CIPIA-FS10

Product Manual

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1. About this Manual

1.1. Intended Audience

This product manual is intended for use by product development, technical support, and professional services teams within Telematics Service Providers (TSPs) and software platform providers, who plan to utilize Cipia-FS10 video telematics capabilities as part of their product offering.

1.2. Document Scope

The main objectives of this document are to describe the value, purpose, functionality, features and user interfaces of the Cipia-FS10 device.

1.3. Related Documentation

The following documents should be used in conjunction with this manual to provide the teams with the full picture covering the scope of work, tools, and resources available and/or required for the successful integration process.

- Cipia-FS10 Integration Manual
- Cipia-FS10 EVK quick start Manual
- Cipia-FS10 OTA Protocols Description
- Installer App API Description
- Installer App Manual
- Server API Document
- Middleware Description Document

2. Cipia-FS10 Overview

Cipia-FS10 is a driver monitoring device with embedded computer vision capabilities. It is designed to improve driver and fleet safety through video telematics applications. The Cipia-FS10 device detects driver drowsiness, distractions, and dangerous actions, providing real-time driver alerts, as well as tailored fleet manager alerts and insights via your fleet management server.

The Cipia-FS10 device is an in-cab device which incorporates Cipia's driver monitoring software engine and is intended for sales in the fleet management aftermarket segment. Target customers include Telematics Service Providers (TSPs), distributers, resellers, and integrators, as well as big commercial fleets with their own Telematics solution.

The system has embedded machine vision hardware resources and is intended to provide real-time monitoring, alerting, and reporting capabilities whenever the driver is drowsy, asleep, or not attentive to the road.

The system can optionally connect to an onboard telematics system, or other WAN-connected device in the vehicle, to report real time safety events to the back-end application (in case it is not equipped with its own cellular connectivity resources).

The main features and functions of the Cipia-FS10 system include:

- **Driver state analysis**

Cipia-FS10 driver state analysis capabilities include detection of:

- **Driver Distraction** – based on gaze direction and the analysis of other facial features, alerts when the driver is not looking at the center of the road. Alerts are correlated with the vehicle status (speed, gear, etc.)
- **Driver Drowsiness (fatigue)** – reporting and alerting when the driver is drowsy or asleep.
- **Mobile phone usage** – alerting when the driver is holding his mobile phone.
- **Smoking** – alerting when the driver is identified as smoking.
- **Seat belt usage** – alerting when the vehicle is moving but the driver is not wearing seatbelt.

- **Driver identity detection**

  After a short enrollment process, which enables adding a specific driver to the device database, when a driver is recognized, the system reports his ID. This information can be used for driver authentication policies within the fleet.

  Tamper proofing

  The system can report when the camera has different faults such as over exposure, blocked camera, cable-disconnect, device displacement etc.

- **Video capture**

  Cipia-FS10 enables the capture of video in the following ways:

  - **Autonomously** – trigger video capture of the driver during few seconds before and after a safety event detected by the machine vision algorithms.
  - **From connected device** – trigger video capture of the driver during few seconds before and after a safety event detected by a connected device.
  - **Server command (Instantaneous)** – trigger predefined length, immediate video capture of the driver once a command is received from the backend.
  - **Server command (DVR) –** Retrieve footage from on-going digital video recording buffer in SD card, according to the time frames defined in the command.

  - **Alerting and reporting methods**

  Cipia-FS10 reports on detected behaviors and events to the:

  - **Driver** – auditory (both signals and speech), visual and/or haptic (e.g., seat or seatbelt vibration) alerts upon detection of undesired behavior.
  - **Fleet manager** – real-time alerts of hazardous events with or without video footage captured around the time of the detected event.

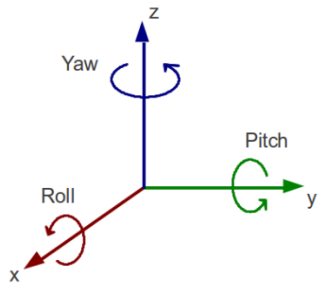
3. Cipia-FS10 Hardware and Interfaces

3.1. Cipia-FS10 Device Basics

The Cipia-FS10 device is designed to be both functional and attractive. It is professional and robust and suits the vehicle environment.

Figure 1: Cipia-FS10 Device

- **Size** – The dimensions of the product are (excluding mounting accessories) 120mm (L) x 95mm (W) x 30mm (T). The Cipia-FS10 device does not compromise the driver's field of view in an inconvenient or illegal way.
- **Weight** – The device weights ~390g including harness and mounting arm.
- **Device orientation tuning** – The device has a mounting arm that allows for 3D movement and provides for the highest installation flexibility while keeping driver's face within the internal camera frame. The mounting arm is lockable and can be installed on the dashboard or windshield, using double-sided adhesive and/or screws. The special screw heads are for professional use only.



- In the diagram, X axis is pointing at the driver.
  - **Installation cable** – The installation cable is connected/soldered to the inner-board and comes out of the enclosure surface through a silicone strain-relief that ensures elasticity and strength against pulling. All wires are covered by a single jacket coming out of the device enclosure.
  - **Camera & IR LEDs window** – The enclosure includes an IR-transparent cover for the camera lens and IR LEDs. IR illumination is not visible to the driver.
  - **User Interfaces** – The following mechanical interfaces exist for the MMI features.

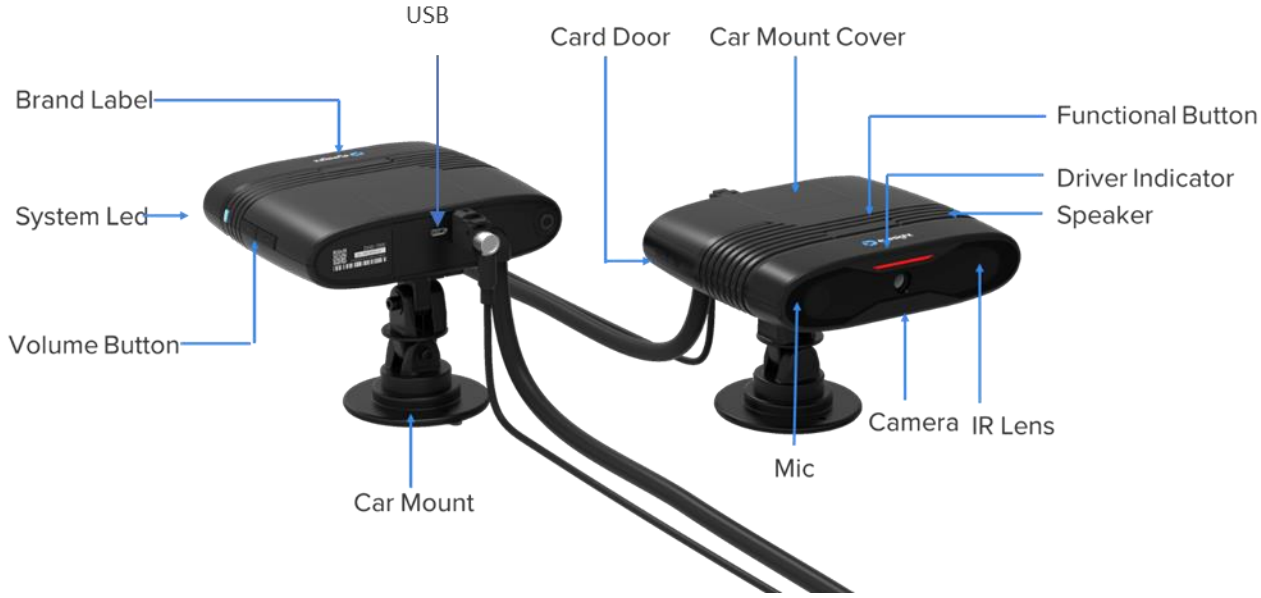


Figure 2: Cipia-FS10 Device Interfaces

Table: User Interfaces

Interface	Description
Card door	SIM/SD cards. Used by technicians and installers during installation or service.
Functional Button	Activation/HW reset/Event triggering.
Driver Indicator	Red LED used to provide visual feedback to the driver.
Speaker	For audible signals and speech alerts.
Mic	Used to record cabin voice (Programmable).
System LED	Tricolor used to designate system status.
Volume button	Volume control.
USB port	Micro USB port for debugging servicing and data upload in case events and video footage cannot be uploaded wirelessly.

