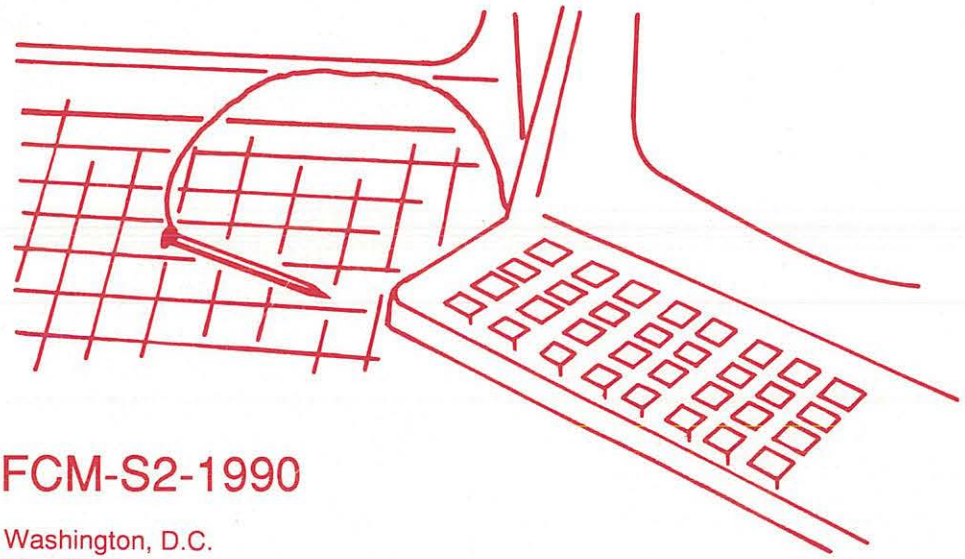
U.S. DEPARTMENT OF COMMERCE / National Oceanic and Atmospheric Administration

OFCM

OFFICE OF THE FEDERAL COORDINATOR FOR
METEOROLOGICAL SERVICES AND SUPPORTING RESEARCH

Standard Formats for Weather Data Exchange Among Automated Weather Information Systems



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FEDERAL COORDINATOR
FOR
METEOROLOGICAL SERVICES AND SUPPORTING RESEARCH

11426 Rockville Pike, Suite 300
Rockville, Maryland 20852

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CHANGE AND REVIEW LOG

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FOREWORD

The Office of the Federal Coordinator for Meteorological Services and Supporting Research (OFCM), through its infrastructure of committees and working groups under the Interdepartmental Committee for Meteorological Services and Supporting Research (ICMSSR), prepares standard data formats for weather information and protocols of communications to improve the exchange of information among the Federal agencies and for efficient applications by the users.

This document presents an update of standard data formats. It simplifies the treatment of multiple groups of mixed formatted binary data blocks, includes the formatting and use of meteorological data from satellites, and expands the graphics capability for users.

The efforts of the members of the Working Group for Communication Interfaces and Data Exchange (WG/CIDE) in preparing this update are gratefully acknowledged.

Robert L. Carnahan
Federal Coordinator for
Meteorological Services
and Supporting Research

Standard Formats for Weather Data Exchange
Among
Automated Weather Information Systems

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CHAPTER 1

INTRODUCTION

1.1. Purpose. This Weather Data Exchange Format Document presents a common set of formats to be used for the presentation of weather data among Federal agencies. The document includes formats which meet current and planned requirements of the National Weather Service (NWS), United States Air Force (USAF), United States Navy (USN), and Federal Aviation Administration (FAA). WMO Sponsored international codes (for example, GRIB, GRID, and BUFR) are not addressed in this document

A potential user should not attempt to apply specific formats without: (1) a thorough knowledge of the format contents, (2) an understanding of the product data set format syntax necessary to organize the data, and (3) an understanding of general techniques as applied to automated computer graphics. Reference to Appendix F during the reading of this document will greatly aid the user in understanding the formats.

1.2. Objective. The objectives of this standard formats document are:

A. To provide a level of data structuring above the telecommunications that is not dependent on the networking and data link procedures.

B. To provide a format that will support existing products and message data, both graphic and nongraphic.

C. To provide a device independent format that will allow for expansion to handle new data structures or graphics devices without having to redefine the general structure of the format.

D. To provide a format that will be convenient for the host processor to generate and for the receiving hardware to process.

E. To provide a format that readily allows receivers to bypass data formats not usable or necessary at the receiving station.

F. To provide a format which is byte oriented with 8 bits per byte (octets).

1.3. Scope. This document specifies the format structure for data transfer, identifies categories of products covered by the formats and defines the formats for each data category to the

byte level. Telecommunications protocols are not covered in this document.

1.4. Essential Principles. In order to facilitate automated processing by computer at the sites being serviced by this format, the following principles must apply:

A. The defined meaning and size of an element must remain absolutely constant, regardless of the mode/submode block (see Section 2.2, Block Format) in which it appears. Elements which are common to more than one mode/submode block must appear in those blocks as defined:

1. In their defined order.
2. In their defined format.
3. Having constancy of meaning regardless of block type.

B. The defined field size (in either bits or bytes) for an element must remain constant throughout the code.

C. Redundancy and duplication shall be avoided. This especially applies to defining "new" elements or new block types (mode/submode) which are nearly a duplication of an existing element or block type. For example: Rather than defining a new grid type code, the existing codes should be used by adding to its definition.

D. Formats shall be "self-contained" as far as technically feasible. That is, they should carry within the code all that is necessary to decode and use the information without reference to assumed or previously understood rules not contained in this publication.

E. Format elements must always be general rather than device specific or machine specific. For example, a number that must be represented in floating point format as an element should have field lengths which conform easily to byte and/or byte pair boundaries. The format of such elements should fall naturally into the structure of the block which holds them.

1.4.1. Guidelines. In order to maintain fidelity with Objective A, Section 1.2 with respect to "data structuring above the telecommunications level," it is important to adhere to the following guidelines:

A. Elements included in this document are present for the purpose of non-telecommunication processing. These

data are the innermost part of an envelope whose outer parts are concerned with telecommunications processing.

B. Changes or enhancements to the telecommunications sections of the product transmission are completely independent of changes to the formats contained herein. Conversely, changes to these formats should not impact in any way the telecommunications format.

CHAPTER 2

GENERAL FORMAT DEFINITION

2.1. Format Structure. The format structure is constructed with information blocks. Information blocks provide control information and contain data. Figure 2-1 displays the general format of information blocks. A specific grouping of these blocks is used to create a product (see Section 2.1.2.1) and is considered a product data set.

2.1.1. Information Blocks Definition. An information block is a series of bytes identifying, controlling, or containing information used to create products. These blocks are characterized as control blocks, product definition blocks, data description blocks and data blocks.

2.1.1.1. Control Blocks. The control blocks are Product Identification, End of Product and parameter control blocks. The Product Identification Block is a standard block used for all products. Its purpose is to convey the information needed to uniquely identify each product so that appropriate processing routines may be initiated by the receiving system. The End of Product block is a standard block that signifies the end of the product data set. Other control blocks (see Chapter 4) provide product data set wide control of parameters in the data blocks.

2.1.1.2. Product Definition Block. The Product Definition block shall contain all information required to define the nature of the product being transferred (product area, scale, orientation, etc.).

2.1.1.3. Data Description Block. The Data Description block shall contain all information required to describe the contents of the data block(s) that follow (number and type of elements, element arrangement, units, etc.). The data description block shall be used when additional information about the structure and content of the data block(s) is required.

2.1.1.4. Data Block. The Data Block(s) shall contain the data in the format, units, etc., specified by the data description block, if not inherent in the data block itself.

2.1.2. Blocking Conventions. Multiple information blocks are used to create a product.

2.1.2.1. Product Data Set Structure. The product data set components shall be: a Product Identification block; a Product Definition block; one or more sets of control, data description, and data blocks; and each product data set shall be

terminated by an End of Product block. Figure 2-2 displays the general Product Data Set Structure.

2.1.2.2. Block Sequencing. The Product Identification block shall always be the first block in the product data set. The Product Definition Block, when required (see Section 3.4.1) shall immediately follow the Product Identification Block. Define Plot Parameters and Define Data Width/Field Width blocks may be interspersed with the data blocks and may appear anywhere in the product data set after the Product Identification block but before the data to which it applies. Multiple sets of Data Description blocks (when used), followed by one or more Data Blocks, may be used as required by the product originator to define all components of the product.

