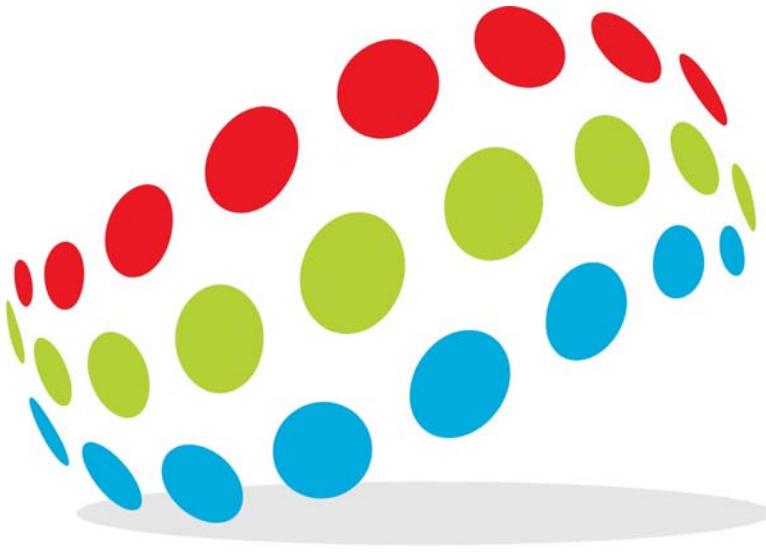


# FJ110C Integration Guide

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**Positioning Universal Inc.**

*Version 2.0*

## Document Revisions

Date	Version Number	Document Changes
2015.09.22	1.0	First Release
2015.09.29	1.1	Corrected error in MEID coding in section 4.1
2015.12.02	1.2	Updated for FW Version 1130
2015.12.08	1.3	Added ACK format description
2016.03.14	2.0	Major Update: Acceleration, Pulse command, Config command, New Ignitionmodes

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## 1 Introduction

The FJ110C is a vehicle tracking device that uses a GPS satellite receiver to determine location information and a CDMA transceiver to communicate information to and from a land based server. In addition, the FJ110C has several Inputs that may be configured to detect states of sensors and Outputs that can control accessories.

The FJ110C is powered by standard vehicle power (12V or 24V). It accepts several harnesses: a 2 wire power harness, and 5 wire IO harness, and a mini-USB connection.

Communications between the FJ110C and the server are carried out using the UDP protocol with sequence acknowledgment messages to confirm receipt of messages by the server. Configuration of the device can be conducted using serial communications over the USB port or by sending SMS messages to the device.

## 2 Hardware



### 2.1 Physical and Electrical Specifications

Dimensions: 83mm \*43.2mm \*17.7mm

Weight: 54.5 g (with optional battery)

Input Voltage: 6-36VDC

Power consumption:

- Active mode: 70mA @ 12VDC

- Sleep mode: <6mA @ 12VDC

Operating temperature: -40°C to 80°C

Storage temperature: -40°C to 85°C

### 2.2 Input/Output

Digital Inputs: 3

Relay driver Outputs: 2

Function LEDs: 2

- GPS Status GREEN

- Cellular Status AMBER

Debug/ConfigUSB, 115200 Baud

### 2.3 GPS Specification

-163dBm Tracking Sensitivity

Location Technology(56 channel GPS)

Location Accuracy (2 meter CEP50)

## 2.4 Cellular Communication

CDMA2000 1xRTT 800/1900 Mhz

UDP/SMS

## 2.5 Harnesses

There are 3 harnesses that may be used with the FJ110C:

1. 2 wire power harness
2. 5 wire I/O harness
3. Mini USB cable



The picture above shows the 2 wire power harness and the 5 wire I/O harness. The wiring details are:

Power Harness 2 wires

1. Red **V+** is connected to Positive , +12VDC or +24VDC
2. Black **V-** is connected to Negative or Ground

I/O Harness 5 wires

1. Orange or White **Input 0** is an input biased low which is typically connected to Ignition Sense. Should be V+ when the vehicle is ON.
2. Yellow **Input 1** is an input biased high, negative trigger.
3. Brown **Input 2** is an input biased high, negative trigger.
4. Green **Output 0** is an output, open collector, may be used for Starter Disable.
5. Blue **Output 1** is an output, open collector, may be used for a Buzzer

USBCable

The USB cable connects between the USB of a computer and the mini-USB type connector on the FJ110C. Unlike SVR110G, the FJ110C supports direct USB.

### 3 Configuration Commands

Commands in blue are for SMS or UDP. With serial, commands must be preceded by “AT+CMD=” and the command itself included in quotations as per the first example below. For the rest of the document, the basic commands used for SMS or UDP are shown, but sending commands or queries by serial always requires that they be preceded by “AT+CMD=” and the command itself included in quotations. Commands and Queries are not case sensitive.

The FJ110C sends UDP reports to the data server based on the occurrence of events as configured using these commands. Per section 4, these reports will have a

#### 3.1 System Commands

Most parameter write commands require the use of the device password, so that additional security can be used if desired. The default password is “000000” and examples in this document will use this value. The password can be changed using the password command as follows:

**password,oldpassword,newpassword#**

SMS Example: **password,000000,secret#**

Serial Example: **AT+CMD=”password,000000,secret#”**

The response will indicate success or failure of the command.

The current firmware version can be queried using:

**version,0#**

The version is distinguished by its date stamp.

A message report of any specified event code can be forced with a special Report command:

**report,[password],[code]#**

Example: **report,000000,9#**

This example command would cause a message with event code 9 (Heartbeat) to be generated and sent to the server.

The device can be rebooted using the command:



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**reboot,000000#**

The current GPS fix status can be queried using the command:

**Getgps?**

The GPS module can be reset using the command:

**gpsrestart,000000#**

### 3.2 Other communications parameter Commands and Queries

#### Data Server

To write parameters for the Data IP and port, use the command:

**data,password,IP:port#**

SMS Example:           **data,000000,54.208.13.17:45000#**

Serial Example:        **AT+CMD="data,000000,54.208.13.17:45000#"**

To read the current values of the Data IP and Port, use the Query:

**data?**

### 3.3 Movement Related Commands and Queries

#### Moving Interval

To write the moving report interval, use the command:

**interval,password,seconds#**

Example:           **interval,000000,120#**

To read the current moving report interval, use the Query:

**interval?**

#### Heartbeat

To set a heartbeat that reports on a regular interval independent of movement, use the command:

**heartbeat**,password,minutes#

Example: **heartbeat,000000,60#**

To read the current heartbeat interval, use the Query:

**heartbeat?**

*Note that the result of the query is in seconds.*

### Heading Change

To set Heading Change reports based on degrees of heading change, with minimum meters to reset

**heading**,password,degrees,meters#

Example: **heading,000000,20,30#**

To read the current heading change values, use the Query:

**heading?**

### Stop

To define elapsed time below a speed at which a Stop event is generated and Moving interval reports cease, use the command:

**stop**,password,minutes,km/hr#

Example: **stop,000000,6,5#**

To read the current stop setting, use the Query:

**stop?**

*Note that the result of the query is in seconds and km/hr.*

### Speedalarm

To define a speed at which an alarm report is generated, use the command:

**speedalarm**,password,km/hr#

Example: **speedalarm,000000,120#**

To read the current speedalarm setting, use the Query:

## **speedalarm?**

### Odometer

To set the current value of the odometer which is incremented automatically by movement, use the command:

**mileage**,password,meters#

Example:       **mileage,000000,120500#**

To read the current odometer setting, use the Query:

**mileage?**

*Note that the specification of the odometer and the query results are in meters.*

### Tow

To define the conditions under which a Tow alert (type 25) is generated, use the command:

**tow**,password,distance#

### Sleep Mode

Enables or disables the sleep mode on the device.

SleepmodeStatus0 = sleep mode off

SleepmodeStatus1 = sleep mode on

**sleepmode**,password,SleepmodeStatus#

Example:       **sleepmode,000000,1#**

To read the current sleep mode value, use the Query:

**sleepmode?**

### GPS Mode

Selects the GPS mode on the device, turns on or off Assisted GPS.

GPS Mode options:

gpsmodeType1 = MSA

gpsmodeType2 = MSB

gpsmodeType3 = Standalone

**gpsmode**,password,GPSModeType#

Example: **gpsmode,000000,3#**

To read the current GPS mode value, use the Query:

**gpsmode?**

**NOTE: Currently, only Standalone mode is supported. Attempting to other modes may result in GPS malfunction and excessive data use.**

### Ignition Mode

Selects the ignition detection mode of the device.

Ignition Mode options:

Ignitionmode0 = Hardwired ignition reporting on Input 0 (white or orange wire)

Ignitionmode1 = Voltage based virtual ignition reporting (not recommended)

Ignitionmode2 = GPS speed based virtual ignition reporting

Ignitionmode 3 = No ignition events are generated

Ignitionmode 4 = Acceleration based virtual ignition reporting

Ignitionmode 5 = Mixed mode virtual ignition reporting

**ignitionmode**,password,IgnitionmodeType#

Example: **ignitionmode,000000,1#**

To read the current ignition mode value, use the Query:

**ignitionmode?**

### GPS Retry

Sets the interval at which the GPS module will reset when in a no-fix condition.

**gpsretry**,password,RetryDelayInMinutes#

Example: **gpsretry,000000,10#**

To read the current GPS retry interval, use the Query:

**gpsretry?**

Where

Queries for the current device location and returns the results in a Google Maps hyperlink.

**where?**

### 3.4 Input Control

Special notes regarding inputs:

#### **Input 0 - pin 1, orange wire, biased low, typically used for ignition**

Input high (positive trigger) generates message type 4 (usually interpreted as Ignition ON)

Input low (open or negative trigger) generates message type 5 (usually interpreted as Ignition OFF)

#### **Input 1 - pin 2, yellow wire, biased high**

Input high (open or positive trigger) generates message type 13

Input low (open or negative trigger) generates message type 14

#### **Input 2 - pin 23 brown wire, biased high**

Input high (open or positive trigger) generates message type 6

Input low (open or negative trigger) generates message type 7

Also note: The Input Status Byte indicates state of inputs when a message is sent. Bit 0 represents Input 0, bit 1 represents Input 1, and bit 2 represents Input 2. **Note that a value of 1 in the bit represents Input LOW and a 0 represents Input HIGH.**

Input Report Debounce

To set the time required for an input status change to be effective, use the command:

**debounce**,password,input,seconds#

Example: **debounce,000000,1,5#**

Vibration Alert

To turn ON the vibration alert, use the command:

**vibration,000000,1#**

To turn OFF the vibration alert, use the command:

**vibration,000000,0#**

### 3.5 Outputs

#### Special notes regarding outputs

When outputs are clear, they are floating and do not drive voltage. When Outputs are set, they pull to ground. They can sink the currents of typical drive coils for automotive relays. The typical application is to use the output wire as a switched ground to control whether current flows through a relay.

**Output 0 – pin 4, Green Wire**

**Output 1 – pin 5, Blue Wire**

#### Starter Interrupt Device

The starter interrupt device sets a relay to disable a starter. It is only effective as long as the device has a cellular data connection, so that a vehicle is not stranded in a non-signal location. Also, messages are sent via UDP to indicate SID status to the data server. To activate SID, use the command:

**sidon,output#**

Example: **sidon,0#**

To deactivate SID, use the command:

**sidoff,output#**

Example: **sidoff,0#**

#### Pulse

The pulse command pulses an output according the details in the command:

**pulse,output,pulses,ms on, ms off#**

Example: **buzz,1,3,1000,500#**

*This command would generate 3 pulses on output 1 of 1000ms (1 second) duration, spaced 500ms (0.5 seconds) apart.*

#### Buzzer

The **buzz** command pulses an buzzer according the details in the command:

**buzz**,output,pulses,ms on, ms off#

Example: **buzz,1,3,1000,500#**

*This command would generate 3 pulses on output 1 of 1000ms (1 second) duration, spaced 500ms (0.5 seconds) apart.*

The **buzz** command is intended for internal buzzers, while the **pulse** command is intended for the external outputs.

### Set and Clear Outputs

These commands set and clear an output. They are independent of UDP connection status and don't generate UDP confirmation messages:

To set an output use:

**outset**,password,output#

Example: **outset,000000,0#**

To clear an output use:

**outclr**,password,output#

Example: **outclr,000000,0#**

## 3.6 Config command

The **config** command provides the ability to configure most features of the trackers using a single command.

The format of the **config** command is:

**config**,[password],[interval\_seconds],[stop\_minutes],[stop\_speed],[heading\_degrees],[heading\_distance],[heartbeat\_minutes],[tow\_distance],[speedalarm],[vibration\_mode],[sleepmode],[accelmode],[gpsmode],[ignitionmode],[accelvi\_threshold],[accelvi\_duration],[quiet\_time],[IP],[port]#

an example is:

**config,000000,120,2,7,30,20,240,500,0,1,1,0,3,4,0.1,0.25,3,192.168.1.100,5001#**

This example would configure a device as:

```
interval= 120 seconds
stop=2 minutes below 7 km/hrstop_speed
heading= 30 degrees, 20 meters minimum distance
heartbeat = 240 minutes (4 hours)
tow=500 meters
speedalarm = 0 (disabled)
vibration = 1 (enabled)
sleepmode = 1 (enabled)
accelmode = 0 (disabled)
gpsmode = 3 (standalone)
ignitionmode = 4 (accelerometer based virtual ignition)
accelvi = 0.1G threshold for at least 0.25 seconds duration, off with 3 minutes quiet time
IP= 192.168.1.100
port= 3001
```

If ignition mode is not accelerometer based, then the accelvi values are ignored.

The device will respond to a command with an acknowledgement that includes the identifier (IMEI or MEID) and either Success or Failure.

If one wishes to use the **config** command and leave certain parameters unchanged, then the command can be used with an asterisk in the spot of those parameters. For example:

```
config,000000,120,2,7,30,20,240,500,0,1,1,0,3,4,*,*,*,*#
```

This command would set the parameters for values shown, but the accelvi parameters as well as IP and port would be unchanged.

Please note that the examples provided are only an example - they are not the default values.

The query **config?** should provide the correct values per the specification. For example:

```
config?
```

```
A100004950011A config=120,2,7,30,20,240,500,0,1,1,0,3,4,0.1,0.25,3,192.168.1.100,5001
```

NOTE: It is strongly recommended that the device be rebooted after using the config command. This can be achieved with a power cycle, or using the reboot command.



## 4 Accelerometer Features

The FJ110C has an optionally-populated 3-axis accelerometer which is used to detect and report certain aspects of driving behavior, a possible impact, and/or as virtual ignition to detect when a vehicle may be in motion.

### 4.1 Accelmode command

The **accelmode** command is used to enable or disable the reporting of acceleration features. It has 3 possible values: 0, 1, or 2.

- 0 – acceleration features disabled
- 1 – impact alert only enabled
- 2 – all acceleration features enabled

The format is **accelmode**,[password],[mode]#

For example:

```
accelmode,000000,1#
```

This example would set the device to accelmode=1, and only impact events would be reported.

The device should respond to the accelmode command with an acknowledgement containing its identifier (IMEI or MEID) and Success or Failure.

The **accelmode?** query is used to request the current accelmode value. The device should respond with the identifier and current value of the accelmode parameter. For example:

```
A100004950011A Accelmode=1
```

### 4.2 Acceleration Feature Parameter Setting

There are 4 types of Acceleration features:

1. Harsh Braking
2. Hard Acceleration
3. Swerve (hard turns)
4. Impact (Crash)

Each type of feature sets up alert profiles that result in the device sending messages when the acceleration profile conditions are detected by the accelerometer. Note that regardless

of the values of these parameters, the features are only active if enabled by the parameter **accelmode**.

### 4.3 Braking Command

The **braking** command sets the parameters used to qualify an acceleration event. The format of the command is:

**Braking**,[password],[threshold],[duration],[delta V],[rise\_time],waveform#

The parameters are as follows:

Threshold: The acceleration level that must be exceeded to trigger. units: g

Duration: The minimum time for which the threshold must be exceeded. units :seconds

DeltaV: Delta Velocity(Acceleration accumulated value) units: km/hr

RiseTime: Rise time is the time from event start to peak acceleration. unit:seconds

waveform: Waveform report enable (for future use)

For example,

**Braking,000000,0.3,0.1,5,0,0#**

Threshold = 0.3G.

Duration = 0.2 second.

DeltaV= 5km/hr.

RiseTime= 0.

Waveform = 0 (disabled).

The **braking?** query is used to request the current braking parameters. The device responds with the identifier and a list of the braking parameters.

### 4.4 Harshaccel Command

The **harshaccel** command sets the parameters used to qualify an acceleration event. The format of the command is:

**harshaccel**,[password],[threshold],[duration],[delta V],[rise\_time],waveform#

The parameters are as follows:

Threshold: The acceleration level that must be exceeded to trigger. units: g

Duration: The minimum time for which the threshold must be exceeded. units :seconds

DeltaV: Delta Velocity(Acceleration accumulated value) units: km/hr

RiseTime: Rise time is the time from event start to peak acceleration. unit:seconds

waveform: Waveform report enable (for future use)

For example,

**harshaccel,000000,0.2,1,10,0,0#**

Threshold = 0.2G.

Duration =1 second.

DeltaV= 10km/hr.

RiseTime= 0.

Waveform = 0 (disabled).

The **harshaccel?**query is used to request the current harsh acceleration parameters. The device responds with the identifier and a list of the acceleration parameters.

#### 4.5 Swerve Command

The **swerve**command sets the parameters used to qualify a swerve or hard turn event. The format of the command is:

**swerve**,[password],[threshold],[duration],[delta V],[rise\_time],waveform#

The parameters are as follows:

Threshold: The acceleration level that must be exceeded to trigger. units: g

Duration: The minimum time for which the threshold must be exceeded. units :seconds

DeltaV: Delta Velocity(Acceleration accumulated value) units: km/hr

RiseTime: Rise time is the time from event start to peak acceleration. unit:seconds

waveform: Waveform report enable (for future use), must be 0.

For example,

**swerve,000000,0.25,0.1,0,0,0#**

Threshold = 0.25G.

Duration = .1 second.

DeltaV= 0km/hr.

RiseTime= 0.

Waveform = 0 (disabled).

The **swerve?**query is used to request the current swerve parameters. The device responds with the identifier and a list of the swerve parameters.

#### 4.6 Impact Command

The **impact**command sets the parameters used to quality an impact or collision while moving. The format of the command is:

**impact**,[password],[threshold],[duration],[delta V],[rise\_time],waveform#

The parameters are as follows:

Threshold: The acceleration level that must be exceeded to trigger. units: g

Duration: The minimum time for which the threshold must be exceeded. units :seconds

DeltaV: Delta Velocity(Acceleration accumulated value) units: km/hr

RiseTime: Rise time is the time from event start to peak acceleration. unit:seconds

waveform: Waveform report enable (for future use)

For example,

**impact,000000,0.5,0.15,0,0.5,0#**

Threshold = 0.5G.

Duration = .15 sec.

DeltaV= 0km/hr.

RiseTime= 0.5 sec

Waveform = 0 (disabled).

The **impact?**query is used to request the current impact parameters. The device responds with the identifier and a list of the impact parameters.

## 5 Trip and Parked Modes of Operation

During operation, the FJ110C is determined to be either in “Trip” mode or “Parked” mode. Trip mode is usually initiated by an “Ignition ON” event report (type 4), based either on a detected ignition event using hardwired ignition, or a virtual ignition event as determined by the device based on the configuration settings.

During trip mode, Interval reports (type 0) and Heading change reports (type 24) may be generated according to GPS results and the configuration settings. Sleep is never entered while in Trip mode.

Trip mode is usually terminated with an Ignition OFF event report (type 5) based on either hardwired ignition or a virtual ignition event as determined by the device based on configuration settings. When Trip mode is terminated, the device is considered to be in Parked mode. In Parked mode, no Interval or Heading Change events are generated.

Depending on configuration, significant distance travel detected by the GPS while in Parked mode will generate a “Tow Alert” (event 25) and the device enters Trip Mode. When Towing stops, a “Stop” event will be generated (type 8) and the device enters Parked mode.

### 5.1 Ignition Modes

The determination of Ignition ON and Ignition OFF, and thus Trip mode versus Parked mode, is based on the setting of the Ignitionmode configuration setting.

Ignitionmode Type 0 = Hardwired ignition reporting on Input 0. Input 0 is biased low and the device detects ignition on when the voltage on input 0 is pulled high and ignition off when input 0 returns low.

Ignitionmode Type 1 = Voltage based ignition reporting. An algorithm on the device monitors the voltage level on the power harness, and determines when a change in ignition state has occurred. In some cases with new vehicle batteries, an ignition off situation is not promptly detected, so operation in this mode may be disappointing.

Ignitionmode Type 2 = GPS speed based ignition reporting. Movement of a speed greater than a threshold is deemed to indicate ignition on, while the passing of a specified time below the speed threshold is deemed to indicate ignition off.

Ignitionmode Type 3 = No ignition. In this case, trip mode is initiated when the GPS detects speed above the threshold. Parked mode is initiated when a Stop is detected and reported.

Ignitionmode Type 4 = Accelerometer. In this case, trip mode is initiated when the accelerometer detects an acceleration event that exceeds the threshold value for at least the minimum specified duration. Parked mode is initiated when a Stop is detected by GPS and reported or when the accelerometer detects no vibration for the specified time.

Ignitionmode Type 5 = Mixed mode. In this case, trip mode is initiated when any of the triggers for virtual ignition – Voltage, GPS speed, or accelerometer. Parked mode is initiated when a Stop is detected by GPS and reported or when the accelerometer detects no vibration for the specified time.

The SMS command to set ignitionmode is:

**ignitionmode**,password,IgnitionmodeType#

Example: **ignitionmode,000000,1#**

To read the current ignition mode value, use the Query:

**ignitionmode?**

## 5.2 Acceleration Virtual Ignition

To define the conditions under which an Ignition ON event is generated when in ignitionmode 4, use the command

**accelvi**,password,threshold,duration, quiet\_time#

Example: **accelvi,000000,0.1,0.2,5#**

This example would configure the device to generate an Ignition ON event if the G-sensor detects acceleration exceeding 0.1G in any horizontal direction for at least 0.2 seconds while in Parked mode. This feature should work even if the accelerometer is not aligned.

An Ignition OFF event is generated when the GPS detects a stop based on the parameters of the Stop feature, or if no GPS is available, then an Ignition OFF is generated when the G-sensor detects no vibration for 5 minutes.

Note that no Tow Alerts are generated if Ignition mode is Type 2 (GPS) or Type 3 (No Ignition).

To read the current setting, use the Query:

**accelvi?**

## 5.3 Ignition Mode 0 – Hardwired

If **ignitionmode=0** the device is expecting input 0 to be connected to a signal wire that goes high when the vehicle ignition key is turned ON. Any significant movement that occurs when ignition is turned OFF is expected to be a towing event.

Trip mode with Hardwired Ignition

If the voltage on input 0 goes high, then an **Ignition ON** report (type 4) is generated, and the device enters Trip mode. In Trip mode, the device reports an **Interval** report (type 0) regularly at the timing specified by the [interval](#) setting.

If the [heading](#) parameter is not set to zero degrees, then **Heading Change** events (type 24) will also be reported according to the angle and distance specified while moving in Trip Mode.

If the vehicle stops moving, but input 0 remains high indicating that the vehicle is idling, then the **Interval** reports continue to be generated.

#### Parked Mode with Hardwired Ignition

When input 0 detects that ignition voltage has gone low, an **Ignition OFF** report (type 5) is generated. Trip mode is terminated, and the device is now placed into Parked mode. In parked mode, no **Interval** or **Heading Change** reports are sent.

If the GPS detects travel at a significant speed and it reaches a distance equal to the [tow](#) distance, then a **Tow Alert** (type 25) is generated. When the towing movement stops for the time specified in the [stop](#) parameter, then a **Stop** event (type 8) is reported.

## 5.4 Ignition Mode 1 – Voltage Based Virtual Ignition

If [ignitionmode=1](#) the device reports Ignition events and changes trip/parked mode based on the voltage detected on the power harness. Any significant movement that occurs in parked mode is expected to be a towing event.

#### Trip mode with Voltage Based Virtual Ignition

If the voltage on the power harness goes above a threshold, then an **Ignition ON** report (type 4) is generated, and the device enters Trip mode. In Trip mode, the device reports an **Interval** report (type 0) regularly at the timing specified by the [interval](#) setting.

If the [heading](#) parameter is not set to zero degrees, then **Heading Change** events (type 24) will also be reported according to the angle and distance specified while moving in Trip Mode.

If the vehicle stops moving, but voltage remains high indicating that the vehicle is idling, then the **Interval** reports continue to be generated.

#### Parked Mode with Voltage Based Virtual Ignition

When voltage drops below the threshold, an **Ignition OFF** report (type 5) is generated. Trip mode is terminated, and the device is now placed into Parked mode. In parked mode, no **Interval** or **Heading Change** reports are sent.

If the GPS detects travel at a significant speed and it reaches a distance equal to the [towalert](#) distance, then a **Tow Alert** (type 25) is generated. When the towing movement stops for the time specified in the [stop](#) parameter, then a **Stop** event (type 8) is reported.

## 5.5 Ignition Mode 2 – GPS Based Virtual Ignition

If `ignitionmode=2` the device reports Ignition events and changes trip/parked mode based on travel detected by the GPS. Tow alerts are not generated in this mode.

### Trip mode with GPS Based Virtual Ignition

If the speed and distance as detected by GPS goes above a threshold, then an **Ignition ON** report (type 4) is generated, and the device enters Trip mode. In Trip mode, the device reports an **Interval** report (type 0) regularly at the timing specified by the `interval` setting.

If the `heading` parameter is not set to zero degrees, then **Heading Change** events (type 24) will also be reported according to the angle and distance specified while moving in Trip Mode.

### Parked Mode with GPS Based Virtual Ignition

When speed drops below the threshold for the period of time specified by the stop parameter, an **Ignition OFF** report (type 5) is generated. Trip mode is terminated, and the device is now placed into Parked mode. In parked mode, no **Interval** or **Heading Change** reports are sent.

Also, if the GPS fix is lost for the period of time specified by the stop parameter, an **Ignition OFF** report (type 5) is generated. Trip mode is terminated, and the device is now placed into Parked mode. In parked mode, no **Interval** or **Heading Change** reports are sent.

No **Stop** or **Tow** reports are generated at all in Ignitionmode 2.

## 5.6 Ignition Mode 3 – No Ignition

If `ignitionmode=3` the device does not report Ignition events at all. It changes trip/parked mode based on travel detected by the GPS. Tow alerts are not generated in this mode.

### Trip mode with No Ignition

If the speed and distance as detected by GPS goes above a threshold, then the device enters Trip mode. In Trip mode, the device reports an **Interval** report (type 0) regularly at the timing specified by the `interval` setting.

If the `heading` parameter is not set to zero degrees, then heading events (type 24) will also be reported according to the angle and distance specified while moving in Trip Mode.

### Parked Mode with No Ignition

When speed drops below the threshold for the period of time specified by the stop parameter, then a **Stop** report (type 8) is generated. Trip mode is terminated, and the device is now placed into Parked mode. In parked mode, no **Interval** or **Heading Change** reports are sent.

No Tow alerts are generated in Ignitionmode 3.



## 5.7 Ignition Mode 4 – Accelerometer Based Virtual Ignition

If `ignitionmode=4` the device reports Ignition events and changes trip/parked mode based on acceleration detected by the G-sensor. Tow alerts are not generated in this mode.

### Trip mode with Accelerometer Based Virtual Ignition

If the acceleration as detected by the G-sensor goes above a threshold value for at least the specified duration, then an **Ignition ON** report (type 4) is generated, and the device enters Trip mode. In Trip mode, the device reports an **Interval** report (type 0) regularly at the timing specified by the `interval` setting.

If the `heading` parameter is not set to zero degrees, then **Heading Change** events (type 24) will also be reported according to the angle and distance specified while moving in Trip Mode.

### Parked Mode with Accelerometer Based Virtual Ignition

When speed as detected by the GPS drops below the threshold for the period of time specified by the stop parameter, an **Ignition OFF** report (type 5) is generated. Trip mode is terminated, and the device is now placed into Parked mode. In parked mode, no **Interval** or **Heading Change** reports are sent.

If no GPS fix is present, then when no vibration is detected for the quiet time specified by the `accelvi` parameter setting, an **Ignition OFF** report (type 5) is generated. Trip mode is terminated, and the device is now placed into Parked mode. In parked mode, no **Interval** or **Heading Change** reports are sent.

No **Stop** or **Tow** reports are generated at all in Ignitionmode 4.

## 5.8 Ignition Mode 5 – Mixed Mode Virtual Ignition

If `ignitionmode=5` the device reports Ignition events and changes trip/parked mode based on multiple possible triggers. Tow alerts are not generated in this mode.

### Trip mode with Mixed Mode Virtual Ignition

Either of the virtual ignition ON triggers (voltage, speed, acceleration) can trigger in mixed mode. If any of the triggers is detected when in Parked mode, then an **Ignition ON** report (type 4) is generated, and the device enters Trip mode. In Trip mode, the device reports an **Interval** report (type 0) regularly at the timing specified by the `interval` setting.

If the `heading` parameter is not set to zero degrees, then **Heading Change** events (type 24) will also be reported according to the angle and distance specified while moving in Trip Mode.

### Parked Mode with Mixed Mode Virtual Ignition

When speed as detected by the GPS drops below the threshold for the period of time specified by the stop parameter, an **Ignition OFF** report (type 5) is generated. Trip mode is

terminated, and the device is now placed into Parked mode. In parked mode, no **Interval** or **Heading Change** reports are sent.

If no GPS fix is present, then when no vibration is detected for the quiet time specified by the accelvi parameter setting, an **Ignition OFF** report (type 5) is generated. Trip mode is terminated, and the device is now placed into Parked mode. In parked mode, no **Interval** or **Heading Change** reports are sent.

No **Stop** or **Tow** reports are generated at all in Ignitionmode 5.

## 5.9 Tow Alert Operation

This section describes what the expected reporting behavior is in the event that Tow conditions are detected.

When Ignitionmode is set to 0 (Hardwired) or 1 (Voltage based Virtual Ignition), it is possible that the vehicle moves without an **Ignition ON** event. This might be the result of a vehicle being Towed.

If the device detects movement of greater than the distance specified by the Tow parameter with a reliable GPS fix while ignitionmode is set to 0 or 1, and without an ignition ON event being triggered by the ignition wire or by voltage, then the device should generate a **TOW** alert (type 25) and enter Trip mode. While it continues to move, it should generate **Interval** and **Heading Change** events according to the parameters set. When the speed drops below the threshold set by the Stop parameter for the specified stop time, or if the GPS fix is lost for the specified stop time, then a **Stop** event (type 8) is generated and the devices enters Parked mode.

## 6 Parsing Guide

Normal communications between the FJ110C and the data server takes the form of messages that are sent from the device to the server based on occurrences that the device determines on the basis of GPS information, timers, power events, and inputs. After sending the message, the device is available to receive an Acknowledgment message (ACK) for 15 seconds. If the ACK is not received, the device tries again on a schedule with increasing delays between messages. If more messages are queued on the device for sending in the meantime, the device will store them in memory. Once communications successfully resumes, the device will deliver the stored messages in the order they were generated. A successful ACK is required for each message before the next message will be sent.

### 6.1 Message Structure

Messages are represented here as Hex characters. A typical 46 byte message is shown below as example that defines the message structure:

```
0xA100004950077E521252E55CAF0D0B52E55CA4138C122BBA2D971800000459005403021F
00090710023C052C019F
```

The table below explains the contents of the message.

bytes	example	which means	description, units
7	A100004950077E	A100004950077E	MEID packed BCD
1	0x52	R	message type Report
1	0x12	18 <sup>th</sup> message	Sequence number
4	0x52E55CAF	2014/01/26 19:06:23	Message generated timestamp UNIX
1	0x0D	13 Satellites	Satellite Count
1	0x0B	HDOP 1.1	HDOP*10
4	0x52E55CA4	2014/01/26 19:06:12	GPS Fix timestamp UNIX
4	0x138C122B	32.7946795	Latitude*10000000 (2s complement)
4	0xBA2D9718	-117.1417320	Longitude (2s complement)
4	0x00000459	40 km/hr	Speed (cm/sec)
2	0x0054	84	Heading (degrees)
1	0x03	00000011	Input status byte
1	0x02	00000010	Output Status byte
1	0x1F	31	Event type (reason)
4	0x00090710	591.63km	Distance Log (meters)
2	0x023C	5.72V	ADC Volts * 100
2	0x052C	13.24V	External Volts * 100
2	0x102D	4.023V	Backup Volts * <b>1000</b>

## 6.2 Message Elements

The elements of the message are as follows:

MEID – this is the hex MEID number of the CDMA module, in packed BCD format

Message type – normal event messages are of type “Report”

Sequence number – this is a one byte number that increments with each report. It starts at 0 on power up, and after 0xFF (255) is reached, it continues at 0 again

Message timestamp – this is the time that the message was originally generated on the device, not necessarily when it was successfully transmitted. The format is Unix, second since 1970.

Satellites – the number of satellites being received

HDOP – the Horizontal Dilution of Precision, multiplied by 10 so that it can represent a number with a single decimal.

GPS timestamp – this is the time of the latest valid GPS fix. It may be the same as the event timestamp if the fix is current, or from earlier if the device does not have a valid fix

Latitude – an integer representing latitude to 7 decimals. 2s complement format for negative values.

Longitude – an integer representing longitude to 7 decimals. 2s complement format for negative values.

Speed based on GPS – in cm/sec

Heading based on GPS – in degrees

Input status – one byte whose bits represent the detected status of inputs. A value of 1 for bit 0 represents a low voltage on Input 0, for example

Output Status – one byte whose bits represent the state of outputs as set by commands to the device. A value of 1 for bit 0 represents that output zero is set (pulled low).

Event Type – the reason this message was generated. See the table for Event types

Distance Log – distance log as incremented by GPS, in meters

ADC – the voltage to 2 decimals of an input if configured as an ADC

External – the voltage supplied to the device via the power harness, to 2 decimals

Battery – the voltage of the backup battery if present, to 3 decimals

### 6.3 Event Codes

The table below relates the Event codes in the message to the reason the message was generated:

Message #	Message Type	Description
0	Interval	Auto Report (auto report when moving)
1	Vibration	Vibration alarm(report when GPS is OFF and vibration detected)
2	Power Disconnect	Power cut alarm (report when external power is cut off)
3	Power Connect	Power connected alarm (external power has been connected)
4	Ignition ON	Hardwired or Virtual Ignition ON detected
5	Ignition OFF	Hardwired or Virtual Ignition OFF detected
6	Input 2 High	Input2 high alarm
7	Input 2 Low	Input2 low alarm
8	Stop	Device has stopped moving
9	Heartbeat	Heartbeat periodic report
13	Input 1 High	Input1 high alarm
14	Input 1 Low	Input 1 Low alarm
19	Crash Alarm	Crash Detected
24	Heading Change	Heading change detected
25	Tow Alert	Device is moving but being pulled
35	Starter Disabled	An output has been set by SMS command
36	Starter Enabled	An output has been cleared by SMS command
41	Harsh Accel	Harsh acceleration has been detected
42	Harsh Brake	Harsh Braking has been detected
43	Swerve Left	A left swerve has been detected
44	Swerve Right	A right swerve has been detected

Generation of these messages will occur based on the configuration settings on the device. The device is preconfigured by the software loaded on the device in the factory. The defaults in the software may vary depending on the configuration ordered with devices.

### 6.4 Acknowledgement

After the device sends a message, it awaits an ACK from the receiving server to confirm that the message has been successfully received and parsed. If it does not receive the ACK, it will try again with the same message. This repeats until the device receives the correct ACK message, after which it is ready to send the next message that is created or in the queue.

The ACK message is comprised of 4 bytes, of the form "ACK[n]" where n is the sequence number of the message that was received. For example, if the sequence number of the message was "8", then the ACK message would be "ACK8", or in hex 0x41434B08.



## FCC Regulations:

- 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 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.

### **Caution :**

Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

**The device cannot be used within 20cm of any persons and must not be co-located within 20cm of other transmitter antennas.**