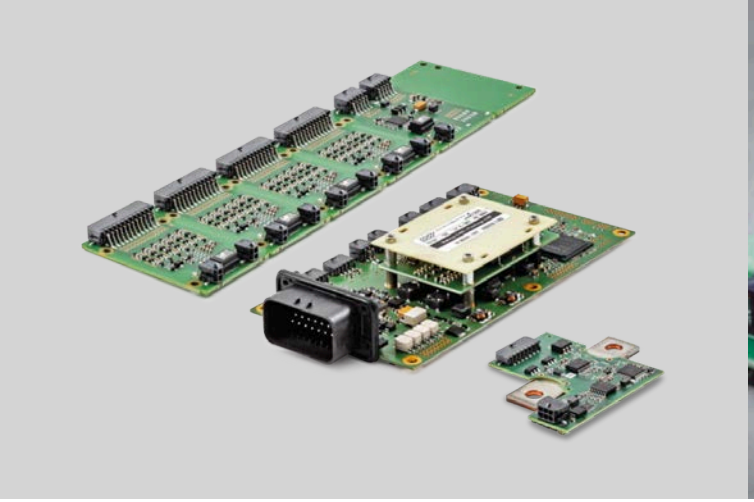
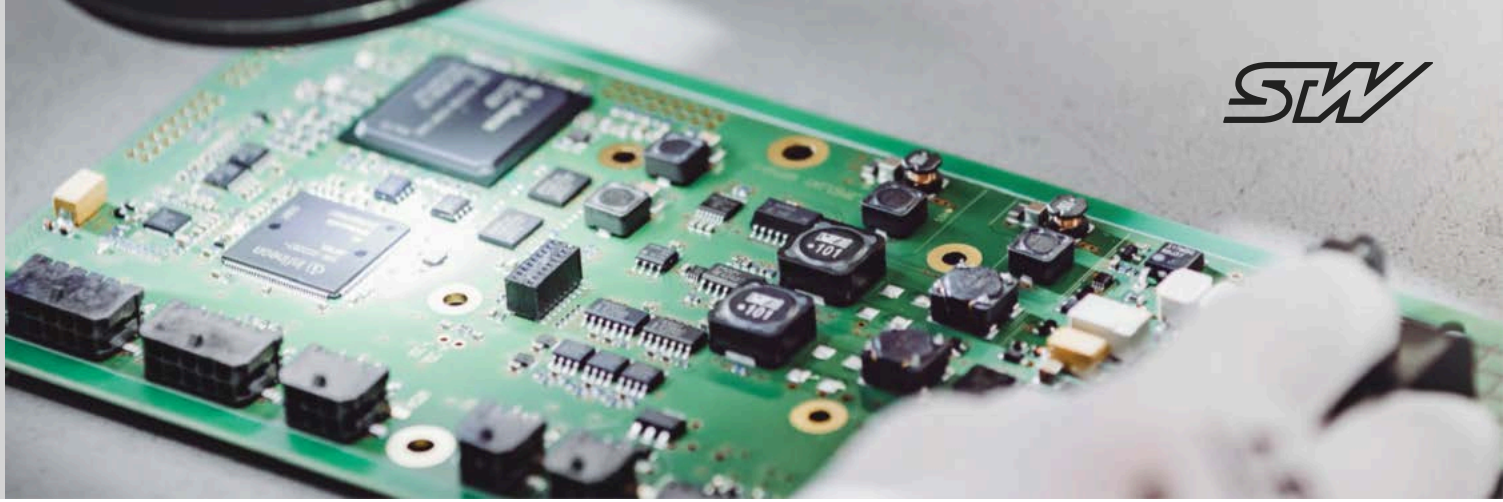




mBMS.2

Battery Management System

KEY FEATURES

- For automotive grade High Voltage Batteries
- Scalable solution including Hard- and Software
- mBMS Toolchain, a set of PC based configuration and flash tools
- For all Lithium-Ion family members, incl. LFP, NMC and LTO
- Native support for parallel Batteries