2.2. Block Format. Each block may contain the following fields: a LENGTH field, the MODE and SUBMODE fields, the DATA field, and a CHECKSUM field. These fields are defined in the notes following Figure 2-1. The LENGTH and CHECKSUM fields provide internal block information. The MODE and SUBMODE fields indicate the general content of the DATA field in the block.

2.2.1. Block Termination. The LENGTH field, if used, identifies the end of the block by providing a count of all byte pairs contained in the block. If the LENGTH field is not used, termination of a block can be accomplished by setting the most significant bit of the last byte in the data field. The originator must be able to guarantee that all other bytes in the data field have a zero in the most significant bit; otherwise, the LENGTH field will be necessary. In the case of text data, ETX plus ETB, or NULL, shall be used to end a block. (See Section 2.2.3.2.B.)

2.2.2. Block Size. Block length shall be variable but shall not exceed 4096 bytes, including the LENGTH and CHECKSUM fields when used. Multiple data blocks shall be used as required by the product originator to conform to the block length restriction and enhance circuit efficiency.

2.2.3. Block Format Conventions. The following general format conventions shall be observed within all blocks:

A. Bit numbering shall be right to left, starting with zero (the least significant bit).

B. Byte numbering shall be left to right, starting with byte zero.

C. All fields in the blocks shall be in one or more bytes unless otherwise specified in the block format or the data description block.

D. All block formats shall be arranged into two byte pairs with the bytes ordered left to right.

E. The LENGTH and CHECKSUM fields shall be used as required by the product originator. The presence or absence of the LENGTH and CHECKSUM fields shall be indicated by the flag in the LENGTH field. If the LENGTH and CHECKSUM fields are not used, the two left-most bits in byte zero of the block (i.e., the two most significant bits of the MODE byte) become the flag bits.

2.2.3.1. Graphic Display Information. The data contained in blocks which are display-oriented shall observe the following conventions:

A. All negative binary data shall be in two's complement form.

B. Binary data shall be right justified and zero filled.

C. All data is represented in octal notation unless otherwise noted.

2.2.3.2. Text Information. The data contained in text blocks (e.g. displayable messages) shall observe the following conventions:

A. All text data shall be seven (7) bit ASCII (ANSI X3.4-1977). Parity, if used, is transparent to these formats, except when the uppermost bit of the last data byte is being used to identify the last byte for recognition of block termination. (See Section 2.2.1.)

B. Text data shall be left justified within a field and blank filled. When using the text code form, one of two options will be used to terminate the text strings. The first option is to use the null (0) byte as the only termination for all text strings. In this case the characters ETX, ETB, and RS will not be used. The second option will use the RS character to separate records within a text data block. The control character ETB will be used at the end of blocks which are not the final block of a product data set. The character ETX will be the final character of an ASCII block which is the final block in a product data set. The most significant bit of the final byte (ETB or ETX) in the block may also be used for termination of a block when the previous bytes contain zeros in the most significant bit.

2.3. Coordinate System Conventions. Many of the products transmitted in the formats specified in this document use one of three coordinate systems to register and locate features at their proper position on a map or background. Once the coordinate system is selected, that system is then used for all subsequent coordinate references. The user needs to have a thorough understanding of the particular coordinate system being used and the implication that system has on proper data interpretation. The coordinate system in use for a product is indicated by a COORDINATE FLAG code found in the Product Definition Block. The three coordinate systems which can be used are:

Latitude/Longitude
Cartesian
Pixel.

The choice of coordinate systems affects interpretation of the following product registration information (applicable mode/submodes appear in parenthesis):

Reference M,N Coordinates	(4/20, 7/20)
M,N Maximum	(4/30)
M,N Center	(4/30)
M,N Coordinates	(4/1, 4/2, 4/3, 4/4, 4/5, 4/6, 4/7, 4/10, 5/1, 5/2, 5/3)
Delta M,N	(4/2, 4/5, 5/1)
ISTART, JSTART	(7/20)
IPOLE, JPOLE	(7/20)

The explicit meaning of the coordinate flag remains in effect until changed by a new coordinate flag presented in a new Product Definition Block within the product data set in question.

2.3.1. Latitude/Longitude Coordinate System (Coordinate Flag = 0). With this system, all product registration data use latitude and longitude to position features. All grid coordinate references appear in standard latitude and longitude on earth.

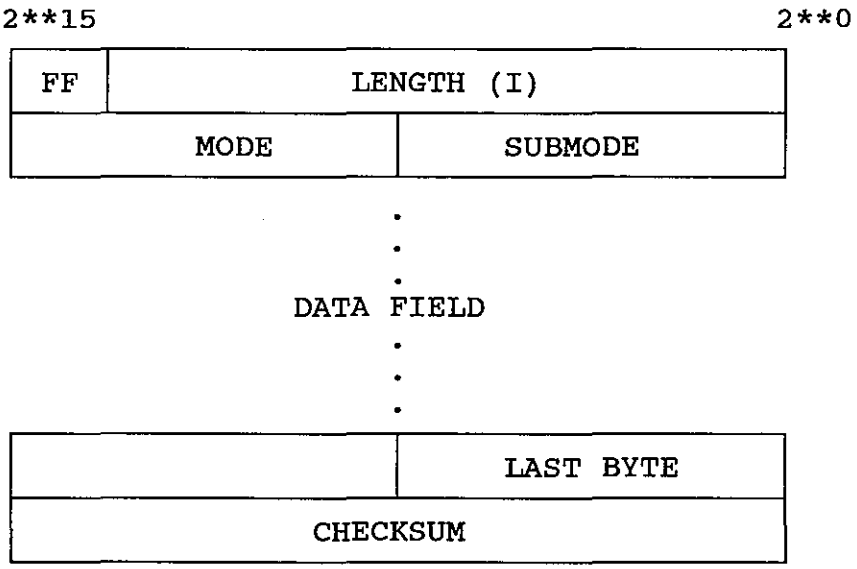
2.3.2. Cartesian Coordinate System (Coordinate Flag = 1). Many of the numerical models used in meteorology use some form of Cartesian coordinate grid system for mathematical manipulations. Because of this, it is convenient to output products with data registered to these Cartesian grid points. The array of points themselves are created projecting the earth onto a flat plane, selecting a coordinate system origin, and defining an array of uniformly spaced points. The agencies involved in producing the products described in this document each have their own unique Cartesian coordinate grid systems but they are related. Mathematical equations can be used to convert from one system to

the other but the user must have basic knowledge concerning the grid system of the source. This information includes:

Projection
Grid density
Indexing conventions
Origin point
Location of pole (in Cartesian coordinates)
Standard longitude
U,V-Wind component conventions.

Knowing these, the user can properly interpret the coordinate information imbedded in the product.

2.3.3. Pixel Coordinate System (Coordinate Flag = 2). In some cases, it is convenient to send product coordinate information relative to a logical display reference system, called pixel in this case. The origin (0,0) of the logical display space is the lower left corner and the indexing convention follows the right hand rule. Products are described relative to this logical display space in terms of horizontal (I-direction or X-direction) and vertical (J-direction or Y-direction) displacement from the origin. This pixel grid coordinate system can be translated by the user into whatever system needed for product manipulation and display.



NOTES:

1. FF . Flag: The Flag field is a two-bit LENGTH/CHECKSUM indicator. Possible combinations of these two bits are:

Flag Bits	*LENGTH field*	*CHECKSUM field*
00	*YES*	*YES*
01	*YES*	*NO*
11	*NO*	*NO*

If the most significant Flag bit is one (1), the least significant six bits of the left-hand byte will contain the Mode. The Flag bit combination 10 is not used as an indicator since there will never be a CHECKSUM field if the LENGTH field is not present. Blocks that contain non-text data shall always have a LENGTH field.

2. LENGTH: The LENGTH is the total number of two byte pairs in the current block, including the bytes containing the LENGTH and CHECKSUM fields if present.

3. The notation (I) indicates an unsigned integer quantity, e.g., LENGTH (I) indicates the LENGTH is an integer number.

4. MODE: The MODE indicator byte is contained in all transmission blocks and tells to the receiver the type of block being transferred. Note that the most significant bit will be a one (1) if LENGTH and CHECKSUM fields are not present.

Figure 2-1. General Block Format; Mode X, Submode Y

NOTES: Figure 2-1 (Cont.)

5. SUBMODE: The SUBMODE is used to group each MODE into its logical subdivisions for the purpose of clarity in defining a block of data within a transmission mode.

