# Hardware Documentation

## *PicoMODA5*

Version 0.01
(2014-11-13)



# Preliminary

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Elektronik Systeme


Untere Waldplätze 23
D-70569 Stuttgart
Fon: +49(0)711-123722-0
Fax: +49(0)711 – 123722-99

# About This Document

This document describes the hardware of the PicoMODA5. The latest version of this document can be found at http://www.fs-net.de.

# History

| Date | V | Platform | A,M,R | Chapter | Description | Au |
|---|---|---|---|---|---|---|
| 13/11/2014 | | PicoMODA5 | A | - | Hardware documentation, preliminary | KW |
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| | |
|---|---|
| V | Version |
| A,M,R | Added, Modified, Removed |
| Au | Author |

# Table of Content

# 1 Technical Data Connectors

The PicoMODA5 is equipped with a TycoElectronics 5177984-6 (140 pin, 0.8mm) connector from ‘0.8mm Free Height (FH) Connectors’ series.
For position and orientation please look chapter 4 “DimensionsA”

Matching connectors are:
5mm stacking height: TycoElectronics 5177983-6
9mm stacking height: TycoElectronics 5-5179009-6
13mm stacking height: TycoElectronics 5-5179010-6

# 2 Connectors

## 2.1 Counting of the connector pins

The connector plug of PicoMODA5 will be treated as follows.
Pin 1 is marked in Figure 2. The row with pin 1 contains all odd-numbered pins (1, 3, 5, 7 etc.), and corresponding to this, the row without pin 1 contains all even-numbered pins (2, 4, 6, 8 etc.).

## 2.2 IO-Pin limitations

PicoMODA5 is equipped with 45 pins that can be used as digital-IO. Most of these pins are multiplexed, so you have to make sure that these pins are used for one purpose only. For example, if you intend to use IO0 to IO3 you have to make sure that the COM2 is disabled. Additionally there are some IO-Pins which are used internally and whose primary function can’t be disabled completely.

## 2.3 Connector J1 (main connector)

| J1 | | | |
|---|---|---|---|
| **Pin** | **Signal** | **Default Interface** | **Alternative Function** |
| 1 | IO64 | SPI CS | I/O-Pin 64 |
| 2 | IO65 | SPI CLK | I/O-Pin 65 |
| 3 | IO66 | SPI MISO | I/O-Pin 66 |
| 4 | IO67 | SPI MOSI | I/O-Pin 67 |
| 5 | CAN-TX | CAN2.0 TX | |
| 6 | CAN-RX | CAN2.0 RX | |
| 7 | RX- | Ethernet RX- | |
| 8 | TX- | Ethernet TX- | |
| 9 | RX+ | Ethernet RX+ | |
| 10 | TX+ | Ethernet TX+ | |
| 11 | V33 | +3,3V ±5% DC | |
| 12 | V33 | +3,3V ±5% DC | |
| 13 | GND | GND | |
| 14 | GND | GND | |
| 15 | /PONRES | CPU Reset (active low) | |
| 16 | VBAT | +3V … +3,6V DC (Battery buffering RTC) (*) | |
| 17 | IO1 | COM2 TxD | |
| 18 | IO0 | COM2 RxD | |

