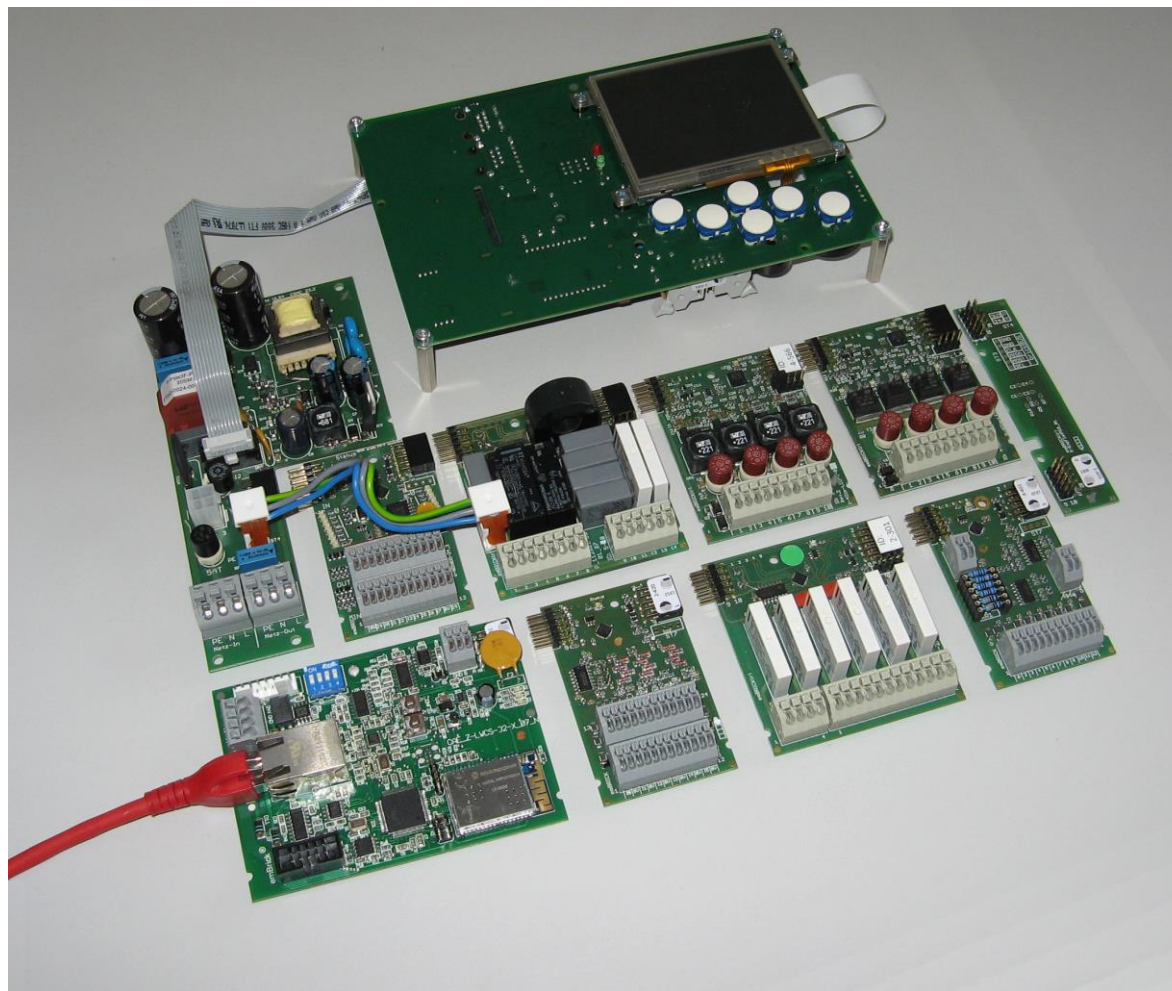


emBRICK® - EPC

Embedded Patch-board Controller



Application Examples

Rev. 7p

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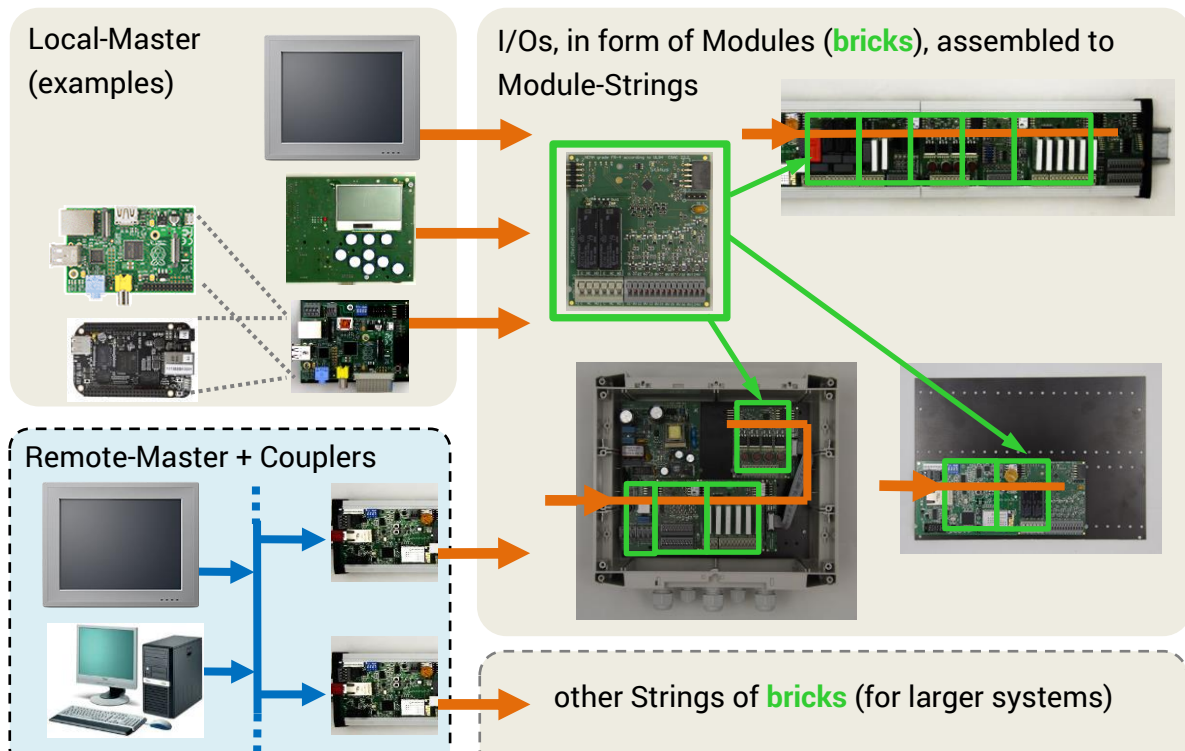
1. The emBRICK® Mission

The mission of *emBRICK®* is an **open** and **free** I/O system to ...

build **compact** and **industrial suited** electronic **control systems**
by **assembling** small **existing/own** embedded **boards** (**bricks**) ...

... via a SPI-based **local interface** and optional **remote buses** (LAN, WLAN, CAN, RSxxx, ...).

We call this new class of controllers simple **EPC** (= **E**mbedded **P**atch-board **C**ontroller).



emBRICK® combines in a perfect way the **cost-efficient** and **tailored** characteristics of a dedicated embedded system with the **ready to use** and **flexibility** of a PLC system.

To ensure a high acceptance, it is an open and free system. I.e. besides buying existing devices, everyone can develop his own components to realize easily his individually tailored, cost-efficient and industrial-suited measure and control system.

1.1 Typical Applications

- Small, medium and large size **measure and control systems**
- **Sectoral purpose**, with direct sensor/actor interface
- **Autonomous single box** control solutions i.e. with HMI and communication interfaces
- **Rapid hardware prototyping** system for control and measuring applications
- **PLC replacement** (i.e. with a Soft-PLC, IPC or an embedded controller)
- Medium and large size **distributed IO-systems** (i.e. building automation)
- Physical front-end for **IoT** (Internet of Things)

For more details see *Product_Catalogue* and *Application_Manual*.

