

Openmoko Phoenix (GTA04)

System Manual

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1. Important Information

1.1. Limitations

This device is not yet FCC approved! Import into and operation into the USA and other regions may be prohibited. Please refer to local FCC agencies.

1.2. Product Safety

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1.3. Coypright.

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2. Welcome

With the Openmoko GTA04 „new personality board“ you have choosen a bright future for your existing Openmoko Freerunner (or Neo 1973) by simply swapping the motherboard and reviving it like a „Phoenix“.

2.1. Feature comparison

Feature	GTA02 / GTA01	GTA04
Display	VGA	VGA (touch screen single touch with pressure detection)
Processor	400 MHz, S3C2442 (GTA01: S3C2410)	600/720 MHz, OMAP3530 / DM3730
Processor Functions	ARM v4	ARMv7 (Cortex A8), NEON, integrated DSP (TMS320C64x)
GPU	GTA02: Smedia Glamo	OpenGL® ES 2.0 capable 2D/3D graphics accelerator
RAM	256 MB (GTA01: 128 MB)	256 MB
Flash	256 MB (GTA01: 64 MB)	256 MB
ext. Memory	Mini-SD	Mini-SD
WAN	Triple-Band GSM, GPRS	Quad-Band GSM, EDGE, UMTS HSDPA 7.2 MBit, HSUPA
GPS	16 channel, int/ext. Antenna	20 channel, int/ext. Antenna
FM Radio	-	FM receiver and transmitter, both with RDS
LAN	802.11b/g (GTA02 only), Bluetooth	802.11b/g, Bluetooth
USB	1.1: Client, Charger, (inofficial Host mode)	2.0: full OTG (Client, Charger, Host)
Camera	-	1.3 Mpx (optional)
Sensors	2 Accelerometers	2-axis Accelerometers (optional) 3-axis Compass (optional) 3-axis Gyroscope (optional) Barometer/Thermometer Ambient Light (optional)

Feature	GTA02 / GTA01	GTA04
Audio / Video	Ear, Microphone, Handsfree speaker (GTA01: Stereo), 2.5mm 6pin Audio Headset Jack	Ear, Microphone, (Stereo) Handsfree, 2.5mm 6pin AV Jack (Composite-Video-Out, Audio in/out, Remote Control)
Battery	replaceable 3.7 V Lilon, 1200 mAh	replaceable 3.7 V Lilon, 1200 mAh
Camera	-	optional 1.3 MPx camera module
Others	2 Buttons, 3 LEDs (GTA01 no LEDs)	2 Buttons, 4 LEDs RS232 (full level, RX/TX/RTS/CTS) Expansion connectors (internal)

DRAFT - Subject to Change

3. Package Contents

##Photo##

- GTA04 mother board
- ??? Torx T5
- ??? Plastic Guitar Pick (plectrum) - (smallest M size 0.73 mm)
- ??? RS232 cable
- IMEI & S/N Label
- this manual
-
-

3.1. Device options

3.1.1. PDA

this variant has no UMTS module installed.

3.1.2. Smartphone

this variant comes with UMTS, WLAN, Bluetooth and GPS

3.1.3. High-End

this variant also has all sensors (Compass, Altimeter, Gyroscope, ...)

3.1.4. Module

we can produce module variants. They do have board to board connectors on the display side, but typically lack (depending on your needs)

- display connector
- headset jack
- pogo pins for speakers
- microphone
- battery connector
- backup battery/capacitor
- AUX and Power buttons
- LEDs
- RS232 connector (RS232 level shifter is installed)
- LIS302 accelerometer (can be added on adapter board)

For other options, please contact us.

4. Do it Yourself

This section is about self-installation of the new motherboard into an existing Freerunner (or Neo 1973) case. If you don't feel comfortable to do it yourself after reading this section, please contact your vendor for a PCB-swapping service.

4.1. Preparation

You need:

- 1 plane and clean working surface
- 1 Openmoko neo Freerunner (GTA02) or Openmoko Neo1973 (GTA01)¹
- 1 GTA04 mother board
- 1 Torx T5
- 1 Guitar pick 0.73 mm (smallest M size) or similar tool
- 1 Swiss Army Knife (or similar)
- 1 Telephone / Credit / Debit or similar card
- 1 Towel

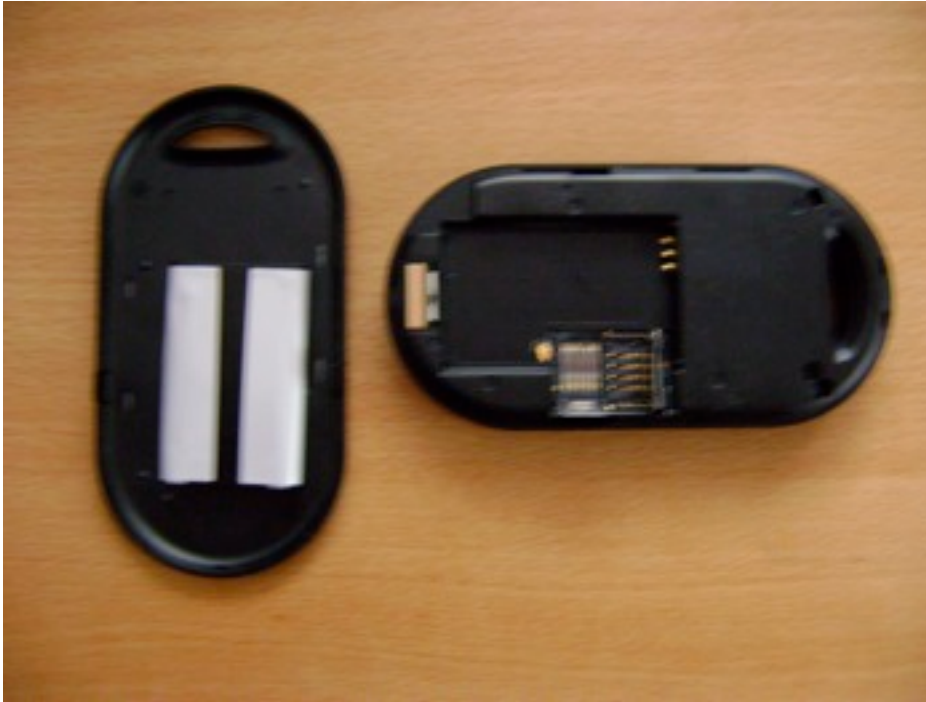


4.2. Opening the GTA

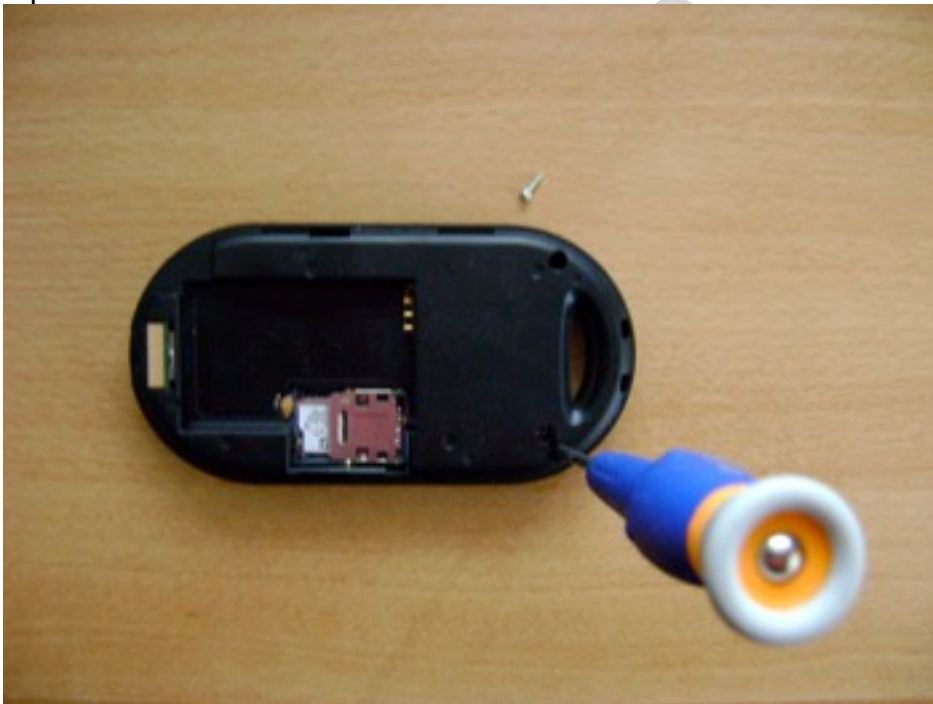
1. please discharge yourself (or optimally, you have a ESD safe environment)
2. remove battery cover
3. remove battery (if present)

¹ The photos show a neo Freerunner. For the Neo1973 the procedure is identical although the inner parts of the device look slightly different.

