

epConnected Vehicle

Vehicle Connectivity Module With OBD-II, Cellular, & GPS

Product User Manual

Embedded Planet Inc. | v2.0.0 | 10 Jul 2023



About This Manual

The **epConnected Vehicle User Manual** provides detailed information encompassing the design, description, and integration of the epConnected Vehicle product. For elaboration on drawings, software, or other specific product details there may be other sources of information to which this document points as reference. For the latest documentation, including document & certification updates, please always refer to the Embedded Planet documentation page: <https://www.embeddedplanet.com/product-documentation>

Product Web Page

The **epConnected Vehicle product page** by Embedded Planet provides description & resources related to this product. The page can be located at <https://www.embeddedplanet.com/connected-vehicle>

Acronyms & Abbreviations

Term	Description
EPI	Embedded Planet, Inc.
IoT	Internet of Things
OBDII	On-board Vehicle Diagnostics
PID	Vehicle Parameter Identifier
DTC	Vehicle Diagnostic Trouble Code

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1. INTRODUCTION

The epConnected Vehicle provides a solution for bringing cellular data collection and management to vehicle interfaces. epConnected Vehicle uses Embedded Planet’s Agora module with a custom host board to communicate with a vehicle’s OBDII port. The monitored vehicle data is then sent over cellular using LTE Cat-M1 technology. The board is powered through an OBDII cable (12V). The epConnected Vehicle includes a plastic housing with user interfaces for CAN/power, cellular antenna (SMA), GNSS antenna (SMA), as well as flanges for mounting.



Powered by Agora



The epConnected Vehicle leverages the capabilities of the Agora module by Embedded Planet. To learn more about Agora & how to leverage its capabilities, visit <https://www.embeddedplanet.com/agora>.

1.1. Contact Information, Support

For general contact, technical assistance, technical questions contact Embedded Planet at:

- Sales: sales@embeddedplanet.com
- Information Requests: info@embeddedplanet.com
- Technical Support: support@embeddedplanet.com

1.2. Ordering Information

The orderable part number for Connected Vehicle is “EPCNCT-VEH1.2-A”. Availability is contingent on current stocking & ordering conditions. Please contact Embedded Planet sales for questions: sales@embeddedplanet.com. The Embedded Planet shop is hosted at <https://shop.embeddedplanet.com>. During the ordering process, a phone number and/or email address will be needed to direct alarms to the proper location.

1.3. Vehicle Compatibility

In the US, all cars and light truck model years 1996 and newer are OBD2 compliant. epConnected Vehicle conforms to SAE standard J1979 to communicate to vehicles through the OBD2 port. The unit can communicate with standard and extended CAN, as well as 250k and 500k baud. This covers most OBD2 vehicles.

