STANDARD

Device Families Command Specification

HCF_SPEC-160, Revision 1.1

Release Date: 12 May, 2011

Release Date: 12 May, 2011

Document Distribution / Maintenance Control / Document Approval
To obtain information concerning document distribution control, maintenance control, and document approval please contact the HART Communication Foundation (HCF) at the address shown below.

Trademark Information
HART® is a registered trademark of the HART Communication Foundation, Austin, Texas, USA. Any use of the term HART hereafter in this document, or in any document referenced by this document, implies the registered trademark. WirelessHART® is a trademark of the HART Communication Foundation. All other trademarks used in this or referenced documents are trademarks of their respective companies. For more information contact the HCF Staff at the address below.

Attention: Foundation Director
HART Communication Foundation
9390 Research Boulevard
Suite I-350
Austin, TX 78759, USA
Voice: (512) 794-0369
FAX: (512) 794-3904

http://www.hartcomm.org

Intellectual Property Rights
The HCF does not knowingly use or incorporate any information or data into the HART Protocol Standards which the HCF does not own or have lawful rights to use. Should the HCF receive any notification regarding the existence of any conflicting Private IPR, the HCF will review the disclosure and either (a) determine there is no conflict; (b) resolve the conflict with the IPR owner; or (c) modify the standard to remove the conflicting requirement. In no case does the HCF encourage implementers to infringe on any individual's or organization's IPR.

Table of Contents

Table of Figures

Index to Tables

Preface

The Device Families Command Specification provides a structure that allows the definition of HART commands for the configuration and support of Field Devices. Device Variables are classified into families based on the type of Device Variables (i.e., process connections) they support, e.g., pressure, temperature, valve/ actuators, vortex flow, etc. Basing the Device Family on Device Variables allow even complex multi-variable devices to be supported using this structure. In other words, Device Variables in a multi-variable Field Device may support several different Device Families.

As Device Families are defined and their configuration parameters characterized, the resulting commands will be incorporated into new revisions of *Device Families Command Specification*. As a result, this Specification is anticipated to be revised and the number of families increase with time. Revision control procedures specific to this Specification are included to facilitate this growth.

This specification is the result of long discussions in the HART Interoperability Working Group and builds on HART 6 features in several areas including: Engineering Unit Code Expansion, Sensor Trim, and Device Variable Status. This specification builds on these HART 6 features to allow host commissioning of a Field Device without any prior knowledge of that Field Device. In other words Device Family Commands add another level of interoperability to the HART Protocol. Table 1 shows how the Device Family Commands meets these objectives.

Table 1. Satisfying Device Family Requirements

	Requirement	Implementation
1	Identify the number of device variables supported by the Field Device	"Identity commands" include a byte indicating the maximum number of Device Variables that can be in the Field Device. This requirement was identified long before Device Families were conceived.
2	Determine what Device Family each Device Variable belongs to	The Device Variable Family code is used to identify the Device Variable's Device Family (see Command 54).
3	Identify which Device Variable supports Device Family commands	A byte in Command 54 indicates whether the Device Variable supports the Device Family commands.
4	Unambiguously communicate the Device Family properties to and from the Field Device	As the *Device Families Command Specification* grows, common well defined properties will be specified. These properties will have clear unambiguous definitions. Additional Tables will be added ,as necessary, for codes and enumerations included in a particular Device Family definition. Change control procedures are included to ensure the integrity of the *Device Families Command Specification*.
5	Sufficient command numbers must be available to support all the possible Device Families.	Device Families use extended command numbers 1024-33,791. The MSB of the extended command numbers contains the Device Family code from the Common Tables. This provides sufficient command numbers and allows easy decoding of commands in Field Devices.
6	Multi-variable devices may support several Device Families.	Device Family commands specify the Device Variable being affected. Each Device Variable may support any one Device Family.

Introduction

The HART community adopts a rigorous definition of interoperability to avoid misunderstandings common in popular marketing usage::

Interoperability Interoperability is the ability for like devices from different manufacturers to work together in a system and be substituted one for another without loss of functionality at the host system level.