4. remove SIM and SD (if present)



5. Open the two Torx screws



6. take the Guitar pick and insert between middle and front cover at the side where the Torx screws had been

7. carefully open the snap-fits around the front cover



8. remove the Front cover (take care that the GPS antenna does not fall out)

4.3. Removing the GTA PCB

1. place the Freerunner or Neo1973 in front of you with the headset jack pointing to you as shown on the photo



2. carefully open the snap-fit on the left side and lift the PCB a little



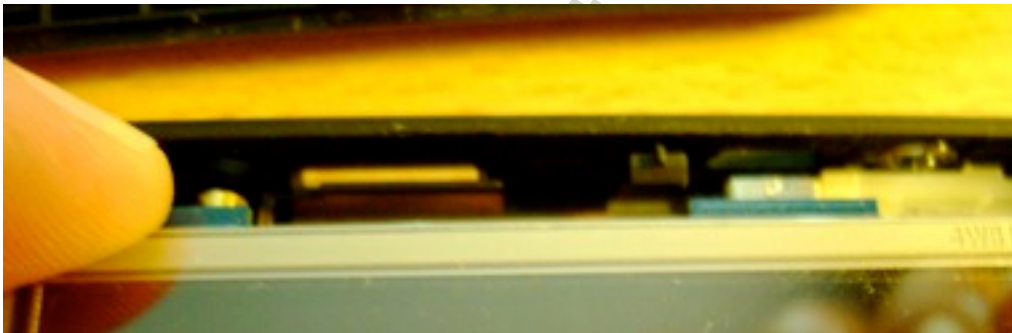
3. bend away the middle cover so that the headset jack snaps out



4. carefully tilt the PCB



5. pull the PCB towards you so that the USB and GPS antenna connectors slide out from the middle cover



DRAFT - 3

6. take out the GPS antenna and the PCB (carefully so that you don't break the cable connecting both)



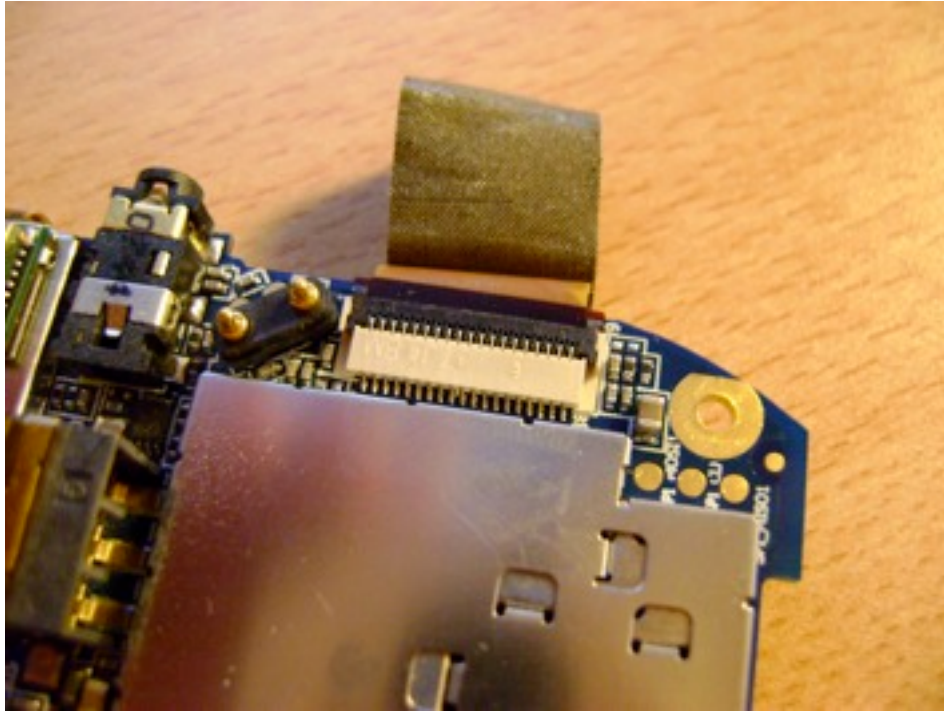
7. carefully unplug the GPS antenna from the U.FL socket



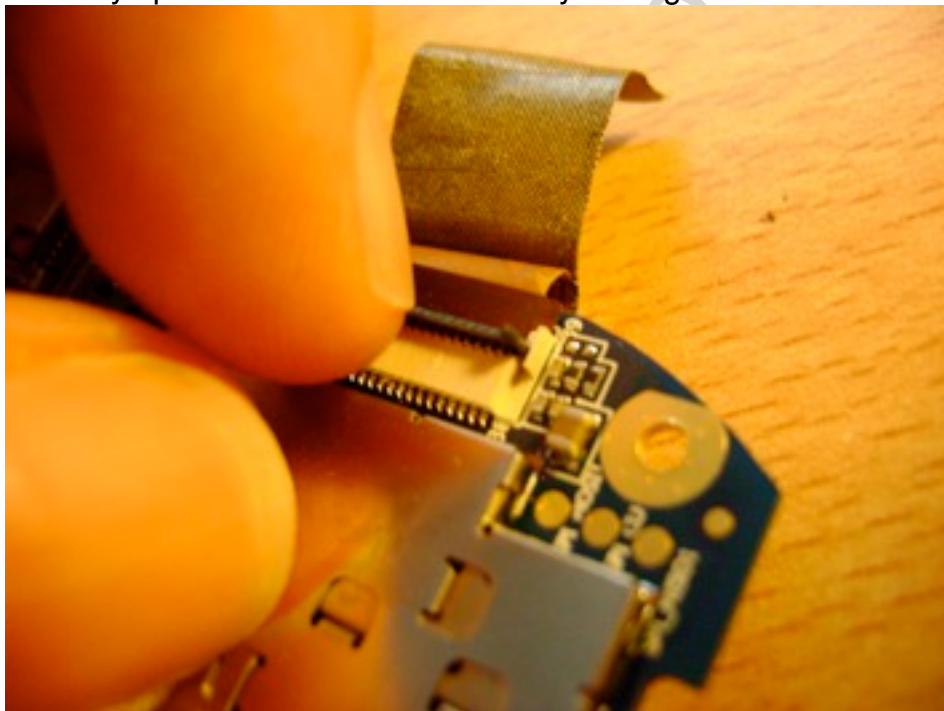
Please take care that the plastic parts for the buttons don't come out of the middle cover. You do not need to remove the GSM antenna.

4.4. Removing the Touch&LCD module from the PCB

1. open the silver tape on the flexible PCB



2. carefully open the PCB connector with your finger nail



3. The display module is mounted by 3 stripes of double-sided transparent tape. There are also 4 conducting silver pads only glued to the PCB as shown in the photo below (after removing the display).
In the following steps, please don't damage the silver pads or the black mat and be very careful not to damage the flexible PCB connectors (there is one for connecting the touch screen to the module that you can see only after removing the display module; on the left side of the next picture).

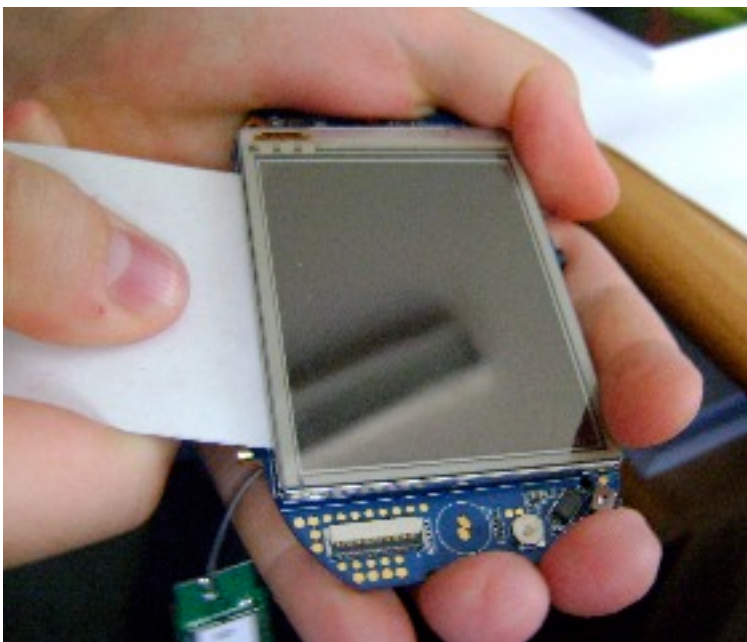
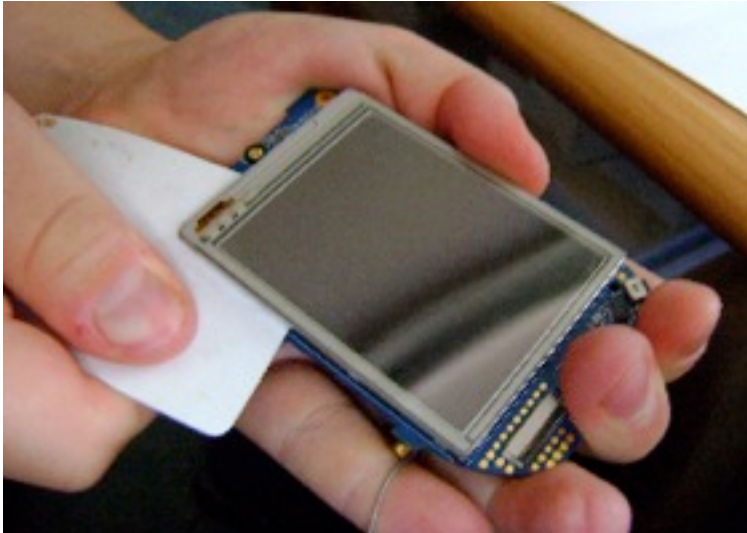


4. Now carefully insert the Telephone Card between the LCD and the black mat on the PCB.



Start with the top right corner (far away from flexible cable) and insert between silver pad and display backplane.