TECHNICAL DATA

- Measurement of cell voltage and temperature
- Cell balancing
- Current measurement up to 2000 A
- Voltage measurement up to 800 V
- Isolation monitoring
- SOC, SOF (PP), SOH Ri determination
- Auxiliary output lines
- Dedicated safety and application processors
- Vehicle interface (CAN busses, interlock generator/ detector, KL15, KL30c)

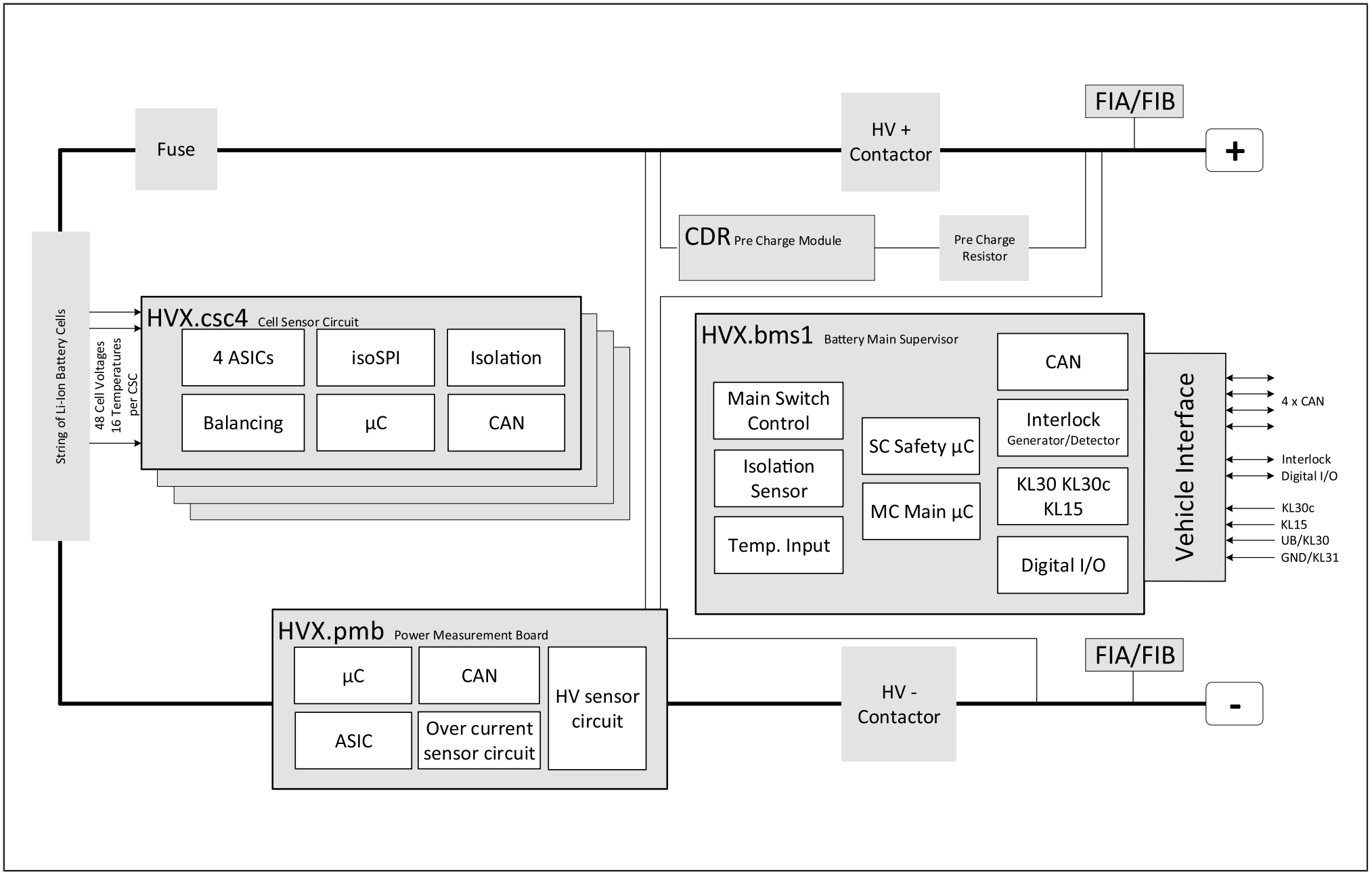
ACCESSORIES

- EMC filter modules
- Pre-charge module
- Load resistor
- Main contactors
- Connector sets

Sensor-Technik Wiedemann GmbH

Am Bärenwald 6
87600 Kaufbeuren
+49 8341 9505-0
info.stw@wiedemann-group.com
www.stw-mm.com

BLOCK DIAGRAM



TECHNICAL DATA

External Interfaces (vehicle side)

LV Connector Type	23-pole AMPSEAL (TE connectivity)	
CAN	CAN 1 - ESS-CAN CAN 2 - Interpack CAN CAN 3 - Sensor CAN CAN 4 - SC-Meas CAN	CAN 2.0 B, 500 kBit/s
Interlock	Detector and generator Alternating current (±20 mA/88 Hz) Reaction: enter safe state (main switch off) Maximum external loop resistance: 350 Ω	

Internal Interfaces (battery side)

Connector Type	Micro-Fit (Molex)		
Indicators	On-board LEDs		
Cell voltage measurement	Range: 1 V ... 5 V Accuracy: 2.5 mV @ 2.5 V ... 4.3 V		
Cell temperature measurement	NTC-Sensor, 10 kΩ, characteristics: EPCOS 8016, $B_{25/100}$ = 3988 K Range: -50 °C ... +125 °C (-67 °F ... 257 °F) Accuracy: 2 K plus sensor tolerance		