2. PRODUCT DESCRIPTION

2.1. Overview

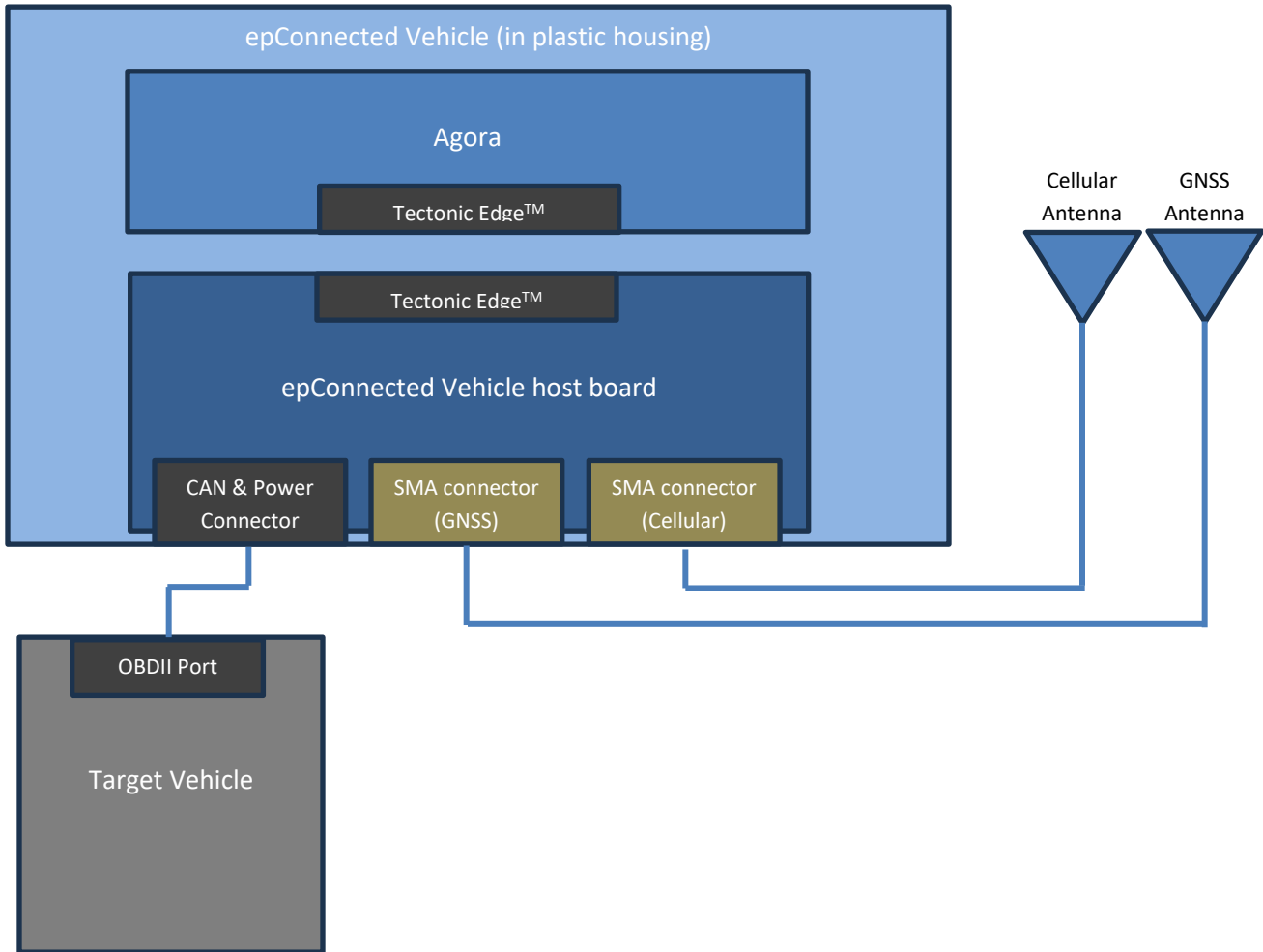
epConnected Vehicle consists of an enclosure containing circuit boards, connectors, cables, and accessories. Users can pull vehicle diagnostic data from a vehicle's ECU along with location information and display the data on a cloud service.

2.2. Main Features

Feature/Specification	Description
Vehicle Protocol	OBDII (J1979)
Cellular Capabilities	Cellular Technologies: LTE-M (LTE CAT M1) Operating Frequencies: 699MHz to 1980MHz RF Output Power: Up to +23 ±2 dBm (Power Class 3) Region: North America
LTE CAT M1 Specification	Bands (WW): B1(2100), B2(1900), B3(1800), B4(AWS1700), B5(850), B8(900), B12(700), 13(700), B18(800), B19(800), B20(800), B26(850), B28(700)
Cellular Certifications	PTCRB: Complete AT&T TRENDI: Complete VERIZON ODI: Complete
Wireless Protocols	HTTP
SIM	Removable: 4FF (nano) SIM card slot
GNSS Specifications	Constellations: GPS, GLONASS, BeiDou, Galileo, QZSS Tracking Sensitivity: -161dBm Navigation Sensitivity: -158dBm Cold Start Sensitivity: -146dBm
Supported Cloud Platform	Thingsboard
Firmware Update Over-The-Air (FOTA) Capability	Yes
SMS/Email Alerts	Yes, for out of bounds supported PIDs and all DTCs
OBD2 Protocol Support	500k Baud, 11-bit CAN 500k Baud, 29-bit CAN 250k Baud, 11-bit CAN 250k Baud, 29-bit CAN

2.3. Block Diagram

The block diagram below depicts the epConnected Vehicle with the external connections of the vehicle and two antennas.



2.4. Electrical Specifications

Feature/Specification	Description
Input Voltage	12V (Through OBDII Connector)
Average Idle Current (Vehicle Off)	8-12mA

If a vehicle is expected to remain off for an extended period of time, it is recommended to disconnect epConnected Vehicle from the vehicle.