1.2 Basic Characteristics

- **free** - also for commercial use in own appliances (for pure EMS with a license fee)
- **open** - supplying reference schematics, protocol source code, samples and starter kits
- **adaptable** to all systems, using common, low cost standard μ Cs/components
- **half ... third price** compared to common control systems (complete system view)
- scalable local and remote topologies, **1 ... >1000 I/Os**, up to **1ms update**, deterministic
- **low own power** consumption, average 50mW/slave module in operation (outputs inactive)
- global and sector specific modules for **direct connection** of various **sensors and actors**
- **easy installation**, no configuration necessary, simple plug modules together and use
- works with / programmable by **various established**, well known **platforms / languages**

1.3 Available Hardware Products

Beside own developments, currently the following components are available from IMACS:

Slave-Modules > 50 different modules for the sectors: General Purpose, Building Automation, Process Control (Safety, Medical/Analytics planed)

Master boards Core: Cortex-M3/4, ARM9/11, PIC24/32; HMI: 128x64 ... WVGA

Adaption boards for LAN, WLAN, CAN, RSxxx, Raspberry Pi, Beaglebone Black

Appliances / Enclosures ready Single Box Controller for and top-het rail and wall mounting

Starterkits for MSVC, CODESYS, Raspberry Pi, Beaglebone Black

1.4 Available Host Platforms, Connectivity

emBRICK® can be adapted to all platforms with almost every footprint/performance. For master units, currently the following system implementations are available (others planed):

Computer platforms PC, Embedded-PC, Module-PC, Raspberry Pi, Beaglebone Black

μ Controller platforms ARM-Ax, ARM-Cortex-Mx, Microchip PIC24 / PIC32

Host Interfaces Ethernet, CAN, RS232, RS485

Wireless Interfaces WLAN

1.5 Available Programming Platforms

emBRICK® can be programmed by various systems, languages and IDEs (integrated development interface). Currently for master units the following systems are available (others planed):

OS / RTOS Windows, Linux, FreeRTOS, proprietary

Programming languages C, C++, IEC61131, Model-based (by implementing UML)

Model-based / Soft-PLC CODESYS, radCASE, Enterprise Architect

C/C++ IDEs MSVC, Cocox (GCC), MPLab (Microchip), Geany (Raspberry Pi), every other C/C++ IDE

2. Introduction

2.1 About this Manual

This manual contains basic system, architectural and topological information of *emBRICK®* and its communication technology *brickBUS®* with the focus on planners and users.

2.2 References / Manual Overview

For *emBRICK®* and *brickBUS®* the following documents are available. Before reading this document it is recommended to read them in the given order:

For *emBRICK®* and *brickBUS®* the following documents are available. Before reading this document it is recommended to read them in the given order:

- [System Manual](#)(*embrick_System-Manual_#.pdf*) ... the basic system manual that contains the idea, the intention and the basic technical concept of *emBRICK®/ brickBUS®* like mechanics, electronics and communication protocol. It includes the glossary for all other documents.
- [Application Examples](#)..... (*emBRICK_Application-Examples_#.pdf*) ... overview of typical *emBRICK®* device configurations and sample constellations for different industrial applications. It gives an idea how to use *emBRICK®* as an alternative to a normal PLC or an individual PCB / embedded system.
- [Product Catalogue](#) (*emBRICK_Product-Catalogue_#.pdf*) ... contains the overviews and detailed datasheets of all IMACS-available *emBRICK®* components and products. This includes electrical and mechanical characteristics, terminal assignment and notes about their usage.
- [Programmers Manual](#) (*emBRICK_Programmers-Manual_#.pdf*) ... is the manual for application software programmers when using established programming systems like Embedded-IDEs, Soft-PLCs, CASE-Tools but also native C/C++-coding.
- [FAQ Manual](#)..... (*emBRICK_FAQ-Manual_#.pdf*) ... contains answers to the most frequently asked questions about *emBRICK®* and its usage.
- Developers Manual..... is the manual for system developers, who like to create their own slave modules or master adaptations. It includes all technical details specifications of *brickBUS®* and also sample schematics and code samples of the software stacks. This document is only available on request from IMACS GmbH and needs the agreement on the *emBRICK®* free license conditions. Please contact support@embrick.de.

2.3 Glossary

See appendix of the *system manual*.

