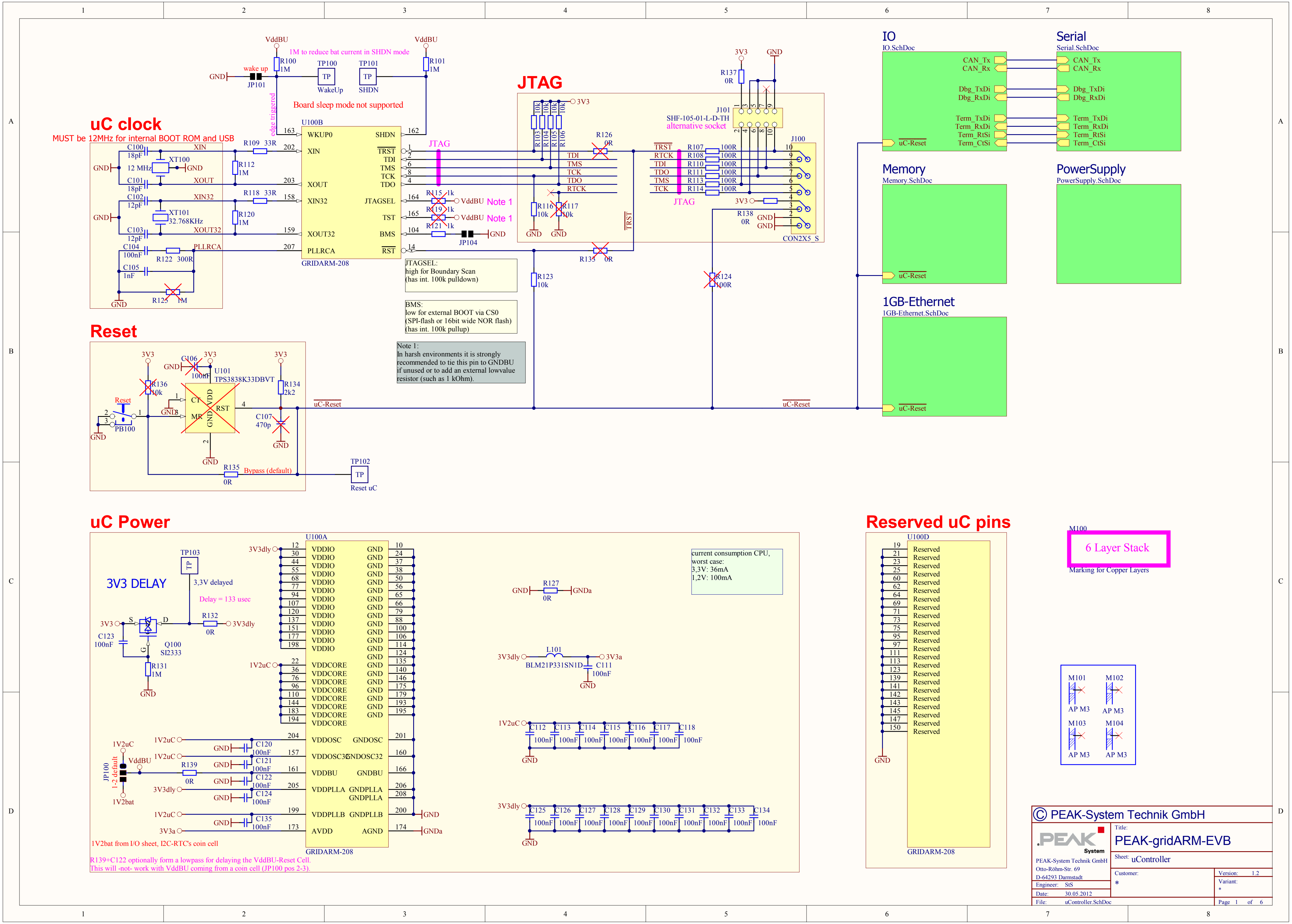
Jumper	Setting	Function
JP429	1-2	Real-time counter in the microcontroller is supplied by the button cell (only useful with JP100 on 2-3)
	2-3*	RTC at the I²C bus is supplied by the button cell
JP430	open*	System EEPROM writable
	closed	System EEPROM write-protected
JP431	1-2*	PA02: interrupt from I²C I/O module
	2-3	PA02: microSD card detection
JP432	1-2*	PA15: output for µC status LED
	2-3	PA15: input for USB detection
JP500	1-2	CAN transceiver supply 3.3 V (e.g. TI SN56HVD230)
	2-3*	CAN transceiver supply 5 V (e.g. NXP 82C251)
JP505 + JP506	1-2 + 1-2	LEDs: CAN bus
	2-3 + 2-3*	LEDs: RS-232 Debug
JP600	1-2*	Board supply from USB
	2-3	Board supply via supply socket (8 - 30 V DC)