6. DATA FIELD: The DATA FIELD bytes contain information about the data and/or the data itself. Each block (i.e., MODE and SUBMODE combination) has information defined in this field for specific applications. The DATA FIELD will end on a two byte boundary, with binary data being zero filled and alphanumeric data being blank filled if necessary.

7. CHECKSUM: The CHECKSUM is a two's complement 16 bit field containing the arithmetic sum of all 16 bit byte pairs in the block with no end around carry. Adding all the byte pairs in a Mode/Submode that contains a CHECKSUM field will produce a sum equal to zero.

Decimal	Hex Print		
5	0005	00	5
769	0301	MODE	SUBMODE
86	0056	YEAR	
54	0036	SERIAL DAY	
914	FC6E	CHECKSUM	

CHECKSUM = -914_{10} = $FC6E_{16}$

Figure 2-1. (Cont.) General Block Format; Mode X, Submode Y

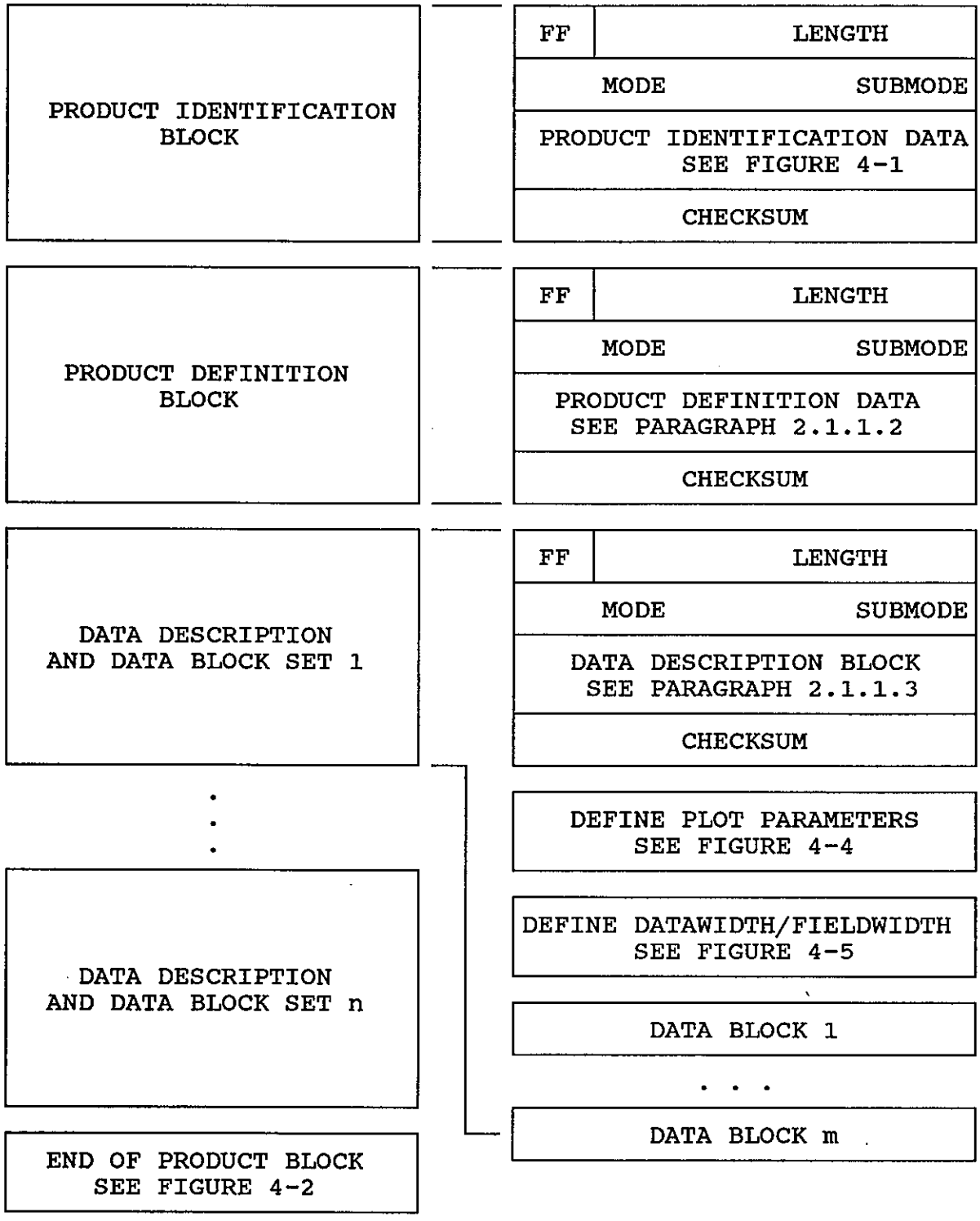


Figure 2-2. General Product Data Set Structure

CHAPTER 3

PRODUCT CONTENT

3.1. Data Categories. The formats contain information blocks of two basic types: 1) product data set control and 2) product data.

3.1.1. Product Data Set Control. The product data set control information includes the blocks for beginning and ending the product data set, for defining parameter values and fields within the product data set, and which contain other product related information. Also, user specific internal system data control is provided for.

3.1.2. Product Data. The product data can be specified by the following categories:

A. Formatted Binary
B. Vector Graphic
C. Alphanumeric
D. Raster Scan
E. Gridded

3.1.2.1. Formatted Binary Data. Formatted binary data consists of machine-readable decoded weather observation/forecast data.

3.1.2.2. Vector Graphic Data. Vector graphic data shall be used to describe weather maps/charts. Vector graphic data includes vectors, graphic symbols and geographic background.

3.1.2.3. Alphanumeric Data. Alphanumeric (A/N) data shall be used for man-readable messages consisting of A/N character strings and labels for display products.

3.1.2.4. Raster Scan Data. Raster scan data shall be pixel data describing visual imagery such as satellite pictures, radar pictures, gray level imagery or facsimile images. This data may be in either packed or unpacked form.

3.1.2.5. Gridded Data. Gridded data shall consist of sets of machine readable weather data located at a regular array of grid points.

3.2. Mode/Submode Designations. All format blocks are identified by mode and submode values. These values are represented in octal notation. The key to general mode/submode assignments is found in Table 3.1. In general, mode numbers

represent data categories and submode numbers represent the specific product definition, data description and data blocks within a data category. Currently defined modes and submodes are shown in Tables 3.2 and 3.3; however, new mode/submode combinations shall be added based on agency needs and committee agreement.

3.2.1. Mode Designations. The data categories in Section 3.1.2 are identified by mode numbers. Mode 1 contains control blocks, Mode 2 is for individual user internal system applications, and Modes 3 through 7 are for the product data. See Table 3.2.

3.2.2. Submode Designations. Table 3.3 presents a listing of the submodes within each mode and gives a reference to corresponding figures.

3.3. Product Format. A product data set is formed to create a product. A complete product shall consist of all information required to describe a bounded group of related data. A product data set contains the product identification, definition, data description and data blocks (the format specified in Chapter 2) as necessary to create the desired product. The product definition block identifies the type of product (e.g., alphanumeric message, graphic display, or satellite image, etc.). Data descriptions and data blocks from any data category may be included in a single product data set if that data is needed for the product (e.g., alphanumeric labels applied to a graphic product). A representative example of a vector graphic product is found in Appendix F, Example No. 1.

3.4. Mode/Submode Combinations. As a rule, the mode/submode designations for a product data category will not be mixed with designations for a different product data category. For example, vector graphic data and gridded data will not appear in the data set defining one product.

3.4.1. Required and Optional Blocks. The following shows the required and optional blocks for each of the product data categories.

3.4.1.1. Systems Data Category

A. Required Blocks

Mode 1/Submode 1
Mode 2/User defined Submode
Mode 1/Submode 2

B. Optional Blocks

Mode 1/Submode 3

3.4.1.2. Formatted Binary Product Data Category

A. Required Blocks

Mode 1/Submode 1
Mode 3/Submode 1
Mode 1/Submode 2

B. Optional Blocks

Mode 1/Submode 3
Mode 1/Submode 6
Mode 3/Submode 20
Mode 3/Submode 21
Mode 3/Submode 22
Mode 3/Submode 23
Mode 3/Submode 30

C. Note: Mode 3/Submode 21 or Mode 3/Submode 22 is required if the format of the data presented in Mode 3/Submode 1 has not been specified external to the product by mutual agreement of the exchanging agencies controlling the weather information systems involved in the data exchange.

