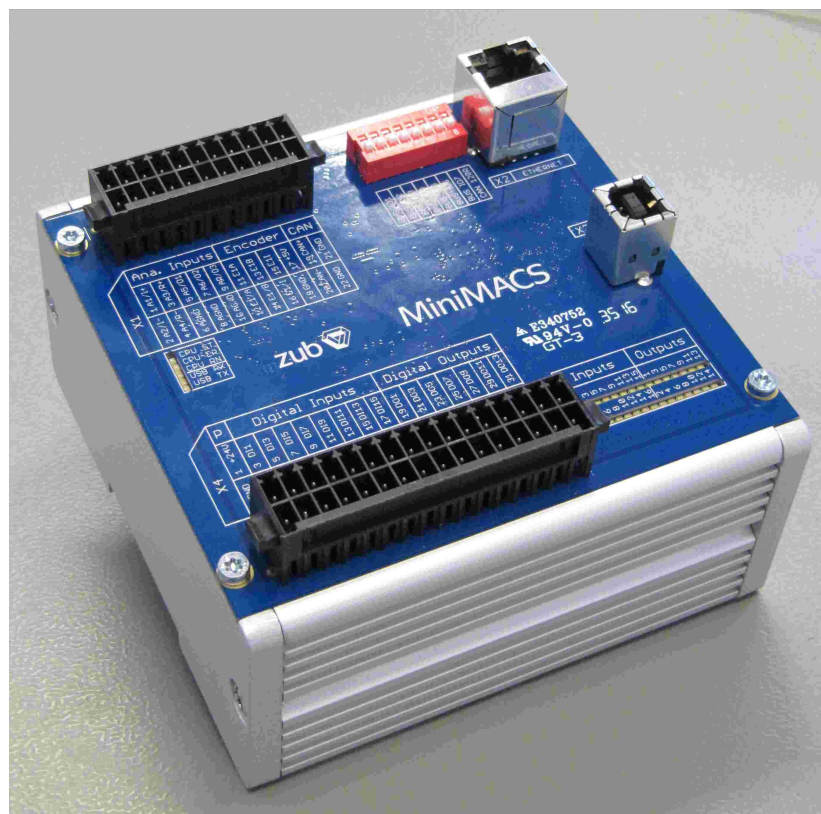# MiniMACS
# Quick Hardware Reference:
# Connectors & Wiring