| J1 | | | |
|---|---|---|---|
| **Pin** | **Signal** | **Default Interface** | **Alternative Function** |
| 19 | IO3 | COM2 RTS | |
| 20 | IO2 | COM2 CTS | |
| 21 | IO5 | COM1 TxD | |
| 22 | IO4 | COM1 RxD | |
| 23 | IO7 | COM3 TxD | I/O-Pin 7 |
| 24 | IO6 | COM3 RxD | I/O-Pin 6 |
| 25 | OTGDM | USB2.0 OTG Dev./Host - | |
| 26 | USBDN | USB2.0 Host - | |
| 27 | OTGDP | USB2.0 OTG Dev./Host + | |
| 28 | USBDP | USB2.0 Host + | |
| 29 | IO9 | I/O-Pin 9 / GPIO5 | |
| 30 | IO8 | USB Host Power On | I/O-Pin 8 |
| 31 | IO11 | I2C SDA | I/O-Pin 11 |
| 32 | IO10 | USB Device Detect | I/O-Pin 10 |
| 33 | IO76 | I/O-Pin 76 | |
| 34 | IO12 | I2C SCL | I/O-Pin 12 |
| 35 | BOOTSEL0 | NC (do not use) | |
| 36 | IO77 | I/O-Pin 77 | |
| 37 | NC | NC (do not use) | |
| 38 | NC | NC (do not use) | |
| 39 | GND | GND | |
| 40 | GND | GND | |
| 41 | IO14 | I/O-Pin 14 / GPIO1 | |
| 42 | IO13 | I/O-Pin 13 / GPIO0 | |
| 43 | IO16 | I/O-Pin 16 / GPIO3 | |
| 44 | IO15 | I/O-Pin 15 / GPIO2 | |
| 45 | IO18 | SD-Card CLK | I/O-Pin 18 |
| 46 | IO17 | I/O-Pin 17 / GPIO4 | |
| 47 | IO20 | SD-Card DAT0 | I/O-Pin 20 |
| 48 | IO19 | SD-Card CMD | I/O-Pin 19 |
| 49 | IO22 | SD-Card DAT2 | I/O-Pin 22 |
| 50 | IO21 | SD-Card DAT1 | I/O-Pin 21 |
| 51 | IO24 | SD-Card Detect | I/O-Pin 24 |
| 52 | IO23 | SD-Card DAT3 | I/O-Pin 23 |
| 53 | IO26 | SD-Card Write Protect | I/O-Pin 26 |
| 54 | IO25 | SD-Card Power Enable | I/O-Pin 25 |
| 55 | IO28 | LCD DEN (Display enable) | I/O-Pin 28 |
| 56 | IO27 | LCD Enable | I/O-Pin 27 |
| 57 | IO30 | LCD VCFL On | I/O-Pin 30 |
| 58 | IO29 | LCD VLCD On | I/O-Pin 29 |
| 59 | GND | GND | |
| 60 | IO31 | LCD VEEK | I/O-Pin 31 |
| 61 | VIO0 | LCD VD0 | I/O-Pin 32 |
| 62 | GND | GND | |
| 63 | VIO2 | LCD VD2 | I/O-Pin 34 |
| 64 | VIO1 | LCD VD1 | I/O-Pin 33 |
| 65 | VIO4 | LCD VD4 | I/O-Pin 36 |
| 66 | VIO3 | LCD VD3 | I/O-Pin 35 |
| 67 | VIO6 | LCD VD6 | I/O-Pin 38 |
| 68 | VIO5 | LCD VD5 | I/O-Pin 37 |
| 69 | VIO8 | LCD VD12 | I/O-Pin 40 |
| 70 | VIO7 | LCD VD7 | I/O-Pin 39 |
| 71 | VIO10 | LCD VD14 | I/O-Pin 42 |
| 72 | VIO9 | LCD VD13 | I/O-Pin 41 |
| 73 | VIO12 | LCD VD18 | I/O-Pin 44 |
| 74 | VIO11 | LCD VD15 | I/O-Pin 43 |
| 75 | VIO14 | LCD VD20 | I/O-Pin 46 |