3.4.1.3. Vector Graphic Product Data Category

A. Required Blocks

Mode 1/Submode 1
Mode 1/Submode 2
One of the following:
    Mode 4/Submode 20
    Mode 4/Submode 30
One or more of any selected one of the following:
    Mode 4/Submode 1
    Mode 4/Submode 2
    Mode 4/Submode 3
    Mode 4/Submode 5
    Mode 4/Submode 6

B. Optional Blocks

Mode 1/Submode 3
Mode 1/Submode 4
Mode 1/Submode 6
Mode 1/Submode 7
Mode 4/Submode 4
Mode 4/Submode 7
Mode 4/Submode 10

Mode 5/Submode 1
Mode 5/Submode 2
Mode 5/Submode 3

3.4.1.4. Alphanumeric Product Data Category

A. Required Blocks

Mode 1/Submode 1
Mode 5/Submode 4
Mode 1/Submode 2

B. Optional Blocks

Mode 1/Submode 3
Mode 5/Submode 20

3.4.1.5. Raster Product Data Category

A. Required Blocks
Mode 1/Submode 1
One or both of the following:
Mode 6/Submode 20
Mode 6/Submode 30
Mode 6/Submode 1
Mode 1/Submode 2

B. Optional Blocks

Mode 1/Submode 3
Mode 1/Submode 5

C. Note: Mode 1/Submode 5 is required if the data presented in Mode 6/Submode 1 has not been specified external to the product as a default datawidth and fieldwidth by mutual agreement of the exchanging agencies controlling the weather information systems involved in the data exchange.

3.4.1.6. Gridded (Packed) Product Data Category

A. Required Blocks

Mode 1/Submode 1
Mode 7/Submode 20
Mode 7/Submode 1
Mode 1/Submode 2

B. Optional Blocks

Mode 1/Submode 3
Mode 1/Submode 5
Mode 1/Submode 6

C. Note: Mode 1/Submode 5 is required if the data presented in Mode 7/Submode 1 has not been specified external to the product as a default datawidth and fieldwidth by mutual agreement of the exchanging agencies controlling the weather information systems involved in the data exchange.

3.4.1.7. Gridded (Unpacked) Product Data Category

A. Required Blocks

Mode 1/Submode 1
Mode 7/Submode 20
Mode 3/Submode 1
Mode 1/Submode 2

B. Optional Blocks

Mode 1/Submode 3
Mode 1/Submode 6
Mode 3/Submode 21

3.4.2. Allowable Mode/Submode Combinations. Table 3.4 summarizes the allowable combinations of defined modes and submodes for the various mode designations.

Table 3-1 Key to Mode/Submode Designations

Number (Octal)		Type of Information
Modes	*001-002*	*Product Control/Internal System Data*
Submodes	*001-007*	*Control or Data Blocks*
Modes	*003-077*	*Product Type (only 3-7 are currently assigned)*
Submodes	*001-017*	*Data Blocks (DB)*
	020, 030, ..., 070	*Product Definition Blocks (PDB)*
	021-027, 031-037, ..., 071-077	*Data Description Blocks (DDB) associated with PDB, (e.g., 21-27 => 20)*
	100-377	*Unassigned, to be designated if the assigned ranges are exhausted.*

Table 3-2. Assigned Mode Designations

Mode (Octal)	*Definition*
001	*Product Data Set Control*
002	*Systems Data*
003	*Formatted Binary**
004	*Vector Graphic*
005	*Alphanumeric*
006	*Raster Scan*
007	*Gridded**

**Note: Packed gridded data is accommodated under Mode 7, unpacked gridded data is accommodated under Mode 3.*

Table 3-3. Assigned Submode Designations

Description	*Submode (Octal)*	*Figure No.*
Mode 1 Product Data Set Control		
Product Identification Block	*1*	*4-1*
End of Product Block	*2*	*4-2*
Classification Block	*3*	*4-3*
Define Plot Parameters Block	*4*	*4-4*
Define Datawidth/Fieldwidth Block	*5*	*4-5*
Product Information Block	*6*	*4-6*
Line Information Block	*7*	*4-7*
Mode 2 Systems Data		
Binary Data Blocks	*User Definable*	*5-1*
Mode 3 Formatted Binary		
Formatted Binary Product Definition Block	*20*	*6-1*
Formatted Binary Data Description Block, Option 1	*21*	*6-2*
Formatted Binary Data Description Block, Option 2	*22*	*6-3*
Formatted Binary Data Block	*1*	*6-4*
Formatted Binary Sequence Block	*23*	*6-5*
Satellite Product definition Block	*30*	*6-6*
Mode 4 Vector Graphic		
Graphics Product Definition Block	*20*	*7-1*
Define Graphics Parameters Block	*30*	*7-2*
Absolute Vectors	*1*	*7-3*
Relative Vectors	*2*	*7-4*
CPC Vectors Block	*3*	*7-5*
Variable Exception Vectors (VEV) Block	*4*	*7-6*
Long/Short Relative Vectors Block	*5*	*7-7*
Point/Slope Vectors Block	*6*	*7-8*
Wind Barbs Vectors Block	*7*	*7-9*
Vector (Arrow) Plot Block	*10*	*7-10*

Table 3-3. (Cont.) Assigned Submode Designations

Description	Submode (Octal)	Figure No.
Mode 5 Alphanumeric		
Alphanumeric Product Definition Block	*20*	*8-1*
Alphanumeric Character Block	*1*	*8-2*
Data Plot Block	*2*	*8-3*
Wind Barbs Data Block	*3*	*8-4*
Alphanumeric Data Block	*4*	*8-5*
Mode 6 Raster Scan		
Satellite Product Definition Block	*20*	*9-1*
Pixel Product Definition Block	*30*	*9-2*
Raster Scan Data Block	*1*	*9-3*
Mode 7 Gridded		
Gridded Product Definition Block	*20*	*10-1*
*Band Index Data Block**	*1*	*10-2*

**Packed gridded products. See Chapter 10.*

Table 3-4. Allowable Mode/Submode Combinations

Mode / Submode	Product Data Category					
	Systems	Formatted Binary	Vector Graphic	A/N	Raster	Gridded
Product Data Set Control						
1/1	r	r	r	r	r	r
1/2	r	r	r	r	r	r
1/3	o	o	o	o	o	o
1/4					o	
1/5					o	o (1)
1/6		o	o			o
1/7			o			
Systems Data						
2/User Defined	r					
Formatted Binary						
3/1		r				r (2)
3/20		o				
3/21		o				o (2)
3/22		o (4)				
3/23		o				
3/30		o				
Vector Graphic						
4/1			r (3)			
4/2			r (3)			
4/3			r (3)			
4/4			o			
4/5			r (3)			
4/6			r (3)			
4/7			o			
4/10			o			
4/20			r (3)			
4/30			r (3)			

Table 3-4. (Cont.) Allowable Mode/Submode Combinations

Mode Submode	Product Data Category				
	Systems	Formatted Binary	Vector Graphic	A/N Raster	Gridded
Alphanumeric					
5/1			*o*		
5/2			*o*		
5/3			*o*		
5/4				*r*	
5/20				*o*	
Raster Scan					
6/1				*r*	
6/20				*r (5)*	
6/30				*r (5)*	
Gridded (Packed)					
7/1					*r (1)*
7/20					*r*
Gridded (Unpacked)					
3/1					*r (2)*
7/20					*r*
3/21					*o (2)*

NOTES:

r - Mode/submode is required

o - Mode/submode is optional

(1) - Used in packed gridded products.

(2) - Used in unpacked gridded products.

(3) - Only one of these mode/submodes will be used.

(4) - Used in formatted mixed products.

(5) - For a non-satellite image, only 6/30 shall be used. For a satellite image, either 6/20 or 6/30 or both shall be used.

CHAPTER 4

CONTROL BLOCKS

4.1. Product Identification Block. This block is required for all data types and shall be formatted as shown in Figure 4-1. The data field shall identify the origin of the product, the classification, retention time, product identifier, and file time. These fields shall be as defined in Figure 4-1 except as otherwise noted below or under individual data type format discussions.

4.2. End of Product Block. The End of Product Block format is shown in Figure 4-2. This block shall be standard for all data types.

4.3. Classification Block. The Classification Block format is shown in Figure 4-3. This block shall be used if additional information regarding the classification of the product data set (other than that information provided in the CLASSIFICATION byte of the Product Identification Block - Figure 4-1) is required.