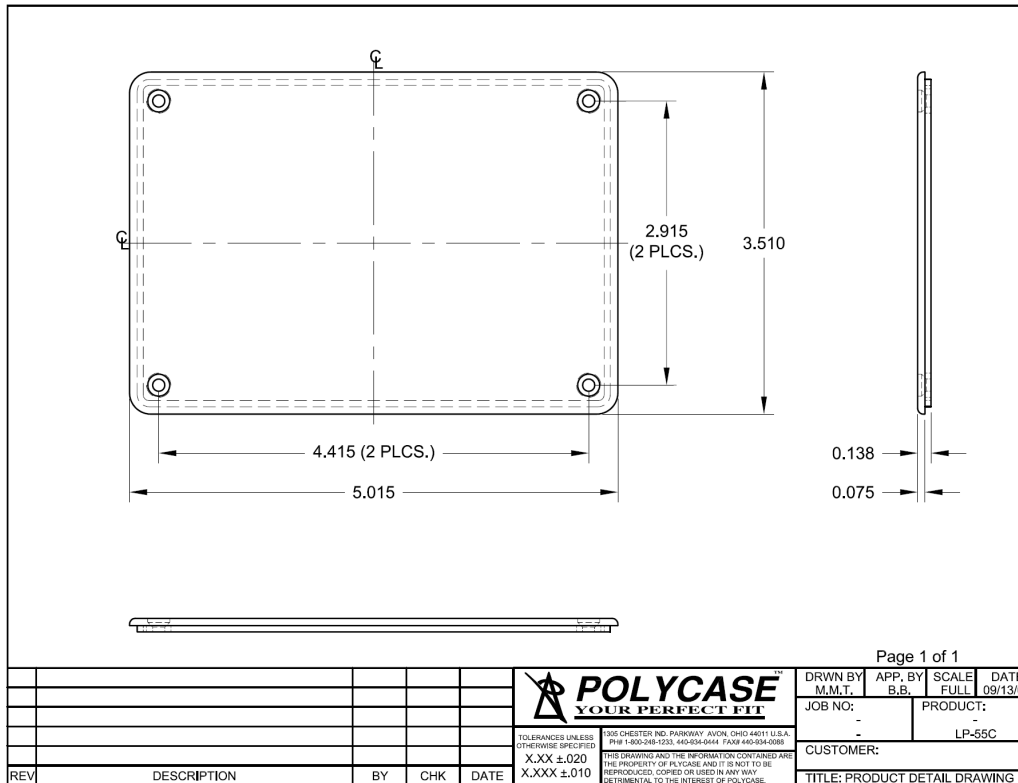
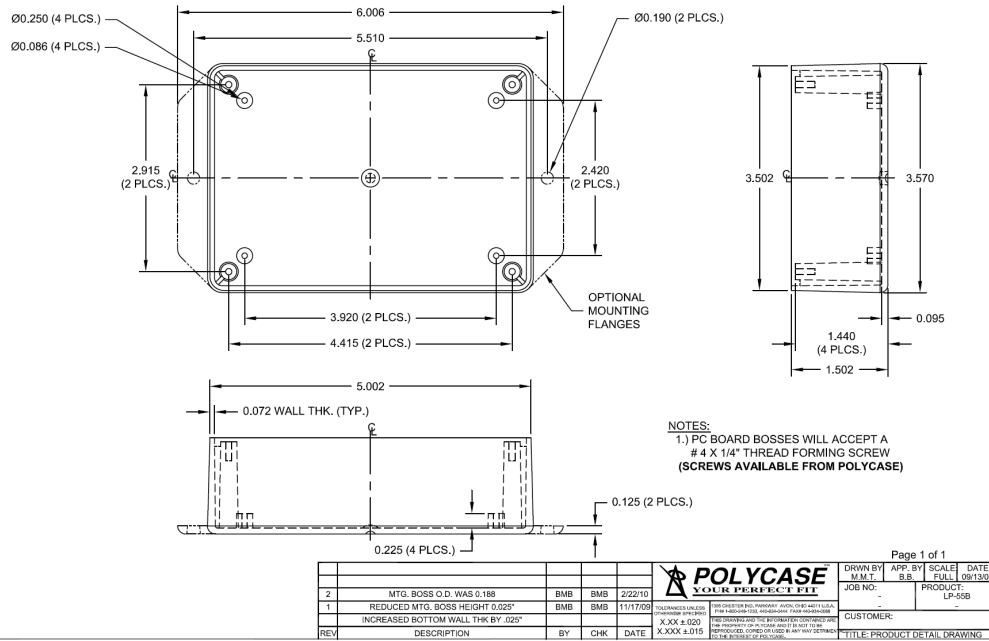
The epConnected Vehicle board is designed to be powered by 12V through an OBDII cable connected to J5. The 12V input on the PCB includes input protection elements designed to guard against egregious fault conditions and withstand alternator load dump conditions. A 1.1A, 60V resettable PTC fuse (polyfuse) in line with the 12V input protects against potential high input current levels. A series rectifier diode at the 12V input assures a one-way flow of energy at the connector. There is a TVS diode positioned for transients at the 12V input with a reverse stand-off voltage of 22V and a maximum clamping voltage of 35.5V. A capacitor bank provides conditioning & stability on the system side of the protection circuitry.