* Setting at delivery

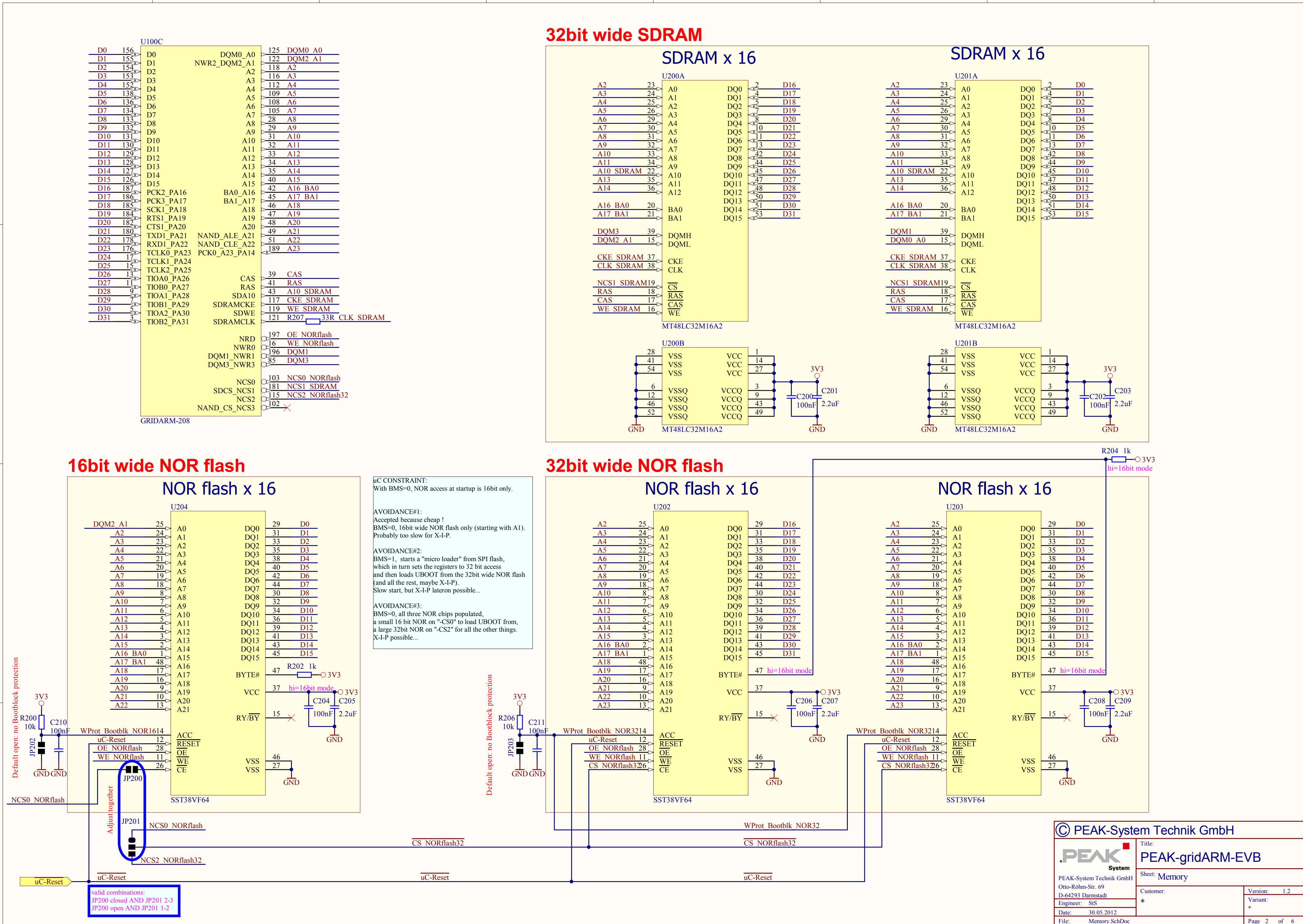
Appendix C Circuit Diagrams

On the following pages, the circuit diagrams of the PEAK-gridARM Evaluation Board are enlisted, split up in the following sections:

- Microcontroller
- Memory
- Ethernet
- I/O
- Serial
- Power Supply



uC clock
MUST be 12MHz for internal BOOT ROM and USB
JTAG
Reset
uC Power
3V3 DELAY
Reserved uC pins
IO
IO.SchDoc
Serial
Serial.SchDoc
Memory
Memory.SchDoc
PowerSupply
PowerSupply.SchDoc
1GB-Ethernet
1GB-Ethernet.SchDoc
1M to reduce bat current in SHDN mode
Board sleep mode not supported
JTAGSEL:
high for Boundary Scan
(has int. 100k pulldown)
BMS:
low for external BOOT via CS0
(SPI-flash or 16bit wide NOR flash)
(has int. 100k pullup)
Note 1:
In harsh environments it is strongly recommended to tie this pin to GNDBU if unused or to add an external lowvalue resistor (such as 1 kOhm).
current consumption CPU, worst case:
3,3V: 36mA
1,2V: 100mA
3,3V delayed
Delay = 133 usec
1V2bat from I/O sheet, I2C-RTC's coin cell
R139+C122 optionally form a lowpass for delaying the VddBU-Reset Cell.
This will -not- work with VddBU coming from a coin cell (JP100 pos 2-3).
6 Layer Stack
Marking for Copper Layers
© PEAK-System Technik GmbH
PEAK-System Technik GmbH
Otto-Röhm-Str. 69
D-64293 Darmstadt
Engineer: StS
Date: 30.05.2012
File: uController.SchDoc
Title: PEAK-gridARM-EVB
Sheet: uController
Customer: *
Version: 1.2
Variant: *
Page 1 of 6