| J1 | | | |
|---|---|---|---|
| **Pin** | **Signal** | **Default Interface** | **Alternative Function** |
| 76 | VIO13 | LCD VD19 | I/O-Pin 45 |
| 77 | VIO16 | LCD VD22 | I/O-Pin 48 |
| 78 | VIO15 | LCD VD21 | I/O-Pin 47 |
| 79 | VIO18 | LCD VLINE | I/O-Pin 50 |
| 80 | VIO17 | LCD VD23 | I/O-Pin 49 |
| 81 | VIO20 | LCD VM | I/O-Pin 52 |
| 82 | VIO19 | LCD VFRAME | I/O-Pin 51 |
| 83 | GND | GND | |
| 84 | GND | GND | |
| 85 | GND | GND | |
| 86 | VIO21 | LCD VCLK | I/O-Pin 53 |
| 87 | IO70 | I/O-Pin 70 | |
| 88 | IO71 | I/O-Pin 71 | |
| 89 | NC | NC )*1 | PTA12 )*2 GPIO |
| 90 | IO72 | I/O-Pin 72 | |
| 91 | NC | NC )*1 | PTA17 )*2 GPIO |
| 92 | NC | NC )*1 | PTD29 )*2 GPIO |
| 93 | IO73 | I/O-Pin 73 | |
| 94 | IOxx | I/O-Pin | |
| 95 | IOxx | I/O-Pin | |
| 96 | NC | NC )*1 | PTD30 )*2 GPIO |
| 97 | NC | NC )*1 | PTA23 )*2 GPIO |
| 98 | IO74 | I/O-Pin 74 | |
| 99 | NC | NC )*1 | PTB10 )*2 GPIO |
| 100 | NC | NC )*1 | |
| 101 | NC | NC )*1 | PTB8 )*2 GPIO |
| 102 | NC | NC )*1 | |
| 103 | NC | NC )*1 | PTB12 )*2 GPIO |
| 104 | NC | NC )*1 | PTD31 )*2 GPIO |
| 105 | NC | NC )*1 | PTB13 )*2 GPIO |
| 106 | NC | NC )*1 | PTB23 )*2 GPIO |
| 107 | NC | NC )*1 | PTB18 )*2 GPIO |
| 108 | NC | NC )*1 | PTB26 )*2 GPIO |
| 109 | NC | NC )*1 | |
| 110 | NC | NC )*1 | PTB2 )*2 GPIO |
| 111 | NC | NC )*1 | VADCSE0 )*2 analog Video In |
| 112 | NC | NC )*1 | AUD_I2C_DAT )*2 for ext. Audiocodec |
| 113 | NC | NC )*1 | VADCSE1 )*2 analog Video In |
| 114 | NC | NC )*1 | AUD_I2C_CLK )*2 for ext. Audiocodec |
| 115 | NC | NC )*1 | VADCSE2 )*2 analog Video In |
| 116 | NC | NC )*1 | CLKOUT2 )*2 for ext. Audiocodec |
| 117 | NC | NC )*1 | VADCSE3 )*2 analog Video In |
| 118 | NC | NC )*1 | I2S_LRCLK )*2 for ext. Audiocodec |
| 119 | NC | NC )*1 | DACO0 )*2 DAC out |
| 120 | NC | NC )*1 | I2S_SCLK )* for ext. Audiocodec 2 |
| 121 | NC | NC )*1 | DACO1 )*2 DAC out |
| 122 | NC | NC )*1 | I2S_DOUT )*2 for ext. Audiocodec |
| 123 | NC | NC )*1 | RMII_TXD0 )*2 for ext. LAN Phy |
| 124 | NC | NC )*1 | I2S_DIN )*2 for ext. Audiocodec |
| 125 | NC | NC )*1 | RMII_TXEN )*2 for ext. LAN Phy |
| 126 | IO75 | I/O-Pin 75 | |
| 127 | NC | NC )*1 | RMII_CLK )*2 for ext. LAN Phy |
| 128 | ETH-ACT | Ethernet Activity | |
| 129 | STA1 | Status 1 | |
| 130 | STA2 | Status 2 | |
| 131 | LOUT | Audio Left Out | |
| 132 | ROUT | Audio Right Out | |

| J1 | | | |
|---|---|---|---|
| **Pin** | **Signal** | **Default Interface** | **Alternative Function** |
| 133 | LIN | Audio Left In | |
| 134 | RIN | Audio Right In | |
| 135 | MICIN | Microphone In | |
| 136 | MICBIAS | Microphone Bias | |
| 137 | X+ | Touch X+ | |
| 138 | X- | Touch X- | |
| 139 | Y+ | Touch Y+ | |
| 140 | Y- | Touch Y- | |

)*1 PMODA5 does not support Adress-/ Data bus. We recommend to use PMODA9 for this feature
)*2 Alternative function on this pin. Just available as mounting option. Function is not supported by PMOD Startinterface. Please contact our technical support for using this function.