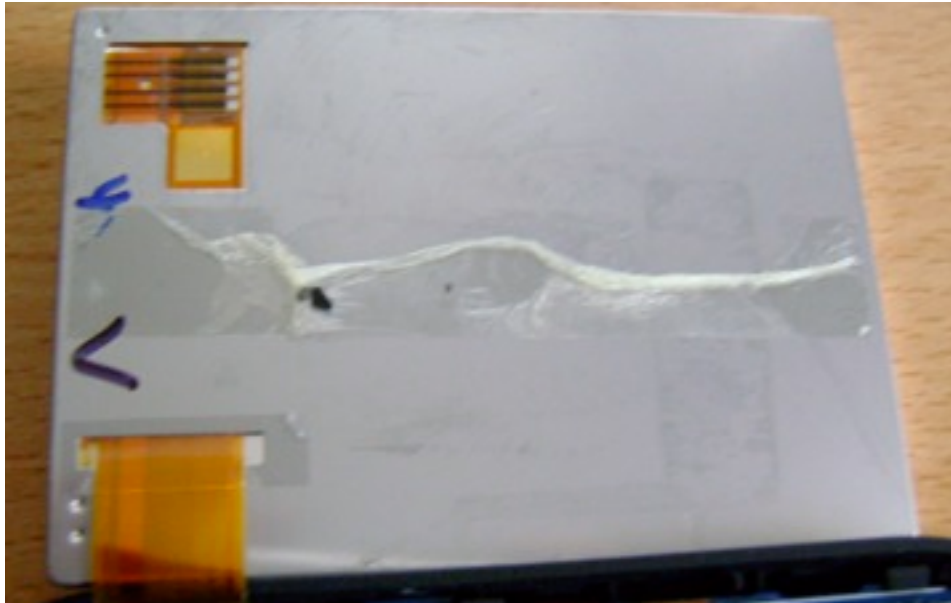
5. Carefully push in the card and move it between LCD module and black mat to remove the LCD (please don't bend the LCD module as it may break the glass)





Finally, you can lift off the display module.

6. Peel off any remaining double-sided tape (photo) from the backside of the LCD



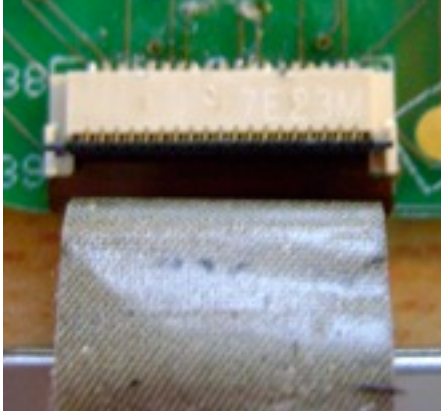
7. Carefully stow away the Freerunner PCB in an anti-static bag (in case you may want to reuse it in the future)

4.5. Glueing the Touch&LCD module onto the GTA04 PCB

1. Peel off the plastic cover on the double-sided tape of the GTA04 PCB
2. carefully position and glue the Module to the new PCB



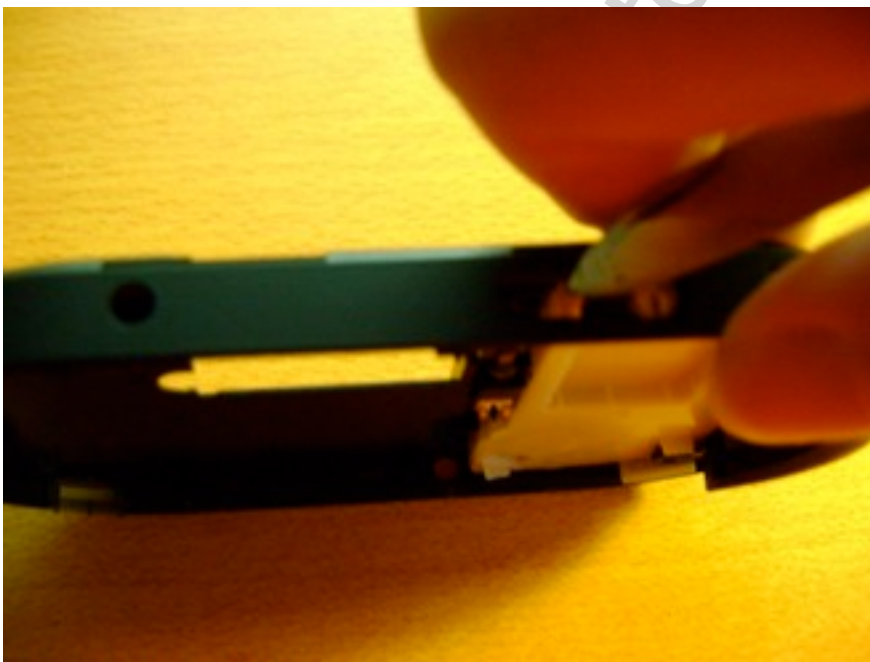
3. open the LCD connector and carefully insert the flexible PCB completely



4. close the LCD connector
##Photo##
5. glue the silver tape over the connector
##Photo##

4.6. Installing the GTA04 PCB in the case

1. take the middle case part and cut out the corners of the USB connector hole (the GTA04 has a real OTG plug which is slightly larger)



A) before:



hole

B) after:



improve photo with paper behind

1. carefully connect the GPS antenna to the U.FL plug
##Photo##
2. Place the middle cover in front of you in the orientation as shown on the Photo



3. carefully insert the internal GPS antenna into the middle cover
4. Insert the PCB at the USB and GPS antenna side into the holes
5. lower the PCB on the Headset Jack side (should not need brute force)

6. Bend away the middle cover part at the headset connector so that the PCB can be fully lowered down



7. Now, check that all snap-fits are engaged properly



4.7. Testing installation

You can already test the device in this status

1. Insert a charged battery
2. Insert a SD card with u-boot, kernel and rootfs
3. Press the Power button
4. The device should boot
5. Check if the LCD and Touch are working - if not, check the Touch&LCD connector

4.8. Closing the Cover

1. place the front cover on the middle case part

2. and close the snap-fits from microphone side to top
3. Turn around the Freerunner and insert and close the Torx screws
4. Check that the AUX and Power buttons are working mechanically
5. Remove the old Openmoko sticker in the battery compartment (you can keep it if you ever want to replace the old PCB back)
6. Glue the new GTA04 sticker in the battery compartment (it shows the new branding, IMEI and certifications). This is required by laws before operating the device.
##Photo##
7. Install SIM, SD and Battery and close the Battery cover
8. Test the device
9. Take the towel to dub your forehead

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5. Hardware description

5.1. Data Sheets

1. FIXME: add DM3730 link/replace GTM501, HMC5843 -> HMC5883

Component	Function	Links
OMAP3530	CPU	http://focus.ti.com/docs/prod/folders/print/omap3530.html
TPS65950	Power Controller	http://focus.ti.com/docs/prod/folders/print/tps65950.html
W2SG0004	GPS	http://www.wi2wi.com/products/datasheets/
W2CBW003	WLAN/BT	http://www.wi2wi.com/wireless.php (more info under NDA only)
GTM501	WWAN	http://www.option.com/en/products/products/modules/gtm501/info-documents/#start (more info under NDA only)
TD028TTEC1	LCD	http://wiki.openmoko.org/wiki/TPO_TD028TTEC1
TSC2007	Touch Controller	http://focus.ti.com/docs/prod/folders/print/tsc2007.html
LIS302	Accelerometer	http://www.st.com/stonline/products/literature/ds/12726.pdf
HMC5843	Compass	http://www.ssec.honeywell.com/magnetic/datasheets/HMC5843.pdf
LSM303	Accelerometer / Compass	http://www.st.com/stonline/products/families/sensors/motion_sensors/lsm303dlh.htm
BMP085	Barometer	http://www.bosch-sensortec.com/content/language1/downloads/BMP085_DataSheet_Rev.1.0_01July2008.pdf
OV9655	Camera	
ITG-3200	Gyroscope	http://invensense.com/mems/gyro/documents/PS-ITG-3200-00-01.4.pdf
Si4705/4721	FM Receiver/ Transceiver	
TCA6507	LED driver	http://focus.ti.com/docs/prod/folders/print/tca6507.html
(HSDL-3602)	IrDA	
(THS8136)	VGA DAC	n.a.

