

Formula Student

Energy Meter Specification 2023

Version history

Author	Date	Version	Comment
AS	20-MAR-2023	1.0	Initial release
AS	23-MAY-2023	2.0	New connector pinouts and component images

Introduction

The Energy Meter is a crucial element for the EV vehicles competing in Formula Student. It allows for the officials to inspect the HV Tractive System for compliance with the rules for both Power consumed and Voltage present in the system.

For the 2023 season Formula Student has redesigned the Energy Meter to improve ease of installation, accuracy, reliability and performance.

This document contains the specification of the new Energy Meter that teams entering an EV in FS Class or an EV FSAI car must design to accommodate.

Energy Meter components

As with the energy meter in previous years, the main logging unit consists of a modified GEMS DA3 data logger. There is nothing shared with the commercial datalogger other than the Data Key and the dimensions of the logger unit. This unit must be installed **outside** of an HV enclosure with easy access to remove the Data Key by officials during dynamic events.

The teams are not permitted to remove the Datakey from the logger unless instructed to do so by an EV Scrutineering official. The teams are not permitted to attempt to access or modify any data recorded on the Data Key. Doing so will be easy to detect and will result in a penalty up to and including disqualification.

The 2023 equipment introduces a new sensor unit to be installed inside a vehicle HV enclosure.

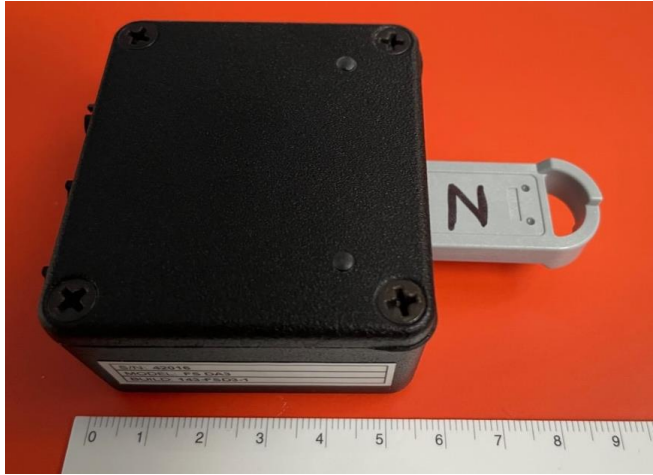
THIS IS NO LONGER A HALL EFFECT CURRENT TRANSDUCER, IT IS A SHUNT IN THE MAIN CURRENT PATH.

Teams will need to provide a break in the negative return path of the HV cables to attach to bus-bar style interfaces to the sensor module. Details are provided below.

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Electrical connections spec

Data logger



Power Supply

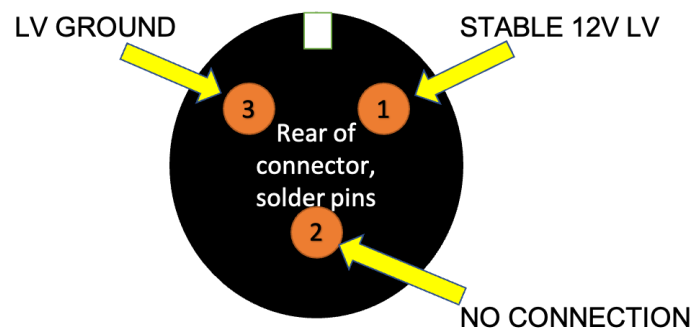
The Data logger (as in previous years) requires a Grounded LV connection. This must be switched by the LV Master Switch, but teams are free to source this supply from anywhere appropriate on the vehicle's LV system.

The nominal supply voltage is 12V DC but the absolute range is 8V to 16V DC.

It is advisable to provide a clean and reliable 12V LV supply as any malfunction of the datalogger due to installation issues (physical or electrical) on the vehicle may result in disqualification from any dynamic event where logs are unavailable.

The connector required for LV supply is a 3-way Binder connector part number 09 9747 70 03.