See PicoMOD Starter kit documentation for connection examples.
See software documentation for configuration of alternative functions.

## 2.4 microSD connector

The on board microSD connector can be used on same time as the SD interface on J1.
There is no sharing with any signal of the connector J1. There is no hot plug detection for this connector, so the software can't detect a card insert after switching on the board.

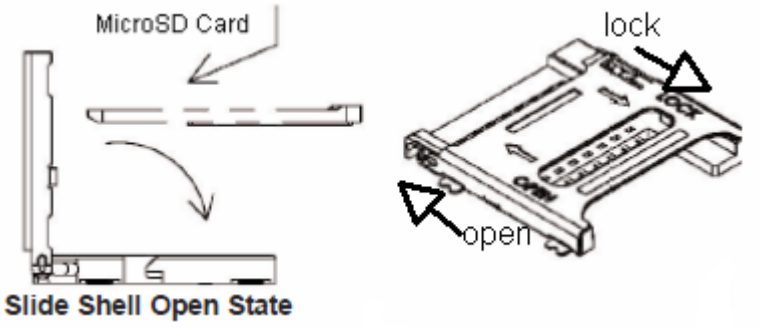


*Figure 1: microSD connector*

# 3 Interface and Signal description

## 3.1 Ethernet connection

LAN TX+/- and RX+/- are 100 ±20% Ohm differential pairs to a 1:1/1:1 transformer. We recommend a connector with integrated transformer in short distance (less than 4 inch = 100 mm) to the module connector. The RX pair should have a 0.2 inch min. distance to TX pair to avoid crosstalk. The intra pair mismatch of each differential pair should be <50 mil (1.27mm). Please also refer our "Ethernet Routing Guidelines" on our web download area and refer the comments at our forum.
The LED signals are low active to drive a 3.3V powered LED with 5mA directly.
If Ethernet is not used please leave signals unconnected.

## 3.2 Serial port

Serial ports are provided with 3.3V TTL signals. These signals are not 5V compliant. Please use a transceiver with 3.3V power supply.
If you don't need the serial port this pins can be used optional as GPIOs.

## 3.3 USB Host

The 90 Ohm differential pair of USB signals doesn't need any termination. For external ports EMV protection is required nearby the USB connector.
With the USB_PWR signal you can switch on the USB power on your current limiting IC.
From the usb.org webpage you can download "High Speed USB Platform Design Guidelines" which provides highly recommended information for a proper working USB design.
If the USB port is not used please leave open.

## 3.4 USB device

The 90 Ohm differential pair of USB signals doesn't need any termination. For external ports ESD and EMV protection is required nearby the USB connector.
The USB_CNX signal is for detecting a connection to a host. This signal connects directly to the USB 5V power (4.75 - 5.25V). A buffer can be added to prevent excessive current flow from the USB connector to the board.
From the usb.org webpage you can download "High Speed USB Platform Design Guidelines" which provide highly recommended information for a proper working USB design.
If the USB device port is not used please leave open.

## 3.5 SPI

The module supports a HS SPI (Serial Peripheral Interface) with a chip select. Signals are 3.3V compliant.

## 3.6 I2C

The module supports an I2C interface. Signals are 3.3V compliant and don't have pull-ups on module. Please add 2.2 kOhm pull-ups to 3.3V on baseboard. 5V devices on baseboard need a level shifter.

## 3.7 CAN

The module provides the CAN TX and CAN RX signals with 3.3V TTL level
The RX signal has an internal pull-up and can be left unconnected when not used.
A 3.3V transceiver like SN65HVD230 is needed to connect to the CAN bus.

