# smartMINI-S

## Technical data and description

With the smartMINI-S, a system has been developed for *condition-based monitoring* and *predictive maintenance* solutions on mobile and stationary machines and plants. Due to its high integration density and compact design, smartMINI-S can also be used as a retrofit in various vehicles.

Around a powerful processor of the ARM Cortex-A7 family, the system offers the following interfaces and integrated sensor technology in a compact design:

- Power supply 9-36 V
- 100 Mbit Ethernet
- USB 2.0
- CAN 2.0 B
- Pluggable LTE modem with GNSS
- 2 digital inputs and optionally 2 digital outputs
- Optional 3D accelerometer

Internally, a smartMIN-S has an eMMC memory that offers a high level of data security in HIREL configuration and, in addition to 2 operating system partitions (YOCTO), provides a further partition for the applications. A second µSD card is installed for storing measurement data and temporary files. Both are equipped with a specially parameterised version of the ext4 file system for high data security and robustness against unforeseen shutdowns. Optionally, SSD storage devices can be connected externally via USB.

The units are delivered with a Linux operating system based on YOCTO and the smartCORE software platform. For customised software configurations or own developments on this platform, please contact us.
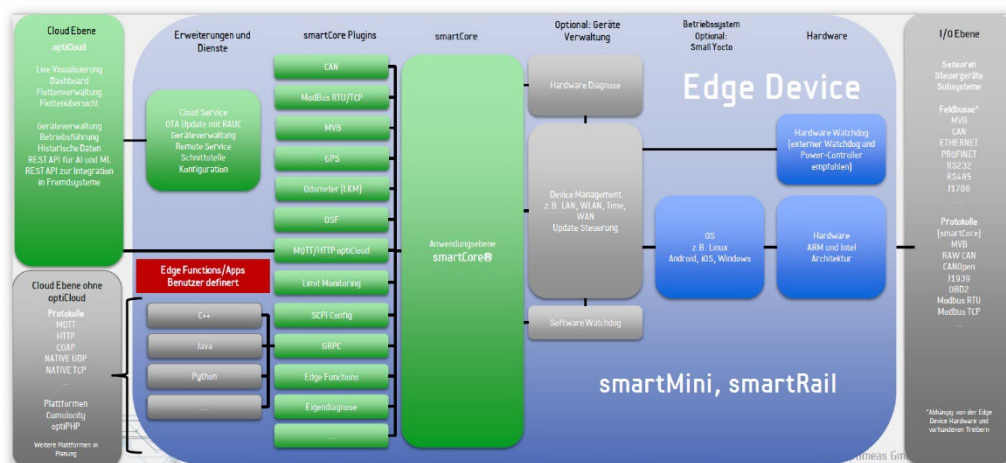
# smartCORE

The smartCORE[1] is an "out of the box" software for embedded IoT and IIoT solutions that we have developed specifically for the smartMINI and smartRAIL device family. With the smartCORE, smartMINI and smartRAIL become the perfect, flexible and high-performance

Measuring device, control system, data logger or gateway for
*Condition Based Monitoring* and *Predictive Maintenance*

for

- Seamless data recording
- Extensible plug-ins for hardware, interfaces or functions
- Intelligent data preprocessing
- Integrated alarm centre
- Almost any protocols
- Cloud connection



In this ecosystem, the smartCORE serves not only as an efficient, fast data pool for exchanging data between the various plug-ins with producer and/or consumer functions, but also for configuring, coordinating and monitoring the individual software components. Typical producer plug-ins are those that receive data from GNSS, MVB, Modbus or CAN bus, for example, and break it down into individual data channels in an interpreted form. Consumer plug-ins are used for data storage or forwarding of temperatures, pressures, speeds, etc. to the data cloud. Data storage in OSF format is optimised for secure, gapless recording and transmission. High-resolution time stamps on each data value are just as much a matter of course as different sampling rates or data reduction without loss of information.

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[1] For detailed information, please refer to the smartCORE data sheet.

# YOCTO-Linux

## Hardware

The YOCTO Linux used on the smartRAIL and smartRAIL-S units is set to the following hardware properties:

| Properties | | smartMINI-s |
|---|---|---|
| *SoM* | | phyCORE -i.MX 6ULL |
| | Processor | NXP i.MX6 ULL |
| | Family | ARM® Cortex®-A7 |
| | Clock | 528 MHz |
| | RAM | 256 MB DDR3 SDRAM |
| | ROM | 4 GB HIREL eMMC |
| | Temperature | -40 °C … 85 °C |
| µSD card 1 | | Measurement data memory |
| µSD card 2 | | t.b.d. |
| Modem | | Quectel with QMI support, e.g. EG25-G |
| *CAN* | | CAN 2.0B, ISO 11898, non-isolated, non-terminated |
| UART | | RS485 / RS232 |
| | | Directional control |
| GPS | | Integrated on modem |

## Software and libraries

With the YOCTO, the following software packages come on the device for the operation of the smartCORE framework:

- Kernel version 4.14 with PREEMPT_RT
- GCC 9 Runtime Libraries
- Qt 5.12
- JSON Message Pack Library
- GRPC 1.24.3
- ProtoBuf 3.11.4
- RAUC for dual boot and take-me-home function

The smartCORE framework itself is based on standardised interfaces to the Linux operating system.

