

OBDII STREAMER FAMILY

User Implementation Document

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Document Revision History

Version	Date	Changes	Author
2.00	10/30/08	Brought over from V1 Streamer and updated for new/revised functionality	Larry Reeves
2.01	1/28/09	Revised based on comments from PSA and a team. review.	Steve Sagerian
2.02	08/3/09	Added Bootloader update to UPDATE_COMPONENT command	Alexandr Kolodinsky
2.03	11/30/09	Added Keepalive message control bypass command and revised the document. Made some minor clarification changes	Alexandr Kolodinsky
2.04	1/26/2010	Reviewed and updated with final changes to V2 prior to beta release	Steve Sagerian
2.05	2/8/2010	Updates for KWP15 protocol and sleep mode is gone complete, no set sleep mode, no wake from sleep and no set low power mode behavior.	Steve Sagerian
2.06	3/12/2010	Update bypass protocol definition	Matt Ollayos
2.07	5/3/2011	Incorrect behavior found describing threshold updates.	Matt Ollayos
2.08	12/13/11	Updated based on Management comments	Chris Politsch
2.09	1/27/12	Removed unused messages	Chris Politsch
2.10	2/14/12	Updated Command 0x21	Chris Politsch
2.11	3/19/13	Removed unsupported parameters, bypass mode references	Larry Reeves

Communication Protocol Definition

All commands and responses to or from the OBDII Streamer are formatted in this style.

Byte	Byte	Byte(s)	Byte	Byte(s)	Byte
Start of Frame	Control Length	Control Bytes	Data Length	Data Bytes	Checksum

Start of Frame $0x01$ – always $0x01$.

Control Length The number of control bytes in the current message. The control length of a request or response varies by command and will be defined under each command's heading in this document.

Control Byte(s) The first control byte in a request is the command being sent. In a response the control byte will be $0x80$ greater than the request control byte.

Each command or response may have additional control bytes as defined by the specific command or response. Each message must have at least one control byte.

Data Length The number of data bytes in the current message. Zero data byte messages are valid.

Data Bytes This field contains the data portion of the message.

Checksum The checksum is a one-byte sum of all bytes including Start of Frame, Control Length, Control Bytes, Data Length, and Data Bytes.

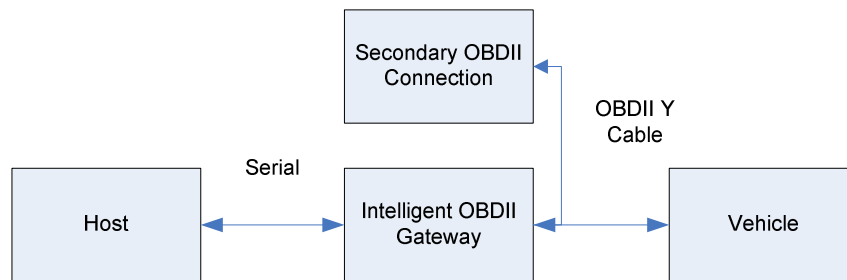
$Checksum = Sum \text{ AND } 0xFF$

Overview

The OBDII Streamer is an OBDII to Serial gateway. The raw data, multiple PIDs per parameter, and timing issues of the OBDII bus are abstracted from the host. The OBDII Streamer allows a developer to quickly access data from the vehicle without having knowledge of the OBDII bus.

The OBDII Streamer is intended to be permanently installed in a vehicle. Coupled with B&B Electronics OBDII Y-Cable the OBDII Streamer will immediately disconnect from the OBDII bus when another scan tool is connected to the bus.

The maximum update rate of data from the OBDII bus is 20Hz. Each parameter enabled constitutes one update from the vehicle. The update rate from the vehicle is not linked to any messages from the host. The host will be able to request data from the OBDII Streamer immediately after the previous response, but the OBDII data will be limited to an update rate of 20Hz.



Vehicle status parameters, such as the MIL, Fuel Level, and Battery Voltage, will be updated from the vehicle no faster than once every 2 seconds. The vehicle parameter DTC's will be updated from the vehicle no faster than once every minute. The host can request these parameters from the OBDII Streamer at any rate desired.

Startup Procedure

When the OBDII Streamer is powered on a CRC check will be performed to verify that the code on the device is valid. This will take approximately 10 seconds and during that time the device is unable to respond to commands.

On initial power on the OBDII Streamer will attempt to detect the vehicle type and supported parameters. This process can take up to 1 minute. During this time the OBDII Streamer will be responsive to host requests. If the OBDII Streamer has detected a vehicle type and supported parameters it will not attempt to detect them again, even if the vehicle type and supported parameters have changed.

While the host is detecting the vehicle's information most messages will be responded to with the following response.

```
0x01 0x01 0x81 0x00 0x83 //Vehicle Not (Yet) Detected Message
```

The following commands will respond normally during startup:

- READ_MODEL_NUMBER
- FIRMWARE_VERSION
- READ_SERIAL
- UPGRADE_FIRMWARE

When the OBDII Streamer has finished the initialization sequence it will send a DEVICE_CONFIGURED message.

After this message is received the OBDII Streamer will be ready for communications.

Non-Volatile Storage

Most configuration settings and parameters are stored in non-volatile memory and do not have to be reconfigured on startup. The following settings and parameters are saved in non-volatile memory.

- Serial Number
- BAUD
- OEM_ID
- Model Number
- VIN
- Firmware/EEPROM Versions
- Vehicle information (OBDII Bus and Available Parameters)
- Enabled/Disabled Parameters
- Update Modes (Time and Threshold based)

Transferring to a New Vehicle

The OBDII Streamer stores all vehicle information in non-volatile memory. To improve startup times in the event of a power loss all parameters will be reloaded from memory.

If the OBDII Streamer is removed from one vehicle and installed in another, the OBDII Streamer must be forced to detect. On startup the previous vehicle's data will be loaded. The behavior of an OBDII Streamer will be unpredictable when connected to a vehicle that is different than the vehicle detected. To force the OBDII Streamer to redetect vehicle information send the REDETECT_VEHICLE command.

Ignition Detection

The vehicles J1962 diagnostic connector is always powered, even with the vehicle ignition off. The OBDII Streamer detects the ignition status by analyzing data retrieved over the OBDII bus. There are two methods used to determine ignition status.

First, the engine speed and vehicle speed are monitored from the vehicle. When engine speed and vehicle speed are detected as zero for 2 minutes the OBDII Streamer will enter Standby mode.

Second, most vehicles stop responding to OBDII requests when the ignition is off. After 20 seconds of no responses from the vehicle the OBDII Streamer will enter Standby mode.