Cell balancing current	120 mA @ Ucell = 3.6 V (derated at high temperature)		
High voltage measurement on HVX.pmb	Range: 0 V ... 800 V Accuracy: offset 0.1 V, gain 1 %		
Current measurement		HVX.pmb-1000	HVX.pmb-2000
	Range	±1000 A	±2000 A
	Accuracy offset	0.1 A	0.2 A
	Accuracy gain	1 %	

Internal Interfaces (battery side)

Coolant temperature measurement	2 x input for NTC-Sensor 10 kΩ Characteristics: EPCOS 8016, $B_{25/100}$ = 3988 K Range: -55 °C ... +125 °C (-67 °F ... 257 °F) Accuracy: 2 K plus sensor tolerance	
Insulation measurement	Between HV (battery) and LV (vehicle chassis) Range: 1 ... 4500 kΩ	
	Accuracy:	0 ... -5 kΩ @ 1 ... 20 kΩ 0 ... -25 % @ 20 ... 1000 kΩ
Main switch control	2 x 1.5 A (hold current), 5 A (pickup current)	

System Data

Wake up options	CAN1 or KL15
Power supply	8 ... 32 VDC
Current consumption (active mode)	Per HVX.bms1 and HVX.pmb combined: 350 mA @ UB = 12 V (main switches off) 185 mA @ UB = 24 V (main switches off) 10 mA per HVX.csc4 (supply from cells)
Current consumption (sleep mode)	Per HVX.bms1 and HVX.pmb combined: < 100 µA @ UB = 12 V 10 µA per HVX.csc4 (supply from cells)
Dimensions (approx.)	HVX.bms1: 212 mm x 100 mm x 33 mm (8.3" x 3.9" x 1.3") HVX.pmb: 95 mm x 61 mm x 15 mm (3.7" x 2.4" x 0.6") HVX.csc4: 300 mm x 75 mm x 13 mm (11.8" x 3.0" x 0.5")
Weight (approx.)	HVX.bms1: 0.23 kg (0.51 lbs.) HVX.pmb: 0.10 kg (0.22 lbs.) HVX.csc4: 0.26 kg (0.57 lbs.)