2.5. Mechanical Specifications

The enclosure for the epConnected Vehicle is a Polycase LP-55FMB. The enclosure includes a lid secured by four screws with two mounting tabs on either side of the enclosure. For more information on the enclosure, including detailed drawings, please refer to <https://www.polycase.com/lp-55f>.



Within this section are mechanical drawings provided for the purpose of understanding the general size, shape, and layout of the epConnected Vehicle device. For the most complete & up-to-date documentation on mechanical drawings, along with more on the epConnected Vehicle device, please refer to the materials provided at <https://www.embeddedplanet.com/product-documentation/#connected-vehicle>.



2.6. Dimensions

The overall dimensions of epConnected Vehicle are:

Parameter (enclosure)	Value (in)	Value (mm)
Length (with mounting tabs)	6.006	152.6
Length (box walls)	5.002	127.1
Width	3.570	90.7
Height	1.64	41.7

2.7. Environmental Specification

Parameter	Min	Typ	Max
Operating Temperature	-17°C	+25°C	+80°C
Storage Temperature	-17°C	+25°C	+80°C
Operating Humidity, non-condensing	20% RH	-	90% RH

2.8. PID's & DTC's

epConnected Vehicle monitors PIDs and DTCs, displays the data on a dashboard, and sends an alert to the user if the ranges are out of spec. Most vehicles support the list of PIDs. If a vehicle does not support any one of the PIDs, the data will display a value of 0, and no alarms will be generated.

The following PIDs are available for customer monitoring:

PID	Description
12	Engine RPM
13	Engine Speed (MPH)
4	Engine Load (%)
5	Coolant Temperature (°F)
16	Air Flow Rate (g/s)
31	Driving Time (s)
66	Control Module Voltage (V)
47	Fuel Level (%)

All DTCs received from the vehicle ECU will be reported to the dashboard.