3. Typical Usage

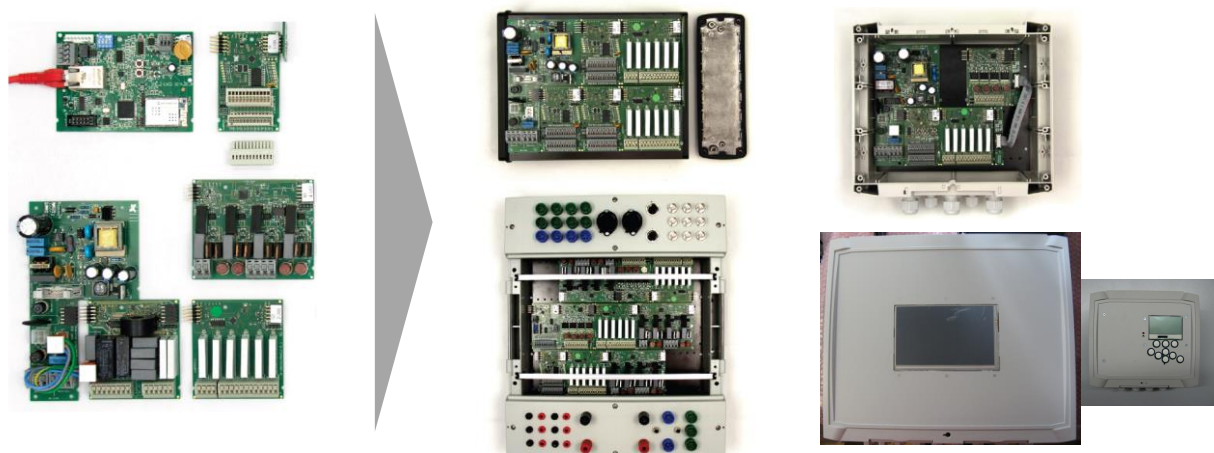
3.1 ... **Single** - as Expansion Boards

For flexible expansions of embedded controllers via a simple SPI-based interface and direct sensor/actor adaption.



3.2 ... **Patch**-Board - as Control-Unit or I/O-Node

Place and fix the single modules on a patch-board and integrate it in various enclosures.



3.3 ... **Top-Hat Rail** - as control-unit or I/O-node

Modules shifted into a top-hat rail enclosure, single or multiple rows controlled by local CPU or remote by using LAN, CAN, RSxxx, ... mounted in a control cabinet, building sub-distribution, ...



3.4 ... **Merge** - as customized/sectoral Board

For higher quantities (typical >250/a) it is possible to merge the circuits of multiple modules together and create a classic single-board I/O (by still using emBRICK® hard- and software technology).

This avoids the add-on costs for the carrier board, the mounting and el. components whereby reaching the price of a typical embedded solution.

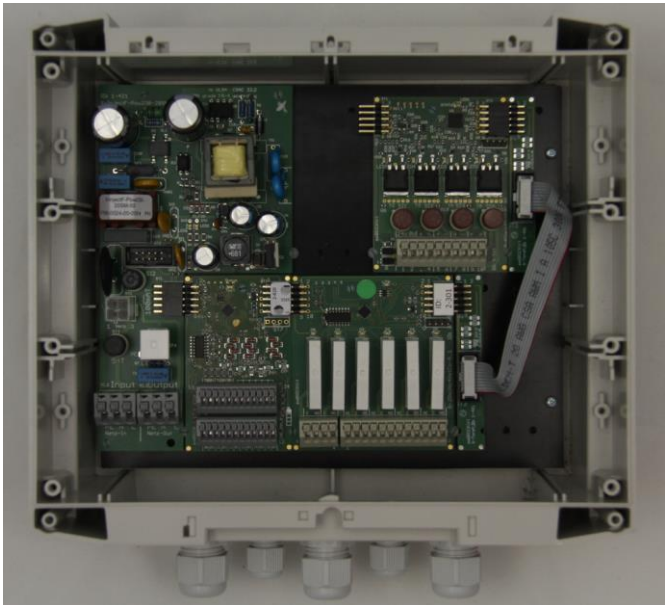
picture coming soon

4. Applications

The following examples are possible mounting ways for different usage/segment/branches.