3.2. System Building Blocks

The following diagram depicts the Cipia-FS10 device's main building blocks, interconnections, and interfaces.

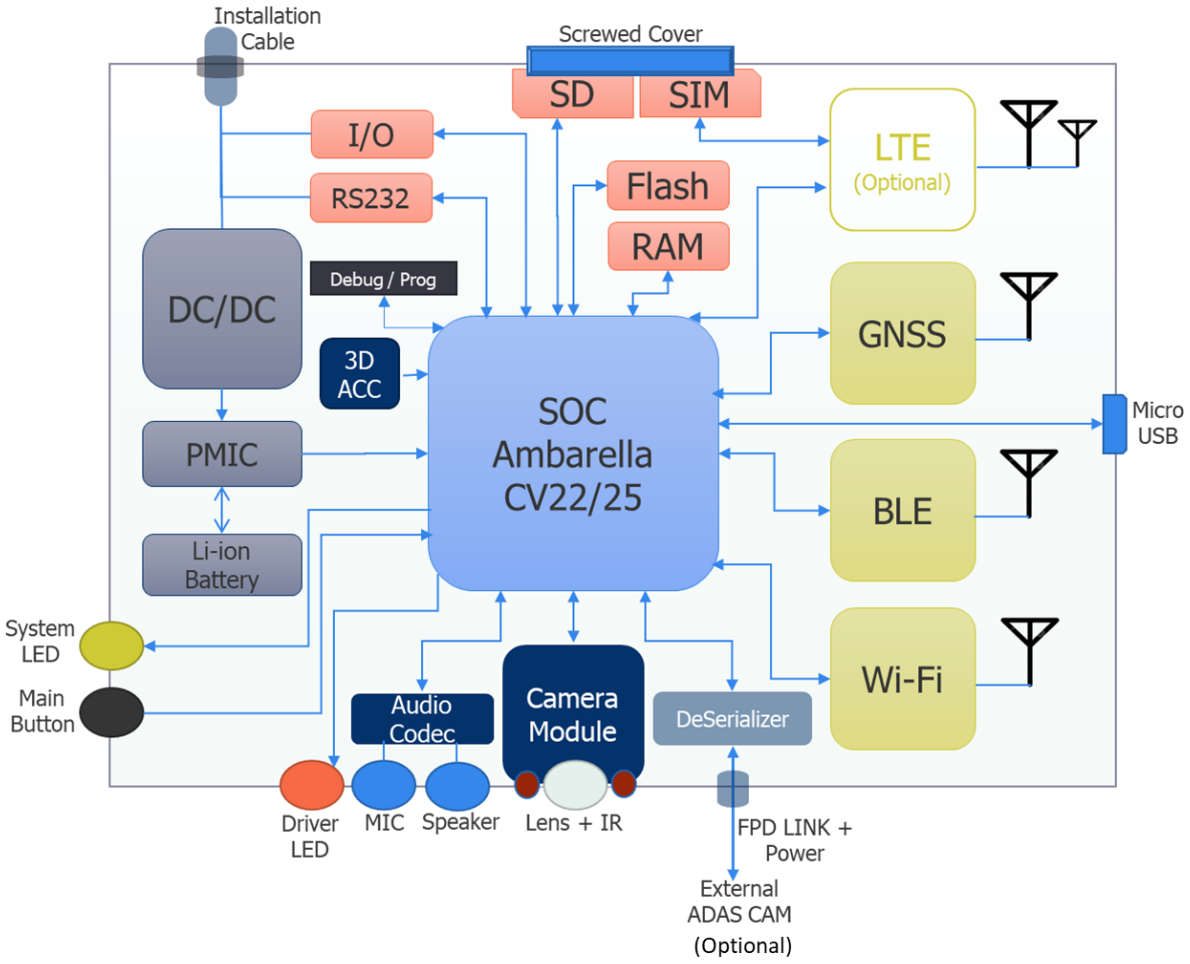


Figure 3: System Building Blocks

3.3. Hardware Specification

Figure 4: Cipia-FS10 Device

Table: Hardware Specifications

Component	Description
Platform Core	
Main Processor (SOC)	Ambarella CV25
RAM	1GB
ROM	8GB
Memory Card	Micro SD card slot – up to 256GB, exFAT, SDHC/SDXC
Watchdog	• SW controlled – for application recovery • HW controlled – for system recovery
Motion Sensor	3D Accelerometer / (±16g, 12bit, 100Hz or better)
OS	Linux v4.14

<table>
<tr><th>Component</th><th>Description</th></tr>
<tr><td colspan="2">Driver Interface</td></tr>
<tr><td>HW Keys</td><td>• 1 x Configurable, multi-purpose
• 2 +/- Volume keys</td></tr>
<tr><td>LEDs</td><td>• 1 x System status (3 color)
• 1 x Driver feedback</td></tr>
<tr><td>Internal Microphone</td><td>High sensitivity, omnidirectional</td></tr>
<tr><td colspan="2">Wireless Communication</td></tr>
<tr><td>Cellular[1]</td><td>• LTE CAT4
• FDD 1/2/3/4/5/7/8/12/13/17/20/28 (Territories/apps not supported: Japan, FirstNet)
• GSM 850/900/1800/1900
• WCDMA 1/2/4/5/8 (DC-HSPA+)
• 3FF, Micro SIM (Internal)
<table>
<tr><th>Band</th><th>Max power(dBm)</th><th>Highest Output Power (dBm)</th></tr>
<tr><td>GSM 900</td><td>35</td><td>25.97</td></tr>
<tr><td>GSM 1800</td><td>32</td><td>22.97</td></tr>
<tr><td>WCDMA Band I</td><td>25</td><td>25</td></tr>
<tr><td>WCDMA Band VIII</td><td>25</td><td>25</td></tr>
<tr><td>LTE Band 1</td><td>25</td><td>25</td></tr>
<tr><td>LTE Band 3</td><td>25</td><td>25</td></tr>
<tr><td>LTE Band 7</td><td>25</td><td>25</td></tr>
<tr><td>LTE Band 8</td><td>25</td><td>25</td></tr>
<tr><td>LTE Band 20</td><td>25</td><td>25</td></tr>
<tr><td>LTE Band 28</td><td>25</td><td>25</td></tr>
<tr><td>LTE Band 38</td><td>25</td><td>25</td></tr>
<tr><td>LTE Band 40</td><td>25</td><td>25</td></tr>
</table></td></tr>
<tr><td>GNSS module</td><td>• 50 Channel, NMEA 0183, AGPS support
• Satellite Systems Support: GPS, GLONASS, Galileo</td></tr>
<tr><td>Wireless LAN</td><td>• Wi-Fi – 802.11 b/g/n/ac,
• Frequency bands - 2.4G (B1-13) /5G (B36-165)
• Dual mode support AP and/or Hotspot
<table>
<tr><th>Band</th><th>Frequency(MHz)</th><th>Max Power (dBm)</th><th>Highest Output Power (dBm)</th></tr>
</table></td></tr>
</table>