DESCRIPTION

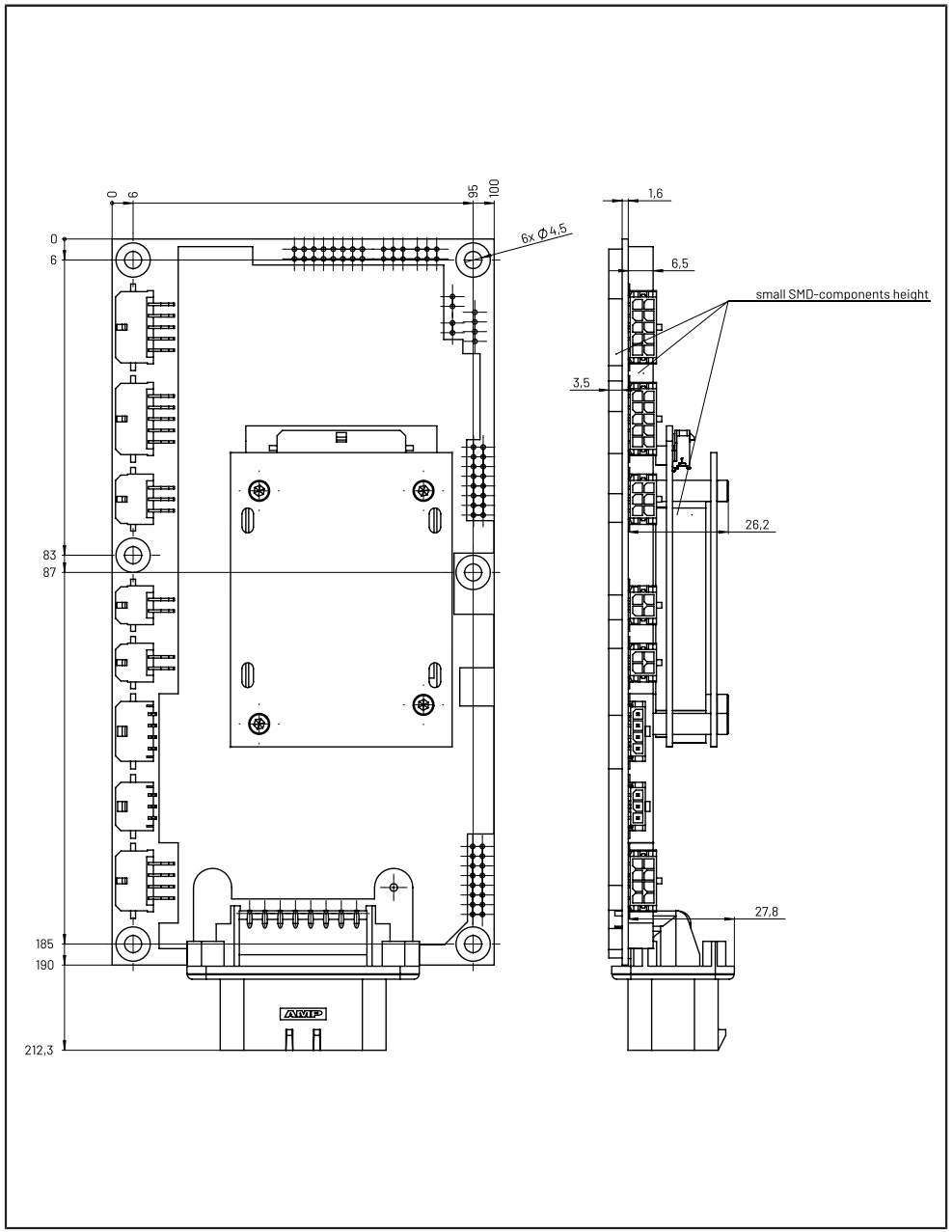
System Data

Operating temperature range	-40 °C ... +80 °C (-40 °F ... 176 °F) ambient temperature