4.4. Define Plot Parameters Block. This block shall be formatted as shown in Figure 4-4. When used, the fields required will be filled and all other fields will be either zero or blank filled, unless the length is used to foreshorten the block when the latter fields are not needed. IF LENGTH is not used, the full format is required. The Define Plot Parameters Block may be used prior to any data block to indicate the settings of display parameters. Once set, the parameters remain in that state until superseded by another Define Plot Parameters Block.

4.5. Define Datawidth/Fieldwidth Block. The Define Datawidth/Fieldwidth Block shall be formatted as shown in Figure 4-5. It may be used to redefine the number of bits allocated to (field width) and used by (data width) each data element in the specified mode/submode. The following rules shall apply to the use of this block:

A. Redefined Datawidth/Fieldwidth values shall not apply to the LENGTH, MODE, SUBMODE, CHECKSUM, or other informational elements in the specified Mode/Submode, i.e., redefined values apply only to the data itself.

B. Redefined values shall remain in effect for all subsequent blocks with the specified Mode/Submode until reset by another Define Datawidth/Fieldwidth Block or End of Product Block, whichever comes first in the product data set sequence.

C. The Define Datawidth/Fieldwidth Block may be inserted anywhere in the product data set but applies only to the blocks that immediately follow it in the product data set sequence.

D. Each block may be used to redefine values for one Mode/Submode. Additional blocks may be used, as required, to redefine values for additional mode/submode blocks. However, these blocks must be inserted immediately before the Mode/Submode to which the redefined Fieldwidth and Datawidth apply.

4.6. Product Information Block. The Product Information Block shall be formatted as shown in Figure 4-6. Use of this block allows entry of the product base date and time, and also the identifier program of the model which was used to generate the product. With appropriate use of the LENGTH, the Base Date/Time may appear alone in the block. This block is intended to appear only once within any product.

4.7. Line Information Block. The Line Information Block shall be formatted as shown in Figure 4-7. It is intended to be used optionally preceding any type of vector block. When the Line Information Block is present, it assigns a labeling value to the displayable line. This block must immediately precede the vector block which it describes. The definition it established remains in effect only for the vector block which immediately follows it.

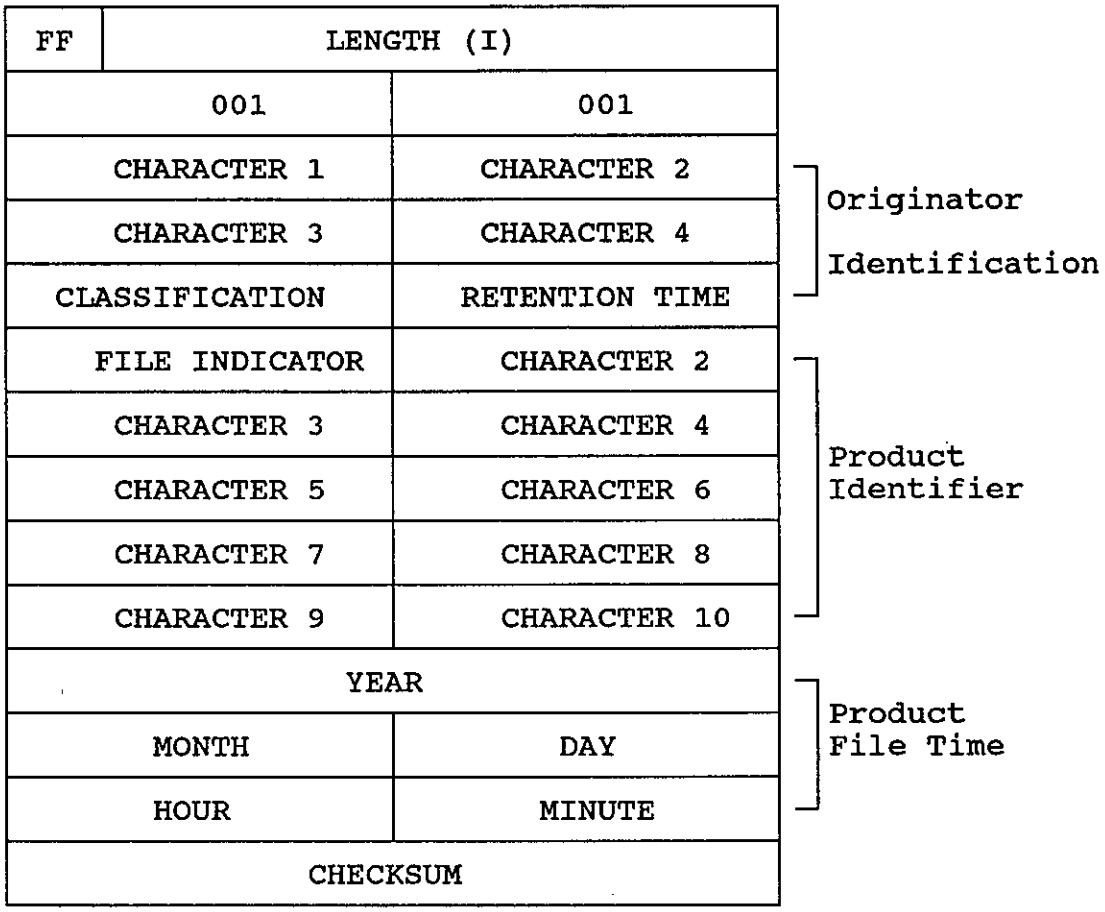


Figure 4-1. Product Identification Block; Mode 1, Submode 1

NOTES: Figure 4-1: Product Identification Block; Mode 1, Submode 1

1. Originator Identification: A four character identifier of the facility that generates or compiles the product.

2. CLASSIFICATION: The classification code is a single ASCII character defining the classification for this product as follows:

U = Unclassified
C = Confidential
S = Secret
T = Top Secret
E = Encrypt for Transmission Only (EFTO)

If additional information is required, a classification Block shall be used. (Section 4.3.)

3. RETENTION TIME: The RETENTION TIME is the default time, in days, the system shall use to retain the product before purging it. This byte will contain 377 (octal) or all binary zeros when this value is not furnished.

4. Product Identifier: The FILE INDICATOR byte plus the succeeding nine ASCII character bytes contain the Product Identifier. The FILE INDICATOR byte (an 8 bit binary value) specifies the naming convention used to identify the product. The Product Identifier is defined as follows:

Characters/ bytes	*Definition*
1	*File Indicator determines originating agency. See Appendix D, Table D-1.*
2-5	*Catalog Number (See Appendix D, Table D-2).*
6-8	*Three character number representing the time in hours from product generation time.*
9-10	*Two ASCII characters defined for products that are transmitted with out a background. Interagency common background descriptions are used. See Appendix C, Table C2-1.)*

5. Product File Time: The Product File Time shall consist of a full century year (16 bit integer), month, day, hour, and minute (8 bit integers). It represents a means of further identifying products with identical Product Identifiers. Unless otherwise specified, this time shall be the date/time the product was generated.

FF	LENGTH (I)
001	002
CHECKSUM	

Figure 4-2. End of Product Block; Mode 1, Submode 2

FF	LENGTH (I)
001	003
CHARACTER 1	CHARACTER 2
CHARACTER 3	CHARACTER 4
.	.
.	.
.	.
	LAST CHARACTER
CHECKSUM	

NOTES: Figure 4-3

1. CHARACTER: The information in ASCII code.

2. This block follows the rules for non-graphic blocks. See Section 2.2.3.2.

Figure 4-3. Classification Block; Mode 1, Submode 3

FF	LENGTH (I)	
001		004
Z	ZOOM THRESHOLD	ZOOM FACTOR
PLOT COLOR		BACKGROUND COLOR
LINE CHARACTER		LINE WIDTH
CHARACTER 1		CHARACTER 2
CHARACTER 3		CHARACTER 4
LOGICAL FILL (R/L)		FILL PATTERN NO.
CHECKSUM		

Line Mnemonic

NOTES:

1. Z: Zoom Disable: If Z=1, the displayable data will be invariant in display size regardless of zoom selection. If Z=0 displayed data are sized according to zoom selection.

2. ZOOM THRESHOLD: The ZOOM THRESHOLD is the minimum magnification that may be applied to the product within the constraints of the data density from which the product was built. This value is the denominator of the fractional area of the entire viewing space. Currently assigned codes (decimal) which are representative of the zoom value are:

00 - Display at all zoom levels (default)
01 - Display at 1X or higher magnification
02 - Display at 2X or higher magnification
03 - Display at 3X or higher magnification
.
.
16 - Display at 16X or higher magnification

3. ZOOM FACTOR: An optional zoom (magnification) factor to be assigned to strings selectively at a local level. These values range from 0-255 (decimal).