Component	Function	Links
USB3322	USB-PHY	Data Brief + Data Sheet für 3310?

5.2. Processor and Power

The processor part consists of a OMAP3530 + Package-on-Package RAM/Flash and the TPS 65950 Power Controller.

Chip	Interface	Connected to
OMAP	Camera	Camera Module and Test Points
	DSS	LCD (R=23-18, G=15-10, B=7-2, DE=0)
	RFBI	n/a
	S-Video out	Headset Jack (Composite only)
	HDQ/1-Wire	Battery ID
	I2C1	TPS65950 CNTL
	I2C2	Touch Screen, Sensors, FM Receiver
	I2C3	Test Points (reserved for DVI control)
	I2C4	TPS65950 Smart Reflex
	McBSP LP 1 (see Section 21.2.1)	FM Transceiver
	McBSP LP 2	Audio TPS 65950 I2S
	McBSP LP 3	Bluetooth PCM
	McBSP LP 4	WWAN PCM
	McBSP.LP 5	LCD control (in GPIO bit-bang mode)
	McSPI1	GPIOs for Board Version
	McSPI2	n/a
	McSPI3	unused
	McSPI4	n/a
	UART1	Bluetooth
	UART2	GPS module (NMEA)
	UART3	RS232 console / IrDA
	HSUSB0	TPS 65950 ULPI
	HSUSB1	n/a

Chip	Interface	Connected to
	HSUSB2	WWAN
	HSUSB3	n/a
	FSUSB1	n/a
	FSUSB2	n/a
	FSUSB3	n/a
	MMC1/SDIO1	SD slot (4/8 bit)
	MMC2/SDIO2	unused (4 bit)
	MMC3/SDIO3	WLAN module (SDIO 4 bit)
	ETK	n/a
	JTAG	n/a
	STDI	n/a
	HWDBG	n/a
	GPT11/GPIO58	LED Backlight enable (PWM)
	BOOT5/GPIO7 (Mode 4)	AUX-Button
TPS	Control	I2C1
	Smart Reflex	I2C4
	PCM	unused (bluetooth?)
	OTG	HSUSB1-ULPI
	I2S	McBSP2
	Keyboard	Test Points
	MIC.Main (2.2k bias)	Microphone
	MIC.Sub, AUX	n/a
	HS.MIC (2.7k bias)	Headset jack
	EAR	Earspeaker
	HSOR/HSOL	Headset jack
	IHF.LEFT/IHF.RIGHT	Music speakers (left channel only for Neo1973)
	VIBRA (LEDA, LEDB)	Vibramotor

Chip	Interface	Connected to
	ADC7	Headset Remote Control current sense
	PWRON	PWR-Button, WWAN-Wakeup, PENIRQ
	GPIO0,1,16,17	LED: AUX-R, AUX-G, PWR-R, PWR-G (oder R&G getauscht?)
	VMMC1 (3.15 V, 220 mA)	SD power
	VMMC2 (3.15 V, 100 mA)	n/a
	VAUX1 (3 V, 200 mA)	not used (Extension)
	VAUX2 (2.8 V, 100 mA)	Sensors
	VAUX3 (3 V, 200 mA)	not used (Extension)
	VAUX4 (3.15 V, 100 mA)	Bluetooth
	VSIM (2.8 V)	int/ext. GPS antenna, Video driver
BT	PCM	McBSP3 (I2S mode)
	UART	UART1
	USB	(Test Points)
	Power (3 - 3.6 V, 55 mA)	VAUX4
WLAN	SDIO/GSPI	MMC3 (4 bit)
	Power (2.7 - 3.3 V, 240 mA)	3.3V LDO (controlled by SYSEN)
WWAN	PCM	McBSP4 (I2S mode)
	USB	HSUSB2
	Wakeup	PWRON
	Power	VBAT
LCD	RGB,SYNC	DSS
	Control Interface	McBSP5 (GPIO bitbang mode?)
	Power (2.8 - 3.3 V, 20 mA)	3.3V LDO (controlled by SYSEN)
	Backlight Enable/PWM	GPT8 (GPIO58)
Touch	I2C	I2C2
	PENIRQ	GPIOxxx
	AUX (ADC channel 6)	Ambient Light Sensor

Chip	Interface	Connected to
	Power (2,7 - 5,5 V, 3 mA)	3.3V LDO (controlled by REGEN)
SD/SIM	SD	MMC1
	Power (SD)	VMMC1 (3.15V, 220 mA)
	SIM	WWAN
	Power (SIM)	WWAN
	Memory on SIM (1-bit SD)	n/a
GPS	Serial	UART2
	Power Up	GPIOxxx (RTS inverted)
	INT/EXT-Antenna Status	GPIOxxx (CTS)
	Power (3.25 - 3.6 V, 50 mA)	3.3V LDO (controlled by REGEN)
	int/ext. Antenna (3 V, 20 mA)	VSIM
LED	Aux, Power LEDs	I2C2
RS232	RX, TX, CTS, RTS	UART3
	Power	3.3V LDO (controlled by REGEN)
IrDA	RX, TX	UART3 (needs to be programmed to IrDA mode for correct pulse shaping)
	On/Off	GPIOxxx
	FIR mode	GPIOxxx
	Power (2.7 - 3.6 V, 5 mA)	3.3V LDO (controlled by REGEN)
	LED Power (400 mA peak)	VBAT
FM Receiver	Control	I2C2
	Voice	McBSP1
Sensors	Accelerator, Compass, Barometer, Gyroscope	I2C2
	Interrupts	GPIOxx
	Power (2.5 - 3.3 V, 2.5 mA)	VAUX2

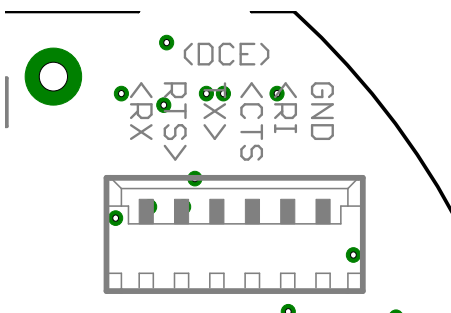
5.3. RS232 and IrDA

5.3.1. RS232 connector

The RS232 includes a 3-15 V level shifter. It supports RX, TX, CTS, RTS of UART3 (compatible to BeagleBoard and the-ROM boot loader).

The RS232 connector is located at the top end of the PCB. It has been designed that you can connect even to a running device after removing the battery cover, opening the Torx screws and removing the front cover:

FIXME: replace by 8 pin connector



NOTE: the interface is named as a DCE (Modem)! Therefore you should connect a DB9f (officially called DE9) socket that directly plugs into a DTE (Terminal/Computer). In this case it does not require a Null-Modem cable.

Pin location and signals:

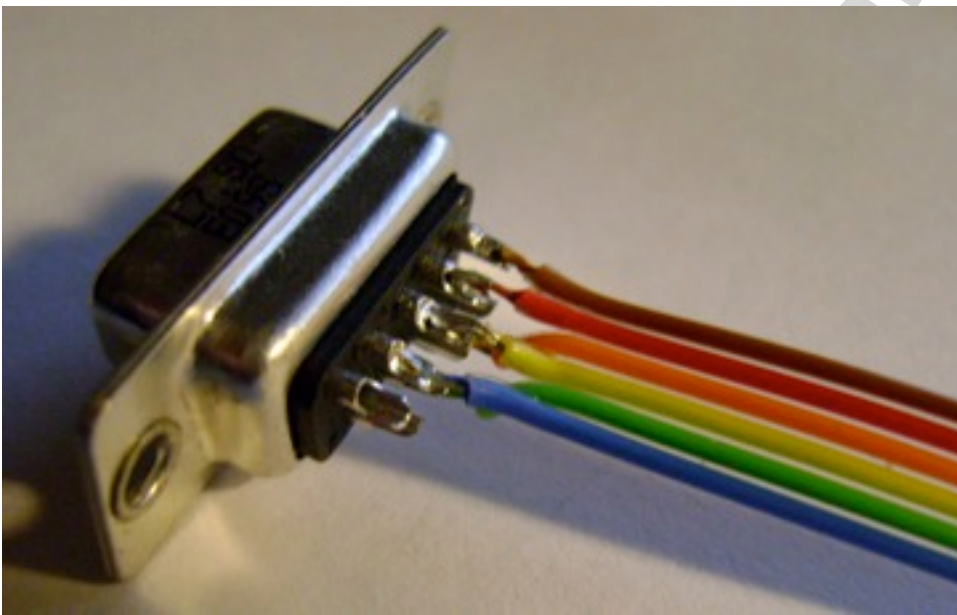
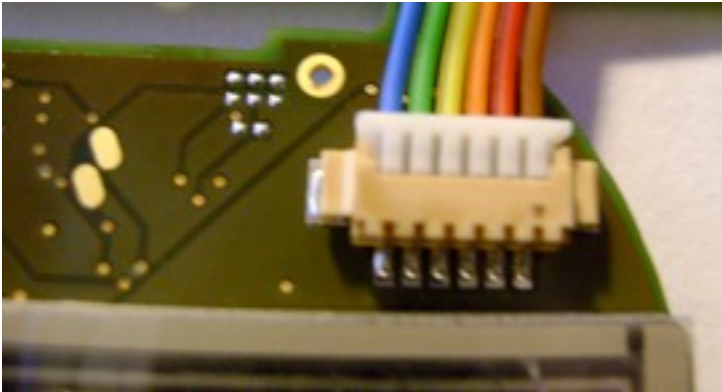
Pin	DCE name	UART	Dir.	Color (in our presoldered cable)	DB9f pin
1	GND	-	-	brown	5
2	EXT	GPIO21	Out	red	1 (DCD) 4 (DTR) 9 (RI)
3	CTS	RTS (GPIO###)	Out	orange	7
4	TX	RX	In	yellow	3
5	RTS	CTS (GPIO###)	In	green	8
6	RX	TX	Out	blue	2
7	GND				GND
8	AC				Power

