IVT-B

Preliminary DataBrief

Datasheet IVT-B

Header

Project	IVT-B Isolated shunt measurement system with CAN	
State	Draft ☑ Review ☐ Released ☐ Note: Printouts are not under version control	
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Release	2010-03-30	
Module Name	IVT-B	
Hardware Version	6	
PCB Version	1	
Software Version	1.1.2, 1.1.3	

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Abbreviations

IVT-B	Isabellenhuette Voltage-Current-Temperature Measurement Board
BAS	Isabellenhuette Standard Shunt
ISA-ASIC	Isabellenhuette Application Specific Integrated Circuit
CAN	Controller Area Network
OCD	Over Current Detection output signal line
OCS	Over Current signal
TRIGGER	Trigger input signal line
tbd	To be defined later
PCB	Printed Circuit Board
sint16	Signed integer (16bit)
sint32	Signed integer (32bit)
0xX	Hexadecimal value preamble
0bX	Binary value preamble

1 Preface

The purpose of this document is to specify the high precision shunt measurement system IVT-B for current, voltage and temperature measurement.
This document defines the electrical, mechanical and operational requirements.

2 Hardware description

2.1 Assembly

Printed circuit board directly soldered onto an Isabellenhuette standard BAS shunt resistor.

2.2 Power supply

Switch mode voltage regulator for wide supply voltage range. Standby mode is not possible.

2.3 Isolation

Both power supply and digital signal lines are galvanic isolated using integrated digital isolators.

2.4 Current measurement

Isabellenhuette proprietary ISA-ASIC measuring voltage drop over shunt resistor. Since FW revision 1.1.1 an automatic range extension is performed if the nominal current range is exceeded.

2.5 Voltage measurement

Isabellenhuette ISA-ASIC measuring input voltage attenuated by a high impedance voltage divider.

2.6 Input filtering

The current signal is directly connected to the designated ISA-ASIC current measurement input (Input 1). The same signal is connected to the second ISA-ASIC input (Input 2) via a double RC filter.
The voltage signal is directly connected to the third ISA-ASIC input (Input 3). The same signal is connected to the fourth ISA-ASIC input (Input 4) via a double RC filter.

2.7 Over current detection

Two Hardware comparators are directly connected to the shunt resistor, one for each current direction. Each comparator compares the voltage drop over the shunt to a threshold voltage provided by a fixed voltage divider or a software adjustable voltage. The over current signal is active low. It is isolated by the digital isolator and provided at the LV connector through a K-Line transceiver.

3 Functional description

After power on the device performs an internal diagnostic check. After that the user defined configuration, operation mode and overcurrent thresholds are loaded from nonvolatile memory

Measurements are performed in Dual Mode. A Primary Channel and a Secondary Channel are measuring alternately at an internal sample rate of approx. 3500 Hz. The Primary channel always measures Input 1 (current unfiltered). The Secondary Channel may be configured to measure one of the following inputs:

Input 1: CU (current unfiltered)
Input 2: CF (current filtered)
Input 3: VU (voltage unfiltered)
Input 4: VF (voltage filtered)
Input 5: T (internal temperature)

There are three options of triggering the transmission of measurement results:

- Free running measurement mode:
  Every time a measurement cycle has completed, result messages are transmitted. The number of average values determines the interval of transmitting result messages.

- Hardware triggered measurement mode:
  As soon as the TRIGGER signal is detected, a complete cycle, determined by configuration of secondary channel and average configuration, is performed and after completion one to three result messages are sent.

- Message triggered measurement mode:
  As soon as the request message is received, a complete cycle, determined by configuration of secondary channel and average configuration, is performed and after completion one to three result messages are sent.

A CAN message; containing measurement results holds at least one of two possible measured values. There are up to three different measurement messages possible, separated by three different CAN-IDs.

If the input signal of the current input exceeds the nominal measurement range, an automatic range switching to an extended range is performed.

4 Measurement specification

4.1 Operation conditions

The module may be used in both 12V and 24V power supply systems, but there is no additional load dump protection above 32V!