## 3.8 SD card

The interface is supporting a SD card channel. For specification and licensing please refer the website of the SD Association http://www.sdcard.org. Pull-ups are integrated on the module. Signals are 3.3V compliant.
Unused signals should be left unconnected.
Signals can be optional used as GPIO.

## 3.9 Touch

The integrated resistive touch controller will support 4 wire analog resistive touch panels without any additional circuit.

## 3.10 Audio I/F

The onboard sound codec supports an analog stereo input and an analog stereo output with 1 $V_{RMS}$ signal level. These signals need serial capacitors.

## 3.11 IO/ IRQ

Multiple general purpose pins with 3.3V logic signal level.

## 3.12 /PONRES

Reset input. Drive with open drain or open collector 3.3V compliant signal. We recommend to pull low this pin with the powergood signal from power supply or using a voltage supervisor. For proper function this signal must be connected.

# 4 Dimensions

| | |
|---|---|
| Board thickness: | 1.6 mm |
| Height of parts on top side: | 3.0 mm |
| Height of parts on bottom side (without connectors): | 2.0 mm |
| Pin pitch of connector: | 0.8 mm |
| Mounting hole diameter: | 2.8 mm |

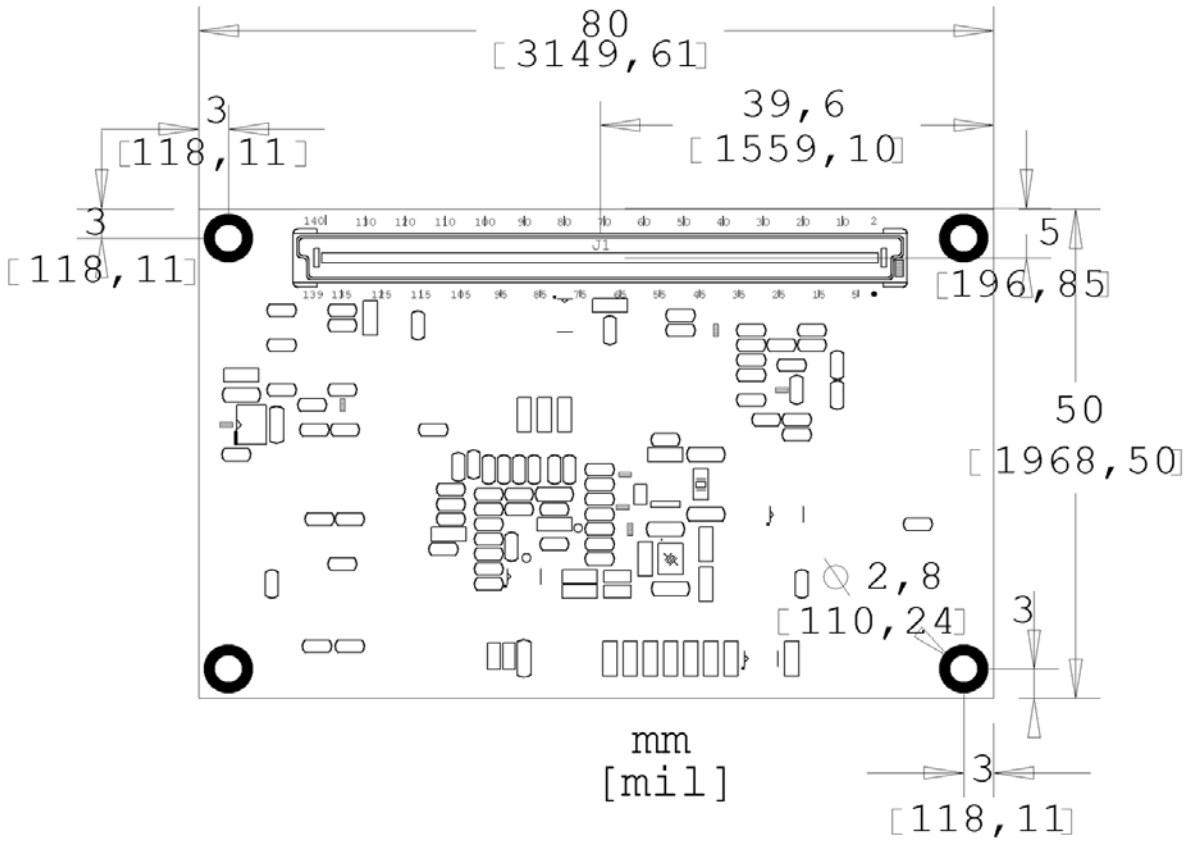


*Figure 2: Bottom view – dimension*

All values can have tolerances of ±0,5mm.
To avoid EMC and ripple pickup the mounting holes are isolated and not connected to any voltage.

# 5 Technical Data

| | |
|---|---|
| Power Supply: | +3.3V DC / ±5% |
| Power supply VBAT | 2.0 … 3.6 V |
| Inputs/Outputs: | max. 45 I/O lines<br>(shared with dedicated interfaces) |
| Touch-Screen: | 4 wire touch input, resistive |
| Interfaces: | 1x Ethernet 10/100Mbit<br>3x Serial with 3,3V-level (1x with RTS/CTS) or 4x Serial without RTS/CTS<br>1x USB2.0 Device or USB2.0Host (high speed 480Mbit/s)<br>1x USB2.0 Host (high speed 480Mbit/s)<br>1x CAN2.0<br>1x I2C<br>1x SPI<br>1x Audio (Line in, Line out, Micro in)<br>1x microSD slot onboard<br>1x SD-Card (external)<br>TFT LCD-interface: 1x 18bit RGB |
| RAM: | 256 MByte DDR3-RAM |
| Flash: | 128 MByte Flash |
| CPU: | Freescale Vybrid |