5.3.2. Building a cable

How to build a cable to connect to a DB-9f plug.

The connector on the GTA04 is a “Molex Pico blade” with 8 pins (53261-0871). We recommend that you get a plug where a cable is already crimped since doing that manually requires quite expensive tools.

On the other end you need to solder to a DB-9f socket. We also offer pre-soldered cables.



There is an additional signal line EXT which can be connected to DCD, DTR or RI to indicate modem status by software. Which one you choose depends on your application. It is controlled by GPIO21.

The AC power supply pins are not connected by default but you can use them as a Y cable by soldering a plug of your choice. Please make sure that you don't swap AC and GND as it will damage the device.

AC power input is rated 3.2 V - ??? V (absolute maximum).

5.3.3. IrDA

There is an optional IrDA transceiver capable of 4 MBit/s that can be used alternatively with the RS232 port and must be switched on by software. To generate IrDA transmit impulses, place UART3 into IrDA mode (OMAP register ###). To generate arbitrary infrared impulses, place the TX line (GPIO ###) into GPIO mode (4).

Power mode (MD0, MD1) is controlled through GPIO 21

Table

Receiver speed (SIR/MIR vs. FIR) controlled through GPIO21 (which is shared with the EXT output of RS232)

Table

5.4. UMTS

Option GTM601 UMTS & GSM Module

connected to the internal USB

PCM connected to McBSP4

GPL Driver is available under by Option and is said to be in mainstream Linux kernel since 2.6.31.

5.5. GPS

5.5.1. Receiver

Wi2Wi W2SG0004 module

connected to UART2 (/dev/ttyS1)

Data rate (after reset): 9600 bit/s, 8 bit, no parity, 1 stop bit; range: 1200 - 115200 bit/s

NMEA (default), SiRFBINARY™ and AI3/F

5.5.2. External antenna and switch

The device automatically switches between internal and external antenna. The selection of the active antenna can be read through GPIO144 (0=int, 1=ext).

The external antenna connector is a MMCX type plug. Please make sure that your antenna has the correct type (or you need an adapter).

The device provides 3 V up to 25 mA for an external active antenna. The antenna must draw at least 10 mA for correct detection.

5.6. WLAN & Bluetooth

Wi2Wi W2CBW003

5.7. WLAN

connected to MMC2 (4 bit SDIO interface)

Reset

5.7.1. Bluetooth

connected to UART1 (/dev/ttyS0)

PCM connected to McBSP3

reset

5.8. FM Receiver

There is an optional FM Receiver Si4705 (or combined receiver/transmitter Si4721) available.

The shield cable of the headset can be used as the FM receiver antenna. The transmitter has ###an internal /### no antenna ###

It is controlled through I2C2.

5.9. Touch Screen and LCD

5.9.1. LCD DSS

is a Toppoly TD028TTEC1 connected to the DSS port.

DSS signal	Display
DSS2-7	Blue (6 bit)
DSS10-15	Green (6 bit)
DSS17-23	Red (6 bit)

PCLK shall be 22 MHz

VSYNC

HSYNC

etc.

polarity...

5.9.2. LCD controller

The display module contains an integrated Toshiba JBT6K74 display controller for which no detailed information is available. Its control port is connected to McBSP5 which is used as GPIO.

assignment

Our U-boot and Linux kernel drivers include drivers controls the McBSP5 in GPIO-bitbang mode. This has been ported from the GTA01/GTA02 kernel source code.

5.9.3. Touch screen

The touch screen is controlled by TSC2007 that is connected to I2C2.

The TSC2007 can measure the touch screen position and pressure, as well as battery voltage and chip temperature (see data sheet). It includes a Median Filter to reduce jitter.

5.9.4. Ambient Light Sensor

there is room for an optional ambient light sensor. The AUX input (ADC channel 6) of the TSC2007 can be used to read out the light level.

5.10. Sensors

are connected to the I2C2 bus.

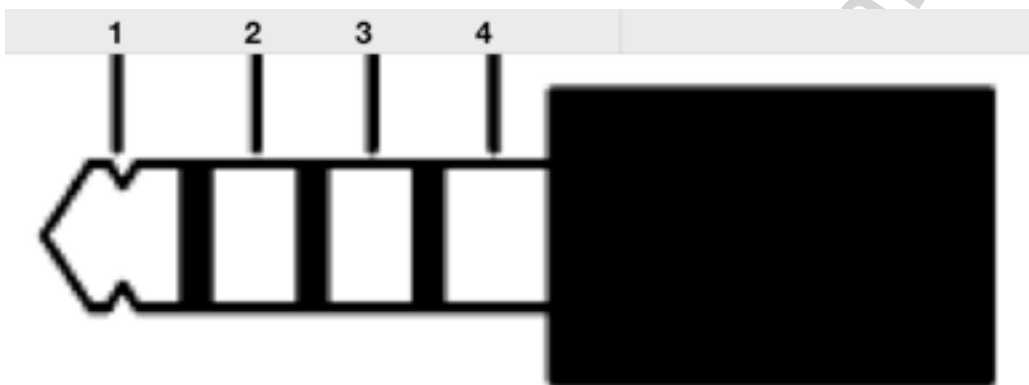
There is either a LSM303DLH or both HMC5883+BMA180. Otherwise there would be address conflicts and multiple drivers for the interrupt lines

Sensor	Type	Bus address	Interrupt
second Accelerometer (bottom)	LIS302	0x1D	GPIO114
Barometer/Thermometer	BMP085	0x77	GPIO113
Compass	HMC5853	0x1E	GPIO112
first Accelerometer (top)	BMA180	0x41	GPIO115
Gyroscope	ITG3200	0x68	GPIO56

Sensor	Type	Bus address	Interrupt
FM Transceiver	Si4705/4721	0x21	GPIO156
Touch Screen Controller, Ambient Light	TSC2007	0x48	GPIO160
Combined Accelerometer	LSM303DLH	0x19	GPIO115
Combined Compass		0x1E	GPIO112
LED driver	TCA6507	0x45	-

5.11. Headset Jack 2.5mm

5.11.1. Pin layout



The pin assignment (not necessarily the diameter) we have choosen is compatible to e.g.:

- Sharp Zaurus SL860
- iPod
- iPhone 2G
- 2.5mm AV-Chinch cables (white, red, yellow)

Pin	Function	Alternate AV function (by SW configuration)	AV-Chinch cable
5 (ring)	Shield		(shield of all 3 ends)
6	Left Earset	Left Audio In	white
1	Right Earset	Right Audio In	red
4 (tip)	Microphone, Accept Call button	75Ω Composite Video Out (PAL/NTSC)	yellow

5.11.2. Microphone Current Sensor

Pin 4 carries a VHSMIC bias (2.5 V) through a 2.7 kOhm resistor. There is a current sensor connected to ADCIN7 of the TPS65950. This allows to detect several different resitances connected between pin 4 and 5.

Many headsets have a button that simply short-circuits the microphone to signal accepting or ending a call.

A Composite Video system can be detected by exhibiting a 75 Ohm resistance.

If no headset is connected, an internal switch and 300 Ohm resistor indicates this state.

A Headset or remote control with several buttons and resistors can be used to indicate more different levels and e.g. provide remote signals like Play, Forward, Backward, Pause etc.

5.11.3. Composite-Video Out

beschreiben (wie umschalten, wie benutzen?)

5.11.4. AUX-In

beschreiben (wie umschalten, wie benutzen?)

5.12. Phone Peripherals

Speakers, Microphone, Vibracall, connected to ...