The OBDII Streamer polls the vehicle for ignition status every two seconds. When the ignition status changes from off to on the device will return to normal mode and will send an ignition status message to the host.

Low Power Modes

Standby Mode:

During Standby Mode the vehicle is polled periodically to find out its ignition status. Standby Mode will be the default mode used.

- Standby Mode is entered within 20 seconds of communications loss.
- Standby Mode is entered within 2 minutes of 0 RPM and 0 Vehicle Speed (Vehicle Speed was added as a condition because a hybrid vehicle can turn the engine off and be running on the electric engine).
- Standby Mode is exited within ten seconds after vehicle starts communicating
- LDV Streamer remains partially responsive to some communications while in Standby Mode.
- Maximum Power Consumption: 0.42W.
- Maximum Time from power-on to valid vehicle data: fifteen seconds when vehicle is running.
- When the vehicle's battery voltage is below 12.6V the vehicle is no longer polled to save more power. When the ignition is turned on the alternator will increase the voltage above 12.6V and the maximum time to normal running mode will be met.

Special Cases:

- First Time Installation: The OBDII Streamer does not enter any low power modes until it has been installed on a vehicle and has detected the supported parameters.
- Firmware updates: After a firmware update, the OBDII Streamer will go into the appropriate power state for normal operation.
- Unintentional Reset (Battery removal, brownout, etc.): After an unintentional reset, the OBDII Streamer will go into the appropriate power state for normal operation.
- Move to Different Vehicle:
 - The LDV Streamer should remain in the appropriate low power mode until it has been determined that the engine is running.
 - The LDV Streamer requires a REDETECT_VEHICLE command to work properly after moving to a different vehicle.

Settings

The following variables make up all of the settings that should be known or changed when using the OBDII Streamer.

Overview

The OBDII Streamer is capable of transmitting messages to the host automatically based on user set criteria. By default these messages are disabled.

Time Based Updates

“Time Based” updates will provide an update of all enabled parameters at every time interval specified by the user.

Time based updating will work simultaneously with “Threshold Based” updating and “As Requested” updating.

Threshold Based Updates

“Threshold Based Updating” will send an update to the host whenever an enabled parameter with threshold checking enabled exceeds the threshold.

“Threshold Based” updating will work simultaneously with “Time Based” updating and “As Requested” updating.

As Requested Updates

“As Requested” update mode allows the host to request a single parameter, or all parameters, at any time and receive a snapshot of the parameter values.

“As Requested” update mode is not an exclusive mode. This means that “Time Based”, and “Threshold Based” update modes can be enabled and parameters can still be requested at any time.

BAUD

The BAUD rate setting is only applicable to the RS-232 serial version of the OBDII Streamer. The BAUD rate will default to 115.2kbps.

OEM_ID

The OEM_ID field is available for the customer to program as they choose. This field is 10 bytes long and defaults to “LDV_OEM_ID”.

An example use of this field is to key the software to a particular piece of hardware.

Update Mode

On initial power up all update modes are disabled. In order to use any of the update modes listed below they must be configured and enabled using the SET_UPDATE_MODE and CHANGE_PARAMETER_THRESHOLD commands.

- Time Based
- Threshold Based

In order to receive automatic messages based on time or threshold the CHANGE_PARAMETER_THRESHOLD command must be sent for each parameter.

Enable_Parameters

By default, all supported parameters will be updated from the vehicle. The Enable_Parameters command can be sent in order to enable updates on only the supported parameters.

Setting the Enable_Parameters command is desirable in some cases to increase the parameter update rate. The update rate for each parameter is equal to the total update rate from the vehicle divided by the number of enabled parameters.

The update rate from the vehicle is fixed and varies from vehicle to vehicle, but will not exceed 20Hz.

Parameters

This list matches a parameter with its identifier.

ID	Parameter	Return Size	Units	Range
0x00	Vehicle Speed	2 Bytes	MPH	0 to 160
0x01	Engine Speed	2 Bytes	RPM	0 to 16384
0x02	Throttle Position	2 Bytes	%	0 to 100
0x03	Odometer	4 Bytes	Miles	0 to 999,992
0x04	Fuel Level	2 Bytes	%	0 to 100
0x07	Engine Coolant Temp	2 Bytes	°F	-40 to 983
0x08	Ignition Status	2 Bytes	On/Off	On/Off
0x09	MIL Status	2 Bytes	On/Off	On/Off
0x0C	Fuel Rate	2 Bytes	Gallons per Hour	0 to 29.99
0x0D	Battery Voltage	2 Bytes	Volts	0 to 18
0x0E	PTO Status	2 Bytes	On/Off	On/Off
0x0F	Seatbelt Fastened	2 Bytes	Yes/No	N/A
0x10	Misfire Monitor	2 Bytes	Status	N/A
0x11	Fuel System Monitor	2 Bytes	Status	N/A
0x12	Comprehensive Component Monitor	2 Bytes	Status	N/A
0x13	Catalyst Monitor	2 Bytes	Status	N/A
0x14	Heated Catalyst Monitor	2 Bytes	Status	N/A
0x15	Evaporative System Monitor	2 Bytes	Status	N/A
0x16	Secondary Air System Monitor	2 Bytes	Status	N/A
0x17	A/C System Refrigerant Monitor	2 Bytes	Status	N/A
0x18	Oxygen Sensor Monitor	2 Bytes	Status	N/A
0x19	Oxygen Sensor Heater Monitor	2 Bytes	Status	N/A
0x1A	EGR System Monitor	2 Bytes	Status	N/A
0x1B	Brake Switch Status	2 Bytes	Pressed/Not Pressed	N/A
0x22	Trip Odometer	4 Bytes	Miles	0 to 999,992
0x23	Trip Fuel Consumption	4 Bytes	Gallons	0 to 999,992

0x00 Vehicle Speed

Scaling Equation:

Result = Returned Data * 1 / 410

Units: Miles per hour

EX: Return Data = 26650

Result = 26650 * 1 / 410

Result = 65 Miles per hour

0x01 Engine Speed

Scaling Equation:

Result = Returned Data * 1 / 4

Units: Revolutions per Minute

EX: Return Data = 12000

Result = 12000 * 1 / 4

Result = 3000 Revolutions per Minute

0x02 Throttle Position

Scaling Equation:

Result = Returned Data * 1 / 655

Units: %

EX: Return Data = 12000

Result = 12000 * 1 / 655

Result = 18.32 % Throttle Pedal Position

0x03 Odometer

Scaling Equation:

Result = Returned Data * 1 / 1

Units: Miles

EX: Return Data = 58,125

Result = 58,125 * 1 / 1

Result = 58,125 Miles

0x04 Fuel Level

Scaling Equation:

Result = Returned Data * 1 / 655

Units: %

EX: Return Data = 23578

Result = 23578 * 1 / 655

Result = 35.99 %

0x07 Engine Coolant Temp

Scaling Equation:

Result = (Returned Data * 1 / 64) - 40

Units: °F

EX: Return Data = 14080

Result = (14080 * 1 / 64) - 40

Result = 180°F

0x08 Ignition Status

Return Value of 1 = Ignition Off

Return Value of 0 = Ignition On

0x09 MIL Status

Return Value of 1 = MIL Off

Return Value of 0 = MIL On

0x0C Fuel Rate

Scaling Equation:

Result = Returned Data * 1 / 2185

Units: Gallons per Hour

EX: Return Data = 25650

Result = 25650 * 1 / 2185

Result = 11.74 Gallons per Hour

0x0D Battery Voltage

Scaling Equation:

Result = Returned Data * 1 / 3641

Units: Volts

EX: Return Data = 45650

Result = 45650 * 1 / 3641

Result = 12.538 Volts

0x0E PTO Status

Return Value of 1 = PTO Off

Return Value of 0 = PTO On

0x0F Seatbelt Fastened

Return Value of 1 = Seat Belt not Fastened

Return Value of 0 = Seat Belt Fastened

0x10 — 0x1A Monitors

Return Value of 1 = Monitor Not Complete

Return Value of 0 = Monitor Complete

0x1B Brake Switch Status

Return Value of 1 = Brake Switch Off

Return Value of 0 = Brake Switch On

0x22 Trip Odometer

Scaling Equation:

Result = Returned Data * 1 / 10

Units: Miles

EX: Return Data = 58,125

Result = 58,125 * 1 / 10

Result = 5,812.5 Miles

0x23 Trip Fuel Consumption

Scaling Equation:

Result = Returned Data * 1 / 128

Units: Gallons

EX: Return Data = 8,128

Result = 8128 * 1 / 128

Result = 63.5 Gallons

NOTE: It is basically returned in Ounces.

Commands

0x02 – READ_MODEL_NUMBER

Description:

This command will return the model number as an alpha-numeric ASCII string.

The following model numbers can be returned depending on the type of Streamer used.
LDVDSV2-S RS-232 OBDII Streamer

Command to Send:

0x01 0x01 0x02 0x00 0x04

Response:

0x01 0x01 0x82 DL MODEL CS

Field Description:

MODEL Variable length model number up to 16 characters long. This field is returned as ASCII characters.

DL Data Length (Length of model number)

CS Summation checksum

Example:

TX: 0x01 0x01 0x02 0x00 0x04

RX: 0x01 0x01 0x82 0x09 0x4C 0x44 0x56 0x44 0x53 0x56 0x32 0x2D 0x53 0x12

The model number returned is LDVDSV2-S.

0x03 – GET_COMPONENT_VERSIONS

Description:

This command will return the version numbers for all updatable components in the device.

Command to Send:

0x01 0x01 0x03 0x00 0x05

Response:

0x01 0x01 0x83 0x0F SW1 SW2 SW3 HW1 HW2 HW3 DB1 DB2 DB3 SYS1 SYS2
SYS3 BL1 BL2 BL3 CS

Field Descriptions:

SW1-SW3	Software version digits 1-3
HW1-HW3	Hardware version digits 1-3
DB1-DB3	Database version digits 1-3
SYS1-SYS3	System manager version digits 1-3
BL1-BL3	Bootloader version digits 1-3
CS	Summation checksum

Example:

TX: 0x01 0x01 0x03 0x00 0x05

RX: 0x01 0x01 0x83 0x0F 0x02 0x00 0x06 0x02 0x00 0x03 0x01 0x08 0x00
0x02 0x00 0x04 0x02 0x00 0x01 0xB3

The version numbers returned as hexadecimal are:

Software version	0x02 0x00 0x0A = 2.0.10
Hardware version	0x02 0x00 0x03 = 2.0.3
Database version	0x01 0x08 0x00 = 1.8.0
System manager version	0x02 0x00 0x04 = 2.0.4
Bootloader version	0x02 0x00 0x01 = 2.0.1

0x04 – OBDII_FIRMWARE_VERSION (Obsolete)Description:

This command is no longer supported as of version 2.

0x05 – FIRMWARE_VERSION (Deprecated)Description:

[Command 0x03 – GET_COMPONENT_VERSIONS should be used instead of this command.]

This command will return the version number of the software component.

Command to Send:

0x01 0x01 0x05 0x00 0x07

Response:

0x01 0x01 0x85 0x03 VER1 VER2 VER3 CS

Field Description:

VER1	Hex version number digit 1
VER2	Hex version number digit 2
VER3	Hex version number digit 3
CS	Summation checksum

Example:

TX: 0x01 0x01 0x05 0x00 0x07

RX: 0x01 0x01 0x85 0x03 0x01 0x00 0x01 0x8C

The version number returned is 0x01 0x00 0x01 = 1.0.1

0x06 – DATABASE_VERSION (Deprecated)Description:

[Command 0x03 – GET_COMPONENT_VERSIONS should be used instead of this command.]

This command will return the version number of the database component.

Command to Send:

0x01 0x01 0x06 0x00 0x08

Response:

0x01 0x01 0x86 0x03 VER1 VER2 VER3 CS

Field Description:

VER1	Hex version number digit 1
VER2	Hex version number digit 2
VER3	Hex version number digit 3
CS	Summation checksum

Example:

TX: 0x01 0x01 0x06 0x00 0x08

RX: 0x01 0x01 0x86 0x03 0x01 0x00 0x01 0x8D

The version number returned is 0x01 0x00 0x01 = 1.0.1

0x09 – CONFIG_OEM_ID

Description:

This command will set or read the 10 digit OEM ID. Each digit of the OEM_ID is 1 byte and can be any possible value. The command to write the OEM ID always expects 10 digits/values and will give an error with any values less than or greater than 10.

The OEM_ID will be saved in non-volatile memory.

The first byte of the data field indicates if the OEM_ID will be read or written.

0x00 = read

0x01 = write

Command to send to read the OEM_ID:

0x01 0x01 0x09 0x01 0x00 0x0C

Response:

0x01 0x01 0x89 0x0B 0x00 OEM_ID CS

Command to send to write the OEM_ID:

0x01 0x01 0x09 DL 0x01 OEM_ID CS

Response:

0x01 0x01 0x89 0x0B 0x01 OEM_ID CS

Field Description:

OEM_ID 10 digit OEM_ID

DL Data field length

CS Summation checksum

Example: Set the OEM_ID

TX: 0x01 0x01 0x09 0x0B 0x01 0x01 0x35 0x73 0x99 0x24 0x72 0xF3 0x17 0xAC
0xBB 0x60

RX: 0x01 0x01 0x89 0x0B 0x01 0x01 0x35 0x73 0x99 0x24 0x72 0xF3 0x17 0xAC
0xBB 0xE0

Example: Read the OEM_ID

TX: 0x01 0x01 0x09 0x01 0x00 0x0C

RX:

0x01 0x01 0x89 0x0B 0x00 0x01 0x35 0x73 0x99 0x24 0x72 0xF3 0x17 0xAC 0xBB
0xDF

0x15 – SERIAL_BAUD

Description:

This command will read or write RS-232 Baud Rate settings.

The configuration data is stored in non-volatile memory and will be loaded on system power-on.

Command to Send:

0x01 0x01 0x15 0x03 RD/WR BAUD 0x01 CS

Response:

0x01 0x01 0x95 0x03 RD/WR BAUD 0x01 CS

Field Description:

RD/WR

This indicates if the message will be a read or a write.

0x00 = read 0x01 = write

Note: If the request message is a configuration read then the BAUD and STATUSMSG fields should not be included in the request message, and the data length will be 1 byte.

BAUD

BAUD setting

0x00 = 9600kbps 0x01 = 19200kbps

0x02 = 38400kbps 0x03 = 56000kbps

0x04 = 115200kbps (Default)

CS

Summation checksum

Example: Baud = 19200kbps

TX: 0x01 0x01 0x15 0x03 0x01 0x01 0x01 0x1D

RX: 0x01 0x01 0x95 0x03 0x01 0x01 0x01 0x9D

0x20 – GET_SUPPORTED_PARAMETERS

Description:

This command will return an identifier byte for each supported parameter.

Only supported parameters will be requested from the vehicle. Parameter values reported for an unsupported parameter are invalid. Supported parameters are available after the vehicle has been detected.

Command to Send:

0x01 0x01 0x20 0x00 0x22

Response:

0x01 0x01 0xA0 DL SUPPORTED_PARAMETERS CS

Field Description:

DL	Data Length Byte
SUPPORTED_PARAMETERS	Variable length data field containing one byte for each supported parameter.
CS	Summation checksum

Example:

TX:

0x01 0x01 0x20 0x00 0x22

RX:

0x01 0x01 0xA0 0x06 0x00 0x02 0x03 0x08 0x09 0x11 0xCF

The supported parameters in this example are:

0x00 – Vehicle Speed

0x02 – Throttle Position

0x03 – Odometer

0x08 – Ignition Status

0x09 – MIL Status

0x11 – Fuel System Monitor

0x21 – ENABLE_PARAMETERS

Description:

This command will enable or disable only the specified parameters to be updated from the vehicle. If parameters are enabled that are not supported by the vehicle the OBDII Streamer will send a response indicating which parameters are not supported.

By default all supported parameters are enabled and queried from the vehicle. Because the update rate of the vehicle is limited to a maximum of 20 Hz, it may be desirable to disable some parameters to get better update rates on parameters of interest.

Command to Send:

0x01 0x01 0x21 DL RD/WR ENABLE/DISABLE PARAMETER_LIST CS

Response to write:

0x01 0x01 0xA1 DL 0x01 ENABLE/DISABLE NOT_SUPP CS

Response to read:

0x01 0x01 0xA1 DL 0x00 PARAMETER_LIST CS

Field Description:

DL	Data Length Byte
RD/WR	This indicates if the message will be a read or a write. 0x00 = read 0x01 = write
ENABLE/DISABLE	Note: If the request message is a configuration read then the ENABLE/DISABLE and PARAMETER_LIST fields should not be included, and the data length will be 1 byte. This field in 1 byte that indicates if the parameters specified in PARAMETER_LIST should be enabled or disabled. The state of the parameters not specified in the PARAMETER_LIST field will not change. 0x00 = Enable specified parameters 0x01 = Disable specified parameters This field will not be present in a response to a read enabled parameters command.
PARAMETER_LIST	Variable length data field containing one byte for each parameter to be enabled. Each byte corresponds to a parameter ID. This should not be included in the request message if reading the ENABLE_PARAMETERS data.

If one byte value 0xFF is used for PARAMETER_LIST then all the supported parameters will be either enabled or disabled according to the ENABLE/DISABLE byte.

NOT_SUPP Variable length field containing one byte for each parameter that was requested to be enabled/disabled, but is not supported by the vehicle. This may be a zero length field.

CS Summation checksum

Example 1: Enable Parameters

TX: 0x01 0x01 0x21 0x04 0x01 0x00 0x02 0x03 0x2D

RX: 0x01 0x01 0xA1 0x02 0x01 0x00 0xA6

The command sent requests Throttle Position and Odometer to be enabled. All parameters that were requested to be enabled are supported by the vehicle.

Example 2: Enable Parameters

TX: 0x01 0x01 0x21 0x04 0x01 0x00 0x02 0x03 0x2D

RX: 0x01 0x01 0xA1 0x03 0x01 0x00 0x02 0xA9

The command sent requests Throttle Position and Odometer to be enabled. All parameters that were requested to be enabled are supported by the vehicle except for Throttle Position.

Example 3: Read Enabled Parameters

TX: 0x01 0x01 0x21 0x01 0x00 0x24

RX: 0x01 0x01 0xA1 0x03 0x00 0x00 0x01 0xA7

The command sent requests a list of all enabled parameters. Vehicle Speed and Engine Speed are enabled and listed in the response.

Example 4: Disable Parameters

TX: 0x01 0x01 0x21 0x04 0x01 0x01 0x02 0x03 0x2E

RX: 0x01 0x01 0xA1 0x03 0x01 0x01 0x02 0xAA

The command sent requests that Throttle position and Odometer be disabled. The response indicates that all the requested parameters except Throttle position were supported and have been disabled.

Note: Engine Speed and Vehicle Speed cannot be disabled.

0x22 – GET_PARAMETER

Description:

This command will return the current value for the requested parameter. Since the most current parameter's results are stored in the OBDII Streamer the response delay will be very short.

Command to Send:

0x01 0x01 0x22 DL PARAMETER_ID CS

Response:

0x01 0x01 0xA2 DL PARAMETER_DATA CS

Field Description:

DL Data Length Byte

PARAMETER_ID Variable length data field containing one byte for each parameter requested. Each byte corresponds to a parameter ID.

Multiple parameters can be specified in the PARAMETER_ID field, or 0xFF can be specified to request all enabled parameters.

A maximum of 11 parameters can be specified in one message. If 0xFF is sent to request all enabled parameters then the response may be broken into multiple responses depending on the number of enabled parameters.

PARAMETER_DATA

The PARAMETER_DATA field is a variable length data field that contains both the requested parameter(s) identifier and the parameter data. All parameter identifiers are one byte long, and parameter data is variable length. The format of the data field is a repeating pattern of *parameter identifier1, Data1, parameter identifier2, Data2,..* etc.

CS Summation checksum

Example:

TX: 0x01 0x01 0x22 0x03 0x01 0x02 0x03 0x2D

RX: 0x01 0x01 0xA2 0x09 0x01 0x01 0x23 0x02 0x98 0x76 0x03 0x55 0x66 0x77 0x88 0x9F

The breakdown of the response is:

Parameter 0x01: Data = 0x0123

Parameter 0x02: Data = 0x9876

Parameter 0x03: Data = 0x55667788 (some parameters are 4 bytes of data, including odometer)

0x23 – GET_VEHICLE_STATUS

Description:

This command will return the status of the vehicle ignition and the secondary OBDII tool status.

Command to Send:

0x01 0x01 0x23 0x00 0x25

Response:

0x01 0x01 0xA3 0x02 IGNITION OBDII_STAT CS

Field Description:

IGNITION

This is a 1 byte field that indicates the status of the vehicle ignition.

0x00 = Ignition OFF

0x01 = Ignition ON

Note: The methods used to determine the ignition status actually detect when the OBDII bus is responding to requests, and not the ignition status. It is possible that some vehicles will continue to respond while the ignition is off. All vehicles are required to communicate when the key is in the on position and the engine is not running.

OBDII_STAT

This is a 1 byte field that indicates if a second scan tool is connected to the OBDII port.

0x00 = No Tool

0x01 = Tool Connected

0xFF = Scan tool status unknown (device in standby mode)

CS

Summation checksum

Example:

TX:

0x01 0x01 0x23 0x00 0x25

RX:

0x01 0x01 0xA3 0x02 0x01 0x00 0xA8

The response indicates that the ignition is on and no secondary tool is connected.

0x24 – REDETECT_VEHICLE

Description:

This command will force all detected vehicle information to be redetected. The REDETECT_VEHICLE command should only be required if the Streamer is removed from one vehicle and moved to another or after exiting Bypass mode to ensure correct vehicle-specific data is stored in non-volatile memory. Issuance of this command will cause Streamer to wake up if it was in Standby mode.

Command to Send:

0x01 0x01 0x24 0x00 0x26

Response:

0x01 0x01 0xA4 0x00 0xA6

This response will be transmitted immediately. When the detection process is finished the DEVICE_CONFIGURED message will be transmitted.

Example:

TX: 0x01 0x01 0x24 0x00 0x26

RX: 0x01 0x01 0xA4 0x00 0xA6 -Received immediately

The configuration time may take up to 1 minute to complete. Any requests during this time will be responded to with a VEHICLE_NOT_DETECTED message.

RX: 0x01 0x01 0x80 0x00 0x82 -DEVICE_CONFIGURED message

0x25 – GET_VEHICLE_INFO

Description:

The GET_VEHICLE_INFO command will return the VIN, OBDII protocol being used, or any DTCs set. In Standby mode, requesting VIN and OBDII protocol returns last saved values read from non-volatile memory while DTCs request will return error 0x0F – command parameter not supported.

Command to Send:

0x01 0x01 0x25 0x01 INFO_TYPE CS

Response:

0x01 0x01 0xA5 DL INFO_TYPE INFO_RESPONSE CS

Field Description:

DL	Data Length Byte
INFO_TYPE	The INFO_TYPE field specifies the return data. 0x00 = VIN 0x01 = OBDII Protocol 0x02 = Diagnostic Trouble Codes (DTCs)
INFO_RESPONSE	This is a variable length response. This field is specified by INFO_TYPE and will be either the VIN or the OBDII Protocol. INFO_TYPE = 0 = VIN The INFO_RESPONSE is a 17 character VIN. INFO_TYPE = 1 = OBDII Protocol INFO_RESPONSE is a 1 digit number that defines the OBDII protocol detected. 0 = None 1 = J1850VPW 2 = J1850PWM 3 = ISO9141-2 5 = KWP2000 6 = CAN 11 bit 7 = CAN 29 bit at 500 kbps 12 = CAN 29 bit at 250 kbps INFO_TYPE = 2 = DTCs The INFO_RESPONSE is a variable length field containing DTCs. The DTCs will be ASCII values and each code will be 5 digits long. Only confirmed DTCs are reported.

CS

Summation Checksum

Example

This command requests all DTCs from the vehicle.

TX: 0x01 0x01 0x25 0x01 0x02 0x2A

RX:

0x01 0x01 0xA5 0x0B 0x02 0x50 0x30 0x34 0x33 0x30 0x50 0x30 0x32 0x35 0x30
0xE2

The above response indicates that two DTCs are present on the vehicle.

0x30 – SET_TIME_UPDATES

Description:

This command will setup the periodic update settings for a single parameter.

Note that when a timed update message is sent to the host the message will be packaged in the same format as command 0x22 but with a new control byte. Time based update messages will use control byte 0xC0.

The SET_UPDATE_MODE command must be sent to enable all parameters configured for time based updates to be sent.

Command to Send:

0x01 0x01 0x30 0x04 PID SETTINGS TVALUE CS

Response:

0x01 0x01 0xB0 0x04 PID SETTINGS TVALUE CS

Field Description:

PID This field is a 1 byte PID. Use this field to select the PID that will be configured.

SETTINGS Settings

Bit 0 - This bit will enable or disable periodic updates for the selected parameter.

0x00 = Disabled

0x01 = Enabled

If disabling a parameter the TVALUE byte must be sent, but can be set to any value since it will be ignored.

TVALUE Time Value

This field is two bytes long and will configure the period between updates. The resolution of the timer is 50mS.

Timeout Range = 50mS to 54.6 minutes

Period = 50mS * TVALUE

Note that if TVALUE of 0 is set the parameter will update once every 50mS.

CS Summation checksum

Example:

This command sets up the vehicle speed PID to be transmitted every 250mS.

TX:

0x01 0x01 0x30 0x04 0x00 0x01 0x00 0x05 0x3C

RX:

0x01 0x01 0xB0 0x04 0x00 0x01 0x00 0x05 0xBC

250mS delay

RX:

0x01 0x01 0xC0 0x03 0x00 0x01 0x23 0xE9

The above response is received 250 mS after the Time Updating was setup and indicates that the vehicle speed has an un-scaled value of 0x0123.

0x31 – SET_THRESHOLD_UPDATES

Description:

This command will setup the threshold triggered messages for a single parameter.

Note that when a threshold is tripped and a message is sent to the host the message will be packaged in the same format as command 0x22 but with a new control byte. Threshold based update messages will use control byte 0xC1.

The SET_UPDATE_MODE command must be sent to enable all parameters configured for threshold based updates to be sent.

Command to Send:

0x01 0x01 0x31 0x04 PID SETTINGS TVALUE CS

Response:

0x01 0x01 0xB1 0x04 PID SETTINGS TVALUE CS

Field Description:

PID This field is a 1 byte PID. Use this field to select the PID that will be configured.

SETTINGS Threshold Settings

Bit 0 - This bit will enable or disable threshold updates for the selected parameter.

0x00 = Disabled

0x01 = Enabled

If disabling a parameter the TVALUE byte must be sent, but can be set to any value since it will be ignored.

Bit 1 – This bit specifies if trigger level is greater than or less than the TVALUE.

0 = Send a message when the parameter > TVALUE

1 = Send a message when the parameter < TVALUE

The TVALUE is compared to the value returned by the device before the parameter scaling is applied. If the parameter being configured has 2 states set the threshold to (< 1) or (> 0). If the parameter being configured is a 4 byte parameter the TVALUE will be compared to all 4 byte of the value.

TVALUE Threshold Value

This field is two bytes long and will configure the threshold value used to determine when to send a message. The value in this field should be passed to the Intelligent OBDII Streamer using reverse scaling.

CS Summation checksum

Example:

This command sets up the vehicle speed PID to be transmitted when the vehicle speed is greater than 40 MPH.

TX:

0x01 0x01 0x31 0x04 0x00 0x01 0x40 0x10 0x88

RX:

0x01 0x01 0xB1 0x04 0x00 0x01 0x40 0x10 0x08

Threshold Value = 0x4010 = 16400

16400 / 410 = 40MPH

Unknown Delay. The following message will be received every time the parameter is updated AND the vehicle speed parameter is over 40 MPH.

RX:

0x01 0x01 0xC1 0x03 0x00 VEHICLE_SPEED CS

0x32 – SET_FULLSPEED_UPDATES (Obsolete)

Description:

This command is no longer supported as of Streamer version 2.

0x33 – READ_PARAMETER_UPDATE_MODES

Description:

This command will return the update mode settings for the specified parameter.

Command to Send:

0x01 0x01 0x33 0x01 PID CS

Response:

0x01 0x01 0xB3 0x06 PID TIME THRESHOLD TSETTINGS CS

Field Description:

PID	This field is a 1 byte PID.
TIME	This field is two bytes and is reports the period set for the selected parameter. Period = TIME * .05 seconds.
THRESHOLD	This field is two bytes and reports the threshold set for the selected parameter.
TSETTINGS	Threshold Settings Bit 0 – Time updates Enabled 0x00 = Disabled 0x01 = Enabled Bit 1 – Threshold updates Enabled 0x00 = Disabled 0x01 = Enabled Bit 2 – Obsolete, always returned as 0x01 Bit 3 – This bit specifies if a message will be sent when the parameter data is above the threshold value or below. 0 = Send a message when the parameter > TVALUE 1 = Send a message when the parameter < TVALUE
CS	Summation checksum

Example:

This command requests the settings for the vehicle speed parameter.

TX:

0x01 0x01 0x33 0x01 0x01 0x37

RX:

0x01 0x01 0xB3 0x06 0x01 0x00 0x05 0x01 0x23 0x01 0xE6

The above response indicates that time based updates are the only enabled updates and a periodic message will be sent every 250 mS.

0x35 – SET_UPDATE_MODE

Description:

This command enables or disables the different types of update modes. All update modes can be enabled simultaneously.

This command is a general enable for all PIDs configured for a particular update mode. For example, if a SET_UPDATE_MODE command is sent to enable time based updating, all parameters configured for time based updating will be enabled and data will start to be transmitted at the user selected intervals.

This configuration data will NOT be saved to non-volatile memory and must be set in order to receive update messages. “As Requested” update mode does not require the SET_UPDATE_MODE message to be sent before parameters can be requested.

Command to Send:

0x01 0x01 0x35 0x02 MODE ENABLE CS

Response:

0x01 0x01 0xB5 0x02 MODE ENABLE CS

Note: If the vehicle is turned off when this command is sent, the response will be an Ignition Off Status Message instead of the above response, and the mode will NOT be enabled.

Field Description:

MODE	The MODE byte selects the update mode. 0x00 = Time Based 0x01 = Threshold Based 0xFF = All Modes
ENABLE	The ENABLE byte enables or disables the specified MODE. 0x00 = Disable 0x01 = Enable
CS	Summation checksum

Example:

TX: 0x01 0x01 0x35 0x02 0x01 0x01 0x3B

RX: 0x01 0x01 0xB5 0x02 0x01 0x01 0xBB

This command enables threshold based updating for all parameters configured with a threshold and enabled.

0x57 – UPDATE_COMPONENT

Description:

This command will allow the upgradeable components in the OBDII Streamer to be updated in the field. The V2 Streamer firmware update protocol is intentionally different from the V1.x streamers to avoid accidental programming of v1.x streamers (or vice versa) in situations where a customer may have mixed streamer populations. The streamer expects to receive the images in Motorola S-record format and in Intel HEX format.

The update of the System Manager can occur either before or after the other components however. If both the FPGA hardware/firmware image and the OBDII database both need to be upgraded, the FPGA hardware/firmware image should be updated first.

- 1) FPGA Firmware/Hardware image
- 2) OBDII database
- 3) System Manager
- 4) Bootloader

Once successfully programmed, the boot loader will reset and run the new firmware.

NOTE:

A minimum of twenty five seconds is required between each file update to allow the firmware to reset and run. The Streamer will not be responsive to host commands during this time.

In the event of an incomplete system manager program for any reason, the hardware will remain in the boot loader.

The Bootloader will validate system manager image stored in non-volatile memory. If the image is valid Bootloader will pass control to system manager. Otherwise hardware will remain in boot load mode.

The only host command device handles in boot load mode is UPDATE_COMPONENT command with component parameter set to “System manager”. Error message with error code 0x0B “System manager image is invalid. Update required” will be sent in response to any other command.

Once successfully started System manager will validate FPGA and Database images stored in non-volatile memory. If the images are valid then FPGA image will be started. Otherwise system manager will enter component update wait mode. The only host commands device will handle in this mode is UPDATE_COMPONENT command. Error messages with error code 0x0C “FPGA image is invalid. Update required” or 0x0C “Database image is invalid. Update required” will be sent in response to any other command. Once FPGA is started it validates database image by software means and if the

database version is not compatible with current firmware version then FPGA will shut down and System manager will expect UPDATE_COMPONENT command.

The programming must always be successfully completed before moving on to the next update file.

Host Command to Send:

0x01 0x01 0x57 0x01 COMP CS

Streamer ACK Response:

0x01 0x01 0xD7 0x00 0xD9

The Streamer will change from its programmed baud rate to the baud rates show in the table below during the component update period. It will return to its previous baud rate after completion of the update process and the streamer reinitializes itself (as detected by the DEVICE_CONFIGURED spontaneous message).

Field Descriptions:

COMP	Byte identifying which component is being updated:
0x01	FPGA Firmware
0x02	Database
0x03	System Manager
0x04	Bootloader

CS Summation checksum

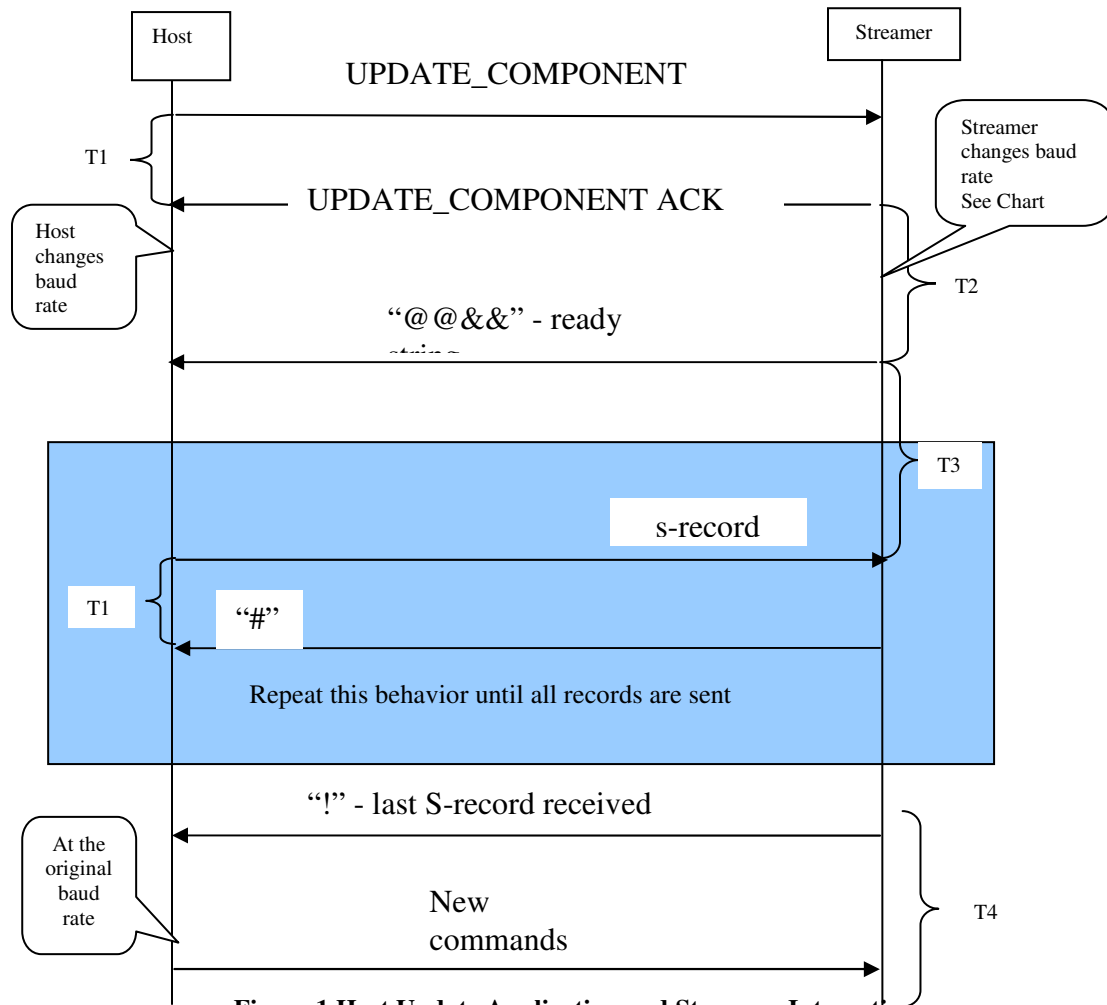


Figure 1 Host Update Application and Streamer Interactions

Baud rate table for component updates

Streamer Option	Baud Rate Change	Notes
LDVDSV2-S	115,200 BPS	The streamer host interface changes to this baud rate as shown in the diagram above, when commanded to begin a component update command.
LDVDSV2-1587	57600 BPS	

Time	Description	Value (min-max)
T1	Streamer to host response time. Used by the host software as a timeout value for host to streamer communications timeouts. If the streamer has not responded within the max time value, the host will time out and terminate the update.	0-25 Seconds
T2	Time needed to switch to the default update baud rate. Minimal guaranteed timeout is 5 seconds after which Streamer will send “ready” string indicating readiness to receive S-records.	5-35 seconds
T3	Host to Streamer response time. Used by the streamer as a timeout value for streamer to host communications timeouts. If no s-record is sent to the device after T3 timeout after the ready to receive “@@&&” is sent then ready to receive will be sent 2 additional times. Time out for the streamer to wait for the next S-record to arrive after sending a “#” indicating that the streamer is ready for the next S-record.	0-45 seconds
T4	Time from acknowledgement of last S-record received to restart of streamer.	0-45 seconds.

If an error occurs then the streamer will send a two byte error code ASCII “E” followed by a numeric digit.

Error Code Name	Description	Error Code
S-record timeout	Streamer did not receive the complete S-record in the allotted time period (T3).	E0
S-record checksum	S-record checksum did not match calculated checksum. The streamer will expect the host to resend the S-record otherwise it will time out.	E1
Hardware Failure	Attempts to program the Flash device failed multiple times. FPGA will not reboot.	E2
Invalid S-record	S-record format error, message corrupted	E3

0x59 – UPGRADE_FIRMWARE (Obsolete)Description:

This command has been replaced by the command 0x57 – UPDATE_COMPONENT.

0x60 – UPDATE_EEPROM (Obsolete)Description:

This command has been replaced by the command 0x57 – UPDATE_COMPONENT.

0x61 – RESET_TRIPDescription:

This command resets the Trip Parameters (Trip Odometer and Trip Fuel Consumption). It will reset the trip parameters stored in EEPROM and RAM to Zero which signifies the start of the trip.

Command to Send:

0x01 0x01 0x61 0x00 0x63

Response:

0x01 0x01 0xE1 0x00 0xE3

Status Messages

Status messages are messages sent from the OBDII Streamer that weren't expected by the host. The status messages include error messages and vehicle status updates.

0x80 – DEVICE_CONFIGURED

Description:

A DEVICE_CONFIGURED message will be sent to the host when the OBDII Streamer has finished detecting bus and supported parameters of the vehicle. When this message is received the host may initiate communications.

Response:

0x01 0x01 0x80 0x00 0x82

0x81 – VEHICLE_NOT_DETECTED

Description:

The OBDII Streamer will respond to the host with a VEHICLE_NOT_DETECTED message during startup. This command indicates that the OBDII connection is not fully configured yet. Since configuration is automatic, no action needs to be taken to configure the bus.

Startup configuration can take up to 1 minute after turning the key on for some vehicles. When configuration is complete a DEVICE_CONFIGURED message will be sent to the host.

Response:

0x01 0x01 0x81 0x00 0x83

0xA3 – Ignition/OBDII Status

Command Byte: 0xA3

Description:

This message will be returned when the status of the vehicle ignition and the secondary OBDII tool status changes. The format of this message is the same as found in the Ignition Status command.

Response:

0x01 0x01 0xA3 0x02 IGNITION OBDII_STAT CS

Field Description:

IGNITION

This is a 1 byte field that indicates the status of the vehicle ignition.

0x00 = Ignition OFF

0x01 = Ignition ON

The method used to determine the ignition status detects when the OBDII bus is responding to requests and when the RPM is not zero.

The ignition will transition from off to on when vehicle or engine speed is not zero.

It is possible that some vehicles will continue to respond while the ignition is off. All vehicles are required to communicate when the key is in the on position and the engine is not running.

OBDII_STAT

This is a 1 byte field that indicates if a second scan tool is connected to the OBDII port.

0x00 = No Tool

0x01 = Tool Connected

CS

Summation checksum

Example:

RX:

0x01 0x01 0xA3 0x02 0x01 0x00 0xA8

This message indicates that the ignition is on and no secondary tool is connected.

0xC0 – Time Based Update Message

Description:

This message will be sent for each enabled parameter after the specified interval. If multiple parameters have time based updates enabled and timeout at the same interval the responses will be combined.

Response:

0x01 0x01 0xC0 DL PARAMETER_DATA CS

Field Description:

DL Data Length Byte

PARAMETER_DATA The PARAMETER_DATA field is a variable length data field that contains both the requested parameter identifiers and the parameter data. All parameter data is two bytes long, and each parameter identifier is one byte long. The format of the data field is a repeating pattern of *parameter identifier1, Data1, parameter identifier2, Data2,..* etc.

CS Summation checksum

Example:

RX:

0x01 0x01 0xC0 0x09 0x01 0x01 0x23 0x02 0x98 0x76 0x03 0x55 0x66 0x77 0x88
0xBD

The breakdown of the response is:

Parameter 0x01: Data = 0x0123
Parameter 0x02: Data = 0x9876
Parameter 0x03: Data = 0x55667788

0xC1 – Threshold Based Update Message

Description:

This message will be sent when threshold based updating is enabled for a parameter and the parameter data breaches the threshold value.

Response:

0x01 0x01 0xC1 DL PARAMETER_DATA CS

Field Description:

DL	Data Length Byte
PARAMETER_DATA	The PARAMETER_DATA field is a 3 byte data field that contains both the requested parameter identifier and the parameter data. The format of the data field is parameter identifier, Data 1, Data 2.
CS	Summation checksum

Example:

RX:

0x01 0x01 0xC1 0x03 0x01 0x01 0x23 0xEB

The breakdown of the response is:

Parameter 0x01: Data = 0x0123

0xD0 – Ignition Off Status Message

Description:

This message will be sent when parameter information is requested from the OBDII Streamer that cannot be updated because the ignition is off.

Response:

0x01 0x01 0xD0 0x00 CS

Field Description:

CS	Summation checksum
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Example:

RX:

0x01 0x01 0xD0 0x00 0xD2

0xFF – Error Messages

Command Byte: 0xFF

Description:

An error message will be sent to the host any time an improperly formatted message has been received.

Response:

0x01 0x02 0xFF \$ERRORCODE 0x00 CS

Field Description:

CS Summation checksum

\$ERRORCODE is one byte in length;

0x00 = Incorrect Checksum

0x01 = Invalid Command

0x02 = Invalid Start of Frame

0x03 = Command Parameters out of Range

0x04 = Incorrect Number of bytes in the Message

0x05 = Obsolete

0x06= Too Many Control Bytes (Out of Range)

0x07= Too Many Data Bytes (Out of Range)

0x0B= System manager image invalid. Update required

0x0C= FPGA image invalid. Update required

0x0D= Database image invalid. Update required

0x0E= Command parameter not supported (may be sent in Standby mode to several commands which are handled properly in regular operating mode)

0x0F=Critical system error (reboot required)

Component file structures

The FPGA hardware/firmware image, the Database image and the Bootloader images follow Motorola SREC format. The System manager image follows Intel Hex format.

Database image will be updated in the same manner as firmware/hardware image since represented in the same file structure (SREC format).

System Bootloader image will be updated in the same manner as firmware/hardware image since represented in the same file structure (SREC format).

Firmware File Naming Conventions

Firmware files will all have a .flash extension and be named as follows:

FPGA_Firmware_Only_v_*VERSION*.flash,

where *VERSION* is the Major and two Minor version numbers of the firmware.

ex. FPGA_Firmware_Only_v_2.1.3.flash

EEPROM Database File Naming Conventions

Database files will all have a .flash extension and be named as follows:

V2_DB_*VERSION*.flash,

where *VERSION* is the Major and two Minor version numbers of the database.

ex. V2_DB_2_3_1.flash

Glossary

DTC	Diagnostic Trouble Code – This is a standardized code that will give an indication of detected malfunctions with a vehicle. See SAE J2012 for more information.
MIL	Malfunction Indicator Light – Same as a check engine light.
OBDII	On Board Diagnostics Generation 2
VIN	Vehicle Identification Number