| Operating Temperature: | 0°C … +85°C |
| Dimensions (l x w x h): | 80 x 50 x 4 mm without connector<br>80 x 50 x 8 mm with connector |
| Weight: | 20 gr. |

## 5.1 Power

| | |
|---|---|
| Power supply: | 3.3V +/- 5% |
| Maximum power consumption[1)]: | 1 A |
| Capacitor charge current on power on: | 1.5 A |
| Typical Current Consumption @25°C | |
| • Desktop Idle: 290 mA | |
| • CPU full load: 370 mA | |
| Power supply RTC battery: | 2.0 … 3.6 V |
| Power consumption @25°C: | typ. 10µA<br>max. 45µA |

1) Theoretical value, Summary of max. datasheet value all chips on module w/o SD card, LCD, USB, backplane logic & transceiver.

Power consumption of connected devices like display, USB devices, SD card has to be added for power calculation.
F&S doesn't guarantee the above values. They are only presented for informational use. Customer has to check power requirement in customer's application.

## 5.2 DC electrical characteristics for 3.3V IO pins

VDD= 3.3V +/- 5%

| Parameter | Description | Condition | Min | Max | Unit |
|---|---|---|---|---|---|
| Vih | High Level Input Voltage | | 0.7*VDD | VDD+0.3 | V |
| Vil | Low Level Input Voltage | | -0.3 | 0.3*VDD | V |
| Voh | High Level Output Voltage | Ioh=-100µA | VDD-0.2 | | V |
| Vol | Low Level Output Voltage | Ioh=100µA | | 0.2 | V |
| Io | Output current | VDD=3.3V | | 2.6 | mA |

## 5.3 ESD and EMI requirements

Because there is no connector to „out of case“ there is no ESD protection for any interface. It needs ESD protection on every connector out of the case on your baseboard.
To reduce EMI the PicoMOD1.2 supports Spread spectrum. This will normally reduce EMI between 9 and 12 dB and so this decrease your shielding requirements. We strictly recommend having your baseboard with controlled impedance and wires as short as possible.

# 6 Storage conditions

Maximum storage on room temperature with non-condensing humidity: 6 months
Maximum storage on controlled conditions 25 ±5 °C, max. 60% humidity: 12 months
For longer storage we recommend vacuum dry packs.

# 7 Appendix

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# Figures