Parameter	min.	typ.	Max.	Unit
Operating temperature	-40		+85	°C
Storage temperature	-40		+105	°C
Supply voltage	+7.0	+12.0	+32.0	V
Supply current	25	60	120	mA
Start up time		50		Ms

Table 4-1 Operation conditions

4.2 Current measurement nominal range

Parameter	min.	Typ.	Max.	Unit
Nominal measurement range	-320		+320	A
Extended measurement range	-1500		+1500	A
Initial Error	-0.1		+0.1	%rdg
Total error [-20…+60°C] Without temperature calibration	-0.5		+0.5	%rdg
Total error [-40…+85°C] Without temperature calibration	-0.8		+0.8	%rdg
Total error [-20…+60°C] With temperature calibration	-0.2		+0.2	%rdg
Total error [-40…+85°C] With temperature calibration	-0.4		+0.4	%rdg
Offset (not included in error)	-50		+50	mA
Noise (without averaging)		120		mA pp
Physical resolution		10		mA
Output resolution		1		mA
Shunt resistance		1		µOhm

Table 4-2 Current measurement characteristics nominal range

4.3 Current measurement extended range

Parameter	min.	Typ.	Max.	Unit

Extended measurement range	−1500		+1500	A
Initial Error	−2.5		+2.5	%rdg
Total error [−20…+60°C] Without temperature calibration	−2.5		+2.5	%rdg
Total error [−40…+85°C] Without temperature calibration	−4.0		+4.0	%rdg
Total error [−20…+60°C] With temperature calibration	−0.5		+0.5	%rdg
Total error [−40…+85°C] With temperature calibration	−1.0		+1.0	%rdg
Offset (not included in error)	−250		+250	mA
Noise (no averaging)		400		mA pp
Physical resolution		40		mA
Output resolution		1		mA
Shunt resistance		100		µOhm

Table 4-3 Current measurement characteristics extended range

4.4 HV voltage measurement

Parameter	Min.	Typ.	Max.	Unit

Nominal measurement range	−620		+620	V
Initial Error	−0.1		+0.1	%rdg
Total error [−20…+60°C] Without temperature calibration	−0.8		+0.8	%rdg
Total error [−40…+85°C] Without temperature calibration	−1.2		+1.2	%rdg
Total error [−20…+60°C] With temperature calibration	−0.5		+0.5	%rdg
Total error [−40…+85°C] With temperature calibration	−1.0		+1.0	%rdg
Offset (not included in error)	−100		+100	mV
Noise (no averaging)		120		mV pp
Physical resolution		30		mV
Output resolution		1		mV
Input resistance		3.3		MOhm

Table 4-4 HV voltage measurement parameters nominal range

4.5 Temperature measurement

The internal temperature measurement is performed on the PCB which is thermally connected to the shunt by the direct solder joint. It does not represent the hot spot temperature of the shunt but more likely the average temperature of the module (PCB and shunt).

Parameter	Min.	Typ.	Max.	Unit
Measurement range	−40		+105	°C
Resolution		0.1		°C
Error (0°C to 85°C)	−3		+3	°C
Error (−40°C to 105°C)	−4		+4	°C

Table 4-5 Temperature measurement parameters

5 Additional features

Additional hardware features of the module are the OCS and the SYNC lines.

5.1 Over current detection line (OCS)

The IVT-B contains hardware over-current detection for both current directions. As soon as the over current is detected the alarm line OCS is activated which signals an over current condition to the external circuit.

Parameter	Min.	Typ.	Max.	Unit

Threshold	100		+500	A
Error	−10		+10	A

Table 5-1 Positive over current detector parameters

Parameter	Min.	Typ.	Max.	Unit
Threshold	−500		−100	A
Error	−10		+10	A

Table 5-2 Negative over current detector parameters

5.2 TRIGGER signal line

The module provides a TRIGGER input signal line. The TRIGGER signal could be used to synchronize the measurement between the module and an external hardware like a battery management system. The TRIGGER input line is fed through a K-Line Driver, so the input signal is in the same range as the supply voltage. The signal is high active. A low to high transition triggers the measurement.

6 Communication

6.1 CAN communication description

Communication consists of a small amount of CAN messages with different CAN IDs at a speed of 500kbits/s.
There is one transmit message (named Command) and four receive messages (named Message) seen from the host's point of view.
Different commands are realized by a Command-ID-byte on position DB0.
A message is reported as a response to a command. The other three messages contain measurement results.

Since FW revision 1.1.0 all five CAN IDs may be permanently changed by a user command.
Since FW revision 1.1.2 the CAN speed may be permanently changed to several bitrates.