## Version 1.1

Document number:
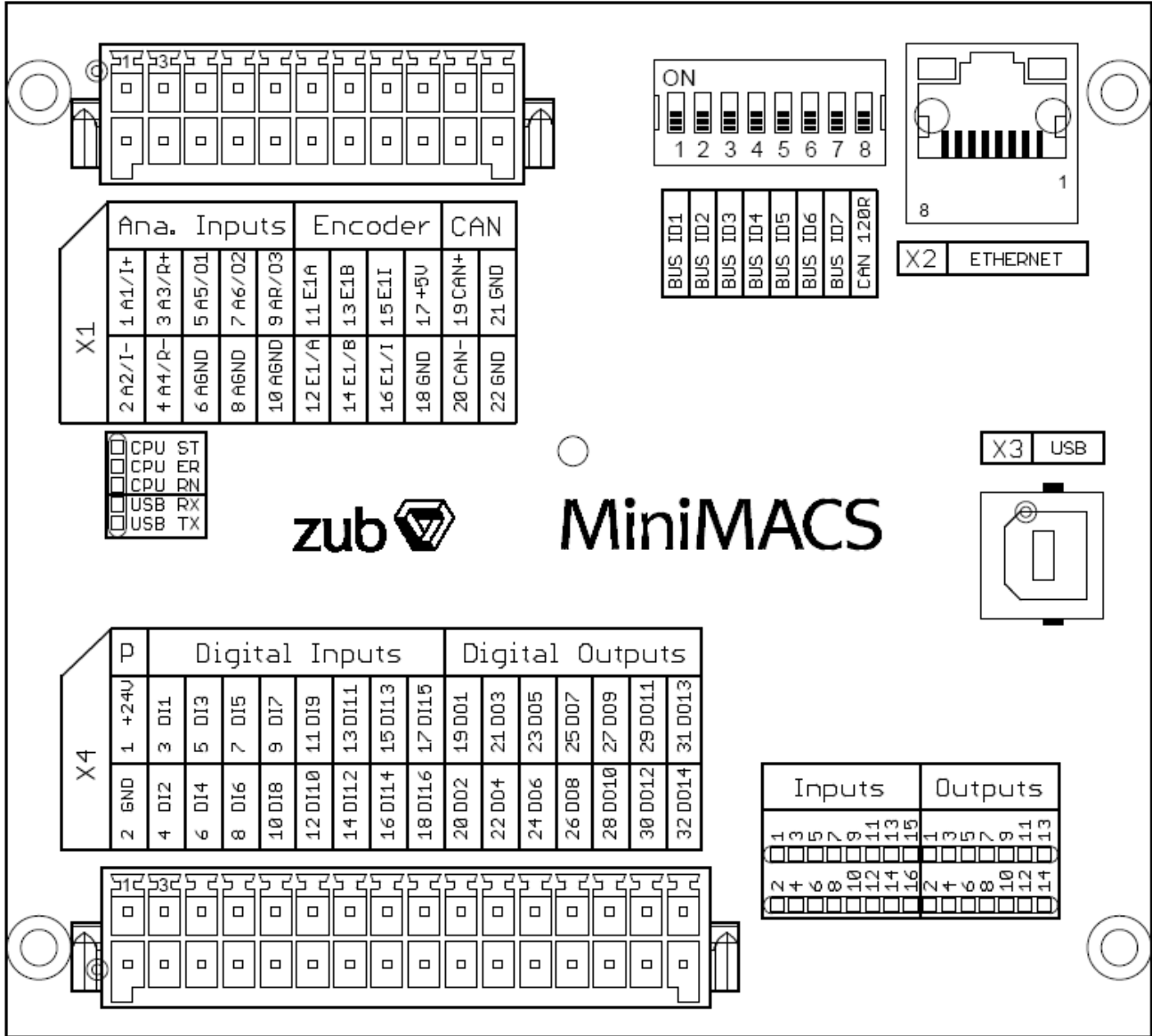
-



Author:
Adrian Küng
ak@zub.ch
zub machine control AG

Date of Creation:
21 February 2017
Date of last Saving:
24 April 2018
Total number of pages:
12