Title: PEAK-gridARM-EVB

Sheet: Memory

PEAK-System Technik GmbH
Otto-Röhm-Str. 69
D-64293 Darmstadt
Engineer: StS

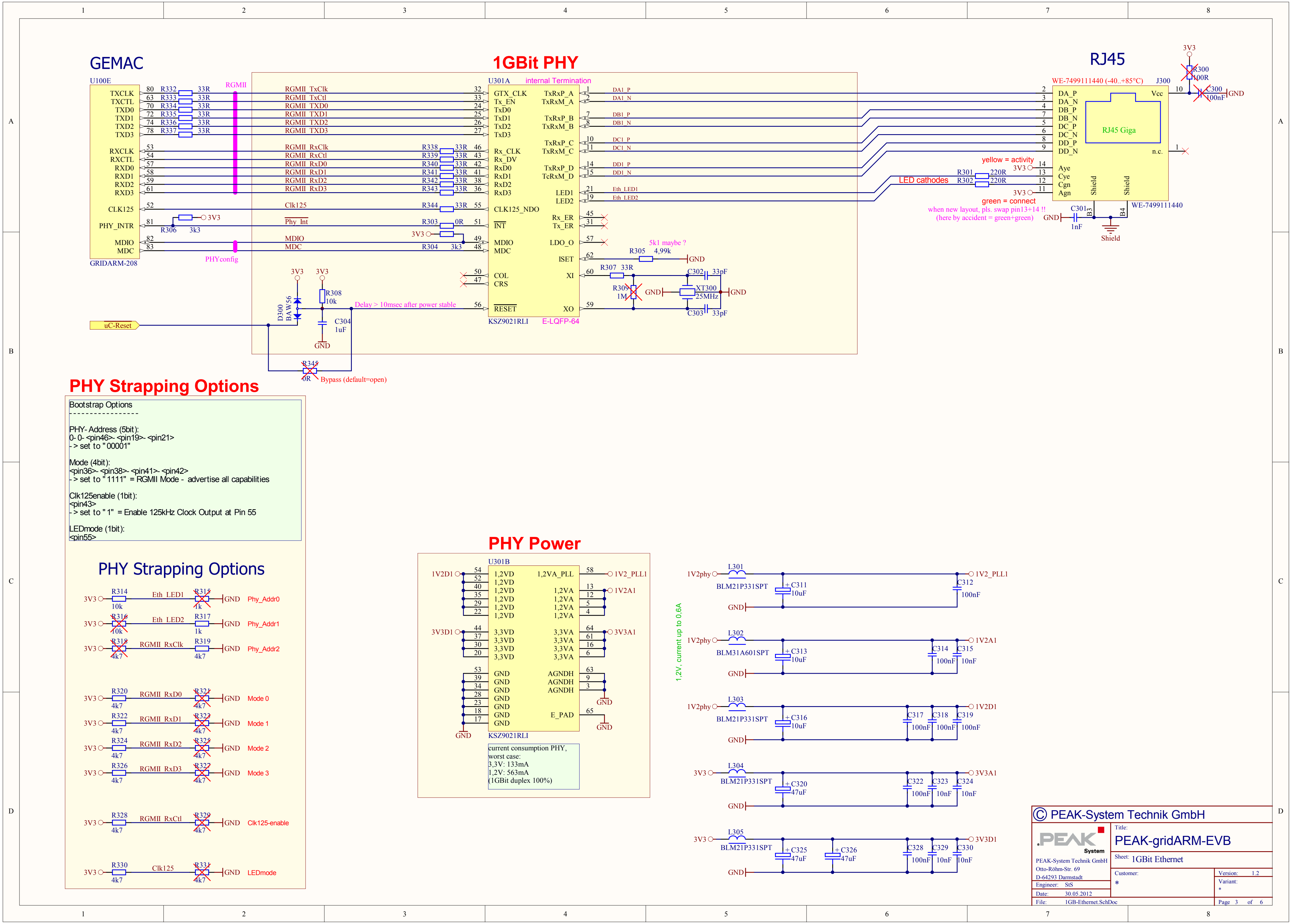
Date: 30.05.2012

File: Memory.SchDoc

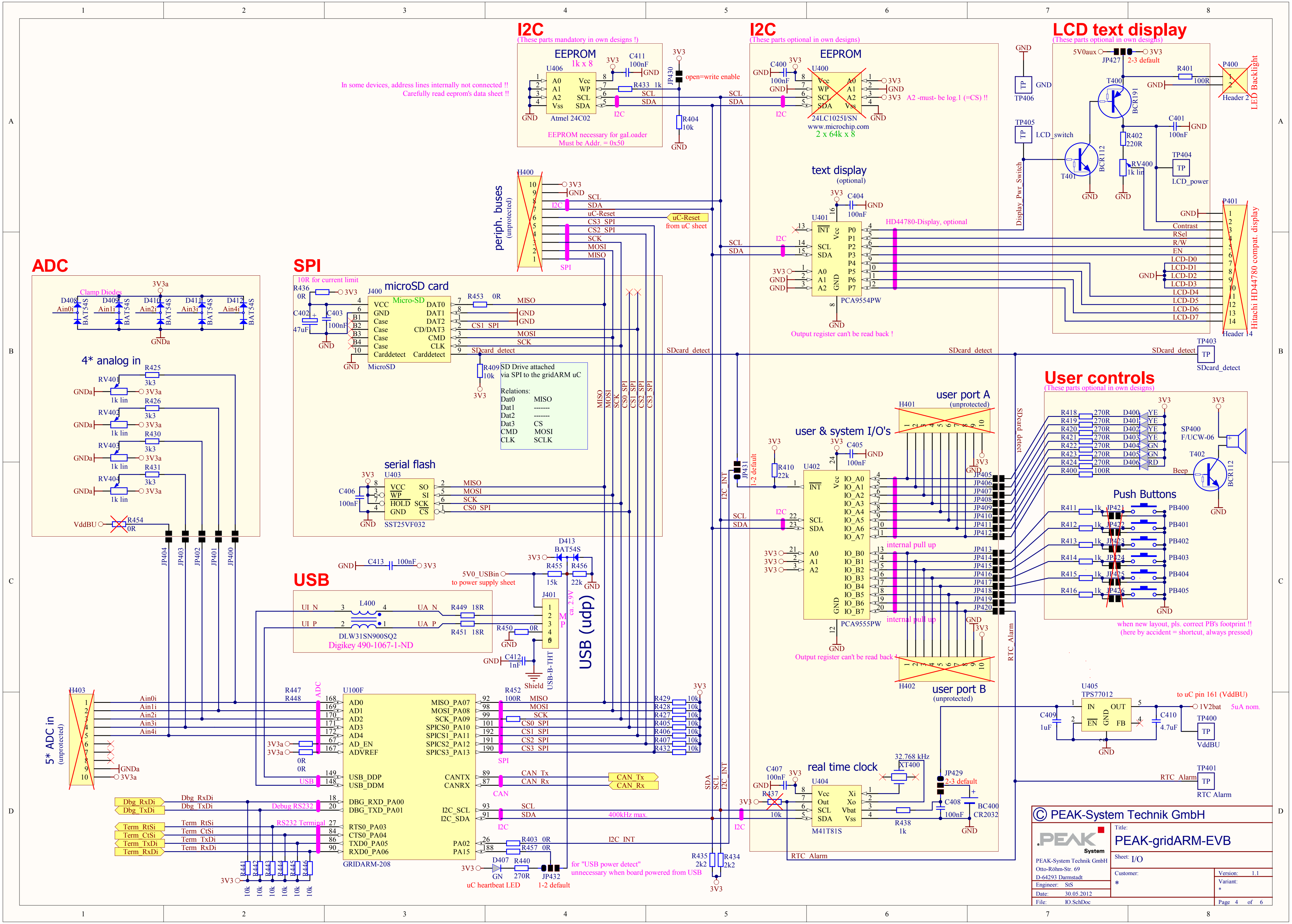
Customer: *

Version: 1.2

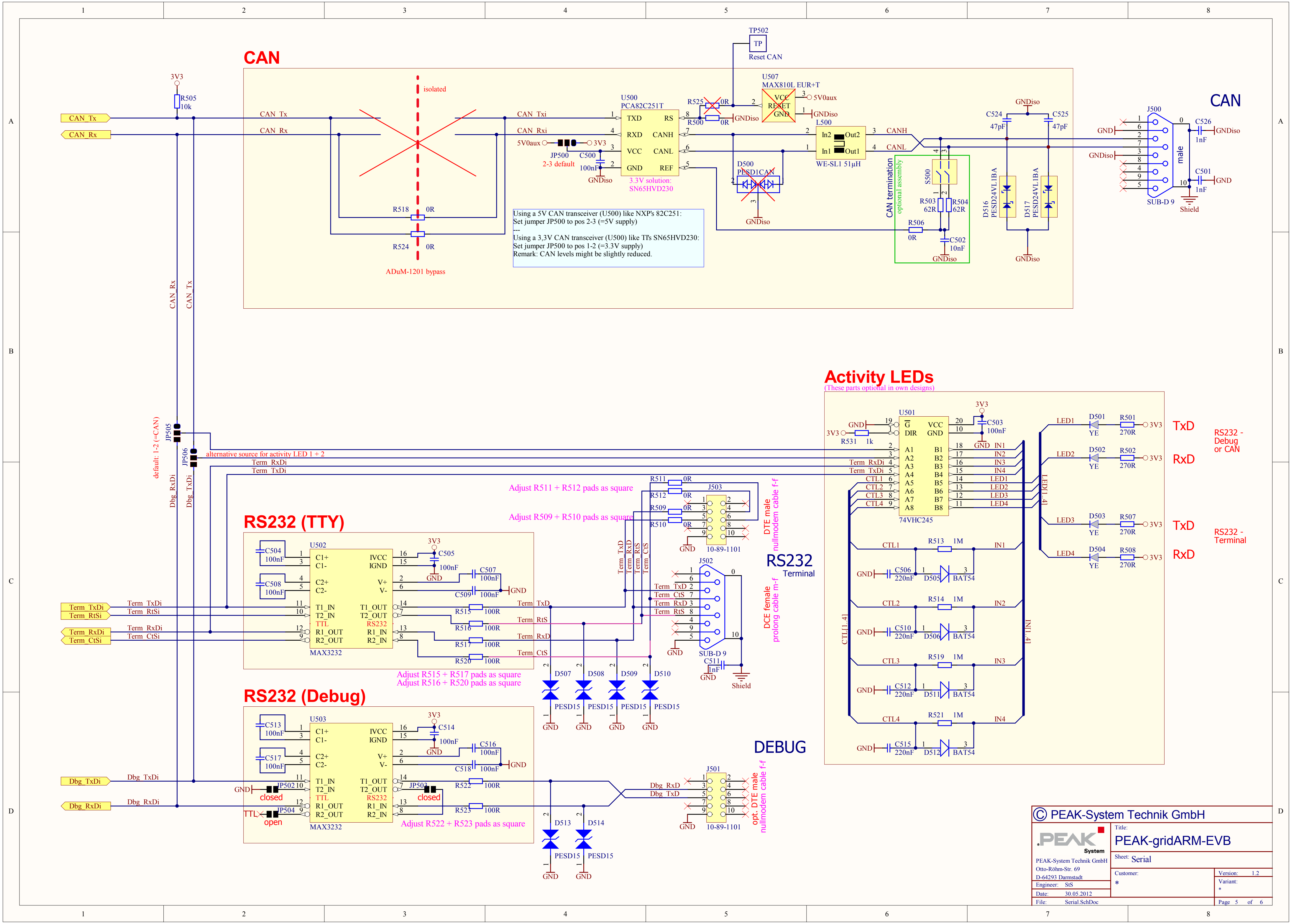
Variant: *


GEMAC
U100E
GRIDARM-208
TXCLK
TXCTL
TXD0
TXD1
TXD2
TXD3
RXCLK
RXCTL
RXD0
RXD1
RXD2
RXD3
CLK125
PHY_INTR
MDIO
MDC
RGMII
PHYconfig
1GBit PHY
U301A
internal Termination
GTX_CLK
Tx_EN
Rx_CLK
Rx_DV
CLK125_NDO
INT
MDIO
MDC
COL
CRS
RESET
TxRxP_A
TxRxM_A
TxRxP_B
TxRxM_B
TxRxP_C
TxRxM_C
TxRxP_D
TcRxM_D
LED1
LED2
Rx_ER
Tx_ER
LDO_O
ISET
XI
XO
KSZ9021RLI
E-LQFP-64
5k1 maybe ?
R305 4,99k
XT300 25MHz
Delay > 10msec after power stable
D300 BAW56
R308 10k
C304 1uF
uC-Reset
R345 0R
Bypass (default=open)
RJ45
J300
WE-7499111440 (-40..+85°C)
RJ45 Giga
yellow = activity
LED cathodes
green = connect
when new layout, pls. swap pin13+14 !!
(here by accident = green+green)
WE-7499111440
C301 1nF
Shield
R300 100R
C300 100nF
PHY Strapping Options
Bootstrap Options