5.13. FM Transceiver with RDS

...

5.14. USB

is a USB OTG 5 pin connector
used to

- charge battery in Client mode
- supply 5V 100 mA (?) in Host mode

5.15. AC connector

Two pins of the RS232 connector are dedicated to operate the device in experimental mode without battery. For a description, refer to the RS232 connector.

5.16. Memory Cards

MMC1 interface (data bits 0-3) is connected to the SD card slot

MMC2 interface (data bits 0-3) is connected to WLAN

MMC3 interface is not available (pins are used for the MMC2 SDIO driver)

5.17. Buttons and LEDs

5.17.1. AUX Button

is connected to BOOT5 so that pressing the button while booting modifies the boot sequence of the built-in boot loader. I.e. NAND is tried last.

You can detect the state by programming the BOOT5 pin to mode 4 (GPIO7) and reading its value.

5.17.2. Power Button

is connected to PWRON of the TPS65950.

The TPS65960 detects and debounces this signal and can either generate interrupts on pressing or releasing, or wake up a sleeping CPU or force power-off when pressed for more than 8 seconds (emergency shut-down).

The current state can be read through the ### register of the TPS65950.

5.17.3. LEDs

The LEDs in the AUX and Power Buttons are controlled by the TCA6507 on address 0x45 on I2C2. See the datasheet how to control the LEDs, e.g. make them light or blink.

Assignment:

Port number	LED Button	LED Color
P0	AUX	red
P1	AUX	green
P3	Power	red
P4	Power	green

The other outputs P2, P5, P6 are reserved for future devices. But they are available on test pads and the expansion connector.

5.18. Test Pads

Note: adding electronic circuits in this area will most likely void the CE, R&TTE and FCC approvals, so you may operate the device only in a development environment or you have to recertificate it yourself.

There is room left for experimental expansion circuits as shown here:

picture

Please be aware that logic levels are 1.8V! Applying 3.3V signals may damage the OMAP subsystem beyond repair!

Pin description:

Name	Use for	Comment
1V8		1.8 V, ??? mA

5.19. Battery holder

For experiments it is sometimes necessary to operate the device completely without a case. This setup does not provide a battery bay and the spring loaded battery contacts will

push away the battery. We have added two holes where you can simply insert a bent paper clip as shown in the photo. This will keep the battery in place.



5.20. Expansion Connector

There is space on the Display side where two Board-2-Board connectors can be installed.

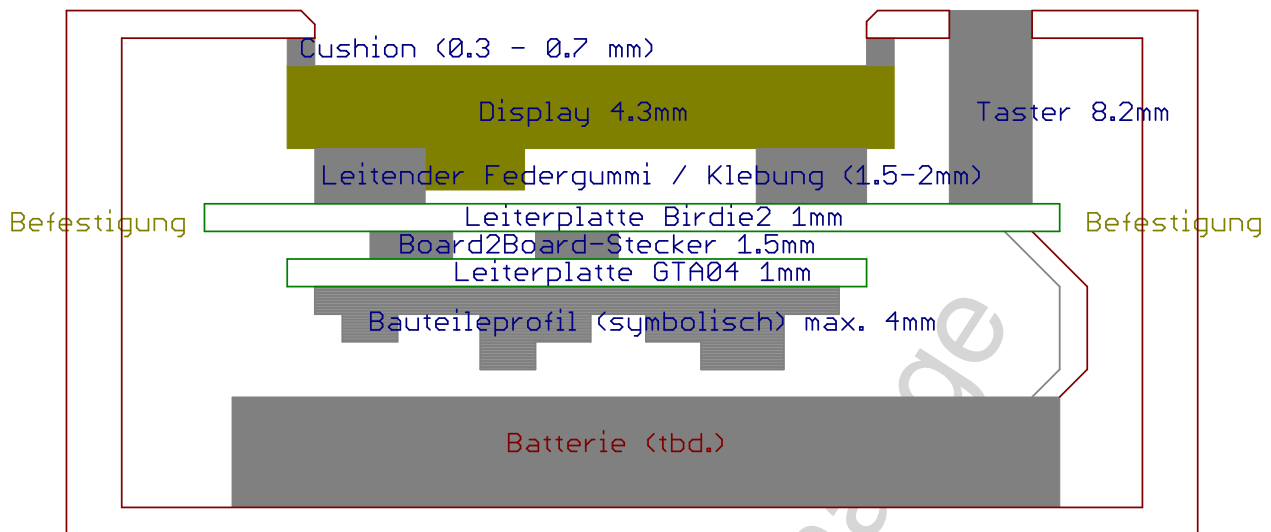
Photo

Please contact us if you want to get boards with these connectors installed and some other components not populated (e.g. microphone, display connector, headset jack, USB-OTG port, battery connector).

These connectors allow to replace the original display and install a adapter board for a different display. These connectors also provide other signals so that the GTA04 board can be used as a module to design your own phone (will have to be larger of course). A cross section showing how to mount a daughterboard with Display is shown here:

Bild anpassen, Englisch!!!

Stapelhöhe der Bauteile



5.20.1. Connecting an external LCD

Note that your display may need level shifters from 1.8V logic to 3.3V levels. This can be done e.g. with a set of SN74LVC8T245 chips.

You also have to design your own backlight converter (TPS61041) and touch screen controller (e.g. TSC2007).

Some more signals and interfaces are available depending on population of components on the module.

5.20.2. Part numbers

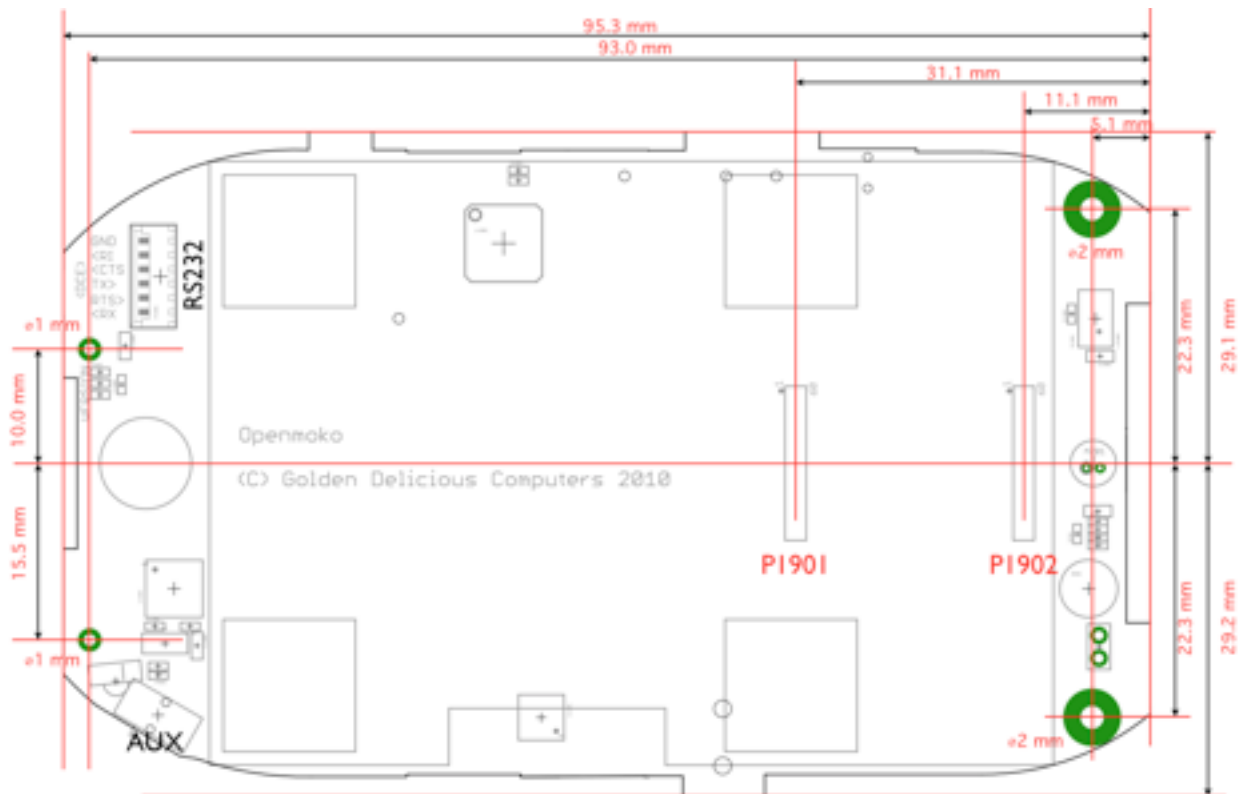
The GTA04 board can be equipped with two receptacles Hirose DF40-60DS-0.4V.

NOTE: it is quite impossible to retrofit the expansion connector. And, it can also only be used if some other components are not populated. So please contact us for get this variant from the factory.