# Table of contents
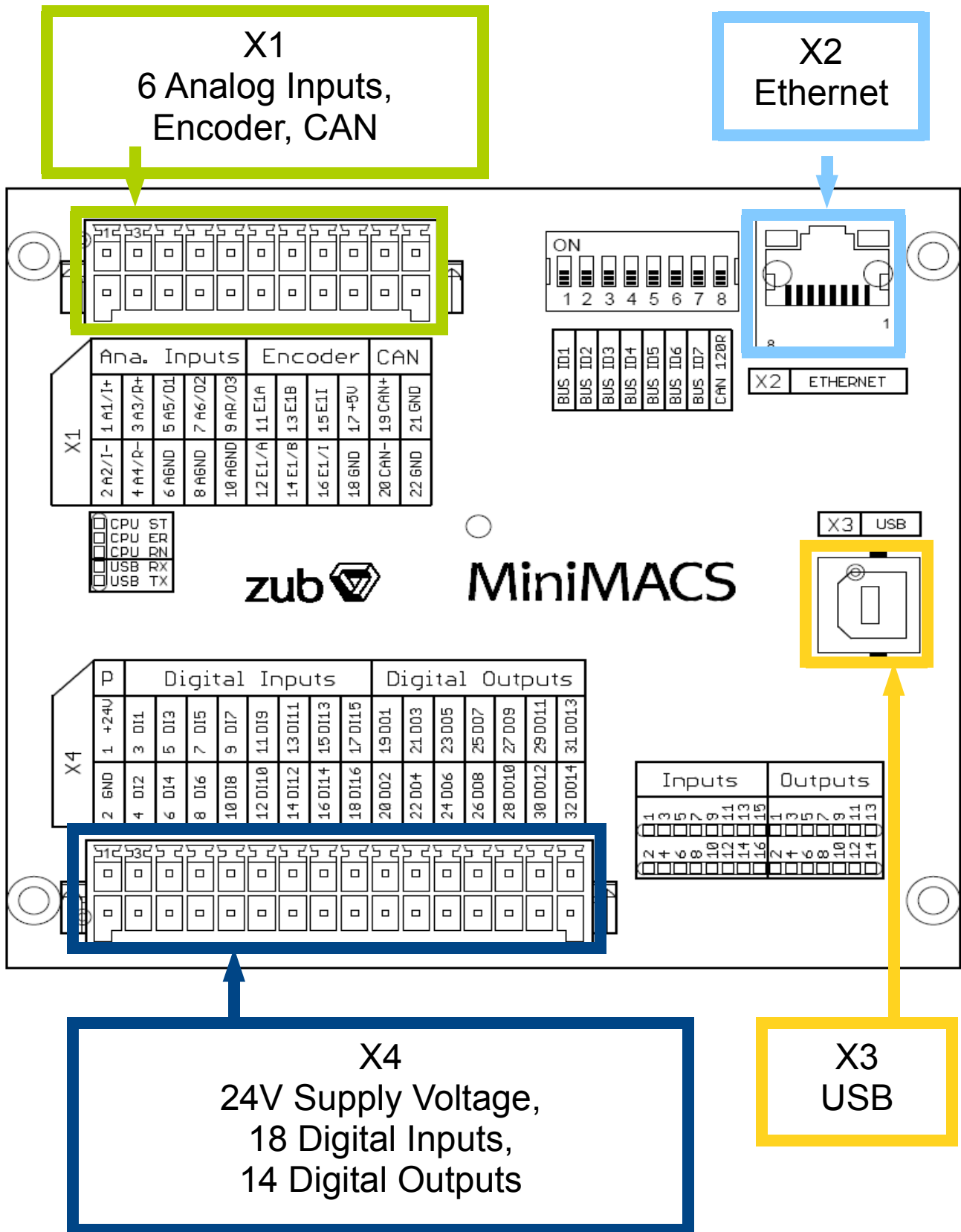
# 1 MiniMACS – A quick glance

## 1.1 MiniMACS – Topview

## 1.2 MiniMACS – Connector Overview



**X1**
6 Analog Inputs,
Encoder, CAN

**X2**
Ethernet

**X4**
24V Supply Voltage,
18 Digital Inputs,
14 Digital Outputs

**X3**
USB
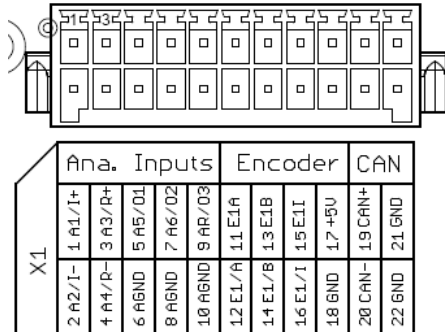
# 2 Connectors

## 2.1 X1: Analog Inputs / Encoder / CAN, without an installed analog option card



Print circuit board terminal:    WAGO 713-1411/037-000, male, 22 pin, RM3.5
Suitable wire connector:    WAGO 713-1111/037-000, female, 22 pin, RM3.5

| Pin | Name | Type | Meaning | Remark (just valid, if no I/O-option is installed!) |
|---|---|---|---|---|
| 1 | A1/I+ | Input | Analog input 1 | 0 - 10V, 11Bit, 280kΩ, 0-50mV dead zone |
| 2 | A2/I- | Input | Analog input 2 | 0 - 10V, 11Bit, 280kΩ, 0-50mV dead zone |
| 3 | A3/R+ | Input | Analog input 3 | 0 - 10V, 11Bit, 280kΩ, 0-50mV dead zone |
| 4 | A4/R- | Input | Analog input 4 | 0 - 10V, 11Bit, 280kΩ, 0-50mV dead zone |
| 5 | A5/O1 | Input | Analog input 5 | 0 - 10V, 11Bit, 280kΩ, 0-50mV dead zone |
| 6 | AGND | n.c. | not in use | not connected => No special analog GND |
| 7 | A6/O2 | Input | Analog input 6 | 0 - 10V, 11Bit, 280kΩ, 0-50mV dead zone |
| 8 | AGND | n.c. | not in use | not connected => No special analog GND |
| 9 | AR/O3 | n.c. | not in use | not connected |
| 10 | AGND | n.c. | not in use | not connected => No special analog GND |
| 11 | A | Input | Encoder channel A | +5V Encoder signal level only! |
| 12 | /A | Input | Inverted A signal | +5V Encoder signal level only! |
| 13 | B | Input | Encoder channel B | +5V Encoder signal level only! |
| 14 | /B | Input | Inverted B signal | +5V Encoder signal level only! |
| 15 | I | Input | Encoder channel Index | +5V Encoder signal level only! |
| 16 | /I | Input | Inverted Index signal | +5V Encoder signal level only! |
| 17 | +5V | Power Output | +5V supply for the encoder | +5V, max. 200mA<br>Do NOT link to another +5V supply!<br>e.g. if a servo drive powers the encoder |
| 18 | GND | GND | GND | Signal GND |
| 19 | CAN+ | Data | CAN High signal line | |
| 20 | CAN- | Data | CAN Low signal line | |
| 21 | GND | GND | GND | Signal GND |
| 22 | GND | GND | GND | Signal GND |