[1] FS-LTE-000/ADS only

<table>
<tr><th>Component</th><th>Description</th></tr>
<tr><td></td><td>
<table>
<tr><td>WI-FI2.4G 802.11b</td><td>2412</td><td>2462</td><td>17</td><td>17</td></tr>
<tr><td>WI-FI2.4G 802.11g</td><td>2412</td><td>2462</td><td>16</td><td>16</td></tr>
<tr><td>WI-FI2.4G 802.11n</td><td>2412</td><td>2462</td><td>13</td><td>13</td></tr>
<tr><td>WI-FI5G U-NII-1 802.11a</td><td>5150</td><td>5250</td><td>7.5</td><td>7.5</td></tr>
<tr><td>WI-FI5G U-NII-1 802.11n</td><td>5150</td><td>5250</td><td>8.5</td><td>8.5</td></tr>
<tr><td>WI-FI5G U-NII-1 802.11ac</td><td>5150</td><td>5250</td><td>8.5</td><td>8.5</td></tr>
<tr><td>WI-FI5G U-NII-3 802.11a</td><td>5725</td><td>5850</td><td>6</td><td>6</td></tr>
<tr><td>WI-FI5G U-NII-3 802.11n</td><td>5725</td><td>5850</td><td>6.5</td><td>6.5</td></tr>
<tr><td>WI-FI5G U-NII3 802.11ac</td><td>5725</td><td>5850</td><td>11.5</td><td>11.5</td></tr>
</table>
</td></tr>
<tr><td>Bluetooth</td><td>BT/BLE Dual mode V5.0
<table>
<tr><td>Band</td><td colspan="2">Frequency(MHz)</td><td>Max Power (dBm)</td><td>Highest Output Power (dBm)</td></tr>
<tr><td>BT 5.0</td><td>2402</td><td>2480</td><td>7</td><td>7</td></tr>
<tr><td>BLE</td><td>2402</td><td>2480</td><td>7</td><td>7</td></tr>
</table>
</td></tr>
<tr><td colspan="2">Integrated Cameras</td></tr>
<tr><td>Driver Facing (DMS)</td><td>• 1.25MP monochrome image sensor
• Fixed focus. Depth of view 40-111cm min
• IR 940nm global shutter
• 30fps
• F# 2.05
• IR LEDs x 2</td></tr>
<tr><td>Road Facing (Optional)</td><td>• Preparation only – FAKRA CONNECTOR
• Interface type FPD-LINK III</td></tr>
<tr><td colspan="2">Communication Interfaces</td></tr>
<tr><td>RS-232</td><td>1 x RS-232 (Tx, Rx, GND)</td></tr>
<tr><td>USB</td><td>1 x USB 2.0 Device/host (Micro-USB port)</td></tr>
<tr><td>Peripherals Control</td><td></td></tr>
<tr><td>GPIO</td><td>• 1 x Ignition sense.
• 1 x Input (0 – 32V). Digital or analog.
• 1 x Open collector output.
• 1 x I/O – Fully configurable by SW.</td></tr>
<tr><td colspan="2">Power</td></tr>
<tr><td>Input Power</td><td>• Direct vehicle battery connection (7-32V)</td></tr>
</table>

Component	Description
	• ISO 7637 & 16750 Compliant
Internal Battery	Li-Ion 3.7V/550mAh - Supports one minute of full functionality and ordered shutdown on power cut-off.
Current @ Sleep Mode	<5mA @ 12V/24V.
Current @ System Active	<250mA @12V/24V.

3.4. Cable Pinouts and Requirements

The Cipia-FS10 device cable is:

- **Length** – 2 meters
- **Interface** – Internal. Pigtail style

Table: Cable Pinouts

Pin#	Signal	Remarks
1	PWR_IN	Red
2	PWR_GND	Black
3	IGN	Purple
4	RS232_TxD	Green/Red
5	RS232_RxD	Yellow/Red
6	COM_GND	Green/Yellow
7	GP_IN	Green
8	GP_OUT	Blue
9	GP_IO	Grey
10	Spare	Red/Black

3.5. Environmental Standards

The Cipia-FS10 device complies with the environmental standards detailed in the table below.

Table: Environmental Standards

Measure	Descriptions
Temperature Range	Operating temp (boot/wakeup): -30°C to +70°C From battery: -20°C to +60°C Storage: -30°C to +80°C
Humidity	95% ±5%RH @ +40°C, non-condensing
IP	IP40
Drop	ASTM/ ISTA
RoHS	RoHS II
REACH / POPs	REACH/POPs compliant (European union)
Conflict Minerals	Compliant with conflict minerals law
Vibration	ISO16750
Mechanical Shock	ISO16750
UV	UV resistant plastic material

3.6. Certification

The Cipia-FS10 device meets the following certification standards:

- FCC
- CE/RED
- IC (Industrial Canada)
- RCM
- RSSC (State Radio Monitoring and Testing Center)
- E-mark
- PTCRB (for cellular model only)
- GCF (for the cellular model only)

4. Using Fleet-Sense

4.1. Solution Architecture

The following diagram depicts the various building blocks and optional interfaces of the Cipia-FS10 when integrated into a Telematics solution environment.

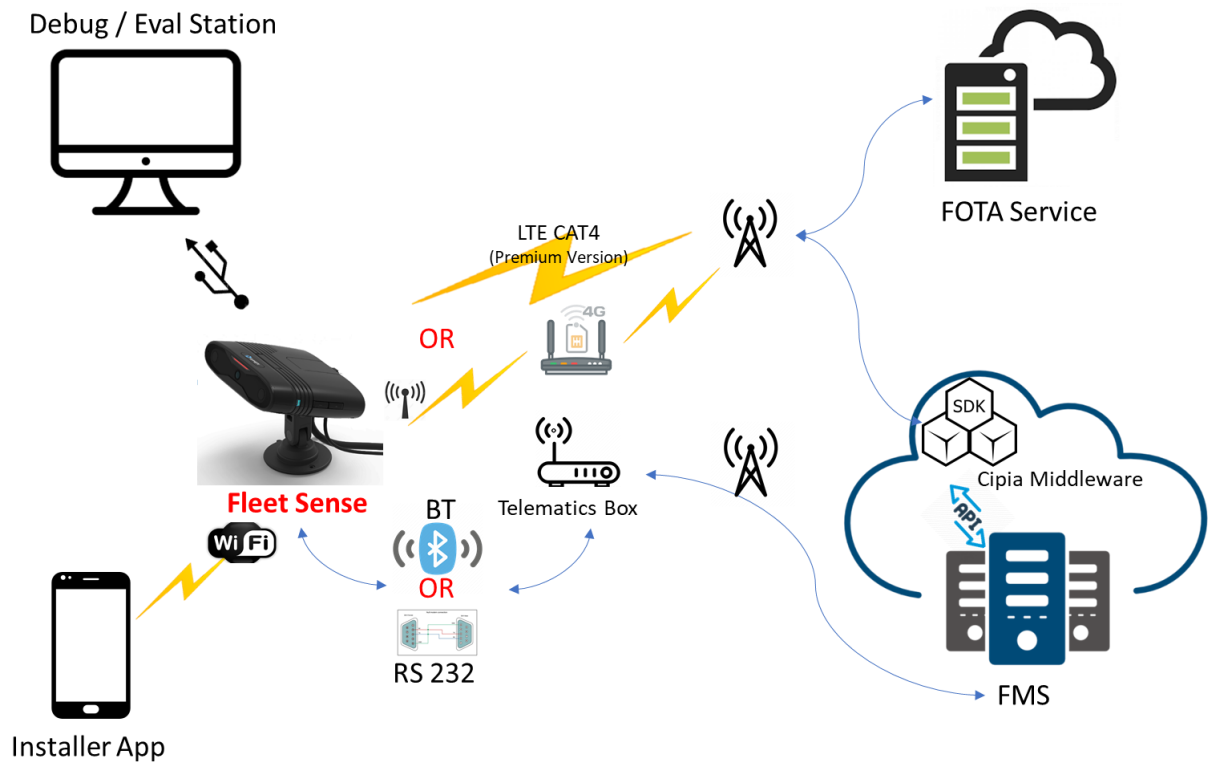


Figure 5: Solution Architecture Diagram

4.2. Operation States and Modes

The Cipia-FS10 application has three operational modes:

1. Installation & Calibration mode – used during installation by a professional/certified technician.
2. Maintenance mode – used during debug or maintenance by technicians or field application engineers.
3. Standard mode – used during normal system operation.