0 - No zoom (default)
1 - 1X
2 - 2X
3 - 3X
.
.

Figure 4-4. Define Plot Parameters Block; Mode 1, Submode 4

NOTES: Figure 4-4 (Cont.):

4. PLOT COLOR and BACKGROUND COLOR: These values range from 0 to 255 (decimal). Application of National Institute of Standards and Technologies (NIST) color standards is to be determined.

5. LINE CHARACTER: Assigned values are:

0 - Continuous (default)
1 - Dotted line (alternate pixels)
2 - Dashed line (short dashes)
3 - Dashed line (long dashes)
4 - Dotted line (every 4th pixel)
5 - Symbolic line

6. LINE WIDTH: This value indicates the thickness of line in pixels.

7. Line Mnemonic: Line mnemonics are specified in Tables A2-1 and A2-2.

8. LOGICAL FILL (R/L): A flag which indicates whether fill is to be done on the Right or on the Left side of the vector string as it proceeds. If no fill is to be used, this value is set to zero (the default value). Numbers in the renge 1 to 127 indicate fill is to be made on the right. Numbers in the range 128 to 255 indicate fill is to be made on the left. Numbers may be chosen within each range to specify a fill algorithm or manner of execution.

9. FILL PATTERN NO.: A preassigned value which specifies the type of pattern to be used in the fill area. A value of zero is used if no fill is being specified (the default value). Pattern numbers are to be assigned by inter-agency agreement.

10. Values defined by this submode are effective on all subsequent modes until redefined.

9. This block can be shortened by using a LENGTH value less than the maximum number of byte pairs shown in the figure. The fields past the LENGTH count will be truncated and the information they control not changed.

Figure 4-4. (Cont.) Define Plot Parameters Block; Mode 1, Submode 4

FF	LENGTH (I)		
001		005	
f	FIELDWIDTH	d	DATAWIDTH
MODE		SUBMODE	
CHECKSUM			

NOTES:

1. f: If this bit is set, the data will be continuous and cross byte and byte/pair boundaries.

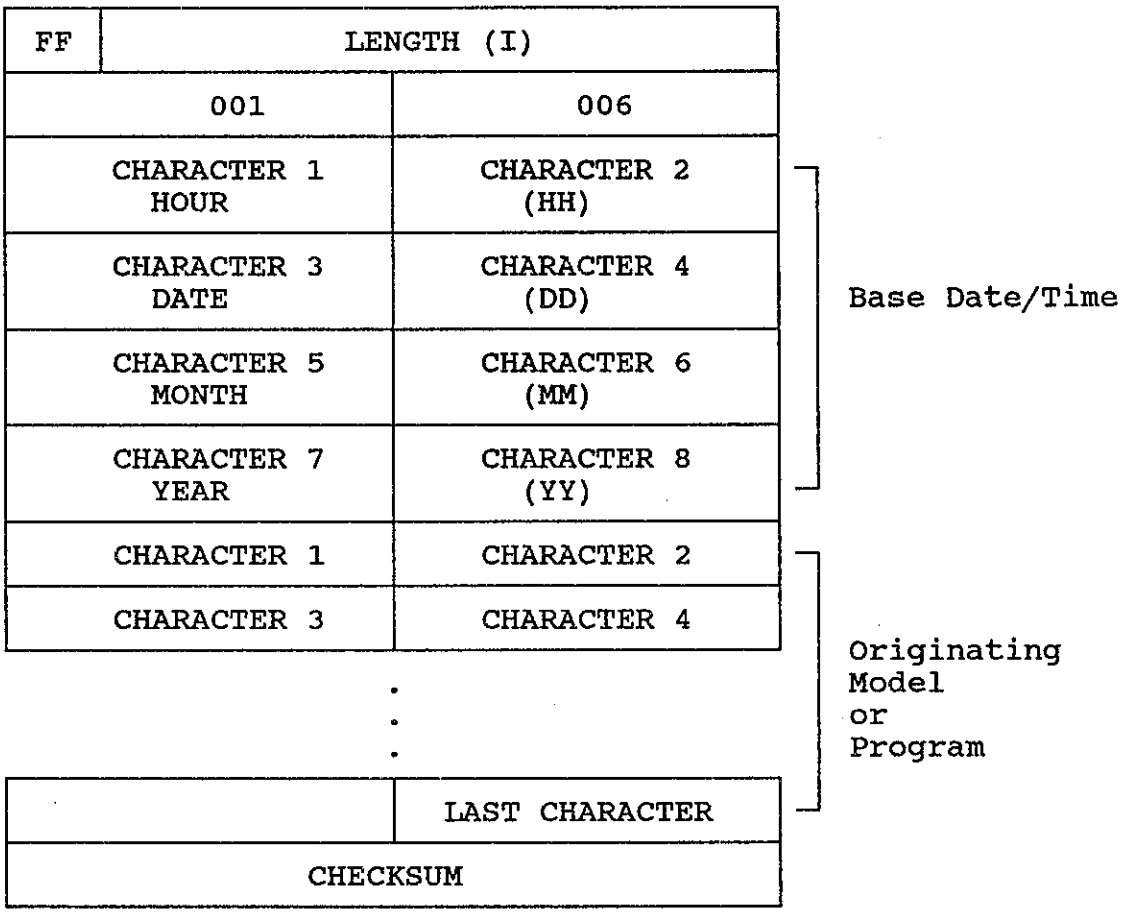
2. FIELDWIDTH: An integer number that defines the number of bits allocated to each data element in the specified mode/submode. The legal range is 1 through 16 (decimal).

3. d: When this bit is set, the data will be left justified in the field defined by FIELDWIDTH; i.e., empty spaces will trail the data.

4. DATAWIDTH: An integer number that defines the number of bits used by the actual data within the FIELDWIDTH. The legal range is 1 through FIELDWIDTH. Example: If the data are three bits wide and are repeated every four bits, then FIELDWIDTH = 4, DATAWIDTH = 3.

5. MODE and SUBMODE: The mode and submode to which the redefined fieldwidth and datawidth apply.

Figure 4-5. Define Datawidth/Fieldwidth Block; Mode 1, Submode 5



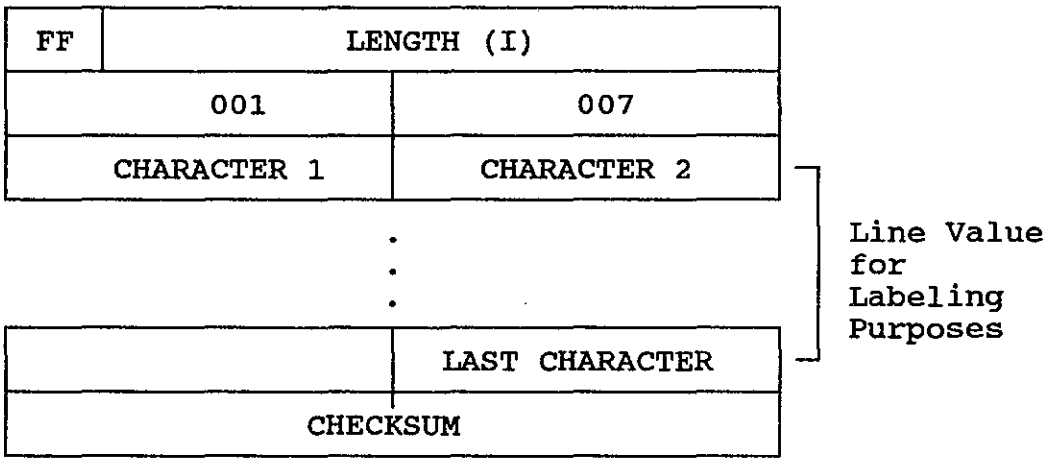
NOTES:

1. Base Date/Time: An eight character ASCII field which specifies the Greenwich Mean Time the product is based on. Characters 1 and 2 give the two digit hour of the 24 hour clock. Characters 3 and 4 are the two digit date of the month. Characters 5 and 6 are the two digit month in the range 01-12. Characters 7 and 8 give the units and tens digit of the year. This is always an eight character field.

2. Originating Model or Program. A variable length string of ASCII characters used to specify the process which generated the product. If LENGTH field has been shortened in the block, then this field is omitted entirely.