# Interfaces of the module

## Ethernet, USB, antenna signals, SD card

On one side, besides status indicators, there are connections for Ethernet, USB 2.0 and antenna connections for modem and GPS.
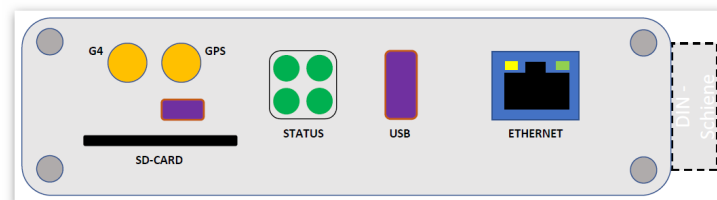


The **antenna signals** for LTE mobile radio and GPS are designed as screwable SMA sockets. If adapters to other connector standards have to be used to connect the antennas, it is recommended that they be designed as cable adapters (see illustration) in order to minimise the mechanical stress on the sockets.

## Power supply, CAN, RS485, Digital I/O

On the opposite side of the unit are connections for power supply, process measurement technology (CAN, RS485) and the connections for the digital inputs and outputs.

# Special approvals and declarations

The CE Declaration of Conformity applies to the *smartMINI-s.*

| EC Declaration of Conformity | CE | The CE mark indicates conformity with the <br><br> • EMC Directive, <br> • RoHS 2011/65/EU (08.06.2011) and the <br> • Low Voltage Directive. |
|---|---|---|

# Technical data

## Supply voltage / ambient conditions

| Symbol | Parameter | Comment | Min | Type | Max | Unit |
|---|---|---|---|---|---|---|
| V$_{CC}$ | Supply voltage | with reverse polarity protection | 9 | 24 | 36 | V DC |
| | Surge protection | Limitation and Poly-Fuse | | yes | | |
| | ESD protection | TVS diode | | | 40 | V |
| I$_{CC}$ | Power consumption | @ 24V (without load on USB/CAN) | 100 | 250 | 420 | mA |
| | Connector | | | Phoenix | | |
| T$_{operating}$ | Operating temperature | | -40 | | 85 | °C |
| | Relative humidity | Nano coating, 50°C | 5 | | 95 | % |
| | Housing | Step file available | | Aluminium | | |
| L | Dimensions:      Length | without plug / feet / clip | | 104 | | mm |
| | | With plugs | | 128 | | mm |
| B | Wide | | | 85 | | mm |
| H | Height | | | 35 | | mm |
| m | Weight | | | 320 | | g |
| | Assembly | Option mounting feet or Mounting rail (EN 50022) | | TS 35 | | |
| | Cooling | | | passive | | |
| | Protection class | (ISO 20653 - 2013) | | IP54 | | |

## SD / SSD

| Symbol | Parameter | Comment | Capacity |
|---|---|---|---|
| | SD 1, internal, accessible | Measurement data | 32 - 256 GB[2] |
| | µSD 2, internal | optional | From 2 GB |
| | SSD, external | via USB 2.0, optional | Capacity according to demand |

The µSD memory cards, like the micro-SIM card of the modem, are not accessible from the outside to protect against unauthorised access and should already be loaded during production.

## Interfaces

| Symbol | Parameter | Comment | Min | Type | Max | Unit |
|---|---|---|---|---|---|---|
| | Type / Quantity | Ethernet | | 1 | | |
| | Transmission rate | | 10 | | 100 | Mbit/s |
| | Status LED | Link, Activity | | 2 | | |
| | Connector | | | RJ45 | | |
| | Type / Quantity | USB 2.0 | | 1 | | |
| | Connector | Not hot-plug capable | | Type-A | | |
| | Type / Quantity | CAN 2.0B, ISO 11898 | | 1 | | |
| | Baud rate | parameterisable | | 500 | 1000 | kBit/s |
| | Connector | | | Phoenix | | |
| | Scheduling | CAN | | no | | Ω |
| | Type / Quantity | RS485 | | 1 | | |
| | Connector | | | Phoenix | | |
| | Type / Quantity | RS232 (instead of RS485) | | 1 | | |
| | Connector | | | Phoenix | | |
| | Type / Quantity | Digital input, isol. | | 1 | | |
| | Voltage | (optocoupler) | 9 | | 36 | V |
| | Power consumption | | 1,5 | | 9 | mA |
| | Connector | (identical with RS485) | | M12 | | |
| | Capture | | | 1 | 10 | Hz |
| | Type / Quantity | Status LED | | 4 | | |
| | | Meaning defined by software | | | | |

[2] Depending on availability and actual need

## Integrated "periphery

| Symbol | Parameter | Comment | Type / Value |
|---|---|---|---|
| | **Real Time Clock** | via I²C | RTC-RV-4162 |
| | Buffer tank | Gold Cap | 0,22F |
| | **Temperature sensor** | via I²C | LM75BD,118 |
| | **Acceleration sensor** | 3D, via I²C | LIS3DHTR LGA16 |
| | **Modem** | G4 (LTE Cat 4) | Quectel EG25-G |
| | Cover | | worldwide |
| | Download | | up to 150Mbps |
| | Upload | | up to 50Mbps |
| | SIM | micro-SIM | 15 x 12 x 0.76 mm |
| | **GNSS** | GPS, GLONASS, BeiDou, Galileo, QZSS | Quectel EG25G |
| | Resolution | Autonomous | < 2.5m CEP |
| | Update rate | | 1Hz |

# Contact

optiMEAS Measurement and Automation Systems GmbH

Am Houiller Platz 4

64381 Friedrichsdorf

+49 (6172) 997712-0

info@optimeas.de

**OptiMEAS**
Measurement and Automation Systems