The following table defines the main attributes for each of these operational modes.

The Cipia-FS10 device maintains two flags in its non-volatile memory to designate whether the device was ever professionally installed and whether it was calibrated. These flags are set/cleared according to the mode transition events described in the diagram below and can be queried by the server side as part of the device properties query (refer to the Cipia-FS10 Integration Manual). The different operation modes and attributes per each, are detailed in the table below.

Figure 6: States and Modes Diagram

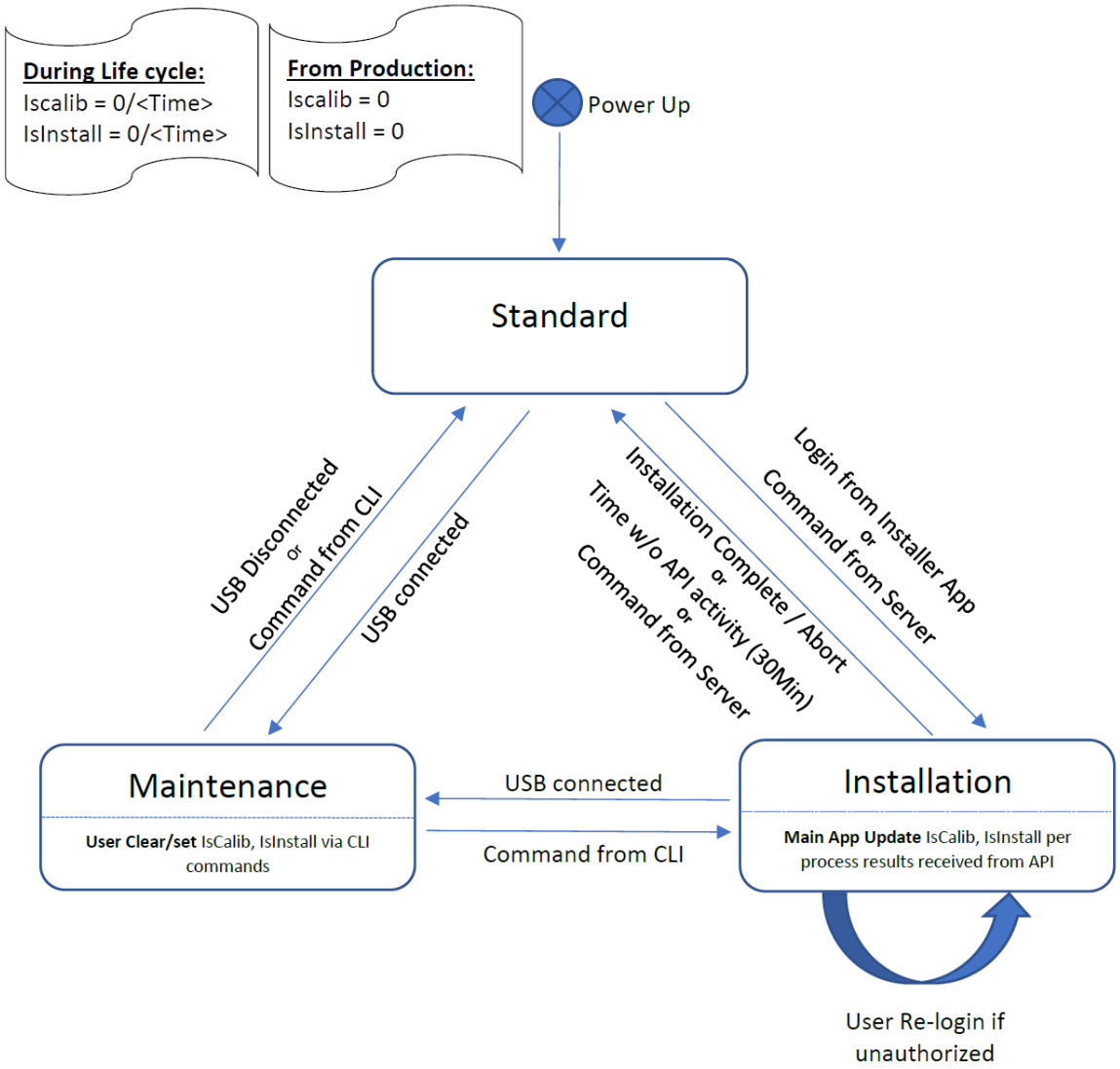


Table: Operations Modes

#	Mode	Activities and Attributes
1	Installation and Calibration	• Vehicle and driver monitoring logic engine is inactive. • All communication modules are enabled regardless of config settings. • Physical installation angles acquisition and store for later detection of tampering. • Config file management by installer/technician. • Camera calibration process. • Face ID enrolment.
2	Maintenance	• Vehicle state and driver monitoring logic is active. • All communication channels are enabled regardless of config settings. • Full access to NVM, RAM, SD card. • Full access to debug resources. • Config file management. • Face ID enrolment. • Pre-recorded video injection. • OS/App/DMS library upgrades.
3	Standard	• Vehicle state and driver monitoring logic is active. • System operates according to config file settings. • Config file management from Server via defined protocols.

4.3. Provisioning and Maintenance

The features and capabilities of the Cipia-FS10 device typically used during the provisioning and maintenance phases of the device life cycle are described below.

Config File Changes

It is possible to alter the configuration file parameters, before or after installation using one of the following connection modes:

- Backend application over cellular/Wi-Fi networks (entire file only).
- Mobile app via BT/Wi-Fi connectivity (either discrete parameter or as a complete file).
- PC via USB (either discrete parameter or as a complete file).
- Backend application through Telematics device connected via RS232 (entire file only).

Upon loading of a new configuration file, the device applies the changes immediately. Some parameter changes require a device reboot for the change to take effect.

Refer to M manual for more information about the configuration file management.

Debug Environment

A desktop connected to a device using the USB interface allows the user or technician to fully debug the device and observe its properties (ID, MAC, settings), operation states and modes, events generated, I/O status, connection status, error messages etc.

Upon detection of a USB master device connection (via the micro-USB port) while the device is powered, the Cipia-FS10 device immediately enters maintenance mode and is ready for communication with the PC's CLI for the following purposes:

- Video buffers download/delete.
- Configuration file review/change.
- Debug (error/activity logs).
- Versions upgrade – both the OS and Cipia-FS10 app.
- Video streaming to PC for evaluation and debug purposes.

Refer to the Cipia-FS10 Command Line Interface Manual for further information about the use of the Cipia-FS10 USB interface.

Installation and Calibration Process

On first boot of the device, it enters Installation and Calibration mode. There are two main processes that should be completed during installation and calibration:

- Camera calibration – allows the Cipia-FS10 to set its relative position in the passenger's compartment compared to the driver's position and via that provide accurate head pose and gaze calculations.
- Installation angles capture – allows the Fleet-Sense device to "remember" its 3D installation orientation and to detect physical tampering.

Once the installation and calibration process has successfully completed, the installer exits calibration mode (using the mobile app) and enters standard operation mode. Calibration settings are saved in the device NVM and passed by the application to the Driver Sense engine on startup. If the calibration process fails, the installer is alerted in the installation application.

While in Standard mode, it is possible to recalibrate the device by sending an appropriate command from the backend or from a mobile application. The commands above are also supported by the server middleware's API and protocols.