The team must assemble a terminated cable with the following pinouts, solder terminations as viewed from the rear of the connector (not the mating face):



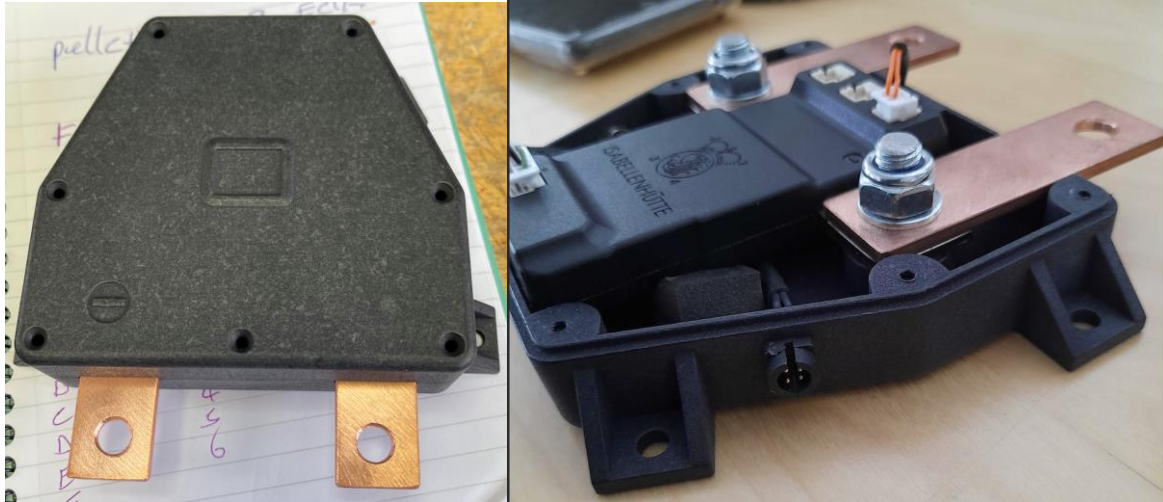
Connection to the Sensor module

There is a single cable to connect the logging unit to the sensor module. This carries LV and CANbus signals.

This cable is provided in the Energy Meter Kit and only requires the team to route it appropriately between the two units, via a suitable gland or equivalent in the HV enclosure.

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Sensor module



The Sensor module has two connectorised interfaces:

1. An HV sense line that must connect to the TS after the positive AIR and before any loads, **teams must assemble this cable themselves in advance**;
2. A connection to the datalogging unit providing LV and CANbus. **This cable is provided.**

THE ENERGY METER IS NOT INTENDED TO BE ATTACHED TO ANY EXISTING VEHICLE CANBUS NETWORKS

The connector pinouts for the HV sense cable are:

Pin 1 and 2: HV+.

Pin 3: No connection.

Teams must manufacture the HV sense wire. It is terminated at the sensor module by a Binder 3-way connector, part number 09 9749 30 03.

NOTE: THIS IS INTENTIONALLY A DIFFERENT CONNECTOR FORMAT TO THE LV CONNECTOR ON THE DATALOGGER MODULE.