3. This block should appear only once with a product.

Figure 4-6. Product Information Block; Mode 1, Submode 6



NOTES:

1. Line Value of Labeling Purposes: A variable length string of ASCII characters which assigns a value (label) to the vector string which follows this block. Only the required number of characters to hold the label will be used. If there are an odd number of characters, the final character will be blank. The line label assigned by this block will remain in force only for the vector block which immediately follows it. If another vector block follows the first with no preceding Line Information Block, it will be assumed to be an unlabeled line.

2. This block is assumed to precede any vector block which is required to be labeled as part of the line display process.

Figure 4-7. Line Information Block; Mode 1, Submode 7

CHAPTER 5

SYSTEMS DATA

5.1. General Information. This mode is provided to support the transmission of system or application binary data. The submodes are user definable internally within the user system and not intended for any other agency use.

5.2. Binary Data Block. The format for this block is depicted in Figure 5-1. No Product Definition or Data Description blocks are necessary with this data block.

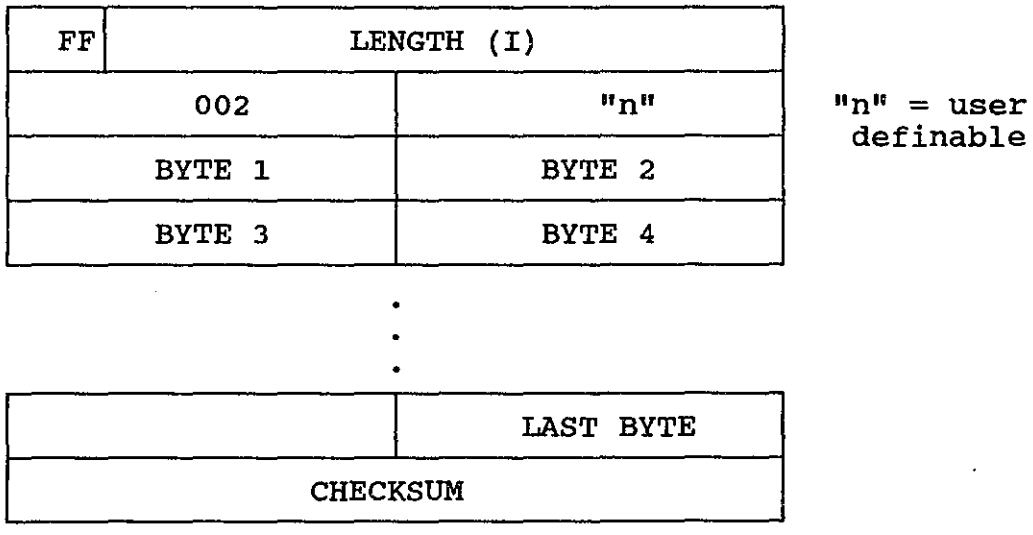


Figure 5-1. Binary Data Block; Mode 2, Submode "n"

CHAPTER 6

FORMATTED BINARY BLOCKS

6.1. Product Definition Block. This block shall be an 18 byte block, including the LENGTH and CHECKSUM fields. The specific format and content shall be as shown in Figure 6-1.

6.2. Satellite Product Definition Block. This block shall be a 22 byte block, including the LENGTH and CHECKSUM fields. This block is designed to define data organized by orbit. The specific format and content shall be as shown in Figure 6-6.

6.3. Data Description Block. The Formatted Binary Data Description blocks, (Option 1 and Option 2) shown in Figure 6-2 and in Figure 6-3, act as data interpretation tables for the data in the following binary data block(s). They describe the data in the Formatted Binary Data block(s) in sufficient detail to allow the receiver to use the data. The length of the description blocks shall depend on the number of repeating data sections required to define the product. (See Note 3 for Figure 6-2 or Figure 6-3.)

6.4. Data Block. The Formatted Binary Data block shall be formatted as shown in Figure 6-4. The data field shall be formatted as specified in the Formatted Binary Data Description blocks, Option 1 or Option 2, whichever is appropriate.

6.5. Presentation of Formatted Binary Data. While the data description blocks serve as data interpretation tables for the data block(s) which may follow, there are a number of ways for presentation of element data in the formatted binary data block. Most element data lends itself to numeric (binary) presentation (e.g., temperature, heights, etc.) while other element data lends itself to presentation as ASCII characters (e.g., station ICAO call letters, present weather). Agencies have some flexibility in choosing an element data presentation method and the user of these products needs to be aware of the method or methods being employed. The following are examples of possible implementations.

A. WMO Block and Station Number: The data description block would show two element mnemonics, one for WMO Block Number (BLK) and one for WMO Station Number (STN). These data could be presented in the data block as 2- and 3-byte ASCII characters or as 1- and 2-byte numeric characters. The user can determine the method of presentation by testing on the "Number of Bytes per Element" - byte in the description block.

B. Present Weather: The data description block would show one of the three present weather mnemonics (WW1, WW2, WW3). The data could be presented in the data block as a numeric code value, following the WMO WW numbering scheme (0-99), or as ASCII characters using the accepted meteorological abbreviations (e.g., RW, K, etc.). The numeric presentation can be done in one byte in the data block but the ASCII presentation must be done in three bytes. Once again, the user can determine the method of presentation by testing on the "Number of Bytes per Element" - byte in the data description block.

C. Barometric Characteristic: The data description block would show BC as the element mnemonic. Table A2-2 shows that the data would be reported in ASCII form as BC0 through BC8, corresponding to the nine possible reported code values (0 through 8). This ASCII presentation would require three bytes in the data block. The actual code value of 0 through 8 could also be reported as a one-byte numeric value, scaled with a multiplier of one and additive constant of zero. The USAF has chosen a third method using a special data block data code of 160 through 168 (decimal) numeric (see Table A2-2), which also take one byte in the data block. However, this code is not considered to be a scaled numeric value, therefore, the multiplier mantissa and characteristic and additive constant are all zero. This logic can be used to determine the method of presentation.

D. Cloud Amount: The data description block could show CTA (total cloud amount), L1A - L4A (layer cloud amount), C1A - C3A (layer cloud amount), CLA, CMA, CHA (low, middle, and high cloud amount), or SKY (sky cover). The data could be presented in the data block as a three-character ASCII string (CAM, CLR, SCT, BKN, OVC, OBS, CA0 - CA9). The data could also be presented as a one-byte numeric value indicating the eighths or tenths of cloud cover or as a percent of cover, with units code and scaling factor being the discriminator. The USAF has chosen a third method using a special data block data code of 149 through 159 (decimal) numeric (see Table A2-2), which also takes one byte in the data block. As with barometric characteristic, this USAF code is not considered to be a scaled numeric value, therefore, the multiplier mantissa and characteristic and additive constant are all zero.

E. Cloud Type, Past Weather, Ship Direction: The data description block could show CLT, CMT, CHT, CT, C1T, C2T, C3T, L1T - L4T, PWX, SD, or SDD for these elements. The data could be shown in three bytes in the data block as ASCII characters, as listed in Table A2-1. The USAF has chosen special data block data codes, which take one byte in the data block, for reporting the element value (Table

A2-2). As with the other special data block data codes, these codes are not considered to be scaled numeric values so the multiplier mantissas and characteristics and additive constants are all zero.

6.5.1. Formatted Mixed Data. The Formatted Binary Data Description Block, Option 2 (Figure 6-3), has been provided to handle the transfer of Profiler and Profiler-related data among both Government and non-Government agencies. It permits mixed numerical representations (two's complement integer, ASCII, IEEE floating point, etc.) and array lengths within the same data block. This means that a data producer can send header information, data elements, and data arrays; use any defined data representation; and send data in any order.

6.6. Data Sequence Block. The Formatted Binary Sequence Block saves needless repeating of Formatted Binary Data Description Blocks within a mix of types of Formatted Binary Data Blocks.

The Data Sequence Block (Mode 3, Submode 23), Figure 6-5, preceded Data Description Blocks (Mode 3, Submode 21) which precede a repeating mix of types of Data Blocks (Mode 3, Submode 1). The Data Sequence Block describes sequences of Data Blocks which follow matched to the corresponding Data Description Blocks for each type Data Block.

FF	LENGTH (I)	
003	020	
CHARACTER 1	CHARACTER 2	┐ Station Call
CHARACTER 3	CHARACTER 4	┘ Letters (ICAO)
WMO BLOCK NUMBER (I)		
STATION NUMBER (I)		
LATITUDE I		
LONGITUDE I		
CHECKSUM		

NOTES:

1. Station Call Letters: The International Civil Aviation Organization (ICAO) identification of the originator station.

2. WMO BLOCK NUMBER: A two digit identifier of a section of the earth based on a system developed by the World Meteorological Organization (WMO).