This is a strong, ambitious definition requiring much more than simply devices co-existing on the same network without disrupting communications. HART promotes interoperability in many ways:

1. Requiring compatibility with the 4-20mA loop which allows a HART device to work with existing plant systems;

2. Providing a well defined Physical Layer for devices to communicate over;

3. Specifying Data Link Layer framing, error detection and bus arbitration requirements to ensure the integrity of communications;

4. Requiring all devices to support all Universal Commands; and

5. Providing Common Practice Commands that are widely applicable to many devices.

The HART Application Layer provides:

- Cyclical process data,
- Range information,
- Device tags,
- Calibration of Loop Current and process values,
- Device status and health information, and
- Several ways to identify devices connected to the HART network.

Device Families extend interoperability by allowing the addition of commands and status to commission and parameterize Field Devices based on the type of process connection they support, e.g., pressure, temperature, valve/ actuators, flow, etc. Since this is based on the Device Variable, more complex multi-variable devices are supported using this same strategy. For example, a hydrostatic tank gauge may support pressure, temperature and level Device Family variables.

The objective of the Device Family Specification is to enable HART compatible hosts to setup and commission devices without using Device Descriptions. Since there are a limited number of HART commands and a large number of potential device families, additional HART commands beyond the 256 available today are necessary to support the new Device Family Commands. The first two bytes in the data field are used to increase the number of HART commands to 65,536 (see the *Command Summary Specification*).

Benefits

The choice to support Device Family Commands is optional. Device Family Commands provide the minimum capabilities necessary to setup and configure a Field Device. All devices must support a mechanism to allow its configuration. As a result, supporting the Device Family Commands should require very little net change in development or material costs using this structure versus developing device specific commands. Furthermore, adopting Device Family Commands provide significant benefits:

1. It provides for consistent and standardized definition of setup and configuration parameters for device families.
2. It is compatible with and builds on the engineering unit code expansion .
3. Codes (enumerations) used in the Device Family Commands are standardized using Tables attached to the individual Device Family Specification.
4. A host can easily determine Device Variables which support Device Family Commands in a Field Device.
5. Field Devices will have better support on a wide range of host systems by standardizing Field Device setup and configuration without requiring the host to support DDs.
6. All hosts can implement a "super generic" mode to allow device commissioning when the device's DD is not available.

Device Families facilitate significant increases in host systems capabilities and Field Device interoperability compared to that allowed using only Universal and Common Practice Commands.

1. SCOPE

Device Families is an Application Layer specification and, accordingly, builds on the Application Layer Requirements found in the *Command Summary Specification.* Conformance to all requirements of the *Command Summary Specification* is a prerequisite to conforming to this specification. This specification includes

- The requirements for the definition and maintenance of Device Family Specifications; and
- Individual Device Family Specifications that are incorporated (by reference) in the *Device Families Command Specification* (see Section 2.2)

This specification contains the rules that must be followed when defining a new Device Family and when performing modifications to this specification. Among these rules are requirements to publish proposed Device Family specifications to allow review and comment by the HCF membership. These proposed Device Family specifications vary in maturity from Concept to Final. As part of this Device Family development process a proposed Device Family specification cannot be included into the *Device Families Command Specification* until proven in device implementations. In other words, actual device implementations are the final validation of a specific Device Family. To encourage and protect early implementations, the HCF staff must be notified of any products using the Device Family prior to its inclusion into the *Device Families Command Specification*. See Section 6.3 for more information.

Each Device Family Specification defines both data items (properties) and commands for an individual Device Family. These commands and properties are applied to individual Device Variables. As a result, a multi-variable Field Device may support several Device Families. The Device Variable Family (see Common Table 20) is used to identify the Device Family a Device Variable supports.

A Device Family implementation, if used in a Field Device, must implement all of the mandatory commands and all Device Family commands implemented (mandatory or optional) must be implemented exactly as specified. Many Device Family Commands refer to tables from the *Common Tables Specification* or the individual Device Family Specification. When these tables are referenced, the tables must be used exactly as specified.

As required by the *Command Summary Specification*, the meaning of a data item, once defined and used in a Field Device, cannot be changed either during the devices operation or in successive revisions of the Field Device. Among other things, this means a Device Variable can support any Device Family. However, once the device developer has decided on the Device Family for a Device Variable it cannot change. In other words, a Device Variable cannot belong to one family today and another tomorrow. Furthermore, a Field Device that supports Device Family Commands in one version must support at least the same commands in successive device revisions.

As new Device Family Specifications are defined, they will be incorporated into this specification.