List 2.1-1: Pin configuration connector X1

Remarks:
- There is a low end dead zone in the range of 0 - 50mV, i.e. measurements below 50mV are not accurate.
- The internal resolution of the A/D conversion is actually 11.5 Bit. Please check the APOSS manual for the actual bit resolution and scaling in use by the APOSS command INAD.
- If no I/O-option is installed, there are no AGND pins available. Please use one of the GND pins of the connectors X1 instead.
- Due to much better EMC immunity it is strongly recommended to use only encoders with inverted signals, so called differential types (RS422).
- If the encoder is linked to the MiniMACS and a servo amplifier, make sure that the encoder supply voltage (+5V) is just provided by one of the units. Do NOT link the +5V of the MiniMACS to the +5V provided by another device.
- If the encoder signals are provided by a servo amplifier (e.g. by an internal resolver to encoder conversion of the servo drive), the +5V supply must NOT be connected!
- The CAN node ID has to be configured by the DIP switches 1 – 7.
- The DIP switch 8 activates / deactivates the bus termination of the CAN bus.

Please find more information about CAN node ID address configuration and the termination in chapter 3 "DIP switches for and Ethernet configuration".

Please refer to the MiniMACS data sheet or technical manual for more information about the technical data.

## 2.2 X1: Analog Input / Outputs, with option -IO1- (= 1 analog input + 3 analog outputs)
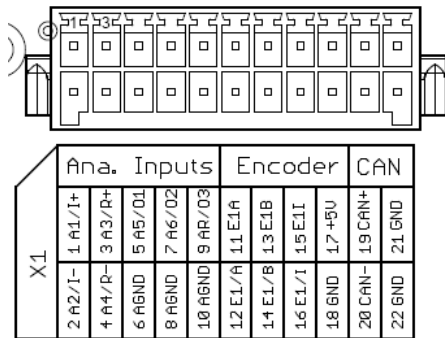


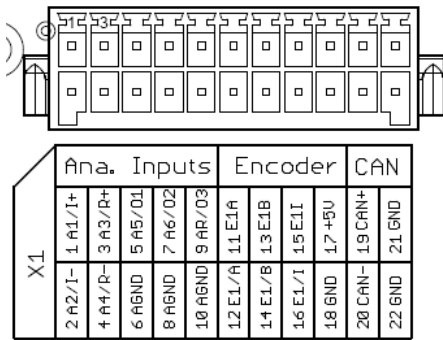| Pin | Name | Type | Meaning | Remark (just valid, if no I/O-option is installed!) |
|---|---|---|---|---|
| 1 | A1/I+ | Input | Differential analog input | -10V … +10V (pin 1 <-> 2), 12 Bit |
| 2 | A2/I- | Input | Differential analog input | -10V … +10V (pin 1 <-> 2), 12 Bit |
| 3 | A3/R+ | Ref.Out | +10V reference output | Reference only: +10V, +/-2.5%, 15mA |
| 4 | A4/R- | Ref.Out | -10V reference output | Reference only: -10V, +/-2.5%, 15mA |
| 5 | A5/O1 | Output | Set value for drive 1 | +/-10V, +/-1%, 12 Bit, set value -> drive 1 |
| 6 | AGND | AGND | Analog GND | Signal common of drive 1 command |
| 7 | A6/O2 | Output | Set value for drive 2 | +/-10V, +/-1%, 12 Bit, set value -> drive 2 |
| 8 | AGND | AGND | Analog GND | Signal common of drive 2 command |
| 9 | AR/O3 | Output | Set value for drive 3 | +/-10V, +/-1%, 12 Bit, set value -> drive 3 |
| 10 | AGND | AGND | Analog GND | Signal common of drive 3 command |
| 11 - 22 | Encoder CAN | | | For details see capitle "2.1. X1: Analog Inputs / Encoder / CAN, without an installed analog option card" |