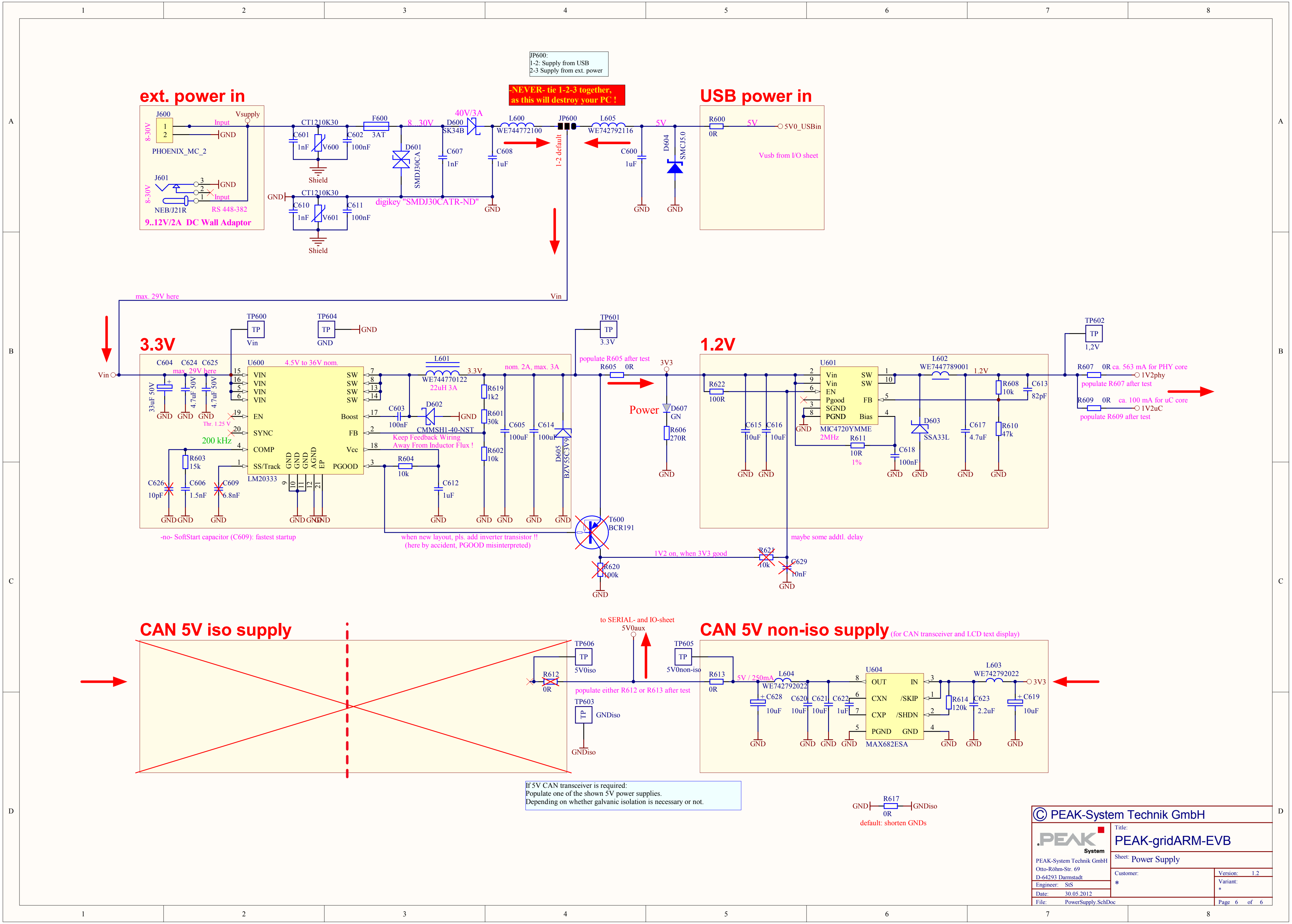
PHY- Address (5bit):
0- 0- <pin46>- <pin19>- <pin21>
-> set to "00001"
Mode (4bit):
<pin36>- <pin38>- <pin41>- <pin42>
-> set to "1111" = RGMII Mode - advertise all capabilities
Clk125enable (1bit):
<pin43>
-> set to "1" = Enable 125kHz Clock Output at Pin 55
LEDmode (1bit):
<pin55>
PHY Strapping Options
Phy_Addr0
Phy_Addr1
Phy_Addr2
Mode 0
Mode 1
Mode 2
Mode 3
Clk125-enable
LEDmode
PHY Power
U301B
KSZ9021RLI
current consumption PHY,
worst case:
3,3V: 133mA
1,2V: 563mA
(1GBit duplex 100%)
1,2V, current up to 0,6A
BLM21P331SPT
BLM31A601SPT
1V2phy
1V2_PLL1
1V2A1
1V2D1
3V3A1
3V3D1
© PEAK-System Technik GmbH
PEAK-System Technik GmbH
Otto-Röhm-Str. 69
D-64293 Darmstadt
Engineer: StS
Date: 30.05.2012
File: 1GB-Ethernet.SchDoc
Title: PEAK-gridARM-EVB
Sheet: 1GBit Ethernet
Customer: *
Version: 1.2
Variant: *
Page 3 of 6