2. REFERENCES

2.1 HART Field Communications Protocol Specifications

These documents published by the HART Communication Foundation are referenced throughout this specification:

HART Field Communications Protocol Specification. HCF_SPEC-13

Command Summary Specification. HCF_SPEC-99

Common Tables Specification. HCF_SPEC-183

Command Response Code Specification. HCF_SPEC-307

2.2 Device Family Specifications

The *Device Families Command Specification* includes documents that define the operation and parameterization of an individual Device Family. This version of the specification includes the sub-documents identified in Table 2.

Table 2. Device Family Specification Documents

Document Title	Rev.	Number
Temperature Device Family Specification	2.0	HCF_SPEC-160.4
PID Control Device Family Specification	1.0	HCF_SPEC-160.7
Level Device Family Specification	1.0	HCF_SPEC-160.11

2.3 Related HART Documents

The HART Protocol Specifications frequently reference the manufacturers' device-specific document. Device-specific documents are developed and controlled by the respective manufacturer and should follow the requirements of the following HART Communication Foundation document:

Requirements for Device Specific Documentation. HCF_LIT-18

3. DEFINITIONS

Terms used in this document and defined in *HART Field Communications Protocol Specification* include: ASCII, Data Link Layer, Delayed Response, Delayed Response Mechanism, Device Variable, Busy, DR_CONFLICT, DR_DEAD, DR_INITIATE, DR_RUNNING, Dynamic Variable, Fixed Current Mode, Floating Point, ISO Latin-1, Master, Multi-drop, Not-A-Number, Packed ASCII, Preamble,

Request Data Bytes, Response Data Bytes, Response Message, Slave, Slave Time-Out, Time Constant, Units Code

Device Family, or Device Family Specification — The definition of the properties, diagnostics and commands required to manage a Device Variable. The Device Family specification includes all the mandatory and optional properties necessary to configure the corresponding class of process connections.

Standard Operating Procedure — A defined process for performing a routine task (e.g., calibrating a Field Device). Generally an SOP includes sequence of actions performed, in a specified order, by the user, Field Device and (perhaps) using another piece of equipment.

4. SYMBOLS/ABBREVIATIONS

HCF **H**ART **C**ommunication **F**oundation

LSB **L**east **S**ignificant **B**yte. The LSB is always the last byte transmitted over a HART data link.

MSB **M**ost **S**ignificant **B**yte. The MSB is always the first byte transmitted over a HART data link.

NAN **N**ot **A** **N**umber

SCADA **S**upervisory **C**ontrol **A**nd **D**ata **A**cquisition. Generally a telemetric system collecting process related or operational data and periodically changing high-level control parameters or setpoints.

SOP **S**tandard **O**perating **P**rocedure

WG **W**orking **G**roup

5. DATA FORMAT

In command specifications, the following key words are used to refer to the data formats. For more information about these formats, see the *Command Summary Specification*.

Bits Each individual bit in the byte has a specific meaning. Only values specified by the command may be used. Bit 0 is the least significant bit.

Enum An enumerated value. Only values specified in the *Common Tables Specification* may be used.

Float An IEEE 754 single precision floating point number. The exponent is transmitted first followed by the most significant mantissa byte.

Packed A string consisting of 6-bit alpha-numeric characters that are a subset of the ASCII character set. This allows four characters to be packed into three bytes. Packed ASCII strings are padded out with space (0x20) characters.

Unsigned-*nn* An unsigned integer where *nn* indicates the number of bits in this integer. Multi-byte integers are transmitted MSB – LSB.

6. SPECIFICATION CONTROL

The *Device Families Command Specification* is designed to allow the addition of a new Device Family. A Device Family has a narrow scope that is not applicable to all devices. As a result, balloting of a new or revised Device Family Specification is not practical. Change control procedures used by other specifications do not apply to the Device Family Specification.

This section defines procedures and requirements that govern: the addition of an individual Device Family to this specification; and the modification of a Device Family included in a revision of this specification. These requirements are designed to:

- Ensure the technical excellence of each Device Family;
- Provide a fair, open and objective basis for the development of Device Families;
- Alignment of the Device Family with Protocol requirements and practices; and
- Allow access and participation by all interested parties.

Any changes to this specification other then additions or changes to a specific Device Family must follow the normal change procedures as defined in *HART Field Communications Protocol Specification*.

The initial release of the Device Family Specification including the initial set of Device Families it contains must be balloted and follow the normal process for HART Specifications as defined in *HART Field Communications Protocol Specification*.

