

## IMD

### Description (type, operation parameters)

An insulation monitoring device (IMD) is installed in the tractive system that continuously monitors the electrical insulation resistance between the active HV conductors of the drive system and the chassis ground reference earth. The IMD is a Bender A ISOMETER ® isoF1 IR1553204 ( [https://www.bender.de/en/products/insulation-monitoring/isometer\\_ir155-3203ir155-3204](https://www.bender.de/en/products/insulation-monitoring/isometer_ir155-3203ir155-3204) ). The response value of the IMD is set to 500 Ohm / Volt, related to the maximum tractive system operation voltage. The tractive system maximum voltage is 72V, so the IMD is at 36 kohms. The IMD specs are shown in Table .

Once power is switched on the IMD performs a Speed Start measurement (SST). This provides the first estimated insulation resistance during a maximum time of 2 seconds. The Direct Current Pulse (DCP) system starts immediately after to continuously take measurements. Faults in the connecting wires or any functional faults will be recognized, and drive a relay open.

Since the IMD provides a LOW signal when there is a fault, the tractive system disabled until it can be reset by a switch that will not be accessible to the driver. Thus, the relay is NO, and open in a fault and it will get closed when there is no fault.

The status of the IMD is shown to the driver by an indicator light in the cockpit that is easily visible even in bright sunlight. In the case of a fault, too low insulation resistance, IMD error, ground error, undervoltage detected or IMD loss of power, the relay will get closed, and a normally closed contact will close, an indicator light will turn on. It is wired in series with a 470 ohm resistor to decrease the current to ~19 mA. The IMD indicator light is clearly marked with the lettering "IMD".

In case of an insulation failure or an IMD failure, the IMD will open the shutdown circuit without the influence of any programmable logic. If the shutdown circuit is opened by the IMD the tractive system will remain disabled until being manually reset by a person directly at the car which is not the driver. It is not possible for the driver to reactivate the tractive system from within the car in case of an IMD fault because the reset button is at the rear of the car out of the driver's reach. No remote reset is installed.

Applying an IMD test resistor, with a value less than 36k ohms, between HV+ and GLV system ground deactivates the system. Disconnecting the test resistor does not reactivate the system. The tractive system remains inactive until it is manually reset.

*Table 4 Parameters of the IMD*

<i>Supply voltage range:</i>	<i>10..36VDC</i>
<i>Supply voltage</i>	<i>12VDC</i>
<i>Environmental temperature range:</i>	<i>40..105° C</i>
<i>Self Test interval:</i>	<i>startup, then 15 min interval</i>
<i>High voltage range:</i>	<i>DC 0..1000V</i>
<i>Set response value:</i>	<i>36 kohms (500 ohms/volt)</i>
<i>Max. operation current:</i>	<i>2mA</i>
<i>Approximate time to shut down at 50% of the response value:</i>	<i>20s</i>

#### **Wiring/cables/connectors/ (updated)**

The connections on the vehicle side use metal ring terminals. The connections on the IMD side use a harness secured to the board. The XLA wires are 18 AWG cable. None of the GLVS wiring and components are orange in color. The high voltage wires are fused with [6.3A Bussmann BKS505HV6.3R fuses](#) rated at 400 VDC, with datasheet shown in . The IMD circuitry is shown in Figure