I2C
(These parts mandatory in own designs !)
EEPROM
1k x 8
Atmel 24C02
EEPROM necessary for gaLoader
Must be Addr. = 0x50
In some devices, address lines internally not connected !!
Carefully read eeprom's data sheet !!
open=write enable
I2C
(These parts optional in own designs)
EEPROM
24LC1025I/SN
www.microchip.com
2 x 64k x 8
A2 -must- be log.1 (=CS) !!
LCD text display
(These parts optional in own designs)
2-3 default
LED Backlight
LCD_switch
Display_Pwr_Switch
LCD_power
text display
(optional)
HD44780-Display, optional
PCA9554PW
Output register can't be read back !
Hitachi HD44780 compat. display
periph. buses
(unprotected)
uC-Reset
from uC sheet
ADC
Clamp Diodes
4* analog in
SPI
10R for current limit
microSD card
Micro-SD
MicroSD
SD Drive attached
via SPI to the gridARM uC
Relations:
Dat0 MISO
Dat1 -------
Dat2 -------
Dat3 CS
CMD MOSI
CLK SCLK
serial flash
SST25VF032
SDcard_detect
User controls
(These parts optional in own designs)
user port A
(unprotected)
user & system I/O's
PCA9555PW
internal pull up
Output register can't be read back !
user port B
(unprotected)
Push Buttons
Beep
when new layout, pls. correct PB's footprint !!
(here by accident = shortcut, always pressed)
USB
5V0_USBin
to power supply sheet
DLW31SN900SQ2
Digikey 490-1067-1-ND
USB-B-THT
Shield
USB (udp)
5* ADC in
(unprotected)
GRIDARM-208
Debug RS232
RS232 Terminal
400kHz max.
uC heartbeat LED
1-2 default
for "USB power detect"
unnecessary when board powered from USB
real time clock
M41T81S
32.768 kHz
to uC pin 161 (VddBU)
5uA nom.
RTC_Alarm
© PEAK-System Technik GmbH
PEAK-System Technik GmbH
Otto-Röhm-Str. 69
D-64293 Darmstadt
Engineer: StS
Date: 30.05.2012
File: IO.SchDoc
Title: PEAK-gridARM-EVB
Sheet: I/O
Customer: *
Version: 1.1
Variant: *
Page 4 of 6


CAN
isolated
ADuM-1201 bypass
U500
PCA82C251T
3.3V solution:
SN65HVD230
JP500
2-3 default
U507
MAX810L EUR+T
TP502
Reset CAN
L500
WE-SL1 51µH
D500
PESD1CAN
S500
CAN termination
optional assembly
D516 PESD24VL1BA
D517 PESD24VL1BA
J500
SUB-D 9
male
Shield
Using a 5V CAN transceiver (U500) like NXP's 82C251:
Set jumper JP500 to pos 2-3 (=5V supply)