Note: These procedures intentionally and explicitly do not establish a fixed maximum time period that shall be considered "reasonable". A premium is placed on consensus and efforts to achieve it. These procedures deliberately defer the swift execution in favor of providing the flexibility to reach a genuine technical consensus.

6.1 Revision Numbers

As per normal Protocol requirements The *Device Families Command Specification* has a major and minor revision number. As a specification is changed, the major and minor revision numbers are incremented as follows:

- The addition of a new Device Family is a functional change to this Specification. The major revision number must be incremented and the minor revision number reset to zero.

- The modification of a Device Family shall be considered a non-functional change to this specifications and the minor revision number must be incremented.

- Any other change to this specification must follow the revision numbering and change control procedures found in the *HART Field Communications Protocol Specification*.

6.2 Device Family Maturity Levels

Proposed Device Family specifications evolve through a series of maturity level before incorporation into this specification. These levels allow for the fair, open and orderly development of a Device Family. In addition, technical excellence increases at each level ensuring the integrity of the *Device Families Specification*.

The proposed Device Family is given a document number in the form HCF_SPEC-160.x where "x" is allocated by the HCF for identification purposes. Document revision numbering shall use the form 'y.z', where 'y' indicates a major revision number and 'z' a minor revision. The initial value for any major revision (i.e., new specification document) is 1. For any major revision, the minor revision number is reset to 0.

As a Device Family is changed, the major and minor revision numbers are incremented as follows:

- The major revision number increments for functional changes that add or modify a Device Family capabilities.

- The minor revision number increments for non-functional changes.

Every publication of a revised Device Family must have a different revision number.

Table 3. Device Family Maturity Levels

Conceptual	Proposals for the addition of a new Device Family may be submitted by any HCF member company or the HCF staff. A Device Family Concept must define, at least, the scope and provide a brief description of the Device Family. Once the concept is established, an HCF technical working group must be formed to produce a draft Device Family specification.
Draft	A Draft Device Family is a complete specification meeting all the appropriate Protocol requirements. A Draft Device Family should have all design and technical decisions resolved. Significant review by interested parties should be complete and a strong consensus formed.
Preliminary	A Preliminary Device Family is a Draft that has been selected for promotion by the Device Family Committee. Once a Device Family reaches Preliminary, a final request for comments is solicited from the HCF membership.
Final	If no significant controversy arises from the final comments, a Preliminary Device Family may be promoted to Final by the Device Family Committee. Once implemented successfully in real devices, the Final Device Family will be incorporated into the next revision of the *Device Families Command Specification*.

6.3 Device Family Specification Process

Proposals for the addition of a new Device Family or the modification of an existing Device Family may be submitted by any HCF member company or the HCF staff. These proposals are forwarded to the Device Family Committee:

- Proposals for a new Device Family must include the Conceptual Device Family Specification.
- Proposed modifications must state the Device Family affected, changes envisioned and the benefits the changes would provide. An updated Draft Device Family Specification should be included with the proposal.
- Proposals for the advancement of a Device Family Specification (e.g., when advancing a specification from Draft to Preliminary) must include the completed specification.

The Device Family Committee must evaluate all proposals in a timely fashion and may reject the specification, modify the specification, forward the specification to a technical working group or,

accept the proposed Device Family Specification. The decisions and rationale for all Device Family Committee actions shall be published in the Committee's Meeting Minutes.

6.3.1 Conceptual and Draft Device Family Specifications

Once the Conceptual Device Family is accepted by the Device Family Committee, it is given a document number and published to the HCF membership along with an invitation to participate in developing a Draft Device Family Specification. The resulting participants form an HCF technical working group to oversee development of the specification. The working group must have meetings, discussions and develop the Draft Device Family Specification. Meeting announcements shall be made sufficiently in advance to allow HCF member participation. Meeting minutes shall be published within four weeks after the meeting. Each revised Draft Device Family specification shall be published to allow for HCF member review. Once the Draft Device Family is complete and a consensus achieved, it is forwarded for review by the Device Family Committee.

6.3.2 Preliminary Device Family Specification

Once a Draft Device Family Specification has been accepted by the Device Family Committee, it is elevated to Preliminary status. The Preliminary Device Family specification must be published to allow comment by the HCF membership. The Device Family Committee shall notify the HCF membership that the Preliminary Device Family is ready for incorporation into the Device Family specification and issue a Last-Call for comments. The comment period must last at least 30 days. All comments are reviewed and, if possible, incorporated into the Preliminary Device Family Specification. Serious flaws indicated in the comments may cause the Device Family Committee to reject the specifications return it to Draft status for further revision by the working group.

