smartMINI

Technical data and description

With smartMINI, 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 can also be used as a retrofit in various vehicles.

Around a powerful processor of the ARM Cortex-A9 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
- 2x CAN 2.0 B
- Integrated LTE modem
- Integrated GNSS receiver with high resolution and update rate
- 2 digital inputs and outputs, one of which can be used as a "terminal 15" control signal
- 3D acceleration sensor

Internally, a smartMINI 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 third operating system partition is provided internally on an optional µSD card, with which a "take-me-home" function can be realised. 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 memory can be connected externally via USB.

A micro-controller serves as a CPU-independent watchdog that can monitor the entire boot process of the CPU and switch to another boot partition in the event of an error. It can switch the power supply of the smartMINI completely off and on again (cold start) to realise a very energy-saving sleep mode and time-controlled wake-up.

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.

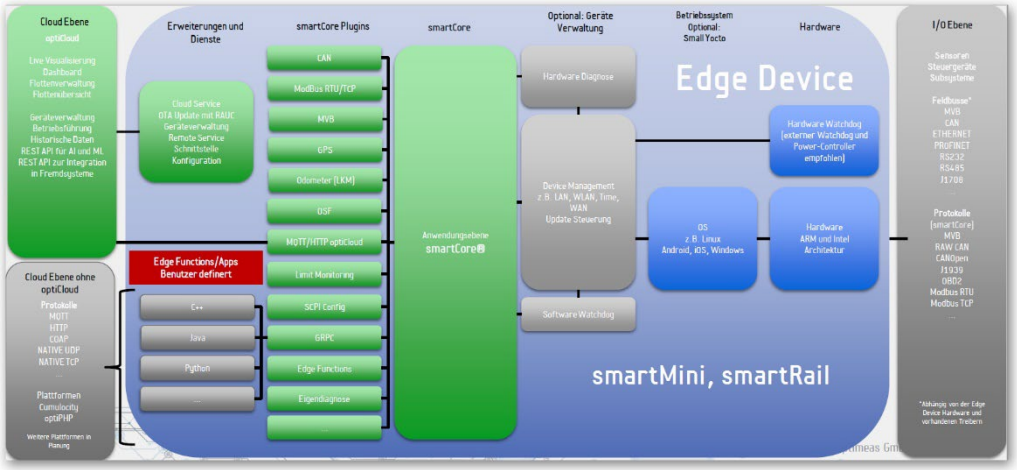
smartCORE

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.

[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	CoM connection
CoM	KARO TX6S-8035	
Processor	NXP i.MX6 Solo	
Family	ARM® Cortex®-A9	
Clock	800 MHz	
RAM	512 MB DDR3 SDRAM	
ROM	2 GB HIREL eMMC	
Temperature	-40 °C ... 105 °C	
µSD card 1	Measurement data memory	Pin 51 - 57
µSD card 2	Take-Me-Home OS	Pin 95 - 101
USB hub		Pin 29 - 31
Modem	Quectel with QMI support, e.g. EG25-G	
I2C		Pin 41/62
RTClock	RTC-RV-4162	
Pwr controller	Atmel SAMD21	
+ GPIO	Boot control	Pin 117
CAN		
Port 0		Pin 76/81
Port 1		Pin 34/36
Console, serial		Pin 59/60
UART	RS485 / RS232 (option)	Pin 63/64
	Directional control	Pin 66
GPS	Quectel L76	Pin 67/68

Software and libraries

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

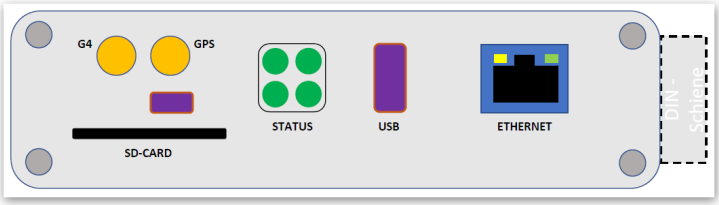
- Kernel version 4.14 with PREEMPT_RT
- GCC 9 Runtime Libraries
- Qt 5.12
- JSON Message Pack Library
- GRPC 1.24.3
- ProtoBuf 3.11.4
- RAUC for dual boot and take-me-home function

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

Interfaces of the module

Ethernet, USB, antenna signals, SD card

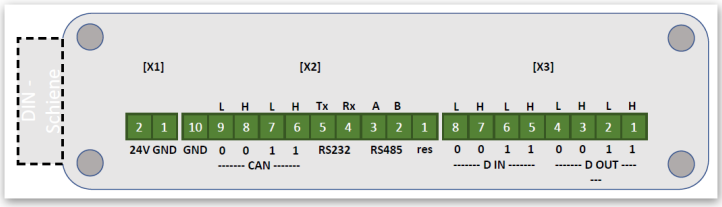
On one side, besides status indicators, there are connections for Ethernet, USB 2.0 and antenna connections for modem and GPS.



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.



CAN-GND is identical to the supply ground. The CAN 0 and 1 connections are ***not*** terminated internally for integration into an existing CAN network.

Special approvals and declarations

The CE Declaration of Conformity applies to ***smartMINI***

EC Declaration of Conformity	CE	The CE mark indicates conformity with the • EMC Directive, • RoHS 2011/65/EU (08.06.2011) and the • 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			

CPU

Symbol	Parameter	Comment	smartMINI
	CoM		**KARO TX6S-8035**
	Processor		NXP i.MX6 Solo
	Family		ARM® Cortex®-A9
	Clock		800 MHz
	RAM	DDR3 SDRAM	512 MB
	ROM	HIREL eMMC	2 GB
	Operating temperature		-40 °C ... 105 °C

SD / SSD

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

The µSD memory cards, like the mini-SIM card of the modem, are not accessible from the outside to protect against unauthorised access and should already be fitted 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			Type-A		
	Type / Quantity	**CAN 2.0B, ISO 11898-2**		2		
	Baud rate	parameterisable		500	1000	kBit/s
	Connector			Phoenix		
	Scheduling	CAN 0 / 1, internal		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
	Micro Controller	Boot, Watchdog, GPIO	Atmel SAMD21
	Modem	G4 (LTE Cat 4)	Quectel EG25-G
	Cover		worldwide
	Download		up to 150Mbps
	Upload		up to 50Mbps
	SIM	mini-SIM	15 x 12 x 0.76 mm
	GNSS	GPS, GLONASS, BeiDou, Galileo, QZSS	Quectel L76
	Resolution	Autonomous	< 2.5m CEP
	Update rate		1Hz (default), up to 10Hz

Contact

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