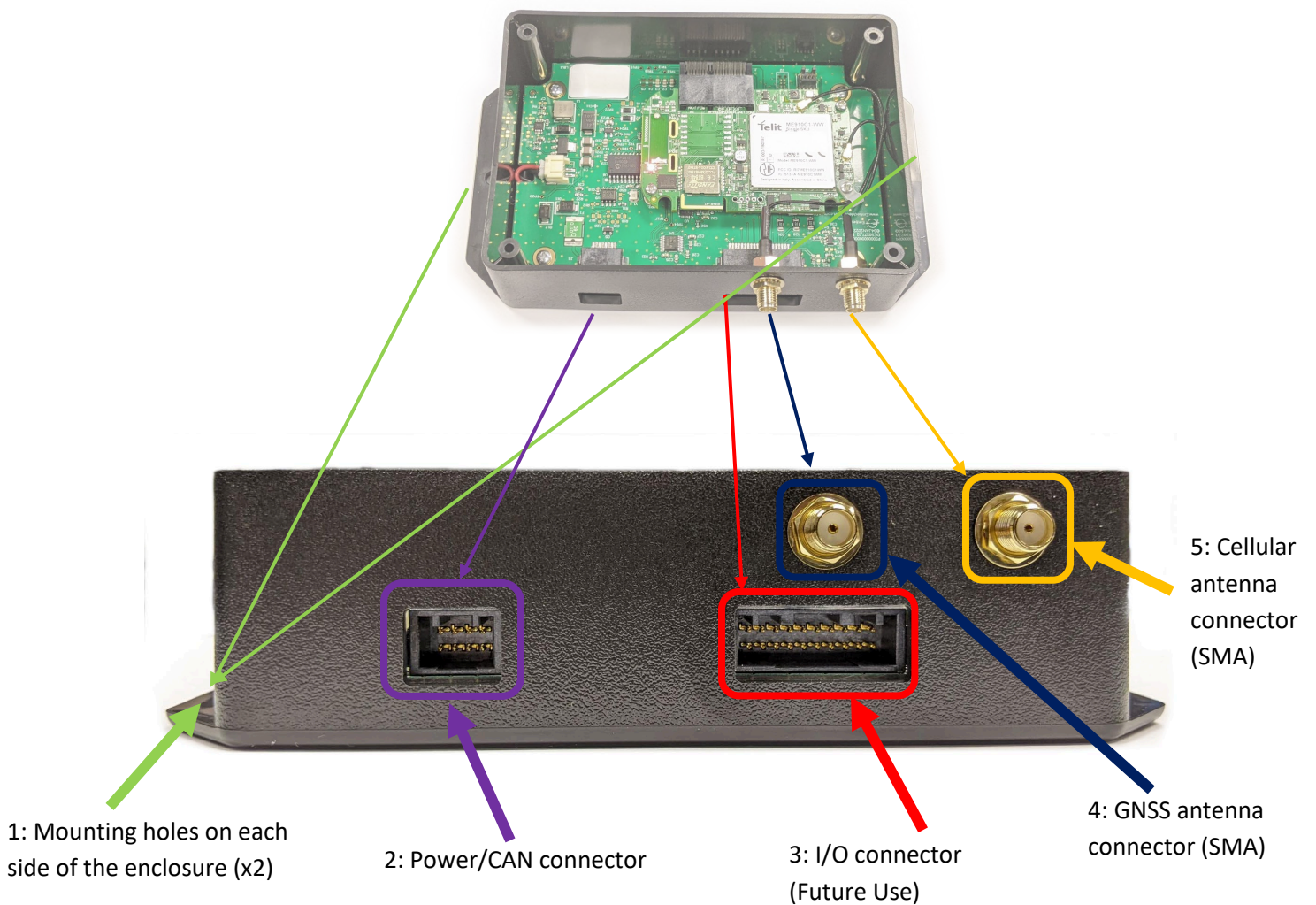
3. GETTING STARTED

3.1.Product Contents

The product box contains:

- Dual Cat-M1 and GNSS Antenna
- epConnected Vehicle (Enclosure containing PCBs, SIM, Connectors, etc.)
- OBD2 Cable

The mounting holes and connectors are labeled in the diagram below for epConnected Vehicle:



3.2. Installing

Once the user has removed the contents from the box, the installation process can be started:

1. Connect the antenna cable labeled GNSS to the GNSS antenna connector on the unit (labeled as number 4 in image above).
2. Connect the antenna cable labeled Cellular to the Cellular antenna connector on the unit (labeled as number 5 in image above).
3. Connect the rectangular side of the OBDII cable to the power/CAN connector on the unit (labeled as number 2 in image above).
4. Mount the enclosure in the vehicle using the mounting holes to secure the unit.
5. Using plastic adhesive on antenna, secure antenna to vehicle glass or on dashboard with sufficient line of sight out of the vehicle.
6. Ensure vehicle engine is off. Connect the DB9 end of OBDII cable to OBDII connector on vehicle.
7. Turn on vehicle engine.
8. Navigate to provided dashboard URL to start seeing data.

3.3. Dashboard

The dashboard is located on Thingsboard. The box contents will include a link to the dashboard for accessing the vehicle data and information. The dashboard can be used for several different applications. There are three separate dashboard pages. The first is for monitoring a fleet of vehicles, the second is the route history of a vehicle, and the third is a vehicle diagnostic data and trouble codes. These are shown in more detail below. Users will receive a URL link to the fleet page, as this serves as the homepage.

Fleet Page (Homepage)

The screenshot displays the 'epConnected Vehicle Dashboard' interface. It is divided into three main sections:

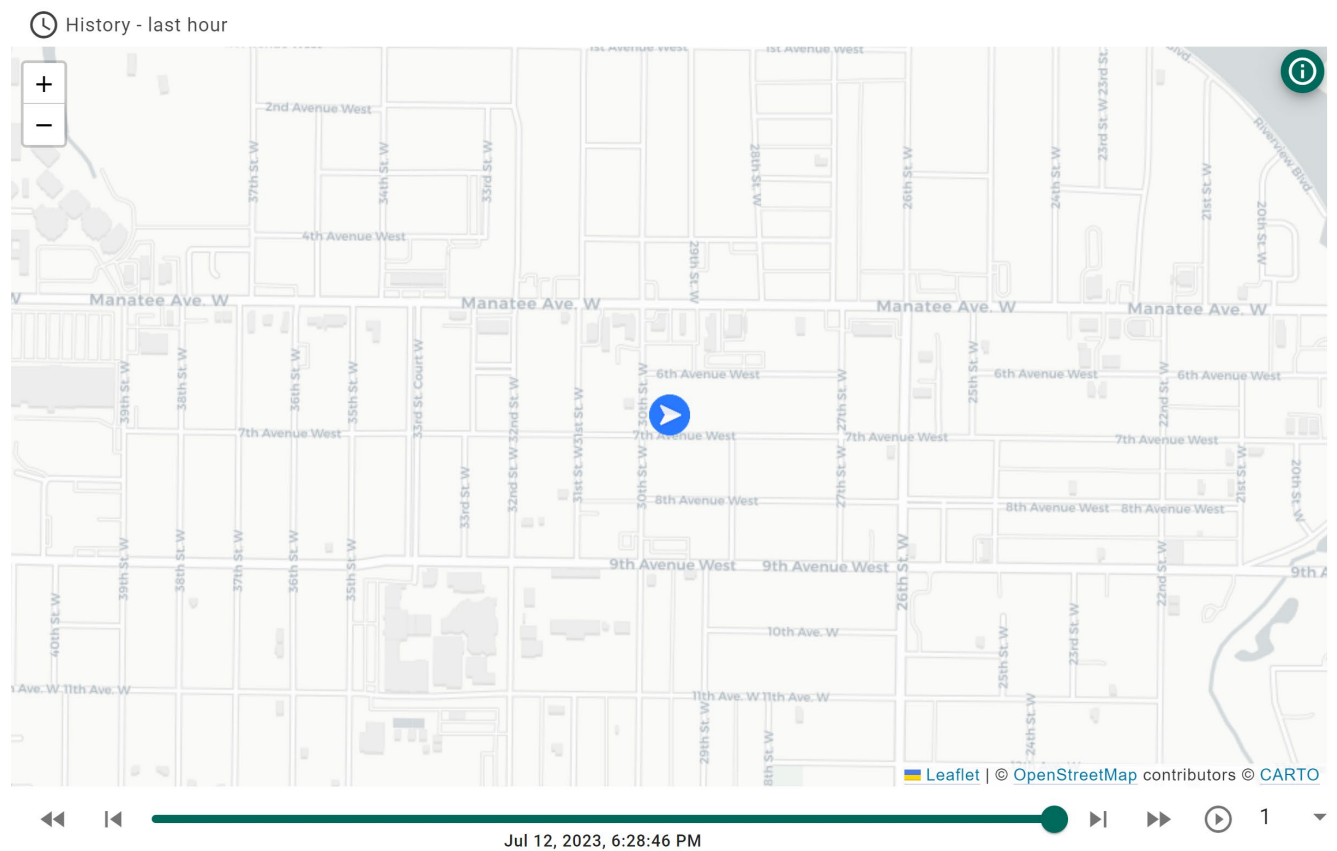
- Table 1 (Red outline):** A table listing vehicles with columns for Vehicle Label, Last Activity Time, Cell Strength, VIN, Active DTCs, and FW Vers.
- Table 2 (Purple outline):** A 'Realtime - last day' log table with columns for Time, Vehicle Label, Severity, Type, and Status.
- Map (Green outline):** A map showing the locations of vehicles. Callouts for 'Mark L CV', 'Dan CV', and 'Mike CV' are visible, displaying speed and driving time.

Vehicle Label	Last Activity Time	Cell Strength	VIN	Active DTCs	FW Vers
Mark L CV	8/4/2023 05:07 PM	Good	2T3xxxxxxxxxxxx	None	00.00.25
Mark T CV	8/4/2023 10:43 AM	Fair	1FTxxxxxxxxxxxx	None	00.00.24
Dan CV	8/4/2023 02:28 PM	Fair	1FTLR4FEXBPA98994	PIDA, PIDB, PIDC	00.00.06
Mike CV	8/4/2023 05:12 PM	Good	1FDWE3FN7NDC14236	P0401	00.00.23

Time	Vehicle Label	Severity	Type	Status
2023-08-04 14:21:12	Mike CV	Warning	DTC:P0401	Active Unacknowledged
2023-08-04 12:55:48	Mike CV	Warning	DTC:P0101	Active Unacknowledged
2023-08-04 12:55:48	Mike CV	Warning	DTC:P0100	Active