6.3.3 Final Device Family Specification

If the comments indicate that consensus has been achieved, the Device Family Committee may elevate the Device Family Specification to Final. The Final Device Family Specification shall be published to the HCF membership. Incorporation into HART compatible products should only occur after a Final Device Family is published. The HCF staff must be notified of any products using the Device Family prior to its inclusion into the *Device Families Specification*. These notifications shall be treated as confidential by HCF Staff and any pending changes to the Device Family Specification will be forwarded to affected developers. Once at least two Field Devices and one host application supports a Device Family interoperability should be tested. Any flaws in the Final Device Family Specification shall be forwarded to the Device Family Committee. Upon successful completion of the interoperability testing the Final Device Family specification will be scheduled for incorporation into the next revision of the *Device Families Command Specification*.

6.4 Device Family Modifications

Once a Device Family Specification is incorporated into the Device Families Specification, modifications or enhancements may occasionally be justified. Modifications are classified by the Device Family Committee as functional or non-functional using the following guidelines:

1. Additions to Tables found in the Device Family Specification should be classified as non-functional.

2. Additions to a Device Family command should be classified as a functional change.

3. Additions of new Device Family commands should be classified as a functional change.

4. Once a Final Device Family Specification has been incorporated into the *Device Families Specification*, additional mandatory commands may not be added.

5. Once a Final Device Family Specification has been incorporated into the *Device Families Specification*, new commands and optional commands may only be elevated to "recommended". Device developers are strongly urged to implement "recommended" commands and must implement "mandatory" commands.

A Device Family Specification containing functional changes must return to the Draft level and progress through the entire process defined in this section. Changes determined as non-functional may, at the discretion of the Device Family Committee, be immediately incorporated into the next revision of the *Device Families Specification*.

6.5 The Device Family Committee

The Executive Committee of the HCF shall appoint the Device Family Committee to control changes to this specification. The Device Family Committee shall consist of three members. The member should have a minimum of 5 years work experience with the Physical, Data Link and Application Layer of the Protocol. Since this group is responsible for the proposed Device Family's technical excellence, experience in only one area of the Protocol is not sufficient. The Device Family Committee shall:

- Review all proposed changes to the *Device Families Command Specification*;

- Ensure the *Device Families Command Specification* change procedures are followed;

- Determine Device Family Specification advancement;

- Document Committee actions; and

- Verify that a Device Family Specification adheres to all requirements of the HART Protocol.

The Chair must keep accurate and complete records of all meetings, design decisions and discussions. The Chair is responsible for publishing meeting minutes. All e-mail and other correspondence must be archived and available to the HCF membership. Device Family Committee actions may not be implemented prior to the publication of the meeting minutes documenting the action being published to the HCF membership.

6.6 Appeals

The Device Families Specification control process is designed in such a way that compromises can be made, and genuine consensus achieved while ensuring the interoperability, value and technical excellence of each individual Device Family Specification. However, there are times when even the most reasonable and knowledgeable people are unable to agree. This section specifies the procedures that shall be followed for disputes that cannot be resolved through Working Group actions that normally reach consensus. These disputes must be resolved through open review and discussion.

6.6.1 Working Group Disputes

Any person who disagrees with a Working Group recommendation shall always first discuss the matter with the Working Group chair, who may involve other members of the Working Group (or the Working Group as a whole) in the discussion.

If resolution cannot be achieved in this manner, then any of the parties may request the assistance of the Device Family Committee. The Device Family Committee shall attempt to resolve the dispute.

If the disagreement cannot be resolved with the assistance of the Device Family Committee then the matter may be appealed to the HCF Executive Committee. The Executive Committee shall review the situation and resolve it in a manner of its own choosing. Executive Committee decisions are final.

6.6.2 Device Family Committee Disputes

The Device Family Committee is responsible for controlling changes to the Device Families Specification. Disagreements with Device Family Committee actions must follow the procedures outlined in this section.

If a person disagrees with the action taken by the Device Family Committee, that person should first discuss the issue with the Device Family Committee Chair. If the complaint is not resolved, then the Device Family Committee should re-examine the action taken, along with input from the complainant, and determine whether any further action is needed. The results of this review must be published in the Committee's meeting minutes.