7 Hardware

7.1 Shunt

Standard: 100 µOhm ISA-Weld Shunt BAS type

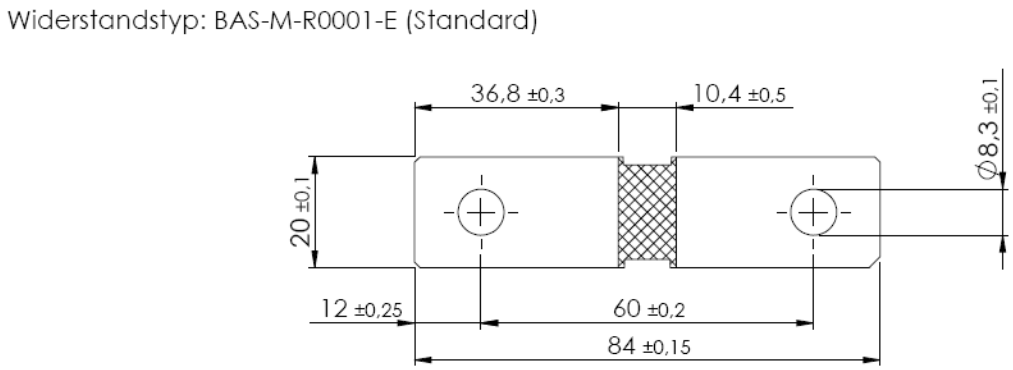

Figure 7-1 Standard Shunt

7.2 PCB

- 4 layer PCB
- Preferred devices: SMD
- Double side mounting of components
- The PCB is directly reflow soldered onto the shunt.
- PCB Size: 55mm x 35mm
- Overall size: 84mm x 55mm x 12mm (without housing)

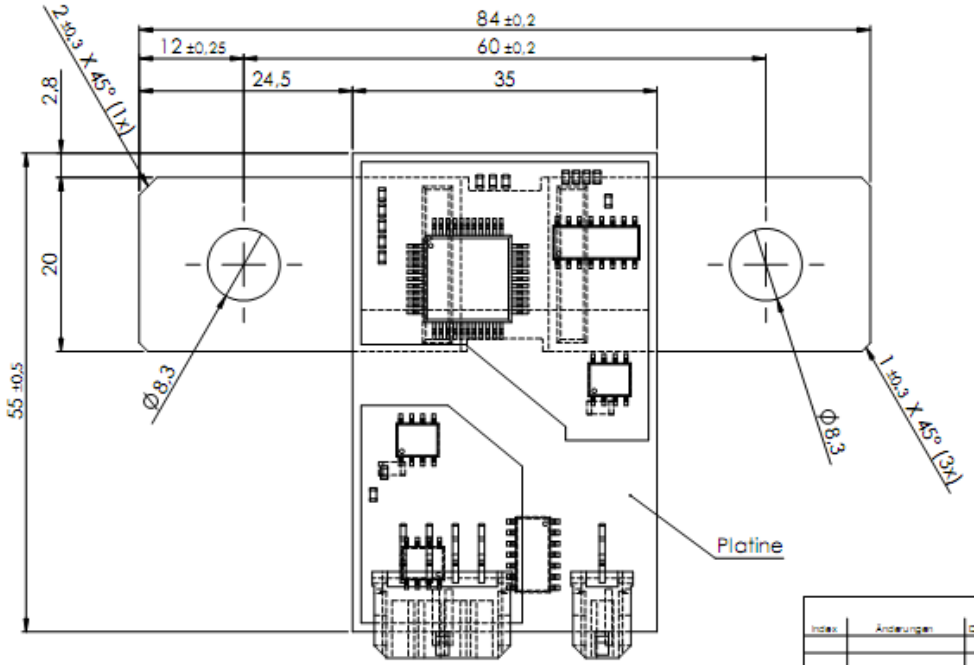

Figure 7-2 PCB drawing

7.3 HV measurement input

The module has one high voltage inputs. The common reference point is the negative side of the shunt. The voltage divider may be switched off to minimize current drawn from the battery. It has bipolar measuring capability.