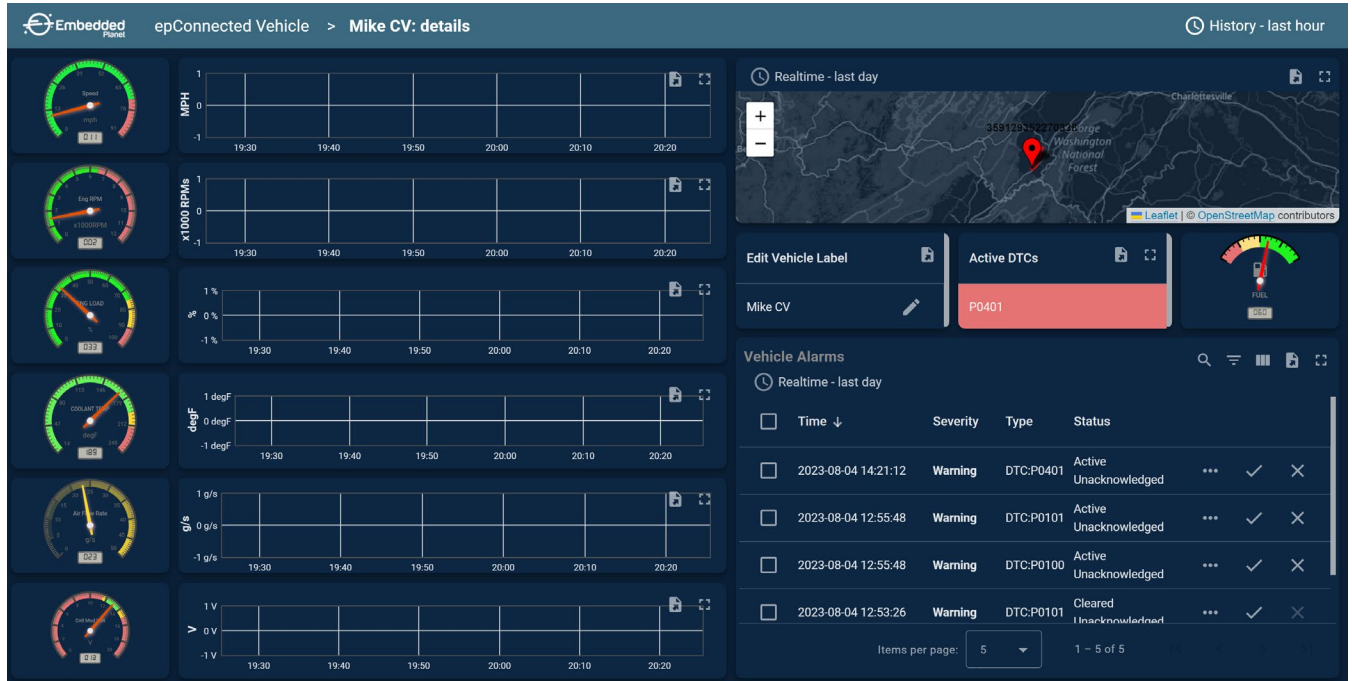
The homepage consists of three main sections. The section labeled in red as one contains a summary of the vehicle information. The vehicle label, last activity time, cell signal strength, VIN, active DTCs, and firmware version are displayed. The cell signal strengths of Excellent, Good, and Fair should be able to communicate successfully over cellular. However, a signal strength of Poor may need to be placed or driven to a location with better cellular service. By selecting a vehicle, you will be directed to the vehicle diagnostic data page. The section labeled in purple as two contains all the latest alarms for the vehicle fleet for the selected period of time. The vehicle label, severity level, acknowledgement status, and type are listed. The alarm types consist of any DTC or PID out of range. The alarms are listed as active and clear. They can be acknowledged for tracking purposes by selecting the checkmark. The section labeled in green as three contains a map of all vehicles registered to the user. Each vehicle has the label, most recent speed, and driving time listed. By selecting the vehicle image, users can navigate to the route history page.

Route History Page



The route history page allows users to visualize the route of a vehicle over a certain period of time. If a route has been taken during that period, it will be highlighted on the page above. Users can close out of this page by clicking the “x” on the top right of page, returning to the home page.

Diagnostic Data Page



The diagnostic data page shows all the most recent data for the vehicle selected on the home page. The left half of the page is for displaying the most recent PID values on a dial, along with the data over a set time period to the respective dial's right. The dials are highlighted in green, yellow, or red to show if the most recent value is within the normal, warning, or alert range, respectively. The right half of the page shows the selected vehicles Alarms, the active DTCs, the fuel level percentage, and a map of the route history of the vehicle. Users can navigate back to the homepage by selecting "epConnected Vehicle" at the top of the page. Users can modify the vehicle label by selecting the pencil icon within the "Edit Vehicle Label" box.

3.4. Alarms

The alarms consist of PIDs out of range and any DTC received by the vehicle ECU. The alarms are shown on the dashboard pages and through an email or text. The list of PID criteria for Alarms is shown below.

PID	Description	Alarm Criteria
12	Engine RPM	N/A
13	Engine Speed (MPH)	ALARM: Above 80 MPH NORMAL: Below 80 MPH
4	Engine Load (%)	N/A
5	Coolant Temperature (°F)	ALARM: Above 240 °F WARNING: Above 220 °F NORMAL: Below 220 °F
16	Air Flow Rate (g/s)	N/A
66	Control Module Voltage (V)	ALARM: Above 15V WARNING: 0-12V and 14-15V NORMAL: 12-14V
47	Fuel Level (%)	ALARM: Below 10% WARNING: 10-15% NORMAL: Above 15%

4. Custom Features

Embedded Planet can collaborate with your team to customize the product related to software, hardware, and cloud connectivity. Reach out to us to discuss additional features. Some of these features may include:

- **Dashboard**
 - Changes to PIDs monitored.
 - Changes to alarm thresholds.