4.1 Global Purpose

4.1.1 Sampe G1 "Compact"



(module mouting example)

Part List:

Qu.	Components	Qu.	Components	Qu.	Components
1 x	CCB_MIND1-B200-28L				
1 x	CAE_G-2RelNo4RelCo-01				
1 x	CAE_G-6Ai2Tmp-03				
1 x	CAI-RS232-01-SOC				

Technical Data:

Enclosure..... see CCB_MIND1-B200-28L in *eB_Products.pdf*
Power..... In: 230V 50Hz
6x relay output..... 2x NO, 4xChange Over, potential free
6x analog input..... 0/4..20mA (with 24V supply of external sensors)
2x sensor input..... Temperature KTY-81 2k, 0..50°C
Interfaces..... RS232, isolated, (CAI-RS232-01-SOC)

Optional:

Mechanics cable gland, front foil
Modules e.g. CAE-5Ai3Imp_01: 5x current Input, 3x pulse-/flow- inputs
..... or all other *emBRICK®* modules
Remote Adapter UMTS-Router

4.1.2 Sample G2 "Power"

Standalone system, with power switching relays, wall mounting



Technical Data:

Enclosure..... see CCB_BRAIN1-B400-70XL/B400-70W in *eB_Products.pdf*
 Power..... In: 230V
 16x relay output..... 230V supplying
 36x relay output..... potential free
 1x digital input..... Inputs (for external potential free contact)
 3x measuring inputs..... drive/pump current (one of three phases)
 3x analog input..... current output 0/4..20mA
 16x temperature sensor KTY-81 2k, -5...45°C
 4x temperature Sensor..... PT1000, -50 .. 300°C
 4 x lamp dimmer output 230V/2A, trailing/leading edge, 0...180° in 65k-steps

Part list: basic / optional

Qu.	Components	Qu.	Components	Qu.	Components
1 x	CCB_MIND1-B400-70W	2 x	CAE_G-3RelNo-01		
2 x	CAE-P-112RelPow-01	1 x	CAE_B-4Dim230T-0#		
1 x	CAE-P-2Rel6Di-01	3 x	CAE_B-8Temp-02		
2 x	CAE_P-6Rel5DiPow-01	1 x	CAE_B-4Ai4Tmp-03		CAE_G-5Ai3Imp
4 x	CAE_G-2RelNo4RelCo-01				

4.2 Building Automation

4.2.1 Sample DBB-Sub1 "Building"

Compact I/O-node for small sub-distributions. Controls one bigger or two smaller rooms.



Technical Data:

Enclosure..... standard top-hat rail
 Power..... 24Vdc / <75mA (with inactive actors)
 Coupling..... LAN
 Programming..... via host; no local configuration/programming

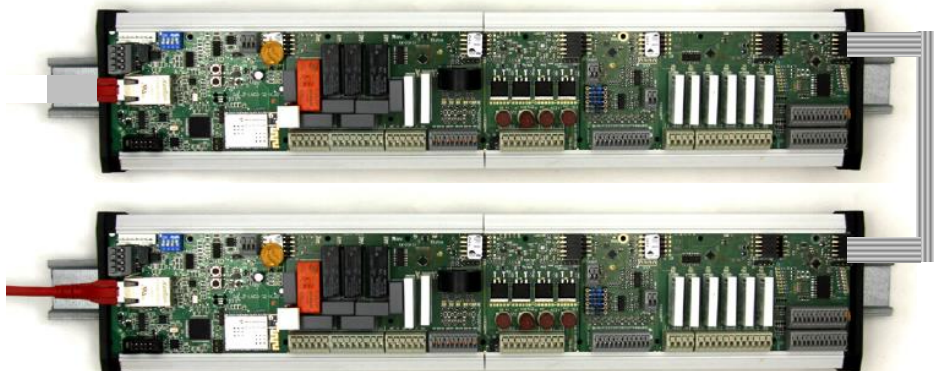
2 x switch..... 4-button-switch
 4 x lamp dimmer output..... 230V/2A, trailing/leading edge, 0...180° in 65k-steps
 4 x LED-dimmer output..... 0 ... 350/700mA (3...20V), current: 0..100% in 65k-steps
 2 x fan output 230V/4A, switching
 2 x jalousie, shutter 230V, standard drive with 2 phases
 4 x Temperature sensor KTY-81 2k, 0...50°C
 4 x heating actor..... 24V valve, PWM
 2 x motion sensor..... Motion Sensor, 5V-supply, analog output
 2 x light intensity sensor..... LDR03 (i.e. inside the motion sensors)
 4 x others..... 24-Output (i.e. to drive power relay)