7.4 Interface / Power Supply

- Power Supply
  - +12V DC
  - GND
- Isolated CAN
  - CAN-H
  - CAN-L
  - CAN-T-A (termination connector)
  - CAN-T-B (termination connector)
- Isolated signal lines
  - OCS (over current detect output)
  - SYNC (synchronization input)

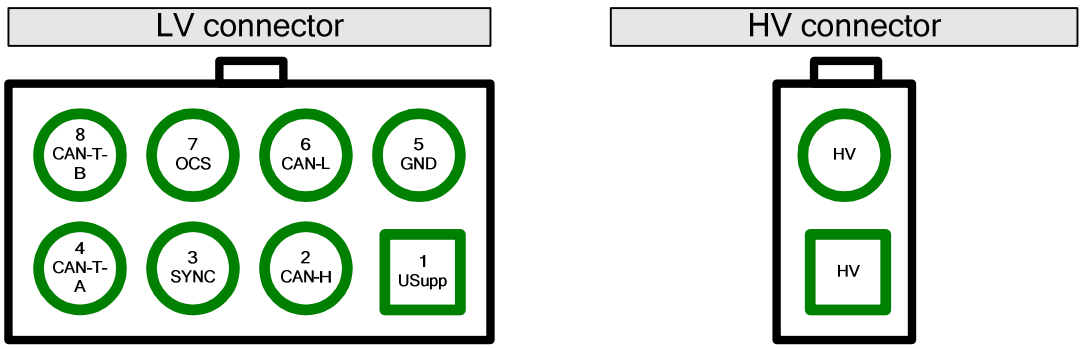

Figure 7-3 Connector pin assignment

If Pins 8 (CAN-T-B) and 4 (CAN-T-A) are shortened externally, the module's internal CAN bus termination is activated.

7.5 Connectors

The module is equipped with two Molex Micro Fit 3.0 male connectors. A 8 pin connector is used for the connection to the LV side. The HV voltage can be connected to a 2 pin connector. These two pins are shorted together internally.

7.6 Package / Housing

The module is supplied in an open version without housing but with a conformal coating.

7.7 System Integration

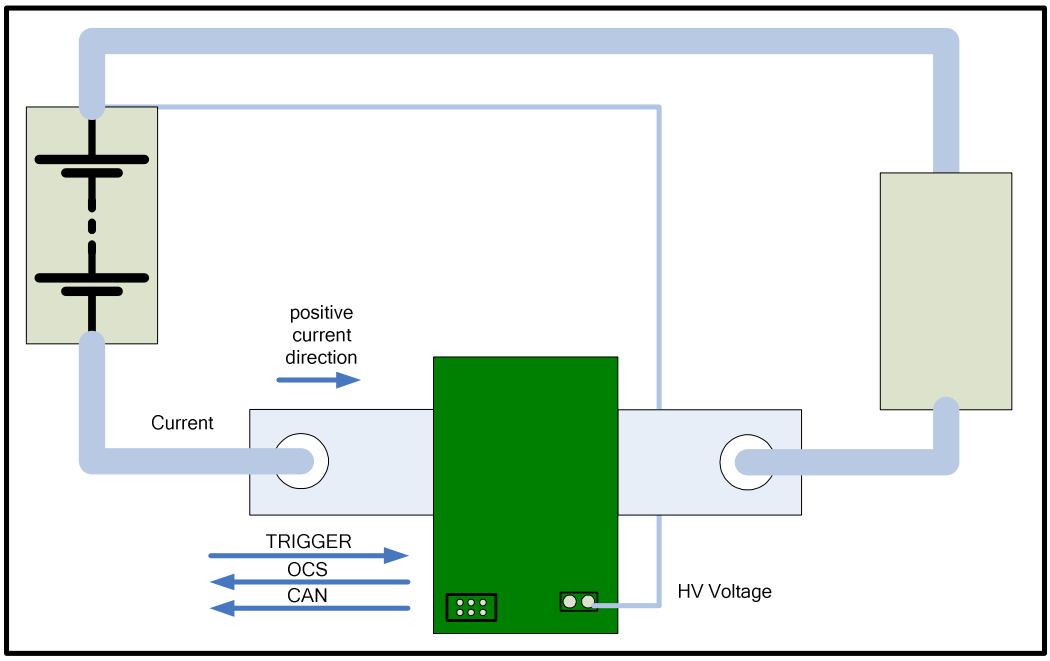

Figure 7-4 System integration