Battery Main Supervisor (HVX.bms1)

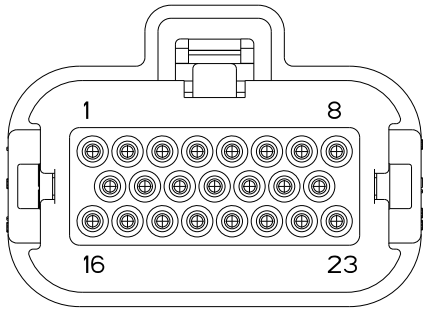
The HVX.bms1 is the central control unit of the battery system. It includes three processors for highest levels of reliability and safety. It collects all information from the sensor modules, from the Cell Sensor Circuits (HVX.csc4) and from the Power Measurement Board (HVX.pmb), calculates the status of the battery system and controls the HV contactors.

TECHNICAL DRAWING



PIN ASSIGNMENT

Pin Assignment Sorted by Pin Numbers:



Pin	Designation	Description	max. Current
1	UB	Power supply for ECU, KL30	0.4 A + current of Pin4
2	OUT1 (CFG0)	Digital output 1 (LSS1) / analog input / master-slave-config.	2 A
3	OUT2	Digital output 2 (LSS1) / analog input	2 A
4	OUT3	Digital output 3 (HSS2) / analog input	2 A
5	N. c.	Do not connect	
6	N. c.	Do not connect	
7	IL_IN_LV	Interlock loop (external)	0.02 A
8	IL_OUT_LV	Interlock loop (external)	0.02 A
9, 10	GND	Ground (LV), KL31	Return of Pin 1-3, 16-19
11	-	-	
12	CAN1_H	ESS-CAN (High)	
13	CAN2_H	Interpack CAN (High)	
14	CAN3_H	Sensor-CAN (High)	
15	CAN4_H	SC-Meas-CAN (High)	
16	KL30c	Power supply for main contactors	Cont. 3 A, inrush 10 A

Pin Assignment Sorted by Pin Numbers:

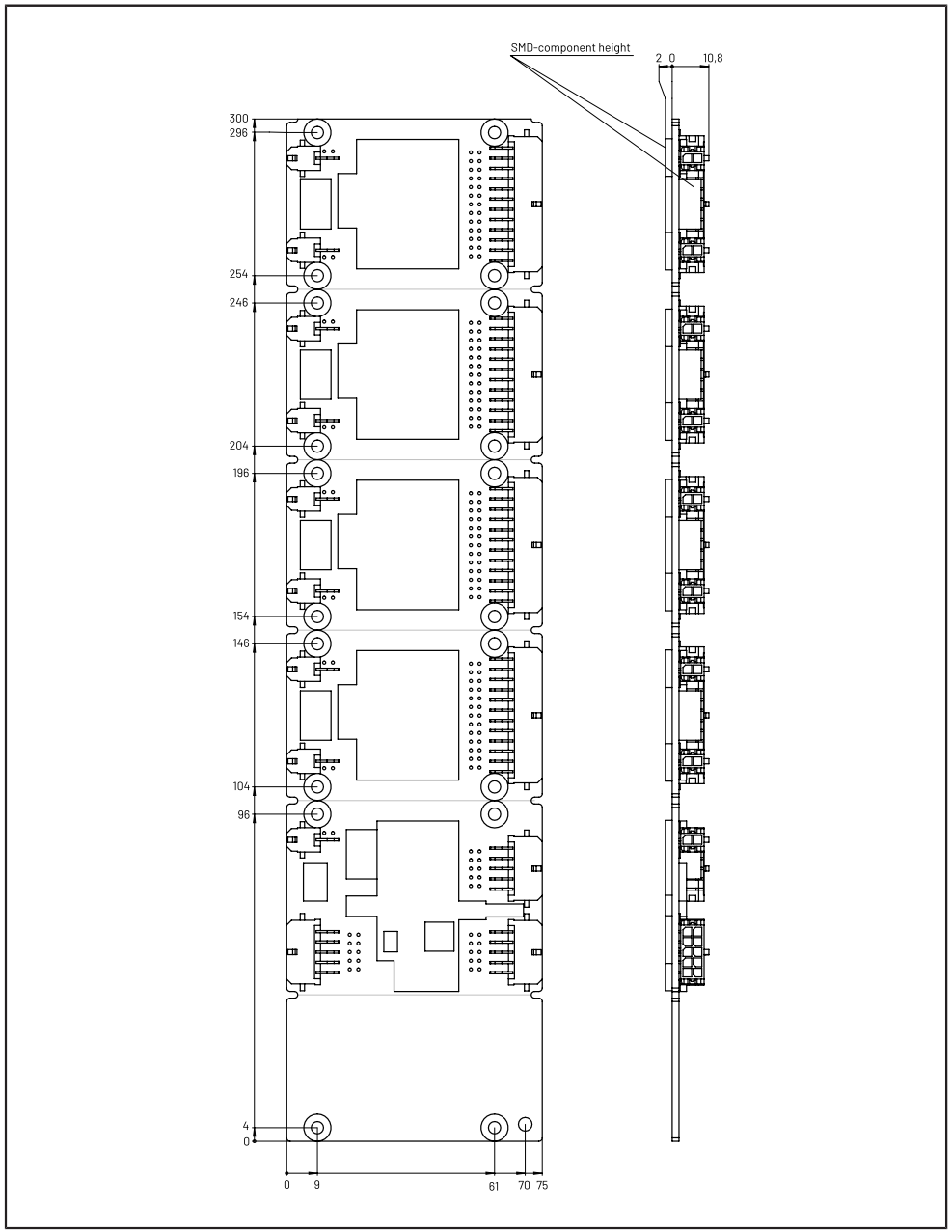
Pin	Designation	Description	max. Current
17	KL15	Ignition (high active input)	
18	IN1 (CFG2)	Analog input 1 / master-slave-config.	
19	IN2 (CFG1)	Analog input 2 / master-slave-config.	
20	CAN1_L	ESS-CAN (Low)	
21	CAN2_L	Interpack CAN (Low)	
22	CAN3_L	Sensor-CAN (Low)	
23	CAN4_L	SC-Meas-CAN (Low)	

DESCRIPTION

Cell Sensor Circuit (HVX.csc4)

The HVX.csc4 supervises the individual cells of the battery by measuring voltage and temperature. Each HVX.csc4 is equipped with a passive discharge path for balancing the charges of the battery cells.

TECHNICAL DRAWING

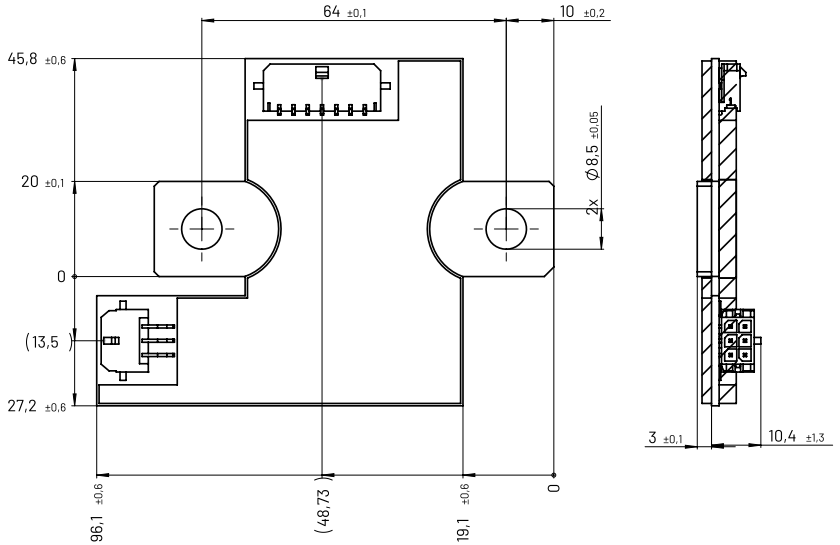


DESCRIPTION

Power Measurement Board (HVX.pmb)

The HVX.pmb measures the current (shunt resistor) which flows in or out of the battery, the high voltage value of the battery stack and the traction net. The HVX.pmb is equipped with a unique redundant safety circuit which enables the PMB to directly signal a current limit violation.