The matching Header is the Hirose DF40-60DP-0.4V (e.g. DigiKey H11839CT-ND). There are variant in 1.5 mm 2.0 mm and 2.5 mm matching height so that you can adjust the distance from your display board.

NOTE: this connector is specified for only 10 insertion cycles (gold plating wears out)!

5.20.3. Position of the connectors relative to board and mounting holes



View on Display/B2B Connector side

5.20.4. Pin numbers

Foto

5.20.5. Signal assignment

P1901 (middle)

	Level	Pin	Pin	Level	
VAC	4-5 V	1	60	4-5 V	VAC
McBSP4-CLKX (GPIO###)	1.8 V	2	59	4-5 V	VAC
McBSP4-FSX (GPIO###)	1.8 V	3	58	5V	VBUS
McBSP4-DX (GPIO###)	1.8 V	4	57	5V	VBUS
McBSP4-DR (GPIO###)	1.8 V	5	56	5V	VBUS
UART3-RX (GPIO###)	1.8 V	6	55	analog	OTG ID
UART3-TX (GPIO###)	1.8 V	7	54		GND
UART3-RTS (GPIO###)	1.8 V	8	53	3.3 V	3V3
UART3-CTS (GPIO###)	1.8 V	9	52	3.3 V	LED6 (3.3V-Reset)
PENIRQ (GPIO160)	1.8 V	10	51		GND
GND		11	50	analog	BATTEMP
Ear+	analog	12	49	analog	BATID
Ear-	analog	13	48	analog	ADCIN2
GND		14	47		GND
USB-OTG D+	analog	15	46	1.8 V	KEYIRQ (GPIO10)
USB-OTG D-	analog	16	45	1.8 V	STARTADC
GND		17	44		GND
HDQ	digital	18	43	analog	Mic+
VBATT	3.6 V	19	42	analog	Mic- (GND)
VBATT	3.6 V	20	41		GND
VBATT	3.6 V	21	40	1.8 V	NRESPWRON
VBATT	3.6 V	22	39	1.8 V	REGEN
VBATT	3.6 V	23	38	1.8 V	I2C3-SDA (GPIO###)
VBATT	3.6 V	24	37	1.8 V	I2C3-SCL (GPIO###)
VBATT	3.6 V	25	36		FM-RX (GND)
GND		26	35	analog	MIC/AV
LS+	analog	27	34	analog	VIB-
LS-	analog	28	33	analog	VIB+
RS+	analog	29	32	analog	HS/AUX-R
RS--	analog	30	31	analog	HS/AUX-L

P1902 (bottom)

	Level	Pin	Pin	Level	
BKBATT	VBATT	1	60		GND
PWRON button (to GND)	VBATT	4	57	OC	LED5
McSPI3-CLK (GPIO###)	1.8V	5	56	OC	LED4
McSPI3-SIMO (GPIO###)	1.8V	4	57	OC	LED3
McSPI3-SOMI (GPIO###)	1.8V	5	56	OC	LED2
McSPI3-CS (GPIO###)	1.8V	6	55	OC	LED1
AUX / USER button to 1V8 (GPIO###)	1.8V	7	54	OC	LED0
1V8	1.8 V	8	53	3.3 V	3V3
I2C2-SDA	1.8V	9	52	1.8V	McBSP5-CLKX (GPIO###)
I2C2-SCL	1.8V	10	51	1.8V	McBSP5-FSX (GPIO###)
USB-WWAN-D+	analog	11	50	1.8V	McBSP5-DX (GPIO###)
USB-WWAN-D-	analog	12	49	1.8V	McBSP5-DR (GPIO###)
NRESWARM	1.8V	13	48	1.8V	GPT11_PWM (GPIO###)
UART2-RX (GPIO###)	1.8V	14	47	1.8V	DSS7 (GPIO###)
UART2-TX (GPIO###)	1.8V	15	46	1.8V	DSS8
UART2-RTS (GPIO146)	1.8V	16	45	1.8V	DSS9
UART2-CTS (GPIO144)	1.8V	17	44	1.8V	DSS10
GND	1.8V	18	43	1.8V	DSS11
DSS6 (GPIO###)	1.8V	19	42	1.8V	DSS12
DSS5	1.8V	20	41	1.8V	DSS13
DSS4	1.8V	21	40	1.8V	DSS14
DSS3	1.8V	22	39	1.8V	DSS15
DSS2	1.8V	23	38	1.8V	DSS16
DSS1	1.8V	24	37	1.8V	DSS17
DSS0 (GPIO###)	1.8V	25	36	1.8V	DSS18
DE	1.8V	26	35	1.8V	DSS19
VSYNC	1.8V	27	34	1.8V	DSS20
HSYNC	1.8V	28	33	1.8V	DSS21
PCLK	1.8V	29	32	1.8V	DSS22
GND		30	31	1.8V	DSS23

6. Booting the device

6.1. Boot process

When power is applied, the OMAP processor starts a first stage bootloader from a built-in ROM. This ROM tries to load a secondard bootloader (X-Loader) from several sources. The order can be changed by the AUX (User) button which makes the ROM check external sources (RS232, USB, MMC) before checking NAND flash.

The next stage boot-loader is the X-Loader (also called MLO if it loads U-Boot from MMC/SD). It runs from the 64k SRAM built into the CPU.

Usually, the X-Loader fetches the thrid stage U-Boot from the same source as the X-Loader was found. I.e. there is a X-Loader in NAND flash that loads U-Boot from NAND flash. On a MMC card there is a file called MLO in the first FAT partition. And, there is a special X-Loader that can load U.Boot through the RS232 interface by using the Kermit protocol.

Anyway, U-Boot is loaded into the (big) SDRAM.

Finally, U-Boot determines where to fetch the Linux kernel from. Usually it looks at NAND flash and MMC. This can also be modified by pressing the AUX button.

This is shown in the following figure

Bild malen

Our U-Boot loads a splash image from MMC:



6.1.1. Choosing boot mode by AUX button

The AUX button is used to switch to „peripheral boot“ mode, i.e. all boot loaders try external media (MMC, USB, UART) before looking for a image in NAND flash.

In our U-Boot version, the AUX button also makes U-Boot load a different splash image showing several boot options.

6.1.2. Choose boot options by GUI

By pressing on the touch screen while in AUX boot mode, our U-Boot allows to choose from several boot options:



The image and the actions can be configured by the boot.scr script and by providing a different bitmap in RGB16 format.

6.1.3. How to boot from RS232,

You can boot through RS232. Please see instructions at
Link

6.2. How to format a bootable SD/MMC card

must be 3.3 V compatible and 4 bit card

create partitions

format first partition in MSDOS (FAT) format

copy MLO file as the first file

then copy u-boot.bin, and others (ulimage.bin, splash.rgb etc.)

Sample Script...

6.3. How to flash the NAND

Spezielle Variante von X-Loader (normaler MLO sucht U-Boot auf MMC!)

Wie speichert man Boot-Splash und boot.scr im Nand?

Am besten wäre ein Kommando im AUX-Boot-Menü das einfach den Inhalt der MMC in den NAND-Flash kopiert (das geht weitgehend!)

7. U-Boot

We provide our own variant of U-Boot but you can easily replace it. So this description is only valid if you have installed our U-Boot in NAND or on SD card.

You can access U-Boot through the RS232 console in 115200 bit/s 8N1 mode.

Note, you must interrupt U-Boot by pressing the Return key before it starts executing the automatic boot commands.

7.1. New commands

To simplify testing and to provide the graphical boot menu we have added some new commands to U-Boot.

<<Liste>>

7.2. Configuring the Splash Screen

We have added a command to U-Boot by which you can map a memory area to the LCD. The area is rectangular 640x480 and is encoded in RGB565 (rgb16) format. I.e. you just need to load a file of 600 KBytes from the boot partition and set the framebuffer base address.

```
mmc init 0
fatload mmc 0 0x81000000 splash.rgb16
lcm fb 0x81000000
```

7.3. Configuring the Boot Menu

creating RGB16 splash images
converting boot.cmd -> boot.scr
adding boot options

7.4. Memory layout

Here is a list showing which memory areas as they are seen from the U-Boot console.

from	to	size	
0x0000 0000	0x0fff ffff	256 MB (2 GBit)	NAND
0x0000 0000	0x0007 ffff	512 KB	X-Loader (flash image)
0x0008 0000	0x0025 ffff	2 MB	U-Boot (flash image)
0x0026 0000	0x0027 ffff	128 KB	U-Boot parameters written by saveenv
0x0028 0000	0x0067 ffff	4 MB	Kernel (flash image loaded by nandboot)
0x0068 0000	0x0fff ffff	250 MB	file system (jffs) etc.
0x4800 0000			internal peripheral registers

from	to	size	
0x8000 0000	0x8fff ffff	256 MB (2 GBit)	RAM
0x8200 0000			default Linux kernel load address

7.5. Environment and Boot parameters

relevant?

kernel boot command line

7.6. Tips & Tricks

7.6.1. Clearing the environment in NAND

Sometimes, you may want to wipe out the U-Boot environment so that it is reinitialized to the default in U-Boot on the next reboot:

```
nand erase 260000 20000
```

7.6.2. Bootdelay has been set to 0

press a key on the RS232 console while the X-Loader message is starting

7.7. Building from Source code

Get sources by:

```
git clone http://git.goldelico.com/gta04-uboot.git
cd gta04-uboot
```

Build:

```
export ARCH=arm
make config_omap3_beagle
make
```

The result will be the file boot/u-boot.bin. Copy this file to the FAT partition of your SD card.