*List 2.2-1: Pin configuration connector X1*

Remarks:
- The -IO1- option card is identical with the one in use by the former products MACS4-...-ANA and MACS5-…-IO1-.
- The -IO1- option card consists of a reference voltage source, one differential analog input (+/-10V), and three analog outputs (+/-10V).
- The -IO1- option card is typically in use to command servo amplifiers or frequency converters by +/-10V signals.
- Default system configuration:
  - A5/O1 is linked to drive 1
  - A6/O2 is linked to drive 2
  - AR/O3 is linked to drive 3

  Each analog output provides a +/-10V output signal to command a servo drive or frequency converter.
- If drives are in use, that are commanded by CAN or EtherCAT bus, the corresponding configuration for each drive has to be done by the application program. Please refer to the APOSS manual to learn more about the configuration of related parameters.

Please refer to the MiniMACS data sheet or technical manual for more information about the technical data of the digital outputs

## 2.3 X1: Analog Inputs, with option -IO2- (= 6 high resolution analog inputs)



| Pin | Name | Type | Meaning | Remark (just valid, if no I/O-option is installed!) |
|---|---|---|---|---|
| 1 | A1/I+ | Input | Analog input 1 | 0 - 10V, 13Bit, 280kΩ |
| 2 | A2/I- | Input | Analog input 2 | 0 - 10V, 13Bit, 280kΩ |
| 3 | A3/R+ | Input | Analog input 3 | 0 - 10V, 13Bit, 280kΩ |
| 4 | A4/R- | Input | Analog input 4 | 0 - 10V, 13Bit, 280kΩ |
| 5 | A5/O1 | Input | Analog input 5 | 0 - 10V, 13Bit, 280kΩ |
| 6 | AGND | AGND | not in use | Analog signal GND |
| 7 | A6/O2 | Input | Analog input 6 | 0 - 10V, 13Bit, 280kΩ |
| 8 | AGND | AGND | not in use | Analog signal GND |
| 9 | AR/O3 | Ref.Out | +10V reference output | Reference: 10V typ., 13mA, ratiometric |
| 10 | AGND | AGND | not in use | Analog signal GND |
| 11 - 22 | Encoder CAN | | | For details see capitle "2.1. X1: Analog Inputs / Encoder / CAN, without an installed analog option card" |

*List 2.3-1: Pin configuration connector X1*

Remarks:
- The -IO2- option card is identical with the one in use by the former product MACS5-…-IO2-.
- The -IO2- option card consists of six analog in puts (0-10V), a ratiometric reference voltage and an integrated contact break detection.
- The -IO2- option card offers a higher resolution and a more accurate A/D conversion, than the standard analog inputs (if no analog option card is mounted).
- The -IO2- option card is typically in use, if analog devices (e.g. potentiometers) provide feedback signals, which have to be processed by the motor control loop or position profile generator.
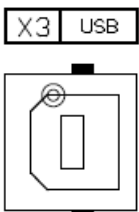
## 2.4 X2: Ethernet
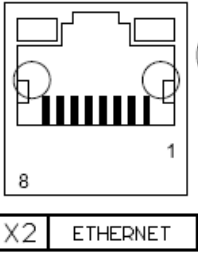


Remarks:
- The MiniMACS is an Ethernet slave device. The MiniMACS can be connected directly (or by a Ethernet hub) to a PC.
- The MiniMACS can not handle other Ethernet slave devices, like cameras or printers by its own.

Please find more information about Ethernet IP address configuration in chapter 3 "DIP switches for and Ethernet configuration".
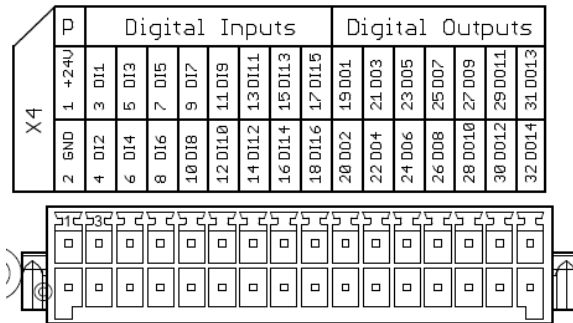
## 2.5 X3: USB



Remarks:
- The MiniMACS is a USB slave device. The MiniMACS can be connected directly (or by a USB hub) to a PC.
- The MiniMACS can not handle other USB slave devices, like cameras, scanners, or bar code readers by its own.