See the Installation Manual for detailed description of the Cipia-FS10 installation and calibration process.

Driver ID Enrollment

There are a few options to add driver face information to the Cipia-FS10 device database:

- By sending a command from the mobile app to capture face attributes currently looking at the camera.
- By sending a command from the backend application to capture the face attributes currently looking at the camera.
- By sending enrolled user data (features vector) to the Cipia-FS10 device, of face attributes captured and saved in another location (using the same camera as used in the vehicle).

Each entry in the device's driver database, managed by the Cipia-FS10 main app, holds the following attributes:

- **Global Driver ID** – A unique identifier, assigned by the TSP or by the Installer Mobile application (this is not the private ID assigned by the DMS library upon successful driver enrollment) and reported as the Driver-ID for any event generated by Cipia-FS10.

- **Private ID** – The Driver's ID assigned by the DMS library upon successful enrollment. This is the ID that is reported by the DMS upon successful driver identification to the main application.
- **Face-ID 'features vector file'** – Generated by the DMS library upon successful enrollment. This file is also reported to the server side, upon successful enrollment procedure, for later remote driver enrollment into other installed Cipia-FS10 devices within the fleet operation.
- **Permission State** – The permission state:
- 0 – Blacklist (Unauthorized)
- 1 – Whitelist (Authorized)
- 2 – Recognized – default permission in case not predefined

A closed enrollment loop means that both the Cipia-FS10 device and the Fleet management DB hold the global driver ID, the permission state, and the vector file per each enrolled driver.

When a driver is enrolled from the mobile app, the following flow is supported:

1. Installer inserts the driver's license number (Global Driver ID).
2. Installer performs the enrollment process in the mobile app.
3. Installer app uploads the driver license number (Global Driver ID), the photo and the features vector file, at the end of the installation/enrollment process, as part of the Installation report data structure.

When a driver is enrolled while seated in the vehicle, through a backend command, the following flow is supported (this is also applicable when enrolling drivers in the office):

1. Server sends command to the device with the assigned Global ID and permission state (this process is only done when the vehicle engine is running and there is a sync between the driver and the operator) to enroll a new driver.
2. Once the command is received and executed successfully, Cipia-FS10 sends the driver's image (photo), and the features vector file back to the server.
3. The FMS app retrieves the image and vector files to close the loop.

When the FMS app enrolls an already enrolled driver, into other vehicles:

1. Per vehicle (Cipia-FS10 device), the middleware API is called with the Global ID number, vector file and permission status. This process is not necessarily done when the vehicle engine is running, and the device might therefore be unavailable for a period.

2. When the device is available, the server sends the command to the Cipia-FS10 device to enroll a new driver along with the features vector file, the permission state, and the Global Driver ID.

The process described above is also the process used when the fleet manager wants to update the permission status of a driver in a specific vehicle - they simply override the existing record with a new data set for the same Global Driver ID. The Cipia-FS10 main app checks if the Global Driver ID already exists in the driver DB, and if so, overrides it with the new data set.

Audio Files Management

Cipia-FS10 triggers sound effects and voice messages.

There is a fixed NMV space allocation for a sound effects folder, independent of the voice messages language defined by the user.

- There is a fixed NVM space allocation for 128 different folders of voice messages, varying by language, dialect, voice gender or tone and indexed between 0 (default) and 127.
- It is possible to modify/add a voice messages folder without the need to upgrade the OS or the Main Application of the Cipia-FS10 device.
- It is possible to update or add voice folders via the OTA protocol or a USB connection to a PC.
- The Cipia-FS10 app triggers the proper file according to the event type and configuration file parameters (active language).
- The default set of sound effect and voice messages folders are loaded on the production line.
- The voice messages packages are versioned, to allow for identifying the default loaded packages (for production purposes only).

Device Reset

The Cipia-FS10 devices supports different system reset options including:

1. HW reset initiated by pressing the main button.
2. Self-reset triggered by the device watchdog mechanisms.
3. OTA reset command which is defined as part of the device bi-directional OTA protocol (secured and authenticated). Each reset event is assigned with a different reason identifier, reported by the device to the backend upon boot.

Device Properties

It is possible to send a device properties query to the Cipia-FS10 device through OTA (both server side and installer application) or via the USB connection. After it receives the query report, and after system boot, the Cipia-FS10 device reports its properties with the following fields in standard JSON format:

Table: Device Properties

#	Field	Description
1.	**Unit ID**	10-char string assigned in production line.
2.	**Hardware Version**	An identifier that uniquely designates the version of the device's main PCB. This should include specification for the MCU model, memory sizes, and revisions.
3.	**OS version**	Including boot loaded, if separate.
4.	**Main App version**	
5.	**DMS library version**	
6.	**Modem Version**	Hardware and software revisions.
7.	**GPS Version**	Hardware and software revisions.
8.	**Production date**	Date of successful production line test.
9.	**Test bench ID**	
10.	**Config file version**	**Note:** If specific parameters were changed rather than the entire file via the installer app, the original config file name is patched with the date and time of the update.
11.	**Audio package**	Attributes of each available set in json schema including: "id", "language", "description" and "version".
12.	**SD card**	Size and type, if available.
13.	**SIM card number**	ICCID.
14.	**IMSI**	SIM card identifier.
15.	**IMEI**	Cellular modem identifier.
16.	**Wi-Fi/BT module version**	Hardware and software revisions.
17.	**Wi-Fi/BT MAC address**	
18.	**Device installed**	Time and date of last installation or NULL.
19.	**Device calibrated**	Time and date of last calibration or NULL.

4.4. Standard Mode

The following table lists all features and functions supported by the Cipia-FS10 device while in standard operation mode.

Table: Standard Mode Functions

#	Function	Description
1	Vehicle & driver monitoring logic	The Cipia-FS10 device monitors all parameters and conditions as listed in the Events section of the configuration file and triggers events when conditions are met.
2	Events management in memory	Every event generated by the Cipia-FS10 application is associated with a unique numeric identifier and is logged in NVM until an ACK is received from the server's communication GW that the message was received successfully. The maximum number of logged events before the system starts to override is set in the config file.
3	Trip ID	Upon detection of an Ignition On event (Logic Rise of IGN line), or upon detection of a driver change without turning off the engine, the Cipia-FS10 device sets a new TRIP ID as the number of the previous trip + 1. Every event generated by the Cipia-FS10 device is sent to the FMS backend with the Trip ID as part of the message structure. The Trip ID is a 3Byte integer and is reset to 0 upon reaching D16,777,215.
4	Vehicle Data Management	The DMS library uses vehicle data to properly activate, deactivate, or adapt inattentiveness monitoring algorithms. If vehicle information is available, the main application reports the following parameters to the DMS library: • Vehicle speed (from GPS) – Whenever GPS data is unavailable or not up to date, or inaccurate (low quality score) the main app transfers an agreed value that designates "unavailable speed" to the library. The main app applies the "movement detection" algorithm while GPS data is unavailable and if vehicle is not moving, 'speed=0' is reported to the library to prevent unneeded events reporting by the library. • Vehicle direction (forward /reverse gear status) – If the reverse switch indicator is connected to one of the device's inputs. • Turn indicator status (blinkers) – If the turn indicator is connected to one of the device's inputs.

