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MOST25 Interface Product Specification (M25M-Sky)

1 Features

Compact Network Interface

2+0 Optical Header

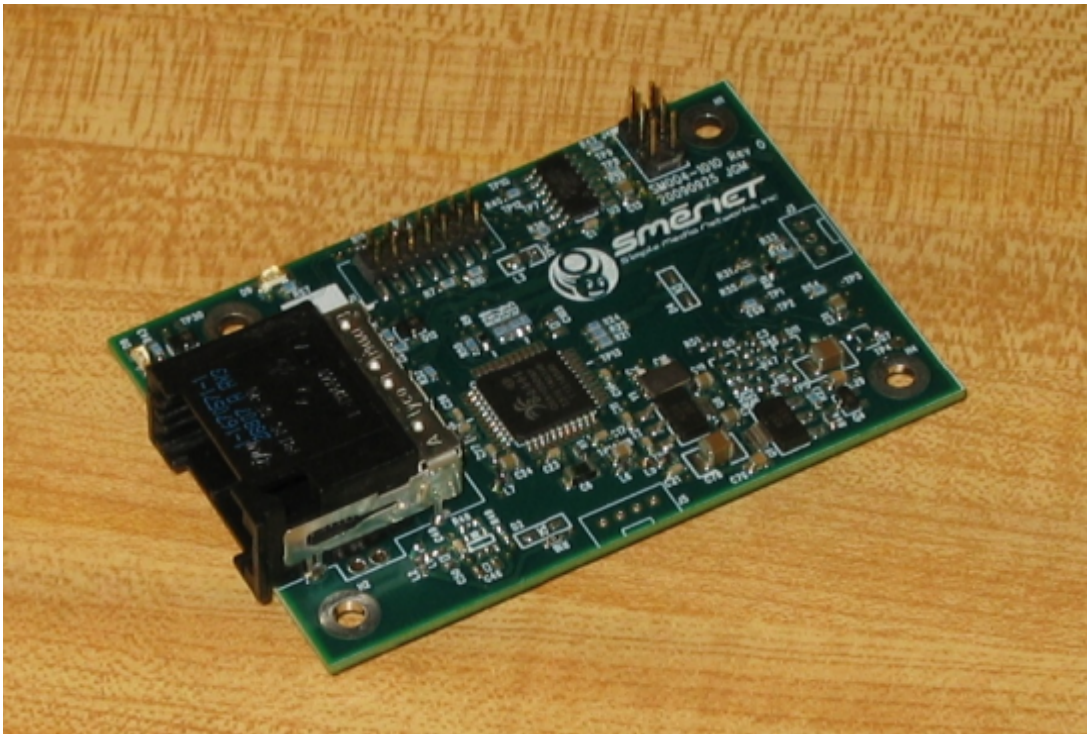
Simple to use API designed for Aston Martin application

Resident Network Stack for MOST network support

I2C bootloader for software updates

2 Description

This document describes the hardware and API for the SMN MOST25 Network Module for system master.



3 Hardware Specifications

3.1 Host Connector:

This is the primary interface between the Network PCB and the Host PCB.

3.1.1 Connector type:

Hirose DF11Z-22DS-2V(50) female header

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3.1.2 Mating connector on Host PCB:

Through-hole: Hirose DF11-22DP-2DSA(01), Board-Board spacing = 7.55mm

SMT: Hirose DF11-22DP-2V(20), Board-Board Spacing = 8.2mm

3.1.3 Pin Assignments:

| | | | |
|----|--------------|----|-----------------|
| 1 | FSY (LRCLK) | 2 | SCK (BCLK) |
| 3 | SR1 | 4 | SX1 |
| 5 | SR0 | 6 | SX0 |
| 7 | RMCK (256fs) | 8 | Reserved/MLBCLK |
| 9 | SCL | 10 | SDA |
| 11 | INT* | 12 | RESET* |
| 13 | RXSTATUS | 14 | ERR/BOOT* |
| 15 | RSOUT | 16 | Reserved/TBD1 |
| 17 | UBOOT* | 18 | Reserved/TBD3 |
| 19 | GND | 20 | Reserved/DIAG* |
| 21 | +3V3 | 22 | +12VP |

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3.1.4 Signal Definitions:

| Pin # | Signal | Type | Description |
|-------|-----------|------|--------------------------------------------------------------------------------------------|
| 1 | FSY | Dout | Frame Sync clock for I2S serial data, clocks at audio sample rate, with leading pulse low. |
| 2 | SCK | Dout | Bit Clock for I2S serial data, clocks at 256Fs with leading pulse low |
| 3 | SR1 | Din | Receive data1 for I2S |
| 4 | SX1 | Dout | Transmit data1 for I2S |
| 5 | SR0 | Din | Receive data0 for I2S |
| 6 | SX0 | Dout | Transmit data0 for I2S |
| 7 | RMCK | Dout | 256Fs Master clock output |
| 8 | Reserved | Dout | Not used |
| 9 | SCL | Di/o | I2C bit clock, Most card includes 4.7k pullup |
| 10 | SDA | Di/o | I2C data, Most card includes 4.7k pullup |
| 11 | INT* | Dout | Active low Interrupt request |
| 12 | RESET* | Din | Active Low reset input. Must be connected to HOST GP output. |
| 13 | RXSTATUS | Dout | High indicates light at receiver, May be connected to Host GP input |
| 14 | ERR/BOOT* | Dout | Low indicates Network is locked. May be connected to Host GP input |
| 15 | RSOUT | | Not used |
| 16 | TBD1 | | Not used, can be connected to GPIO |
| 17 | UBOOT | Din | Held low at Reset starts I2C boot loader, Must be connected to Host GP Output |
| 18 | TBD3 | | Not used, can be connected to GPIO |
| 19 | GND | PWR | Digital Ground |
| 20 | Reserved | | |
| 21 | +3V3 | PWR | Switched +3V3 input for digital logic & FOT. |
| 22 | +12VP | PWR | +12V input for battery monitoring, can be unswitched. Should be protected vs overvoltage. |

3.2 INIC Debug Connector:

This header allows connection of the INIC Explorer for development and test.

3.2.1 Connector Type:

Generic 2x7, .070" male header

| | | | |
|----|-----------|----|-----------|
| 1 | NC | 2 | GND |
| 3 | NC | 4 | ERR/BOOT* |
| 5 | GND | 6 | +3V3 |
| 7 | TDI/DSDA | 8 | TCK/DSCL |
| 9 | +3V3 | 10 | GND |
| 11 | TDO/DINT* | 12 | RST_Debug |
| 13 | NC | 14 | TMS |

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3.2.2 Signal Definitions:

I2S Interface

The I2S interface is preconfigured in “normal” I2S stereo data format:

3.2.2.1 FSY

I2S Frame clock output, 1Fs, active low indicates start of frame

3.2.2.2 SCK

I2S Bit Clock output, 64 bits per frame (64Fs), rising edge on valid data

3.2.2.3 SR0

Audio Data Input stream 0, delayed one bit from FSY edge. MSB is left justified. May be 16 or 24 bits

3.2.2.4 SX0

Audio Data Output stream 0, delayed one bit from FSY edge. MSB is left justified. 16 bits.

3.2.2.5 SR1

Audio Data Input stream 1, delayed one bit from FSY edge. MSB is left justified. May be 16 or 24 bits

3.2.2.6 SDA

SDA is the I2C data signal. A 4.7k pullup resistor is provided.

3.2.2.7 SCL

SCL is the I2C bit clock input. Goal is for operation up to 100kHz. A 4.7k pullup resistor is provided.

3.2.2.8 RXSTATUS

This output signal serves as an indicator of the optical receiver status. High indicates that light is present at the optical receiver.

3.2.2.9 ERR/BOOT*

This output signal is programmed as a lock indicator for the MOST network. A low indicates that the network is locked. This signal must be high impedance at reset.

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3.2.2.10 RESET*

This signal can be used to reset the M25M Module. As the module has internal reset logic, this is primarily needed for initiating the bootloader.

3.2.2.11 RSOUT

This Output signal indicates the reset status of the MOST transceiver. It can be used to reset ADCs etc, but is not generally needed.

3.2.2.12 UBOOT*

This signal is held low while applying reset in order to initiate the Boot Loader sequence.

3.2.2.13 GND

Digital Ground

3.2.2.14 +3V3

Primary supply voltage. This should be a switched supply. When power is applied, the module will start & initialize the MOST network.

3.2.2.15 +12VP

This signal is used to sense battery voltage. It is internally switched, allowing it to be connected directly to the input. Battery level is an integral factor in MOST bus management. When battery level is below the level UVcrit, device on the network are notified and will prepare for shutdown. When battery level is below the UVlo level, the network will be shutdown and remote nodes will enter standby.

3.3 Optical Connector

Tyco # 1-1670571-1, 3.3V Most 2+0 connector with "type A" keying/coding.

3.4 Power State Monitor

The MOST network requires monitoring of the battery voltage, and entry into a low power state. Circuitry will be included on the network interface to monitor the battery level, and trigger the appropriate state changes.

3.5 Mechanical Parameters

3.5.1 Overall Dimensions:

PCB assembly dimension: 2.00" x 3.00" x 1.00"

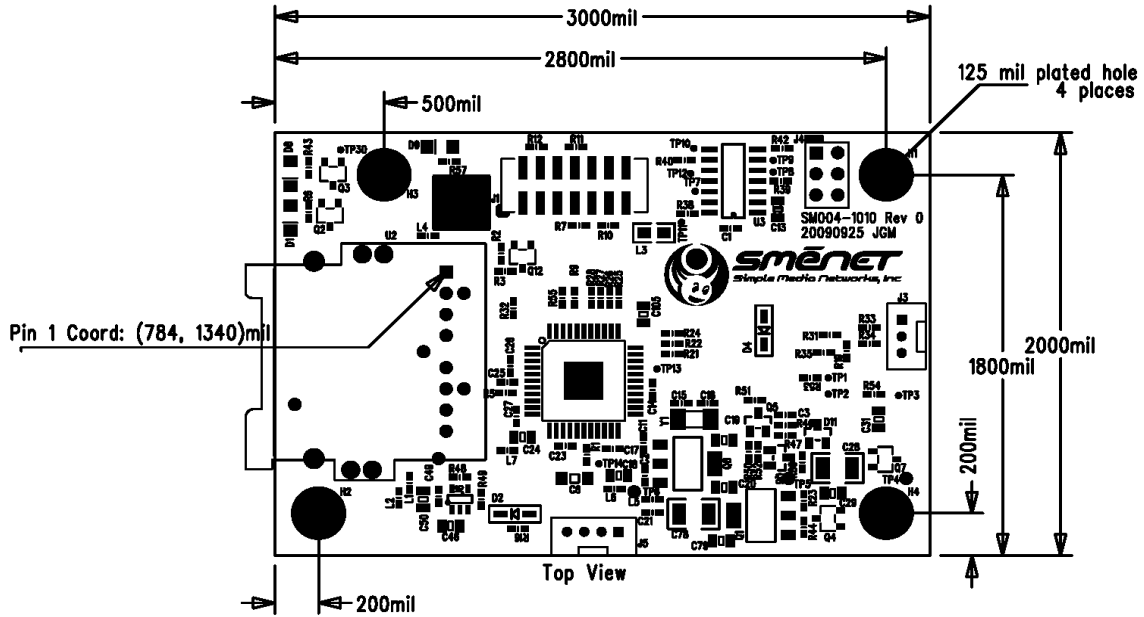
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3.5.2 Board Outline/Placement:

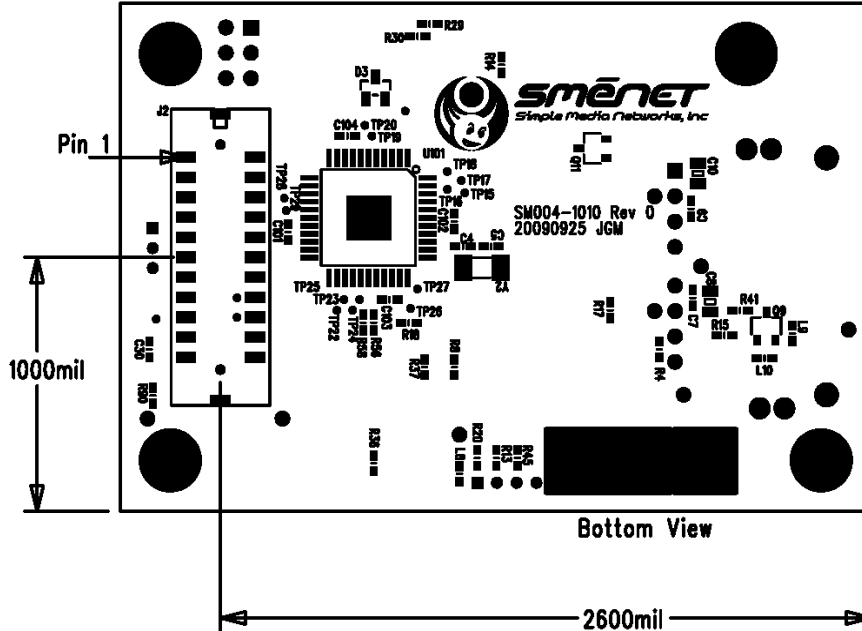


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3.5.3 Mounting locations:

4 110mil holes for #4 screws

The following mounting hole coordinates are relative to the lower left corner of the PCB, as shown in the Top View Drawing. All dimensions in thousandths of an inch (mils):

- (200, 200)
- (2800, 200)
- (2800, 1800)
- (500, 1800)

4 Electrical Specifications

| Symbol | Definition | Min | Nom | Max | Units |
|--------|---------------------------------------------|-----|--------|-----|-------|
| +3V3 | Supply Voltage | | +3.3V | | V DC |
| +12V | Protected Battery Voltage | | 14.4 | 26 | VDC |
| Fs | Most Frame Rate | | 48.00 | | kHz |
| Frmck | Most Master Clock Frequency (256Fs) | | 12.288 | | MHz |
| UVcrit | At Vbat < UVcrit net enters low power state | | 9.0 | | |
| UVlo | At Vbat < UVlo, net will shutdown. | | 7.0 | | |
| I12vp0 | +12V current when +3V3 is <1VDC | | | 20 | uA |

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| | | | | | |
|-------|------------------|-----|--|-----|-----|
| I12vp | +12V current | | | 20 | mA |
| I3V3 | +3V3 current | | | 250 | mA |
| Vih | Input high level | 2.5 | | 3.9 | VDC |
| Vil | Input low level | 0 | | 0.8 | VDC |

5 MOST Network Firmware

The firmware functions as a translation interface between display parameters as defined in the B&O system specification, and the Most messages needed to operate the ASK amplifier.

5.1 Implemented Functionality

The resulting firmware library supports the following functionality on the MOST Network.

Network Manager – The MOSTHandler() task brings on the network, initializes the ASK amplifier, and allocates data channels for the Background audio. In the event of power dropouts, this function handles muting the amplifier and shutting down the network.

Most function blocks implemented are:

Amplifier – Notification and Status handling

NetBlock – Network Management

NetMaster – Network Management

INIC – Network Management

Vehicle – Vehicle CAN gateway

The API uses the following MOST Function blocks to control the ASK DSP amplifier:

Amplifier

FktIDs: SpeakerLevel, Treble, Bass, Fader, Balance, Mute, Connect

Audio Source allocation, and Sink connection are handled automatically once the network is in a stable state.

5.2 Limitations

Software Download over MOST is not implemented.

Diagnostic functions are not implemented.

Wakeup Wire is not implemented.

Ring Break Diagnosis is not implemented.

Foreground audio sinks are not implemented

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6 API Specifications

The API provides a simple set of functions for initialization, network startup, parameter control, and network shutdown. These functions will be passed over I2C to the M25M module.

6.1 I2C Communication

The I2C interface is programmed as a slave at address 0x54. Note that this is the right justified address. In firmware the address is left justified with a trailing R/W bit. In this case the address becomes 0xA8.

All communication is standard I2C with a Start event, followed by master write of the target device address, followed by read or write of data per bit0 of the address byte, and terminated with a Stop event. Improper or incomplete messages are abandoned.

A buffering mechanism is implemented to allow queuing of multiple messages, as well as multiple received messages.

6.2 Command Message Format

All command operators will consist of a single ascii character. Most will be followed by one or more bytes of binary data.

| Command | Command Code Character | Args | Length | Function |
|-------------------|------------------------|---------------------------------------|---------------------------------------|--------------------------------------------------|
| SmnApiSetAudio | 'a', 0x61 | Enum AudioParm Byte Value | 3 bytes | Set audio parameter on Amplifier |
| SmnApiSetSystem | 's', 0x73 | Enum SysParm Long Value | 6 bytes | Get system Parameter |
| SmnApiGetSystem | 'y', 0x79 | Enum SysParm | 2 bytes | Get system Parameter |
| SmnApiSetVehicle | 'v', 0x76 | Enum Vparm Byte Len CAN message | 3 bytes + length of CAN Message | Relay Vehicle CAN message to MOST |
| SmnApiErrorCode | 'e', 0x65 | None | N/A | Reserved for error responses |
| SmnApiMostMessage | 'm', 0x6D | MOST message | 1byte + length of MOST message | Send an arbitrary message on MOST (use caution!) |

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6.3 Event Queue:

A mechanism is required to notify the host application when critical events occur. Such events may be response from the network to a host request, or spontaneous events from the network & system. Since timing of these events is not predictable, these events will be logged into the event queue.

An I2C read from the M25M will retrieve the oldest event from the queue. Returned event codes are removed from the queue. If no events are available, a Queue Empty message will be returned. An empty queue generally implies success of the recent command(s).

The host app should read from the device on a periodic basis to retrieve messages from the event queue.

If a new event occurs and the queue is full, the oldest message will be lost.

The INT* pin will be asserted if the Event Queue is not empty. Use of the INT* pin is optional.

All reads from the M25M will result in a 6byte reply from the Event Queue. If the queue is empty, all zeros will be returned.

6.3.1 Event Message Format

The protocol is designed to keep the interface very simple. In general messages will provide response only on failure. The response will be placed in the Event Queue, which can be checked by the host at will.

For messages which request data, the response will be placed in the Event Queue.

All responses will be in the form of a response type followed by 5 bytes of data. There are effectively three types of message: Queue empty, Status, and Error. Following are the message formats for the three event types:

6.3.1.1 Queue Empty:

Indicates nothing to report. Previous commands completed successfully.
0x00 00 00 00 00 00

6.3.1.2 Status Message

Reports data back to host. Data will be right justified, so a 1 byte status will be placed in <Data0>.

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<commandCode> <system parameter> <Data3> <Data2> <Data1> <Data0>

Example:

'y' [SMN_SYS_TIMER] 0x00 01 1A 2B

6.3.1.3 Error Message:

'e' <commandCode> <ErrorCode> 0x00 0x00 0x00

Example:

'e' 'a' [SMN_API_ERROR_INICBUSY] 0x00 00 00

6.4 System Value Cache

System values will be statically cached in the MOST Handler (eg volume, bass, etc.). In the unlikely event that a remote value is found to not match the system cache value, an error will be logged in the status queue.

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6.5 Function Return Codes

Some functions will return an int result, where 0 indicates function success, and nonzero indicates failure.

Failure Return codes are defined in enum SMNAPI_FUNCTION_STATUS as shown in the following table:

| Function Return Code | Mnemonic | Result |
|----------------------|------------------------------|------------------------------------------------|
| 0 | SMNAPI_SUCCESS | Success |
| -1 | SMNAPI_ERROR_OUT_OF_RANGE | Requested value out of range |
| -2 | SMNAPI_ERROR_INIC_BUSY | INIC not ready (application must resend) |
| -3 | SMNAPI_ERROR_I2C | I2C buffer is full |
| -4 | SMNAPI_ERROR_AMP_MALFUNCTION | A parameter has changed on the amp (not by us) |
| TBD | TBD | TBD |

6.6 Command Reference

This command reference describes the commands in Release0 of the API. **Type details should be taken from the header file smnapi.h.** This is a preliminary release and may not contain all functionality. Changes are likely to arise, and will be documented in the final product spec.

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6.6.1 SmnAPISetAudio

This command sets the value of the named parameter. It will return an error code as described previously. The value is shadowed in the api. Writing of the value will be verified over the network. In the event the value received back does not match the system value, an error will be posted in the status queue.

Host Command: 'a' *AudioParm* *byteValue*

Length: 3 bytes

Response: Errors logged in Event Queue

Example:

host> 'a' [AML_PARM_BASS] 0x02

Supported values are as follows:

| Aston Martin One-77 value translations | | | | | | | |
|----------------------------------------|----------------|-------------|----------------------------|-----------------|----------------|------------------|------------|
| 'AudioParm' | | 'byteValue' | Resulting MOST parameters: | | | | |
| Smn Enum | BnO Command | BnO Range | BnO Meaning | ASK command | MOST/ASK Range | ASK command | Most FktID |
| AML_PARM_MUTE | Mute | 0 | Unmuted | Unmuted | 0 | Mute | 0x113 |
| | | 1 | Muted | Muted | 1 | | |
| AML_PARM_VOLUME | Volume | 0 | Muted | Muted | -127 | SpeakerLevel | 0xE01 |
| | | 29 | Max Volume | Max Volume | 0 | | |
| AML_PARM_BASS | Bass | -10 | Bass Cut | Bass Cut | -10 | Bass | 0x202 |
| | | 0 | Bass Flat | Bass Flat | 0 | | |
| | | 10 | Bass Boost | Bass Boost | 10 | | |
| AML_PARM_TREBLE | Treble | -10 | Treble Cut | Treble Cut | -10 | Treble | 0x203 |
| | | 0 | Treble Flat | Treble Flat | 0 | | |
| | | 10 | Treble Boost | Treble Boost | 10 | | |
| AML_PARM_FADER | Fader | -32 | Front Muted | Front Muted | -10 | Fader | 0x204 |
| | | 0 | Front-Rear Flat | Front-Rear Flat | 0 | | |
| | | 32 | Rear Muted | Rear Muted | 10 | | |
| AML_PARM_BALANCE | Balance | -32 | Right Muted | Right Muted | -10 | Balance | 0x200 |
| | | 0 | Right-Left Flat | Right-Left Flat | 0 | | |
| | | 32 | Left Muted | Left Muted | 10 | | |
| AML_PARM_LENSSTATE | LensState | 0 | Tweeter Hidden | | 0 | LensState | 0xD18 |
| | | 1 | Tweeter Up | | 1 | | |
| AML_PARM_ASCMODE | Sound Focus | 0 | Off | | 0 | AscMode | 0xD19 |
| | | 3 | High | | 3 | | |
| AML_PARM_SURROUNDMODE | Surround Focus | "Auto" | Auto - based on seatbelts | | 4 | SurroundSettings | 0xE05 |
| | | "Driver" | Driver | | 3 | SurroundMode | posx=2 |
| | | "Front" | Front | | 5 | | |
| AML_PARM_SURROUNDLEVEL | Surround Level | -10 | Narrow | | -127 | SurroundSettings | 0xE05 |
| | | 0 | Mid | | 0 | SurroundLevel | posx=1 |
| | | 10 | Wide | | 127 | | |

Notes:

Volume will be implemented using the Volvo SpeakerLevel function.

Volume mutes for values <= -100.

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6.6.2 SmnApiSetSystem

This command sets a system variable in the M25M. Not all variables can be set by the host. The passed value is set for 32 bits in order to support larger parameters, eg timer values.

Host command: 's' *SysParm longValue*

Length: 6 bytes

Response: Errors logged in event queue

Example:

```
host> 's' [SMN_API_INIT] 0x00 00 00 01
```

| SysParm | LongValue (32 bit) | R/W | | Purpose |
|------------------|---------------------------|------------|-----|----------------------------------------------------------------|
| SMN_SYS_STATUS | enum SMNMAIN_AMP_STATE | Read Only | | Read out the Amplifer status on the network |
| SMN_SYS_INIT | 0x00000001 | Write Only | | Initialize the Amplifier values |
| SMN_SYS_NETSTART | 0x00000001 | Write Only | | Force network to startup. Currently this function is automatic |
| SMN_SYS_NETSHUT | 0x00000001 | Write Only | | Force network to shutdown |
| SMN_SYS_TIMER | 0xnxxxxxxxx | Read Only | | Read out the M25M main timer |
| TBD | TBD | TBD | TBD | TBD |

6.6.3 SmnApiGetSystem

This command retrieves a system variable in the M25M. Not all variables can be read by the host. The returned value is 32 bits in order to support larger parameters, eg timer values.

Host command: 'y' *SysParm*

Length: 2 bytes

Response: Reply in event Queue, Errors logged in event queue

Example:

```
host> 'y' [SMN_SYS_STATUS]
```

```
m25m> Asserts INT*
```

```
host> initates read of 6 bytes
```

```
m25m> 'y' [SMN_SYS_STATUS] 0x00000002
```

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6.6.3.1 SMN_SYS_INIT

Writing 0x00000001 sets all of the named amplifier parameters to their default values as defined in AmpDecodeTable[] and stored in the Configuration Memory.

SMN_SYS_NETSTATUS
 SMN_SYS_NETINIT
 SMN_SYS_NETSTART
 SMN_SYS_NETSHUT
 SMN_SYS_NETTIMER

6.6.3.2 SMN_SYS_TBD

Other system parameters will be defined as implemented/needed.

6.6.4 SmnApiSetVehicleSet

This function passes a CAN Vehicle message to the M25M for relay onto the MOST network. Only known messages will be passed. An error code will be logged in the event queue as described previously for unknown messages. The associated CAN values are shadowed in the api. The stored CAN values are accessed by the amplifier either through request only (Get messages from the amplifier), or through Notification Status messages (automatic message sent when data changes).

Host command: 'v' len *CanMessage*

Length: 3+ # CAN Data bytes

Response: Errors logged in event queue

Example:

host> 'v' [AML_VPARAM_AMPTYPE] 0x01 0xB0

Supported parameters are as follows:

| Aston Martin One-77 Vehicle CAN support | | | | | | |
|-----------------------------------------|---------------|---------------------|-----------|-----------------|------------|--------|
| parameter | | len | | data | | |
| Smn Enum | CAN message | data Length (bytes) | CAN Range | Data Definition | Most FktID | Access |
| AML_VPARAM_AMPTYPE | AmpType | 1 | 0xB0 | | 0x2B3 | Get |
| AML_VPARAM_MICROPHONE | Microphone | 1 | 0 | | 0x2B7 | Get |
| AML_VPARAM_CARLINE | Carline | 1 | 0 | | 0xD01 | Get |
| AML_VPARAM_CONVERTIBLE | Convertible | 1 | 0 | | 0xD02 | Get |
| AML_VPARAM_STEERING | SteeringWheel | 1 | 0 | | 0xD03 | Get |

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| | | | | | |
|------------------------|-----------------|---|-----------|-----------------------------------------|--------------|
| AML_VPARAM_VEHICLETYPE | VehicleType | 1 | 0 0xFF | 0xD04 | Notification |
| AML_VPARAM_FANSPEED | FanSpeed | 1 | 0 5 | 0xD11 | Notification |
| AML_VPARAM_ROOFSTATE | RoofState | 1 | 0 | 0xD12 | Notification |
| AML_VPARAM_WINDOWPOS | Window Position | 2 | 0 | 8 bit each, driver & passenger 0xD13 | Notification |
| AML_VPARAM_VEHCLESPEED | Vehicle Speed | 3 | | 16 bit speed, 8 bit quality 0x200 | Notification |

Notes: Can data is not presently translated, same data is sent on MOST

6.6.5 SmnApiMOSTMessage {uint16 msgTgtAddr}{uint8 msgFblockID}{uint8 msgInstID}{uint16 msgFktd}{uint8 msgOpType}{uint8 msgLen}{uint8 * msgData}

This function is provided as a “backdoor” for sending arbitrary Most Control Messages. It is intended for development, debugging, and/or minimal system modifications. Sending messages in this way does not ensure that correct function responses will be acknowledged or properly implemented. For example, sending a get parameter message will function on the network correctly, but no provision is made to receive the reply and send it back. Even so it can be useful for sending basic control messages. The arguments are the associated parts of the MOST message and will be sent without validation.

Host command: ‘m’ <MOST message>

Length: 2+ bytes

Response: Errors logged in event queue

Example:

host> ‘m’ <MOST message>

6.6.6 SmnApiPopEventQueue

This function is removed. All reads will retrieve the oldest event from the queue.

6.7 Configuration

A data segment of memory will be reserved for optional configuration of the remote device parameters. These application parameters are stored in FLASH

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(or EEPROM?) for use by the API, and shall be updateable via the I2C
bootloader.

6.8 MOST NetServices (MNS)

SMeNet stack for MOST will be used for management of the network and
handling of all messages.

7 I2C Bootloader

7.1 Target Processor

The intended processor for this product is Atmel ATXMEGA32D4.

7.2 Bootloader Entry

Reflashing of the M25M firmware shall be possible via I2C. The boot loader will
be initiated by pulling the UBOOT* pin low, and asserting RESET*.

7.3 Bootloader Protocol

The bootloader shall operate with commands and procedures as defined by
Atmel in the following documents:

AVR109: Self Programming <http://www.atmel.com/atmel/acrobat/doc1644.pdf>
Discusses the general programming protocol

AVR1316: XMEGA Self-Programming
http://www.atmel.com/dyn/resources/prod_documents/doc8070.pdf
Updated for the ATXMEGA series

AVR911: AVR Open Source Programmer
http://www.atmel.com/dyn/resources/prod_documents/doc2568.pdf

7.4 Programmer Open Source Examples

At least two variations of open source programming software are available as
follows:

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7.4.1 AVRDUDE

The boot loader will be compatible with the AVRDUDE program, version 5.10. Source for this program is available at <http://download.savannah.gnu.org/releases/avrdude/> and should be used as a model for the Host application. This program is reported to support I2C based programming.

7.4.2 AVROSP

Atmel also provides an open source programmer.
AVR911: AVR Open-source Programmer source
http://www.atmel.com/dyn/resources/prod_documents/AVR911.zip

Additional details will follow as the bootloader is completed and will be provided in the Product Specification.

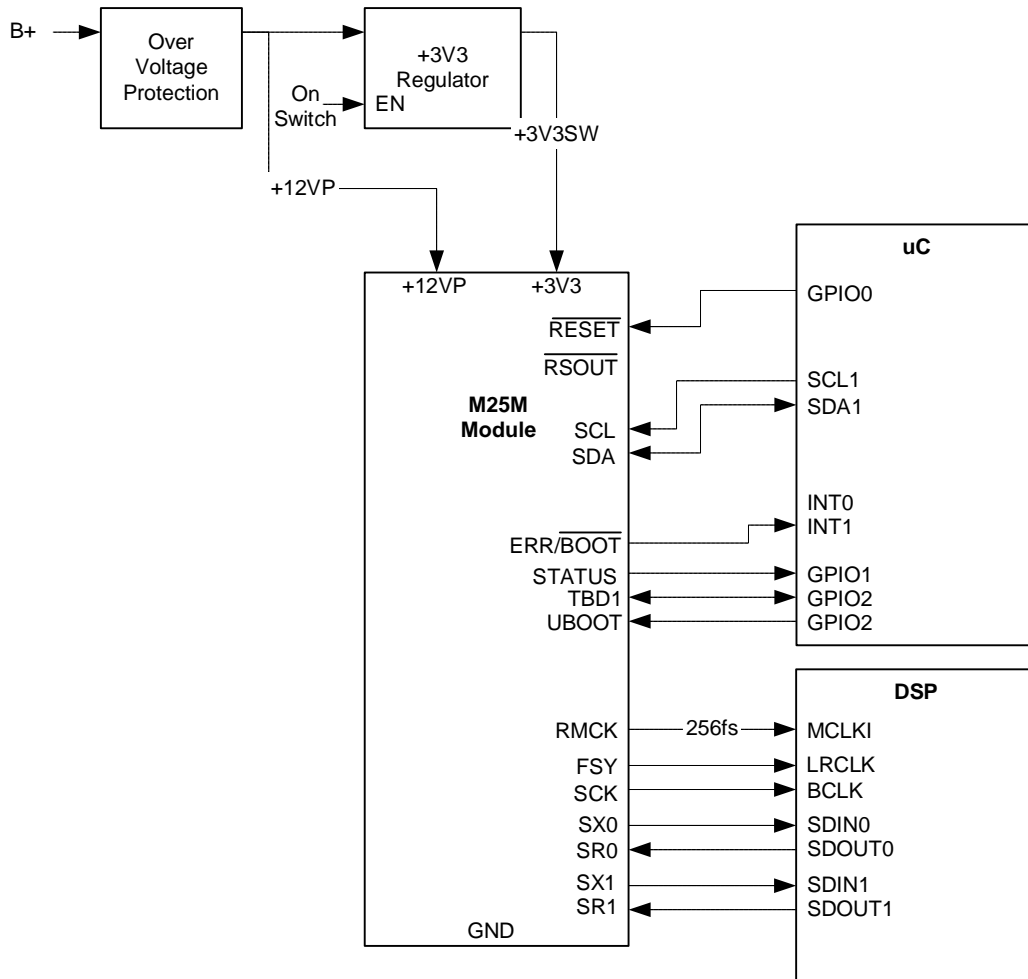
| | | |
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8 Application Circuit



It should be noted that the M25M is the clocking master for the audio sources.

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Change History

20101105: Added pin 11 as INT*, Interrupt request output to external host

20101105: Added detail on SKY-AML I2C protocol, esp regarding response & event queue.

20101130: Corrected UBOOT in table/section 3.1.4

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