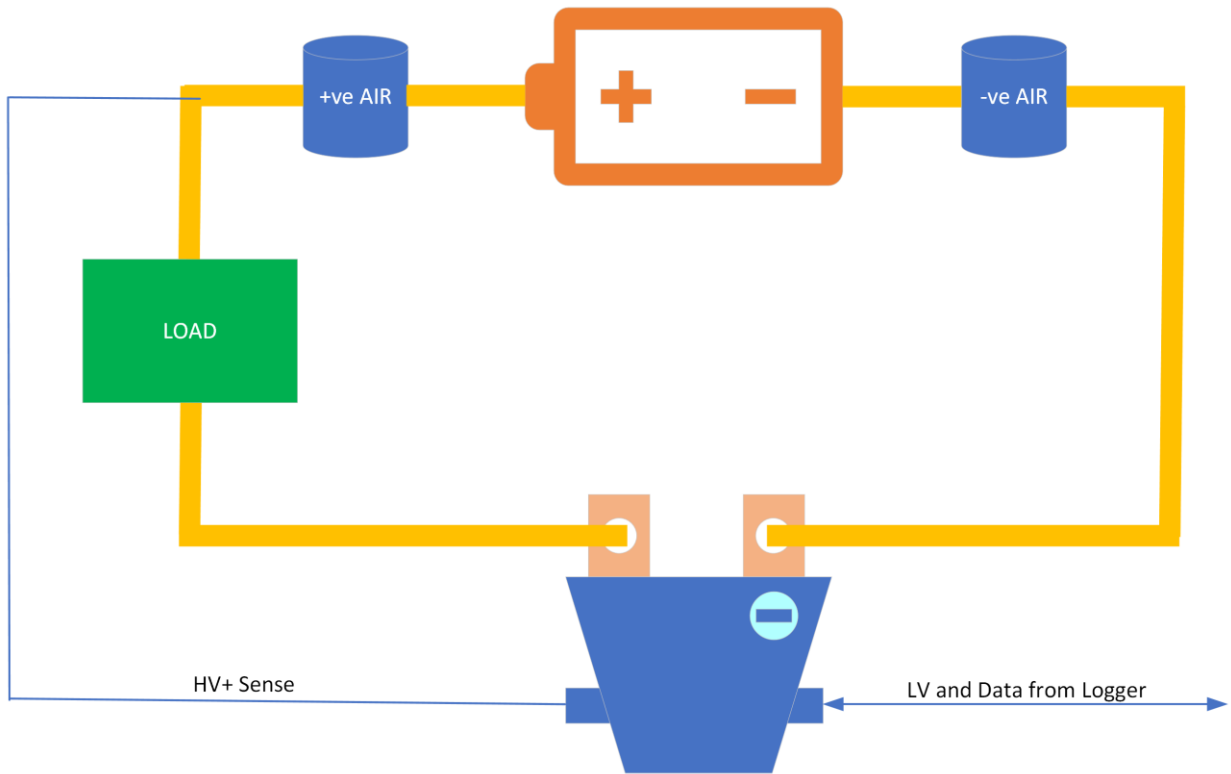
The sensor module has two bus-bar terminals for the main TS current path. The bus bars have 8.3mm drilled holes for attaching HV cables. It is critical to ensure a secure and maximum surface area connection to these bus bar fixtures.

Installation

The Sensor module **must** be installed exactly as described in the diagram below.

- The Sensor **must** be the last element in the high current path before the negative AIR.
- The HV sense line **must** be attached to the HV TS high current path before any loads that drop any voltage. Ideally this is as near to the positive AIR as is feasible within HV enclosures available.
- The connection between vehicle TS cables and the sensor module **must** be suitable for the high current path. A secure and well-matched fitting is critical to the safe working of the device in the vehicle.