Using a 3,3V CAN transceiver (U500) like TI's SN65HVD230:
Set jumper JP500 to pos 1-2 (=3.3V supply)
Remark: CAN levels might be slightly reduced.
CAN_Tx
CAN_Rx
Activity LEDs
(These parts optional in own designs)
U501
74VHC245
TxD
RxD
TxD
RxD
RS232 - Debug or CAN
RS232 - Terminal
default: 1-2 (=CAN)
alternative source for activity LED 1 + 2
RS232 (TTY)
U502
MAX3232
Adjust R511 + R512 pads as square
Adjust R509 + R510 pads as square
Adjust R515 + R517 pads as square
Adjust R516 + R520 pads as square
J503
10-89-1101
DTE male
nullmodem cable f-f
RS232
Terminal
J502
SUB-D 9
DCE female
prolong cable m-f
Term_TxDi
Term_RtSi
Term_RxDi
Term_CtSi
RS232 (Debug)
U503
MAX3232
closed
open
Adjust R522 + R523 pads as square
DEBUG
J501
10-89-1101
opt. DTE male
nullmodem cable f-f
Dbg_TxDi
Dbg_RxDi
PEAK-System Technik GmbH
PEAK-System Technik GmbH
Otto-Röhm-Str. 69
D-64293 Darmstadt
Engineer: StS
Date: 30.05.2012
File: Serial.SchDoc
Title: PEAK-gridARM-EVB
Sheet: Serial
Customer: *
Version: 1.2
Variant: *
Page 5 of 6


JP600:
1-2: Supply from USB
2-3 Supply from ext. power
-NEVER- tie 1-2-3 together,
as this will destroy your PC !
ext. power in
J600
Input
Vsupply
8-30V
GND
PHOENIX_MC_2
J601
Input
8-30V
NEB/J21R
RS 448-382
9..12V/2A DC Wall Adaptor
CT1210K30
C601
1nF
V600
C602
100nF
Shield
C610
1nF
V601
C611
100nF
F600
3AT
8...30V
D601
SMDJ30CA
digikey "SMDJ30CATR-ND"
D600
SK34B
40V/3A
C607
1nF
L600
WE744772100
C608
1uF
JP600
1-2 default
L605
WE742792116
C600
1uF
5V
D604
SMCJ5.0
USB power in
R600
0R
5V
5V0_USBin
Vusb from I/O sheet
max. 29V here
Vin
3.3V
C604
C624
C625
max. 29V here
33uF 50V
4.7uF 50V
4.7uF 50V
TP600
TP
Vin
TP604
TP
GND
U600
4.5V to 36V nom.
VIN
EN
SYNC
COMP
SS/Track
SW
Boost
FB
Vcc
PGOOD
LM20333
Thr. 1.25 V
200 kHz
R603
15k
C626
10pF
C606
1.5nF
C609
6.8nF
-no- SoftStart capacitor (C609): fastest startup
L601
WE744770122
22uH 3A
3.3V
C603
100nF
D602
CMMSH1-40-NST
Keep Feedback Wiring
Away From Inductor Flux !
R604
10k
C612
1uF
R619
1k2
R601
30k
R602
10k
nom. 2A, max. 3A
C605
100uF
C614
100uF
D605
BZV55C3V9
when new layout, pls. add inverter transistor !!
(here by accident, PGOOD misinterpreted)
TP601
TP
3.3V
populate R605 after test
R605
0R
3V3
Power
D607
GN
R606
270R
T600
BCR191
R620
100k
1V2 on, when 3V3 good
R621
10k
C629
10nF
1.2V
U601
R622
100R
C615
10uF
C616
10uF
Vin
EN
Pgood
SGND
PGND
SW
FB
Bias
MIC4720YMME
2MHz
R611
10R
1%
C618
100nF
D603
SSA33L
L602
WE7447789001
1.2V
C617
4.7uF
R608
10k
R610
47k
C613
82pF
maybe some addtl. delay
TP602
TP
1,2V
R607
0R ca. 563 mA for PHY core
1V2phy
populate R607 after test
R609
0R ca. 100 mA for uC core
1V2uC
populate R609 after test
CAN 5V iso supply
to SERIAL- and IO-sheet
5V0aux
TP606
TP
5V0iso
R612
0R
TP603
TP
GNDiso
populate either R612 or R613 after test
CAN 5V non-iso supply (for CAN transceiver and LCD text display)
TP605
TP
5V0non-iso
R613
0R
5V / 250mA
L604
WE742792022
C628
10uF
C620
10uF
C621
10uF
C622
1uF
U604
OUT
CXN
CXP
PGND
IN
/SKIP
/SHDN
GND
MAX682ESA
R614
120k
C623
2.2uF
L603
WE742792022
3V3
C619
10uF
If 5V CAN transceiver is required:
Populate one of the shown 5V power supplies.
Depending on whether galvanic isolation is necessary or not.
R617
0R
GNDiso
default: shorten GNDs
© PEAK-System Technik GmbH
Title:
PEAK-gridARM-EVB
Sheet: Power Supply
PEAK-System Technik GmbH
Otto-Röhm-Str. 69
D-64293 Darmstadt
Engineer: StS
Date: 30.05.2012
File: PowerSupply.SchDoc
Customer:
Version: 1.2
Variant:
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