

Energy Meter and Current Transducer Installation Manual 2021

Overview

The energy meter assembly is made of two separate boxes, as follows:

- Energy Meter (EM) Box, with four socketed cables feeding directly out from the box.
- Current Transducer (CT) Box.

Energy Meter (EM) Box

Fig.1 shows the picture of the Energy Meter box. Each box has four cables connecting through locking bayonet connectors located on one end of the box, as follows:



Figure 1: Energy Meter Box

High Voltage Measurement Cables (1.5m long): This cable provides the high voltage measurement signal to the EM box, and connects to the EM box through a 3-pin small bayonet connector at the TOP LEFT 3-pin socket. The other end of the cable is supplied unterminated, and is to be connected to the external voltage measurement test points on the **non-battery** side of the current limiting resistors that connect between these points and the main DC bus voltage. Teams **MUST** advise the judges at electrical scrutineering of the value used for their

current limiting resistors, so that the voltage measurement can be compensated for their vehicle. If **NO** resistor value is advised, it will be assumed to be 25 kohm.

Connect the negative voltage measurement point to the **BLACK** cable core, and the positive measurement test point to the **RED** cable core. **Do not** shorten this cable - any excess length should be neatly coiled and securely fastened.

EM-CT Cable connection (1.5m long): This cable links the EM box to the CT box. The Micro-USB plug end of this cable plugs into the EM box at the TOP RIGHT micro USB socket. The other end of the cable feeds directly into the CT box, and cannot be disconnected from the CT box.

Power Connection Cable (1.5m long): This cable provides the incoming low voltage power supply (9V to 36V) and connects to the EM box using a 2-pin bayonet connector at the BOTTOM RIGHT 2-pin socket. The other end of the cable is supplied unterminated. Connect the low voltage supply positive terminal to the **WHITE** core of the unterminated end, and the low voltage supply negative terminal to the **BLACK** core of the unterminated end. **Do not** shorten this cable - any excess length should be neatly coiled and securely fastened.

USB Comms Cable (1.5m long): This cable is used for monitoring and confirmation of correct operation of the EM. The Mini-USB plug of this cable port connects to EM box at the BOTTOM LEFT Mini-USB socket. The other end of the cable is a standard USB connector that connects directly into a laptop PCB. This cable is not used during the energy logging process. The free USB end must be secured in a convenient place on the car frame during scrutineering after the operation of the EM has been confirmed, and must be encased in a plastic bag (supplied) after scrutineering and sealed with a cable tie, to water proof it for the duration of racing.

Dimensions: The EM box is made by Takachi (Japan), model number “exw7-6-9”. It has external dimensions of 69mm (W) x 59mm (H) x 85mm (D). An additional clearance around the box of at least 2mm is required to allow for the rubber ears of the sealing gasket. The box has no mounting flanges – teams must individually design their mounting strategy.

The bayonet connectors protrude approximately 45 mm beyond the box end. A 25 mm clearance must also be maintained beyond this distance to allow for cable bending radius.

Hence the total required depth for the EM box and cables is 155mm.

EM Operation: Correct connection and operation of the EM is indicated by the LED located on the end panel of the box. The LED turns on continuously for 5 seconds when the EM is first powered on, and then reverts to a 1 second flash rate as energy logging commences.

Energy usage data is recorded internally to the box and is not user accessible. The data storage element will be initialized during electrical functional scrutineering, and will record energy usage (including peak power detection) from then on whenever the car is energized and operational.

At the end of the last dynamic event, the EM box, current transducer and all associated cables are to be removed from the car while it is in parc ferme, and returned to the judges so that the recorded data can be extracted and analysed.

Current Transducer (CT) Box

Fig.2 shows a picture of the CT box. Each CT box has a center hole of 20mm diameter, through which the main current carrying conductor from the high voltage battery must pass. The CT box connects to the EM box via a 3mm diameter EM-CT Cable that is permanently wired into the box, and pre-terminated with a mini-USB plug at the free end as shown in Fig. 2. The cable exits the box from the back corner, and cannot be disconnected from the box. The cable length is preset at about 1.5m, and cannot be modified. The mini-USB plug diameter is 20 mm.

The CT box dimensions are 56mm (W) x 56mm (H) x 34mm (D). A further 10mm clearance is required at the back corner of the box for the measurement cable to exit and bend.

Teams must design a way of feeding the EM-CT Cable cable between the CT box and the EM box to allow for the plug diameter, so that it can be quickly removed in parc ferme.



Figure 2: Current Transducer Box

Each CT box is marked with an arrow symbol which indicates its positive electrical current flow orientation. Install the CT with its arrow pointing in the direction of positive current flow from the

battery under motor drive conditions. The CT box can be installed on either the outgoing (positive) connection from the battery, or the return (negative) connection to the battery. However, the direction of current flow through the CT box for a driven motor must be positive in the direction of the arrow.

Fig. 3 shows a guidance picture of the installation of the CT box for a positive battery terminal connection.

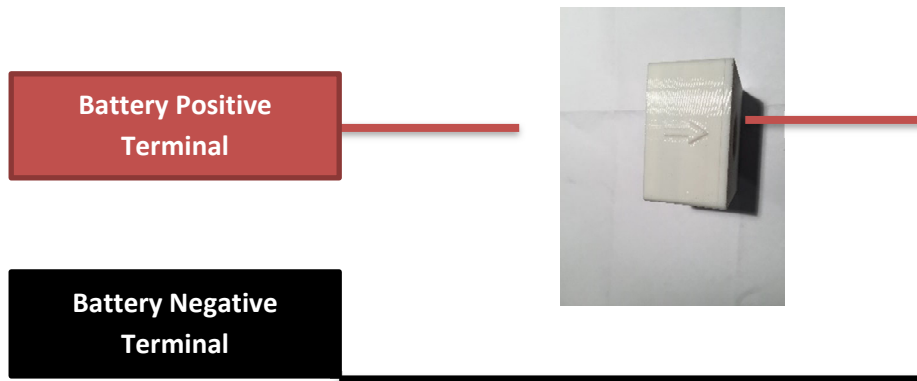


Figure 3: Orientation of CT Box

Installation and Functional Verification

Energy Meters will be supplied to EV teams at the competition when they register.

Teams should fit the CT box and the EM box to their cars before proceeding to Stage One EV Scrutineering. The installation of the meter will be checked as part of this scrutineering.

The correct installation and functional performance of the EM system will be verified as part of the Stage Two EV Functional Scrutineering. The EM system will be tested by briefly energizing the drive and turning the vehicle wheels while it is on chocks, while the USB Comms cable is connected to a scrutineer's laptop computer. Successful completion of this functional testing is a mandatory step in completion of Stage Two EV Functional Scrutineering.

ELECTRICAL SPECIFICATIONS:

Input DC Supply Voltage	9 – 36V
Input DC Supply Current	130mA @ 12V
Maximum Rated HV DC Voltage	±750V
HV DC Voltage Measurement Range	0 to 600V
HV DC Voltage Input Impedance	1.8 MΩ
IDC Current Transducer	Tamura “L06P800S05” LEM
IDC Current Measurement Range	-200A to 440A

MECHANICAL SPECIFICATIONS:

EM Box	69mm (W) x 59mm (H) x 85mm (D)
EM Box part number	Takachi “exw7-6-9”
CT Box	56mm (W) x 56mm (H) x 34mm (D)