If this does not resolve the dispute then an appeal may be made to the Executive Committee. The Executive Committee shall review the situation and resolve it in a manner of its own choosing. Executive Committee decisions are final.

6.6.3 Appeals Procedure

All appeals must include a detailed and specific description of the issues that are in dispute.

All appeals must be initiated within two months of Meeting Minutes publishing the Working Group or Device Family Committee action or decision being challenged.

At all stages of the appeal process, the Working Group or committee may define the procedures they will follow in making their decision.

7. DEVICE FAMILY REQUIREMENTS

This section defines:

- The required content of an individual Device Family Specification;
- The general process used by a WG for developing the Device Family; and
- The records that must be available from the WG (e.g., meeting minutes).

Requirements for Device Family commands numbering are also included in this section.

7.1 Device Family Specification Content

All Device Family Specifications must use the outline in Table 4.

7.1.1 Device Family Commands

This section defines the requirements for the construction of Device Family commands including the formation and allocation of command numbers; the Device Variable Status command; and as well as general command construction itself. Command Requirements include:

1. Device Families use the HART 16bit extended command numbers. Command numbers must embed the Device Variable Family code in the most significant 8 bits to allow easy decoding of commands in Field Devices (see Figure 1).

2. READ and WRITE commands must be segregated to allow bit 7 to indicate the command type. This simplifies command processing when the device is Write Protected. COMMAND commands are generally placed in the WRITE command partition. All extended command numbers are transmitted MSB first.

3. All commands must include the Device Variable index number as the first Request Data Byte and the first Response Data Byte.

4. Actual command numbers must not be allocated until the Device Family Specification is promoted to Final.

5. The first command for any Device Family must be the "More Device Family Status" command for that Device Family. This is the command with the LSB 8bits of the extended command number set to zero (0x00). The first data byte after the Device Variable index number in this command must be the Device Family Status Byte (see the *Command Summary Specification*). This command is always a mandatory Device Family command.

Table 4. Device Family Specification Outline

	Section	Content
1	**Scope**	This section defines the Device Family and what features of the corresponding class of process connections are covered.
2	**References**	References to other applicable documents. Generally, these may include industry related documents or other standards.
3	**Definitions, Acronyms and Symbols**	Any terms that are used in the Device Family specification are defined. Diagrams are provided to clarify definitions and reduce ambiguity.
4	**Overview**	The Overview adds to the scope statement to provide context for the command definitions that follow. The intended operation of the Device Family is described here. Diagrams should be included to clarify the intent of the Device Family. Design decisions should be documented and Device Family Standard Operating Procedures (if any) must be defined in this section. The rational for the division between mandatory and optional Device Family properties should be included. If more then one Device Variable (i.e., process connections) is required, then the relationship between the Device Variables must be documented in this section.
5	**Status**	The Status section defines the Device Family-specific status information including the status information in the Device Variable Status byte.
6	**Commands**	All mandatory and optional commands are documented in this section. Each command definition must indicate whether its support is mandatory or optional.
7	**Tables**	Any new Common Tables required by the Device Family are specified here.

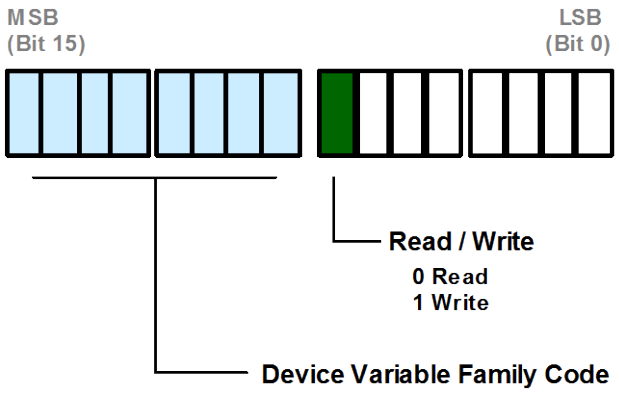

Figure 1. Device Families Command Number Format

7.2 Developing a New Device Family

A new Device Family begins with a concept. The concept may be formulated by any HCF member company or the HCF staff. Any Device Family concept must include a precise definition of the scope for the new Device Family and must include a description of the Device Family itself. Existing Device Families should be reviewed to minimize redundancy and ensure that interoperability is actually advanced. Once the concept is complete, it can be presented to the Device Family Committee. After a Device Family Concept is accepted by the Device Family Committee and the HCF membership is canvassed, a Technical Working Group will be formed to develop the Device Family Specification.