#	Function	Description
		• Vehicle yaw rate – Designates the change in vehicle heading angle compared to the previous heading angle received from GPS receiver, whenever GPS data is available and accurate.
5	Time management	The Cipia-FS10 OS maintains accurate "system time" in GMT based on available clock sources like the cellular network and/or GPS. If neither of the two exist or are 'up to date', the Cipia-FS10 device manages accurate time (using the internal real-time clock) with a maximum deviation of 86 seconds per 24 hours (0.1%).
6	Location management	The Cipia-FS10 main application updates the accurate location register (RAM) at least every 1 second throughout the entire trip. The first location in a new trip is logged only after an accurate FIX is acquired by the system GNSS. The location register is not updated if the FIX quality parameter is not higher than the programmed threshold. Every new location record is registered along with its <fix quality parameter>, <location acquisition time>, <speed (m/sec)> and <heading angle> Whenever the location register is not updated for longer than the TH configuration parameter, the Cipia-FS10 device generates a "GPS loss" event.
7	Video capturing and upload	The Cipia-FS10 application manages two video cyclic buffers, for each connected camera (DMS & ADAS-optional), if enabled in configuration (See 'ContRecording'' parameter): • Event video buffer in RAM, intended to save a few seconds of video before and after the occurrence of a safety event. • Global cyclic buffer in SD card, intended to allow retrieval of video footage upon request from mobile app or server. Video in the global cyclic buffer is compressed using H.264 codec which can be used also by the FMS to play the video. The event video buffer from RAM is captured and saved into NVM when the event occurs and according to configuration file settings. It is possible to instruct the Cipia-FS10 device to start recording NOW a footage with a certain length, on receiving such a command from the server. The captured video includes the "pre-buffer" that was in RAM at the time the command was received. The Cipia-FS10 device supports uploading of video footage from the global cyclic buffer, according to the time frame

#	Function	Description
		defined in a command, if the time frame is still available in the device's memory and if the requested time frame is no longer than 10 minutes. The OTA bi-directional protocol supports the described video capturing commands: • 'Start recording now' command. • 'Retrieve footage from Memory' command.
8	Power Management	The Cipia-FS10 app distinguishes between 3 power modes: (1) ON, (2) OFF, (3) Standby/sleep Ignition line is the usual trigger for transitions between ON and SLEEP modes. OFF mode is the power state of the device during shipment or after loss of external power and depletion of internal backup battery. In normal operation, after the device is connected to an 8-32V power source, it would never go OFF, unless main power source is disconnected. If Main Button settings_Param1 is set to 'enabled', pressing on the main button for between 5 and 10 seconds, while the Cipia-FS10 device is ON, triggers the device to enter sleep mode. If Main Button settings_Param1 is set to 'disabled', the user is never able to put the device into SLEEP mode. Regardless of the setting of the Main Button settings_Param1, if the device is powered, it monitors the Ignition line and moves between SLEEP and ON modes accordingly. Transitions between power modes is reported to the server if the corresponding events are enabled. Upon detection of power drop below 7V, on the power input line, for longer than the time set in config file parameter, the Cipia-FS10 device generates an error event with the appropriate reason (and the cyclic video buffer) and commences a shutdown procedure that is completed in less than 20 seconds. The Cipia-FS10 device wakes up again once reconnected to a stable 7-32V power source. If there is no connection to the server at the time of the power loss, the event is stored in NVM and uploaded upon the next successful power-up.
9	Tampering detection	The Cipia-FS10 application continuously monitors the installation angles of the device using it embedded 3D Accelerometer, and if a deviation from the original installation is identified (as was acquired during calibration), an error event with the appropriate reason (device shifted) is generated. In addition, if the image is lost (camera is blocked), or no activity is detected, during DRIVE state for more than 30

#	Function	Description
		seconds, an error event with the appropriate reason (camera blockage) is generated.
10	Battery charge management	The internal Li-Ion battery charging is managed by the Cipia-FS10 main application or a parallel service managed by the OS according to known charging best practices for Li-Ion batteries (temperature, aging, usage profile) to achieve longest possible effective lifetime without compromising the ability of the battery to power the device for at least one minute upon power loss. Since the internal battery is used only as backup for power loss incidents and in normal use case scenarios the battery will not go through charge/discharge cycles, the main app manages the battery voltage in the range of 3.9V to 4.05V always.
11	Inner Core Temperature management	The Cipia-FS10 application monitors the temperature on critical components of the device (PMIC, MCU) and takes actions such as cores or communication modules shutdown to prevent permanent damage if overheating is identified. In the event of an overheating incident, the system generates and sends an event in advance before a potential shutdown in communication.
12	FOTA	The main application or a service background agent manages Firmware-Over-The-Air (FOTA) update capabilities using a 3rd party's off-the shelf service. The FOTA agent maintains periodic connection with the OTA server to check for available updates and can upgrade/downgrade, if instructed to, three different layers of the SW: OS, Main application and DMS libraries. For devices connected using BLE or RS232, FOTA update should be done using Wi-Fi hotspot, either locally in the vehicle or in some hub to which the vehicle arrives.
13	Output activation	The fleet-Sense main app should be able to activate General Purpose Outputs in one of the following cases: 1. When the DMS library output requires such activation as a measure to warn the driver or draw his attention (for example – when the output is connected to seat buzzer) 2. When a command is received from the server (MQTT) or from the serial port (T-Box) or from the BT link (T-Box) or from CLI. A few Output activation application notes: • Server command has higher priority over DMS activation if a conflict between two activations exists. • GPIO can only be activated by the server while GPO can be activated either by internal logic or by the server.

#	Function	Description
		• Default output state is "Normally open" (disconnected). Once activated, output is connected to GND.
14	Drivers DB update	Upon acquisition of an improved picture/vector file of a driver face who already exists in the Cipia-FS10 database, Cipia-FS10 generates an appropriate event and sends it to the backend along with the improved data file.

4.5. Cipia-FS10 Events

The following table describes the various event types which can be detected and reported to the backend application by the Cipia-FS10 device as a function of the vehicle status (ignitions switch/speed/heading angle change), external triggers, driver behavior or system status changes.

Each event generated by the Cipia-FS10 device state machine is sent to the server application (if enabled in the configuration file) with the following event attributes[2]:

- **Device ID** – A unique ten-character string, across all manufactured fleet-sense devices.
- **Message ID** – A 13-digit Unix timestamp, millisecond resolution.
- **Self-IP** – IP address if connected through cellular modem or hotspot (should be 0.0.0.0 if connected through BT/RS232).
- **Trip ID** – A numerator which allows the server side to group events within a single trip performed by a certain driver.
- **Driver ID** – The driver ID number if identified. If the driver is not identified by the Cipia-FS10 device, this field holds zeros. Driver ID is sent along with the permission state of the specific driver (if enrolled).
- **Event date & time** – Upon event detection by the DMS algorithm, the Cipia-FS10 App fetches the system accurate time and associates it with the generated event.
- **Last known location** – Upon event detection by the DMS algorithm, the Cipia-FS10 App fetches the system location (LAT/LONG, decimal angle representation) and associates it with the generated event.

[2] For detailed information about the OTA protocol attributes, including data formats, types, lengths, and handshake mechanism, refer to the Cipia-FS10 Integration Manual.

- **Location time –** Upon event detection by the DMS algorithm, the Cipia-FS10 App fetches the "last location time" and associates it with the generated event. If the location time is different from the event time, it means that the event location/speed/heading are not necessarily accurate.
- **Speed (m/sec)** – Upon event detection by the DMS algorithm, the Cipia-FS10 App fetches the speed register and associates it with the generated event.
- **Heading angle** – Upon event detection by the DMS algorithm, the Cipia-FS10 App fetches the heading-angle register and associates it with the generated event.
- **Location quality** – Upon event detection by the DMS algorithm, the Cipia-FS10 App fetches the FIX quality (HDOP) and associate it with the generated event. If the FIX quality is higher or close to threshold (HDOP<3), it means that there might be a significant deviation in the "Last know location" from the actual location of the device at the time of the event generation.
- **Ext Power (mV)** – External input voltage at the time of the event detection.
- **Internal battery Power (mV)** – Internal backup battery voltage at the time of the event detection.
- **I/O array status** – An object representing the status of all discrete/analog inputs and outputs of the Cipia-FS10 device including:
  - PortID (IGN/GPI/GPIO/GPO),
  - Type (In / Out),
  - Current logic state (Active / Inactive)
  - Port voltage level (Integer)
- **Event ID** – A string designating the event type as listed in the table below.
- **Event Attr1** – Additional information related to the event type provided, such as system boot failure type, reset type, safety event reason, external triggering reason etc. If the generated event does not have additional info, this field is zeroed.
- **Snapshot/Footage/Vector exists** – A field designating whether image or footage was captured for this event.