Part list:

Qu.	Components	Qu.	Components	Qu.	Components
1 x	CAE_Z-LWCS-M32-03	1 x	CAE_B-4DimLedI-0#		
1 x	CAE_G-8Di8Do-01				
1 x	CAE_B-4Dim230T-0#				
1 x	CAE_G-2RelNo4RelCo-01				
1 x	CAE_G-4Ai4Temp-01				

4.2.2 Sample DBB-Sub2 "Building"

Compact I/O-node for bigger sub-distributions. Controls one floor or 4..5 rooms.



Technical Data:

Enclosure..... standard top-hat rail
 Power..... 24Vdc / <150mA (with inactive actors)
 Data coupling LAN / WLAN
 Programming..... via host; no local configuration/programming

6 x switch..... 4-button-switch
 12 x lamp dimmer output 230V/2A, trailing/leading edge, 0...180° in 65k-steps
 12 x LED-dimmer output 0 ... 350/700mA (3...20V), current: 0..100% in 65k-steps
 6 x fan output 230V/4A, switching
 6 x jalousie, shutter 230V, standard drive with 2 phases
 12 x Temperature sensor KTY-81 2k, 0...50°C
 12 x heating actor..... 24V valve, PWM
 6 x motion sensor..... Motion Sensor, 5V-supply, analog output
 2 x light intensity sensor..... LDR03 (i.e. inside the motion sensors)
 12 x others..... 24-Output (i.e. to drive power relay)

Part list:

Qu.	Components	Qu.	Components	Qu.	Components
1 x	CAE_Z-LWCS-M32-03	3 x	CAE_B-4DimLedi-0#		
6 x	CAE_G-8Di8Do-01	2 x	CAE_X-ExpM10-01		
3 x	CAE_B-4Dim230T-0#	1 x	CAE_X-10Wire20		
3 x	CAE_G-2RelNo4RelCo-01	1 x	CAE_B-6moti2LDR-01		
3 x	CAE_G-4Ai4Temp-01				

4.3 Process Control

4.3.1 Sample DAB_ROS-30

Reverse Osmosis Controller (EWS OS3030-Replacement), 128x64 graphic display



(module mounting example)

Technical Data:

Enclosure..... see CCB_MIND1-B200-28L in *eB_Products.pdf*
 Power..... In: 230V
 Relais output 6x 2x NO, 4xChange Over, potential free
 Analog input 6x 0/4..20mA (with 24V supply of external sensors)
 Sensor input 2x Temperature KTY-81 2k, 0..50°C
 Interfaces..... RS232, isolated, (CAI-RS232-01-SOC)

Optional:

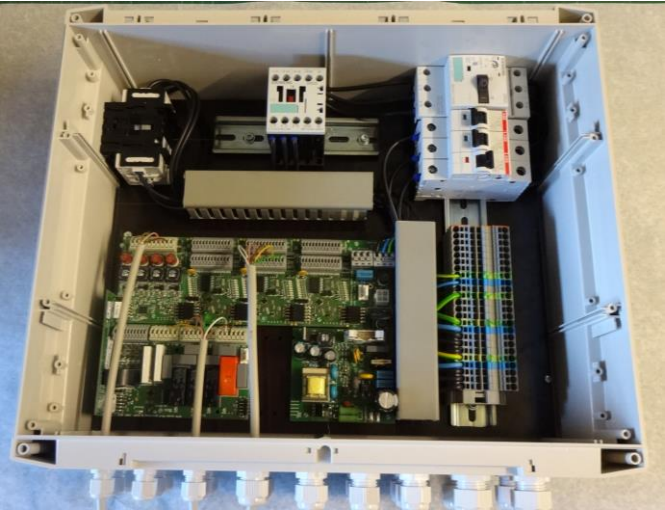
Mechanics cable gland, front foil
 Modules e.g. CAE-5Ai3Imp_01: 5x current Input, 3x Pulse-/Flow-inputs
 or all other *emBRICK®* modules
 remote adapter UMTS-Rouner

Partlist:

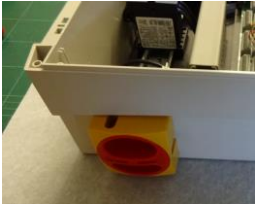
Qua.	Component	Qua.	Comonent	Qua.	Comonent
1 x	CCB_MIND1-B400-35XL	1 x	CAS_Sock1p16A-IP65-01	opt.	CAE-5Ai3Imp_01
1 x	CAE_P-112RelPow-01	1 x	CAS_Sw25-3p	opt.	CAP_Drive3p25A-01
1 x	CAE_P-2Rel6Di-01	1 x	CAE_X-Pow3Cable6_01		
1 x	CAE_P-LfTmPAoDAIoImp-01				
1 x	CAS_Pow3p25A-B400-01				

4.3.2 Sample DAB_ROS-150-P / DAB_ROS-250-P

Reverse Osmosis Controller, 3.5" 320x240 Dots (-150-P) or 7" 640x240 Dots (-250-P) color graphic touch display, power-pump outputs (= OS3050 replacement, 230V version, with optional one/two additional 3p power output)



(module mounting example)



3,5"



7"

Technical Data:

- Enclosure..... see CCB_MIND1-B400-35XL/BRAIN1-B400-70W
..... in *eB_Products.pdf*
- Power..... In: 3x400V/20A, Out: 1x Schuko-Plug-IP65
- 4x relais output..... 230V, 2x Change Over, potential free
- 6x digital input..... Inputs (for external potential free contact)
- 1x measuring inputs..... drive/pump current (one of three phases)
-
- 1x analog output current output 0/4..20mA
- 1x power unit..... main switch, top-hat rail, clamps, small cable channels

Optional:

- Mechanics cable gland, front foil
- Analog input CAE-5Ai3Imp_01: 5x current input, 3x pulse-/flow-input
..... other *emBRICK®* modules
- Power outputs CAP_Drive3p25A-01 (power relay, drive protector, wiring)

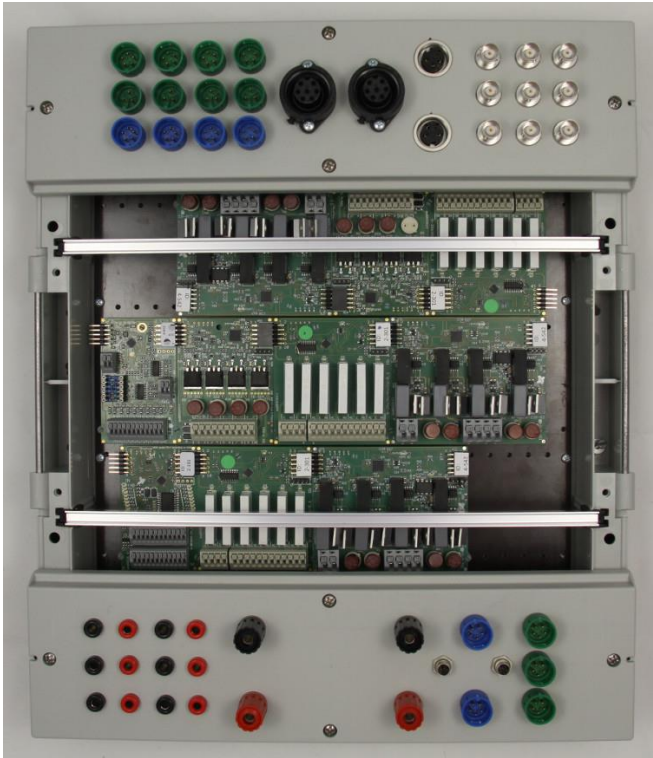
Part List:

Qua.	Components	Qua.	Components	Qua.	Components
1 x	CCB_MIND1-B400-35XL	1 x	CAS_Sock1p16A-IP65-01	opt.	CAE-5Ai3Imp_01
1 x	CAE_P-112RelPow-01	1 x	CAS_Sw25-3p	opt.	CAP_Drive3p25A-01
1 x	CAE_P-2Rel6Di-01	1 x	CAE_X-Pow3Cable6_01		
1 x	CAE_P-LfTmpAoDAiolmp-01				
1 x	CAS_Pow3p25A-B400-01				