The WG developing a Device Family must reach consensus before the Device Family Specification can be promoted. The general process for developing the Device Family Specification is as follows:

1. Applicable industry standards and other Device Families should be reviewed. Frequently these sources may help in standardizing terminology and concepts. Sources applicable to the Device Family will be included the References section of the Device Family Specification.

2. Properties of the family must be defined. Properties must not change without operator intervention. If they do, then the data item may be a Device Variable and not a property.

3. For each Device Family, The WG must determine which data items to classify as a Device Variable. A Device Family may use one or more Device Variables. Device Variables are data items that vary as the process changes (see the *Command Summary Specification*). However, not all data items that vary as the process changes should be Device Variables. The WG might choose to not classify a data item as a Device Variable if it is not useful to a control or SCADA system (i.e., the data item is only useful for diagnostics).

4. The status information applicable to a Device Family must be determined by the WG (see Section 7.2.1).

5. All enumerations must have associated Tables developed by the WG. These Tables will be incorporated into either the *Common Tables Specification* or the *Device Families Command Specification*. In general, one byte enumerated tables reserve codes 240-249 for use as manufacturer specific enumerations. The WG must determine whether this is appropriate for their Device Family.

6. A Device Family may have a single Extended Unit Code Table associated with it (see the *Common Tables Specification*). If the Device Family uses an Extended Unit Code Table, that must be documented in the Device Family Specification.

7. Classify the properties as optional or mandatory. The more mandatory properties the WG can agree on the better the interoperability. In other words, the WG must agree on as many mandatory properties as possible while balancing the resources mandatory properties require of Field Devices to support the Device Family.

   Note: To simplify Host development all mandatory commands and data items for a Device Family must be identified solely by the Device Family Code (e.g., returned in Command 54)

8. Group the properties into READ commands to optimize upload speeds.

9. Define WRITE commands. WRITE commands are frequently optional and usually contain a single properties. Remember that all floating point numbers must have an associated implicit or explicit unit code.

10. Draft the Device Family Specification. The resulting document must include the Device Variables, commands, properties and associated Standard Operating Procedures (SOPs).

The multiple nationalities participating in the HCF, the languages they speak and even the jargon used inside different corporate cultures, complicates the identification of Device Family properties. Terms and jargon used by the WG must be standardized. A block diagram should be developed and used for reference by the WG. The diagram should also be included in the Device Family specification.

7.2.1 Device Family Status

One of the most important benefits of developing a Device Family is the standardization of status information. Device Family status can be returned two ways: (1) in the least significant bits of the Device Variable Status Byte (see the *Command Summary Specification*); and (2) in the first command of the Device Family.

Device Family status may consist of both status bits and enumerations as well as operating mode information. This status information must be returned in the first command for the Device Family. The first command in a Device Family has the LSB of the extended command number set to zero similar to Command 48, More Status Available. The difference is that this command is controlled and completely specified in the Device Family Specification. This higher degree of interoperability makes the status information useful to a wide range of host devices. The Device Family Status command must always be a mandatory command.

In addition, three bits are available for each Device Family in the Device Variable Status Byte. The WG must identify the most important status information for inclusion in these 3 bits. The WG should not immediately define all 3 bits. Some bits should be reserved for later additions (if possible). The Table for the Device Variable Status Byte must be developed for inclusion in the *Common Tables Specification*.

7.3 Device Family WG Responsibilities

Device Family development must be an open and fair process. As a result, the WG Chair must keep accurate and complete records of all meetings, design decisions and discussions. All E-Mail and other correspondence must be archived and available to the HCF membership. The WG Chair is responsible for publishing meeting minutes and each revision of the Device Family Specification (see Section 6).

ANNEX A. REVISION HISTORY

A1. Changes from Revision 1.0 to 1.1

The document titled Temperature Device Family Specification, HCF_SPEC-160.4, Rev. 1.0 was modified and a new revision, 2.0, created. Consequently, modifications were made to Table 2 of this document.

The document titled Level Device Family Specification, HCF_SPEC-160.11, Preliminary was modified and a new revision, 1.0, created. Consequently, modifications were made to Table 2 of this document.

A2. Revision 1.0

Initial Revision.