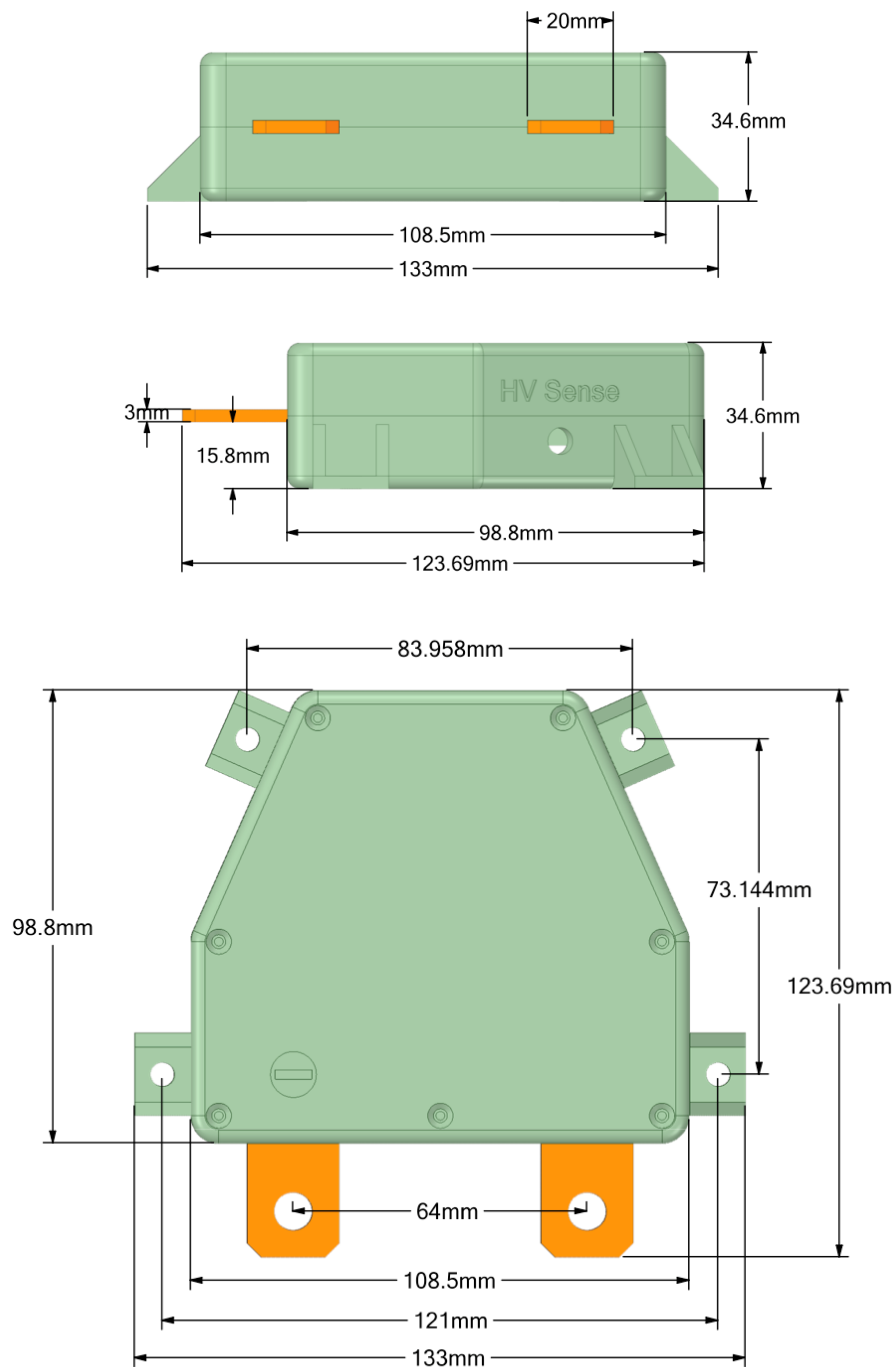
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Sensor module dimensions

The sensor module dimensions are provided to indicate constraints for accommodating the unit inside an HV enclosure. Mounting lugs are included to allow for securing the unit. Teams should ensure that the unit is secured appropriately within their vehicle HV enclosure. Usage of the mounting lugs is optional but the unit must be prevented from being loose in the HV enclosure and potentially loosening the HV TS connections.



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Sensor characteristics

Voltage

The sensor is capable of measuring **+1000V** with a linear accuracy of 0.1% to 0.4% of reading.

The sensor must not exceed +1200V.

Current

The current shunt is rated at a nominal +/- **300A**. The reading accuracy up to +/- 300A is +/- 0.1% to 0.4% of reading.

Over-current of the sensor module is possible, with reduced accuracy at +/- 3% reading as follows:

- 320A for five minutes
- 430A for 30 seconds
- 600A for 10 seconds
- 1600A for 1 second
- 3600A for 200 milliseconds

Document revision

This document is available from the Formula Student website.

This document will be up-versioned with new information about the equipment as it becomes available.