4.4 Measuring and Testing

4.4.1 Sample DMB-MEAS1

Measuring Box, wall mounted, 24Vdc Power-supply



(module mounting example)

Technical Data:

Enclosure..... see CAH_YCHCc7000 in *eB_Products.pdf*
Power..... In: 24Vdc
Relays output 6x 2x NO, 4xChange Over, potential free
Analog input 6x 0/4..20mA (with 24V supply of external sensors)
..... 5x 0..10V (with 24V supply of external sensors)
Sensor input 2x Temperature KTY-81 2k, 0..50°C
Coupling CAN, LAN, WLAN, RS232

Part list:

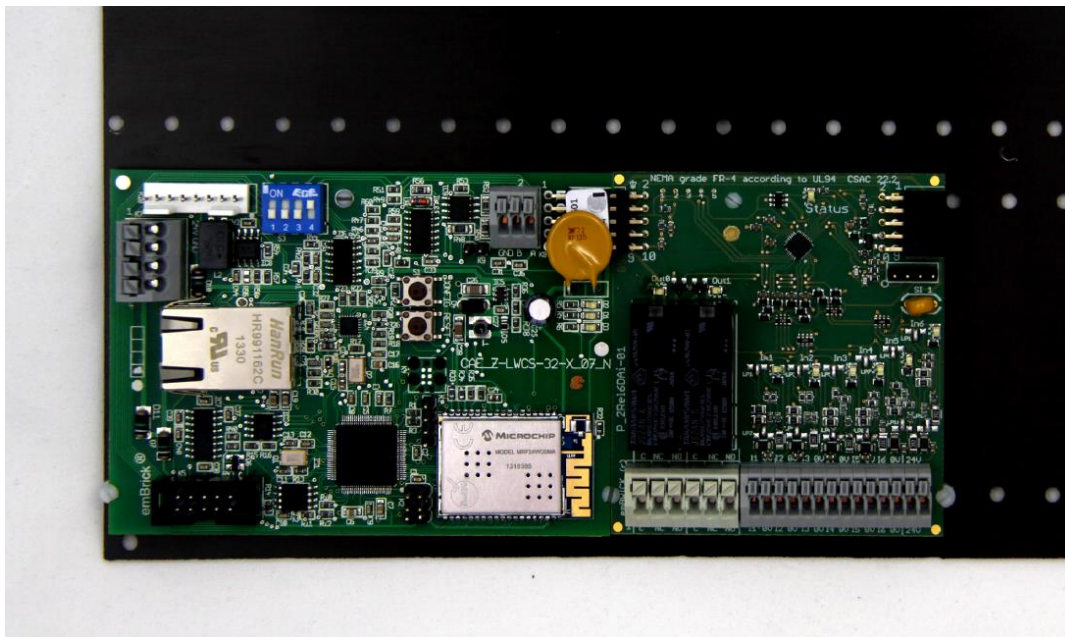
Qu.	Components	Qu.	Components	Qu.	Components
1 x	CAE_Z-LWCS-M32-	1 x	CAE_G-2RelNo4RelCo-01		
1 x	CAE_G-8Di8Do-01				
1 x	CAE_G-6Ai2Tmp-03				
1 x	CAE_G-5Ai3Imp-01				

4.5 Internet of Things

4.5.1 Sample TES-IOT-1

Base unit with Internet-connection and a universal I/O-module. All other emBRICK modules can be individual connected additionally.

As a software example the starterkit TES_eB-STK-C1 is usable.



Technical Data:

Enclosure..... Patch-Board
 Power..... 24Vdc / <75mA (with inactive actors)
 Coupling..... LAN, WLAN
 Programming..... via host; no local data processing necessary (possible on request)

4x digital input..... n-switching, common ground

2x analog inputs..... voltage input 0 ... 10V

2x relays, output..... change over, potential free

Part list:

Qu.	Components	Qu.	Components	Qu.	Components
1 x	CAE_Z-LWCS-M32-01				
1 x	CAE_P-2Rel4Di2Ai-01				

4.6 Industrial Automation / Motion / Robotic

Content in preparation

4.7 Medical / Analytics

Content in preparation

4.8 Customized Solutions

Content in preparation