XT2500
Product Manual

Firmware Version: 1188GA1

Revised August 12, 2022

TABLE OF CONTENTS

1. Revision History

1.1. Firmware

1.1.1. Resolved Issues

- Firmware will no longer revert to a backup image that is on a different major release.
- BG77 information now populates cleaner in the FWC parameter.

1.1.2. Features and Functionality

- A DTC change event will be generated whenever a new DTC is detected.
- IP address parameter is now available.

1.1.3. Installation and Upgrade Notes

1188GA1.1 is upgrade compatible with all 1188Fxx.x releases and can be upgraded over the diagnostic serial port using xmodem-128 or via AWS IOT JOBs service. This firmware should only be installed on XT2594 Harpsichord devices devices.

- 1188GA1.x is downgrade compatible with all 1188GAx.x releases.

1.1.4. Configuration Notes

- Configuration 89 added for update inhibition configuration (e.g. don’t do a fw update when you have a trip to send).
- Configurations 26, 27, 28, 57, 59 have been modified and updated to configuration version 1.

1.1.5. Limitations

- SMS split-by-size (setting in config 8) results in incomplete response with modem firmware version 6.05 when the response is large enough to split
    - The split-by-line setting may be used instead as a work-around

1.1.6. Known Issues

- Quectel modems cannot perform FTP update when commanded via SMS.
- Device sometimes does not send power stage transition event before sleep.
- Redundant DTCs are not parsed.

2. Functional Description

2.1. Mechanical

Mechanical	
Dimensions	2.63” x 1.49” x 1.06” (6.7 x 5.3 x 2.7 cm)
Weight	2 oz. (57 g)
Physical Connections	J1962 (with adapters available)
Operating Temperature	-25°C to 70°C (-13°F to 158°F)

2.2. Overview

The XT2500 series is a plug-n-play universal vehicle tracking unit (VTU) for use in light duty/passenger vehicles. The XT2500 also suits clientele with large fleets of heavy duty trucks with 9-pin/6-pin Deutsch connectors (RP1226 for newer trucks) via a cable harness/adapter. The XT2500 utilizes a cellular modem, a Bluetooth modem, a GPS modem, and an integrated accelerometer to collect information about the vehicle for a variety of applications.

One key benefit of the XT2500 is the flexibility of the device, allowing it to suit an individual client’s desires. The device can be expanded by connecting to an external XT1065 I/O box. The XT1065 I/O box includes additional interfaces such as digital inputs, digital outputs, analog inputs, RS232 interface, and Dallas/Maxim 1-wire interface. The XT2500 is a versatile device that can include an optional Bluetooth interface for ELD applications and optional internal battery and buzzer for driver behavior alerts. The XT2500 devices can be controlled through various channels, ranging from simple system parameters to more complex device interpreter scripts, which offer maximum customization as they are written completely by the customer.

3. General Operation

The XT2500 is connected to the vehicle and communicates to the server via the cellular network. It is equipped with a buzzer and LEDs to provide auditory and visual feedback to the driver.

The XT2500 excels in vehicle tracking by utilizing its GPS engine to maintain global positioning of the vehicle throughout the duration of the trip. While tracking, the device is capable of monitoring and reporting a large selection of diagnostic information from the vehicle.

The XT2500 can be configured to report a variety of parameters per customer specified thresholds, automatically packaging and sending data to a centralized server. Developed with security in mind, the XT2500 supports TLS1.2 encryption and mutual authentication with backends to keep user data safe.

At the end of a trip, the XT2500 will report configured parameters to the server before entering a sleep mode. This prevents the device from continuing to draw power from the vehicles' battery. The XT2500 is equipped with a 250mAh "last-gasp" battery that allows the device to send its final reports to the server after the vehicle has been shut off.

4. INTERFACES

4.1. HARPSIOBOX CONNECTOR

Connection	Description
Inputs 1 - 4	Has internal Pull-Direction that is configured via Configuration 71: Input Configuration on p. 184. When the Pull-Direction bit is enabled (0x40) in the FLAGS parameter, the configured Input is defaulted to "set" until it is grounded. When the Pull-Direction bit is disabled (0x00), it is defaulted to "clr" until it is pulled up to 12V. If pulled up to 12V or grounded, the pin will remain 'set' or 'clr' respectively regardless of the state of bit 0x40.

Pin State	Bit 0x40 ON	Bit 0x40 OFF
Float	Clr	Set
12V Applied	Set	Set
Grounded	Clr	Clr

UART 1	RS232. Treated as a console interface and can be used for enabling debug prints.
UART2	Not connected.
Output 1	Outputs current battery voltage to pin on command. (Output Voltage range of 3V-4.2V)
Output 2	Outputs current battery voltage to pin on command. (Output Voltage range of 3V-4.2V)
Output 3	Outputs current battery voltage to pin on command. (Output Voltage range of 3V-4.2V)
External 3v3 Power Supply	Not connected.
OWB	Currently only driver ID is supported.

4.2. XT2500 LED BEHAVIOR

NOTE: The solid LEDs described will have a 1/16th second blip every 1 and 15/16th seconds to indicate the LED is not stuck on solid.

4.2.1. LED 1

Pattern/Color	Description
Off	Power-on default
Solid blue	BLE connected only
Solid red	Ignition on only
Solid Purple	BLE connected and ignition on

4.2.2. LED 2

Pattern/Color	Description
Off	Power-on default
Off	GSM disabled
Fast blink yellow	GSM enabled, no registration
Solid yellow	GSM enabled, registered

4.2.3. LED 3

Pattern/Color	Description
Off	Power-on default
Off	GPS disabled
Slow blink green	GPS enabled, no lock
Solid green	GPS enabled, locked

4.3. I/O Box LED Behavior

Pattern/Color	Description
Yellow Solid	Boot or wake from sleep.
Green Solid	Established successful communication with the XT2500.
Red Solid	Cannot establish connection with the XT2500 within 30 seconds.

5. Power Management

Abbreviation	Definition	Note
PS	Power Stage	N/A
PMU	Power Management Unit	A single module, subsystem, or assembly which can be controlled or configured to manage power consumption.
PS0	Power Stage0	N/A
PS1	Power Stage1	N/A
PS2	Power Stage2	N/A
SS	Snapshot	This is a power substage (temporarily entered from a power stage, then returns to the same power stage)

5.1. Power Stages

The power stages are intended to have reduced levels of power consumption.

5.2. Power Stage Transitions

The device enters PS0 upon powering up, and transitions sequentially between PS0, PS1, and PS2. The device can transition from any power stage into Snapshot and will return to the same power stage upon returning from Snapshot.

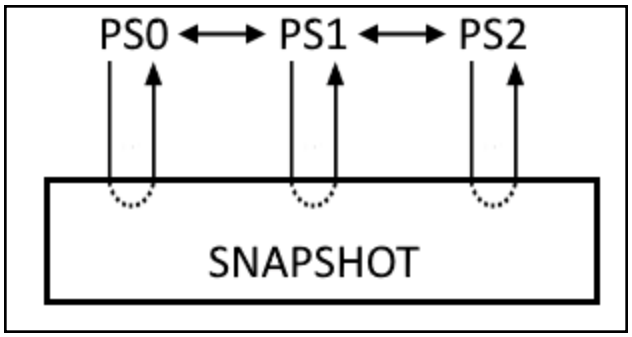


Figure 4-1: Transition paths between power stages and snapshot.

5.2.1. Triggering sequential Power Stage Transitions

Transitioning to an adjacent PS is triggered by a configurable set of criteria. When the criteria are met, the transition is triggered, and the device will fully transition to the target PS. Once triggered, PS transitions will always fully complete, they cannot be cancelled mid-transition.

5.2.2. Transitioning to Snapshot

Transitioning to SS is triggered by the expiration of a configurable snapshot interval.

5.2.3. Transition from Snapshot

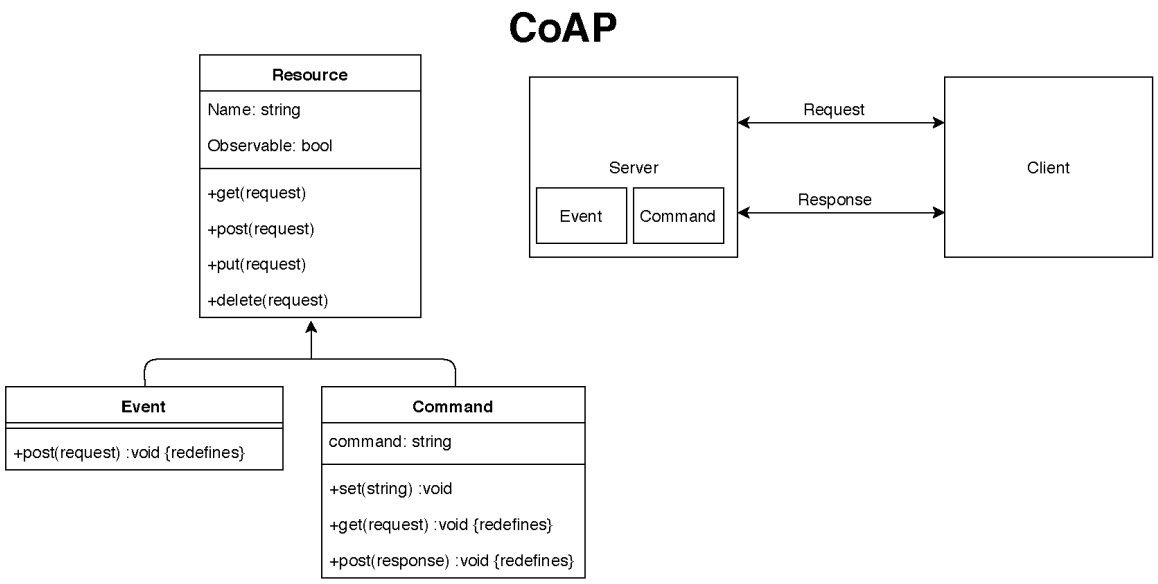
Once SS is entered it may wait for necessary PMUs to get to a certain state (ex. GPS position locked, Cellular registration, etc.). The device will create a record, or multiple records, containing the most up-to-date system information (a "snapshot") and the device will do some combination of: save the record, send the record. After the snapshot record has been saved and/or sent, the device will transition back to its previous PS.

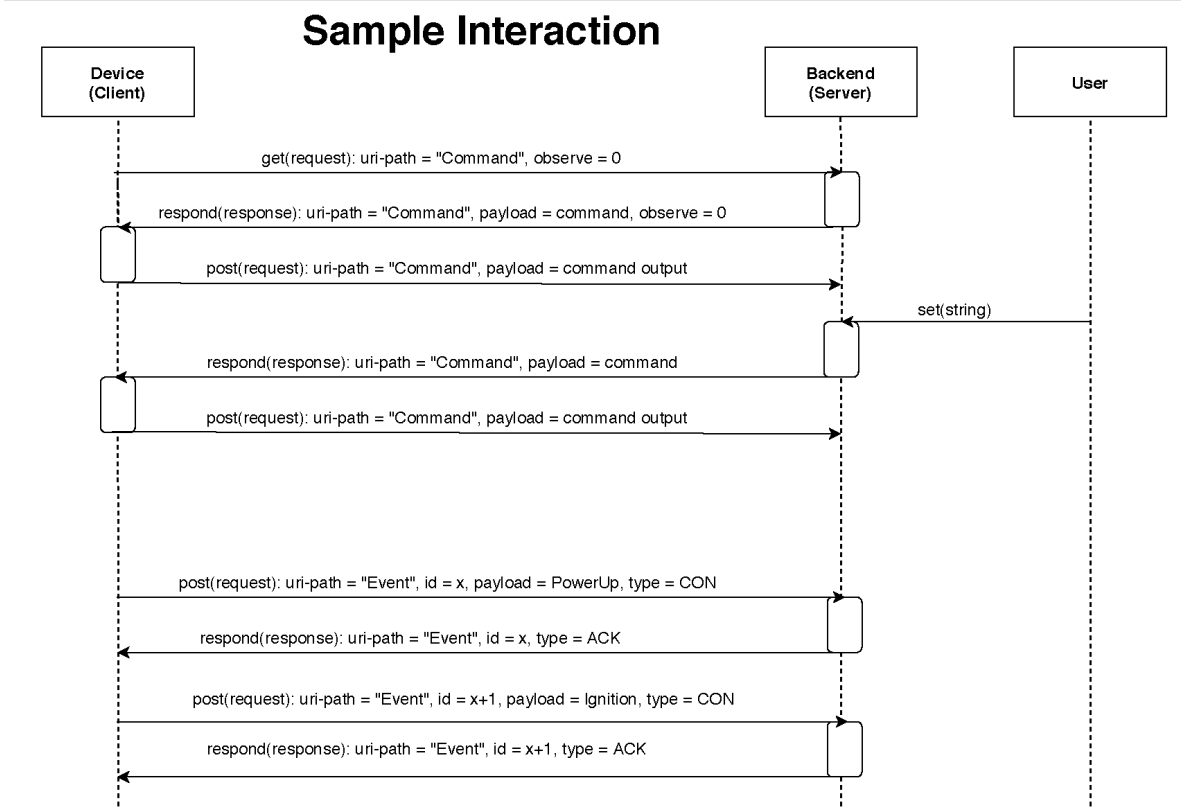
5.3. Power State Current Draw Averages

State	Cellular	GPS	MCU	(mA)
1	ON	ON	ON	77.0
2	ON	Low Power	ON	59.5
3	OFF	Low Power	Deep Sleep	2.5

6. PROTOCOL SPECIFICATION

6.1. COAP SERVER INTERACTION





6.1.1. Overview

- Device performs the CoAP Client role, and the Customer Backend performs the CoAP Server role.
- Device will post events to the configured event resource and will accept commands from the configured command resource.
- Device can be configured to send confirmable (CON) and non-confirmable (NON) messages.
    - CON messages must be responded to with an ACK.
- Server must have separate resources for events and commands.
    - Preferably two unique resources per device (1 event and 1 command).
    - One aggregate Event resource may be used in lieu of an event resource per device.
    - The command resource must be per device if commands want to be issued on a per-device basis.

6.1.2. Event Resource Behavior

- Server only needs to implement the POST method for this resource.
- Device will POST events to this event resource for both NON and CON message types.
    - The POST requests will contain the event data in MessagePack in the CoAP Payload field.
- For CON messages, the server MUST send a response containing the following
    - Message ID that matches the corresponding event POST
    - The URI-Path option containing the resource name.
        - An event resource called "XT-events" would populate the URI-Path with "XT-events"
    - Message TYPE must be ACK
- For NON messages, the server is not required to send an ACK.
- For both NON and CON messages the server MAY send diagnostic error codes as responses. For CON messages this would be in lieu of an ACK.

6.1.3. Command Resource Behavior

- Server must make the command resource Observable for commands to be received in real-time.
- Server only needs to implement GET and POST methods for this resource.
- Device will perform a GET request with the Observe option to this resource upon each successful network connection.
    - This will trigger the server to send any pending command to the device in response to this request.
- Subsequent commands will be sent from the server automatically after the data in the GET resource has changed.
    - This will trigger the device to execute the new command.
- ALL command responses will be sent to the POST method of the command resource.
    - This includes the initial command obtained from the GET request as well as any subsequent commands obtained as a result of the server keeping the device updated with changes to the GET data.

6.1.4. CoAP Backoff and Message ID Behavior

- The Message ID contained in the CoAP header is unique per outgoing message regardless of destination resource.
  - This means responses to commands will increment the message ID, as well as any events sent.
- If QoS=1 is configured in the device NetConfig the device will be expecting acknowledgements to event payloads.
  - If an ACK is not received in 5 seconds, or if the ACK does not correspond to the event just sent the device will enter backoff.
  - Ack behavior is detailed in the Event Resource Behavior overview.
  - Subsequent missing ACKs will increase the backoff level.

NOTE: A delay may occur in reporting a non-acked event or command request in the event that there is a concurrent protocol backoff.

6.1.5. Timing

The device can enter three different backoff states: Cellular, Protocol, and Connection. It is possible to be in multiple backoff states at a given time.

Cellular backoff is enforced by the network when the device is unable to establish a connection to the network or a server through a socket connection.

Cellular Backoff Level	Timer (minutes)
GSMBACKOFFLEVEL_0	0
GSMBACKOFFLEVEL_1	2
GSMBACKOFFLEVEL_2	5
GSMBACKOFFLEVEL_3	8
GSMBACKOFFLEVEL_4	15

Protocol backoff occurs when the device does not receive an acknowledgement from the server after sending an event. The following is the holdoff pattern for the protocol:

1. Send event
2. Wait 5 seconds for ACK
3. Enter backoff level 1 (1 minute)
4. Repeat steps 1-4
5. Enter backoff level 2 (5 minutes)
6. Repeat steps 1-4
7. Enter backoff level 3 (10 minutes)
8. Repeat steps 1-4
9. Enter backoff level 4 (15 minutes)
10. Repeat steps 1-4
11. Enter backoff level 5 (15 minutes)

Protocol Backoff	Timer (minutes)
BACKOFFLEVEL_0	0
BACKOFFLEVEL_1	1
BACKOFFLEVEL_2	5
BACKOFFLEVEL_3	10
BACKOFFLEVEL_4	15
BACKOFFLEVEL_5	15

6.1.6. Max-Age Option

Max-Age is an option (not required by the CoAP specification; but still defined by the specification) in which *observable* resources can establish a inactivity timeout between a client and server. After this timeout expires; the client or server is required to attempt to re-establish the connection. **Max-Age is defined in seconds**.

The Max-Age option is used in Xirgo firmware in order to maintain the connection to the server's Command resource (through server resets, loss of coverage, ect). When the device performs the initial GET request with the Observe option on the Command resource, the server can add the Max-Age option in its response. Any Max-Age will be respected within the CoAP specification. If no Max-Age is specified, the device will assume 0, or never attempt to re-establish the connection. If a Max-Age is specified, the device will re-establish (re-send the initial GET request with the Observe option) the observe relation after an inactivity interval occurs on that resource for longer than the specified Max-Age (ie. if no commands are sent/received for Max-Age seconds).

Xirgo Firmware does NOT respect Max-Age on the event resource.

7. Event Description and Default Mask

7.1. [1] Ignition On

Ignition On is triggered when a logical TRUE status has been derived based on Configuration 12: Ignition Status Determination Masks on p. 126and the current logical statuses of all ignition sources available on the system (Parameter 51: IS (Ignition Source) on p. 69).

Default Mask	{ 0x01,0x2d,0x01,0x23,0x90,0x40,0x0d,0x00,0x00,0x01,0x00,0x21,0xc0,0x00,0x02,0x00 }
Default String	EV, GSPT, SV, HP, CQ, GS, AXYZ, VN, TID, CI, HBE, CNT, CT, BT, IS, IG, PT, GSM, ADC0, ADC1, LOC

7.2. [2] Ignition Off

Ignition Off is triggered when a logical FALSE status has been derived based on Configuration 12: Ignition Status Determination Masks on p. 126 and the current logical statuses of all ignition sources available on the system (Parameter 51: IS (Ignition Source) on p. 69).

Default Mask	{ 0x01,0x2d,0x01,0x01,0x01,0x00,0x06,0x00,0x00,0x61,0x00,0x21,0xc0,0x00,0x02,0x00 }
Default String	EV, GSPT, SV, HP, CQ, GS, AXYZ, IT, UT, BT, IG, OT, OTP, PT, GSM, ADC0, ADC1, LOC

7.3. [3] Ignition On Periodic

Ignition On Periodic is triggered at the periodicity defined by Configuration 17: Ignition On Periodic Reporting Interval on p. 132 after the system has detected Ignition On based on Configuration 12: Ignition Status Determination Masks on p. 126.

Default Mask	{ 0x81,0x2d,0x01,0x21,0x31,0x40,0x1d,0x00,0x00,0x01,0x00,0x21,0xc0,0x00,0x02,0x00 }
Default String	EV, SPT, GSPT, SV, HP, CQ, GS, AXYZ, TID, IT, CI, AC, CNT, CT, BT, IS, ACV, IG, PT, GSM, ADC0, ADC1, LOC

7.4. [4] Ignition Off Periodic

Ignition Off Periodic is triggered at the periodicity defined by Configuration 18: Ignition Off Periodic Reporting Interval on p. 133 after the system has detected Ignition Off based on Configuration 12: Ignition Status Determination Masks on p. 126.

Default Mask	{ 0x01,0x2d,0x01,0x01,0x01,0x00,0x06,0x00,0x00,0x01,0x00,0x21,0xc0,0x00,0x02,0x00 }
Default String	EV, GSPT, SV, HP, CQ, GS, AXYZ, IT, UT, BT, IG, PT, GSM, ADC0, ADC1, LOC

7.5. [5] Power Up

Power Up is triggered by device power up or reset. Event is enabled by PMASK parameter of Configuration 5: Device Power Up Message on p. 112.

Default Mask	{ 0x01,0x2d,0x31,0x00,0x8c,0x00,0x06,0x00,0x00,0x01,0x80,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, GSPT, SV, HP, CQ, GS, FWM, FWO, BN, PN, HBE, UT, BT, IG, FWB, GSM, ADC0, ADC1, LOC

7.6. [6] Power Up GPS

Power Up GPS is triggered when the first locked GPS fix has been acquired after device power up or reset . Event is enabled by PMASK parameter of Configuration 5: Device Power Up Message on p. 112.

Default Mask	{ 0x01,0x2d,0x01,0x00,0x0e,0x00,0x06,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, GSPT, SV, HP, CQ, GS, SI, BN, PN, UT, BT, IG, GSM, ADC0, ADC1, LOC

7.7. [7] Power Up GSM

Power Up GSM is triggered when the GSM registration has been acquired after device power up or reset. Event is enabled by PMASK parameter of Configuration 5: Device Power Up Message on p. 112.

Default Mask	{ 0x01,0x2d,0x01,0x00,0x0e,0x00,0x06,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, GSPT, SV, HP, CQ, GS, SI, BN, PN, UT, BT, IG, GSM, ADC0, ADC1, LOC

7.8. [8] Low Battery

Low battery is triggered by parameters within Configuration 13: Device Battery Health Monitoring on p. 127.

Default Mask	{ 0x01,0x2d,0x01,0x00,0x0e,0x00,0x06,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, GSPT, SV, HP, CQ, GS, SI, BN, PN, UT, BT, IG, GSM, ADC0, ADC1, LOC

7.9. [9] Acceleration

Acceleration is triggered when the threshold determined by Configuration 29: Accelerometer Shock/Vibration on p. 151 is exceeded.

Default Mask	{ 0x01,0x2d,0x01,0x21,0x00,0x00,0x16,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, GSPT, SV, HP, CQ, GS, AXYZ, TID, UT, BT, ACV, IG, GSM, ADC0, ADC1, LOC

7.10. [10] Acceleration VBUS

Acceleration VBUS is triggered when any of the configured thresholds in Configuration 24: Acceleration Threshold VBUS on p. 141 are exceeded.

Default Mask	{ 0x81,0x2d,0x01,0x21,0x00,0x00,0x16,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, SPT, GSPT, SV, HP, CQ, GS, AXYZ, TID, UT, BT, ACV, IG, GSM, ADC0, ADC1, LOC

7.11. [11] Acceleration GPS

Acceleration GPS is triggered when any of the configured thresholds in Configuration 25: GPS Acceleration Threshold on p. 142 are exceeded.

Default Mask	{ 0x81,0x2d,0x01,0x21,0x00,0x00,0x16,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, SPT, GSPT, SV, HP, CQ, GS, AXYZ, TID, UT, BT, ACV, IG, GSM, ADC0, ADC1, LOC

7.12. [12] Stage 0 Periodic

Stage 0 periodic is triggered when the device is in Power Stage 0, and the conditions configured in Configuration 28: Snapshot Configuration on p. 150 have been met.

Default Mask	{ 0x01,0x2d,0x01,0x21,0x10,0x00,0x06,0x00,0x00,0x61,0x00,0x20,0xc0,0x00,0x26,0x00 }
Default String	EV, GSPT, SV, HP, CQ, GS, AXYZ, TID, CI, UT, BT, IG, OT, OTP, GSM, ADC0, ADC1, LOC, PS, PSTI

7.13. [13] Stage 1 Periodic

Stage 1 periodic is triggered when the device is in Power Stage 1, and the conditions configured in Configuration 28: Snapshot Configuration on p. 150 have been met.

Default Mask	{ 0x01,0x2d,0x01,0x21,0x10,0x00,0x06,0x00,0x00,0x61,0x00,0x20,0xc0,0x00,0x26,0x00 }
Default String	EV, GSPT, SV, HP, CQ, GS, AXYZ, TID, CI, UT, BT, IG, OT, OTP, GSM, ADC0, ADC1, LOC, PS, PSTI

7.14. [14] Stage 2 Periodic

Stage 2 periodic is triggered when the device is in Power Stage 2, and the conditions configured in Configuration 28: Snapshot Configuration on p. 150 have been met.

Default Mask	{ 0x01,0x2d,0x01,0x21,0x10,0x00,0x06,0x00,0x00,0x61,0x00,0x20,0xc0,0x00,0x26,0x00 }
Default String	EV, GSPT, SV, HP, CQ, GS, AXYZ, TID, CI, UT, BT, IG, OT, OTP, GSM, ADC0, ADC1, LOC, PS, PSTI

7.15. [15] Battery Disconnect

Battery disconnected is triggered when the external power source is less than 6V for the period of time determined by Configuration 13: Device Battery Health Monitoring on p. 127 and it was previously considered connected.

Default Mask	{ 0x01,0x2d,0x01,0x00,0x0e,0x00,0x06,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, GSPT, SV, HP, CQ, GS, SI, BN, PN, UT, BT, IG, GSM, ADC0, ADC1, LOC

7.16. [16] Battery Reconnect

Battery reconnected is triggered when the external power source is greater than 8V for the period of time determined by Configuration 13: Device Battery Health Monitoring on p. 127 and it was previously considered disconnected.

Default Mask	{ 0x01,0x2d,0x01,0x00,0x0e,0x00,0x06,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, GSPT, SV, HP, CQ, GS, SI, BN, PN, UT, BT, IG, GSM, ADC0, ADC1, LOC

7.17. [17] Battery Disconnect Periodic

Battery disconnect periodic triggers at the rate determined by Configuration 13: Device Battery Health Monitoring on p. 127 while the battery is disconnected (see [15] Battery Disconnect on p. 29).

Default Mask	{ 0x01,0x2d,0x01,0x00,0x10,0x00,0x06,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, GSPT, SV, HP, CQ, GS, CI, UT, BT, IG, GSM, ADC0, ADC1, LOC

7.18. [18] Direction Change

Direction Change is triggered when the heading delta with respect to the heading at the prior direction change event exceeds the threshold configured in Configuration 34: Direction Change on p. 154.

Default Mask	{ 0x81,0x2d,0x01,0x21,0x00,0x00,0x16,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, SPT, GSPT, SV, HP, CQ, GS, AXYZ, TID, UT, BT, ACV, IG, GSM, ADC0, ADC1, LOC

7.19. [19] Speed VBUS

Speed VBUS is triggered after exceeding the speed threshold configured in Configuration 35: VBUS Speed Threshold on p. 155. After this event has been triggered, speed must fall below ("SPD_THS" – “HYST” in configuration 35) before the event will occur again.

Default Mask	{ 0x81,0x2d,0x01,0x21,0x00,0x00,0x16,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, SPT, GSPT, SV, HP, CQ, GS, AXYZ, TID, UT, BT, ACV, IG, GSM, ADC0, ADC1, LOC

7.20. [20] Speed GPS

Speed GPS is triggered after exceeding the speed threshold configured in Configuration 36: GPS Speed Threshold on p. 156. After this event has been triggered, speed must fall below ("SPD_THS" – “HYST” in configuration 36) before the event will occur again.

Default Mask	{ 0x81,0x2d,0x01,0x21,0x00,0x00,0x16,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, SPT, GSPT, SV, HP, CQ, GS, AXYZ, TID, UT, BT, ACV, IG, GSM, ADC0, ADC1, LOC

7.21. [21] GEOFENCE CROSSING

Device must be in/out of a geofence for the number of seconds determined by ENTER_S and EXIT_S parameters in Configuration 37: General Geofence on p. 157.

Default Mask	{ 0x81,0x2d,0x01,0x21,0x00,0x00,0x16,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, SPT, GSPT, SV, HP, CQ, GS, AXYZ, TID, UT, BT, ACV, IG, GSM, ADC0, ADC1, LOC

7.22. [23] ODOMETER VBUS

Odometer GPS is triggered each time the device travels the threshold distance defined in Configuration 38: VBUS Odometer Threshold on p. 158. Event is enabled by ENABLE parameter of the VBUS Odometer Threshold (38) configuration.

Default Mask	{ 0x81,0x2d,0x01,0x21,0x00,0x00,0x16,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, SPT, GSPT, SV, HP, CQ, GS, AXYZ, TID, UT, BT, ACV, IG, GSM, ADC0, ADC1, LOC

7.23. [24] ODOMETER GPS

Odometer GPS is triggered each time the device travels the threshold distance defined in Configuration 39: GPS Odometer Threshold on p. 158. Event is enabled by ENABLE parameter of configuration 39.

Default Mask	{ 0x81,0x2d,0x01,0x21,0x00,0x00,0x16,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, SPT, GSPT, SV, HP, CQ, GS, AXYZ, TID, UT, BT, ACV, IG, GSM, ADC0, ADC1, LOC

7.24. [25] INPUT 1 SET

Input 1 Set is triggered when the state of Input 1 transitions from deasserted to asserted and remains in that state for the hysteresis duration as defined by the HYST parameter in Configuration 71: Input Configuration on p. 184. Event is enabled by the FLAGS parameter of configuration 71.

Default Mask	{ 0x81,0x2d,0x01,0x21,0x00,0x00,0x16,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00, 0x00,0x00,0x00,0xc0,0x03,0x00,0x00,0x00,0x00 }
Default String	EV, SPT, GSPT, SV, HP, CQ, GS, AXYZ, TID, UT, BT, ACV, IG, GSM, ADC0, ADC1, LOC, IN1, IN2, IN3, IN4

7.25. [26] INPUT 1 CLEAR

Input 1 Clear is triggered when the state of Input 1 transitions from asserted to deasserted and remains in that state for the hysteresis duration as defined by the HYST parameter in Configuration 71: Input Configuration on p. 184. Event is enabled by the FLAGS parameter of configuration 71.

Default Mask	{ 0x81,0x2d,0x01,0x21,0x00,0x00,0x16,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00, 0x00,0x00,0x00,0xc0,0x03,0x00,0x00,0x00,0x00 }
Default String	EV, SPT, GSPT, SV, HP, CQ, GS, AXYZ, TID, UT, BT, ACV, IG, GSM, ADC0, ADC1, LOC, IN1, IN2, IN3, IN4

7.26. [27] INPUT 2 SET

Input 2 Set is triggered when the state of Input 2 transitions from deasserted to asserted and remains in that state for the hysteresis duration as defined by the HYST parameter in Configuration 71: Input Configuration on p. 184. Event is enabled by the FLAGS parameter of configuration 71.

Default Mask	{ 0x81,0x2d,0x01,0x21,0x00,0x00,0x16,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00, 0x00,0x00,0x00,0xc0,0x03,0x00,0x00,0x00,0x00 }
Default String	EV, SPT, GSPT, SV, HP, CQ, GS, AXYZ, TID, UT, BT, ACV, IG, GSM, ADC0, ADC1, LOC, IN1, IN2, IN3, IN4

7.27. [28] INPUT 2 CLEAR

Input 2 Clear is triggered when the state of Input 2 transitions from asserted to deasserted and remains in that state for the hysteresis duration as defined by the HYST parameter in Configuration 71: Input Configuration on p. 184. Event is enabled by the FLAGS parameter of configuration 71.

Default Mask	{ 0x81,0x2d,0x01,0x21,0x00,0x00,0x16,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00, 0x00,0x00,0x00,0xc0,0x03,0x00,0x00,0x00,0x00 }
Default String	EV, SPT, GSPT, SV, HP, CQ, GS, AXYZ, TID, UT, BT, ACV, IG, GSM, ADC0, ADC1, LOC, IN1, IN2, IN3, IN4

7.28. [29] INPUT 3 SET

Input 3 Set is triggered when the state of Input 3 transitions from deasserted to asserted and remains in that state for the hysteresis duration as defined by the HYST parameter in Configuration 71: Input Configuration on p. 184. Event is enabled by the FLAGS parameter of configuration 71.

Default Mask	{ 0x81,0x2d,0x01,0x21,0x00,0x00,0x16,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00, 0x00,0x00,0x00,0xc0,0x03,0x00,0x00,0x00,0x00 }
Default String	EV, SPT, GSPT, SV, HP, CQ, GS, AXYZ, TID, UT, BT, ACV, IG, GSM, ADC0, ADC1, LOC, IN1, IN2, IN3, IN4

7.29. [30] INPUT 3 CLEAR

Input 3 Clear is triggered when the state of Input 3 transitions from asserted to deasserted and remains in that state for the hysteresis duration as defined by the HYST parameter in configuration Configuration 71: Input Configuration on p. 184. Event is enabled by the FLAGS parameter of configuration 71.

Default Mask	{ 0x81,0x2d,0x01,0x21,0x00,0x00,0x16,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00, 0x00,0x00,0x00,0xc0,0x03,0x00,0x00,0x00,0x00 }
Default String	EV, SPT, GSPT, SV, HP, CQ, GS, AXYZ, TID, UT, BT, ACV, IG, GSM, ADC0, ADC1, LOC, IN1, IN2, IN3, IN4

7.30. [32] Output Manual Override

Output Manual Override is triggered when the manual override sequence has been detected on a device which has one of its inputs defined as wired ignition as determined by the FLAGS parameter in Configuration 71: Input Configuration on p. 184. The AMO count of Configuration 44: Output on p. 160 must not have been exceeded for the override to occur.

Default Mask	{ 0x05,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x78,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0xC0,0x1F,0x00,0x00,0x00,0x00 }
Default String	EV, D, OC, MNR, OT, OTP, IN1, IN2, IN3, IN4, OT1, OT2, OT3

7.31. [33] Diagnostics

Diagnostics is triggered by the !ate:33 command.

Default Mask	{ 0x01,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00 }
Default String	EV

7.32. [34] Movement Start

Movement Start is triggered based on GPS speed and the settings in Configuration 45: Vehicle Movement Detection on p. 161 . Event is enabled by FLAGS parameter of configuration 45.

Default Mask	{ 0x81,0x2d,0x01,0x21,0x00,0x00,0x16,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, SPT, GSPT, SV, HP, CQ, GS, AXYZ, TID, UT, BT, ACV, IG, GSM, ADC0, ADC1, LOC

7.33. [35] Movement Stop

Movement Stop is triggered based on GPS speed and the settings in Configuration 45: Vehicle Movement Detection on p. 161 . It will not trigger if GPS Speed is one of the sources used in Configuration 12: Ignition Status Determination Masks on p. 126 . Event is enabled by FLAGS parameter of Configuration 45: Vehicle Movement Detection on p. 161.

Default Mask	{ 0x81,0x2d,0x01,0x21,0x00,0x00,0x16,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, SPT, GSPT, SV, HP, CQ, GS, AXYZ, TID, UT, BT, ACV, IG, GSM, ADC0, ADC1, LOC

7.34. [36] System Report 0

System report 0 is triggered by !ate:36.

Default Mask	{ 0x01,0x2d,0x01,0x00,0x1e,0x00,0x06,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, GSPT, SV, HP, CQ, GS, SI, BN, PN, CI, UT, BT, IG, GSM, ADC0, ADC1, LOC

7.35. [37] SYSTEM INFORMATION

System Information is triggered by !ate:37. Event can also be triggered upon completion of a device firmware update if enabled by MASK parameter of Configuration 48: System Information Event on p. 164.

Default Mask	{ 0x01,0x2d,0x01,0x00,0x1e,0x00,0x06,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, GSPT, SV, HP, CQ, GS, SI, BN, PN, CI, UT, BT, IG, GSM, ADC0, ADC1, LOC

7.36. [38] PARK

Park is triggered when the system has detected Ignition Off based on Configuration 12: Ignition Status Determination Masks on p. 126 and Movement status is stopped based on Configuration 45: Vehicle Movement Detection on p. 161 and remains in that state for the duration as defined by the PT parameter in Configuration 49: Park Time Threshold on p. 165 . Event is enabled by MASK parameter of configuration 49.

Default Mask	{ 0x01,0x2d,0x01,0x00,0x1e,0x00,0x06,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, GSPT, SV, HP, CQ, GS, SI, BN, PN, CI, UT, BT, IG, GSM, ADC0, ADC1, LOC

7.37. [39] IDLE START

Idle Start is triggered when the system has detected Ignition On based on Configuration 12: Ignition Status Determination Masks on p. 126 and Movement status is stopped based on Configuration 45: Vehicle Movement Detection on p. 161 and remains in that state for the duration as defined by the IDT parameter in Configuration 50: Idle Detection Thresholds on p. 166 . Event is enabled by IDM parameter of configuration 50.

Default Mask	{ 0x01,0x2d,0x01,0x00,0x1e,0x00,0x06,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, GSPT, SV, HP, CQ, GS, SI, BN, PN, CI, UT, BT, IG, GSM, ADC0, ADC1, LOC

7.38. [40] IDLE STOP

Idle Stop is triggered when the system idle state is true, and the device detects either Ignition Off based on Configuration 12: Ignition Status Determination Masks on p. 126 or Movement status is moving based on Configuration 45: Vehicle Movement Detection on p. 161 and remains in the changed state for the duration as defined by the IDS parameter in Idle Detection Threshold (50) configuration. Event is enabled by IDM parameter of Configuration 50: Idle Detection Thresholds on p. 166.

Default Mask	{ 0x01,0x2d,0x01,0x00,0x1e,0x00,0x06,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, GSPT, SV, HP, CQ, GS, SI, BN, PN, CI, UT, BT, IG, GSM, ADC0, ADC1, LOC

7.39. [41] IDLE PERIODIC

Idle Periodic is triggered when the system idle state is true and remains in that state for the duration as defined by the IDP parameter in Configuration 50: Idle Detection Thresholds on p. 166. Event will report at IDP interval until system idle state changes. Event is enabled by IDM parameter of Configuration 50: Idle Detection Thresholds on p. 166.

Default Mask	{ 0x01,0x2d,0x01,0x00,0x1e,0x00,0x06,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, GSPT, SV, HP, CQ, GS, SI, BN, PN, CI, UT, BT, IG, GSM, ADC0, ADC1, LOC

7.40. [42] POWER UP BEST TIME

Power Up Best Time is triggered when a time value has been received by either the GPS or GSM module after device power up or reset. Event is enabled by PMASK parameter of Configuration 5: Device Power Up Message on p. 112.

Default Mask	{ 0x01,0x2d,0x01,0x00,0x1e,0x00,0x06,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, GSPT, SV, HP, CQ, GS, SI, BN, PN, CI, UT, BT, IG, GSM, ADC0, ADC1, LOC

7.41. [43] ADC THRESHOLD

ADC Threshold is triggered when one of the configured logical ADC thresholds has been crossed as defined by Configuration 52: ADC Basic on p. 166 and/or Configuration 53: ADC Advanced on p. 167.

Default Mask	{ 0x01,0x2d,0x01,0x00,0x1e,0x00,0x06,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, GSPT, SV, HP, CQ, GS, SI, BN, PN, CI, UT, BT, IG, GSM, ADC0, ADC1, LOC

7.42. [44] ADC PERIODIC

ADC Periodic is triggered at the period defined by the PER_EVENTMASK parameter of Configuration 53: ADC Advanced on p. 167 and based on the ADC value with respect to the thresholds defined in Configuration 52: ADC Basic on p. 166.

Default Mask	{ 0x01,0x2d,0x01,0x00,0x1e,0x00,0x06,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, GSPT, SV, HP, CQ, GS, SI, BN, PN, CI, UT, BT, IG, GSM, ADC0, ADC1, LOC

7.43. [48] MOTION

Motion is triggered when the device was previously not in motion and transitions to motion as determined by the MO_WIN_S parameter in Configuration 56: Motion/No-Motion on p. 171.

Default Mask	{ 0x81,0x2d,0x01,0x21,0x00,0x00,0x16,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, SPT, GSPT, SV, HP, CQ, GS, AXYZ, TID, UT, BT, ACV, IG, GSM, ADC0, ADC1, LOC

7.44. [49] NO-MOTION

No-motion is triggered when the device was previously in motion and transitions to no-motion and determined by the NOMO_WIN_S parameter in Configuration 56: Motion/No-Motion on p. 171.

Default Mask	{ 0x81,0x2d,0x01,0x21,0x00,0x00,0x16,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, SPT, GSPT, SV, HP, CQ, GS, AXYZ, TID, UT, BT, ACV, IG, GSM, ADC0, ADC1, LOC

7.45. [50] MOTION PERIODIC

Periodically triggered while the device is in motion as determined by Configuration 56: Motion/No-Motion on p. 171.

Default Mask	{ 0x81,0x2d,0x01,0x21,0x00,0x00,0x16,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, SPT, GSPT, SV, HP, CQ, GS, AXYZ, TID, UT, BT, ACV, IG, GSM, ADC0, ADC1, LOC

7.46. [51] NO-MOTION PERIODIC

Periodically triggered while the device is not in motion as determined by Configuration 56: Motion/No-Motion on p. 171.

Default Mask	{ 0x81,0x2d,0x01,0x21,0x00,0x00,0x16,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00 }
Default String	EV, SPT, GSPT, SV, HP, CQ, GS, AXYZ, TID, UT, BT, ACV, IG, GSM, ADC0, ADC1, LOC

7.47. [52] POWERSTAGE TRANSITION

Power Stage Transition is triggered any time the power stage changes as defined by Configuration 27: Power Stage Transition on p. 144.

Default Mask	{ 0x01,0x2d,0x01,0x00,0x1e,0x00,0x06,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x22,0x00 }
Default String	EV, GSPT, SV, HP, CQ, GS, SI, BN, PN, CI, UT, BT, IG, GSM, ADC0, ADC1, LOC, PSTI

7.48. [56] ACCELERATION POSITIVE X THRESHOLD

Acceleration positive X threshold is triggered by detected acceleration on the positive X axis exceeding the threshold defined in Configuration 63: Accel on Axis on p. 181

Default Mask	{ 0x75,0x6f,0x03,0x00,0x60,0x00,0x00,0x00,0x10,0x01,0x00,0x00,0x00,0x00,0x00,0x04 }
Default String	EV, D, LT, LN, AL, GSPT, HD, SV, HP, CQ, MI, GS, GT, AC, DC, IN2S, IG, AVT

7.49. [57] ACCELERATION NEGATIVE X THRESHOLD

Acceleration Negative X threshold is triggered by detected acceleration on the negative X axis exceeding the threshold defined in Configuration 63: Accel on Axis on p. 181

Default Mask	{ 0x75,0x6f,0x03,0x00,0x60,0x00,0x00,0x00,0x10,0x01,0x00,0x00,0x00,0x00,0x00,0x04 }
Default String	EV, D, LT, LN, AL, GSPT, HD, SV, HP, CQ, MI, GS, GT, AC, DC, IN2S, IG, AVT

7.50. [58] Acceleration Positive Y Threshold

Acceleration positive Y threshold is triggered by detected acceleration on the positive Y axis exceeding the threshold defined in Configuration 63: Accel on Axis on p. 181

Default Mask	{ 0x75,0x6f,0x03,0x00,0x60,0x00,0x00,0x00,0x10,0x01,0x00,0x00,0x00,0x00,0x00,0x04 }
Default String	EV, D, LT, LN, AL, GSPT, HD, SV, HP, CQ, MI, GS, GT, AC, DC, IN2S, IG, AVT

7.51. [59] Acceleration Negative Y Threshold

Acceleration negative Y threshold is triggered by detected acceleration on the negative Y axis exceeding the threshold defined in Configuration 63: Accel on Axis on p. 181

Default Mask	{ 0x75,0x6f,0x03,0x00,0x60,0x00,0x00,0x00,0x10,0x01,0x00,0x00,0x00,0x00,0x00,0x04 }
Default String	EV, D, LT, LN, AL, GSPT, HD, SV, HP, CQ, MI, GS, GT, AC, DC, IN2S, IG, AVT

7.52. [60] Acceleration Orientation

Acceleration orientation is triggered when the status of Parameter 156: OS (Orientation Status) on p. 96 changes.

Default Mask	{ 0x75,0x6f,0x03,0x00,0x60,0x00,0x00,0x00,0x10,0x01,0x00,0x00,0x00,0x00,0x00,0x0 }
Default String	EV, D, LT, LN, AL, GSPT, HD, SV, HP, CQ, MI, GS, GT, AC, DC, IN2S, IG

7.53. [61] Faulty Alternator

A Faulty Alternator event is triggered when the alternator voltage falls beneath the configured low-threshold of expected alternator voltage for longer than the configured time. This event corresponds to faulty_alternator_ status 2: Alternator determined faulty.

A Faulty Alternator event is triggered when the alternator voltage is higher than the configured high-threshold of expected alternator voltage for longer than the configured time. This event corresponds to faulty_alternator_ status 0: Alternator determined normal. This event is only generated if the alternator was previously determined faulty.

Default Mask	{ 0x00 }
Default String	

7.54. [65] Scantool Detection

Scantool Detection is triggered when a scantool is detected on the same bus as the device. This results in the device entering backoff, which prevents data transmission over the CAN-BUS. Backoff time is 30 180 seconds. See TRIP_MASK in Configuration 23: VBUS Mask on p. 139 for more details.

Default Mask	{ 0x31,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00, 0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x40 }
Default String	EV, LT, LN, SCT

7.55. [68] INPUT 4 SET

Input 4 Set is triggered when the state of Input 4 transitions from deasserted to asserted and remains in that state for the hysteresis duration as defined by the HYST parameter in Configuration 71: Input Configuration on p. 184. Event is enabled by the FLAGS parameter of configuration 71.

Default Mask	{ 0x81,0x2d,0x01,0x21,0x00,0x00,0x16,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00, 0x00,0x00,0x00,0xc0,0x03,0x00,0x00,0x00,0x00 }
Default String	EV, SPT, GSPT, SV, HP, CQ, GS, AXYZ, TID, UT, BT, ACV, IG, GSM, ADC0, ADC1, LOC, IN1, IN2, IN3, IN4

7.56. [69] INPUT 4 CLEAR

Input 4 Clear is triggered when the state of Input 4 transitions from asserted to deasserted and remains in that state for the hysteresis duration as defined by the HYST parameter in configuration Configuration 71: Input Configuration on p. 184. Event is enabled by the FLAGS parameter of configuration 71.

Default Mask	{ 0x81,0x2d,0x01,0x21,0x00,0x00,0x16,0x00,0x00,0x01,0x00,0x20,0xc0,0x00,0x02,0x00, 0x00,0x00,0x00,0xc0,0x03,0x00,0x00,0x00,0x00 }
Default String	EV, SPT, GSPT, SV, HP, CQ, GS, AXYZ, TID, UT, BT, ACV, IG, GSM, ADC0, ADC1, LOC, IN1, IN2, IN3, IN4

7.57. [71] SNAPSHOT

Power Stage Periodic is triggered when the device is in any power stage and the conditions configured in Configuration 28: Snapshot Configuration on p. 150 have been met.

Default Mask	{ 0x00 }
Default String	

7.58. [72] DTC

DTC event is triggered when DTCs are read. To determine when and how often DTCs are read, refer to Configuration 92: Enable DTCs on p. 195.

Default Mask	{0x05,0x00,0x00,0x44,0x00,0x00,0x04,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00, 0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x04}
Default String	EV, D, DTC, MIL, BT, DTC2

8. Parameter List

Description	Index / Value
Parameter 0: EV (Event Identifier) on p. 42	1 / 0x01
Parameter 2: D (Date) on p. 44	1 / 0x04
Parameter 3: TZ (Time Zone Offset) on p. 44	1 / 0x08
Parameter 4: LT (Latitude) on p. 44	1 / 0x10
Parameter 5: LN (Longitude) on p. 45	1 / 0x20
Parameter 6: AL (Altitude) on p. 45	1 / 0x40
Parameter 7: SPT (VBUS Speed) on p. 45	1 / 0x80
Parameter 8: GSPT (GPS Speed) on p. 46	2 / 0x01
Parameter 9: HD (GPS Heading) on p. 46	2 / 0x02
Parameter 10: SV (GPS Satellites) on p. 46	2 / 0x04
Parameter 11: HP (GPS PDOP) on p. 47	2 / 0x08
Parameter 12: BV (Battery Voltage) on p. 48	2 / 0x10
Parameter 13: CQ (Cellular Signal Quality) on p. 48	2 / 0x20
Parameter 14: MI (Virtual Odometer GPS) on p. 49	2 / 0x40
Parameter 15: MG (Vehicle Fuel Efficiency) on p. 49	2 / 0x80
Parameter 16: GS (GPS Lock Status) on p. 50	3 / 0x01
Parameter 17: GT (GPS Time Since Last Lock) on p. 50	3 / 0x02
Parameter 18: FL (Fuel Level) on p. 51	3 / 0x04
Parameter 19: XY (Geofence Status) on p. 51	3 / 0x08
Parameter 20: FWM (Main Firmware Version String) on p. 51	3 / 0x10
Parameter 23: LGTM (Last Gasp Timestamp) on p. 52	3 / 0x80
Parameter 24: AXYZ (Accelerometer XYZ Vectors) on p. 52	4 / 0x01
Parameter 25: VN (Vehicle Identification Number) on p. 52	4 / 0x02
Parameter 26: DTC (Vehicle Bus Diagnostic Trouble Codes) on p. 53	4 / 0x04
Parameter 28: FP (Fingerprint) on p. 55	4 / 0x10
Parameter 29: TID (Trip Identifier) on p. 56	4 / 0x20
Parameter 30: MIL (Malfunction Indicator Lamp) on p. 56	4 / 0x40
Parameter 31: RM (RPM) on p. 57	4 / 0x80
Parameter 32: IT (Trip Idle Time) on p. 57	5 / 0x01
Parameter 33: SI (SIM ICCID) on p. 58	5 / 0x02
Parameter 34: BN (Boot Count) on p. 58	5 / 0x04
Parameter 35: PN (Power-loss Count) on p. 59	5 / 0x08
Parameter 36: CI (Cellular Network Information) on p. 59	5 / 0x10
Parameter 37: AC (Acceleration) on p. 61	5 / 0x20
Parameter 39: HBE (Device Reset Reason) on p. 62	5 / 0x80
Parameter 40: MTN (Maintenance Log) on p. 62	6 / 0x01
Parameter 41: IM (Cellular IMEI) on p. 63	6 / 0x02
Parameter 42: HACC (GPS Horizontal Accuracy Estimate) on p. 64	6 / 0x04
Parameter 43: OB (Vehicle Bus Protocol) on p. 64	6 / 0x08

Description	Index / Value
Parameter 44: MID (Manufacturer ID) on p. 65	6 / 0x10
Parameter 45: OMI (Virtual Odometer VBUS) on p. 66	6 / 0x20
Parameter 46: CNT (Trip Count) on p. 66	6 / 0x40
Parameter 47: CH (Configuration Hash) on p. 67	6 / 0x80
Parameter 48: CT (Cellular Network Time) on p. 67	7 / 0x01
Parameter 49: UT (Device Uptime) on p. 67	7 / 0x02
Parameter 50: BT (Best Time) on p. 68	7 / 0x04
Parameter 51: IS (Ignition Source) on p. 69	7 / 0x08
Parameter 52: ACV (Acceleration VBUS) on p. 69	7 / 0x10
Parameter 53: ACC (Accelerometer) on p. 70	7 / 0x20
Parameter 55: CP0 (Custom PID 0) on p. 70	7 / 0x80
Parameter 56: CP1 (Custom PID 1) on p. 70	8 / 0x01
Parameter 57: CP2 (Custom PID 2) on p. 71	8 / 0x02
Parameter 58: CP3 (Custom PID 3) on p. 71	8 / 0x04
Parameter 59: CP4 (Custom PID 4) on p. 71	8 / 0x08
Parameter 60: CP5 (Custom PID 5) on p. 72	8 / 0x10
Parameter 61: CP6 (Custom PID 6) on p. 72	8 / 0x20
Parameter 62: CP7 (Custom PID 7) on p. 72	8 / 0x40
Parameter 63: CP8 (Custom PID 8) on p. 73	8 / 0x80
Parameter 64: CP9 (Custom PID 9) on p. 73	9 / 0x01
Parameter 65: MPG (Miles Per Gallon) on p. 73)	9 / 0x02
Parameter 72: IG (Ignition) on p. 76	10 / 0x01
Parameter 73: DBO (Data Bytes Output) on p. 76	10 / 0x02
Parameter 74: DBI (Data Bytes Input) on p. 76	10 / 0x04
Parameter 75: OC (Override Count) on p. 77	10 / 0x08
Parameter 76: MNR (Pending Output State Timer) on p. 77	10 / 0x10
Parameter 77: OT (Output State) on p. 77	10 / 0x20
Parameter 78: OTP (Output Pending State) on p. 78	10 / 0x40
Parameter 87: FWB (Firmware Bootloader Version) on p. 78	11 / 0x80
Parameter 88: PT (Park Time) on p. 79	12 / 0x01
Parameter 90: PBMI (Proprietary and OBDII Bus Odometer) on p. 79	12 / 0x04
Parameter 91: PBFL (Proprietary Bus Fuel Level) on p. 80)	12 / 0x08
Parameter 92: NKR (NanoKernel) on p. 80	12 / 0x10
Parameter 93: GSM (GSM Registration) on p. 81	12 / 0x20
Parameter 94: GSMP (GSM Registration Percentage) on p. 81	12 / 0x40
Parameter 95: GPSP (GPS Lock Percentage) on p. 82	12 / 0x80
Parameter 96: GPSQ (GPS Quality Lock Percentage) on p. 82	13 / 0x01
Parameter 97: PBOL (Proprietary Bus Oil Life) on p. 82	13 / 0x02
Parameter 98: PBLF (Proprietary Bus Left Front Tire Pressure) on p. 83	13 / 0x04
Parameter 99: PBRF (Proprietary Bus Right Front Tire Pressure) on p. 83	13 / 0x08
Parameter 100: PBLR (Proprietary Bus Left Rear Tire Pressure) on p. 84	13 / 0x10

Description	Index / Value
Parameter 101: PBRR (Proprietary Bus Right Rear Tire Pressure) on p. 84	13 / 0x20
Parameter 102: ADC0 (Analog to Digital Converter Index 0) on p. 85	13 / 0x40
Parameter 103: ADC1 (Analog to Digital Converter Index 1) on p. 86	13 / 0x80
Parameter 107: SG0 (Smart Group 0) on p. 87	14 / 0x08
Parameter 109: EH (Engine Hours) on p. 87	14 / 0x20
Parameter 112: FLF (Fuel Level Filtered) on p. 88	15 / 0x01
Parameter 113: LOC (Location) on p. 88	15 / 0x02
Parameter 114: PS (Power Stage) on p. 89	15 / 0x04
Parameter 115: DSN (Device Serial Number) on p. 89	15 / 0x08
Parameter 116: ACT (Cellular Access Technology) on p. 90	15 / 0x10
Parameter 117: PSTI (Power Stage Transition Information) on p. 90	15 / 0x20
Parameter 118: DID (Driver Identification Number) on p. 91	15 / 0x40
Parameter 119: USEQ (Unidentified Driver Record Sequence Number) on p. 92	15 / 0x80
Parameter 120: JOMI (JBUS True Odometer) on p. 92	16 / 0x01
Parameter 121: JEH (JBUS Engine Hours) on p. 92	16 / 0x02
Parameter 122: AVT (Acceleration Vector Threshold Violation) on p. 93	16 / 0x04
Parameter 147: PBBL (Proprietary Bus Parking Brake Lamp) on p. 93	19 / 0x08
Parameter 148: PBBS (Proprietary Bus Parking Brake Status) on p. 93	19 / 0x10
Parameter 149: PBSP (Proprietary Bus Shifter Position) on p. 94	19 / 0x20
Parameter 150: PBDS (Proprietary Bus Driver Seatbelt) on p. 94	19 / 0x40
Parameter 151: PBPS (Proprietary Bus Passenger Seatbelt) on p. 95	19 / 0x80
Parameter 152: PBAL (Proprietary Bus Airbag Lamp) on p. 95	20 / 0x01
Parameter 153: FA (Faulty Alternator) on p. 95	20 / 0x02
Parameter 156: OS (Orientation Status) on p. 96	20 / 0x10
Parameter 163: OT2 (Output 2 Status) on p. 99	21 / 0x08
Parameter 164: OT3 (Output 3 Status) on p. 99	21 / 0x10
Parameter 190: SCT (Scantool) on p. 100	24 / 0x40
Parameter 191: CNUM (MSISDN) on p. 1	24 / 0x80
Parameter 197: PFLF (PPID Fuel Level Filtered) on p. 102	25 / 0x20
Parameter 208: IN4S (Input 4 State) on p. 102	27 / 0x01
Parameter 209: IN4A (Input 4 Set Count) on p. 102	27 / 0x02
Parameter 216: DIAG (Diagnostic Information) on p. 103	28 / 0x01
Parameter 217: PD0 (PID Data 0) on p. 103	28 / 0x02
Parameter 218: PD1 (PID Data 1) on p. 104	28 / 0x04
Parameter 219: PD2 (PID Data 2) on p. 104	28 / 0x08
Parameter 220 TRPM (Trip VBUS Data) on p. 104	28 / 0x10
Parameter 221: HDOP (GPS HDOP) on p. 104	28 / 0x20

8.1. Parameter 0: EV (Event Identifier)

The EV parameter identifies the event which triggered this record to be generated.

Schema

{“EV”:EV}

Param	Type	Description
EV	STR8	8-bit string value.

Value	Description
0	Reserved
1	Ignition On / Trip Start / Engine On
2	Ignition Off / Trip End / Engine Off
3	Ignition On Periodic Report
4	Ignition Off Periodic Report
5	Power-up Message
6	Power-up Message on GPS Lock
7	Power-up Message on GSM
8	Low Battery Alert
9	Accelerometer Shock Event
10	Acceleration based on VBUS speed
11	Acceleration based on GPS speed
12	Stage 0 Periodic Event Reporting
13	Stage 1 Periodic Event Reporting
14	Stage 2 Periodic Event Reporting
15	Battery Disconnect Event
16	Battery Reconnect Event
17	Battery Periodic Disconnect
18	Direction Change
19	Speed VBUS
20	Speed GPS
21	Geofence Crossing
23	Odometer VBUS
24	Odometer GPS
25	Input 1 Set
26	Input 2 Clear
27	Input 2 Set
28	Input 2 Clear
29	Input 3 Set

Param	Type	Description	
		Value	**Description**
		30	Input 3 Clear
		33	Diagnostics
		34	Movement Start
		35	Movement Stop
		36	System Report 0
		37	System Information
		38	Park
		39	Idle Start
		40	Idle Stop
		41	Idle Periodic
		42	Best Time
		43	ADC Threshold
		44	ADC Periodic
		48	Motion
		49	No-Motion
		50	Motion Periodic
		51	No-Motion Periodic
		52	Powerstage Transition
		54	ELD Live Record
		55	ELD UDR
		56	Acceleration Positive X Threshold
		57	Acceleration Negative X Threshold
		58	Acceleration Positive Y Threshold
		59	Acceleration Negative Y Threshold
		60	Acceleration Orientation
		65	Scantool Detection
		68	Input 4 Set
		69	Input 4 Clear
		71	Snapshot
		72	DTC

8.2. Parameter 2: D (Date)

Schema
{“D”:D}

Param	Type	Description
D	UINT32	The D parameter provides UNIX epoch time; the number of seconds since 00:00:00 January 1, 1970 UTC. A null value indicates that the current time is not known.

8.3. Parameter 3: TZ (Time Zone Offset)

The TZ parameter presents the local time offset in 15-minute increments from UTC.

Schema
{“TZ”:TZ}

Param	Type	Description
TZ	INT8	Number of 15-minute increments from UTC. A null value indicates that the current time is not known.

8.4. Parameter 4: LT (Latitude)

GPS Latitude. Specifies north-south position of a point on the Earth’s surface. Latitude is an angle which ranges from 0 degrees at the equator to 90 degrees (north or south) at the poles.

Schema
{“LT”:LT}

Param	Type	Description
LT	INT32	Decimal degrees of Latitude multiplied by 1e6.

8.5. Parameter 5: LN (Longitude)

GPS Longitude. Specifies the east-west position of a point on the Earth's surface. Longitude is an angle which ranges from 0 degrees at the prime meridian to 180 degrees (east or west).

Schema
{"LN":LN}

Param	Type	Description
LN	INT32	Decimal degrees of Longitude multiplied by 1e6.

8.6. Parameter 6: AL (Altitude)

GPS Altitude. Specifies the distance from sea-level.

Schema
{"AL":AL}

Param	Type	Description
AL	INT32	Integer tenths of meters above or below sea-level.

8.7. Parameter 7: SPT (VBUS Speed)

VBUS Speed. Speed from the Vehicle Bus in kilometers per hour.

Schema
{ "SPT" : SPT }

Param	Type	Description
SPT	UINT16	Kilometers per hour.

8.8. Parameter 8: GSPT (GPS Speed)

GPS Speed. Speed from GPS in kilometers per hour.

Schema

{ “GSPT” : GSPT }

Param	Type	Description
GSPT	UINT16	Kilometers per hour.

8.9. Parameter 9: HD (GPS Heading)

GPS Heading. Navigation heading measured in tenths of degrees, e.g. a value of 1800 = 180.0 degrees.

Schema

{ “HD” : HD }

Param	Type	Description
HD	UINT16	0 to 360 degrees device heading. 0 or (360) degrees indicates a direction toward true North. 90 degrees indicates a direction toward true East. 180 degrees is true South and 270 degrees is true West.

8.10. Parameter 10: SV (GPS Satellites)

GPS Satellites.

Schema

{ “SV” : SV }

Param	Type	Description
SV	UINT8	Number of satellites used in the navigation solution.

8.11. PARAMETER 11: HP (GPS PDOP)

GPS position dilution of precision (PDOP).

Schema

{ “HP” : HP }

Param	Type	Description
HP	UINT8	PDOP in tenths.

DOP Value	Rating	Description
< 10	Ideal	Highest possible confidence level used for applications demanding the highest possible precision.
10-20	Excellent	At this confidence level, positional measurements are considered accurate enough to meet all but the most sensitive applications.
20-50	Good	Represents the minimum appropriate level for making business decisions. Positional measurements could be used to make reliable in-route navigation suggestions to the user.
50-100	Moderate	Positional measurements could be used for calculations, but the fix quality could still be improved. A more open view of the sky is recommended.
100-200	Fair	Represents a low confidence level. Positional measurements should be discarded or used only to indicate a very rough estimate of the current location.
200 – 255	Poor	At this level, measurements are inaccurate by as much as 300 meters with a 6-meter accurate device (50 DOP * 6 meters) and should be discarded.

8.12. Parameter 12: BV (Battery Voltage)

The Battery Voltage parameter presents the primary device power supply voltage measurement. Battery Voltage range is specified in the Maximum Ratings section of the manual.

Schema

{ “BV“: [BV, STATUS, HEALTH] }

Param	Type	Description
BV	UINT16	Battery voltage in millivolts.
STATUS	UINT8	Battery status. **Status** **Description** 0 None. 1 Battery disconnected. 2 Battery connected.
HEALTH	UINT8	Battery health. See Configuration 13: Device Battery Health Monitoring on p. 127 for more details on thresholds. **Status** **Description** 0 Battery okay. (Default). 1 Battery low.

8.13. Parameter 13: CQ (Cellular Signal Quality)

The CQ parameter indicates the received signal strength indication (RSSI) from the cellular modem. There are periods of time, such as tower hand-off, when this value may not be valid for a short period of time.

Schema

{“CQ”:CQ}

Param	Type	Description
CQ	INT16	The range of the values is dependent on the cellular module. Reports the raw dBm (negative value). When the RF power level of the received signal is the highest possible, the value 31 is reported. When it is not known, not detectable or currently not available, 99 is returned. During certain periods of time such as tower hand-off, the CQ value will be temporarily unavailable.

8.14. Parameter 14: MI (Virtual Odometer GPS)

MI provides a virtual lifetime odometer and trip odometer using GPS locations. The value is updated once per minute or whenever the GPS heading changes by more than 15 degrees since it was last updated.

Schema

{ “MI” : ODOMETER_M,TRIPODOM_M }

Parameter	Type	Description
ODOMETER_M	UINT32	Odometer value in meters.
TRIPODOM_M	UINT32	Current trip odometer in meters.

8.15. Parameter 15: MG (Vehicle Fuel Efficiency)

Schema

{ “MG” : MG }

Param	Type	Description
MG	UINT16	Instantaneous miles-per-gallon calculated during an ignition on sequence.

8.16. Parameter 16: GS (GPS Lock Status)

NOTE: GS may present NULL if the message payload is built before the GPS component is initialized.

Schema

{ “GS” : GS }

Param	Type	Description
GS	UINT8	GPS Lock Status.

Status	Description
0	None. Lock status unknown.
1	Locked. GPS is locked, but the result is filtered. This can mean it has not been locked for enough consecutive solutions or an accuracy figure of merit is unsatisfactory to consider this position LockedGood.
2	Unlocked. GPS solution is not locked.
3	LockedGood. GPS solution is locked and integrated.
4	Sleep. The GPS receiver is powered down.
5	Filtered. The response has been filtered.

8.17. Parameter 17: GT (GPS Time Since Last Lock)

Schema

{ “GT” : GT }

Param	Type	Description
GT	UINT32	Provides the number of seconds since last LockedGood status as described in parameter GS.

8.18. Parameter 18: FL (Fuel Level)

Schema

{ “FL” : FL }

Param	Type	Description
FL	UINT8	Fuel Level displayed as 0 to 100 percent.

8.19. Parameter 19: XY (Geofence Status)

Geofence Status and last entered fence index.

- Device can be in 10 fences at a given time, on a first-come-first-served basis. Once three geofences have been entered, the device will ignore further geofences until it has exited one of the first three.
- XY returns geofence state changes and/or “inside geofence” status.

Schema

{“XY”:{ID:STATUS}}

Parameter	Type	Description
ID	UINT16	ID of the geofence.
STATUS	UINT8	X bit returns geofence status. **Value** — **Description** 0 — Outside geofence. When reported due to a geofence crossing event, this can be interpreted as a geofence “exit”. 1 — Inside geofence. When reported due to a geofence crossing event, this can be interpreted as a geofence “enter”.

8.20. Parameter 20: FWM (Main Firmware Version String)

Schema

{ “FWM” : FWM }

Param	Type	Description
FWM	STR8	Main firmware version string.

8.21. Parameter 23: LGTM (Last Gasp Timestamp)

The LGTM parameter provides UNIX epoch time; the number of seconds since 00:00:00 January 1, 1970 UTC. This value is stored to non-volatile memory every 5 minutes to provide an estimate of when the device was last removed from power.

Schema

{ “LGTM” : LGTM }

Param	Type	Description
LGTM	UINT32	Seconds.

8.22. Parameter 24: AXYZ (Accelerometer XYZ Vectors)

Accelerometer X, Y, Z force vectors.

Schema

{ “AXYZ” : { X, Y, Z } }

Param	Type	Description
X	INT16	X-vector milli-G
Y	INT16	Y-vector milli-G
Z	INT16	Z-vector milli-G

8.23. Parameter 25: VN (Vehicle Identification Number)

VN provides the vehicle identification number from the OBDII MODE9 PID2 parameter.

Schema

{ “VN” : VN }

Param	Type	Description
VN	STR8	Vehicle Identification Number (VIN).

8.24. Parameter 26: DTC (Vehicle Bus Diagnostic Trouble Codes)

DTC provides a list of codes by ECU.

Schema

```
{ “DTC” :
   { “DI”    : { N_ECU_RESPONDED, N_ECU_HASDTC }}
  { ECUID : { NC, NCR, DTC_1, …, DTC_N }}
  { … }
}
```

Param	Type	Description
N_ECU	UINT8	Number of ECUs that responded to the request.
N_ECU_ HASDTC	UINT8	Number of ECUs that had DTCs.
ECUID	UINT32	ECU ID.
NC	UINT8	Number of codes present on vehicle bus.
NCR	UINT8	Number of codes reported in message. NCR will be less than or equal to NC.
DTC_N	UINT32	Diagnostic trouble code. Msgpack reports the codes as decimal values between 0 and 4294967295. The hexadecimal equivalent of the value is decoded differently depending on which protocol is in use.

Byte 3	Byte 2	Byte 1	Byte 0
Bits 31 - 24	Bits 23 - 16	Bits 15 - 8	Bits 7 - 0

OBDII

Bits	Description
31 - 16	0
15 - 14	DTC type

Value	Description
00	'P'
01	'C'
10	'B'
11	'U'

Bits	Description
13 - 0	Code

J1939

Param	Type	Description

Bits	Description
31	SPN conversion method

Value	Description
0	Valid data reported by vehicle
1	Invalid data reported by vehicle. Used by certain vehicles until 1997.

Bits	Description
30 - 29	0
28 - 24	FMI
23 - 0	SPN

J1708

Bits	Description
31 - 29	0
28	Fault type

Value	Description
0	PID
1	SID

Bits	Description
27 - 24	FMI
23 - 17	0
16	DTC type

Value	Description
0	Standard
1	Expansion

Bits	Description
15 - 8	SID/PID
7 - 0	Count

8.25. PARAMETER 28: FP (FINGERPRINT)

Fingerprint provides a description of the available MODE 1 PIDs.

Schema

```
{ “FP” :
   { ECUID : { MODE1P00, MODE1P20, MODE1P40, MODE1P60, MODE1P80, MODE1PA0 } }
   { … }
}
```

Param	Type	Description
ECUID	UINT32	ECU ID.
MODE1P00	UINT32	Mask from MODE 1 PID 0.
MODE1P20	UINT32	Mask from MODE 1 PID 20.
MODE1P40	UINT32	Mask from MODE 1 PID 40.
MODE1P60	UINT32	Mask from MODE 1 PID 60.
MODE1P80	UINT32	Mask from MODE 1 PID 80.
MODE1PA0	UINT32	Mask from MODE 1 PID A0.

8.26. Parameter 29: TID (Trip Identifier)

Trip identifier provides a unique ID for each trip. This value is stored in non-volatile memory and is incremented at trip start. This parameter will only start reporting after detecting an ignition on event. Until then, it will report as "None". This parameter is deprecated in favor of TID2.

Schema

{ “TID”: ["DSN" , N_BOOTCNT, TRIP_INDEX] }

Param	Type	Description
DSN	STR8	Device Serial Number. • Maximum length is 30 characters • Supports alphanumeric characters (A-Z and a-z), digits (0-9)
N_BOOTCNT	UINT16	Device boot counter. This increments as the device initializes after a power-up or reset.
TRIP_INDEX	UINT32	Trip index is the number of trips since the device has been installed. This value is stored in non-volatile memory and is updated on trip completion. • Trips which are interrupted do not cause the trip index to increment. • TRIP_INDEX does not maintain across power cycles/reboots and must be used in conjunction with N_BOOTCNT to get a unique identifier for that trip. Consequently, it will always reset back to 1 for the first trip after a firmware upgrade or reboot.

8.27. Parameter 30: MIL (Malfunction Indicator Lamp)

Malfunction indicator lamp (MIL) status is provided by MODE 1 PID 01

Schema

{ “MIL” : MIL }

Param	Type	Description
MIL	BOOL	MIL Status • True: MIL set • False: MIL not set

8.28. Parameter 31: RM (RPM)

RM indicates the rotational speed of the engine in revolutions per minute (rpm) generally of the crankshaft.

Schema

{ “RM” : RM }

Param	Type	Description
RM	UINT16	Revolutions per minute.

8.29. Parameter 32: IT (Trip Idle Time)

See Configuration 50: Idle Detection Thresholds on p. 166 for more details.

Schema

{ “IT” : IT }

Param	Type	Description
IT	UINT32	Engine idle time during trip in seconds.

8.30. PARAMETER 33: SI (SIM ICCID)

Subscriber identification module (SIM), SIM card, integrated circuit card identifier (ICCID). The ICCID is stored in the SIM card and/or engraved or printed on the SIM card body. The ICCID is defined by the ITU-T recommendation E.118 as the Primary Account Number. The ICCID structure is based on ISO/IEC 7812.

The ICCID is composed of 3 subparts:

- Issuer identification number (IIN), Maximum of seven digits.
  - Major industry identifier (MII), 2 fixed digits, 89 for telecommunication purposes.
  - Country code, 1-3 digits, as defined by ITU-T recommendation E.164.
  - Issuer identifier, 1-4 digits.
- Individual account identification
  - Individual account identification number. Its length is variable, but every number under one IIN has the same length.
- Check digit
  - Single digit calculated from the other digits using the Luhn algorithm.

Schema

{ “SI” : "SI" }

Param	Type	Description
SI	STR8	ICCID as an ASCII string.

8.31. PARAMETER 34: BN (BOOT COUNT)

Schema

{ “BN” : BN }

Param	Type	Description
BN	UINT16	Boot Count indicates the number of device power-ups and resets which have occurred since production of the device.

8.32. Parameter 35: PN (Power-loss Count)

Power-loss is determined as device power-up during fielded operation. This state of unexpected power-up is determined based on the storage of a last-gasp-timestamp. If this value is present on device power-up, we determine that unexpected power-loss had previously occurred. In devices which contain a back-up (or last gasp) battery this is determine by device loss of main power.

Schema

{ “PN” : PN }

Param	Type	Description
PN	UINT16	This parameter tracks the number of unexpected losses of power. In devices with a backup battery, this is determined by loss of main power.

8.33. Parameter 36: CI (Cellular Network Information)

Basic cellular network information.

Schema

{ “CI” : [REG, CID, TAC, QUAL, RAT, RSSI, BER, RSRQ, RSRP, OPER] }

Param	Type	Description
REG	UINT8	Registration status. **Status** — **Description** 0 — Not registered, not searching for an operator to register to. 1 — Registered, home network. 2 — Not registered, trying to attach or searching for an operator to register to. 3 — Registration denied. 4 — Unknown, possibly out of coverage. 5 — Registered, roaming. 6 — LTE. 7 — LTE Roaming.
CID	UINT32	E-UTRAN cell identifier.
TAC	UINT16	Tracking area code.
QUAL	UINT8	The allowed range is 0-7 and 99. The information provided depends on the selected RAT. • In UMTS RAT indicates the Energy per Chip/Noise (ECN0) ratio in dB

Param	Type	Description
		levels of the current cell. 3GPP TS 25.133 specifies the range 0-49 for EcN0 which is mapped to the range 0-7 of QUAL. • In LTE RAT indicates the Reference Signal Received Quality (RSRQ). TS 36.133 specifies the range 0-34 for RSRQ which is mapped to the range 0-7 of QUAL.

Status	UMTS RAT	LTE RAT
0	ECN0_LEV >= 44	RSRQ_LEV < 5
1	38 <= ECN0_LEV < 44	5 <= RSRQ_LEV < 10
2	32 <= ECN0_LEV < 38	10 <= RSRQ_LEV < 14
3	26 <= ECN0_LEV < 32	14 <= RSRQ_LEV < 18
4	20 <= ECN0_LEV < 26	18 <= RSRQ_LEV < 22
5	14 <= ECN0_LEV < 20	22 <= RSRQ_LEV < 26
6	8 <= ECN0_LEV < 14	26 <= RSRQ_LEV < 30
7	ECN0_LEV < 8	RSRQ_LEV >= 30
99	Not Known or Not Detectable	

RAT — UINT8 — Radio Access Technology.

Status	Description
0	None
1	2G
2	3G
3	LTE

RSSI — INT16 — Received Signal Strength Indication.

Status	Description
0	Less than -110 dBm
1 - 62	From -110 to -49 dBm with 1dBm steps
63	-48 dBm or greater
99	Not Known or Not Detectable

BER — UINT8 — Bit Error Rate.

Status	Description
0 - 7	RXQUAL values described in GSM TS 05.08
99	Not Known or Not Detectable

RSRQ — INT16 — Reference Signal Received Quality.

Param	Type	Description
		Status / **Description** 0 / -19 dB or less 1 - 33 / From -19.5 dB to -3.5 dB with 0.5 dB steps 34 / -3 dB or greater 255 / Not Known or Not Detectable
RSRP	INT16	Reference Signal Received Power. **Status** / **Description** 0 / -141 dBm or less 1 - 96 / From -140 dBm to -45 dBm with 1 dBm steps 97 / -44 dBm or greater 255 / Not Known or Not Detectable
OPER	STR8	Mobile Network Operator (MNO) short alphanumeric format. Max 10 characters.

8.34. PARAMETER 37: AC (ACCELERATION)

AC provides acceleration as measured by the device using rate of change in velocity with respect to time. This measurement uses the speed information provided by the GPS receiver.

Schema

{ “AC” : AC }

Param	Type	Description
AC	INT16	Measured in tenths of kilometers-per-hour-per-second (0.1 kmh/s).

8.35. Parameter 39: HBE (Device Reset Reason)

HBE provides the last device reset reason. This includes power-up/power-on.

Schema

{ “HBE” : HBE }

Param	Type	Description
HBE	UINT8	Reset Reason

Status	Description
0	Unknown reset.
1	Hardware watchdog reset.
2	Brown-out reset.
3	Hibernate reset.
4	User reset.
5	Software reset. This is initiated by the embedded firmware.
6	Power on reset.
7	Main oscillator reset.

8.36. Parameter 40: MTN (Maintenance Log)

Device maintenance log provides diagnostic information collected during the life of the device.

Schema

{ “MTN” :[NCON, NBC, NPL, NSR, NPR, NUKR, NWR, NBR, NHR, NUR, HBE, NCR, NPD, NND, NFR, NFW, NER, ELC,GFR]}

Parameter	Type	Description
NCON	UINT32	Number of console commands received.
NBC	UINT16	Device boot counter. This increments as the device initializes after a power-up or reset.
NPL	UINT16	Power loss counter.
NSR	UINT16	Software reset counter.
NPR	UINT16	Power-on resets.
NUKR	UINT16	Unknown resets.
NWR	UINT8	Hardware watchdog resets.
NBR	UINT8	Brown-out resets.
NHR	UINT8	Hibernate resets.
NUR	UINT8	User-initiated resets.

Parameter	Type	Description
ELC	UINT8	Event log percentage full.
HBE	UINT8	Last reset cause. Status: 0 Unknown reset. 1 Hardware watchdog reset. 2 Brown-out reset. 3 Hibernate reset. 4 User reset. 5 Software reset. This is initiated by the embedded firmware. 6 Power On reset. 7 Main oscillator reset.
NCR	UINT16	Cellular modem reset counter.
NPD	UINT16	Protocol disconnect counter (e.g. MQTT or CoAP).
NND	UINT16	Network disconnect counter.
NFR	UINT16	Number of failed read attempts from the event file system.
NFW	UINT16	Number of failed write attempts from the event file system.
NER	UINT16	Number of event log resets.
GFR	UINT8	GSM file system reversions.

8.37. Parameter 41: IM (Cellular IMEI)

International Mobile Equipment Identity (IMEI) is a number used to uniquely identify the device's cellular module.

Schema

```
{ “IM” : "IMEI" }
```

Param	Type	Description
IMEI	STR8	15 decimal digits (14 digits plus a check digit).

8.38. Parameter 42: HACC (GPS Horizontal Accuracy Estimate)

Schema

{ “HACC” : HACC }

Param	Type	Description
HACC	UINT8	HACC provides a horizontal accuracy estimate in meters based on the GPS solution.

8.39. Parameter 43: OB (Vehicle Bus Protocol)

Last detected vehicle bus protocol.

Schema

{ “OB” : OB }

Param	Type	Description
OB	UINT16	Bus Protocol.

Status	Description
0	None / Unknown
1	ISO_08
2	ISO_94
3	KW_SLOW
4	KW_FAST
5	PWM
6	VPW
7	CAN_11_500
8	CAN_11_250
9	CAN_11_125
10	CAN_29_500
11	CAN_29_250
12	CAN_29_125
13	J1939
14	J1708

8.40. PARAMETER 44: MID (MANUFACTURER ID)

Device Manufacturer Identification.

Schema

{ “MID” : [CM, CF, GM, GF, XM] }

Param	Type	Description
CM	UINT8	Cell Module Type. **Value** / **Description** 0 None 1 u-blox TOBY R200 2 u-blox TOBY R202 3 u-blox SARA R410 4 u-blox LARA R202 5 Quectel BG95 M1 6 Quectel BG95 M2 7 Quectel BG95 M3 8 Quectel BG95 MF 9 Quectel BG77
CF	UINT8	Cell Module Firmware. This enumeration specifies if the cell module firmware is supported by the cellular module. **Value** / **Description** 0x00 None 0xfd Known Unspecified 0xfe Unknown 0xff Invalid
GM	UINT8	GPS Module HW, **Value** / **Description** 0 None 3 80000
GF	UINT8	GPS Module FW.

Param	Type	Description
		Value **Description** 0 None 4 ROM CORE 2.01 (75331) 5 ROM CORE 3.01 (107888)
XM	UINT8	Xirgo Device HWID

8.41. Parameter 45: OMI (Virtual Odometer VBUS)

OMI provides a virtual odometer and trip odometer using data presented by the vehicle bus. Distance is calculated using speed over time.

Schema

{ “OMI” : ODOMETER_M,TRIPODOM_M }

Parameter	Type	Description
ODOMETER_M	UINT32	Calculated distance in meters.
TRIPODOM_M	UINT32	Calculated mileage in meters since last ignition on.

8.42. Parameter 46: CNT (Trip Count)

CNT is a running count of the number of trips that the device has registered.

Schema

{ “CNT” : CNT }

Param	Type	Description
CNT	UINT32	Trip Counter

8.43. Parameter 47: CH (Configuration Hash)

CH provides a 32-bit murmur3 hash of the device configuration.

Schema
{ “CH” : CH }

Param	Type	Description
CH	UINT32	Hash

8.44. Parameter 48: CT (Cellular Network Time)

Schema
{ “CT” : CT }

Param	Type	Description
CT	UINT32	The CT parameter reports in UTC and is recorded by the cellular network. A null value indicates that the current time is not known.

8.45. Parameter 49: UT (Device Uptime)

Schema
{ “UT” : UT }

Param	Type	Description
UT	UINT32	UT provides the number of seconds since the device was powered.

8.46. PARAMETER 50: BT (BEST TIME)

BT provides a device derived current time based on prioritized time sources.

NOTE: Priority of time sources match the enumeration found in the SRC parameter below. I.e., GPS older than 1 second will always be prioritized before cell time unless the configured priority is GSM_REAL for configuration 30. The prioritized timesource will take precedence if available.

Schema

{ “BT” : [T, SRC, OFS] }

Param	Type	Description
T	UINT32	The T parameter provides UNIX epoch time; the number of seconds since 00:00:00 January 1, 1970 UTC
SRC	UINT8	Time source used
OFS	UINT32	Seconds since time was last retrieved from time source.

Value	Description
0	None
1	GPS (obtained within the last second)
2	GPS (older than 1 second)
3	Cellular

8.47. Parameter 51: IS (Ignition Source)

IS reports the on/off state of all possible signals/data sources that detect the vehicle ignition state, as determined by Configuration 12: Ignition Status Determination Masks on p. 126. The parameter is a bitfield; each bit indicates the on/off state of an individual ignition source. The bit positions of the ignition sources map directly to those used in the 'and' and 'or' masks of the ignition mask.

Schema

{ “IS” : IS }

Param	Type	Description
IS	UINT16	Ignition Source

Value	Description
0x00	Ignition Unknown
0x01	VBUS
0x02	Virtual Battery (alternator based)
0x04	Virtual Vibration (accelerometer based)
0x08	Virtual Movement (GPS based)
0x10	Wired Ignition
0x20	VBUS Ignition Pin (tied to pin 8 on external pins)

8.48. Parameter 52: ACV (Acceleration VBUS)

ACV provides acceleration as measured by the device using rate of change in velocity with respect to time. This measurement uses the speed information provided by the vehicle bus.

Schema

{ “ACV” : ACV }

Param	Type	Description
ACV	INT16	Measured in tenths of kilometers-per-hour-per-second (0.1 kmh/s).

8.49. Parameter 53: ACC (Accelerometer)

Accelerometer force vectors { X, Y, Z } are provided in the ACC parameter. The capture occurs when the threshold set in Configuration 29: Accelerometer Shock/Vibration on p. 151 is exceeded.

Schema
{“ACC”:{“X” : [X00, X01, ..., X98, X99] },{ “Y” : [Y00, Y01, ..., Y98, Y99] },{ “Z” : [Z00, Z01, ..., Z98, Z99] } }

Param	Type	Description
X##	INT16	X vector milli-G.
Y##	INT16	Y vector milli-G.
Z##	INT16	Z vector milli-G.

8.50. Parameter 55: CP0 (Custom PID 0)

Custom PID returns raw data from user-defined custom PIDs. See Configuration 7: Custom Parameter IDs on p. 115 for more information.

Schema
{ "CP0" : { PID : DATA } }

Param	Type	Description
PID	INT8	PID selected in custom configuration.
DATA	BIN8	Size of data returned is determined by custom PID configuration.

8.51. Parameter 56: CP1 (Custom PID 1)

Custom PID returns raw data from user-defined custom PIDs. See Configuration 7: Custom Parameter IDs on p. 115 for more information.

Schema
{ "CP1" : { PID : DATA } }

Param	Type	Description
PID	INT8	PID selected in custom configuration.
DATA	BIN8	Size of data returned is determined by custom PID configuration.

8.52. Parameter 57: CP2 (Custom PID 2)

Custom PID returns raw data from user-defined custom PIDs. See Configuration 7: Custom Parameter IDs on p. 115 for more information.

Schema
{ "CP2" : { PID : DATA } }

Param	Type	Description
PID	INT8	PID selected in custom configuration.
DATA	BIN8	Size of data returned is determined by custom PID configuration.

8.53. Parameter 58: CP3 (Custom PID 3)

Custom PID returns raw data from user-defined custom PIDs. See Configuration 7: Custom Parameter IDs on p. 115 for more information.

Schema
{ "CP3" : { PID : DATA } }

Param	Type	Description
PID	INT8	PID selected in custom configuration.
DATA	BIN8	Size of data returned is determined by custom PID configuration.

8.54. Parameter 59: CP4 (Custom PID 4)

Custom PID returns raw data from user-defined custom PIDs. See Configuration 7: Custom Parameter IDs on p. 115 for more information.

Schema
{ "CP4" : { PID : DATA } }

Param	Type	Description
PID	INT8	PID selected in custom configuration.
DATA	BIN8	Size of data returned is determined by custom PID configuration.

8.55. Parameter 60: CP5 (Custom PID 5)

Custom PID returns raw data from user-defined custom PIDs. See Configuration 7: Custom Parameter IDs on p. 115 for more information.

Schema
{ "CP5" : { PID : DATA } }

Param	Type	Description
PID	INT8	PID selected in custom configuration.
DATA	BIN8	Size of data returned is determined by custom PID configuration.

8.56. Parameter 61: CP6 (Custom PID 6)

Custom PID returns raw data from user-defined custom PIDs. See Configuration 7: Custom Parameter IDs on p. 115 for more information.

Schema
{ "CP6" : { PID : DATA } }

Param	Type	Description
PID	INT8	PID selected in custom configuration.
DATA	BIN8	Size of data returned is determined by custom PID configuration.

8.57. Parameter 62: CP7 (Custom PID 7)

Custom PID returns raw data from user-defined custom PIDs. See Configuration 20: Proprietary PIDs on p. 1 for more information.

Schema
{ "CP7" : { PID : DATA } }

Param	Type	Description
PID	INT8	PID selected in custom configuration.
DATA	BIN8	Size of data returned is determined by custom PID configuration.

8.58. Parameter 63: CP8 (Custom PID 8)

Custom PID returns raw data from user-defined custom PIDs. See Configuration 7: Custom Parameter IDs on p. 115 for more information.

Schema

{ "CP8" : { PID : DATA } }

Param	Type	Description
PID	INT8	PID selected in custom configuration.
DATA	BIN8	Size of data returned is determined by custom PID configuration.

8.59. Parameter 64: CP9 (Custom PID 9)

Custom PID returns raw data from user-defined custom PIDs. See Configuration 7: Custom Parameter IDs on p. 115 for more information.

Schema

{ "CP9" : { PID : DATA } }

Param	Type	Description
PID	INT8	PID selected in custom configuration.
DATA	BIN8	Size of data returned is determined by custom PID configuration.

8.60. Parameter 65: MPG (Miles Per Gallon)

MPG returns three filtered versions of fuel efficiency. This is the average miles per gallon in tenths.

Schema

{ "MPG" : [MPG_EMA, MPG_CMA, MPG_TRIPCMA] }

Param	Type	Description
MPG_EMA	UINT16	Exponential Moving Average within a 10-minute window (in tenths of MPG).
MPG_CMA	UINT16	Cumulative Moving Average accumulated since device power-on (in tenths of MPG).
MPG_ TRIPCMA	UINT16	Cumulative Moving Average during the last trip (in tenths of MPG).

8.61. Parameter 67: IN1A (Input 1 Set Count)

IN1A is the number of seconds that Input 1 has been active since boot.

Schema
{“IN1A”:IN1A}
Data Type
{“IN1A”:UINT32}
JSON Syntax
{"IN1A":INTEGER}
Example
{“IN1A”:0}
MessagePack Bytestream
D9 04 49 4E 31 41 CE 00 00 00 00

Parameter	Type	Description
IN1A	UINT32	Number of seconds input 1 has been active since boot.

8.62. Parameter 68: IN2S (Input 2 State)

IN2S configures the current state of Input Pin 2.

Schema
{“IN2S”:IN2S}
Data Type
{“IN2S”:UINT8}
JSON Syntax
{"IN2S":INTEGER}
Example
{“IN2S”:0}
MessagePack Bytestream
D9 04 49 4E 32 53 CC 00

Parameter	Type	Description
IN2S	UINT8	Input 2 pin state

Value	Description
0	Clear
1	Set

8.63. Parameter 69: IN2A (Input 2 Set Count)

IN2A is the number of seconds that Input 2 has been active since boot.

Schema
{“IN2A”:IN2A}
Data Type
{“IN2A”:UINT32}
JSON Syntax
{"IN2A":INTEGER}
Example
{“IN2A”:0}
MessagePack Bytestream
D9 04 49 4E 32 41 CE 00 00 00 00

Parameter	Type	Description
IN2A	UINT32	Number of seconds input 2 has been active since boot.

8.64. Parameter 70: IN3S (Input 3 State)

IN3S configures the current state of Input Pin 3.

Schema
{“IN3S”:IN3S}

Parameter	Type	Description
IN3S	UINT8	Input 3 pin state

Value	Description
0	Clear
1	Set

8.65. Parameter 71: IN3A (Input 3 Set Count)

IN3A is the number of seconds that Input 3 has been active since boot.

Schema
{“IN3A”:IN3A}

Parameter	Type	Description
IN3A	UINT32	Number of seconds input 3 has been active since boot.

8.66. Parameter 72: IG (Ignition)

The ignition state is governed by the states of the ignition sources in Parameter 51: IS (Ignition Source) on p. 69 and how the combination of their states determines ignition to be on or off (Configuration 12: Ignition Status Determination Masks on p. 126).

Schema

```
{ “IG” : IG }
```

Param	Type	Description
IG	UINT8	Ignition status.

Value	Description
0	None (ignition never determined).
1	Ignition on.
2	Ignition off.

8.67. Parameter 73: DBO (Data Bytes Output)

DBO returns the number of data bytes output by the device.

Schema

```
{“DBO”:DBO}
```

Parameter	Type	Description
DBO	UINT32	Number of output bytes.

8.68. Parameter 74: DBI (Data Bytes Input)

DBI returns the number of data bytes input by the device.

Schema

```
{“DBI”:DBI}
```

Parameter	Type	Description
DBI	UINT32	Number of input bytes.

8.69. Parameter 75: OC (Override Count)

OC is the number of manual overrides that have been triggered on the output pin.

Schema
{“OC”:{"1":OC,"2":OC,"3":OC}}

Parameter	Type	Description
OC	UINT8	Number of manual overrides.

8.70. Parameter 76: MNR (Pending Output State Timer)

Number of seconds remaining until a pending output state will be applied to the specified output pin.

Schema
{“MNR”:{'1':MNR, '2':MNR, "3":MNR}}

Parameter	Type	Description
MNR	UINT32	Seconds remaining until the pending output state is applied.

8.71. Parameter 77: OT (Output State)

OT is output state that is currently applied to the output pin.

Schema
{“OT”:{"1": OT, "2": OT,"3" : OT}}

Parameter	Type	Description
OT	UINT8	Output state.

Value	Description
0	Clear
1	Set

8.72. Parameter 78: OTP (Output Pending State)

Pending output state that will be applied to the output pin when the delay time has expired. If no delayed output state has been set, this will be equal to the OT parameter.

Schema

{“OTP”:{"1": OTP, "2": OTP, "3": OTP}}

Parameter	Type	Description
OTP	UINT8	Pending output state that will be applied to the output pin when the delay time has expired.

Value	Description
0	Clear
1	Set

8.73. Parameter 87: FWB (Firmware Bootloader Version)

Main firmware bootloader version string.

Schema

{“FWB”:FWB}

Parameter	Type	Description
FWB	STR8	FW Bootloader Version String.

8.74. Parameter 88: PT (Park Time)

The vehicle is considered parked when it has stopped moving (See Configuration 45: Vehicle Movement Detection on p. 161), the ignition is off (See Parameter 72: IG (Ignition) on p. 76), and it has been in that state for a configurable amount of time (See Configuration 49: Park Time Threshold on p. 165). This parameter will only reset after an ignition on/off event. It will retain its value in movement and ignition off and will continue incrementing where it left off when movement stops again.

Schema

{“PT”:PT}

Parameter	Type	Description
PT	UINT32	The number of seconds since the vehicle stopped moving and had the ignition off.

8.75. Parameter 90: PBMI (Proprietary and OBDII Bus Odometer)

Proprietary bus odometer.

Schema

{ "PBMI" : {"UNITS" : VALUE} }

Param	Type	Description
UNITS	STR8	Unit currently available. **Unit** — **Description** KM — Kilometer.
VALUE	FLOAT	Float 32 value of represented unit.

8.76. Parameter 91: PBFL (Proprietary Bus Fuel Level)

Proprietary bus fuel level.

Schema

```
{ "PBFL" : { "UNITS" : VALUE } }
```

Param	Type	Description
UNITS	STR8	Unit currently available. **String** **Description** % Percent
VALUE	FLOAT	Float 32 value of represented unit.

8.77. Parameter 92: NKR (NanoKernel)

NanoKernel information.

Schema

```
{ "NKR": ["NAME", "REVISION" , VERSION, "VIN"] }
```

Param	Type	Description
NAME	STR8	NKR file name. Maximum size is 32.
REVISION	STR8	Current revision of the NKR file. Maximum size is 10.
VERSION	UINT32	Current version of the NKR file.
VIN	STR8	Vehicle identification number. Maximum size is 18.

8.78. Parameter 93: GSM (GSM Registration)

GSM registration status.

Schema
{“GSM”:GSM}

Parameter	Type	Description
GSM	UINT8	GSM Registration State

Value	Description
0	None
1	Home
2	Searching
3	Denied
4	Unknown
5	Roaming

8.79. Parameter 94: GSMP (GSM Registration Percentage)

GSM registration time divided by GSM On time, displayed as a percentage with one decimal point of precision. Not tracked while device is in Deep Sleep mode.

Schema
{“GSMP”:GSMP}

Parameter	Type	Description
GSMP	UINT32	Percent of GSM Registered Time.

8.80. Parameter 95: GPSP (GPS Lock Percentage)

GPS lock time divided by GPS On time displayed as a percentage with one decimal point of precision.

Schema

{“GPSP”:GPSP}

Parameter	Type	Description
GPSP	UINT32	Percentage of total accumulated GPS lock time over total accumulated GPS power-on time.

8.81. Parameter 96: GPSQ (GPS Quality Lock Percentage)

GPS quality lock time displayed as a percentage with one decimal point of precision. Determined when the GPS has at least five locked satellites divided by GPS On time.

Schema

{“GPSQ”:GPSQ}

Parameter	Type	Description
GPSQ	UINT32	Percentage of total accumulated GPS locked good time over total accumulated GPS power-on time.

8.82. Parameter 97: PBOL (Proprietary Bus Oil Life)

Proprietary bus oil life remaining.

Schema

{ "PBOL" : { "UNITS" : VALUE } }

Param	Type	Description
UNITS	STR8	Units currently available. **Unit** — **Description** % — Percent of life remaining
VALUE	FLOAT	Float 32 value of represented unit.

8.83. Parameter 98: PBLF (Proprietary Bus Left Front Tire Pressure)

Proprietary bus tire pressure for left front tire.

Schema

```
{ "PBLF" : { "UNITS" : VALUE } }
```

Param	Type	Description
UNITS	STR8	Units currently available. **Unit** **Description** kpa Kilopascals
VALUE	FLOAT	Float 32 value of represented unit.

8.84. Parameter 99: PBRF (Proprietary Bus Right Front Tire Pressure)

Proprietary bus tire pressure for right front tire.

Schema

```
{ "PBRF" : { "UNITS" : VALUE } }
```

Param	Type	Description
UNITS	STR8	Units currently available. **Unit** **Description** kpa Kilopascals
VALUE	FLOAT	Float 32 value of represented unit.

8.85. Parameter 100: PBLR (Proprietary Bus Left Rear Tire Pressure)

Proprietary bus tire pressure for left rear tire.

Schema

```
{ "PBLR" : { "UNITS" : VALUE } }
```

Param	Type	Description
UNITS	STR8	Units currently available. **Unit** — **Description** kpa — Kilopascals
VALUE	FLOAT	Float 32 value of represented unit.

8.86. Parameter 101: PBRR (Proprietary Bus Right Rear Tire Pressure)

Proprietary bus tire pressure for right rear tire.

Schema

```
{ "PBRR" : { "UNITS" : VALUE } }
```

Param	Type	Description
UNITS	STR8	Units currently available. **Unit** — **Description** kpa — Kilopascals
VALUE	FLOAT	Float 32 value of represented unit.

8.87. Parameter 102: ADC0 (Analog to Digital Converter Index 0)

Information about logical ADC 0.

Schema

{“ADC0”:[ID,MV,FLAGS]}

Parameter	Type	Description
ID	UINT8	Physical ADC ID.

Value	Description
0	None.
1	Main voltage
2	Battery voltage
3	External ADC 1
4	External ADC 2
5	External ADC 3

MV	UINT16	Voltage of this ADC (mV).
FLAGS	UINT16	Mask of ADC transition states

Value	Description
0x01	Indicates this ADC is currently above threshold 1.
0x02	Indicates this ADC is currently above threshold 2.
0x04	Indicates this ADC is currently transitioning above or below threshold 1.
0x08	Indicates this ADC is currently transitioning above or below threshold 2.
0x10	Indicates this ADC transitioned above or below threshold 1 this second.
0x20	Indicates this ADC transitioned above or below threshold 2 this second.
0x40	Indicates this ADC triggered a periodic event this second.

8.88. Parameter 103: ADC1 (Analog to Digital Converter Index 1)

Information about logical ADC 1.

Schema

{“ADC1”:[ID,MV,FLAGS]}

Parameter	Type	Description
ID	UINT8	Physical ADC ID. **Value** — **Description** 0 — None. 1 — Main voltage 2 — Battery voltage 3 — External ADC 1 4 — External ADC 2 5 — External ADC 3
MV	UINT16	Voltage of this ADC (mV).
FLAGS	UINT16	Mask of ADC transition states **Value** — **Description** 0x01 — Indicates this ADC is currently above threshold 1. 0x02 — Indicates this ADC is currently above threshold 2. 0x04 — Indicates this ADC is currently transitioning above or below threshold 1. 0x08 — Indicates this ADC is currently transitioning above or below threshold 2. 0x10 — Indicates this ADC transitioned above or below threshold 1 this second. 0x20 — Indicates this ADC transitioned above or below threshold 2 this second. 0x40 — Indicates this ADC triggered a periodic event this second.

8.89. Parameter 107: SG0 (Smart Group 0)

Smart Group 0 returns cellular statistics information.

Schema
{“SG0”:[ERROR_CNT,S_START_CNT,S_END_CNT,S_CONN_CNT,S_DISCON_CNT,S_NOREG_CNT,S_NOCON_CNT,S_BACKOFF_CNT,S_REG_LOSS_CNT,S_DROP_CNT,S_TIMEO_CNT,NET_HANDOFF_CNT,S_BYTES_IN,S_BYTES_OUT,SMS_IN,SMS_OUT,SMS_SPAM]}

Parameter	Type	Description
ERROR_CNT	UINT8	Initialization failure count.
S_START_CNT	UINT32	Started sessions counter.
S_END_CNT	UINT32	Completed sessions counter.
S_CONN_CNT	UINT32	Sessions the device was able to connect to the server counter.
S_DISCON_CNT	UINT32	Device initiated server disconnects counter.
S_NOREG_CNT	UINT16	Session failures due to no registration counter.
S_NOCON_CNT	UINT16	Session failures due to no server connection counter.
S_BACKOFF_CNT	UINT16	Session aborted due to active backoff counter.
S_REG_LOSS_CNT	UINT16	Session where registration is lost during session counter.
S_DROP_CNT	UINT16	Sessions dropped by the network or the server.
S_TIMEO_CNT	UINT16	Sessions that timeout counter.
NET_HANDOFF_CNT	UINT16	Network hand-off counter.
S_BYTES_IN	UINT32	Bytes received on session socket.
S_BYTES_OUT	UINT32	Bytes sent on session socket.
SMS_IN	UINT16	Incoming SMS
SMS_OUT	UINT16	Outgoing SMS
SMS_SPAM	UINT16	Incoming malformed/unknown SMS

8.90. Parameter 109: EH (Engine Hours)

Schema
{“EH”:EH}

Parameter	Type	Description
EH	UINT32	Engine hours counter in seconds. The counter accumulates while Ignition On is detected, counter stops during Ignition Off. The counter is reset when the device is power cycled.

8.91. Parameter 112: FLF (Fuel Level Filtered)

OBDII fuel level filtered with a simple moving average and additional outlier rejection displayed in tenths of a percent. e.g.: 800 = 80.0%

Schema

```
{ "FLF" : FLF }
```

Param	Type	Description
FLF	UINT16	Fuel Level 0.0 to 100.0 percent.

8.92. Parameter 113: LOC (Location)

LOC reports the last known location. If location is unknown, the parameter will report NULL. If location is known, the parameter reports a fixmap.

Schema

```
{“LOC”:[“FT”:FT, “UTC”:UTC, “LT”:LT, “LN”:LN, “AL”:AL, “HD”:HD, “SP”:SP, “QUAL”:QUAL, “HACC”:HACC] }
```

Parameter	Type	Description
FT	UINT8	Fixtype **Value** / **Description** 0 – None 1 – GPS
UTC	UINT32	Epoch time.
LT	INT32	Latitude.
LN	INT32	Longitude.
AL	INT32	Altitude.
HD	INT16	Heading.
SP	UINT16	Speed.
QUAL	UINT16	Dilution of precision.
HACC	UINT8	Horizontal accuracy.

8.93. Parameter 114: PS (Power Stage)

Reports the current power stage the device is in.

NOTE: This field will report "Nil" until the first Power Stage Transition from PS0.

Schema

{"PS":PS}

Param	Type	Description
PS	UINT8	Power Stage. Value: Description 0: Power Stage 0 1: Power Stage 1 2: Power Stage 2 255: Snapshot

8.94. Parameter 115: DSN (Device Serial Number)

Returns device serial number.

Schema

{ "DSN" : DSN}

Param	Type	Description
DSN	STR8	Device serial number. • Maximum length is 30 characters • Supports alphanumeric characters (A-Z and a-z), digits (0-9)

8.95. Parameter 116: ACT (Cellular Access Technology)

Reports the cellular access technology.

Parameter Data Presentation

{“ACT”:ACT}

Parameter	Type	Description
ACT	UINT8	Cellular Access Technology

Value	Description
0	None
1	2G
2	3G
3	LTE

8.96. Parameter 117: PSTI (Power Stage Transition Information)

Provides information about the most recent power stage transition.

NOTE: This field will report "Nil" until the first Power Stage Transition from PS0.

Schema

{“PSTI”:[PSTIDX,TRANS_CNT,[CID0, CID1, … , CIDN]]}

Parameter	Type	Description
PSTIDX	INDEX	Identifies the next power stage ID.

Value	Description
0	PS0
1	PS1
2	PS2
4	Ship Mode
255	Snapshot

TRANS_CNT	UINT32	Number of total transitions.
CID	ARRAY	Trigger(s) that caused the power stage transition. Where the key is the criterion ID and the value is a group of data describing the trigger cause(s). If device transitioned from one Power Stage to another:

Parameter	Type	Description		
		Value	**Description**	**Data Reported**
		0	Ignition off	
		1	Ignition on	
		2	ADC Main above threshold	mV
		3	ADC Main below threshold	mV
		6	Vibration	
		7	InStage	
		8	Battery Low	
		9	Battery Normal	
		11	Input 2	MASK
		12	Input 3	
		13	Shock	
		19	GSMRI	
		20	User 0	
		21	User 1	
		22	Input 4	
		24	Timer A	
		25	Timer B	
		26	Timer C	
		27	Timer D	
		29	No Motion to Motion	
		30	Motion to No Motion	
		31	Motion Periodic	
		32	No Motion Periodic	
		35	ADC 0	
		36	ADC 1	
		37	ADC 2	

8.97. Parameter 118: DID (Driver Identification Number)

Schema

{“DID”:DID}

Param	Type	Description
DID	UINT32	Driver identification number. This parameter can be set via the ELD DRIVER ID described in Characteristics on p. 254. Additionally, it can be collected via OWB on devices that support the I/O Box.

8.98. Parameter 119: USEQ (Unidentified Driver Record Sequence Number)

Schema

{“USEQ”:USEQ}

Param	Type	Description
USEQ	UINT32	Unidentified Driver Record sequence number. Each time an unidentified driver record is collected, this number increments. The sequence number gets reset on each device reset and when the UDR log is emptied.

8.99. Parameter 120: JOMI (JBUS True Odometer)

This parameter is used for heavy duty trucks.

Schema

{“JOMI”:ODOMETER_M,TRUEODOM_M,TRIPODOM_M}

Param	Type	Description
ODOMETER_M	UINT32	Odometer derived from the OMI parameter (calculated based on speed).
TRUEODOM_M	UINT32	True odometer derived from PBMI read directly from the vehicle ECU.
TRIPODOM_M	UINT32	Reports 0.

8.100. Parameter 121: JEH (JBUS Engine Hours)

Schema

{“JEH”:[ENGINE_S, ENGINE_BUS_S, IDLE_S, IDLE_BUS_S]}

Param	Type	Description
ENGINE_S	UINT32	Engine hours collected from the software in seconds.
ENGINE_ BUS_S	UINT32	Engine hours collected from the vehicle in seconds.
IDLE_S	UINT32	Number of seconds the vehicle has spent idle (ignition on and not moving) collected by the software.
IDLE_BUS_S	UINT32	Number of seconds the vehicle has spent idle (ignition on and not moving) collected by the vehicle.

8.101. Parameter 122: AVT (Acceleration Vector Threshold Violation)

Provides a mask of all the configuration 63 (accel-on-axis) indices that are in violation during the current second. See Configuration 63: Accel on Axis on p. 181 for more details.

Schema

```
{ “AVT” : [AVT] }
```

Param	Type	Description
AVT	INT16	Mask of indices. Bit 0 is index 0 of the config 63, bit 1 is index 1, etc.

8.102. Parameter 147: PBBL (Proprietary Bus Parking Brake Lamp)

Schema

```
{"PBBL":"PBBL"}
```

Param	Type	Description
PBBL	UINT8	Available values. Index: Description 0: Lamp off. 1: Lamp on. 254: Unknown state. 255: Invalid state.

8.103. Parameter 148: PBBS (Proprietary Bus Parking Brake Status)

Schema

```
{"PBBS":"PBBS"}
```

Param	Type	Description
PBBS	UINT8	Available values. Index: Description 0: Brake off. 1: Brake on. 254: Unknown state. 255: Invalid state.

8.104. Parameter 149: PBSP (Proprietary Bus Shifter Position)

Schema

{"PBSP":"PBSP"}

Param	Type	Description
PBSP	UINT8	Available values.

Index	Description
16	Neutral.
17	Second.
18	Low.
19	Forward/drive.
20	Park.
21	Reverse.
254	Unknown state.
255	Invalid state.

8.105. Parameter 150: PBDS (Proprietary Bus Driver Seatbelt)

Schema

{"PBDS":"PBDS"}

Param	Type	Description
PBDS	UINT8	Available values.

Index	Description
0	Not buckled.
1	Buckled.
254	Unknown state.
255	Invalid state.

8.106. Parameter 151: PBPS (Proprietary Bus Passenger Seatbelt)

Schema

{"PBPS":"PBPS"}

Param	Type	Description
PBPS	UINT8	Available values. **Index** / **Description** 0 – Not buckled. 1 – Buckled. 254 – Unknown state. 255 – Invalid state.

8.107. Parameter 152: PBAL (Proprietary Bus Airbag Lamp)

Schema

{"PBAL":"PBAL"}

Param	Type	Description
PBAL	UINT8	Available values. **Index** / **Description** 0 – Lamp off. 1 – Lamp on. 254 – Unknown state. 255 – Invalid state.

8.108. Parameter 153: FA (Faulty Alternator)

Returns an unsigned integer associated with a transition in the alternator voltage outside of the configured expected behavior.

Schema

{ "FA" : FAULTY_ALTERNATOR_STATUS}

Param	Type	Description
FAULTY_ALTERNATOR_STATUS	UINT8	True or False **Value** / **Description** 0 – Alternator determined to be normal. 2 – Alternator determined to be faulty.

8.109. Parameter 156: OS (Orientation Status)

Device accelerometer orientation status. Orientation must be achieved before acceleration-on-axis events (events 56-59) can be triggered.

Schema

{“OS”:[STATUS, CONFIDENCE] }

Parameter	Type	Description
STATUS	UINT8	Orientation status. **Value** — **Description** 0 — Not oriented. 1 — Oriented.
CONFIDENCE	UINT16	Higher values represent high confidence in orientation status. Range is from 0 to 1500.

8.110. Parameter 158: IN1 (Input 1 Status)

IN1 bypasses the hysteresis that IN1S (Input 1 State) on p. 1 implements; this parameter provides the current state of input 1 and the accumulated time when input 1 is active.

Schema

{“IN1”:[IN1_STATE, IN1_TIME]}

Data Type

{“IN1”:[UINT8,UINT32]}

JSON Syntax

{"IN1":[INTEGER,INTEGER]}

Parameter	Type	Description
IN1_STATE	UINT8	Current state.
IN1_TIME	UINT32	Accumulated time when the input is active.

8.111. Parameter 159: IN2 (Input 2 Status)

IN2 bypasses the hysteresis Parameter 68: IN2S (Input 2 State) on p. 74 implements; this parameter provides the current state of input 2 and the accumulated time when input 2 is active.

Schema
{“IN2”:[IN2_STATE, IN2_TIME]}
Data Type
{“IN2”:[UINT8,UINT32]}
JSON Syntax
{"IN2":[INTEGER,INTEGER]}

Parameter	Type	Description
IN2_STATE	UINT8	Current state.
IN2_TIME	UINT32	Accumulated time when the input is active.

8.112. Parameter 160: IN3 (Input 3 Status)

IN3 bypasses the hysteresis Parameter 68: IN2S (Input 2 State) on p. 74Parameter 70: IN3S (Input 3 State) on p. 75 implements; this parameter provides the current state of input 3 and the accumulated time when input 3 is active.

Schema
{“IN3”:[IN3_STATE, IN3_TIME]}

Parameter	Type	Description
IN3_STATE	UINT8	Current state.
IN3_TIME	UINT32	Accumulated time when the input is active.

8.113. Parameter 161: IN4 (Input 4 Status)

IN3 bypasses the hysteresis Parameter 208: IN4S (Input 4 State) on p. 102 implements; this parameter provides the current state of input 4 and the accumulated time when input 4 is active.

Schema
{“IN4”:[IN4_STATE, IN4_TIME]}

Parameter	Type	Description
IN4_STATE	UINT8	Current state.
IN4_TIME	UINT32	Accumulated time when the input is active.

8.114. Parameter 162: OT1 (Output 1 Status)

Schema
{“OT1”:[OTS,OTP,OTC,OTX,MASK]}
Data Type
{“OT1”:[UINT8,UINT8,UINT8,UINT32,UINT32]}
JSON Syntax
{"OT1":[INTEGER,INTEGER,INTEGER,INTEGER,INTEGER]}

Parameter	Type	Description
OTS	UINT8	Current state. This sub-parameter reports the Parameter 77: OT (Output State) on p. 77.
OTP	UINT8	Pending State. This sub-parameter reports the Parameter 78: OTP (Output Pending State) on p. 78
OTC	UINT8	Count of manual overrides used.
OTX	UINT32	Number of seconds until the output will change to the requested state.
MASK	UINT32	Bitmask.

Value	Description
0x1	Command active.
0x2	Loss of registration active.
0x4	Manual override active.

8.115. Parameter 163: OT2 (Output 2 Status)

Schema

{“OT2”:[OTS,OTP,OTC,OTR,OTX]}

Data Type

{“OT2”:[UINT8,UINT8,UINT8,UINT32,UINT32]}

JSON Syntax

{"OT2":[INTEGER,INTEGER,INTEGER,INTEGER,INTEGER]}

Parameter	Type	Description
OTS	UINT8	Current state. This sub-parameter reports the Parameter 77: OT (Output State) on p. 77.
OTP	UINT8	Pending State. This sub-parameter reports the Parameter 78: OTP (Output Pending State) on p. 78
OTC	UINT8	Count of manual overrides used.
OTX	UINT32	Number of seconds until the output will change to the requested state.
MASK	UINT32	Bitmask.

Value	Description
0x1	Command active.
0x2	Loss of registration active.
0x4	Manual override active.

8.116. Parameter 164: OT3 (Output 3 Status)

Schema

{“OT3”:[OTS,OTP,OTC,OTR,OTX]}

Parameter	Type	Description
OTS	UINT8	Current state. This sub-parameter reports the Parameter 77: OT (Output State) on p. 77.
OTP	UINT8	Pending State. This sub-parameter reports the Parameter 78: OTP (Output Pending State) on p. 78
OTC	UINT8	Count of manual overrides used.
OTX	UINT32	Number of seconds until the output will change to the requested state.
MASK	UINT32	Bitmask.

Value	Description
0x1	Command active.
0x2	Loss of registration active.
0x4	Manual override active.

8.117. Parameter 190: SCT (Scantool)

Scantool provides the CAN ID and first two bytes of the scantool's payload.

Schema

```
{ "SCT": [{"ID": INTEGER}, {"Payload": [INTEGER, INTEGER]}] }
```

Param	Type	Description
ID	UINT32	CAN ID
Payload	UINT8	First two bytes of the payload from scantool.

8.118. Parameter 194: DTC2 (Vehicle Bus Diagnostic Trouble Codes)

DTC2 provides a list of codes. This parameter supports pending and permanent DTCs and identifies which physical interface the DTC was on.

Schema

```
{ "DTC2": [ECUID,CODE,IDENT,TYPE] }
```

Param	Type	Description
ECUID	UINT32	ECU ID.
CODE	UINT32	Diagnostic trouble code. Msgpack reports the codes as decimal values between 0 and 4294967295. The hexadecimal equivalent of the value is decoded differently depending on which protocol is in use.

Byte 3	Byte 2	Byte 1	Byte 0
Bits 31 - 24	Bits 23 - 16	Bits 15 - 8	Bits 7 - 0

OBDII

Bits	Description
31 - 16	0
15 - 14	DTC type

Value	Description
00	'P'
01	'C'
10	'B'
11	'U'

Bits	Description
13 - 0	Code

J1939

<table>
<tr><th>Param</th><th>Type</th><th>Description</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th>Bits</th><th>Description</th></tr>
<tr><td>31</td><td>SPN conversion method
<table><tr><th>Value</th><th>Description</th></tr><tr><td>0</td><td>Valid data reported by vehicle</td></tr><tr><td>1</td><td>Invalid data reported by vehicle. Used by certain vehicles until 1997.</td></tr></table></td></tr>
<tr><td>30 - 29</td><td>0</td></tr>
<tr><td>28 - 24</td><td>FMI</td></tr>
<tr><td>23 - 0</td><td>SPN</td></tr>
</table>
J1708
<table>
<tr><th>Bits</th><th>Description</th></tr>
<tr><td>31 - 29</td><td>0</td></tr>
<tr><td>28</td><td>Fault type
<table><tr><th>Value</th><th>Description</th></tr><tr><td>0</td><td>PID</td></tr><tr><td>1</td><td>SID</td></tr></table></td></tr>
<tr><td>27 - 24</td><td>FMI</td></tr>
<tr><td>23 - 17</td><td>0</td></tr>
<tr><td>16</td><td>DTC type
<table><tr><th>Value</th><th>Description</th></tr><tr><td>0</td><td>Standard</td></tr><tr><td>1</td><td>Expansion</td></tr></table></td></tr>
<tr><td>15 - 8</td><td>SID/PID</td></tr>
<tr><td>7 - 0</td><td>Count</td></tr>
</table>
</td></tr>
<tr><td>IDENT</td><td>UINT8</td><td>Physical interface.
<table><tr><th>Index</th><th>Description</th></tr><tr><td>1</td><td>CAN1</td></tr><tr><td>2</td><td>CAN2</td></tr><tr><td>3</td><td>CAN3</td></tr><tr><td>4</td><td>J1708</td></tr></table></td></tr>
<tr><td>TYPE</td><td>UINT8</td><td>Code type.</td></tr>
</table>

Param	Type	Description
		Index: Description 1: Stored 2: Pending 3: Permanent

8.119. Parameter 197: PFLF (PPID Fuel Level Filtered)

PPID fuel level filtered with a simple moving average and additional outlier rejection displayed in tenths of a percent. e.g.: 800 = 80.0%

Schema

```
{ "PFLF" : PFLF }
```

Param	Type	Description
PFLF	UINT16	Fuel Level 0.0 to 100.0 percent.

8.120. Parameter 208: IN4S (Input 4 State)

IN4S configures the current state of Input Pin 4.

Schema

```
{“IN4S”:IN4S}
```

Parameter	Type	Description
IN4S	UINT8	Input 4 pin state Value: Description 0: Clear 1: Set

8.121. Parameter 209: IN4A (Input 4 Set Count)

IN4A is the number of seconds that Input 4 has been active since boot.

Schema

```
{“IN4A”:IN4A}
```

Parameter	Type	Description
IN4A	UINT32	Number of seconds input 4 has been active since boot.

8.122. Parameter 216: DIAG (Diagnostic Information)

Provides information about recent crashes that can be useful for diagnosing errors on remote devices.

Schema

{“DIAG”: [TYPE, R0, R1, R2, R3, R12, LR, PC, PSR, PTR, ID, "NAME"]}

Parameter	Type	Description
TYPE	UINT8	Type of crash.
R0	UINT32	Register 0 value.
R1	UINT32	Register 1 value.
R2	UINT32	Register 2 value.
R3	UINT32	Register 3 value.
R12	UINT32	Register 12 value.
LR	UINT32	Link register value.
PC	UINT32	Program counter value.
PSR	UINT32	Program status register.
PTR	UINT32	Stack pointer value.
ID	UINT8	Interrupt request ID value.
NAME	STR8	Name of the tasklet that caused the crash. If not obtainable, "None" is returned.

8.123. Parameter 217: PD0 (PID Data 0)

Schema

{ "PD0": { ID: [VALUE, AGE_S], ID: null, ID: [VALUE, AGE_S], etc... } }

Parameter	Type	Description
ID	UINT8	ID corresponds to a PID that is set in Configuration 86: PIDs on p. 187. If the value is null, no value for the set PID has been recorded.
VALUE	Numeric	Value is the last recorded numeric value for the set PID.
AGE_S	UINT32	How many seconds have elapsed since the value was recorded.

8.124. Parameter 218: PD1 (PID Data 1)

Schema

{ "PD1": { ID: [VALUE, AGE_S], ID: null, ID: [VALUE, AGE_S], etc... } }

Parameter	Type	Description
ID	UINT8	ID corresponds to a PID that is set in Configuration 86: PIDs on p. 187. If the value is null, no value for the set PID has been recorded.
VALUE	Numeric	Value is the last recorded numeric value for the set PID.
AGE_S	UINT32	How many seconds have elapsed since the value was recorded.

8.125. Parameter 219: PD2 (PID Data 2)

Schema

{ "PD2": { ID: [VALUE, AGE_S], ID: null, ID: [VALUE, AGE_S], etc... } }

Parameter	Type	Description
ID	UINT8	ID corresponds to a PID that is set in Configuration 86: PIDs on p. 187. If the value is null, no value for the set PID has been recorded.
VALUE	Numeric	Value is the last recorded numeric value for the set PID.
AGE_S	UINT32	How many seconds have elapsed since the value was recorded.

8.126. Parameter 220 TRPM (Trip VBUS Data)

Schema

{“TRPM”:[RPM, TIMESTAMP]}

Param	Type	Description
RPM	DYNAMIC INT	Revolutions per minute.
TIMESTAMP	DYNAMIC INT	Timestamp saved when the RPM sample is collected. Reported in milliseconds.

8.127. Parameter 221: HDOP (GPS HDOP)

Schema

{ “HDOP” : HDOP }

Parameter	Type	Description
HDOP	UINT8	HDOP in tenths.

9. Device Configuration

NOTE: Configuration changes will not take place until `!csu` is issued. If this command is issued without making any configuration changes, the response will be `INVALID`.

Description
Configuration 1: Cellular Radio Link Access Point Name on p. 107
Configuration 2: GSM Network Profile on p. 108
Configuration 3: GSM Endpoint on p. 108
Configuration 4: Network Quality of Service on p. 110
Configuration 5: Device Power Up Message on p. 112
Configuration 6: GPS Configuration on p. 113
Configuration 7: Custom Parameter IDs on p. 115
Configuration 8: SMS on p. 116
Configuration 9: Event Parameter Mask on p. 116
Configuration 11: Periodic Reset on p. 125
Configuration 12: Ignition Status Determination Masks on p. 126
Configuration 13: Device Battery Health Monitoring on p. 127
Configuration 14: Alternator Detection Configuration on p. 128
Configuration 15: MQTT Identity and Event Configuration on p. 129
Configuration 16: DNS Cache Configuration on p. 132
Configuration 17: Ignition On Periodic Reporting Interval on p. 132
Configuration 18: Ignition Off Periodic Reporting Interval on p. 133
Configuration 19: Logging on p. 133
Configuration 21: Event Log Trip Buffering on p. 138
Configuration 22: Compression Type on p. 139
Configuration 23: VBUS Mask on p. 139
Configuration 24: Acceleration Threshold VBUS on p. 141
Configuration 25: GPS Acceleration Threshold on p. 142
Configuration 26: Power Stage PMU Modes on p. 143
Configuration 27: Power Stage Transition on p. 144
Configuration 28: Snapshot Configuration on p. 150
Configuration 29: Accelerometer Shock/Vibration on p. 151
Configuration 30: Best Time Configuration on p. 152
Configuration 33: Buzzer Configuration on p. 153
Configuration 34: Direction Change on p. 154
Configuration 35: VBUS Speed Threshold on p. 155
Configuration 36: GPS Speed Threshold on p. 156
Configuration 38: VBUS Odometer Threshold on p. 158
Configuration 39: GPS Odometer Threshold on p. 158
Configuration 43: Heartbeat on p. 159

Description
Configuration 44: Output on p. 160
Configuration 45: Vehicle Movement Detection on p. 161
Configuration 46: Xirgo Gateway Service on p. 162
Configuration 47: FTP Settings on p. 163
Configuration 48: System Information Event on p. 164
Configuration 49: Park Time Threshold on p. 165
Configuration 50: Idle Detection Thresholds on p. 166
Configuration 52: ADC Basic on p. 166
Configuration 53: ADC Advanced on p. 167
Configuration 55: CoAP on p. 169
Configuration 56: Motion/No-Motion on p. 171
Configuration 57: Snapshot Transition on p. 172
Configuration 58: Mapster on p. 177
Configuration 59: Power Stage Event Reporting on p. 179
Configuration 62: GPS Assist on p. 180
Configuration 63: Accel on Axis on p. 181
Configuration 68: LED Behavior on p. 182
Configuration 71: Input Configuration on p. 184
Configuration 74: Faulty Alternator on p. 185
Configuration 77: Bluetooth Enable on p. 185
Configuration 81: Queue Limiting on p. 186
Configuration 86: PIDs on p. 187
Configuration 87: ELD on p. 193
Configuration 89: Update Inhibit on p. 194
Configuration 90: Diagnostic Mask on p. 194
Configuration 92: Enable DTCs on p. 195

9.1. Configuration 1: Cellular Radio Link Access Point Name

Configures the APN and the PDN address type for a cellular radio interface.

NOTE: A correct APN is required to register with a cellular network.

Read Schema
!cp:1,INDEX
Write Schema
!cs:1,INDEX,APN,APNT

Param	Type	Description
INDEX	UINT8	Determines the APN index in use. The current valid range is 0.
APN	STRING	63-byte maximum length.
APNT	UINT8	**Value** / **Description** 0 / IPV4 1 / IPV4V6

9.2. Configuration 2: GSM Network Profile

Configures the operator profile, enabling SIM card identification and authentication to the selected network.

Read Schema
!cp:2
Write Schema
!cs:2,PROFILE

Parameter	**Type**	**Description**

Value	**Description**	**SARA-R410-02B**	**LARA-R202-82B**	**LARA-R202-02B**
0	Default	N/A	N/A	N/A
1	SIM Select	Not supported	Not supported	Not supported
2	ATT	Supported	Not supported	Supported
3	Verizon	Supported	Not supported	Not supported
4	Telstra	Not supported	Not supported	Not supported
5	CT	Not supported	Not supported	Supported
6	U.S. Cellular	Not supported	Supported	Not supported

9.3. Configuration 3: GSM Endpoint

Configures network endpoint for communication with the backend server.

Read Schema
!cp:3,INDEX
Write Schema
!cs:3,INDEX,HOST,PORT,TRANSPORT,FORMAT,COMPRESS

Parameter	**Type**	**Description**
INDEX	UINT8	Valid index is 0.
HOST	STRING	Fully qualified domain name of the host. • 127-byte maximum length. • The encoding of the FQDN shall follow the Name Syntax defined in RFC 2181 [18], RFC 1035 [19] and RFC 1123 [20].

<table>
<tr><th>Parameter</th><th>Type</th><th>Description</th></tr>
<tr><td></td><td></td><td>• The FQDN consists of one or more labels. Each label is coded as a one octet length field followed by that number of octets coded as 8-bit ASCII characters.
• Following RFC 1035 [19] the labels shall consist only of the alphabetic characters (A-Z and a-z), digits (0-9) and the hyphen (-).
• The FQDN is not case sensitive/significant.
• The FQDN is not terminated by a length byte of zero.
• This setting can alternatively be an Internet Protocol Address provided as a 32-bit numeric address written as four numbers separated by periods. Each number can be zero to 255.</td></tr>
<tr><td>PORT</td><td>UINT16</td><td>Host port number.
• 0 to 65535</td></tr>
<tr><td>TRANSPORT</td><td>UINT8</td><td>Defines which bitrune transport is in use.
<table><tr><th>Value</th><th>Description</th></tr><tr><td>0</td><td>None</td></tr><tr><td>1</td><td>MQTT</td></tr><tr><td>3</td><td>COAP</td></tr></table></td></tr>
<tr><td>FORMAT</td><td>UINT8</td><td>Defines which formatizer is in use.
<table><tr><th>Value</th><th>Description</th></tr><tr><td>0</td><td>None</td></tr><tr><td>2</td><td>Message Pack</td></tr><tr><td>4</td><td>JSON</td></tr></table></td></tr>
<tr><td>COMPRESS</td><td>UINT8</td><td>Defines which compressor is in use.
<table><tr><th>Value</th><th>Description</th></tr><tr><td>0</td><td>None</td></tr><tr><td>1</td><td>LZ4</td></tr></table></td></tr>
</table>

9.4. CONFIGURATION 4: NETWORK QUALITY OF SERVICE

Configures the device quality-of-service level. At QoS 0, the device uses less data, however, there is no guarantee the messages are received by the server. At QoS 1, messages are guaranteed to be delivered at least once, but this increases data usage. Additionally, if messages are delivered more than once, 'wasted' data use also increases.

Read Schema
!cp:4
Write Schema
!cs:4,QOS,MASK,eDRX,NCSTATIONARY_M,NCMOVING_M,APN_MODE

<table>
<tr><th>Parameter</th><th>Type</th><th>Description</th></tr>
<tr><td>QOS</td><td>DECIMAL</td><td>Mask
<table><tr><th>Value</th><th>Description</th></tr><tr><td>0</td><td>'Fire-and-forget' service level. Device sends messages and does not wait for server response (no ACK).</td></tr><tr><td>1</td><td>Device sends messages and waits for server response (ACK).</td></tr></table></td></tr>
<tr><td>MASK</td><td>ASCII HEX</td><td>Mask
<table><tr><th>Value</th><th>Description</th></tr><tr><td>1</td><td>Allows device to update the network configuration via the network.</td></tr><tr><td>4</td><td>When this bit is set, parameters that are "stale" or "not yet valid" will not be included in the record and will not be present in the report. When this bit is NOT set, parameters that are "stale" or "not yet valid" are included in the record and will be in the report as NIL (msgpack) and null (JSON).</td></tr></table></td></tr>
<tr><td>eDRX</td><td>DECIMAL</td><td>Mask

Extended Discontinuous Reception (Boolean). Allows paging to only operate for a period and again some time later. In between paging windows, the module is in deep sleep mode.

The module can still receive downlink message while in deep sleep. The messages will be cached by the network and delivered in the next paging window.</td></tr>
</table>

Parameter	Type	Description
		Value / **Description** 0 – Disabled 1 – eDRX Enabled
NCSTATIONARY_M	UINT16	Number of minutes the device can be stationary with a registration status of not-registered and not-searching (CREG 0) before cycling the auto-registration configuration of the modem.
NCMOVING_M	UINT16	Number of minutes the device can be moving with a registration status of not-registered and not-searching (CREG 0) before cycling the auto-registration configuration of the modem.
APN_MODE	UINT8	APN Mode. **Value** / **Description** 0 – APN Mode None

9.5. CONFIGURATION 5: DEVICE POWER UP MESSAGE

Configures when the device creates a Power Up event. Multiple Power Up events can be triggered throughout device power on.

Read Schema
!cp:5,“”
Write Schema
!cs:5,PMASK

Param	Type	Description
PMASK	ASCII HEX	Power up message mask.

Value	Description
0x0	Device will not record any power up messages.
0x1	System: No criterion; Taken as close to device power up as possible. See event [5] Power Up on p. 28 for more information.
0x2	GSM: Cellular Registration; Taken as soon as the device obtains registration on the network. See event[7] Power Up GSM on p. 28 for more information.
0x4	GPS: GPS Lock; Taken as soon as the device obtains a series GPS locks that pass the configured filtering. See event [6] Power Up GPS on p. 28 for more information.
0x8	Best Time: Known-good time from an outside source (GSM or GPS); Taken as soon as the device obtains a valid time from an outside source. See event [42] Power Up Best Time on p. 35 for more information.

9.6. CONFIGURATION 6: GPS CONFIGURATION

Configures the GPS date threshold used to filter bad GPS dates. There are times when a GPS receiver can present a date and time as valid without knowing that the date is valid. When this condition occurs, the date is almost always in the past and can be filtered with a simple threshold. The firmware hard-codes this to the year that the firmware was released by default.

The dilution of precision (DOP) parameter allows for a threshold to be applied to the DOP figure of merit presented in the GPS solution. If the DOP presented is above the provided threshold the solution is filtered (considered to be unlocked). The lower the DOP, the more accurate the solution.

The HACC parameter allows for a threshold to be applied to the Horizontal Accuracy Estimate figure of merit provided with the GPS solution. If the GPS HACC is more than the threshold then the solution is filtered (considered to be unlocked).

The AOP_CONFIG parameter enables AssistNow Autonomous. The AssistNow Autonomous feature provides functionality like AssistNow Offline without the need for a host and a connection. Based on a broadcast ephemeris downloaded from the satellite (or obtained by AssistNow Online), the receiver can autonomously generate an accurate satellite orbit representation that is usable for navigation much longer than the underlying broadcast ephemeris was intended for. This makes downloading new ephemeris or aiding data for the first fix unnecessary for subsequent start-ups of the receiver.

Job Read Schema
!cp:6
Job Write Schema
Revision 1: !cs:6,YEAR,DOP,HACC,ASSIST,SPEED_FMASK,SATELLITES *Revision 0:* !cs:6,YEAR,DOP,HACC,ASSIST,SPEED_FMASK

Param	Type	Description
YEAR	UINT16	It is recommended to configure this value to the current 4-digit year.
DOP	UINT8	Dilution of Precision in tenths

DOP Value	Rating	Description
< 10	Ideal	Highest possible confidence level to be used for applications demanding the highest possible precision.
10-20	Excellent	At this confidence level, positional measurements are considered accurate enough to meet all but the most sensitive applications.
20-50	Good	Represents a level that mars the minimum appropriate for making business decisions. Positional measurements could be used to make

<table>
<tr><th>Param</th><th>Type</th><th>Description</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th>DOP Value</th><th>Rating</th><th>Description</th></tr>
<tr><td></td><td></td><td>reliable in-route navigation suggestions to the user.</td></tr>
<tr><td>50-100</td><td>Moderate</td><td>Positional measurements could be used for calculations, but the fix quality could still be improved. A more open view of the sky is recommended.</td></tr>
<tr><td>100-200</td><td>Fair</td><td>Represents a low confidence level. Positional measurements should be discarded or used only to indicate a very rough estimate of the current location.</td></tr>
<tr><td>200 – 255</td><td>Poor</td><td>At this level, measurements are inaccurate by as much as 300 meters with a 6-meter accurate device (50 DOP * 6 meters) and should be discarded.</td></tr>
</table>
</td></tr>
<tr><td>HACC</td><td>UINT8</td><td>Meters as a radius measurement from the presented GPS coordinate.</td></tr>
<tr><td>ASSIST</td><td>ASCII HEX</td><td>Enable AssistNow setting.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0x0</td><td>Assist none</td></tr>
<tr><td>0x1</td><td>AssistNow Autonomous</td></tr>
<tr><td>0x2</td><td>Online</td></tr>
</table>
</td></tr>
<tr><td>SPEED_FMASK</td><td>ASCII HEX</td><td>Speed Filter Mask. Determines which conditions clamp the speed and heading to Null.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0x01</td><td>Quality – If the speed is < 10 MPH and number of satellites is < 7 the speed is clamped to 0.
If the speed is < 5 MPH and number of satellites is < 9 the speed is clamped to 0.</td></tr>
<tr><td>0x02</td><td>Motion – If the motion state is stopped the speed is clamped to 0.</td></tr>
<tr><td>0x04</td><td>Movement – If the movement state is stopped the speed is clamped to 0.</td></tr>
<tr><td>0x08</td><td>Ignition – If the ignition state is off the speed is clamped to 0.</td></tr>
<tr><td>0x10</td><td>Vibration – If the vibration state is STOP the heading is clamped to 0.</td></tr>
</table>
</td></tr>
</table>

Param	Type	Description
SATELLITES	UINT8	This parameter causes the device to remove any GPS solutions that contain less satellites visible than the configured value. For example, if this parameter is set to 5, any solution that does not contain at least 5 satellites will be removed.

9.7. CONFIGURATION 7: CUSTOM PARAMETER IDS

Allows configuration of up to 10 customized OBD-II PIDS. The returned data size from each custom PID is specified by the SIZE parameter, and returned data is unformatted. Only ODB-II Service 01 PIDS are supported.

On some protocols the number of PIDs per second may be limited. Exceeding this limit can cause clock stretching. For example, if the protocol only supports 3 PIDs per second, and 6 PIDs are configured, the reporting frequency will shift to 0.5 Hz.

Job Read Schema
!cp:7,INDEX
Job Write Schema
!cs:7,INDEX,PID,SIZE,PERIOD

Param	Type	Description
INDEX	UINT8	Valid inputs are 0 - 9.
PID	ASCII HEX	PID service index followed by the PID index described in hexadecimal using two characters. I.e., Service 1, PID F (15) would be written as 10F. Invalid PIDs or PIDs lacking a service index will not present data.
SIZE	UINT8	Number of bytes returned from VBUS for specified PID. 1 - 17 bytes.
PERIOD	UINT8	Valid range is 1 - 255 seconds.

9.8. CONFIGURATION 8: SMS

Configures the remote SMS destination number and events based on application triggers.

Read Schema
!cp:8
Write Schema
!cs:8,DST,EVENT1,EVENT2,FLAGS

Parameter	Type	Description
DST	STRING	Default destination where SMS responses are sent. • Maximum 19 characters allowed
EVENT1	UNIT16	Set to 0.
EVENT2	UINT16	Set to 0.
FLAGS	ASCII HEX	Security level flags.

Value	Description
0x01	SMS responses are directed back to the number which sent the message.
0x02	Not supported.
0x04	SMS command will only be accepted if the message contains a salted hash of the following: IMEI + CCID + COMMAND + SALT.
0x08	Multisize - SMS responses will be split on size.
0x10	Multiline - SMS responses will be split on lines.
0x20	7BIT - SMS response will only use 7bit encoding.
0x40	7BIT_EXT - SMS response will only use 7bit + extended encoding.

9.9. CONFIGURATION 9: EVENT PARAMETER MASK

Configures the parameter sets for each individual event.

Read Schema
!cp:9,EV
Write Schema
Revision 1: !cs:9,EV,MASK[1]MASK[2]...MASK[28],ATTR *Revision 0:* !cs:9,EV,MASK[1]MASK[2]...MASK[16],ATTR

Param	Type	Description
EV	UINT16	Refer to Parameter 0: EV (Event Identifier) on p. 42 for details on available event identifiers.

<table>
<tr><th>Param</th><th>Type</th><th>Description</th></tr>
<tr><td>MASK[1]</td><td>ASCII HEX</td><td>Mask Byte 1. Bitmask of parameter values.
<table><tr><th>Value</th><th>Description</th></tr><tr><td>0x01</td><td>EV</td></tr><tr><td>0x02</td><td>Reserved</td></tr><tr><td>0x04</td><td>D</td></tr><tr><td>0x08</td><td>TZ</td></tr><tr><td>0x10</td><td>LT</td></tr><tr><td>0x20</td><td>LN</td></tr><tr><td>0x40</td><td>AL</td></tr><tr><td>0x80</td><td>SPT</td></tr></table></td></tr>
<tr><td>MASK[2]</td><td>ASCII HEX</td><td>Mask Byte 2. Bitmask of parameter values.
<table><tr><th>Value</th><th>Description</th></tr><tr><td>0x01</td><td>GSPT</td></tr><tr><td>0x02</td><td>HD</td></tr><tr><td>0x04</td><td>SV</td></tr><tr><td>0x08</td><td>HP</td></tr><tr><td>0x10</td><td>BV</td></tr><tr><td>0x20</td><td>CQ</td></tr><tr><td>0x40</td><td>MI</td></tr><tr><td>0x80</td><td>MG</td></tr></table></td></tr>
<tr><td>MASK[3]</td><td>ASCII HEX</td><td>Mask Byte 3. Bitmask of parameter values.
<table><tr><th>Value</th><th>Description</th></tr><tr><td>0x01</td><td>GS</td></tr><tr><td>0x02</td><td>GT</td></tr><tr><td>0x04</td><td>FL</td></tr><tr><td>0x08</td><td>XY</td></tr><tr><td>0x10</td><td>FWM</td></tr><tr><td>0x20</td><td>Reserved</td></tr><tr><td>0x40</td><td>Reserved</td></tr><tr><td>0x80</td><td>LGTM</td></tr></table></td></tr>
<tr><td>MASK[4]</td><td>ASCII HEX</td><td>Mask Byte 4. Bitmask of parameter values.
<table><tr><th>Value</th><th>Description</th></tr><tr><td>0x01</td><td>AXYZ</td></tr><tr><td>0x02</td><td>VN</td></tr></table></td></tr>
</table>

Param	Type	Description
		Value **Description** 0x04 DTC 0x08 Reserved 0x10 FP 0x20 TID 0x40 MIL 0x80 RM
MASK[5]	ASCII HEX	Mask Byte 5. Bitmask of parameter values. **Value** **Description** 0x01 IT 0x02 SI 0x04 BN 0x08 PN 0x10 CI 0x20 AC 0x40 Reserved 0x80 HBE
MASK[6]	ASCII HEX	Mask Byte 6. Bitmask of parameter values. **Value** **Description** 0x01 MTN 0x02 IM 0x04 HACC 0x08 OB 0x10 MID 0x20 OMI 0x40 CNT 0x80 CH
MASK[7]	ASCII HEX	Mask Byte 7. Bitmask of parameter values. **Value** **Description** 0x01 CT 0x02 UT 0x04 BT 0x08 IS 0x10 ACV

Param	Type	Description
		Value **Description** 0x20 ACC 0x40 Reserved 0x80 CP0
MASK[8]	ASCII HEX	Mask Byte 8. Bitmask of parameter values. **Value** **Description** 0x01 CP1 0x02 CP2 0x04 CP3 0x08 CP4 0x10 CP5 0x20 CP6 0x40 CP7 0x80 CP8
MASK[9]	ASCII HEX	Mask Byte 9. Bitmask of parameter values. **Value** **Description** 0x01 CP9 0x02 MPG 0x04 IN1S 0x08 IN1A 0x10 IN2S 0x20 IN2A 0x40 IN3S 0x80 IN3A
MASK[10]	ASCII HEX	Mask Byte 10. Bitmask of parameter values. **Value** **Description** 0x01 IG 0x02 DBO 0x04 DBI 0x08 Reserved 0x10 Reserved 0x20 Reserved 0x40 Reserved 0x80 Reserved

Param	Type	Description
MASK[11]	ASCII HEX	Mask Byte 11. Bitmask of parameter values.

Value	Description
0x01	Reserved
0x02	Reserved
0x04	Reserved
0x08	Reserved
0x10	Reserved
0x20	Reserved
0x40	Reserved
0x80	FWB

MASK[12]	ASCII HEX	Mask Byte 12. Bitmask of parameter values. Reserved, set value to 00.

Value	Description
0x01	PT
0x02	Reserved
0x04	PBMI
0x08	PBFL
0x10	NKR
0x20	GSM
0x40	GSMP
0x80	GPSP

MASK[13]	ASCII HEX	Mask Byte 13. Bitmask of parameter values.

Value	Description
0x01	GPSQ
0x02	PBOL
0x04	PBLF
0x08	PBRF
0x10	PBLR
0x20	PBRR
0x40	ADC0
0x80	ADC1

MASK[14]	ASCII HEX	Mask Byte 14. Bitmask of parameter values.

Value	Description
0x01	Reserved
0x02	Reserved

Param	Type	Description
		Value **Description** 0x04 Reserved 0x08 SG0 0x10 Reserved 0x20 EH 0x40 Reserved 0x80 Reserved
MASK[15]	ASCII HEX	Mask Byte 15. Bitmask of parameter values. **Value** **Description** 0x01 FLF 0x02 LOC 0x04 PS 0x08 DSN 0x10 ACT 0x20 PSTI 0x40 Reserved 0x80 Reserved
MASK[16]	ASCII HEX	Mask Byte 16. Bitmask of parameter values. **Value** **Description** 0x01 JOMI 0x02 JEH 0x04 AVT 0x08 Reserved 0x10 Reserved 0x20 Reserved 0x40 Reserved 0x80 Reserved
MASK[17]	ASCII HEX	Mask Byte 17. Bitmask of parameter values. Reserved, set value to 00.
MASK[18]	ASCII HEX	Mask Byte 18. Bitmask of parameter values. Reserved, set value to 00.
MASK[19]	ASCII HEX	Mask Byte 19. Bitmask of parameter values. **Value** **Description** 0x01 Reserved 0x02 Reserved 0x04 Reserved

Param	Type	Description
		Value **Description** 0x08 PBBL 0x10 PBBS 0x20 PBSP 0x40 PBDS 0x80 PBPS
MASK[20]	ASCII HEX	Mask Byte 20. Bitmask of parameter values. **Value** **Description** 0x01 PBAL 0x02 FA 0x04 Reserved 0x08 Reserved 0x10 OS 0x20 Reserved 0x40 IN1 0x80 IN2
MASK[21]	ASCII HEX	Mask Byte 21. Bitmask of parameter values. **Value** **Description** 0x01 IN3 0x02 IN4 0x04 OT1 0x08 OT2 0x10 OT3 0x20 Reserved 0x40 Reserved 0x80 Reserved
MASK[22]	ASCII HEX	Mask Byte 22. Bitmask of parameter values. **Value** **Description** 0x01 Reserved 0x02 BB 0x04 Reserved 0x08 Reserved 0x10 Reserved 0x20 Reserved

Param	Type	Description
		Value **Description** 0x40 Reserved 0x80 Reserved
MASK[23]	ASCII HEX	Mask Byte 23. Bitmask of parameter values. Reserved, set value to 00.
MASK[24]	ASCII HEX	Mask Byte 24. Bitmask of parameter values. **Value** **Description** 0x01 Reserved 0x02 Reserved 0x04 Reserved 0x08 Reserved 0x10 Reserved 0x20 Reserved 0x40 SCT 0x80 Reserved
MASK[25]	ASCII HEX	Mask Byte 25. Bitmask of parameter values. **Value** **Description** 0x01 Reserved 0x02 Reserved 0x04 DTC2 0x08 Reserved 0x10 Reserved 0x20 PFLF 0x40 Reserved 0x80 Reserved
MASK[26]	ASCII HEX	Mask Byte 26. Bitmask of parameter values. **Value** **Description** 0x01 Reserved 0x02 Reserved 0x04 Reserved 0x08 Reserved 0x10 Reserved 0x20 Reserved 0x40 Reserved 0x80 Reserved

<table>
<tr><th>Param</th><th>Type</th><th>Description</th></tr>
<tr><td>MASK[27]</td><td>ASCII HEX</td><td>Mask Byte 27. Bitmask of parameter values.
<table><tr><th>Value</th><th>Description</th></tr><tr><td>0x01</td><td>IN4S</td></tr><tr><td>0x02</td><td>IN4A</td></tr><tr><td>0x04</td><td>Reserved</td></tr><tr><td>0x08</td><td>Reserved</td></tr><tr><td>0x10</td><td>Reserved</td></tr><tr><td>0x20</td><td>Reserved</td></tr><tr><td>0x40</td><td>Reserved</td></tr><tr><td>0x80</td><td>Reserved</td></tr></table></td></tr>
<tr><td>MASK[28]</td><td>ASCII HEX</td><td>Mask Byte 28. Bitmask of parameter values.
<table><tr><th>Value</th><th>Description</th></tr><tr><td>0x01</td><td>DIAG</td></tr><tr><td>0x02</td><td>PD0</td></tr><tr><td>0x04</td><td>PD1</td></tr><tr><td>0x08</td><td>PD2</td></tr><tr><td>0x10</td><td>TRPM</td></tr><tr><td>0x20</td><td>HDOP</td></tr><tr><td>0x40</td><td>Reserved</td></tr><tr><td>0x80</td><td>Reserved</td></tr></table></td></tr>
<tr><td>ATTR</td><td>UINT16</td><td>Event attributes
<table><tr><th>Value</th><th>Description</th></tr><tr><td>1</td><td>Flush (causes trip log to be sent)</td></tr><tr><td>4</td><td>NoCache (Causes record to only be attempted for sending once – not supported yet)</td></tr></table></td></tr>
</table>

9.10. CONFIGURATION 11: PERIODIC RESET

Configures the time to reset the cellular modem (GSM) or system. This periodic reset prevents the modem or device from being stuck in an inoperable state.

The GSM_RESET timer is started when the cellular module is initialized. The cellular module is initialized after power up, wake from deep sleep, asynchronous module reset, or software reset. The GSM_RESET timer is reset when a successful publish has occurred.

The SYS_RESET timer is started when device is first initialized. The timer is cleared with either a software reset or power cycle. The SYS_RESET timer is reset when an Ignition On or Ignition Off event occurs.

Read Schema
!cp:11,“”
Write Schema
!cs:11,GSM_RESET_M,SYS_RESET_M,FLAGS

Parameter	Type	Description
GSM_RESET_M	UINT16	Minutes before resetting GSM. • 1 – 65535 minutes • Setting this value to 0 disables the feature • 60 is default
SYS_RESET_M	UINT16	Minutes before resetting SYSTEM. • 30 – 65535 minutes • Setting this value to 0 disables the feature • 1440 is default
FLAGS	ASCII HEX	Flags to determine which activities update the reset timer. If the GSM event flag is turned on, the timer for the GSM reset is updated (preventing the device from doing a reset until it fails to send another event after GSM reset minutes) whenever the device successfully sends an event.

Value	Description
0x00100	GSM event.
0x10000	Ignition off.
0x20000	Ignition on.

9.11. Configuration 12: Ignition Status Determination Masks

Provides a method of controlling what causes ignition on to be determined on the platform. The masks can be used to configure which system states are necessary for deriving ignition. The method of operation is that either of the AND mask or the OR mask can be satisfied to determine ignition as on.

For VBUS ignition source to be considered On, alternator source must also be detected On, thus VBUS ignition source is dependent on Configuration 14: Alternator Detection Configuration on p. 128.

Read Schema
!cp:12,“”
Write Schema
!cs:12,AM,OM,AND_MODE

Param	Type	Description
AM	DECIMAL	AND mask **Value** / **Description** 1 — VBUS Ignition (ECU comms) 2 — Virtual Battery (alternator based) 4 — Virtual Vibration (accelerometer based) 8 — Virtual Movement (GPS based) 0x20 — VBUS Ignition Pin (tied to pin 8 on external pins)
OM	DECIMAL	OR mask **Value** / **Description** 1 — VBUS Ignition (ECU comms) 2 — Virtual Battery (alternator based) 4 — Virtual Vibration (accelerometer based) 8 — Virtual Movement (GPS based) 0x20 — VBUS Ignition Pin (tied to pin 8 on external pins)
AND_MODE	UINT8	AND Mode determines Ignition Off behavior if Ignition On state is derived via AND mask. **Value** / **Description** 0 — Any Off 1 — All Off

9.12. Configuration 13: Device Battery Health Monitoring

Configures thresholds and counts which determine whether a battery is normal or low. Thresholds must exceed the configuration count before state transitions occur.

- Low battery threshold is determined by subtracting low battery hysteresis (LBH) from normal battery threshold (NBT).
- The disconnect/reconnect threshold is hard-coded to 6.0 volts.
- From a disconnect state, once the device measures over 6.0 volts for DCC seconds, the device will enter the appropriate power state:
  - Normal if voltage is above NBT
  - Low if voltage is below NBT

Read Schema
!cp:13,“”
Write Schema
!cs:13,NBT,LBH,LBC,NBC,DCC,BER,DC_PERIODIC

Param	Type	Description
NBT	UINT16	Normal battery threshold. (millivolts)
LBH	UINT16	Low battery hysteresis. (millivolts)
LBC	UINT16	Count needed to enter Low Battery state from Normal Battery state. (seconds)
NBC	UINT16	Count needed to enter Normal Battery state from Low Battery state. (seconds)
DCC	UINT16	Count needed to enter Disconnect state from Low/Normal Battery state, or to enter Low/Normal Battery state from Disconnect state. (seconds)
BER	ASCII HEX	Modifies battery event reporting behavior. **Value** — **Description** 0x1 — Low battery event reporting 0x2 — Battery disconnect event reporting 0x4 — Battery reconnect event reporting 0x8 — Battery periodic disconnect reporting
DC_ PERIODIC	UINT16	Battery periodic disconnect report. (minutes)

9.13. Configuration 14: Alternator Detection Configuration

Configures voltage threshold which can be used to determine whether the vehicle alternator is On or Off. Alternator must be detected On before the device attempts vehicle bus communications.

While dynamic modes are enabled, the “On” threshold is determined dynamically by averaging the voltage when the VBUS ignition is Off. The configured hysteresis is then added to that average to derive the new “On” threshold. Once the new threshold is determined, the alternator state works in the same manner as Simple mode: Measured voltage must be above the ONTHS threshold for ONCNT seconds. Once on, the alternator state will return to “Off” when the voltage falls below ONTHS for more than ONCNT seconds.

Read Schema
!cp:14,“”
Write Schema
!cs:14,ONTHS,ONCNT,ONHYST,MODE

Param	Type	Description
ONTHS	*Rev 1*: UINT16 *Rev 0*: UINT8	Starting threshold in tenths of volts. (125 = 12.5)
ONCNT	UINT8	Number of seconds above for On or below for Off.
ONHYST	UINT8	Deadband configuration in tenths of volts. (If ONTHS is 125 and ONHYST is 5, On is ≥ 12.5 V and Off is < 12 V.)
MODE	UINT8	Mask

Value	Description
0	Simple. Uses the 12.5 – 12.0V deadband threshold.
1	Dynamic SMA. On/Off based on a simple moving average.
2	Dynamic EMA. On/Off based on an exponential (fading) moving average.

9.14. Configuration 15: MQTT Identity and Event Configuration

Configures the MQTT client identity and MQTT event topic. CLIENT_ID and EVENT_TOPIC parameters support 'string-factory' variables. It is possible to enter variables into these strings. The following are available variables, where `%` denotes a variable:

- `%p` = Platform number
- `%d` = Device serial number (DSN)
- `%m` = International Mobile Equipment Identity (IMEI)
- `%%` = %

Any unsupported variables will be returned as they are written. For example, `%s` will return `%s`, whereas `%p` will return the platform number.

Example: !cp:15

!cp:15:1,XT%p-%d,/devices/XT%p-%d/events,60,1800,%logtopic,%shadowtopic

OK

CAUTION: SHADOW_TOPIC *must* begin with the CLIENT_ID and must be a subset of the original delta topic. Due to limitations within AWS, follow the example format.

Example: XT2469-182000531/shadow/delta
CLIENT_ID/shadow/delta

If SHADOW_TOPIC is enabled, there must be a rule enabled to redirect delta publishes to a separate topic.

Read Schema
!cp:15,""
Write Schema
Revision 2: !cs:15,MASK,CLIENT_ID,EVENT_TOPIC,KEEPALIVE_S,SESSION_S,BLOB_TOPIC,SHADOW_TOPIC,TRIPSTREAM_TOPIC
Revision 1: !cs:15,MASK,CLIENT_ID,EVENT_TOPIC,KEEPALIVE_S,SESSION_S,LOG_TOPIC,SHADOW_TOPIC,TRIPSTREAM_TOPIC,IMPACT_TOPIC
Revision 0: !cs:15,MASK,CLIENT_ID,EVENT_TOPIC,KEEPALIVE_S,SESSION_S,LOG_TOPIC,SHADOW_TOPIC

Param	Type	Description
MASK	UINT16	The mask defines whether a dynamic trailing string is appended to the event topic.

<table>
<tr><th>Param</th><th>Type</th><th>Description</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0x1</td><td>Appends dynamic trailer. Appends trailer indicating payload formatting and compression scheme. See Configuration 3: GSM Endpoint on p. 108 for details on which formatizer and compression is configured.

String appended dependent on formatizer:

<table>
<tr><th>Formatizer</th><th>Appended String</th></tr>
<tr><td>Msgpack</td><td>/data.msgpack</td></tr>
<tr><td>JSON</td><td>/data.json</td></tr>
</table>

String appended dependent on compression used:

<table>
<tr><th>Compression</th><th>Appended String</th></tr>
<tr><td>LZ4</td><td>.lz4</td></tr>
<tr><td>LZ4X2</td><td>.lz4x2</td></tr>
<tr><td>ZLIB</td><td>.zlib</td></tr>
</table>
</td></tr>
<tr><td>0x2</td><td>Shadow trim topic subscribe. Enables subscription to custom shadow topic for trimmed deltas. This subscription is in place of the default shadow topic.</td></tr>
<tr><td>0x4</td><td>Configuration Sync - Performs a configuration synchronization on transport initialization.</td></tr>
</table>
</td></tr>
<tr><td>CLIENT_ID</td><td>STRING</td><td>Character array that sets the MQTT client identifier. Maximum length 32.

<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>STRING</td><td>MQTT ClientID</td></tr>
</table>
</td></tr>
<tr><td>EVENT_TOPIC</td><td>STRING</td><td>Character array that specifies the MQTT event topic. Maximum length 128.

<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>STRING</td><td>MQTT Event topic</td></tr>
</table>
</td></tr>
<tr><td>KEEPALIVE_S</td><td>UINT16</td><td>AWS keepalive time in seconds. Valid range 60 – 1200 (seconds).</td></tr>
<tr><td>SESSION_S</td><td>UINT16</td><td>Determines how long the device will waits between events before ending the MQTT session.

<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>The device will not disconnect MQTT session</td></tr>
<tr><td>Non-zero</td><td>Number of seconds device waits before disconnecting MQTT session (seconds)</td></tr>
</table>
</td></tr>
</table>

Param	Type	Description
BLOB_TOPIC	STRING	MQTT topic where device publishes both impact and log data. Data published to this resource will always be in an uncompressed Msgpack object with the following format: `{ "TYPE": <type_uint8>, "REV": <rev_uint8>, "CMP": "lz4/lz4x2/zlib", "DATA": <binary_data> (lz4/lz4x2/zlib compressed) }` The `TYPE` field provides what type of data is in the `DATA` field. The `REV` field accounts for a change to the format for the specific type. The `CMP` field is dependent on which compressor is configured in Configuration 3: GSM Endpoint on p. 108. If no compressor is used, the `CMP` field will not be present and the `DATA` field will be uncompressed. If the `CMP` field is present, it will be a string of lz4, lz4x2, or zlib. The `DATA` will then be compressed with that algorithm. The `DATA` field contains the actual log or impact data.
LOG_TOPIC	STRING	Defines the MQTT topic where logs are published.
SHADOW_ TOPIC	STRING	Defines the MQTT topic where trimmed shadow messages are received.
TRIPSTREAM_ TOPIC	STRING	Defines the MQTT topic where tripstream data is received.
IMPACT_TOPIC	STRING	Defines the MQTT topic where impact data is received. **NOTE:** It is mandatory to enter a value in this field but it will be ignored.

9.15. Configuration 16: DNS Cache Configuration

Allows configuration of DNS caching on the device.

Read Schema
!cp:16,“”
Write Schema
!cs:16,FLAGS,TIMETOLIVE

Param	Type	Description
FLAGS	DECIMAL	Modifies event behavior. **Value** – **Description** 0 – Disable DNS caching. 1 – Enable DNS caching.
TIMETOLIVE	UINT32	Seconds for which a DNS cache entry is valid.

9.16. Configuration 17: Ignition On Periodic Reporting Interval

Configures the interval for the periodic reports during a trip (while ignition is determined on).

Read Schema
!cp:17,“”
Write Schema
!cs:17,IP,FLAGS,MAX_REP

Parameter	Type	Description
IP	UINT32	Ignition On Periodic Interval (seconds).
FLAGS	UINT8	Enables/disables ignition on periodic reporting. **Value** – **Description** 0x0 – Disable. 0x1 – Enable.
MAX_REP	UINT8	Reserved; enter 0 in the job write schema.

9.17. Configuration 18: Ignition Off Periodic Reporting Interval

Configures the interval for the periodic reports between trips (while ignition is determined off).

Read Schema
!cp:18,“”
Write Schema
!cs:18,IP,FLAGS

Param	Type	Description
IP	UINT32	Ignition Off Periodic Interval. (seconds)
FLAGS	UINT8	Enables/disables ignition off periodic reporting.

Value	Description
0x0	Disable.
0x1	Enable.

9.18. Configuration 19: Logging

Configures which events trigger logs, the log recording duration, and the channels the logs report on.

Job Read Schema
!cp:19,“”
Job Write Schema
Revision 2: !cs:19,T_MASK,DURATION_S,LOGMASK,LEVMASK,EVMASK[0]EVMASK[1]...EVMASK[8],DESTINATION
Revision 1: !cs:19,T_MASK,DURATION_S,LOGMASK,LEVMASK,EVMASK[0]EVMASK[1]...EVMASK[8]
Revision 0: !cs:19,T_MASK,DURATION_S,LOGMASK,LEVMASK

Param	Type	Description
T_MASK	UINT16	Trigger that will cause logging to begin.

Value	Description
0x01	Ignition On
0x02	Alternator On
0x04	Registration State
0x08	GPS Lock
0x10	Movement Start
0x20	Movement Stop
0x40	Enable logging when any event enabled in EMASK (see below) is stored in the event log. If EVMASK is 0 then this bit will not enable logging.

<table>
<tr><th>Param</th><th>Type</th><th>Description</th></tr>
<tr><td>DURATION_S</td><td>UINT16</td><td>Duration logging will be active. (seconds)</td></tr>
<tr><td>LOGMASK</td><td>UINT16</td><td>Diagnostic channels which are turned on.

<table><tr><th>Value</th><th>Description</th></tr><tr><td>0x001</td><td>GPS</td></tr><tr><td>0x002</td><td>GSM</td></tr><tr><td>0x008</td><td>VBUS</td></tr><tr><td>0x010</td><td>NanoKernel</td></tr><tr><td>0x020</td><td>Event Filesystem</td></tr><tr><td>0x040</td><td>XOR</td></tr><tr><td>0x080</td><td>Backend</td></tr><tr><td>0x100</td><td>Power Management</td></tr><tr><td>0x200</td><td>Geofence</td></tr><tr><td>0x400</td><td>Debugging</td></tr><tr><td>0x800</td><td>XDM</td></tr></table></td></tr>
<tr><td>LEVMASK</td><td>UINT8</td><td>Mask applied to the diagnostic channels.

<table><tr><th>Value</th><th>Description</th></tr><tr><td>0x00</td><td>Off</td></tr><tr><td>0x01</td><td>Debug</td></tr><tr><td>0x02</td><td>Information</td></tr><tr><td>0x04</td><td>Warning</td></tr><tr><td>0x08</td><td>Error</td></tr><tr><td>0x10</td><td>Fatal</td></tr><tr><td>0x20</td><td>Trace</td></tr><tr><td>0xFF</td><td>All</td></tr></table></td></tr>
<tr><td>EVMASK</td><td>ASCII HEX</td><td>EVMASK[0]

<table><tr><th>Value</th><th>Description</th></tr><tr><td>0x01</td><td>Reserved</td></tr><tr><td>0x02</td><td>Ignition On (1)</td></tr><tr><td>0x04</td><td>Ignition Off (2)</td></tr><tr><td>0x08</td><td>Periodic Ignition On (3)</td></tr><tr><td>0x10</td><td>Periodic Ignition Off (4)</td></tr><tr><td>0x20</td><td>Power Up (5)</td></tr><tr><td>0x40</td><td>Power Up GPS (6)</td></tr><tr><td>0x80</td><td>Power Up GSM (7)</td></tr></table>
EVMASK[1]</td></tr>
</table>

Param	Type	Description

Value	Description
0x01	Low Battery (8)
0x02	Acceleration (9)
0x04	Acceleration VBUS (10)
0x08	Acceleration GPS (11)
0x10	Stage 0 Periodic (12)
0x20	Stage 1 periodic (13)
0x40	Stage 2 Periodic (14)
0x80	Battery Disconnect (15)

EVMASK[2]

Value	Description
0x01	Battery Reconnect (16)
0x02	Battery Disconnect Periodic (17)
0x04	Direction Change (18)
0x08	Speed VBUS (19)
0x10	Speed GPS (20)
0x20	Geofence Crossing (21)
0x40	Unused
0x80	Odometer VBUS (23)

EVMASK[3]

Value	Description
0x01	Odometer GPS (24)
0x02	Input 1 Set (25)
0x04	Input 1 Clear (26)
0x08	Input 2 Set (27)
0x10	Input 2 Clear (28)
0x20	Input 3 Set (29)
0x40	Input 3 Clear (30)
0x80	N/A

EVMASK[4]

Value	Description
0x01	Output Manual Override (32)
0x02	Diagnostics (33)
0x04	Movement Start (34)
0x08	Movement Stop (35)
0x10	System Report 0 (36)
0x20	System Info (37)

Param	Type	Description

Value	Description
0x40	Park (38)
0x80	Idle Start (39)

EVMASK[5]

Value	Description
0x01	Idle Stop (40)
0x02	Idle Periodic (41)
0x04	Power Up Best Time (42)
0x08	ADC Threshold (43)
0x10	ADC Periodic (44)
0x20	N/A
0x40	N/A
0x80	N/A

EVMASK[6]

Value	Description
0x01	Motion (48)
0x02	No-Motion (49)
0x04	Motion Periodic (50)
0x08	No-Motion Periodic (51)
0x10	powerstage Transition (52)
0x20	Unused
0x40	N/A
0x80	N/A

EVMASK[7]

Value	Description
0x01	Accel Positive X Threshold (56)
0x02	Accel Negative X Threshold (57)
0x04	Accel Positive Y Threshold (58)
0x08	Accel Negative Y Threshold (59)
0x10	Accel Orientation (60)
0x20	Faulty Alternator (61)
0x40	N/A
0x80	Watchdog (63)

EVMASK[8]

Value	Description
0x01	N/A

<table>
<tr><th>Param</th><th>Type</th><th>Description</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0x02</td><td>Scantool Detection (65)</td></tr>
<tr><td>0x04</td><td>N/A</td></tr>
<tr><td>0x08</td><td>N/A</td></tr>
<tr><td>0x10</td><td>Input 4 Set (68)</td></tr>
<tr><td>0x20</td><td>Input 4 Clear (69)</td></tr>
<tr><td>0x40</td><td>N/A</td></tr>
<tr><td>0x80</td><td>Snapshot (71)</td></tr>
</table>
EVMASK[9]
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0x01</td><td>DTC (72)</td></tr>
<tr><td>0x02</td><td>N/A</td></tr>
<tr><td>0x04</td><td>N/A</td></tr>
<tr><td>0x08</td><td>N/A</td></tr>
<tr><td>0x10</td><td>N/A</td></tr>
<tr><td>0x20</td><td>N/A</td></tr>
<tr><td>0x40</td><td>N/A</td></tr>
<tr><td>0x80</td><td>N/A</td></tr>
</table>
</td></tr>
<tr><td>DESTINATION</td><td>UINT8</td><td>Destination where logging data is sent.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0x0</td><td>Customers server as specified in Configuration 3: GSM Endpoint on p. 108</td></tr>
<tr><td>0x1</td><td>Sensata's PIDs server</td></tr>
</table>
</td></tr>
</table>

9.19. CONFIGURATION 21: EVENT LOG TRIP BUFFERING

Configures the overall trip-log buffering strategies for the device. Configurable features include a trigger-event mask, a buffer collection timeout and a raw buffer size threshold.

Read Schema

!cp:21,“”

Write Schema

Revision 1: !cs:21,FLAGS,SECONDS,SIZE
Revision 0: !cs:21,SECONDS,SIZE

Param	Type	Description
FLAGS	UINT16	Dynamic array flag. When enabled, the array should only be used if necessary. **Value** — **Description** 0x0 — Default event reporting. 0x1 — Enable dynamic arrays. 0x2 — SEQ. Setting this flag causes the MessagePack event payload to be wrapped with a volatile event counter.
SECONDS	UINT16	This data-latency-threshold timer (seconds) starts when the first entry is placed into the event buffer. When this timer expires AND another event is generated, the buffer will be flushed (packaged and sent to server). • Configuring this as 0 has the effect of disabling buffering entirely.
SIZE	UINT16	Raw output buffer size (bytes) threshold. When this threshold is reached the buffer is flushed (packaged and sent to server). • Max 8 kilobytes. • Configuring this as 0 has the effect of disabling buffering entirely.

9.20. Configuration 22: Compression Type

Configures the type of compression/decompression used for message reporting.

NOTE: This configuration is in the process of being deprecated, Compression Type is now set in Configuration 3: GSM Endpoint on p. 108

Read Schema
!cp:22,""
Write Schema
!cs:22,MODE

Param	Type	Description
MODE	UINT8	Compression type used.

Value	Description
0	None
1	LZ4

9.21. Configuration 23: VBUS Mask

VBUSMASK determines which parameters are queried in session detect and session start states.

Read Schema
!cp:23,""
Write Schema
!cs:23,DETECT_MASK,START_MASK,MODE

Param	Type	Description
DETECT_ MASK	ASCII HEX	Mask of parameters queried during a VBUS session detect state. These are only queried after power cycle.

Value	Name	Description
0x00000001	VIN.	Enable VIN read.
0x00000002	LILHAMMER_ END.	Not used.
0x00000004	BIGHAMMER END.	Speed == 0 and stale RPM for 30 seconds ends the session.
0x00000008	BACKOFF_OBDII	Backoff on detection of OBDII scantool requests.
0x00000010	BACKOFF_	Backoff on detection of

Param	Type	Description

Value	Name	Description
	ONSTAR	proprietary ONSTAR requests.
0x00000020	BACKOFF_ DIAGSESSION	Backoff on detection of proprietary start of a diagnostic session.
0x00000040	BACKOFF_TP	Backoff on detection of proprietary tester present message.
0x00000080	BACKOFF_ SECURITY	Backoff on detection of proprietary request to set security mode.
0x00000100	TRIP_DELAY	Delay vehicle bus communications for 10 seconds after an ignition on state.
0x00000200	BACKOFF_ ENDTRIP	When a backoff is detected, the trip is ended and the device waits for the next ignition cycle to restart vehicle communications.
0x00000400	J1708_ONLY	Set the vehicle as a J1708/J1587 vehicle only.
0x80000000	PIDS	Enable proprietary PID feature.

START_MASK — ASCII HEX

Mask of parameters that are either queried at trip start, or enable filters that force a backoff. This difference is denoted in parentheses in each field.

Value	Description
0x04	Freeze Frame (only queried at trip start).
0x08	DTC (used instead of the DTC nugget).

MODE — UINT8

Selects standard OBDII or proprietary PID mode. PPID mode is only supported with ISO15765-4 CAN-BUS vehicles.

Value	Description
0	Normal.
255	Disables vehicle communication.

9.22. CONFIGURATION 24: ACCELERATION THRESHOLD VBUS

Configures the VBUS acceleration event trigger threshold.

Read Schema
Revision 1: !cp:24,INDEX
Revision 0: !cp:24,""
Write Schema
Revision 1: !cs:24,INDEX,ENABLED,POS_THS,NEG_THS
Revision 0: !cs:24,ENABLED,POS_THS,NEG_THS

Param	Type	Description
INDEX	UINT8	Index of acceleration threshold configuration. (0 - 2)
ENABLED	UINT8	This parameter determines whether the VBUS acceleration threshold, and associated event ([10] Acceleration VBUS on p. 28), are enabled. **Value** **Description** 0 Disabled 1 Enabled
POS_THS	UINT16	This parameter controls the threshold for acceleration, as measured over the vehicle bus at a frequency of 1hz, which will trigger an ACCELVBUS event upon being crossed. • Tenths of kilometers-per-hour, per second
NEG_THS	UINT16	This parameter controls the threshold for deceleration, as measured over the vehicle bus at a frequency of 1hz, which will trigger an ACCELVBUS event upon being crossed. • Tenths of kilometers-per-hour, per second

9.23. CONFIGURATION 25: GPS ACCELERATION THRESHOLD

Configures the GPS acceleration event trigger threshold.

Read Schema
Revision 1: !cp:25,INDEX *Revision 0:* !cp:25,“”
Write Schema
Revision 1: !cs:25,INDEX,ENABLED,POS_THS,NEG_THS *Revision 0:* !cs:25, “ENABLED,POS_THS,NEG_THS

Param	Type	Description
INDEX	UINT8	Index of acceleration threshold configuration. (0 - 2)
ENABLED	ASCII HEX	This parameter determines whether the GPS acceleration threshold, and associated event ([11] Acceleration GPS on p. 29), are enabled. **Value** **Description** 0 Disabled 1 Enabled
POS_THS	UINT16	This parameter controls the threshold for acceleration, as measured by the GPS at a frequency of 1hz, which will trigger an ACCELGPS event upon being crossed. • Tenths of kilometers-per-hour, per second
NEG_THS	UINT16	This parameter controls the threshold for deceleration, as measured by the GPS at a frequency of 1hz, which will trigger an ACCELGPS event upon being crossed. • Tenths of kilometers-per-hour, per second

9.24. CONFIGURATION 26: POWER STAGE PMU MODES

Configures the desired PMU mode for each stage.

Read Schema
!cp:26,PSIDX,PMUIDX
Write Schema
!cs:26,PSIDX,PMUIDX,PMUID,PMUMODE

Param	Type	Description
PSIDX	INDEX	Power stage index. **Value** – **Description** 0 – PS0 1 – PS1 2 – PS2
PMUIDX	INDEX	PMU index, valid inputs: 0 - 2
PMUID	UINT8	ID of configurable PMU. **Value** – **Description** 1 – Cellular module 2 – GPS module 3 – Primary microcontroller
PMUMODE	UINT8	Desired power mode of the PMU **Cellular (PMU ID: 1)** 1 – Cellular Module On 2 – Cellular Module Off 3 – Cellular Module Low Power **GPS (PMU ID: 2)** 1 – GPS Module On 2 – GPS Module Off 4 – GPS Module Power Supply Off **Microcontroller (PMU ID: 3)** 1 – Microcontroller Running 2 – Microcontroller Deep Sleep

9.25. CONFIGURATION 27: POWER STAGE TRANSITION

Configures the criteria which triggers a power stage transition.

Read Schema
Revision 1: !cp:27,TCIDX
Revision 0: !cp:27,PSTIDX, TCIDX
Write Schema
Revision 1: !cs:27,TCIDX:SRC,DST,ENABLED,ID,AGE,THS,TYPE
Revision 0: !cs:27,PSTIDX,TCIDX,ENABLE,ID,AGE,THS,TYPE

Parameter	Type	Description
PSTIDX	INDEX	Power stage transition index.

Value	Description
0	PS0 to PS1
1	PS1 to PS2
2	PS2 to PS1
3	PS1 to PS0
4	PS0 to PS2
5	PS2 to PS0

Parameter	Type	Description
TCIDX	INDEX	Transition criterion index.

Revision	Range
0	0 - 7
1	0 - 47

Parameter	Type	Description
SRC	UINT8	The starting power stage.

Value	Description
0	PS0
1	PS1
2	PS2

Parameter	Type	Description
DST	UINT8	The destination power stage.

Value	Description
0	PS0
1	PS1
2	PS2

<table>
<tr><th>Parameter</th><th>Type</th><th>Description</th></tr>
<tr><td>ENABLE</td><td>UINT8</td><td>Enable/Disable Power Stage Transition Event.
<table><tr><th>Value</th><th>Description</th></tr><tr><td>0x0</td><td>Disable this criterion.</td></tr><tr><td>0x1</td><td>Enable this criterion.</td></tr></table></td></tr>
<tr><td>ID</td><td>UINT8</td><td>ID of configurable criteria.

NOTE: Iobox must be connected for Input 1/2/3/4 to be available in deep sleep. Currently, the only supported mask in deepsleep is 0x3 - clear->set and set->clear

NOTE: If any ADCs are configured for the external ADC on the I/O Box they will only work properly if an I/O Box is connected. They will not work in deepsleep.
<table><tr><th>Value</th><th>Description</th><th>Deep Sleep</th></tr><tr><td>0</td><td>Ignition off</td><td>Not Available</td></tr><tr><td>1</td><td>Ignition on</td><td>Not Available</td></tr><tr><td>2</td><td>ADC Main above threshold</td><td>Yes</td></tr><tr><td>3</td><td>ADC Main below threshold</td><td>Yes</td></tr><tr><td>4</td><td>Motion / No Motion detected</td><td>Yes</td></tr><tr><td>6</td><td>Vibration</td><td>Yes</td></tr><tr><td>7</td><td>InStage (minimum time in current stage)</td><td>Yes</td></tr><tr><td>10</td><td>Input 1</td><td>Limited. See limitation note above.</td></tr><tr><td>11</td><td>Input 2</td><td>Limited. See limitation note above.</td></tr><tr><td>12</td><td>Input 3</td><td>Limited. See limitation note above.</td></tr><tr><td>13</td><td>Shock</td><td>Yes</td></tr><tr><td>19</td><td>GSMRI. Cell ring indicator pin, only SMS currently supported.</td><td>Yes</td></tr><tr><td>20</td><td>User 0</td><td>No</td></tr><tr><td>21</td><td>User 1</td><td>No</td></tr><tr><td>22</td><td>Input 4</td><td>Limited. See</td></tr></table></td></tr>
</table>

Parameter	Type	Description

Value	Description	Deep Sleep
		limitation note above.
24	Timer A	No
25	Timer B	No
26	Timer C	No
27	Timer D	No
30	GSM registration state	No
31	ADC 0	Yes. See limiation note above.
32	ADC 1	Yes. See limiation note above.
33	ADC 2	Yes. See limiation note above.

AGE — UINT32

Length of time (seconds) criteria must be true. The Input 1 and Input 2 criteria correlate to the Input Mask bits specified in the THS parameter.

Criterion availability from the following power stages:

Criterion
Ignition off
Ignition on
ADC Main above threshold
ADC Main below threshold
Motion/No-motion
Vibration
InStage (min time in current stage)
Input 1 Clear to Set
Input 1 Set to Clear
Input 1 Set
Input 1 Clear
Input 2 Clear to Set
Input 2 Set to Clear
Input 2 Set
Input 2 Clear
Input 3 Clear to Set
Input 3 Set to Clear
Input 3 Set
Input 3 Clear
Shock

Parameter	Type	Description
		Criterion GSMRI User 0 User 1 Input 4 Clear to Set Input 4 Set to Clear Input 4 Set Input 4 Clear Timer A Timer B Timer C Timer D GSM registration state ADC 0 ADC 1 ADC 2
THS	INT32	Threshold configuration parameter lists either units or the mask.

Criterion	Type	Description
Ignition off	Not Used	N/A
Ignition on	Not Used	N/A
ADC Main above threshold	Threshold	Threshold in millivolts
ADC Main below threshold	Threshold	Threshold in millivolts
Motion / No Motion	Mask	When the following bits are set, they look to the AGE parameter and not the motion/no-motion configuration.
Vibration	Not Used	N/A
InStage	Not Used	N/A

Transition Mask	
0x1	No-motion to motion
0x2	Motion to no-motion
0x4	Motion periodic
0x8	No-motion periodic

Parameter	Type	Description		
		Criterion	**Type**	**Description**
		Input 1	Mask	**Input Mask** 0x1 Clear to Set 0x2 Set to Clear 0x4 Set 0x8 Clear
		Input 2	Mask	**Input Mask** 0x1 Clear to Set 0x2 Set to Clear 0x4 Set 0x8 Clear
		Input 3	Mask	**Input Mask** 0x1 Clear to Set 0x2 Set to Clear 0x4 Set 0x8 Clear
		Shock	Not Used	N/A
		GSMRI	Not Used	N/A
		User 0	Threshold	Must be set to 1.
		User 1	Threshold	Must be set to 1.
		Input 4	Mask	**Input Mask** 0x1 Clear to Set 0x2 Set to Clear 0x4 Set 0x8 Clear
		TIMER (A,B,C,D)	Mask	Timer Criterion. **Transition Mask** 0x00001 Ignition off. 0x00002 Ignition on. 0x00010 Motion. 0x00020 No-Motion. 0x00040 Battery low. 0x00080 Battery normal. 0x00100 Input 1 set.

<table>
<tr><th>Parameter</th><th>Type</th><th>Description</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th>Criterion</th><th>Type</th><th>Description</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th colspan="2">Transition Mask</th></tr>
<tr><td>0x00200</td><td>Input 1 clear.</td></tr>
<tr><td>0x00400</td><td>Input 2 set.</td></tr>
<tr><td>0x00800</td><td>Input 2 clear.</td></tr>
<tr><td>0x01000</td><td>Input 3 set.</td></tr>
<tr><td>0x02000</td><td>Input 3 clear.</td></tr>
<tr><td>0x04000</td><td>Input 4 set.</td></tr>
<tr><td>0x08000</td><td>Input 4 clear.</td></tr>
</table>
</td></tr>
<tr><td>GSM registration state</td><td>Threshold</td><td>
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Not registered.</td></tr>
<tr><td>1</td><td>Registered.</td></tr>
</table>
</td></tr>
<tr><td>ADCx</td><td>Threshold</td><td>See Configuration 52: ADC Basic on p. 166 for more information.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Below threshold 1</td></tr>
<tr><td>1</td><td>Above threshold 1</td></tr>
<tr><td>2</td><td>Below threshold 2</td></tr>
<tr><td>3</td><td>Above threshold 2</td></tr>
</table>
</td></tr>
</table>
</td></tr>
<tr><td>TYPE</td><td>UINT8</td><td>Transition will trigger if all AND are true, or any OR criteria are true. All criteria are forced to use OR type when transitioning from a power stage that has the micro-controller configured for deep sleep.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>None</td></tr>
<tr><td>1</td><td>AND</td></tr>
<tr><td>2</td><td>OR</td></tr>
</table>
</td></tr>
</table>

9.26. CONFIGURATION 28: SNAPSHOT CONFIGURATION

Configures the conditions under which the device temporarily transitions out of a power stage to report a periodic power stage event (Events [12] Stage 0 Periodic on p. 29, [13] Stage 1 Periodic on p. 29, and [14] Stage 2 Periodic on p. 29). The device then transitions back to the previous power stage.

If the device is in deep sleep, it will transition from deep sleep to send a periodic power stage event and then return to deep sleep.

Read Schema
!cp:28,SSIDX
Write Schema
!cs:28,SSIDX,W_CONFIRM, W_GPS,W_NET, FLAGS

Parameter	Type	Description
SSIDX	INDEX DECIMAL	Snapshot index, each power stage has a unique snapshot. I.e. Power stage 0 is connected to Snaphot 0. **Value** **Description** 0 SS0 1 SS1 2 SS2
W_CONFIRM	UINT32	The max amount of time the device waits for the event to be sent before transitioning back to the previous power stage.
W_GPS	UINT32	Number of seconds to wait for GPS lock before creating snapshot event.
W_NET	UINT32	Number of seconds to wait for network registration before creating snapshot event.
FLAGS	DECIMAL	Flags mask to enable snapshot behavior options. **Value** **Description** 1 Wait GPS Lock 2 Wait Network 4 Deliver 8 Snapshot Delivery Confirm 16 Deep Snap Filter (enables sending ONLY periodic power stage events in snapshot). 32 Wait Max. Forces device to stay in snapshot mode for a configurable number of seconds. 64 Disable periodic power stage events (12, 13, 14).

9.27. CONFIGURATION 29: ACCELEROMETER SHOCK/VIBRATION

Configures the conditions under which the device records an accelerometer event. If this threshold is enabled and exceeded by any one accelerometer vector for the set duration, a shock event will be generated and the accelerometer code will collect the last 100 samples from the buffer, which will be reported in Parameter 53: ACC (Accelerometer) on p. 70.

Read Schema
!cp:29,“”
Write Schema
Revision 1: !cs:29,ENABLED,THRESH_SHOCK,DURATION,THRESH_VIBRATION,FREQUENCY_HZ
Revision 0: !cs:29,ENABLED,THRESH_SHOCK,DURATION,THRESH_VIBRATION

Parameter	Type	Description
ENABLED	DECIMAL	Enable/Disable Accelerometer Event. **Value** — **Description** 0 — Disable. 1 — Enable.
THRESH_SHOCK	UINT16	Threshold is measured in milli-Gs and is used for shock detection. Valid range is 0 to 2000.
DURATION	UINT16	Duration is measured in milliseconds.
THRESH_ VIBRATION	UINT16	Threshold is measured in milli-Gs and is used for vibration detection. Valid range is 0 to 2000.
FREQUENCY_HZ	UINT16	Sample rate of accelerometer vectors in Hz. The only valid value is 100.

9.28. CONFIGURATION 30: BEST TIME CONFIGURATION

Sets the priority of the time source vs. cellular time and the maximum age of the prioritized value before it switches to the deprioritized value when available.

Setting this value to zero will disable switching to the lower priority time source and will always use the prioritized time source + system RTC if available.

Read Schema
Revision 1: !cp:30,TIME_TTL, PRIORITY
Revision 0: !cp:30, TIME_TTL
Write Schema
Revision 1: !cs:30,TIME_TTL, PRIORITY
Revision 0: !cs:30,TIME_TTL

Param	Type	Description
TIME_TTL	UINT32	Configure threshold or disable switch to lower priority time source. **Value** — **Description** 0 — Always use the prioritized time source + system RTC if available. Non-zero — Duration in seconds before switching to the lower priority time source. Recommended range is 21600 seconds (6 hours) to 86400 seconds (1 day).
PRIORITY	UINT8	Allows the prioritization of real GPS or real GSM time sources. If no available, priority is given to time sources with GPS older than 1 second above cell time. See note in Parameter 50: BT (Best Time) on p. 68. **Value** — **Description** 0 — GPS_REAL 1 — GSM_REAL

9.29. CONFIGURATION 33: BUZZER CONFIGURATION

Allows configuration of buzzer songs, and their triggers. Buzzer songs must include at least 1 frequency/duration pair and may include up to 10 pairs.

Read Schema
Revision 1: !cp:33,INDEX
Revision 0: !cp:33,“”
Write Schema
Revision 1: !cs:33,INDEX,VOLUME,MASK,DEBOUNCE_S[,FRQ,DUR]
Revision 0: !cs:33,VOLUME,MASK[,FRQ,DUR]

Param	Type	Description
INDEX	UINT8	Song index that is being set/requested.(0 - 4)
VOLUME	UINT8	Volume as a percentage of max. (1 - 100)
MASK	ASCII HEX	This mask defines which things trigger this buzzer song.

Value	Description
0x001	Ignition On
0x002	Speed threshold exceeded
0x008	Accel/Decel (GPS 0) threshold exceeded
0x010	Accel/Decel (VBUS 0) threshold exceeded
0x020	Idle Start
0x040	Idle Periodic
0x080	Accel/Decel (GPS 1) threshold exceeded
0x100	Accel/Decel (GPS 2) threshold exceeded
0x200	Accel/Decel (VBUS 1) threshold exceeded
0x400	Accel/Decel (VBUS 2) threshold exceeded
0x800	Ignition Off
0x1000	Driver ID . Triggers a buzzer song anytime the driver ID is set. The buzzer will not trigger if Bluetooth connection is lost or the driver ID is reset to zero.

DEBOUNCE_S	UINT16	Debounce time in seconds. This prevents a triggered buzzer song from being played within a certain number of seconds from the previous time it was played.
FRQ	UINT16	Frequency in Hz.
DUR	UINT16	Duration in milliseconds.

9.30. CONFIGURATION 34: DIRECTION CHANGE

Configures the direction change event trigger criteria.

Read Schema
!cp:34,“”
Write Schema
Revision 1: !cs:34,FLAGS,SPD_THS,HEAD_THS,EXPIRE_MS *Revision 0:* !cs:34,FLAGS,SPD_THS,HEAD_THS

Param	Type	Description
FLAGS	UINT8	Event flags. **Value** / **Description** 0x0 – Disable direction change reporting. 0x1 – Enable direction change reporting. 0x2 – Expire Immediately.
SPD_THS	UINT8	GPS-based speed (kph) must be above this threshold in order to send direction change events.
HEAD_THS	UINT16	Triggers the event if the GPS-based heading changes by more than this amount from the last time this event was sent (Tenths of degrees). A value of 0 will inhibit [18] Direction Change on p. 30
TIMEOUT_MS	UINT16	Timeout in milliseconds used to determine when to invalidate the pinned heading for event [18] Direction Change on p. 30. If 0x2 (expire immediately) is set this parameter is ignored.

9.31. CONFIGURATION 35: VBUS SPEED THRESHOLD

Configures the speed threshold exceeded event trigger criteria. If this threshold is enabled, and is exceeded by VBUS speed (calculated at 1hz), an event will be generated. After the threshold has been exceeded, the speed must fall below the threshold minus hysteresis for the event to be enabled again.

Read Schema
!cp:35,“”
Write Schema
Revision 1: !cs:35,ENABLE,SPD_THS,HYST,TIME *Revision 0:* !cs:35,ENABLE,SPD_THS,HYST

Param	Type	Description
ENABLE	UINT8	Modifies event behavior. **Value** – **Description** 0x0 – Disable VBUS speed reporting. 0x1 – Enable VBUS speed reporting.
SPD_THS	UINT8	VBUS-based speed threshold (kph) to trigger event.
HYST	UINT8	After this event has been triggered, speed must fall below ("SPD_THS" – “HYST”) before this event can occur again. (kph)
TIME	UINT8	Time in seconds speed must be above the threshold to trigger an event.

9.32. CONFIGURATION 36: GPS SPEED THRESHOLD

Configures the speed threshold exceeded event trigger criteria. If this threshold is enabled, and is exceeded by GPS speed (calculated at 1hz), an event will be generated. After the threshold has been exceeded, the speed must fall below the threshold minus hysteresis for the event to be enabled again.

Read Schema
!cp:36,“”
Write Schema
!cs:36,ENABLE,SPD_THS,HYST

Param	Type	Description
ENABLE	UINT8	Enables/disables GPS speed reporting. **Value** – **Description** 0x0 – Disable. 0x1 – Enable.
SPD_THS	UINT8	GPS-based speed threshold (kph) to trigger event.
HYST	UINT8	After this event has been triggered, speed must fall below ("SPD_THS" – “HYST”) before this event can occur again. (kph)

9.33. CONFIGURATION 37: GENERAL GEOFENCE

Allows configuration of geofences. These settings are applied to all added geofences. XT2500 supports the following:

- 11-point polygons
- circle, rectangle (stored as 2 points), and polygon fences
- 3 concentric fences (the device can be inside or integrating into 3 fences max)
- 500 total fences

Read Schema
!cp:37,“”
Write Schema
!cs:37,MASK,TIMEOUT,ENTER_S,EXIT_S

Parameter	Type	Description
MASK	ASCII HEX	Enables/disables Timeout. **Value** — **Description** 0 — Disable. 1 — Enable.
TIMEOUT	UINT16	Timeout in seconds. If the timeout is enabled in the mask, this will cause an exit from any entered geofences after this number of seconds has elapsed without GPS lock.
ENTER_S	UINT8	Number of consecutive seconds device must be inside a fence before declared inside.
EXIT_S	UINT8	Number of consecutive seconds device must be outside a fence before declared outside.

9.34. CONFIGURATION 38: VBUS ODOMETER THRESHOLD

Configures the criteria used to trigger an odometer threshold exceeded event. If this thresh is enabled, and is exceeded by 1 kilometer (calculated at 1hz) an event will be generated.

Read Schema
!cp:38,“”
Write Schema
!cs:38,ENABLE,THRESH

Param	Type	Description
ENABLE	UINT8	Enables/disables VBUS odometer threshold. **Value** – **Description** 0 – Disable. 1 – Enable.
THRESH	UINT32	Sets the distance interval between VBUS odometer threshold exceeded events. (kilometers)

9.35. CONFIGURATION 39: GPS ODOMETER THRESHOLD

Configures the criteria used to trigger an odometer threshold exceeded event. If this thresh is enabled, and is exceeded by 1 kilometer (calculated at 1hz) an event will be generated.

Read Schema
!cp:39,“”
Write Schema
!cs:39,ENABLE,THRESH

Parameter	Type	Description
FLAGS	DECIMAL	Enables/disables GPS odometer threshold. **Value** – **Description** 0 – Disable. 1 – Enable.
THRESH	UINT32	Sets the distance interval between GPS odometer threshold exceeded events. (meters)

9.36. CONFIGURATION 43: HEARTBEAT

The Heartbeat configuration causes a heartbeat event to be generated after the configured time.

Read Schema
!cp:43,“”
Write Schema
!cs:43,FLAGS,INTERVAL_S

Param	Type	Description
FLAGS	ASCII HEX	Enables/disables heartbeat reporting. **Value** — **Description** 0 — Disable. 1 — Enable.
INTERVAL_S	UINT32	Sets the interval timer in seconds. After this time elapses, an event is generated if the flags parameter is enabled.

9.37. CONFIGURATION 44: OUTPUT

Determines the Output pin function and override configuration.

Read Schema
!cp:44,“”
Write Schema
!cs:44,ID,FLAGS,N_MANOVER,MANOVER_M,STATE,GSMOVER_M

Parameter	Type	Description
OUTPUT_ID	UINT8	Defines the output ID to be configured. **Value** – **Description** 1 – Output 1. 2 – Output 2.
FLAGS	UINT8	Enables/disables GSM registration loss override. **Value** – **Description** 0x0 – Disable. 0x1 – Enable.
AMO	UINT8	Allowed Manual Overrides. The number of manual overrides that can occur.
MOM	UINT32	Manual Override Minutes. The number of minutes the override will apply for when an override is triggered.
STATE	UINT8	The current desired state of the starter control pin. **Value** – **Description** 0 – Vehicle starter is enabled (vehicle can start). 1 – Vehicle starter is disabled (vehicle cannot start).
GOM	UINT32	Length of time in minutes the device needs to continuously not have a GSM connection before a GSM override is applied to the output.

9.38. CONFIGURATION 45: VEHICLE MOVEMENT DETECTION

Configures the criteria used to determine whether a device is moving.

Read Schema
!cp:45,“”
Write Schema
!cs:45,FLAGS,START_THS,STOP_THS,START_S,STOP_S

Parameter	Type	Description
FLAGS	DECIMAL	Enables/disables generation of the vehicle movement detection event(s). See events [34] Movement Start on p. 33 and [35] Movement Stop on p. 33 **Value** — **Description** 0 — Disable. 1 — Enable.
START_THS	UINT8	Threshold speed for determining movement has started (KPH).
STOP_THS	UINT8	Threshold speed for determining movement has stopped (KPH).
START_S	UINT16	Time in seconds needed to be above the start threshold to transition to a moving state.
STOP_S	UINT16	Time in seconds needed to be below the stop threshold to transition to a stopped state.

9.39. CONFIGURATION 46: XIRGO GATEWAY SERVICE

Configures the check-in behavior for PPIDs and where they report to.

Read Schema
!cp:46,“”
Write Schema
!cs:46,FLAGS,HOST,PORT,INTERVAL_S

Param	Type	Description
FLAGS	UINT32	Controls the PPID check-in behavior. **Value** — **Description** 0x1 — Enables PPID check-in when a new VIN is discovered. 0x2 — Enables Periodic check-ins at the configured interval. 0x4 — Causes the device to refuse updates for the nanokernel or the vec_bin from XGS if it remains plugged into the same vehicle. If this flag is still set when the device is plugged into a new vehicle, receipt of a new nanokernel and vec_ bin will be allowed once when it recieves a new VIN, after which updates will continue to be prevented. 0x8 — Skips downloads when all pins are configured.
HOST	UINT8	Resource address where check-in messages and sent and NK artifacts are retrieved from.
PORT	UINT16	Resource port.
INTERVAL_S	UINT32	Interval between periodic check-ins (a periodic check-in can only be triggered at ignition off).

9.40. CONFIGURATION 47: FTP SETTINGS

Configures FTP authentication and endpoint information, and determines active or passive FTP mode.

Read Schema
!cp:47,“”
Write Schema
!cs:47,MODE

Param	Type	Description
MODE	UINT8	Determines FTP mode. **Value** — **Description** 0 — Active. (default) 1 — Passive.

9.41. CONFIGURATION 48: SYSTEM INFORMATION EVENT

Allows configuration of when the system info event is recorded.

Read Schema
Revision 1: !cp:48,INDEX
Revision 0: !cp:48,“”
Write Schema
Revision 1: !cs:48,INDEX,OR_MASK,AND_MASK,FLAGS,INTERVAL_S
Revision 0: !cs:48,OR_MASK,AND_MASK,FLAGS,INTERVAL_S

Param	Type	Description
INDEX	UINT8	Valid range is 0-2.
OR_MASK	ASCII HEX	OR mask. **Value** / **Description** 0x01 – Update. 0x02 – Ignition on. 0x04 – Ignition off.
AND_MASK	ASCII HEX	AND mask. **Value** / **Description** 0x01 – Update. 0x02 – Ignition on. 0x04 – Ignition off.
FLAGS	ASCII HEX	Flags mask. **Value** / **Description** 0x1 – Asserted. 0x2 – Not asserted.
INTERVAL_S	UINT32	Periodic System Information Event reporting interval in seconds.

9.42. CONFIGURATION 49: PARK TIME THRESHOLD

Determines when the device will send a park time threshold exceeded event.

NOTE: This feature does not work with Virtual GPS Ignition Type.

Read Schema
!cp:49,“”
Write Schema
!cs:49,FLAGS,PT_THRESH

Parameter	Type	Description
FLAGS	ASCII HEX	Enables/disables the park detection event. **Value** — **Description** 0 — Disable. 1 — Enable.
PT_THRESH	UINT32	Park Time threshold in seconds.

9.43. CONFIGURATION 50: IDLE DETECTION THRESHOLDS

Configures the idle start, stop, and periodic events.

Read Schema
!cp:50,“”
Write Schema
!cs:50,IDM,IDT,IDS,IDP

Parameter	Type	Description
IDM	DECIMAL	Idle Report Mask. **Value** – **Description** 0 – None (default) 1 – Start Alert 2 – Stop Alert 4 – Periodic Alert
IDT	UINT32	Idle time start threshold in seconds.
IDS	UINT32	Idle time stop threshold in seconds.
IDP	UINT32	Idle time periodic threshold in seconds.

9.44. CONFIGURATION 52: ADC BASIC

Basic ADC configuration determines how physical ADCs are tied to specific functions and threshold event reporting.

Read Schema
!cp:52,INDEX
Write Schema
!cs:52,IDX,PADC,FLAGS,EVMASK,THRESHOLD1,THRESHOLD2

Parameter	Type	Description
IDX	UINT8	Index of logical ADC being configured. (0 - 4)
PADC	UINT8	Selects the physical ADC the logical ADC uses for input. **Value** – **Description** 0 – None. 1 – Main voltage. 2 – Battery voltage. 3 – External ADC 1.

Parameter	Type	Description
FLAGS	ASCII HEX	Selects additional options for the ADC. **Value** / **Description** 0x1 – Enable advanced configuration. 0x2 – Reserved. 0x4 – Interpret as wired ignition (THRESHOLD1 parameter acts as the logic level threshold when this is set).
EVMASK	ASCII HEX	Determines when to send ADC event. **Value** / **Description** 0x1 – Above threshold 1. 0x2 – Below threshold 1. 0x4 – Above threshold 2. 0x8 – Below threshold 2.
THRESHOLD1	UINT16	Voltage (in mV) threshold event trigger 1.
THRESHOLD2	UINT16	Voltage (in mV) threshold event trigger 2.

9.45. Configuration 53: ADC Advanced

Advanced ADC configuration allows classification and tracking of input voltages, threshold duration, and hysteresis settings.

The index defines the logical ADC, multiple logical ADCs may use a single physical ADC as its source.

NOTE: THS1 and THS2 are configured in ADC (Configuration 52) of the same index.

The threshold above/below count determines how long the voltage must be above/below the threshold before a state-change is detected.

The threshold above/below hysteresis determines how much above/below the threshold a voltage must be before a state-change is detected.

Read Schema
!cp:53,IDX
Write Schema
!cs:53,IDX,THS1_AC,THS1_BC,THS2_AC,THS2_BC,THS1_AH,THS1_BH,THS2_AH,THS2_BH,LL_PER_S,HL_PER_S,LH_PER_S,HH_PER_S,PER_EVENTMASK

Parameter	Type	Description
IDX	UINT8	Index of logical ADC being configured. (0 - 4)
THS1_AC	UINT32	Duration in seconds that voltage must be above threshold 1 to detect a state change and send an event (if the event is enabled).
THS1_BC	UINT32	Duration in seconds that voltage must be below threshold 1 to detect a state change and send an event (if the event is enabled).
THS2_AC	UINT32	Duration in seconds that voltage must be above threshold 2 to detect a state change and send an event (if the event is enabled).
THS2_BC	UINT32	Duration in seconds that voltage must be below threshold 2 to detect a state change and send an event (if the event is enabled).
THS1_AH	UINT16	Sets the hysteresis which is used in conjunction with THS1 required to move from a "below" to an “above” threshold state. Actual threshold voltage can be found by adding THS1 and THS1_AH.
THS1_BH	UINT16	Sets the hysteresis which is used in conjunction with THS1 required to move from an “above” to a "below" threshold state. Actual threshold voltage can be found by subtracting THS1_BH from THS1.
THS2_AH	UINT16	Sets the hysteresis which is used in conjunction with THS2 required to move from a "below" to an “above” threshold state. Actual threshold voltage can be found by adding THS2 and THS2_AH.
THS2_BH	UINT16	Sets the hysteresis which is used in conjunction with THS2 required to move froman “above” to a "below" threshold state. Actual threshold voltage can be found by subtracting THS2_BH from THS2.
LL_PER_S	UINT32	Duration in seconds at which the device sends periodic events from the LL state.
HL_PER_S	UINT32	Duration in seconds at which the device sends periodic events from the HL state.
LH_PER_S	UINT32	Duration in seconds at which the device sends periodic events from the LH state.
HH_PER_S	UINT32	Duration in seconds at which the device sends periodic events from the HH state.
PER_ EVENTMASK	ASCII HEX	Event mask to select which states will send a periodic event.

Value	Description
0x1	Periodic LL
0x2	Periodic HL
0x4	Periodic LH
0x8	Periodic HH

9.46. CONFIGURATION 55: COAP

This configuration controls what resources the device will report to within the configured endpoint. The following are available substitutions to place within any of the resource names during configuration with characters before and/or after them, where `%` denotes a variable:

- `%p` = Platform number
- `%d` = Device serial number (DSN)
- `%m` = International Mobile Equipment Identity (IMEI)
- `%%` = %

Any unsupported variables will be returned as they are written. For example, `%s` will return `%s`, whereas `%p` will return the platform number.

> **Example:**
>
> !cs:55,0,xt%p/%d/event,xt%p/%d/command,xt%p/%d/config,xt%p/%d/blob,xt%p/%d/tripstream

Read Schema
!cp:55,“”
Write Schema
Revision 2: !cs:55,FLAGS,EVENT,CMD,CFG,BLOB,TRIPSTREAM *Revision 1:* !cs:55,FLAGS,EVENT,CMD,CFG,LOG,TRIPSTREAM,IMPACT *Revision 0:* !cs:55,FLAGS,EVENT,CMD,CFG,LOG

Parameter	Type	Description
FLAGS	UINT32	Placeholder for CoAP transport (not supported).
EVENT	UINT8	CoAP resource where device publishes event data. Max character length is 127.
CMD	UINT8	CoAP resource observed for device commands. Max character length is 127.
CFG	UINT8	CoAP resource where device publishes a read-only configuration (not supported). Max character length is 127.
LOG_TOPIC	STRING	Defines the CoAP resource where logs are published.
BLOB	UINT8	CoAP resource where device publishes both impact and log data. Data published to this resource will always be in an uncompressed Msgpack object with the following format: `{`

Parameter	Type	Description

		<pre>"TYPE": <type_uint8>,
		"REV": <rev_uint8>,
		"CMP": "lz4/lz4x2/zlib",
		"DATA": <binary_data> (lz4/lz4x2/zlib compressed)
		}</pre>
		The TYPE field provides what type of data is in the DATA field.
		
		The REV field accounts for a change to the format for the specific type.
		
		The CMP field is dependent on which compressor is configured in Configuration 3: GSM Endpoint on p. 108. If no compressor is used, the CMP field will not be present and the DATA field will be uncompressed. If the CMP field is present, it will be a string of lz4, lz4x2, or zlib. The DATA will then be compressed with that algorithm.
		
		The DATA field contains the actual log or impact data.

TRIPSTREAM	UINT8	CoAP resource where device publishes tripstream data. Max character length is 127. Unused.
IMPACT_ TOPIC	STRING	Defines the CoAP resource where impact data is received. **NOTE:** It is mandatory to enter a value in this field but it will be ignored.

9.47. CONFIGURATION 56: MOTION/NO-MOTION

System configuration for determining motion and no-motion events. Events can be configured to report at periodic intervals or by percent of a state over a time window.

Read Schema
!cp:56,“”
Write Schema
!cs:56,MO_WIN_S,MO_HIT_PCT,MO_PER_S,NOMO_WIN_S,NOMO_HIT_ PCT, EVENT_REP

Parameter	Type	Description
MO_WIN_S	UINT32	Time in seconds for detecting motion state change from no motion to motion. (Max of 1024 seconds)
MO_HIT_PCT	UINT8	The percentage of time slices in current window required to transition motion state to no-motion state.
MO_PER_S	UINT32	Duration in seconds at which motion periodic events are sent.
NOMO_WIN_S	UINT32	Time in seconds for detecting no-motion state change from motion to no motion. (Max of 1024 seconds)
NOMO_HIT_ PCT	UINT8	The percentage of time slices in current window required to transition no-motion state to motion state.
NOMO_PER_S	UINT32	Duration in seconds at which no-motion periodic events are sent.
EVENT_REP	ASCII HEX	Send an event to backend server.

Event Mask	
0x1	No-motion to motion.
0x2	Motion to no-motion.
0x4	Motion periodic.
0x8	No-motion periodic.

9.48. CONFIGURATION 57: SNAPSHOT TRANSITION

Configures the conditions under which the device transitions to and from a snapshot.

NOTE: It is important to keep note of power stage transition timers when setting periodic snapshot timers because a power stage transition will reset them. Additionally, if periodic snapshot timers are longer than the power stage transition timers, they will never generate a snapshot if a timer is the only criteria for the power stage transition.

Read Schema
Revision 1: !cp:57,TRIDX
Revision 0: !cp:57,SSDIX,TRIDX
Write Schema
Revision 1: !cs:57,TRIDX,STAGE_ID,FLAGS,ID,AGE,THS,TYPE
Revision 0: !cs:57,SSIDX,TRIDX,FLAGS,ID,AGE,THS,TYPE

Parameter	Type	Description
SSIDX	INDEX	Snapshot index. Each Power Stage has a unique snapshot. **Value** – **Description** 0 – PS0 1 – PS1 2 – PS2
TRIDX	INDEX	Trigger criterion index. **Revision** – **Range** 0 – 0 - 7 1 – 0 - 23
STAGE_ID	UINT8	The power stage the transition from snapshot is setup from. **Value** – **Description** 0 – PS0 1 – PS1 2 – PS2
FLAGS	UINT8	Modifies trigger criterion behavior. **Value** – **Description** 0x0 – Disable the trigger. 0x1 – Enable the trigger.

Parameter	Type	Description
ID	UINT8	ID of configurable trigger criterion.

NOTE: Iobox must be connected for Input 1/2/3/4 to be available in deep sleep. Currently, the only supported mask in deepsleep is 0x3 - clear->set and set->clear

NOTE: If any ADCs are configured for the external ADC on the I/O Box they will only work properly if an I/O Box is connected. They will not work in deepsleep.

Value	Description	Available in Deep Sleep
0	Ignition off	No
1	Ignition on	No
2	ADC Main above threshold	Yes
3	ADC Main below threshold	Yes
4	Motion / No Motion detected	Yes
6	Vibration	Yes
7	InStage (minimum time in current stage)	Yes
10	Input 1	Limited. See limitation note above.
11	Input 2	Limited. See limitation note above.
12	Input 3	Limited. See limitation note above.
13	Shock	Yes
20	User 0	No
21	User 1	No
22	Input 4	Limited. See limitation note above.
24	Timer A	No
25	Timer B	No
26	Timer C	No
27	Timer D	No
30	GSM registration state	No
31	ADC 0	Yes. See limiation note above.
32	ADC 1	Yes. See limiation note above.

Parameter	Type	Description

Value	Description	Available in Deep Sleep
33	ADC 2	Yes. See limiation note above.

AGE — UINT32 — Length of time the trigger criteria must be true. (seconds)

Criterion
Ignition off
Ignition on
ADC Main above threshold
ADC Main below threshold
Motion/No-motion
Vibration
InStage (min time in current stage)
Input 1 Clear to Set
Input 1 Set to Clear
Input 1 Set
Input 1 Clear
Input 2 Clear to Set
Input 2 Set to Clear
Input 2 Set
Input 2 Clear
Input 3 Clear to Set
Input 3 Set to Clear
Input 3 Set
Input 3 Clear
Shock
GSMRI
User 0
User 1
Input 4 Clear to Set
Input 4 Set to Clear
Input 4 Set
Input 4 Clear
Timer A
Timer B
Timer C
Timer D
GSM registration state
ADC 0
ADC 1
ADC 2

<table>
<tr><th>Parameter</th><th>Type</th><th>Description</th></tr>
<tr><td>THS</td><td>INT32</td><td>
<table>
<tr><th>Criterion</th><th>Type</th><th>Description</th></tr>
<tr><td>Ignition off</td><td>Not Used</td><td>N/A</td></tr>
<tr><td>Ignition on</td><td>Not Used</td><td>N/A</td></tr>
<tr><td>ADC Main above threshold</td><td>Threshold</td><td>Threshold in millivolts</td></tr>
<tr><td>ADC Main below threshold</td><td>Threshold</td><td>Threshold in millivolts</td></tr>
<tr><td>Motion / No Motion</td><td>Mask</td><td>The least significant bits (0x01, 0x02) and the most significant bits (0x04, 0x08) cannot be enabled at the same time within the same TCIDX. For example, a value of 3 or 12 would be acceptable, but a value of 15 would not.

<table>
<tr><th colspan="2">Wake Mask</th></tr>
<tr><td>0x1</td><td>No-motion to motion</td></tr>
<tr><td>0x2</td><td>Motion to no-motion</td></tr>
<tr><td>0x4</td><td>Motion periodic</td></tr>
<tr><td>0x8</td><td>No-motion periodic</td></tr>
</table>
</td></tr>
<tr><td>Vibration</td><td>Not Used</td><td>N/A</td></tr>
<tr><td>Instage</td><td>Not Used</td><td>N/A</td></tr>
<tr><td>Input 2</td><td>Mask</td><td>The least significant bits (0x01, 0x02) and the most significant bits (0x04, 0x08) cannot be enabled at the same time within the same TCIDX. For example, a value of 3 or 12 would be acceptable, but a value of 15 would not.

<table>
<tr><th colspan="2">Input Mask</th></tr>
<tr><td>0x1</td><td>Clear to Set</td></tr>
<tr><td>0x2</td><td>Set to Clear</td></tr>
<tr><td>0x4</td><td>Set</td></tr>
<tr><td>0x8</td><td>Clear</td></tr>
</table>
</td></tr>
</table>
</td></tr>
</table>

Parameter	Type	Description

Criterion	Type	Description
Input 3	Mask	The least significant bits (0x01, 0x02) and the most significant bits (0x04, 0x08) cannot be enabled at the same time within the same TCIDX. For example, a value of 3 or 12 would be acceptable, but a value of 15 would not. **Input Mask** 0x1 Clear to Set 0x2 Set to Clear 0x4 Set 0x8 Clear
Shock	Not Used	N/A
Input 4	Mask	The least significant bits (0x01, 0x02) and the most significant bits (0x04, 0x08) cannot be enabled at the same time within the same TCIDX. For example, a value of 3 or 12 would be acceptable, but a value of 15 would not. **Input Mask** 0x1 Clear to Set 0x2 Set to Clear 0x4 Set 0x8 Clear
Battery ADC above	Threshold	Threshold in millivolts
Battery ADC below	Threshold	Threshold in millivolts
Timer A	Yes	Yes
Timer B	Yes	Yes
Timer C	Yes	Yes
Timer D	Yes	Yes
GSM registration state	Threshold	**Value** **Description** 0 Not registered. 1 Registered.
ADCx	Threshold	See Configuration 52: ADC Basic

Parameter	Type	Description
		Criterion / Type / Description on p. 166 for more information. Value / Description 0 Below threshold 1 1 Above threshold 1 2 Below threshold 2 3 Above threshold 2
TYPE	UINT8	Snapshot will trigger if all AND are true, or any OR criteria are true. All criteria are forced to use OR type when transitioning from a power stage that has the micro-controller configured for deep sleep. Value / Description 1 AND 2 OR

9.49. CONFIGURATION 58: MAPSTER

Mapster is a subsystem that creates a mapping from the system defined event IDs to XT event IDs and Verbose event IDs. Event IDs are presented to the backend in the EV parameter which reports the events as a string.

Read Schema
!cp:58,“”
Write Schema
!cs:58,FLAGS,EVENTMAP_ID

Parameter	Type	Description
FLAGS	ASCII HEX	Reserved
EVENTMAP_ID	UINT8	Determines which mapping is used to report event IDs Value / Description 0 Default system ID 1 XT

9.49.1. Mapster Default Table

Default System ID	XT ID
1	6011

Default System ID	XT ID
2	6012
3	4001
4	4002
5	6115
6	6015
7	6014
8	
9	6060
10	
11	6006
12	6080
13	6081
14	6082
15	
16	
17	
18	6001
19	
20	6002
21	6004
23	
24	6005
25	6021
26	6022
27	6019
28	6020
31	4006
32	6044
33	4050
34	6030
35	6031
36	7001
37	6050
38	6032
39	6017
40	6018
41	6016
43	6048
44	6049
45	4051
46	4052

Default System ID	XT ID
47	4053
48	6070
49	6071
50	6072
51	6073

9.50. Configuration 59: Power Stage Event Reporting

Enables event reporting upon entering a new power stage.

Read Schema
!cp:59,""
Write Schema
Revision 1: !cs:59,R_MASK, FLAGS, SPECIAL_REPORTING *Revision 0:* !cs:59,R_MASK,FLAGS

Parameter	Type	Description
R_MASK	UINT8	Report Mask. Sends event 52 upon entering power stage if enabled in mask. On device reset, event 52 will be sent if Power Stage 0 is enabled in mask. **Value** / **Description** 0x01 — Power Stage 0. 0x02 — Power Stage 1. 0x04 — Power Stage 2.
FLAGS	UINT8	Reserved.
SPECIAL_ REPORTING	UINT8	Reserved. **Value** / **Description** 0x01 — Low Battery Lockout. 0x02 — Ship Mode.

9.51. CONFIGURATION 62: GPS ASSIST

Configures the Multiple GNSS Assisted (MGA).

Read Schema
!cp:62,“”
Write Schema
!cs:62,FLAGS,TOKEN,GNSS,TACC,DTYPE,AGE,DELAY,ATMPTS

Param	Type	Description
FLAGS	UINT32	Settings for GPS assistance. **Value** / **Description** 0x1 – Turn off the MGA download if a good lock is achieved. 0x2 – Turn off the MGA download if there are ≥ 9 sats. 0x4 – Turn off the MGA download if there DOP ≤ 1.5.
TOKEN	STRING	Token used for the MGA download service (maximum length of 63 characters).
GNSS	ASCII HEX	Mask of which GNSS data to be requested. **Value** / **Description** 0x01 – GPS 0x02 – QZSS 0x04 – GLONASS 0x08 – BEIDOU 0x10 – GALILEO
TACC	UINT16	Timing accuracy (0-3600 seconds).
DTYPE	UINT8	Types of data to retrieve. **Value** / **Description** 0x1 – Ephemeris 0x2 – Almanac 0x4 – Auxiliary 0x8 – Position
AGE	UINT32	MGA valid period in seconds. Must be greater than or equal to 3600.
DELAY	UINT16	Initial delay before downloading in seconds. Must be less than 3600.
ATMPTS	UINT8	Maximum number of MGA download attempts for each MGA period.

9.52. CONFIGURATION 63: ACCEL ON AXIS

Contains the thresholds and settings used to detect acceleration events using the accelerometer hardware. This configuration utilizes an oriented accelerometer and detects events "on-axis". When the thresholds and conditions defined by this configuration are satisfied, events 56 to 59 will be generated.

Read Schema
!cp:63,“”
Write Schema
Revision 1: !cs:63,IDX,FLAGS,THS,ACTIVE_MS,HYST_MS,DIR *Revision 0:* !cs:63, “IDX,THS,ACTIVE_MS,HYST_MS,DIR
Shadow Schema
Revision 1: 63:IDX,FLAGS,THS,ACTIVE_MS,HYST_MS,DIR *Revision 0:* 63:IDX,THS,ACTIVE_MS,HYST_MS,DIR

Param	Type	Description
IDX	UINT8	Index of acceleration on axis threshold configuration (0 - 3).
FLAGS	UINT8	Enables/disables triggering events 56 to 59 for set thresholds. **Value** – **Description** 0 – Disabled (default). 1 – Enabled.
THS	INT16	Force threshold (milli-Gs)
ACTIVE_MS	UINT16	Time (milliseconds) the threshold must be exceeded before a violation event occurs.
HYST_MS	UINT16	Time (milliseconds) after threshold is no longer exceeded when the violation event ends.
DIR	UINT8	Direction of force. X axes are the front/back of the car for braking/accelerating while the Y axes are for turning the car right/left. **Value** – **Description** 0 – Positive Y axis (right). 1 – Negative Y axis (left). 2 – Positive X axis (front). 3 – Negative X axis (back).

9.53. CONFIGURATION 68: LED BEHAVIOR

LED behavior is configured by a 32-bit mask that describes a two second duration. Each bit of the mask represents a duration of 1/16 second.

Read Schema
!cp:68,LEDIDX
Write Schema
!cs:68,LEDIDX,STATEIDX,TRIGGER,MODE,ITERATIONS,MASK,FLAGS

Param	Type	Description
LEDIDX	UINT32	Index of LED
STATEIDX	UINT16	There are 6 state slots per LED. Valid range is 0 - 5.
TRIGGER	UINT8	Triggers for LED behavior changes
MODE	UINT8	Modes determine the presentation type. Background mode is used for state presentation, while Event mode is for transitory presentations.

Index	Description
0	Default
1	GPS Lock
2	GPS No Lock
3	GPS Off
4	GPS On
5	GSM Registration
6	GSM No Registration
7	GSM Off
8	GSM On
9	Trip Start
10	Trip End
11	PPIDDISCO
12	BLE Connect
13	BLE No Connect
14	BLE Off
15	BLE On
16	Alternator On
17	GSM Roaming
224	UAP 0
225	UAP 1
226	UAP 2
227	UAP 3

Param	Type	Description
		Example: The LED Background mode could be a steady blinking green LED. At a Triggered Event, the LEDs can be configured to an Event pattern. After the Event mode pattern is complete, the LEDs would resume the Background mode. **Index** — **Description** 0 — Background 1 — Event
ITERATIONS	UINT16	LED behavior iterations. 0 is disable, 65535 is forever.
MASK	UINT32	Mask to determine LED blink pattern. Each bit represents 1/16th of a second. A blink pattern of ON for one second, OFF for one second uses the mask: 0xFFFF0000
FLAGS	UINT8	LED Flags. **Value** — **Description** 0x1 — Disable LED pattern in PS0. 0x2 — Disable LED Pattern in PS1. 0x4 — Disable LED pattern in PS2.

9.54. CONFIGURATION 70: ACCELEROMETER

Read Schema
!cp:70,“”
Write Schema
!cs:70,EWMA_ALPHA,EWMA_WINDOW,FIR_MODE,VECTOR_FORCE,VECTOR_ORIENTATION,VECTOR_IMPACT

Parameter	Type	Description
EWMA_ALPHA	UINT8	EWMA alpha value: 0 - 20.
EWMA_WINDOW	UINT16	EWMA sample window.
FIR_MODE	UINT8	Reserved. Selects FIR filter.
VECTOR_FORCE	UINT8	Selects the vectors used for force threshold. **Value** — **Description** 0 — Accelerometer orientation vector raw. 1 — Accelerometer Orientation Vector EWMA. 2 — Accelerometer orientation vector FIR.

9.55. CONFIGURATION 71: INPUT CONFIGURATION

Read Schema

{ “!cp”: [71, “INDEX”] }

Write Schema

Revision 1: !cs:71,INDEX,FLAGS,HYSTERESIS_S,BLANKING_S

Revision 0: !cs:71,INDEX,FLAGS,HYSTERESIS_S

Parameter	Type	Description
INDEX	UINT8	Determines which input to configure. **Index** — **Description** 0 — Input1 1 — Input2 2 — Input3 3 — Input4
FLAGS	ASCII HEX	Defines pin behavior. **Value** — **Description** 0x02 — Accumulator. 0x04 — Interpret as wired ignition. 0x08 — Clear event. 0x10 — Set event. 0x20 — Blanking. 0x40 — External Pull direction. If this bit is not set within the FLAGS parameter, it means the pin "clr" by default. To change the state of this pin to set, 12V need to be applied to the pin. If this bit is set within the FLAGS parameter, it means the pin is pulled up is "set" by default. To change the state of the pin to "clr", it will need to be pulled back down by grounding the pin. See Harpsiobox Connector on p. 18 for more information.
HYSTERESIS_S	UINT16	Hysteresis in seconds.
BLANKING_S	UINT16	Blanking duration. If blanking is enabled when a set/clear event is fired for a given input, further instances of transitions to that state will not generate an event during the blanking period. Once the blanking period

Parameter	Type	Description
		passes, events can once again be generated. **NOTE:** Blanking for SET and CLEAR are independent.

9.56. Configuration 74: Faulty Alternator

Configures the thresholds for determining if an alternator's behavior is deemed faulty.

Read Schema
!cp:74,“”
Write Schema
!cs:74,HIGH_THRESH,LOW_THRESH,DBNC,DBNC_FAULTY

Param	Type	Description
HIGH_ THRESH	UINT8	The threshold in decivolts that the alternator voltage must go back above for DBNC seconds to be considered normal, after previously being considered faulty, and trigger a faulty alternator normal event.
LOW_ THRESH	UINT8	The threshold in decivolts the alternator voltage must go under for DBNC_ FAULTY seconds to be considered faulty and trigger a faulty alternator event.
DBNC	UINT8	Time in seconds used to determine a faulty alternator normal event.
DBNC_ FAULTY	UINT8	Time in seconds used to determine a faulty alternator event.

9.57. Configuration 77: Bluetooth Enable

Allows various operational/behavioral settings of bluetooth component.

Read Schema
!cp:77,""
Write Schema
!cs:77,FLAGS

Param	Type	Description
FLAGS	UINT8	Enables/disables bluetooth component. **Value** — **Description** 0 — Disable. 1 — Enable

9.58. CONFIGURATION 81: QUEUE LIMITING

Allows for configuration of the number of events stored by the device. When the configured limit is met, the oldest events are dropped.

Read Schema
!cp:81,INDEX
Write Schema
!cs:81,INDEX,FS,MODE,THRESH

Param	Type	Description
INDEX	UINT8	Valid index is 0.
FS	UINT8	Filesystem. Configures which filesystem the limit is applied to. **Value** — **Description** 1 — Triplog
MODE	UINT8	Mode. Identifies how the limit operates on the queue. **Value** — **Description** 0 — Disabled. 1 — First in, first out (FIFO). Makes space for new items to maintain the limit. When there are pending events (events in a transport buffer) because event buffering is enabled, this will revert to block mode and new items will not be logged. 2 — Block. Prevents new items when there are too many entries in the log.
THRESH	UINT16	Threshold. Number of entries allowed in the queue (when enabled).

9.59. CONFIGURATION 86: PIDS

Read Schema
!cp:86,INDEX
Write Schema
!cs:86,INDEX,FLAGS,PID_NUGGET_ID,INTERVAL_S

Parameter	Type	Description
INDEX	UINT8	Valid range is 0 to 23. It is recommended to start at index 4 when starting a new configuration setting.

FLAGS	UINT16	PID mask.
		
		If one of the PIDs has 0x08, 0x10, and/or 0x10 enabled, then parameters PD0/1/2 will attempt to report that PID's value. A single PID can get reported in multiple PD0/1/2 parameters, but a PD0/1/2 parameter can only report up to 10 PIDs at once.
		
		Example PID data set:
		
		`!cp:86,0:9,0,1`
		`!cp:86,1:19,1,1`
		`!cp:86,2:11,2,15`
		`!cp:86,3:21,3,5`
		`!cp:86,4:39,33,0`
		
		In this example, the PD0 parameter will report values for IDs 0, 1, and 33 since 0x08 is set with 9, 19, and 39. The PID1 parameter will report IDs 1, 2, and 33 since 0x10 is set with 19, 11, and 39. And the PID2 parameter will report 3 and 33 since 0x20 is set with 21 and 29.
		
		Value — **Description**
		0x00 — Disable.
		0x01 — Enable.
		0x02 — Capture one per trip.
		0x04 — High priority. Ensures PID is captured at its interval when there are timeslice conflicts with another PID.
		0x08 — PD0.
		0x10 — PD1.
		0x20 — PD2.

PID_NUGGET_ID	UINT8	Nugget ID.

Parameter	Type	Description

NOTE: In the nugget list below, there are some nuggets that do not have their own individual reference identifier to be packed into an event message. The PID data (PD0/1/2 found above in FLAGS) must be used to move parameter(s) that do not have their own reference identifier into event messages. A maximum of 10 nuggets per PD structure is allowed.

Nugget ID	Units	PD Req.	JBUS|OBDII|PPID	Description
0	KPH	N	J|O	Speed (Factory default is 1)
1	RPM	N	J|O	(Factory default is 1)
2	%	N	J|O|P	Fuel level (Factory default is 30)
3	MPG	N	J|O	Miles per gallon (Factory default is 5)
4	Celsius	Y	J	Engine coolant temp
5	Discrete	Y	J	PTO status
6	Sec	N	J|O	Engine time
7	Sec	Y	J	PTO time
8	Sec	Y	J	Idle Time
9	%	Y	J	Throttle
10	%	Y	J	Engine load
11	%	Y	J	Accelerator Pedal Position

Value	Description
0x0	No PTO drive engaged
0x1	At leaset one PTO drive engaged
0x2	Error
0x3	Status not available

Parameter	Type	Description

Nugget ID	Units	PD Req.	JBUS|OBDII|PPID	Description
12	%	Y	J	Engine torque
13	Celsius	Y	J	Intake manifold temperature
14	Celsius	Y	J	Intake air temperature
15	Celsius	Y	J	Engine oil temperature
16	Discrete	Y	J|P	Park Brake Status

Value	Description
0x0	Parking brake not set
0x1	Parking brake set
0x2	Error
0x3	Status not available

18	Liters	Y	J	Fuel Used
19	Sec	Y	J	Cruise Time
20	Liters	Y	J	PTO Fuel used
21	Sec	y	J	Total Vehicle Hours
22	Liters	Y	J	Idle Fuel Used
23	Discrete	y	J|P	Gear Position (PRNDL)

Value	Description
0x0	JBUS
0	Neutral
1-125	JBUS Reverse Gears
126	JBUS Park
127-	JBUS

Parameter	Type	Description				
		Nugget ID	**Units**	**PD Req.**	**JBUS|OBDII|PPID**	**Description**
						Value / **Description** 250 / Forward Gears 0x01-0x10 / Gear 1-16 0x10 / Neutral 0x11 / Low 0x12 / Second 0x13 / Drive/Forward 0x14 / Park 0x15 / Reverse 0x16 / Overdrive
		25	%	Y	J	Oil Level
		26	KPA	Y	J	Oil Pressure
		27	KPA	Y	J	Coolant Pressure
		28	%	Y	J	Coolant Level
		29	Celsius	Y	J	Fuel Temperature
		33	Discrete	N	O	Malfunction Indicator Lamp **Value** / **Description** 0x0 / Off 0x1 / On
		34	Discrete	N	J	LAMP status (only available on heavy duty vehicles).

Parameter	Type	Description				
		Nugget ID	Units	PD Req.	JBUS|OBDII|PPID	Description
						Value: Description 0x00: No Lamp 0x01: Flashing Protect Lamp 0x02: Flashing Amber Warning Lamp 0x04: Flashing Red Stop Lamp 0x08: Flashing Malfunction Indicator Lamp 0x10: Protect Lamp 0x20: Amber Warning Lamp 0x40: Red Stop Lamp 0x80: Malfunction Indicator Lamp
		150	Kilometers	N	J|O|P	True odometer (Factory default is 5)
		152	%	N	P	Oil Life Remaining
		153	Kilopascals	N	P	Left Front Tire Pressure
		154	Kilopascals	N	P	Right Front Tire Pressure
		155	Kilopascals	N	P	Left Rear Tire Pressure

Parameter	Type	Description

Nugget ID	Units	PD Req.	JBUS|OBDII|PPID	Description
156	Kilopascals	N	P	Right Rear Tire Pressure
157	Kilopascals	N	P	Left Rear Inside Tire Pressure
158	Kilopascals	N	P	Right Rear Inside Tire Pressure
159	Kilopascals	N	P	Spare Tire Pressure
160	Discrete	N	P	Brake lamp

Value	Description
0x0	Off
0x1	On

163	Discrete			Driver seat belt

Value	Description
0x0	Detached
0x1	Attached
0x2	Reserved
0x3	Reserved

164	Discrete			Passenger seat belt

Value	Description
0x0	Detached
0x1	Attached

165	Discrete			Airbag lamp

Parameter	Type	Description
		Nugget ID: — | Units: — | PD Req.: — | JBUS|OBDII|PPID: — | Description: Value: 0x0 — Description: Off Value: 0x1 — Description: On
Interval_S	UINT16	Period at which this PID should be requested on the vehicle bus (seconds).

9.60. CONFIGURATION 87: ELD

Read Schema
!cp:87,""
Write Schema
!cs:87,FLAGS,UDR_INTERVAL_S

Parameter	Type	Description
FLAGS	UINT16	ELD creation flags. Value: 0x1 — Description: Enable. Value: 0x2 — Description: UDR Enable. Value: 0x4 — Description: DID via BLE.
UDR_INTERVAL_S	UINT16	Interval in seconds between UDR creation when the DID parameter has not been set and a trip is active.

9.61. CONFIGURATION 89: UPDATE INHIBIT

Configures when to prevent the installation of updates after downloading them. If both the FLAGS and TIMEOUT are set to 0, the inhibitor flags are bypassed (I.e. not in a trip, and/or triplog is empty). If the timeout is exceeded the installation will proceed. Alternatively, the command !mfs:20 can be sent to force the installation.

Read Schema
!cp:89,“”
Write Schema
!cs:89,FLAGS,TIMEOUT

Param	Type	Description	
FLAGS	UINT16	**Value**	**Description**
		0x1	Prevent updates from installing during a trip.
		0x2	Prevent Updates from installing when the eventlog is not empty.
TIMEOUT	UINT16	Maximum delay in minutes before installing the update.	

9.62. CONFIGURATION 90: DIAGNOSTIC MASK

Allows configuration of event 33 (diagnostic) generation based on specific criteria.

Read Schema
!cp:90,“”
Write Schema
!cs:90,MASK

Parameter	Type	Description	
MASK	ASCII HEX	Mask values.	
		Value	**Description**
		0x1	Generate a diagnostic event on power-up if a Watchdog reset occurs.

9.63. CONFIGURATION 92: ENABLE DTCS

Enables DTCs, sets a periodic rate in seconds, and sets a maximum speed (kph) for DTC gathering.

Read Schema
!cp:92
Write Schema
!cs:92,FLAGS,INTERVAL_S,SPEED_KPH

Parameter	Type	Description
Flags	UINT8	Flags. **Value** — **Description** 0x0 — DTC configuration disabled. 0x1 — DTCs enabled. 0x2 — Capture once at the start of each trip.
INTERVAL_S	UINT16	Interval in seconds between DTC gathering. The recommended time is approximately 10 minutes (600 seconds).
SPEED_KPH	UINT8	Speed threshold in kilometers per hour. DTC gathering will not occur while the vehicle speed is greater than SPEED_KPH.

10. SUBSYSTEMS

10.1. APPLICATION

10.1.1. Application Reset

Performs a software reset.

NOTE: If the <flags> field is not filled out when issuing this command, it will default to 0x1 and will not save the stash.

Command Type	Syntax
UART	**Command** !nx:<flags> **Network Response** OK

Parameter	Type	Description
<flags>	UINT8	Optional flags field.

Value	Description
0x1	Does NOT save configurations prior to the reboot.

10.2. BACKEND

10.2.1. Backend Debug Enable

Turn on back-end server communication debug prints.

Command Type	Syntax
UART	**Command** !sde **Response** OK

10.2.2. Backend Debug Disable

Turn off back-end server communication debug prints.

Command Type	Syntax
UART	**Command** !sdd **Response** OK

10.2.3. Backend Check-In

Sending this command causes the device to perform a check-in with AWS where commands can then be issued via job.

Command Type	Syntax
JOB, UART, or SMS	**Command** @callhome

10.3. Boot Count

10.3.1. Boot Count Query

Requests current boot count.

Command Type	Syntax
UART	**Command** !nbc **Response** OK

10.3.2. Boot Count Set

Sets new boot count

Command Type	Syntax
UART	**Command** !nbc:<new_count> **Response** OK

10.4. BUZZER

10.4.1. Play Song

Plays any of the configured songs.

Command Type	Syntax
UART	**Command** !zp,<index> **Response** OK

Parameter	Type	Description
<index>	UINT8	Index of configured song.

10.5. CELLULAR

10.5.1. Cellular Debug Enable

Requests cellular subsystem to route debug messaging to the interface which the command was sent to.

Command Type	Syntax
UART	**Command** !gde **Response** OK

10.5.2. Cellular Debug Disable

Requests cellular subsystem to disable routing of debug messaging to the interface which the command was sent to.

Command Type	Syntax
UART	**Command** !gdd **Response** OK
JOB	**Command** { “!gdd”: [“”: “”] } **Response** OK

10.5.3. Cellular Print Information

Provides information about the cellular subsystem. This include the model, firmware revision, IMEI and CCID.

Command Type	Syntax
UART	**Command** !gpd **Response** Model: <model> FW Revision: <fwrev> IMEI: <imei> CCID: <ccid>
JOB	**Command** { “!gpd”: [“”: “”] } **Response** Model: <model> FW Revision: <fwrev> IMEI: <imei> CCID: <ccid>

Parameter	Type	Description
<model>	STRING	Cellular Model
<fwrev>	STRING	Cellular Firmware Revision
<imei>	STRING	IMEI
<ccid>	STRING	CCID

10.5.4. Cellular Reset

Resets the cellular module. If the reset is performed without a specified severity level, the device progresses through sequenced security levels as needed. If the device can not be successfully reset at the current severity level, it automatically progresses to the next method of reset.

If the severity is specified (!gx:<severity>), the device uses only the specified severity level which is implemented per module:

SARA-R410M

Severity Level	Description
1	AT+CFUN=1,1
2	Power-off via RESET pin for 10s
3	Power-off via ONOFF pin
4	Load switch off for 15s

LARA-R202

Severity Level	Description
1	AT+CFUN=1,1
2	Power-off via RESET pin for 10s
3	Power-off via ONOFF pin
4	Load switch off for 15s

NOTE: These descriptions are subject to change over firmware versions if any new behavior is needed.

Command Type	Syntax
UART	**Command** !gx **OR** !gx:<severity> **Response** OK

10.5.5. Load Certificates

Loads specified certificate onto device. This command can only be used after the device has been set to bypass mode, and previous certificates have been deleted from the module.

Command Type	Syntax
UART	**Command** !gcc:<index> **Response** OK
JOB	**Command** { “!gcc”: [“<index>”: “”] } **Response** OK

Parameter	Type	Description	
<index>	UINT8	**Value**	**Description**
		0	Device Private Key
		1	Device Certificate
		2	Server Certificate 1
		3	Server Certificate 2
		4	Server Certificate 3
		5	Server Certificate 4
		6	Server Certificate 5
		7	Server Certificate 6
		8	Server Certificate 7
		9	Server Certificate 8

10.5.6. GSM uFOTA Command

The uFOTA check-in command (!gfc) is a job-only command, and will not work via the console.

Causes the device cell module to check in to the uFOTA server to determine if a cell module firmware is available. If an update is available, the device will install the new firmware.

If the command is sent before new firmware is available or before the device IMEI has been added to the campaign, the server will instruct the device to try again in 3,153,600 seconds (1 year).

Command Type	Syntax
JOB	**Command** { “!gfc”: [“”, “”] } **Response** AT+UFOTACONF=2,31536000

10.5.7. Cellular Status

Provides information about the cellular status.

Command Type	Syntax
UART	**Command** !gps **Response** PowerMode: <PowerMode> State: <state> Pins: <pins> Certificates: <certificates>

Parameter	Type	Description
<PowerMode>	STRING	Displays the current power mode.
<state>	STRING	Displays the current cellular state (e.g. ATTACHED).
<pins>	STRING	Displays state (s/c) of the following pins: `<PWR_ON>, <RESET_N>, <PWR>, <PWR_IND>` **Pin** — **Description** PWR_ON — Pin is cleared to power on the module. RESET_N — Pin is set to reset the cellular module. PWR — Pin is set to enable the voltage regulator that powers the cellular module. PWR_IND — Indicates whether the module is powered on.
<certificates>	STRING	Displays the number of certificates.

10.5.8. Cellular Statistics

Provides information about the cellular statistics.

Command Type	Syntax
UART	**Command** !gpc **Response** Data Bytes Out: <#>, In: <#> Session Socket: <#>, Http: <#>, Ftp: <#> Session Activate Attempt: <#>, Success: <#> Session Deactivate Attempt: <#>, Success: <#> Session Connect Attempt: <#>, Success: <#> Session Disconnect Attempt: <#>, Success: <#> Registration State: <#> {#s} Registration Change: {#} Registration Time: {#s,#s} Module Reset: <#>, Crash: <#> Errors: <errors> Flow-Control Module CTS: <#>, Device CTS: <#>

10.6. Event Filesystem

10.6.1. Event Filesystem Debug Enable

Turn on event filesystem debug prints.

Command Type	Syntax
UART	**Command** !ede **Response** OK

10.6.2. Event Filesystem Debug Disable

Turn off event filesystem debug prints.

Command Type	Syntax
UART	**Command** !edd **Response** OK

10.6.3. Event Filesystem Print Information

Print information about the event filesystem state.

Command Type	Syntax
UART	**Command** !epi:<file_system_id> **Response** index: ffff5630 segment0.key: cafebabe, index: ffff5631 segment0.bitmap: 00 00 00 00 00 00 00 00 00 00 7F FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF table.head: 2000, tail: 40000, wr: 1af6e, rd: 19c58, rdptr: 1ac58 segment1.key: cafebabe, index: ffff5630 segment1.bitmap: 00 00 00 00 00 00 00 00 00 00 3F FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF table.head: 2000, tail: 40000, wr: 1af6e, rd: 19c58, rdptr: 1af6e OK
JOB	**Command** { “!epi”: [<file_system_id>, “”]} **Response** index: ffff5630 segment0.key: cafebabe, index: ffff5631 segment0.bitmap: 00 00 00 00 00 00 00 00 00 00 7F FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF table.head: 2000, tail: 40000, wr: 1af6e, rd: 19c58, rdptr: 1ac58 segment1.key: cafebabe, index: ffff5630 segment1.bitmap: 00 00 00 00 00 00 00 00 00 00 3F FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF table.head: 2000, tail: 40000, wr: 1af6e, rd: 19c58, rdptr: 1af6e OK

Parameter	Type	Description
<file_system_ID>	UINT8	Identifies the triplog the user wants to erase. **Value** **Description** 7 TRIPLOG

10.6.4. Event Filesystem Reset

Clear the event filesystem event log.

Command Type	Syntax
UART	**Command** !ex:<file_system_id> **Response** OK
JOB	**Command** { “!ex”: [<file_system_id>, “”]} **Response** OK

Parameter	Type	Description
<file_system_id>	UINT8	Identifies the triplog the user wants to erase. **Value** **Description** 7 TRIPLOG

10.6.5. Event Filesystem Header Read

Reads events and prints diagnostic information from a selected number of records.

Command Type	Syntax
UART	**Command** !er:<file_system_ID>,<count> **Response** read <number of records> records <index0>:<readptr0>,<ret0> event: <event id>, extension_size: <extension size>

Parameter	Type	Description
<file_system_ID>	UINT8	Identifies the triplog the user wants to erase. **Value** **Description** 7 TRIPLOG
<count>	UINT16	Number of records.

10.7. GPIO

10.7.1. GPIO Pin Configuration

Pin ID	Pin Function
1	Input 1
2	Input 2
4	Output 1
5	Output 2
6	GSM Module Reset
7	GSM Module ON/OFF
8	GSM Module Power
11	UART1Rts
12	UART1Cts
13	GPS Power
20	Button 1
21	Blue LED
23	Accelerometer INT1
24	Accelerometer INT2
30	Main Voltage ADC
31	GSM Voltage ADC
35	Battery ADC
36	Temp ADC
37	External ADC1
73	External ADC2
88	Buzzer
223	External ADC3
224	TRILED_Red
225	TRILED_Green
226	TRILED_Blue
227	OWB FetCtl
228	OWB LdoEn
229	OWB I/O
230	Temperature Switch
231	Charge Status
232	Charge Fault
233	Charge Set

10.7.2. GPIO Print

Display pin configuration.

Command Type	Syntax
UART	**Command** !ip:<func> **Response** **INPUT** <func>,<type>,<state>,<mode>,<trigger> **OUTPUT** <func>,<type>,<state> **PERIPH** <func>,<periph> OK
JOB	**Command** { “!ip”: [<func>, “”]} **Response** N/A

Parameter	Type	Description
<func>	UINT16	Function Identifier ‘*’ will print all pins.
<type>	UINT8	Pin Type **Value** — **Description** Input — GPIO Input Output — GPIO Output Periph — Peripheral controlled pin
<state>	UINT8	Pin State **Value** — **Description** SET — Pin is asserted CLEAR — Pin is not asserted
<mode>	UINT8	Pin Mode **Value** — **Description** ACTIVE_HIGH — Pin is asserted when logic level is high and not asserted when logic level is low.

Parameter	Type	Description
		Value / **Description** ACTIVE_LOW / Pin is asserted when logic level is low and is not asserted when logic level is high
<trigger>	UINT8	Pin Trigger **Value** / **Description** NONE / This pin does not generate system interrupts SET / Pin generates an interrupt when <state> transitions from CLEAR to SET. CLEAR / Pin generates an interrupt when <state> transitions from SET to CLEAR. BOTH / Pin generates an interrupt when <state> transitions from either SET to CLEAR or CLEAR to SET.

10.7.3. GPIO Clear

Clear output pin state.

Command Type	Syntax
UART	**Command** !ic:<func> **Response** OK
JOB	**Command** { “!ic”: [<func>, “”]} **Response** N/A

Parameter	Type	Description
<func>	UINT16	Function Identifier

10.7.4. GPIO Set

Set output pin state.

Command Type	Syntax
UART	**Command** !is:<func> **Response** OK
	Command { “!is”: [<func>, “”]} **Response** N/A

Parameter	Type	Description
<func>	UINT16	Function Identifier

10.8. GPS

10.8.1. GPS Debug Enable

Requests GPS subsystem to route debug messaging to the interface which the command was sent to.

Command Type	Syntax
UART	**Command** !yde **Response** OK

10.8.2. GPS Debug Disable

Requests GPS subsystem to disable routing of debug messaging to the interface which the command was sent to.

Command Type	Syntax
UART	**Command** !ydd **Response** OK
JOB	**Command** { “!ydd”: [“”: “”] } **Response** OK

10.8.3. GPS Print Information

Provides information about the GPS subsystem. This includes the state, mode, and power mode at the time the command was issued.

Command Type	Syntax
UART	**Command** !ypi **Response** State: <state> Mode: <mode> PowerMode: <powermode>
JOB	**Command** { “!ypi”: [“”: “”] } **Response** State: <state> Mode: <mode> PowerMode: <powermode>

Parameter	Type	Description	
<state>	String	**Value**	**Description**
		NONE	State-machine is disabled
		INIT	Initializing
		PREPARE	Being configured for solutions
		ACTIVE	Normal operation
		RESET	Chip is being reset
		TESTINIT	Test mode is being initialized
		TEST	Test mode is active
<mode>	String	**Value**	**Description**
		OFF	Chip is Off
		ON	Chip is On
		REFRESH	Chip is On for the function of an ephemeris refresh
<powermode>	String	**Value**	**Description**
		OFF	Chip is Off
		ON	Chip is On
		OFFREFRESH	Chip is in an Off mode where it will manage a periodic ephemeris refresh

10.9. LED

10.9.1. LED Enable/Disable

Enables/disables normal LED activity.

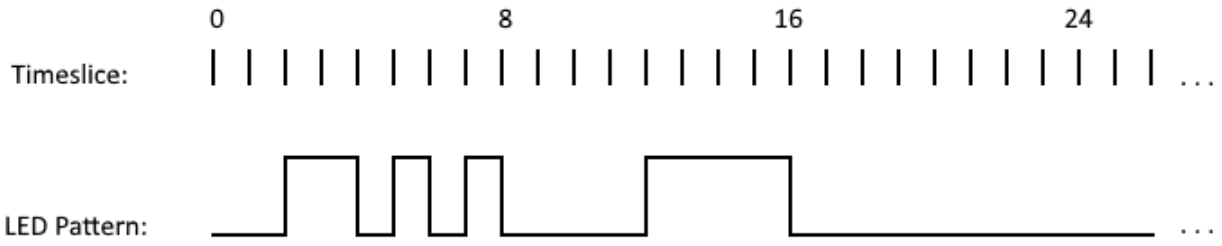
10.9.2. LED Configuration

Command Type	Syntax
UART	**Command** !lps:<ident>,<mode>,<iterations>,<mask>,<slice_reset>,<flags> **Response** OK

Parameter	Type	Description
<ident>	UINT8	Identity of LED. **Value** — **Description** 1 — Green 4 — Blue 16 — Amber **Index** — **Description** 4 — Center blue 64 — Left orange 128 — Right orange 512 — Left green 1024 — Right green 4096 — Left blue 8192 — Right blue
<mode>	UINT8	**Value** — **Description** 0 — Background: Changes base LED behavior. 1 — Event: Triggers configured pattern then returns to background behavior.
<iterations>	UINT32	Duration of sequence. Entering values over 0xFF will cause the pattern to repeat indefinitely.
<mask>	UINT32 HEX	AND pattern mask of the 32 time slices
<slice_reset>	N/A	Unused.
<flags>	UINT32	LED flags inhibit the particular LED pattern from being displayed if the device is in the corresponding power stage. If there is a second pattern that is inhibited and active, e.g. an inhibited event pattern and an uninhibited background pattern, it will still display.

Parameter	Type	Description	
		Value	**Description**
		0x1	Disable LED pattern in PS0.
		0x2	Disable LED Pattern in PS1.
		0x4	Disable LED pattern in PS2.

```
/*Pattern progresses from lsb to msb
    * pattern.mask = 0x0000f0ac;
    *
    * slice  0: (0x0000f0ac & 0x00000001) = 0
    * slice  1: (0x0000f0ac & 0x00000002) = 0
    * slice  2: (0x0000f0ac & 0x00000004) = non-zero
    * slice  3: (0x0000f0ac & 0x00000008) = non-zero
    * slice  4: (0x0000f0ac & 0x00000010) = 0
    * slice  5: (0x0000f0ac & 0x00000020) = non-zero
    * slice  6: (0x0000f0ac & 0x00000040) = 0
    * slice  7: (0x0000f0ac & 0x00000080) = non-zero
    * slice  8: (0x0000f0ac & 0x00000100) = 0
    * slice  9: (0x0000f0ac & 0x00000200) = 0
    * slice 10: (0x0000f0ac & 0x00000400) = 0
    * slice 11: (0x0000f0ac & 0x00000800) = 0
    * slice 12: (0x0000f0ac & 0x00001000) = non-zero
    * slice 13: (0x0000f0ac & 0x00002000) = non-zero
    * slice 14: (0x0000f0ac & 0x00004000) = non-zero
    * slice 15: (0x0000f0ac & 0x00008000) = non-zero
    * slice 16: (0x0000f0ac & 0x00010000) = 0
    * ...
    * slice 31: (0x0000f0ac & 0x80000000) = 0
```



10.10. MANAGER

10.10.1. Manager Enable Security

Enables JTAG security on the microprocessor.

Command Type	Syntax
UART	**Command** !mss **Response** OK
JOB	**Command** { “!mss”: [“”, “”] } **Response** N/A

10.10.2. Set Device Description Parameter

Configure parameter in the persistent device description.

Command Type	Syntax
UART	**Command** !mcs:<item>[,<params>] **Response** OK
JOB	**Command** { “!mcs”: [“<item>”, “<params>”] } **Response** N/A

Parameter	Type	Description
<item>	UNIT8	**Value** — **Description** 0 — Reset Description 1 — Version 3 — Mask Bits 4 — Pin Configuration 5 — Sensor Conversions 6 — HWID 7 — DSN 8 — Cellular Model 9 — FW Update AES Key 10 — Customer AES Key 11 — Sim Position 12 — Sim Default 13 — Dual Sim Supported 14 — Auxiliary Port Selection 15 — Version String 16 — Transport AES Key 17 — FW Mode Bits 18 — FW Flag Bits 19 — Certificate Mark Configuration 20 — HW Platform 21 — Hardware Options **<params>** — **Description** 0,0 — Accelerometer disable 0,1 — Accelerometer enable

Parameter	Type	Description

Value	Description
22	SMS Salt
23	Number of LEDs
24	Sets the number of LED bs that have defined behavior in the device description. <IDX>,<LED ID>,<BEHAVIOR> **IDX** Index oif the LED behavior being updated. Should be less than the number of LEDs set by !mcs:23 **LED ID** The identifier of the LED on the board we want assign a behavior. The LED's that are available on a particular board can be found via the !lil command. The ident describes the physical LED.

Bits	Description
15:13	LED instance, 0 = the first LED of this kind, 1 = seconds instance of this kind, etc. Range 0- 7.
12:10	LED count, number of colors/gpio for the LED object, typically 1 or 3 for single or tri-color LED.
9:0	LED colormask for each individual color, not combinations. See LEDCOLORMASK enumerations.

Behavior

Value	Description
0	No flashing ever
1	GPS legacy behavior (See green LED for description of this behavior)
2	GSM legacy behavior (See blue LED for description of this behavior)

25	Under voltage lockout threshold in mV. Determines when the device will enter lockout mode based on internal battery voltage.
26	Under voltage lockout hysteresis in mV. Hysteresis used to determine when the device should exit lockout mode based on internal battery voltage. Device exits when voltage exceeds Undervoltage Lockout + Undervoltage Hysteresis.

Parameter	Type	Description

Value	Description
27	Sensor conversion setup. <IDX>,<FAMILY>,<FUNCTION>,<CONVERSION>,<SLOPE>,<OFFSET>

IDX

Family Enumeration

Value	Description
0	PIO
1	ADC
2	MEMS
3	OWB
4	MAX

Function Enumeration

Value	Description
0	None
1	Main Voltage
2	GSM Voltage
3	GPS Voltage
4	VBUS 5 Voltage
5	Battery Voltage
6	Ext 1 Voltage
7	Ext 2 Voltage
8	Ext 3 Voltage
9	Temperature Voltage
10	Accelerometer
11	Input 1
12	Input 2
13	Input 3
14	Button 1
15	Temperature Switch
16	Charge Status
17	Charge Fault
18	Maximum

Conversion Type Enumeration

Value	Description
0	Count to mV
1	Count to °C * 1E -3

Parameter	Type	Description

Value	Description
	Slope Slope int32_t in units of the base conversion type *10^6 (if we are mV, then slope is taken in Volts*10^6)

Value	Description
0	units of the base conversion type *10^6

Value	Description
	Offset Offset int32_t in units of the base conversion type *10^6(if we are mV, then slope is taken in Volts*10^6)

Value	Description
0	units of the base conversion type *10^6

Value	Description
28	Firmware Options.

Value	Description
0	Battery lockout
1	Charge monitor

Value	Description
36	GPS model.

Value	Description
0	GPSHWRevision_uBlox_00040007
1	GPSHWRevision_uBlox_00070000
2	GPSHWRevision_uBlox_00080000
3	GPSHWRevision_sony_CDX5612
4	GPSHWRevision_quectel_BGSOC
5	GPSHWRevision_alt_ALTSOC
6	GPSHWRevision_uBlox_000A0000

10.10.3. Watchdog Disable

Triggers a watchdog reset by letting the time elapse.

Command Type	Syntax
UART	**Command** !mwd **Response** OK
JOB	**Command** { “!mwd”: [“”, “”] } **Response** N/A

10.10.4. Reset Diagnostic Data

Resets the diagnostic counters.

Command Type	Syntax
UART	**Command** !mdr **Response** OK

10.10.5. Diagnostic Print

Prints a list of diagnostic values.

Command Type	Syntax
UART	**Command** !mpd **Response** OK

10.10.6. Manager print

Prints information stored in device description, DSN, platform, etc.

Command Type	Syntax
UART	**Command** !mcp **Response** OK
JOB	**Command** { “!mcp”: [“”, “”] } **Response** N/A

10.10.7. Crash Information

Reports information when unexpected resets ocurr.

Command Type	Syntax
UART	**Command** !mhp **Response** OK

10.11. NANOKERNEL

10.11.1. Check-in Set

Forces the device to check-in to the Xirgo gateway server once a trip is completed.

Command Type	Syntax
UART	**Command** !qcs **Response** OK

10.11.2. Clear Fault State

Clears the nanokernel fault state which allows device to resume PPID requests after a nanokernel fault has been detected. A reset command (!nx) must be executed after this command.

Command Type	Syntax
UART	**Command**
	!qsr
	Response
	OK

10.12. Power Management

10.12.1. Power Management Debug Enable

Requests Power Management subsystem to route debug messaging to the interface which the command was sent to.

Command Type	Syntax
SET	**Command** !bde **Response** OK

10.12.2. Power Management Debug Disable

Requests Power Management subsystem to disable routing of debug messaging to the interface which the command was sent to.

Command Type	Syntax
UART	**Command** !bdd **Response** OK
JOB	**Command** { “!bdd”: [“”: “”] } **Response** OK

10.12.3. Power Management Ship Mode Enable

Enable ship mode by setting user trigger 0.

Command Type	Syntax
UART	**Command** !but:<id> **Network Response** OK

Parameter	Type	Description
ID	UINT8	Set user trigger. **Value** / **Description** 0 – User trigger 0 1 – User trigger 1

10.13. UPDATE

10.13.1. Firmware Update

Command to initiate update of various system components.

NOTE: GSMFW method does not accept port when an HTTP URI is passed in.

Command Type	Syntax
UART	**Command** !uf:<type>,<xmodem>
JOB	**Command** { “!uf”: [“<type>”: “<uri>”] }

Parameter	Type	Description
<type>	UINT8	**Value** / **Description** 1 – Main Firmware 2 – Bootloader 3 – Main firmware and Bootloader package 6 – Geofence 10 – Command List 20 – Cellular Module Firmware 30 – Security Truststore 31 – Device Certificate

<table>
<tr><th>Parameter</th><th>Type</th><th>Description</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>32</td><td>Device Private Key</td></tr>
<tr><td>33</td><td>Server Certificate (Certificate Authority)</td></tr>
<tr><td>40</td><td>BLE Firmware</td></tr>
<tr><td>41</td><td>VEC</td></tr>
</table>

NOTE: The command list can support all commands. Any command that resets the unit should be placed at the end of the list as they will interrupt the process.
</td></tr>
<tr><td><xmodem></td><td>STRING</td><td>Update via xmodem transfer over UART.</td></tr>
<tr><td><uri></td><td>STRING</td><td>Absolute URI of resource

The absolute URI must include the port even when using the default HTTPs port 443.
Username/password in the URI for basic authentication is not supported.

<table>
<tr><th>Method</th><th>Description</th></tr>
<tr><td>ftp://</td><td>Update via FTP over the network.</td></tr>
<tr><td>http://</td><td>Update via HTTP over the network.</td></tr>
<tr><td>https://</td><td>Update via HTTPS over the network.</td></tr>
</table>
</td></tr>
</table>

10.14. User Configuration

10.14.1. Configuration Set

Sets configuration id with given arguments and assumes most current revision. See Device Configuration section for further detail.

Command Type	Syntax
UART	**Command** !cs : <id>,<args> **Response** OK

10.14.2. Configuration Print

Prints active configuration of specified id and assumes the most current revision. See Device Configuration section for further detail.

Command Type	Syntax
UART	**Command** !cp : <id> **Response** OK

10.14.3. Configuration Set Version

Allows the user to specify a version for the configuration to set. Revision 255 is current. This command follows the same syntax as `!cs` other than the `<revision>` parameter. See the Device Configuration section for details on a specific configuration.

Command Type	Syntax
UART	**Command** !css:<id>,<revision>,<args> **Response** OK

10.14.4. Configuration Get Version

Allows the user to specify a version for the configuration to get. Revision 255 is current. This command follows the same syntax as `!cp` other than the `<revision>` parameter. See the Device Configuration section for details on a specific configuration.

Command Type	Syntax
UART	**Command** !csp:<id>,<revision> **Response** OK

10.14.5. Configuration Revision Set

Sets the configuration ID to the specified revision.

Command Type	Syntax
UART	**Command** !crs:<config_id>,<revision> **Response** OK

10.14.6. Configuration Revision Return

Returns the revision number of the configuration ID entered.

Command Type	Syntax
UART	**Command** !crg:<config_id> **Response** <revision>

10.14.7. Configuration Revision Return All

Returns all the revisions of configurations. If the configuration is current (255), it will not be returned.

Command Type	Syntax
UART	**Command** !crg:* **Response** <config_id>:<revision>

10.14.8. Configuration Revision Write Current

Sets all configuration revisions that are specified and applies any specific changes the user has made.

NOTE: If pinning to the current firmware, issue !crx and !crw in that order.

Command Type	Syntax
UART	**Command** !crw **Response** OK

10.14.9. Revision Reset

Resets configurations to unspecified, meaning they will use the latest on the device

Command Type	Syntax
UART	**Command**
	!crx
	Response
	OK

10.14.10. Save Configuration Stash

Overwrites the current configuration, saving the stash. A software reset is subsequently performed. If a configuration change is made, this command must be issued for the changes to take affect.

NOTE: An error will be returned if the current configuration matches the new desired configuration. There will be no update to current configurations and no software reset.

Command Type	Syntax
UART	**Command**
	!csu
	Response
	OK

10.14.11. Configuration Default

Stores the current active configuration as the default configuration. The 32-bit ASCII Hexadecimal mask defines which configurations are saved to the default. If no mask is provided, ***ALL*** configurations will be saved to the default configuration.

See Device Configuration section for further detail.

Command Type	Syntax
UART	**Command**
	!cd : <mask>
	Response
	OK

Definitions

Config Byte 0			
ID	**Type**	**Name**	**32-bit Mask**
1	ASCII HEX	GSMAPN	0x00000002
2	ASCII HEX	GSMMNO	0x00000004
3	ASCII HEX	ENDPOINT	0x00000008
4	ASCII HEX	NETCONFIG	0x00000010
5	ASCII HEX	PWRUPMSG	0x00000020
6	ASCII HEX	GPSCONFIG	0x00000040
7	ASCII HEX	CUSTOMPID	0x00000080
8	ASCII HEX	SMS	0x00000100
9	ASCII HEX	EVENTMASK	0x00000200
11	ASCII HEX	PERIODICRESET	0x00000800
12	ASCII HEX	IGNITIONMASK	0x00001000
13	ASCII HEX	BATTERY	0x00002000
14	ASCII HEX	ALTERNATORCONFIG	0x00004000
15	ASCII HEX	MQTTCONFIG	0x00008000
16	ASCII HEX	DNSCONFIG	0x00010000
17	ASCII HEX	IGNONPERIOD	0x00020000
18	ASCII HEX	IGNOFFPERIOD	0x00040000
19	ASCII HEX	LUMBERJACK	0x00080000
20	ASCII HEX	PROPRIETARYPID	0x00100000
21	ASCII HEX	EVENTREPORT	0x00200000
22	ASCII HEX	COMPRESSIONTYPE	0x00400000
23	ASCII HEX	VBUS	0x00800000
24	ASCII HEX	ACCTHSVBUS	0x01000000
25	ASCII HEX	ACCTHSGPS	0x02000000
26	ASCII HEX	POWERSTAGEPMU	0x04000000
27	ASCII HEX	POWERSTAGETRX	0x08000000
28	ASCII HEX	SNAPSHOTCFG	0x10000000
29	ASCII HEX	XCLCONFIG	0x20000000
30	ASCII HEX	TIME	0x40000000
31	ASCII HEX	XBPS	0x80000000

Config Byte 1			
ID	**Type**	**Name**	**32-bit Mask**
33	ASCII HEX	BUZZERSONG	0x00000002
34	ASCII HEX	DIRECTIONCHANGE	0x00000004
35	ASCII HEX	SPEEDTHSVBUS	0x00000008
36	ASCII HEX	SPEEDTHSGPS	0x00000010
37	ASCII HEX	GEOFENCECONFIG	0x00000020

Config Byte 1			
ID	Type	Name	32-bit Mask
38	ASCII HEX	ODOMETERTHSVBUS	0x00000040
39	ASCII HEX	ODOMETERTHSGPS	0x00000080
43	ASCII HEX	HEARTBEAT	0x00000800
45	ASCII HEX	MOVEMENT	0x00002000
46	ASCII HEX	XGS	0x00004000
47	ASCII HEX	FTPCONFIG	0x00008000
48	ASCII HEX	SYSTEMINFO	0x00010000
49	ASCII HEX	PARKCONFIG	0x00020000
50	ASCII HEX	IDLECONFIG	0x00040000
52	ASCII HEX	ADC	0x00100000
53	ASCII HEX	ADCADVANCED	0x00200000
54	ASCII HEX	ADCFILTER	0x00400000
55	ASCII HEX	COAP	0x00800000
56	ASCII HEX	MONOMO	0x01000000
57	ASCII HEX	SNAPSHOTTRX	0x02000000
58	ASCII HEX	MAPSTER	0x04000000
59	ASCII HEX	PSTRXEVENT	0x08000000
62	ASCII HEX	GPSASSIST	0x40000000
63	ASCII HEX	ACCELONAXIS	0x80000000

Config Byte 2			
ID	Type	Name	32-bit Mask
68	ASCII HEX	LED	0x00000010
70	ASCII HEX	ACCELEROMETER	0x00000040
74	ASCII HEX	FAULTERNATOR	0x00000400
77	ASCII HEX	BLUETOOTH	0x00002000
81	ASCII HEX	QUEUELIMIT	0x00020000
86	ASCII HEX	PIDS	0x00400000
87	ASCII HEX	ELD	0x00800000
89	ASCII HEX	UPDATEINHIBIT	0x02000000
90	ASCII HEX	DIAGNOSTICS	0x04000000

10.14.12. Configuration Info

Returns information about the configuration signature.

Command Type	Syntax
UART	**Command** !ci **Network Response** signature: <config signature stored in ram>, mask: <config mask> sigtest: <config signature calculated> OK

10.14.13. Configuration Reset

Resets device to default configuration settings. See Device Configuration command for further detail. Only supported on the UART interface located on the connector.

CAUTION: This command resets all configuration settings, including network settings.

NOTE: Defaulted configurations will NOT get applied until after the !csu command is issued.

Command Type	Syntax
UART	**Command** !cx **Response** OK

10.15. VBUS

10.15.1. VBUS Supported Protocols

CAN ISO1765
ISO 15765-4 CAN (11 bit ID,500 Kbaud)
ISO 15765-4 CAN (29 bit ID,500 Kbaud)
ISO 15765-4 CAN (11 bit ID,250 Kbaud)
ISO 15765-4 CAN (29 bit ID,250 Kbaud)
ISO
ISO 14230-4 KWP (5 baud init,10.4 Kbaud)
ISO 14230-4 KWP (fast init,10.4 Kbaud)
ISO 9141-2
J1850
SAE J1850 VPW
SAE J1850 PWM

10.15.2. VBUS Debug Enable

Requests VBUS subsystem to route debug messaging to the interface which the command was sent to.

NOTE: Only supported on the UART interface located on the connector.

Command Type	Syntax
UART	**Command**
	!vde
	Response
	OK

10.15.3. VBUS Debug Disable

Requests VBUS subsystem to disable debug messaging to the interface which the command was sent to.

NOTE: Only supported on the UART interface located on the connector.

Command Type	Syntax
UART	**Command**
	!vdd
	Response
	OK

10.15.4. VBUS Set Voltage

Requests VBUS subsystem to overwrite VBUS interpreted alternator voltage.

NOTE: Only supported on the UART interface located on the connector.

Command Type	Syntax
UART	**Command** !vsv:<voltage> **Response** OK

10.15.5. VBUS Set Motion

Requests VBUS subsystem to set motion state.

NOTE: Only supported on the UART interface located on the connector.

Command Type	Syntax
UART	**Command** !vsm:<state> **Response** OK

10.15.6. VBUS Production Test

Runs the VBUS production test, that tests all the RX/TX pins on the device.

- Device must be connected to a HARP device that is configured for VBUS testing.
- The VBUS debug enable command (!vde) must be sent before this command or the results will not display.
- The test output is displayed via the VBUS debug prints.

Command Type	Syntax
UART	**Command** !vt **Response** OK

10.15.7. Clear "Fallback to OBDII" status

Only applies if the VBUS MODE is configured as Proprietary PID w/ OBDII Fallback. Sending this command will clear the fallback state, allowing the device to attempt PPID communication again. After clearing, the possibility to fallback will remain unless the VBUS MODE is changed. A reset must be sent after clearing the fallback state, in order for the change to take effect.

Command Type	Syntax
UART	**Command**
	!vsr
	Response
	OK

10.16. XOR

10.16.1. Xirgo Core Data Processing

XOR collects and processes data from all subsystems, (VBUS, GPS, etc.). XOR is the source of all event parameters.

10.16.2. XOR Debug Enable

Requests XOR subsystem to route debug messaging to the interface which the command was sent to.

Command Type	Syntax
UART	**Command**
	!ade
	Response
	OK

10.16.3. XOR Debug Disable

Requests XOR subsystem to disable debug messaging to the interface which the command was sent to.

Command Type	Syntax
UART	**Command**
	!add
	Response
	OK

10.16.4. Set System Parameter

Sets the value for a system parameter.

Command Type	Syntax
UART	**Command** !apu:<param>,<ASCII-HEX Bytes>[,<OFFSET>] **Response** OK

10.16.5. XOR Generate Event

Generates the event provided and stores the event to either a buffer or EFS. Events logged to EFS will be sent out along with other events. Events stored in the buffer will be printed as a response to the !ate command.

Command Type	Syntax
UART	**Command** !ate:<event_id>,<dest> **Response** OK

Parameter	Type	Description
<event_id>	UINT8	See events section.
<dest>	UINT8	Destination. **Value** / **Description** 1 – EFS 2 – Buffer Returns on the channel from which the command was sent, for example CoAP, SMS, etc.

10.16.6. XOR Event Enable Mask

Setting this mask controls whether an event is enabled or disabled. does not persist over a power cycle.

Command Type	Syntax
UART	**Command** !aem:<mask[0]><mask[1]><mask[2]>,… **Network Response** OK Peripheral: <peripheral> Address: <addr> Size: <bytes> Hardware ID: <HWID>

Mask[0] bit	Type	Description
02	UINT8	Ignition On
04	UINT8	Ignition_Off
08	UINT8	Ignition_On_Periodic
10	UINT8	Ignition_Off_Periodic
20	UINT8	Power Up
40	UINT8	Power Up Gps
80	UINT8	Power Up Gsm

Mask[1] bit	Type	Description
02	UINT8	Acceleration
08	UINT8	Acceleration (GPS)
10	UINT8	Stage 0 Periodic
20	UINT8	Stage 1 Periodic
40	UINT8	Stage 2 Periodic

Mask[2] bit	Type	Description
04	UINT8	Direction Change
10	UINT8	Speed (GPS)
20	UINT8	Geofence Crossing

Mask[3] bit	Type	Description
01	UINT8	Odometer (GPS)
02	UINT8	Input 1 Set
04	UINT8	Input1 Clear
08	UINT8	Input 2 Set
10	UINT8	Input 2 Clear
80	UINT8	Heartbeat

Mask[4] bit	Type	Description
01	UINT8	Output Manual Override
02	UINT8	Diagnostics
04	UINT8	Movement Start
08	UINT8	Movement Stop
10	UINT8	System Report_0
20	UINT8	System Info
40	UINT8	Park
80	UINT8	Idle Start

Mask[5] bit	Type	Description
01	UINT8	Idle Stop
02	UINT8	Idle Periodic
04	UINT8	Power Up Best Time
08	UINT8	ADC Threshold
10	UINT8	ADC Periodic
20	UINT8	Diagnostics_1
40	UINT8	Diagnostics_2
80	UINT8	Diagnostics_3

Mask[6] bit	Type	Description
01	UINT8	Motion
02	UINT8	No-motion
04	UINT8	Motion Periodic
08	UINT8	No-motion Periodic
10	UINT8	Power Stage Transition

Mask[7] bit	Type	Description
04	UINT8	BLE Beacon Report

11. EOL Device Provisioning

11.1. Certificate Rotation

If the root certificate used for signing certificates is older than 30 days or has been used to sign 5,000 or more device certificates, a new root certificate is created.

11.2. Root Certificate Generation

1. Generate root keypair.
2. Use keypair public key to create X.509 verification certificate.
    a. 30-day expiration.
    b. Random serial number.
    c. Subject: “As specified by customer”.
    d. Write verification certificate to filesystem.
    e. Generate verification certificate keypair.
    f. Use verification certificate to create PKCS10 certificate signing request (CSR). Subject = “CN={AWS IOT REGISTRATION CODE}”.
    g. Sign with verification certificate private key using SHA256withRSAencryption.
    h. Write certificate signing request (CSR) to filesystem.
    i. Generate signed X.509 verification certificate using root CA. 30 days valid period from time of creation. Root CA private key used to sign with SHA256withRSA.
    j. Write certificate to filesystem.

11.3. Device Certificate Generation

1. Generate device keypair.
2. Use verification certificate to create PKCS10 certificate signing request (CSR). Subject “OU=Xirgo Technologies,O=Xirgotech.com Inc.,L=Camarillo,ST=Calafornia,C=US”.
3. Sign with device certificate private key using SHA256withRSAencryption.
4. Write certificate signing request (CSR) to filesystem.
5. Generate signed X.509 device certificate using root CA. Valid for 10 years from time of creation. Root CA private key used to sign with SHA256withRSA.
6. Write signed certificate to filesystem.
7. Load device signed certificate and private key into keystore.

8. Register device with Amazon IoT. This sends the root CA, verification certificate and device certificate to Amazon's API.
9. Build firmware image with embedded device private key, device public certificate and necessary server certificates.
10. Delete all device certificates from filesystem.

11.4. CERTIFICATE REGISTRATION

Steps to register the certificates on the device

11.4.1. Requirements

1. Java 10 must be installed on the computer running the script.
2. The input file, **input.csv** must have correct information.
3. The configuration file, **config.properties** must be in the same directory as the jar being run.
4. Verify the following items in **config.properties** match the details provided for the customer.
    a. apiKey
    b. outputFolder
    c. caCertFolder
    d. modelNumber
    e. serverUrl
    f. serverCert
    g. clientId
    h. mqttEndpoint

11.4.2. Procedure

1. Create/edit the file: **input.csv**.
2. Enter a list of device serial numbers, and the associated IMEI's into **input.csv**.
    a. Each line of the file should be formatted as follows:

```
<Device Serial Number>,<Device IMEI>
```

3. In a terminal, Run the following command:

```
java -jar <JAR file provided by Xirgo> -i <path to input.csv>
```

4. For each serial number/IMEI pair provided, three .BIN files will be outputted into the 'outputFolder' as defined in the **config.properties** file:

a. <DeviceSerialNumber>DeviceCert.bin
b. <DeviceSerialNumber>PrivateKey.bin
c. ServerCert.bin (only one of these is created, regardless of how many s/n's are provided)

5. md5.log will also be generated in the same output folder. This file contains certificate md5 checksums. Each line of this file is formatted as follows:

```
<serial #>,<private key md5>,<device cert md5>,<server cert md5>
```

12. Authentication to the Device Console

12.1. Manual Authentication

To manually authenticate the device to the console:

12.1.1. Enabling Authentication

1. Set the encryption key.

   ```
   !mcs:10,<key in ASCII hex>
   ```

2. Enable console authentication.

   ```
   !mcs:18,1,1
   ```

3. Reset the device.

12.1.2. Logging into the Console

NOTE: XT2500 utilizes 128-bit AES ECB encryption, which is 32 hex characters.

1. Send login commandLog into the device via console. The device will prompt ASCII hex string challenge login.
2. Decrypt the AES challenge against the key set in Step 2.

   ```
   Aes_login.exe <KEY> <CHALLENGE>
   ```

3. Copy the device response from step 2 and send the response to the device via console.
4. Device sends “accepted” upon successful login.

12.1.3. Disabling Authentication

Send the following command to disable console authentication:

```
!mcs:18,1,0
```

13. AWS IoT Jobs

AWS IoT jobs can be used to define a set of remote operations that are sent to and executed on one or more devices connected to AWS IoT.

13.1. What is a job

A job is a remote operation that is sent to and executed on one or more devices connected to AWS IoT. For example, a job can be defined that instructs a set of devices to download and install a firmware update, reboot or perform configuration updates, maintenance operations, or remote troubleshooting.

13.2. What is a job ID

Job IDs are unique identifiers assigned to a job during creation. The job length must be at least 1 but no more than 64 alphanumeric characters.

13.3. Job document

To create a job, a job document must first be created that is a description of the remote operations to be performed by the devices.

Job documents are UTF-8 encoded JSON documents and should contain any information devices need to perform a job. A job document will most likely contain one or more URLs where the device can download an update or some other data. The job document itself can be stored in an Amazon S3 bucket or be included inline with the command that creates the job.

13.4. Job target

When creating a job, specify a list of targets that are the devices performing the operations. The targets can be things, thing groups, or both. AWS IoT jobs send a message to each target to inform it that a job is available.

13.5. Job execution

A job execution is an instance of a job on a target device. The target starts an execution of a job by downloading the job document. It then performs the operations the document specifies and reports its progress to AWS IoT. An execution number is a unique identifier of a specific job execution on a specific target. The Jobs service provides commands to track the progress of a job execution on a specific target and the progress of a job generally across all the targets of the job.

13.6. Snapshot job

By default, a job is sent to all targets specified when a job is created. After those targets complete the job (or report that they are unable to do so), the job is complete. This is a snapshot job.

13.7. CONTINUOUS JOB

A continuous job is one that continues to run and is executed when a change is detected in a target. For example, a job will run on a device when the thing representing the device is added to a target group, even after the job was completed by all things originally in the group. A continuous job can be used to onboard or upgrade devices as they are added to a group. A job can be made continuous by setting an optional parameter when the job is created.

13.8. JOB STATUS

The AWS Jobs interface reports the following job status:

Status	Description
Queued	AWS is waiting for the device to request this job.
In-Progress	The device requested the job and is processing it.
Success	The device successfully executed the job and sent the command response.
Failed	The job was either invalid or the device was unable to execute the command.

NOTE: If an Over-The-Air update is interrupted with a power cycle while In-Progress, the job status will report as Failed.

13.9. ROLLOUTS

When creating a job, the speed targets are notified of a pending job execution can be specified. This allows creation of a staged rollout to better manage updates, reboots, and other operations.

The following field can be added to the CreateJob request to specify the maximum number of targets that will be informed of the job per minute:

```
"jobExecutionRolloutConfig": {
        "maximumPerMinute": "integer"
    }
```

13.10. PRE-SIGNED URIS

To allow a device secure, time-limited access to data beyond that included in the job document itself, use pre-signed Amazon S3 URIs. Place your data in an Amazon S3 bucket and add a placeholder link to the data in the job document. When the Jobs service receives a request for the job document, it parses the job document looking for placeholder links and it replaces them with pre-signed Amazon S3 URIs.

General format to pre-sign where *bucket* is your bucket name and *key* is the object in the bucket to which you are linking.

```
$aws s3 presign <S3 Bucket/Key> --expires-in <Seconds>
```

Sample command to presign a URI

```
$aws s3 presign ltem/AAzW.1168BA3.1.e6089f9.x00 --expires-in 3600
```

General OTA job format

```
$aws iot create-job --job-id "<ID>" -- targets "<target>" --
document "<document>"
```

Sample OTA job

```
$aws iot create-job --job-id "111" --targets arn:aws:iot:us-west-
2:011929418200:thing/XT2469-182000531 –document

"{"!uf":[1,"https://s3.amazonaws.com/ltem/AAz1.1168BA2.6.bd88028.x00"]}"
```

13.11. USING THE AWS-IOT CONSOLE APPLICATION TO CREATE JOBS

This command creates a job that contains commands "!cp:3", "!nx", and "!cp:15". Jobs containing a job key with the first character "#" can support multiple commands in an array. In the example below, configuration 3 is set, a reset is initiated, and then the sequence is continued and configuration 15 is set.

NOTE: Jobs that require a reset may occur in any order.

```
$ aws iot create-job --job-id "multi15" --targets "arn:aws:iot:

us-west-2:190567248221:thing/XT2469-8675309" --document='{"#jobs":
["!cp:3,0","!nx","!cp:15"]}'

{

"jobArn": "arn:aws:iot:us-west-2:190567248221:job/multi15",

"jobId": "multi15"

}
```

This command creates a job that contains the command ‘:cp2’ which prints config element #2 (GSMENDHOST).

```
$ aws iot create-job --job-id "2" --targets "arn:aws:iot:us-west-
2:190567248221:thing/XT2473-1" --document="{"!cp":[2,""]}"

{

"jobArn": "arn:aws:iot:us-west-2:190567248221:job/2",

"jobId": "2"
```

```
}
```

This command creates a job that contains the command ':uf1' which initiates a firmware update using the absolute URI presented as a parameter option.

```
$ aws iot create-job --job-id "4" --targets "arn:aws:iot:us-west-
2:190567248221:thing/XT2473-1" --document='{"!uf":[1,"https://s3-us-west-
2.amazonaws.com:443/bucket/key"]}'

{

"jobArn": "arn:aws:iot:us-west-2:190567248221:job/4",

"jobId": "4"

}
```

CAUTION: Job IDs must be a non-zero value between 1 and 64 alphanumeric characters. Strings that evaluate to 0 will cause the device to report Rejected. Job ID of 0 is not supported.

13.12. When Does the Device Process Jobs?

The device will subscribe to the jobs topic after any trip data has been published. After connecting the device will retrieve any queued jobs using the start-next topic.

13.13. Jobs and Thing Shadow Interaction

Configuration settings changed by Jobs will only persist if the configuration does not exist in the Thing Shadow. The Thing Shadow will reset configurations to their Desired state upon the next Shadow update.

CAUTION: Do not use Job write interface to set device configurations that are in Desired section of the Thing Shadow.

13.14. Job/Shadow Configuration Syntax

To write and read configurations using job/shadow syntax, use the following general shemas.

Job Read Schema
{ "!cp": [##, ""] }
Job Write Schema
{ "!cs": [##, "PARAMETER_1,PARAMETER_2,PARAMETER_3, .. "]}
Shadow Schema
{ "##": "PARAMETER_1, PARAMETER_2, PARAMETER_3, .. " }

14. THING SHADOW

14.1. SHADOW GUIDELINES

All hexadecimal strings should be set as caps. Hexadecimal strings written in lowercase will conflict with the Shadow and resolving those conflicts will increase data use.

If too many configurations are set at once, especially array based configurations, the shadow update may fail.

When setting a configuration in the desired section with type ASCII HEX, the number of digits must match the number in the reported section of the shadow (including leading zero's). The example below illustrates a case where the delta will never be resolved if the previously mentioned guideline is not followed.

```
{
  "desired": {
    "config": {
      "8": ",0,0,D",
      "23": "000000FF,FF,0"
    }
  },
  "reported": {
    "device": {
      "CH": "2023142434",
      "FWM": "AHz1.1188DB9.1.6c567b8*",
      "NKR": "_,0,",
      "XVEC": "0,0,0",
      "PIDS": "0,0,0,0"
    },
    "error": {
      "config": "8"
    },
    "config": {
      "8": ",0,0,0D",
      "23": "000000FF,00FF,0"
    }
  },
  "delta": {
    "config": {
      "8": ",0,0,D",
      "23": "000000FF,FF,0"
    }
  }
}
```

14.2. DEFAULT CONFIGURATION


```
"desired": {
   "config": {
     "4": "1,0",
     "5": 255,
     "6": "2018,60,100",
     "9": {
       "1": "7D58357F01,1",
       "2": "7D58457F01,1",
       "3": "3D5871028C,0",
       "4": "3F58717F0D1703,0",
       "5": "3F58717F0D1703,1",
       "6": "3F58717F0D1703,1",
       "7": "3F58717F0D1703,1",
       "8": "3D50F1000E,1",
       "9": "3F58717F0D1703,0",
       "10": "3F58717F0D1703,0",
       "11": "3F58717F0D1703,0",
       "12": "3F58717F0D1703,0",
       "13": "BD4801A0,1"
     },
     "10": "1,86400",
     "11": "60,1440",
     "12": "0,1,0",
     "13": "12000,30,12500,30",
     "14": "125,3,3,1",
     "17": 30,
     "18": 3600,
```

```
    "19": "600,1,1",
    "20": "600,1,1",
    "21": "600,8000",
    "22": 1,
    "23": "255,65535",
    "24": "0,0",
    "25": "0,0",
    "26": {
      "1": "600,131328",
      "2": "0,0"
    },
    "27": "1,2",
    "28": {
      "1": "1536,1",
      "2": "0,0",
      "3": "0,0",
      "4": "0,0"
    },
    "29": "0,0,0,0,0,0,0,0",
    "30": "1800",
    "31": {
      "1": "300,393472",
      "2": "300,0"
    },
    "32": "1,16",
    "33": {
      "1": "4,544",
      "2": "65535,544",
```

```
      "3": "1024,32",
      "4": "0,0"
    },
    "34": "0,0,13200,0,0,0,0,0",
    "35": "3600"
  }
}
```

14.3. When Does the Device Synchronize With the Shadow?

The device will subscribe to the shadow update topic when the connection to AWS IoT is established. After connecting the device will trigger an update by publishing. There are three cases in which the device will synchronize with the Shadow:

Initiated By	Synchronization Type	Case
Device	Full Synchronization	The first time the device connects to AWS from power-up.
Device	Full Synchronization	Any time a configuration is changed by a system other than the Shadow, such as a console command or Job.
AWS	Partial Synchronization	Any time a "delta" is calculated between the "desired" and "reported" sections AWS will publish a message to the shadow/update topic which will cause the device to sync with the shadow.

During a full synchronization, the device reports all configurations to the “reported” section. During a partial synchronization, the device reports only configurations within the “delta” section to the “reported” section.

14.4. Shadow Delete

The Shadow Delete command (!nsd) is a job-only command, and will not work via the console.

This command publishes a message to shadow topic which deletes the Shadow “desired” section. Using the Shadow Delete command will also remove any deltas.

The reported section is not affected.

14.4.1. Syntax

Type	Syntax
JOB	{ “!nsd”: [“”, “”] }

14.5. Device Information

At the end of a shadow there will be a "device" section that details the following parameters: CH, FWM, NKR, XVEC, and PIDS.

At the end of a shadow there will be a "device" section that details the following parameters: CH, FWM, NKR, and XVEC.

Parameter	Description
CH	Config hash is an identifier for what configs are currently in use.
FWM	Displays the firmware string.
NKR	Displays the name, revision, version, and VIN.
XVEC	Displays the status, number of PIDS requested, and number of PIDS detected.
PIDS	Displays the status, hash, checkin hash, and status hash.

15. Certificate Loading Procedure

When neither the module nor the device's trust store have certificates currently loaded:

1. Put the device in bypass mode 1.

   ```
   !mcs:3,21,1
   ```

2. Set device certificate mask.

   ```
   !mcs:19,8007
   ```

3. Issue a software reset to the device.

   ```
   !nx
   ```

4. Convert certificates from DER to PEM format with proper headers if not already in PEM format:
   a. Use OpenSSL commands to convert the certificate format using openssl x509:

   ```
   openssl x509 -in <Device Certificate> -inform DER -out
        certificate.der.crt -outform PEM
   ```

   ```
   openssl x509 -in <Root AWS> -inform DER -out
        root_aws.der -outform PEM
   ```

   ```
   openssl rsa -in <PEM key> -inform DER -out
        private.der.key -outform PEM
   ```

Value	Description
<Device Certificate>	Device certificate
<Root AWS>	Certificate the device uses to validate the server. Root AWS certificate can be: • Root certificate authority • Server public certificate • Intermediate certificate
<PEM Key>	Private key

   a. The header syntax is:

   ```
   0x58 0x43 <type> 0x00 <size>
   ```

Value	Type	Description
0x58	N/A	Required
0x43	N/A	Required

Value	Type	Description	
<type>	DECIMAL INT	**Value**	**Description**
		0	Private Key
		1	Device Certificate
		2	Server Certificate 0
		3	Server Certificate 1
		4	Server Certificate 2
		5	Server Certificate 3
		6	Server Certificate 4
		7	Server Certificate 5
		8	Server Certificate 6
		9	Server Certificate 7
		10	Server Certificate 8
		11	Server Certificate 9
0x00		Reserved	
<size>		4-byte file size • Little endian format. Least significant bit is ordered first.	

5. Send the console the following command:

   ```
   !uf:30,xmodem
   ```

6. Send the <DeviceSerialNumber>TRUSTSTORE.BIN via XMODEM.

7. Send the following command to load all keys and certificates onto the cellular module and print md5 checksums:

   ```
   !gcc
   ```

   Example Print:

   ```
   DevicePrivateKey:0 Loaded [A3A4A46AC04C2A5EDDE649D4520C5646]
   DeviceCertificate:1 Loaded [4A9ECE79520A90698007F8C1D9E25E50]
   ServerCertificate:2 Loaded [CB17E431673EE209FE455793F30AFA1C]
   OK
   ```

8. Remove device from bypass mode.

   ```
   !mcs:3,21,0
   ```

9. Confirm load by printing the certificate mask. A response of `8007` confirms auto load is enabled, and the device key, device certificate, and server certificate 0 are loaded.

   ```
   !mcp
   ```

16. Xirgo ELD Over BLE API Specification

16.1. Introduction

Electronic Logging Device (ELD) is a United States federally mandated regulation maintained by the Federal Motor Carrier Safety Administration (FMCSA), a division of the Department of Transportation.

From the FMCSA's website:

> *The electronic logging device (ELD) rule – congressionally mandated as a part of MAP-21 – is intended to help create a safer work environment for drivers, and make it easier and faster to accurately track, manage, and share records of duty status (RODS) data. An ELD synchronizes with a vehicle engine to automatically record driving time, for easier, more accurate hours of service (HOS) recording.*

This device may function as an ELD using Bluetooth Low Energy (BLE) to deliver vehicle and driving data to another internet connected device as part of an ELD rule compliant system.

16.2. Unidentified Driver Records

In addition to live ELD data, this device can store Unidentified Driver Records (UDRs). These records will be stored when a trip occurs, and no Driver ID has been set on the device. The period at which records are generated is set in the Xirgo device configuration. The records will include nearly the same information as a live record but will be stored in non-volatile device flash for later consumption.

These records may be read by a connected central device at any time. The connected central device must ACK the reading of a record after it has been consumed to indicate to the Xirgo device that the record can now be discarded. Failure to ACK will result in the Xirgo device running out of UDR storage space. The Xirgo device can store up to a certain number of UDRs at a time (currently TBD).

16.3. CONFIGURATIONS

The following configurations are available for the ELD over the BLE system:

16.3.1. BLE Enable/Disable

Bit 0 of the FLAGS field of the BLUETOOTH configuration (77).

16.3.2. ELD Enable/Disable

Bit 0 of the FLAGS field of the ELD configuration (87).

16.3.3. UDR Enable/Disable

Bit 1 of the FLAGS field of the ELD configuration (87).

16.3.4. DID Via BLE Enable/Disable

Bit 2 of the FLAGS field of the ELD configuration (87). When DID via BLE is enabled, the connected Central device is expected to manage the setting of the Driver ID via the “ELD DRIVER ID” characteristic upon connection. Failure to do so will result in the device entering an unidentified driver state. Upon disconnection to the Central device, the Xirgo device will reset the DID to 0, putting it into an unidentified driver state once more.

16.3.5. UDR Event Period

The UDR_INTERVAL_S period of the ELD configuration (87).

16.4. ADVERTISEMENT DATA

The advertisement data for all devices will fit the following format:

Complete local name (0x9): "ELD <device serial number>"

16.5. CONNECTING

The device has a GAP role of Peripheral and can be connected to a Central device. The device uses “Just Works” security as specified by the Bluetooth Core Specification Version 4.2.

16.6. MTU SIZE

After connecting, Xirgo recommends that the initiating device negotiates an MTU size exchange to 164 bytes for optimal message packets sizing. Using a larger MTU size may create resource constraints on the device and using a smaller MTU size will result in chunked messages, which creates more overhead and takes more time to transmit.

16.7. SERVICES

The device has only one primary service with the following UUID:

`9e675d27-6168-435f-aeab-8b3b55b88352`

16.8. CHARACTERISTICS

16.8.1. ELD UDR

Description: The UDR read characteristic. Performing a read will read one record from non-volatile memory.

UUID: 705dfc85-d511-4dc6-b6eb-834a66338303

R/W: READ only

Format: msgpack byte array

Size: size may vary

16.8.2. ELD UDR ACK

Description: The UDR ACK characteristic. This characteristic must be written to acknowledge consumption of a UDR. The data written does not matter.

UUID: 4c10425e-95c0-490c-870e-d6a1688f0982

R/W: READ/WRITE

Format: UINT8

Size: 1 byte

16.8.3. ELD LIVEREC

Description: The live record read characteristic. Reading this will return a live record, generated from data that is stale by no more than 1 second.

UUID: edf3390e-7595-44ec-b0ec-78c0994ec480

R/W: READ only

Format: msgpack byte array

Size: size may vary

16.8.4. ELD DRIVER ID

Description: A readable/writable Driver ID characteristic. If DID via BLE is enabled in the device configuration, then the Central device is being used to set the Driver ID. It must set it immediately upon connection to avoid the device thinking it is in an unidentified driver state, which will enable the creation of UDRs if a trip starts. Upon disconnection to the Central device, the Xirgo device will reset the DID to 0, putting it into an unidentified driver state once more.

UUID: 66f1f9bd-a832-434e-a5ae-4b4d306dfe5e

R/W: READ/WRITE

Format: UINT32

Size: 4 bytes

16.9. Live Record Format

The record is a byte-array that encodes a msgpack object. The format of the msgpack object is identical to the formatting of events published to the event data topic at the configured endpoint.

The live record contains the following system parameters:

Parameter	ID
LT	004
LN	005
SPT	007
SV	010
HP	011
MI	014
GS	016
VN	025
RM	031
BN	034
OMI	045
BT	050
MPG	065
EH	109
DID	118
JOMI	120
JEH	121

16.10. Unidentified Driver Record Format

The record is a byte-array that encodes a msgpack object. The msgpack formatting of the record is identical to the formatting of events published to the event data topic at the configured endpoint.

The UDR contains the same parameters as the live record, with the addition of two more parameters:

Parameter	ID
UT	049
USEQ	119

17. UART COMMAND LIST

Subsystem	Command Description	UART Command
Backend		
	Debug Enable	!sde
	Debug Disable	!sdd
Boot Count		
	Query	!nbc
	Set	!nbc:<new_count>
Cellular		
	Debug Enable	!gde
	Debug Disable	!gdd
	Print Information	!gpd
	Load Certificates	!gcc<index>
	GSM uFOTA (job only)	!gfc
	Statistics	!gpc
	Status	!gps
Event Filesystem		
	Debug Enable	!ede
	Debug Disable	!edd
	Print Information	!epi
	Test	!et
	Reset	!ex:<file_system_id>
GPIO		
	Print Configuration	!ip:<func>
	Clear Output Pin State	!ic:<func>
	Set Output Pin State	!is:<func>
GPS		
	Debug Enable	!yde
	Debug Disable	!ydd
	Print Information	!ypi
LED		
	List LEDs	!lil
	Override Sequence	!los:<identifier>,<mask>,<duration>
	LED Configuration	!los:<ident>,<mode>,<iterations>,<mask>,<slice>
Manager		
	Enable Security	!mss
	Set Description Parameter	!mcs:<item>[,<params>]
	Watchdog Disable	!mwd
	Print	!mcp
Sentinel		
	Debug Enable	!sde

Subsystem	Command Description	UART Command
	Debug Disable	!sdd
	Watchdog Enable	!sw
System on Chip		
	Debug Enable	!sde:<mask>
	Debug Disable	!sdd
	Print Info	!spi
	Priority Set	!sps:<priority,<persist>
	Shadow Sync	!sss
	Check-in	@callhome
NanoKernel		
	Check-in set	!qcs
	Clear Faule State	!qsr
Power Management		
	Debug Enable	!bde
	Debug Disable	!bdd
	Ship Mode Enable	!but:<id>
Update		
	Update Firmware	!uf:<type>
User Configuration		
	Configuration Set	!cs: <id>,<args>
	Save Configuration Stash	!csu
	Configuration Set Version	!css:<id>,<revision>,<args>
	Configuration Print Version	!csp:<id>,<revision>
	Configuration Print	!cp : <id>
	Configuration Default	!cd : <mask>
	Configuration Reset	!cx
VBUS		
	Debug Enable	!vde
	Debug Disable	!vdd
	Set Voltage	!vsv:<voltage>
	Set Motion	!vsm:<state>
	Production Test	!vt
	Clear "Fallback to OBDII" Status	!vsr
XFS		
	Print Information	!fpi
XOR		
	Debug Enable	!ade
	Debug Disable	!add

Subsystem	Command Description	UART Command
	Set Parameter Value	!apu:<param>,<ASCII-HEX Bytes>[,<OFFSET>]
	Generate Event	!ate:<event_id>,<dest>

18. Configuration Revision Example

18.1. What is a Configuation Revision

As configuration functionality expands over time, there will be minor changes to the way a certain configuration works. If the change results in the user needing to interact with the configuration in a different way, a new revision will be created. This change will allow users to use both the original configuration and the new configuration revision.

18.2. How to Use the Newest Configuration Revision

By default, the existing configuration of the previous revision will behave the same under the newer revision across firmware updates.

18.3. How to Check Which Configuration Revision is Being Used

Issue a !crg:<config_id> to print the revision being used. A return of 255 represents the most recent revision. A return of an integer represents the revision number for the configuration. For example, if the most recent revision of a configuration is 2, a return of 255 or 2 represents the same revision. Go to the desired configuration description to see what the most recent revision is.

Additionally, you can issue a !crg:* to return the revisions of all configurations. A revision will be returned if it is something other than the most recent revision or if the revision is set (see Writing Configuration Revisions).

18.4. Writing Configuration Revisions

To write a configuration revision, a user may do one of the following:

- Issue a !crw to set the currently defined revisions for all configurations. Issuing a !crg* will now return the set revisions for all configurations.
- Issue a !crs:<config_id>,<config_revision> to set the revision of an individual configuration.

After writing the configuration revision, the device configuration revisions will persist on an update to a newer firmware. This means the user will continue using a defined revision rather than using a newer revision if available.

18.5. Resetting Configuration Revisions

To reset the configuration revisions of all configurations to the most recent revision, issue a !crx. This will overwrite written configuration revisions for all configurations.

18.6. Example Use Case

For this example there have been changes to a configuration that resulted in revision 1 to be made available on newer firmware. The user is unsure how this new revision may change the way they configure the device and wish to preview the revision on the device before electing to use the latest revision. This may be the case if the user has scripts which expect configuration schema to remain the same.

On the older firmware with the configuration revision the user wishes to preserve, write the configuration revisions and verify they were written:

1. Issue `!crs:<config_id>,<config_revision>`.

> **NOTE:** !crw will also work but will write all configuration revisions to be preserved rather than just the configuration of concern.

2. Issue `!crg:<config_id>`. This returns the written revision.

After updating to the newer firmware, the configuration will still be the revision that was written. To print what the configuration would look like with the newer revision, perform the following:

1. Issue `!csp:<config_id>,<config_revision_to_be_previewed>,<index_parameters_if_needed>`

This allows the user to see how the configuration will be translated on the newer revision. To set the configuration under the newer revision while remaining on your current revision, perform the following:

1. Issue `!css:<config_id>,<config_revision>,<parameters>`.
2. Issue `!csu`.

Now, issuing a `!csp` will print the configuration the user would set if they wrote the revision to the latest with `!crs:<config_id>,<revision_latest>` or by resetting the configuration revisions with `!crx`.

18.7. Accidentally Upgraded to New Configuration Revisions

Issue a `!crs:<config_id>,<old_revision>`.

> **NOTE:** The configuration printed with !cp:* will always print the most recent revision, to validate you have configured your device on the revision you intended, issue a !crg:<config_index> which will return the revision number and print your configuration with !cp:<config_index>

19. Appendix B: Power Stage Transition Example (Multiple Criteria)

How to configure power stage transitions:

As an example, we'll configure the device to transition from power stage 0(PS0) into power stage 1(PS1); based on ignition being off, AND an amount of time in PS0. The device will then be configured to transition back into PS0 on either vibration, OR main voltage above a threshold.

To configure the transition from PS0 into PS1, make the following configuration changes based on the desired revision:

19.1. Configuration Revision 1

19.1.1. Configuration change 1

```
!cs:27,0,0,1,1,0,30,0,1
```

input 1: 27 = configuration index 27 (power stage transition configuration index)

input 2: 0 = transition index (0 specifies that we are configuring the first criterion of 48 (zero indexed))

input 3: 0 = this is the src or source power stage (0 = PS0, transitioning from PS0)

input 4: 1 = this is the dst or destination power stage (1 = PS1, transitioning to PS1)

input 5: 1 = enabled (this criterion is enabled)

input 6: 0 = criterion identifier: ignition-off

input 7: 30 = required age is 30 seconds (ignition must be off for at least 30 seconds)

input 8: 0 = threshold is 0 (doesn't apply to ignition-off criterion)

input 9: 1 = type is AND (this, and all other AND criteria must be true in order to transition)

19.1.2. Configuration Change 2

```
!cs:27,2,1,0,1,6,0,0,2
```

input 1: 27 = configuration index 27 (power stage transition configuration index)

input 2: 2 = transition index 2 specifies that we are configuring the third criterion of 48 (zero indexed)

input 3: 1 = this is the src or source power stage (1 = PS01 transitioning from PS1)

input 4: 0 = this is the dst or destination power stage (0 = PS0, transitioning to PS0)

input 5: 1 = enabled (this criterion is enabled)

input 6: 6 = criterion identifier: ignition-off

input 7: 0 = required age is 0 seconds (vibration will immediately cause this criterion to be true)

input 8: 0 = threshold is 0 (doesn't apply to vibration criterion)

input 9: 2 = type is OR (this criterion alone may trigger the transition)

19.1.3. Configuration Change 3

```
!cs:27,2,1,0,1,6,0,0,2
```

input 1: 27 = configuration index 27 (power stage transition configuration index)

input 2: 2 = transition index 2 specifies that we are configuring the third criterion of 48 (zero indexed)

input 3: 1 = this is the src or source power stage (1 = PS01 transitioning from PS1)

input 4: 0 = this is the dst or destination power stage (0 = PS0, transitioning to PS0)

input 5: 1 = enabled (this criterion is enabled)

input 6: 6 = criterion identifier: ignition-off

input 7: 0 = required age is 0 seconds (vibration will immediately cause this criterion to be true)

input 8: 0 = threshold is 0 (doesn't apply to vibration criterion)

input 9: 2 = type is OR (this criterion alone may trigger the transition)

19.1.4. Configuration Change 4

```
!cs:27,3,1,0,1,2,2,12500,2
```

input 1: 27 = configuration index 27 (power stage transition configuration index)

input 2: 3 = transition index 3 specifies that we are configuring the third criterion of 48 (zero indexed)

input 3: 1 = this is the src or source power stage (1 = PS1 transitioning from PS1)

input 4: 0 = this is the dst or destination power stage (0 = PS0, transitioning to PS0)

input 5: 1 = enabled (this criterion is enabled)

input 6: 2 = criterion identifier: adc main-voltage above

input 7: 0 = required age is 0 seconds (vibration will immediately cause this criterion to be true)

input 8: 12500 = threshold is 12500 (thresh is in mV for this criterion, so setting is 12.5V)

input 9: 2 = type is OR (this criterion alone may trigger the transition)

19.2. CONFIGURATION REVISION 0

19.2.1. Configuration change 1

```
!cs:27,0,0,1,0,30,0,1
```

input 1: 27 = configuration index 27 (power stage transition configuration index)

input 2: 0 = transition index 0 (this transition index specifies the PS0 to PS1 transition)

input 3: 0 = transition criteria index 0 (specifies that we are configuring the first criterion of eight (zero indexed))

input 4: 1 = enabled (this criterion is enabled)

input 5: 0 = criterion identifier: ignition-off

input 6: 30 = required age is 30 seconds (ignition must be off for at least 30 seconds)

input 7: 0 = threshold is 0 (doesn't apply to ignition-off criterion)

input 8: 1 = type is AND (this, and all other AND criteria must be true in order to transition)

19.2.2. Configuration change 2

```
!cs:27,0,1,1,7,120,0,1
```

input 1: 27 = configuration index 27 (power stage transition configuration index)

input 2: 0 = transition index 0 (this transition index specifies the PS0 to PS1 transition)

input 3: 1 = transition criteria index 1 (specifies that we are configuring the second criterion of eight (zero indexed))

input 4: 1 = enabled (this criterion is enabled)

input 5: 7 = criterion identifier: in-stage (true when device is fully in the current power stage (not transitioning))

input 6: 120 = required age is 120 seconds (must have been in stage PS0 for at least 120 seconds)

input 7: 0 = threshold is 0 (doesn't apply to in-stage criterion)

input 8: 1 = type is AND (this, and all other AND criteria must be true in order to transition)

19.2.3. Configuration change 3-8

```
!cs:27,0,2,0,0,0,0,0
!cs:27,0,3,0,0,0,0,0
!cs:27,0,4,0,0,0,0,0
!cs:27,0,5,0,0,0,0,0
!cs:27,0,6,0,0,0,0,0
!cs:27,0,7,0,0,0,0,0
```

These configuration changes are just to clear out all the other transition criteria, and ensure that only the two configured above for PS0 into PS1 are active

Now the device will behave transition from PS0 into PS1 after having ignition off for 30 seconds, if it has been in PS0 for at least 120 seconds.

To configure the transition from PS1 into PS0, make the following configuration changes:

19.2.4. Configuration change 9

```
!cs:27,3,0,1,6,0,0,2
```

input 1: 27 = configuration index 27 (power stage transition configuration index)

input 2: 3 = transition index 3 (this transition index specifies the PS1 to PS0 transition)

input 3: 0 = transition criteria index 0 (specifies that we are configuring the first criterion of eight (zero indexed))

input 4: 1 = enabled (this criterion is enabled)

input 5: 6 = criterion identifier: ignition-off

input 6: 0 = required age is 0 seconds (vibration will immediately cause this criterion to be true)

input 7: 0 = threshold is 0 (doesn't apply to vibration criterion)

input 8: 2 = type is OR (this criterion alone may trigger the transition)

19.2.5. Configuration change 10

```
!cs:27,3,1,1,2,2,12500,2
```

input 1: 27 = configuration index 27 (power stage transition configuration index)

input 2: 3 = transition index 3 (this transition index specifies the PS1 to PS0 transition)

input 3: 1 = transition criteria index 1 (specifies that we are configuring the second criterion of eight (zero indexed))

input 4: 1 = enabled (this criterion is enabled)

input 5: 2 = criterion identifier: adc main-voltage above

input 6: 2 = required age is 2 seconds (voltage must be above the threshold for 2 seconds for criterion to be true)

input 7: 12500 = threshold is 12500 (thresh is in mV for this criterion, so setting is 12.5V)

input 8: 2 = type is OR (this criterion alone may trigger the transition)

19.2.6. Configuration change 11-16

```
!cs:27,3,2,0,0,0,0,0
!cs:27,3,3,0,0,0,0,0
!cs:27,3,4,0,0,0,0,0
!cs:27,3,5,0,0,0,0,0
!cs:27,3,6,0,0,0,0,0
!cs:27,3,7,0,0,0,0,0
```

These configuration changes are just to to clear out all of the other transition criteria, and ensure that only the two configured above for PS1->PS0 are active

Now when the device is in PS1, it will transition back into PS0 if either vibration is sensed, or if the main voltage increases above 12.5V for more than 2 seconds

20. Appendix C: Ignition Mask Configuration Example

As an example, to configure the ignition on to occur on Virtual Vibration, OR on Virtual Battery AND Virtual Movement, the user would set the configuration to 10,4,0

20.1. Configuration change 1:

```
!cs:12,10,4,0
```

input 1: 10 = This is setting the AND mask to 10 = 2 (Virtual Battery) + 8 (Virtual Movement). An ignition ON event will be sent if ALL conditions set in this mask are true. In this case, ignition will be considered ON when the alternator is above the ON threshold, and the GPS shows the device is moving.

input 2: 4 = This is setting the OR mask to 4 (Virtual Vibration). An ignition ON event will be sent if ANY conditions set in this mask are true, regardless of AND mask settings. In this case, ignition will be considered ON when the accelerometer senses vibration.

input 3: 0 = This is setting the AND_MODE to 0 (Any Off).

The AND_MODE controls when ignition OFF is determined for conditions set in the AND mask. With the any-off setting, when ignition is currently ON, and one of the conditions becomes false (like Virtual Movement in this example), ignition will be considered OFF from the AND mask's perspective. If the all-off setting (value of 1) were used instead, ALL conditions in the and mask need to be false (Virtual Movement and Virtual Battery, in this example), in order the ignition to turn OFF from the AND mask's perspective. Note that if there are conditions specified in the OR mask, which are still true (accelerometer still senses vibration, in this example), that will over-ride any AND mask behavior, and ignition would still be considered ON, regardless of AND mask, and AND_MODE settings.

21. Regulatory Statements

21.1. FCC

This equipment with FCC-ID: GKM-XT2594 and IC-ID: 10281A-XT2594, Model: XT2500 is subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

NOTICE:

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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.

Changes or modifications made to this equipment not expressly approved by Sensata Technologies may void the FCC authorization to operate this equipment.

NOTE: 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.

Radio frequency radiation exposure Information:

This equipment, XT2500, complies with FCC and ISED radiation exposure limits set forth for an uncontrolled environment. This equipment must be installed and operated with minimum distance of 20cm between the XT2500 and your body.

21.2. IC

Antenna Statement

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Licence exempt

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

1. this device may not cause interference, and
2. this device must accept any interference, including interference that may cause undesired operation of the device

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'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

WARNING: This product can expose you to chemicals including Nickel (Metallic), which is known to the State of California to cause cancer and Bisphenol A (BPA), which is known to the State of California to cause birth defects or other reproductive harm.

For more information go to www.P65Warnings.ca.gov