TECHNICAL DRAWING



SOFTWARE

mBMS Toolchain

Configuration

Configuring the mBMS to suit your application.

Safety parameters	Define and manage system security limits
Application parameters	Illustration of cell characteristics Define the battery application strategy

Update

Software update of the complete energy storage system (ESS)

One-Click-Update	Simple and convenient system administration through automatically configured update packages.

Diagnosis

Allows easy and quick commissioning of the energy storage system (ESS)

Battery data	Running mBMS functions and displays battery data
Failure diagnosis	Supports fault diagnosis by visualization

Safety Functions

Cell Level	Battery enters safe state in the events of cell over voltage, under voltage and over temperature.
Battery Level	Battery enters safe state in the event of over current.
System Integrity	Isolation resistance is monitored. Interlock signals associated with HV and LV connections are detected and generated. A multitude of built in self test and diagnostic routines are performed.

mBMS Toolchain

Management Functions

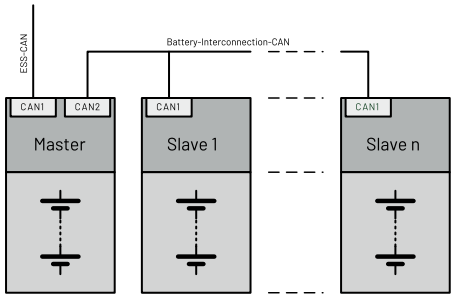
Balancing	Passive balancing towards a determined voltage target is performed on vehicle--request.
Pre Charge	Traction net capacitors are pre charged before the battery is switched on.
Battery State Determination	SOC: state of charge is determined by means of coulomb counting. SOF (PP): available power is determined for charging and discharging. SOH_{Ri} is determined by impedance tracking of a pack. SOH_{MSW}: Main switch ageing is tracked.

Energy Storage Systems (ESS)

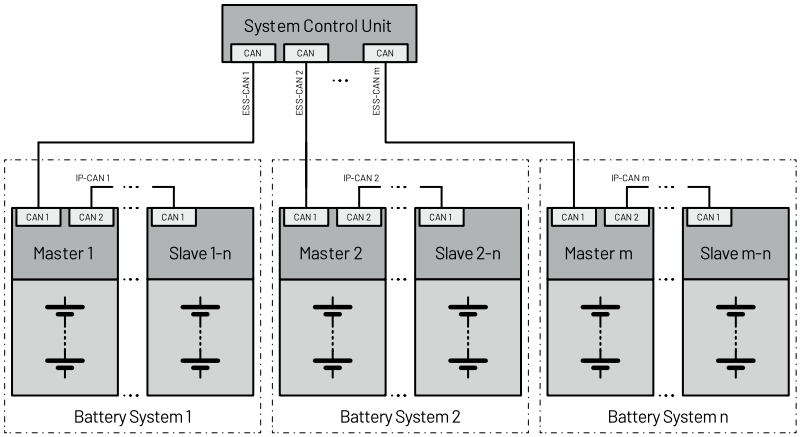
Parallel Packs	An ESS may contain up to eight parallel packs in Master Slave topology An ESS may contain an arbitrary number of parallel packs build up in Multi Master topology
Parallel Cell Strings	Large battery packs built up by strings of parallel cell modules are supported.

TOPOLOGIES

Master/Slave Networking - Parallel Packs:



Multi Master Networking - Parallel Packs:



Parallel Module Architecture: