



AEROSPACE STANDARD

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Superseding AS5394

Health and Usage Monitoring System Advanced Multipoint Interface Specification

RATIONALE

The HM-1 committee has agreed to stabilize this document. HUMS suppliers have continued to utilize proprietary communication protocols rather than standardizing as this document recommends. Stabilization is recommended over cancellation due to useful technical data contained within the document.

STABILIZED NOTICE

This document has been declared "Stabilized" by the SAE HM-1 Integrated Vehicle Health Management Committee and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

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1. SCOPE:

This document specifies a multipoint, digital, serial interface that incorporates other interface standards such as EIA-485 and the nine bit interrupt mode of many microcontrollers. Standardized interfaces are critical to the development of an "open" HUMS architecture.

2. APPLICABLE DOCUMENTS:

EIA-485 "Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems", Electronics Industries Association, April 1983

3. PROTOCOL BASICS AND DEFINITIONS:

3.1 Electrical and Timing Characteristics:

The electrical and timing characteristics of this serial interface shall comply with those described by EIA-485.

3.2 Referencing a Device:

All HUMS Advanced Multipoint Interface Specification (HAMIS) compliant devices shall be referenced using an 8-bit addressing system. (This specification was originally developed by the Rotorcraft Industry Technology Association (RITA) and is also known as RHAMIS.) There are three types of addresses used. Each device shall respond to its own unique address (local address), as well as a global address. Devices may also respond to one or more "group" addresses. The group address, can be used by a system designer to have multiple devices respond to a common command. Two of the 256 available addresses are reserved by this specification as shown in Table 1. The Master Bus Controller should always be Address 1. The user shall assign submasters. All addresses shall be fixed. Submaster shall not change its address once it has taken control over the bus.

TABLE 1 - Reserved Addresses

Address	Device
0	Global
1	Bus Master

- 3.2.1 Global Address: An address recognized by all devices. The global address is used for the exchange of global data and commands. No response shall ever be given to globally addressed command. As shown in Table 1, the global address is always 0.

3.2.2 Group Address: An address recognized by multiple devices. The group address is used for the exchange of group data and commands such as group triggers. No client device shall ever respond on the bus to a group address. Groups are intended to be used for synchronized sampling of smart sensors therefore:

- Most Line Replaceable Units (LRUs) will not be part of a group
- Master will not be part of a group
- Submaster will not be part of a group
- Not all devices need to be able to be part of a group in order to be compliant with this Specification

3.2.3 Local Address: An address recognized by a single device. The local address is used for the exchange of data and commands between two specific devices. Responses are allowed and recommended for locally addressed commands.

3.3 Speed:

The bus shall operate at 1 Megabaud.

3.4 Bit Order:

The least significant bit shall always travel first through the interface.

3.5 Bus Control:

Only one device shall have control of the data interface at any given time. This controlling device sends commands out and expects a response within a designated time. If no response is given in this time it is referred to as a time-out. Time-outs and the system response to time-outs are defined in the "Time-outs" section of this document.

3.6 Error Detection and Resending:

Error detection is handled at the message level and is defined in the "Status Message" section of this document.

3.7 Device Types:

All devices shall be one of the following types: (1) Master, (2) Submaster, or (3) Slave.

3.7.1 Master Device: The functions and features of the Master Device:

- Is also referred to as the bus master controller
- Is responsible for initializing the bus at startup and is the initial bus controller at startup
- Sends the initial commands and re-synchronizes the bus in the case of a "Bus Master Time-out"
- There is only one Master Device on a bus
- Can act as (1) a bus controller or as (2) a client, if it passes control to a submaster
- Master Device shall not be required to respond, on the bus, to incoming messages

3.7.2 Submaster Device: A submaster is any device that is not a master device but may need bus control to poll other submasters or slaves. A submaster, when in control of the bus, may query the bus master at which time the master shall function as a submaster. This device can act as a bus controller or client. When a submaster is not in control of the bus it shall respond as a slave or client.

3.7.3 Slave Device: Any device that never needs to be a bus controller. This device sends and receives data on the bus when commanded by a master or submaster device. This device will always act as a bus client.

3.8 Relationships:

Any two devices that are communicating shall do so in one of two established relationships. These two relationships are the command relationship and query relationship.

3.8.1 Command Relationship: The command relationship exists for the purpose of simple data collection tasks. In the command relationship, certain devices (slaves) exist simply to supply data from the outside world to other devices such as masters or submasters. In the command relationship slave devices shall never have bus control and can only perform one task. If more than one slave task exists for a device it shall be given an address per slave task. Of the two devices in a command relationship, one is the commander and the other is the slave. The commander is either a master or a submaster.

3.8.2 Query Relationship: The query relationship exists in the case where a device may need to take control of the bus in order to carry out its task. There are two devices in a query relationship a commander and a submaster. The commander is either a master or a submaster. A submaster cannot pass control to a different submaster but only back to the master.

4. PROTOCOL PROCEDURES:

Communication between any two devices shall follow one of the procedures specified below.