The Cipia-FS10 protocol supports device authentication and has an error detection mechanism to verify the validity and authenticity of the message.

Each type of event is controlled by configuration parameters defining:

- Whether the event is enabled or disabled.
- The data sets which should be sent to the server upon event generation (data/image/footage).
- The user feedback patterns activated on event detection.

4.6. Configuration Settings

The Cipia-FS10 JSON configuration file allows for simple customizations of the product behavior to comply with different customer needs and use cases.

All configuration file parameters are saved in NVM and survive power loss. Also, the last state of the GPIOs is restored once the system is reconnected to external power.

It is possible to change parameters or the entire configuration file.

The first parameter in each configuration file is the file's name ("ConfigurationName") used by the TSP or the software integrator to manage the various configuration types and versions across his operation. The configuration file name is a string which its convention can be defined by the user to achieve effective configuration files inventory management. Please refer to the Fleet-Sense integration manual for detailed information about configuration file management.

4.7. Telematics GPIO Signaling

It is possible to define (in the config file) that one of the digital inputs of the Cipia-FS10 device be used by the T-Box whenever a driver behavior event is detected by the Telematics box. On activation of this input, the Cipia-FS10 device triggers an event and captures an image or video footage as defined in the config file (with pre- and post-buffers).

The Cipia-FS10 device sends the event data followed by the image/video file. The image/video filename includes an ID that is also included in the event data for easy association on the server side.

4.8. RS232 Connection

The RS232 port may be used to connect the Cipia-FS10 device to a Telematics box whenever a more advanced link (BT, Wi-Fi) is not available. The RS232 connection complies with EIA-232.

The default port settings are 115200, 8, 1, None. It is possible to change the RS232 port settings in the configuration file (a slower communication rate will lengthen the data transfer time and system latency).

The RS232 link is used by the Cipia-FS10 device to transmit event data or snapshots to the server-side. The RS232 link should not be used to transfer video footage unless the data packet size is lower than the maximum defined by the Telematics box datasheet.

The RS232 link is used to receive event meta data when the Telematics box signals the Cipia-FS10 to capture snapshot or footage due to a safety event detected by the Telematics box.

4.9. Bluetooth

Cipia-FS10 supports BLE version 4.2. BLE is used for connection to a BLE-supported Telematics box or dongle.

Proximate devices discovery (scanning) and pairing takes place in Installation and Calibration mode or Maintenance mode. During these modes, the device is always discoverable. If no device was paired while in these modes, BLE is disabled (turned off) during Standard mode and only turned on (discoverable) during 2-minutes after the Ignition on event, to check whether a pairing request was issued.

The pairing method is set in the configuration file: Just Works or Passkey. If set to Passkey, the 6-digit key, which is in the configuration file must be used. The same passkey must be configured in the paired device.

While connected with a Telematics box, the BLE link may be used for:

- Signaling as if it was a digital input (up to 2 inputs may be defined in the protocol).
- Data exchange (serial port profile): Events, snapshot or video footage forwarding to the Telematics box or reception of event's meta data from the Telematics box when a safety event was detected by the Telematics box (for example: type of event and event ID for easy association with the Telematics box generated event).

After the first pairing performed between the Cipia-FS10 device and another device/mobile application, the Cipia-FS10 automatically pairs with the other device on power-up/wakeup event.

4.10. Wi-Fi

The Wi-Fi interface should be used as the main communication link with the server GW whenever LTE is not supported by the Cipia-FS10 device itself and there is another WAN-connected device through which (a hotspot) the Cipia-FS10 device can establish a connection with the server GW.

Another use of the Wi-Fi interface is for video streaming to the Cipia-FS10 mobile app for installation, calibration and debugging purposes. In this scenario, the mobile app connects to the Cipia-FS10 device's access point.

While in Installation and Calibration mode, the Wi-Fi network is turned on by the Cipia-FS10 app and accept connection attempts with the correct PIN and sign-in procedure.

While in Standard mode, and if set accordingly in the configuration file, the Cipia-FS10 device attempts to establish a connection with the network whose attributes are defined in the config file.

If Wi-Fi is defined as the primary link with the server, the Wi-Fi connection is established immediately after the detection of the IGN on event and is maintained continuously during the entire trip according to communication watchdog settings.

5. Cipia-FS10 HMI

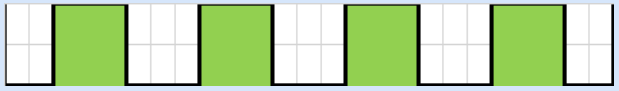
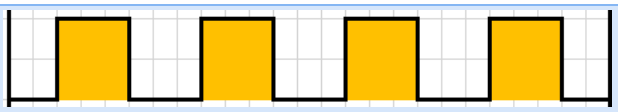
The following table describe the audible and visual feedback provided by the Cipia-FS10 system LED and its speaker in various states of system operation.

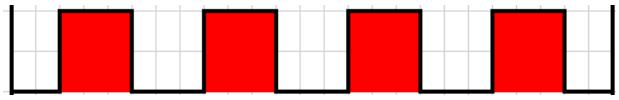
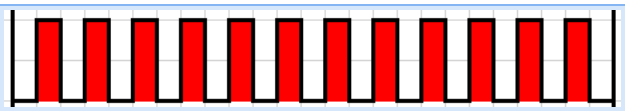
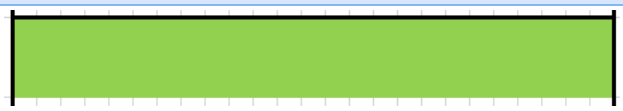
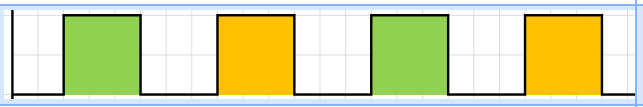
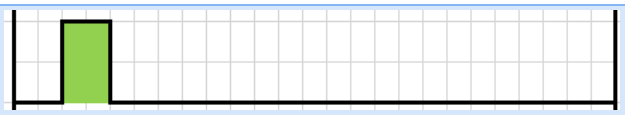
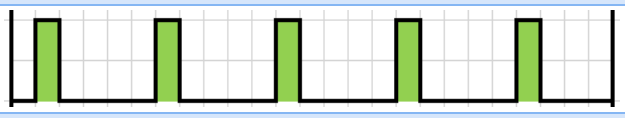
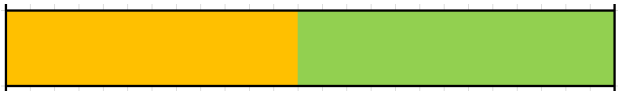
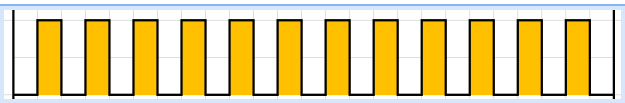
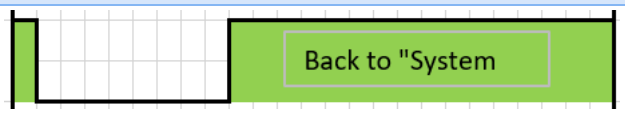
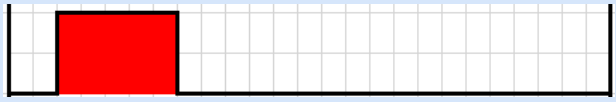
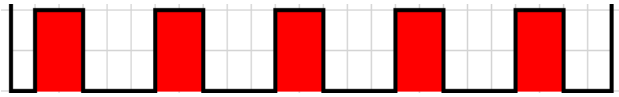
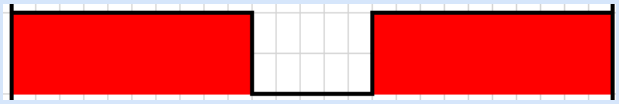
Table: Audible & Visual Feedback