7.8. Project and Bug Reports

<http://projects.goldelico.com/p/gta04-uboot/>

<http://projects.goldelico.com/p/gta04-uboot/issues/create/>

8. Linux Kernel

We provide a Linux Kernel that includes all configuration and drivers for the GTA04.

8.1. Kernel bootargs

which and their meaning...

8.2. Drivers

The following drivers are included

Device file --- function

8.3. Kernel Modules

8.4. Root-Filesystem

You can configure generate a matching Angstrom roots through Narcissus.

We provide a Debian Lenny root file system with some preconfiguration (e.g. inittab, fstab, X11, touch screen).

8.5. Building from Source code

Get sources by:

```
git clone git://projects.godelico.com/gta04-kernel.git cd
linux-omap-2.6
```

Build:

```
export ARCH=arm export CROSS_COMPILE=arm-angstrom-linux-
gnueabi- # adapt to your toolchain
make distclean make omap3_gta04_defconfig make menuconfig
# only needed if you want to change the default
configuration make uImage
```

The result will be the file arch/arm/boot/uImage. Copy this file to the FAT partition of your SD card.

8.6. Project and Bug Reports

<http://projects.godelico.com/p/gta04-kernel/>

<http://projects.godelico.com/p/gta04-kernel/issues/create/>

9. Information for writing Device Drivers

this is a little redundant to Chapter 5!

9.1. GPS

simply use a serial driver (/dev/ttyS1) on UART2.

9.2. Bluetooth

simply use serial interface based driver (HCI) on UART1 (/dev/ttyS0)

9.3. WLAN

needs an SDIO driver for the Marvel 8686 chipset (to be evaluated)

9.4. WWAN

needs an Option Globetrotter HSO driver which should now be in Linux kernel since 2.6.31)

<http://kerneltrap.org/mailarchive/linux-kernel/2008/5/13/1813544>

If not, download the GPL source and instructions here:

####

On some systems you have to

```
ln -s /usr/src /lib/modules/${boardname -r}/build
```

The driver makes several communication channels available as /dev/ttyHSO0 ... ttyHSO4. You can connect through e.g. minicom and issue AT commands.

Important GSM AT commands

Command	Function
ATI	prints identification
AT+CPIN=?	PIN status
AT+CPIN="your pin"	enter PIN
	List of networks in sight
ATDnumber;	voice call dialling (don't forget the semicolon)
ATH	hang up phone call

9.5. I2C1 devices

I2C1 is connected to the TPS65950. It provides the four functional blocks at addresses 0x48, 0x49, 0x4a, 0x4b. For details refer to the TPS65950 documentation.

9.6. I2C2 devices (Sensors)

This bus connects all sensors (and the touch screen controller).

Address	Device Type	Function
0x1C	LIS302	Accelerometer (BOTTOM)
0x77	BMP085	Barometer, Thermometer
0x1E	HMC5883L	Digital Compass
0x41	BMA180	Accelerometer (BOTTOM)
0x48	TSC2007	Touch Screen, Chip Temperature, Ambient Light (AUX channel)
0x21	Si4705/ Si4721	FM Receiver with RDS
0x45	TCA6507	LED driver

9.7. GPIO assignment

This table lists the GPIOs that can and or should reasonably be switched to GPIO mode (4).

GPIO Number	Pin Name	Function (if used as GPIO)
10	SYS_CLKOUT1	connected to temperature sensor of PoP memory. Goes to 1 if chip temperature > 85 °C; should generate an interrupt and reduce power
	GPT11_PWM	switch on/off LCD backlight; should be used in PWM mode
	McBSP5_FSX	Chip-Select for LCD serial interface
	McBSP5_CLKX	LCD serial clock
	McBSP5_DX	LCD serial data output (protected)
	McBSP5_DR	LCD serial data input
112		Enable TV-Out for MIC/AV on headset jack
65		Enable Headset Jack left&right output
171	McSPI1_CLK	sense board version (R307)
172	McSPI1_SIMO	sense board version (R308)
173	McSPI1_SOMI	sense board version (R309)

GPIO Number	Pin Name	Function (if used as GPIO)
174	McSPI1_CS	Reset for USB3322 ULPI-PHY to interface with WWAN module
146	UART2_RTS	GPS-ON/OFF
144	UART2_CTS	internal/external Antenna sense
	McSPI3_CLK	unused
	McSPI3_SIMO	unused
	McSPI3_SOMI	unused
	McSPI3_CS	unused
	SYS_BOOT5	read state of AUX button (1=preserved)
	HDQ	read/write HDQ protocol
114		LIS302/BMA180 INT1
115		LSM303 INT1 (Accelerometer)
62		LSM303 DRDY (Compass)
64		ITG3200 INT
113		BMP085 INT
169		TSC2007 PENIRQ
156		Si47xx INT
21		RS232/IrDA selection
13		RS232 EXT / IrDA FIR-SEL
63		Keyboard INT (optional)

9.8. Board version encoding

GPIO171, 172, and 173 allow to distinguish between board versions by populating 0 Ohm resistors or leaving them out. The GPIO pins are switched to pull-up mode so leaving out a resistor reads the GPIO as a high level.

R309	R308	R307	GPIO173	GPIO172	GPIO171	Version
-	-	-	1	1	1	GTA04A2
-	-	x	1	1	0	GTA04A3

10. Legal Info

The responsible manufacturer according to EU laws (e.g. WEEE, CE, product liability etc.) is Golden Delicious Computers GmbH&Co. KG, Oberhaching, Germany.

10.1. Safety Instructions

- Keep away from liquids.
- Don't expose to direct sunlight.
- Only use the provided charging unit or use the USB socket of a computer.
- Use only safe and correctly installed power outlets.
- This device emits GSM/UMTS radio waves. A medical risk has neither been proven nor disproven so far.
- The Emergency call (112 / 911) capability may be limited. So, please carry a working mobile phone with you for placing emergency calls.
- This device can create audible sounds through the built-in speaker or a connected headset. If the acoustic waves are too powerful and/or for a long duration, this may cause hearing damage.
- The device can be used as a recorder and player device. This requires to comply to intellectual property laws.
- Let repairs and maintenance be done only by qualified service persons.

10.2. CE - Declaration of Conformity

NOTE: this is not valid for the GTA04A2/GTA04A3. They have not yet been certified and can therefore only be operated in a lab situation.

Openmoko GTA04 conforms to the European standards

- EN-301 511
- EN 300 328
- EN 300 440-2
- EN 301 489-1
- EN 55022
- EN 55024
- EN 60950-1
- EN 50360
- EN 50361.

It has been assessed by ###. The Registration number is ###.



The device falls in Equipment Class II.

10.3. FCC - not certified!

The device has no FCC approval yet and can't therefore be operated in the US and some other areas.

10.4. ROHS

This device is in compliance with EC Directive 2002/95/EC.

10.5. Allowed WLAN frequency range

Europe/ETSI: Channel 01 - 13

North America: Channel 01 - 11

In some areas of France, there are additional limitations:

10mW for all channels, 100mW only for channel 10-13

Please refer to local information at www.art-telecom.fr

10.6. Recycling / WEEE (ID: DE80183434)



Electronical devices are not allowed to be put into household waste. Please bring it to an appropriate recycling collection system.



Never put the battery into fire.

This device contains a Lilon battery. It is not allowed to be put into household waste. Please bring the device and the battery to an appropriate recycling collection system or return them to us.

10.7. GPL

The product may contain software that is licenced according to the (L)GPL. Since we consider printing the full licence text here as an ecological waste of paper, please refer to it online: <http://www.gnu.org/licenses/gpl.html>

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The liability is limited as far as possible to the sales price of the device. Golden Delicious Computers GmbH&Co. KG is never liable for loss of data or recordings and for consequential losses, such as loss of use, production and loss of profits.

11. Warranty

This device has 24 months warranty according to the rules of the EU.

Up to 2 bad pixels are not covered by warranty.

In case of technical problems, please contact your retail shop.

Golden Delicious Computers GmbH&Co. KG
Buchenstr. 3
82041 Oberhaching
Germany
Amtsgericht München, HRA 89571
<http://www.goldelico.com>
service@godelico.com
Tel +49 (89) 5429 0367
Fax +49 (89) 5429 0377

DRAFT - Subject to Change

12. Schematics

The following pages show the schematics as current when this manual was printed. They are subject to change. And, not all components are necessarily available or used in the device.

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