- **Wireless Protocols:**
 - BLE
 - LoRa
 - NB-IoT
 - RS-232

- **Sensors:**
 - Environmental
 - IMU
 - ToF

- **Vehicle Protocols:**
 - J1939

- **Cellular Carriers:**
 - AT&T
 - Verizon
 - Roaming

- **Cellular Regions:**
 - Worldwide

- **GPIO**

5. FAQ & Troubleshooting

1. Why is the dashboard not showing any vehicle data:

- a. The unit takes about 90 seconds to go through its initialization process before data will be sent to the dashboard.
- b. Verify OBDII connector is properly connected to vehicle and epConnect Vehicle.
- c. Verify proper connection of cellular antenna cable to epConnected Vehicle.
- d. Ensure the vehicle engine is running.
- e. The unit may be in an AT&T poor cell coverage area, move vehicle and/or cellular antenna.
- f. Remove cover to view red LED and check flash pattern:
 - i. One flash every second: data is being sent to the cloud; data should be visible on dashboard.
 - ii. Two flashes every second: cell strength is sufficient to send data, data should be visible on dashboard.
 - iii. Three flashes every second: poor cell strength, move antenna and/or vehicle.
 - iv. Other: ensure all preceding steps are completed, then reach out to Embedded Planet support.

2. Why is dashboard not showing location:

- a. Follow the steps above for not showing vehicle data, along with:
 - i. GPS can take several minutes to find location, depending on vehicle and antenna location.
 - ii. Check proper GPS antenna connection to unit.
 - iii. Reposition antenna for better line of sight to satellites.

3. Why are no alarms being received through SMS/email:

- a. Verify proper email/phone number on file with Embedded Planet

6. Additional Resources


- Agora module:
<https://www.embeddedplanet.com/agora>
- epConnected Vehicle:
<https://www.embeddedplanet.com/connected-vehicle>
- Embedded Planet Documentation:
<https://www.embeddedplanet.com/product-documentation/#connected-vehicle>

7. Regulatory Information

7.1. Cellular Certifications & Endorsements

PTCRB: (Agora)

<https://www.ptcrb.com/device-details/?model=43504>

Manufacturer	Model Name / Number	Device Type	Technologies
Embedded Planet	EPM2M-AG-CELL	Integrated Device	4G, LPWA 

AT&T TRENDI: (Agora)

<https://marketplace.att.com/certified-devices>

Embedded Planet	EP-CHRONOS
	EPM2M-AG-CELL

7.2. RoHS Compliance

This device complies with the RoHS (Reduction of Hazardous Substances) directive of the European Union, EU Directive 2011/65/EU.

7.3. Interference Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

7.4. FCC and ISED Compliance

The Agora device complies with FCC/ISED radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF) Exposure Guidelines and RSS-102 of the ISED radio frequency (RF) Exposure rules. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. The antenna should be installed and operated with a minimum distance of 20 cm between the radiator and your body.

If the antenna for the Agora device is located farther than 20cm from the human body and there are no adjacent transmitters, the FCC and ISED approvals of the device's Telit ME910C1 cellular module can be reused by the end product.

If the device’s antenna is mounted closer than 20cm from the human body, or if there are adjacent transmitters, additional FCC/ISED testing may be required for the end device.

Orderable Device	FCC ID	ISED ID
Telit ME910C1-WW	RI7ME910C1WW	5131A-ME910C1WW

The FCC ID certificate for the Telit ME910C1-WW can be viewed through the portal in the links below:

ME910C1-WW

<https://fcc.report/FCC-ID/RI7ME910C1WW>

<https://fccid.io/RI7ME910C1WW>

The ISED ID certificate for Agora is available at the link below:

<https://sms-sgs.ic.gc.ca/equipmentSearch/searchRadioEquipments>

Enter “ME910C1-WW” in the *Product Marketing Name (PMN)* field to find the entry for **ME910C1-WW**

Radio Equipment Search

Hardware Version Identification Number (HVIN):

Product Marketing Name (PMN):

7.5. Antenna Notice: FCC & ISED

The Agora radio transmitter has been approved by the FCC & ISED to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with that device.

TABLE 1 – FCC & ISED MAX GAIN BY BAND

Antenna Gain: 2.14 dBi (Omnidirectional type)	
Band	Max Gain for FCC (dBi): WW
FDD 2	9.0
FDD 4	8.7
FDD 5	7.1
FDD 12	6.6
FDD 13	6.9
FDD 26	7.0

7.6. FCC Additional Testing, Part 15 Subpart B Disclaimer

The modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuitry), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed. The end product with an embedded module may also need to pass the FCC Part 15 unintentional emission testing requirements and be properly authorized per FCC Part 15.

8. DOCUMENT HISTORY

TABLE 2 – REVISION HISTORY

Revision	Author	Description	Date
1.0.0	M. Trowbridge	Initial Release (preliminary)	25 Feb 2022
1.1.0	M. Trowbridge	Updated graphics, formatting	11 March 2022
2.0.0	M. Golob	Updating for CV V2	10 July 2023

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