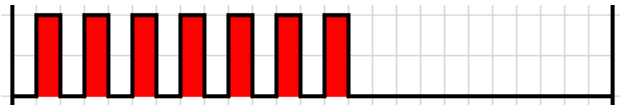
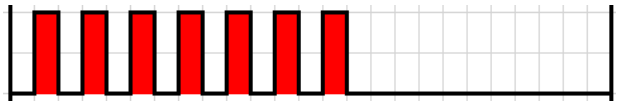
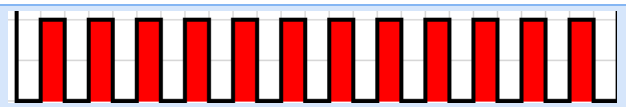
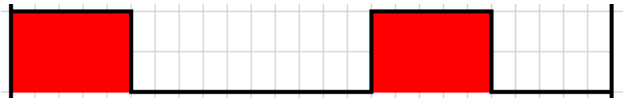
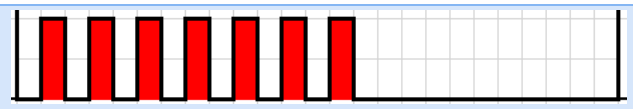
#	Event/State	System LED	Sound	Speech
1.	Power-up (S)	√	×	×
2.	Calibration on (S)	√	×	√
3.	HW problem detected (S)	√	×	×
4.	GPS problem detected (S)	√	×	×
5.	COM problem detected (S)	√	×	×
6.	CAM problem detected (S)	√	×	×
7.	Calibration failed (S)	√	×	√
8.	System on (S)	√	×	×
9.	System error (S)	√	√	×
10.	Sleep mode (S)	√	×	×
11.	External power loss (S)	√	√	×
12.	Entered/exit Maintenance mode (E)	×	√	×
13.	Maintenance mode (S)	√	×	×
14.	Button confirmation (E)	√	√	×
15.	Volume key confirmation (E)	×	√	×
16.	Volume key rejection (E)	×	√	×

The LED patterns are specified in the table below.

Table: LED Patterns

Event / State	LED	Time	Continuous
		1" 2" 3" 4" 5"	
Powering up	System		Yes
CAM problem	System		Yes
GPS problem	System		Yes

Event / State	LED	Time 1" 2" 3" 4" 5"	Continuous
COMM problem	System		Yes
Other HW problem	System		Yes
System OK (standard mode)	System		Yes
GPS location unavailable	System		Yes
System error	System		Yes
Sleep	System		Yes
Powering down	System		Yes
Maintenance mode	System		Yes
Calibration mode	System		Yes
Calibration error			No
Button pressed (Confirmation)	System		No
Driver identified	Driver		No
Unidentified driver	Driver		Yes – Configuratio n
Driver image loss	Driver		Yes – Configuratio n

Event / State	LED	Time	Continuous
		1" 2" 3" 4" 5"	
Driver distracted	Driver		No
Light drowsiness	Driver		No
Drowsiness	Driver		No
Driver asleep	Driver		No - Pattern stops earlier if driver is attentive again
Safety event detected (Seatbelt, Smoking, Phone)	Driver		Yes – configuration
Tbox event triggered	Driver		No

- If sound effects and voice messages are both active in the configuration file, the message is played right after the sound effect.
- All voice messages are only played once. LED and sound effects may be repeated.

6. Test and Evaluation Kit

You can use the Cipia-FS10 Evaluation Kit (EVK) with a test server provided by Cipia (Middleware Server and basic cloud), to test the Cipia-FS10 device behavior, features and functions, without having to professionally install the device or to develop a single line of code.

The EVK Quick Start Manual guides your technical team, providing instructions for the short-term installation of the device using the vacuum mounting arm, predefined default configuration file (only the SIM's APN data must be provided), special harness adapter for 12V power connection to cigarette lighter socket, and authenticated access to Cipia's cloud support pages.

The Cipia Technical Support/Professional Services Team can setup your test environment within a couple of hours of you receiving the EVK. The EVK comes with default configuration parameters. It is possible to modify this system configuration remotely using the server API or using a mobile application communicating with the device through BLE /Wi-Fi.

Using the EVK, you can test the system's real-time driver feedback as well explore the information uploaded to the Middleware Server. This includes the ability to watch snapshots and video footage associated with the events generated by the test device.

7. Standards and regulations notices

7.1. FCC

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This device 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 radiated 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.

Caution: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. This equipment must be installed and operated in accordance with provided instructions and the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

FCC ID:

- ✓ FS10-LOC/FS10-LOC-ADS: **2AZIQFS10L**
- ✓ FS10-LTE/FS10-LTE-ADS: **2AZIQFS10C**

7.2. IC

(EN)This device complies with the applicable industry Canada) License exempt radio apparatus, the operation is authorized under the conditions as follows: (1) this device may not cause interference, and (2) the user of this device must accept any interference caused, even if the interference is likely to affect its performance.

(FR)Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

(EN)Radio frequency (RF) Exposure Information The radiated output power of the Wireless

Device is below the industry Canada (IC) radio frequency exposure limits. The Wireless Device should be used in such a manner such that the potential for human contact during normal operation is minimized. The device has also been evaluated and shown compliant with the IC RF Exposure limits under mobile exposure conditions (antennas at least 20cm from a person’s body).

(FR) informations sur l'exposition de radiofréquences (rf) la puissance de rayonnement de l'appareil sans fil est inférieure à la fréquence radio d'industrie canada (ic) limites d'exposition.l'appareil sans fil devrait être utilisé de façon telle que le potentiel de contact pendant le fonctionnement normal est réduit au minimum. le dispositif a été évalué et qui semble conforme à l'ic des limites d'exposition aux rf sous des conditions d'exposition mobile. (antennes d'au moins 20 cm du corps d'une personne).

(EN)The following statement the following statement must be included with all versions of this document supplied to an OEM or integrator, but should not be distributed to the end user.

This device is intended for OEM integrators only. Please see the full Grant of Equipment document for other restrictions

(FR) l'énoncé suivant la déclaration suivante doit être incluse dans toutes les versions de ce document fourni à un oem ou intégrateur, mais ne devrait pas être distribuées à l'utilisateur final. ce dispositif est destiné aux intégrateurs de oem. voir le document de subvention d'équipement d'autres restrictions.

(EN)For indoor use only.

(FR) pour une utilisation en intérieur uniquement

IC :

- ✓ FS10-LOC/FS10-LOC-ADS: **27633-FS10L**
- ✓ FS10-LTE/FS10-LTE-ADS: **27633-FS10C**

7.3. RED

Hereby, Cipia Vision Ltd. declares that the radio equipment type is in compliance with Directive 2014/53/EU.

The full text of the EU declaration of conformity is available at the following internet address: **https://cipia.com**

Notice: The device complies with RF specifications when the device used at least 20cm from human body.

The device operates on the 5150–5350 MHz frequency range. It is restricted indoor environment only. This product can be used across EU member states.

	AT	BE	BG	HR	CY	CZ	DK
	EE	FI	FR	DE	EL	HU	IE
	IT	LV	LT	LU	MT	NL	PL
	PT	RO	SK	SI	ES	SE	UK(NI)