## 2.6 X4: Digital Inputs / Outputs



Print circuit board terminal:   WAGO 713-1416/037-000, male, 22 pin, RM3.5
Suitable wire connector:   WAGO 713-1116/037-000, female, 22 pin, RM3.5

| Pin | Name | Type | Meaning | Remark |
|---|---|---|---|---|
| 1 | +24V | Supply | Supply voltage for powering the MiniMACS | +24V DC, +/-20% |
| 2 | GND | GND | GND of power supply | |
| - 16 | DI1 - DI16 | Signal Input | Digital sensor signal inputs | Low: <4,6 V / High: >18 V, max. 45 V, max. 1 kHz All types of sensors with 24V signal level can be linked to the digital inputs. |
| 19 - 32 | DO1 - DO14 | Signal Output | Digital Outputs | 24V DC output signals, max. 100mA pull up each |

*List 2.6-1: Pin configuration connector X8*

Remarks:
- The functionality and usage of each input is defined by the application program or a global parameter configuration (see -> I_REFSWITCH, I_POSLIMITSW, I_NEGLIMITSW). Therefore it is possible to use any input for any functionality.
- Application specific functionality can be part of the application code and called up by an interrupt handler for example.
- The assignment of the output lines to a special functionality, like error state messaging or brake control, is NOT pre-configured.
- If a special functionality has to be linked to one or more of the outputs, this has to be done by the MACS parameter settings (-> O_BRAKE, O_AXMOVE, O_ERROR) or directly controlled by the application program. Therefore it is possible to use any output for any information.

Please refer to the MiniMACS data sheet or technical manual for more information about the technical data of the digital inputs and outputs.

# 3  DIP switches for CAN and Ethernet configuration
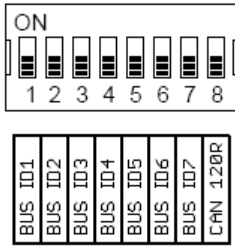


The DIP switches are in use to configure the CAN ID and bus termination, as well as the Ethernet IP address setting, if required.

Configuration of CAN bus:
- The DIP switches 1 - 7 define the CAN node ID of the MiniMACS,
- The DIP switches 8 is in use to activate / deactivate the bus termination of the CAN bus.

Find more information about the CAN bus connectors and the pin assignment in chapter 2.1 "X1: X1: Analog Inputs / Encoder / CAN, without an installed analog option card".

Configuration of Ethernet IP address:
- The default IP address is 172.16.1.xx, where xx corresponds to the setting of the DIP switches 1 - 7. This means, that the last two hex digits of the IP address equal the CAN node ID.
- The global parameters "IPADDRESSMODE" (par.no. 20) and "IPSUBNET" (par.no. 21) can be used to set up the IP address by software without evaluation of the DIP switches. This gives full flexibility to configure the IP address independent of the CAN node ID configuration by the DIP switches.

    Meaning of the parameter "IPADDRESSMODE":
    0:      The IP address is set to IPSUBNET + DIP Switch (default)
    -1:     DHCP mode
    1 – 255: The IP address is set to IPSUBNET + n

    The current active IP address can be readout by SDO 0x2209 / 14.

Find more information about the Ethernet connector in chapter 2.1 "X1: X1: Analog Inputs / Encoder / CAN, without an installed analog option card".

Please refer to the APOSS manuals to find more information about related the configuration parameter settings.

# 4  Status LED



9 LEDs returns a feedback about input, output, software and hardware states.

| LED | Colour | Meaning | Remark |
|---|---|---|---|
| CPU RN | green | Device is running | Active, if internal 3V3 supply is powered up. |
| CPU ST | yellow | Motor control status | Active, if an application is running. |
| CPU ER | red | Error occurred | Active, if the application detects an error. |
| Inputs 1 - 16 | yellow | Status of digital inputs | Active, if 24V is delivered to the input. |
| Outputs 1 - 14 | yellow | Status of digital outputs | Active, if 24V is delivered to the output. |

*List 4-1: Status LED*

# 5  Further information

Please refer to the MiniMACS data sheet, technical manuals, and the online documentation of the APOSS integrated development enviroment for more detailed information.

If you have any questions or you want to discuss your application and the best way to solve your requirements, please feel free to contact us:

zub machine control AG
Buzibachstrasse 31
6023 Rothenburg
SWITZERLAND

Tel.: +41 - (0)41 - 541 50 40
Fax: +41 - (0)41 - 541 50 49

e-mail: info@zub.ch
Website: www.zub.ch