3. STATION NUMBER: A three digit station identification within the region identified by the WMO BLOCK NUMBER.

4. LATITUDE, LONGITUDE I: Latitude and Longitude must be multiplied by .01 to get the actual value. Negative latitude indicates South, negative longitude indicates East.

Figure 6-1 Formatted Binary Product Definition Block; Mode 3, Submode 20

FF	LENGTH (I)	
003	021	
NUMBER OF ELEMENTS	# OF BYTES/SECTION	
NUMBER OF SECTIONS		
CHARACTER 1	CHARACTER 2	┐ Element
CHARACTER 3	CHARACTER 4	┘ Mnemonic
START BYTE	# BYTES/ELEMENT	
UNUSED (ZEROES)	UNITS CODE	
MULT. MANTISSA	MULT. CHAR.	
ADDITIVE CONSTANT		
CHARACTER 1		
Repeated bytes		
ADDITIVE CONSTANT		
CHECKSUM		

NOTES: This block is also used for unpacked gridded products.

1. NUMBER OF ELEMENTS: The number of elements contained in each section of the data block. This field indicates the number of 12 byte repeating sections in the data description block.

2. NUMBER OF BYTES/SECTION: Total number of bytes contained in a repeating section. This is the number of bytes that must be skipped to read a given element from each repeating section.

3. NUMBER OF SECTIONS: The total number of repeating sections in the data block.

Figure 6-2 Formatted Binary Data Description Block, Option 1; Mode 3, Submode 21

NOTES: Figure 6-2 (con't).

4. ELEMENT MNEMONIC: A character set that identifies the element being described. Tables A2-1 and A2-2 (Appendix A) contain the mnemonics lists.

5. START BYTE: The byte number in the data block where the first occurrence of the element can be found. Succeeding occurrences of the element can be found by successively adding the number of bytes per section to the start byte number.

6. NUMBER OF BYTES/ELEMENT: The number of bytes in the data block occupied by the element.

7. UNITS CODE: A code specifying the units of the data elements. The list of units codes is found in Table C2-4 (Appendix C).

8. MULTIPLIER MANTISSA: Integer constant to be multiplied by the element value to obtain the actual value of the element. Used in conjunction with the multiplier characteristic.

9. MULTIPLIER CHARACTERISTIC: Exponent of 10 to be used with the multiplier mantissa to obtain the true value of the element.

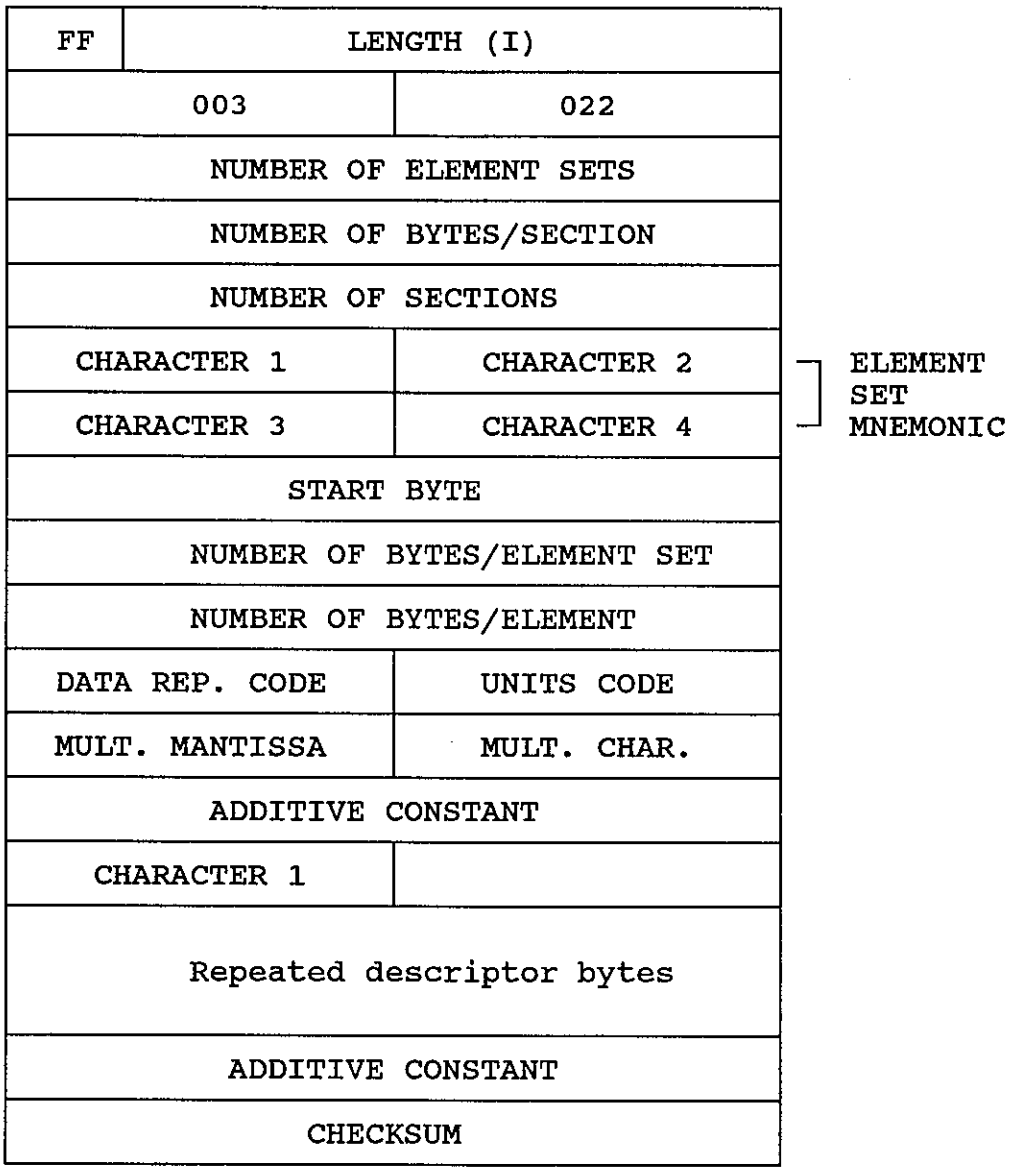
10. ADDITIVE CONSTANT: Integer constant to be added to the element value to obtain the true value of the element.

11. The ninth through twentieth bytes are repeated for each element in the data type being transmitted. These 12 bytes may be repeated for up to 256 parameters (0-255). The actual number of 12 byte fields required depends on the data being transmitted.

12. The actual value of the element is calculated as shown below:

$$\text{Actual Value} = \text{Element Value} * \text{Mult. Mantissa} * 10^{\text{Mult.Char.}} + \text{Additive Constant}$$

Figure 6-2 (Cont.) Formatted Binary Data Description Block, Option 1; Mode 3, Submode 21



NOTES: Figure 6-3: This block is used for formatted mixed data such as two's complement integer, ASCII, IEEE floating point, etc. and array lengths.

1. NUMBER OF ELEMENT SETS: The number of element sets (an element set is either one element or an array of elements) contained in each repeating section of the data block(s). This field indicates the number of 16 byte repeating descriptors in the data description block.

Figure 6-3 Formatted Binary Data Description Block, Option 2; Mode 3, Submode 22

NOTES: Figure 6-3 (Cont.):

2. NUMBER OF BYTES/SECTION: Total number of bytes contained in a repeating section. This is the number of bytes that must be skipped to read the first element of a given element set from each repeating section.

3. NUMBER OF SECTIONS: The total number of repeating sections in the data block(s).

The remaining parts of the data description block are the repeating descriptors described in Note 1.

4. ELEMENT SET MNEMONIC: A four-character set that identifies the element set being described. Tables A2-1 and A2-2 of the reference contain these mnemonics.

5. START BYTE: The byte number in the data block where the first occurrence of the element set can be found. Succeeding occurrences of the element set can be found by successively adding the number of bytes per section to the start byte number.

6. NUMBER OF BYTES/ELEMENT SET: The number of bytes in the data block occupied by the element set.

7. NUMBER OF BYTES/ELEMENT: The number of bytes in the data block occupied by each element of the set. (If this is equal to the NUMBER OF BYTES/ELEMENT SET, then this element is not an array.)

8. DATA REPRESENTATION CODE: A code specifying the representation type of the element. Table C2-5 (Appendix C) lists the codes. Examples of data representation are two's complement integer, Floating point, or ASCII.

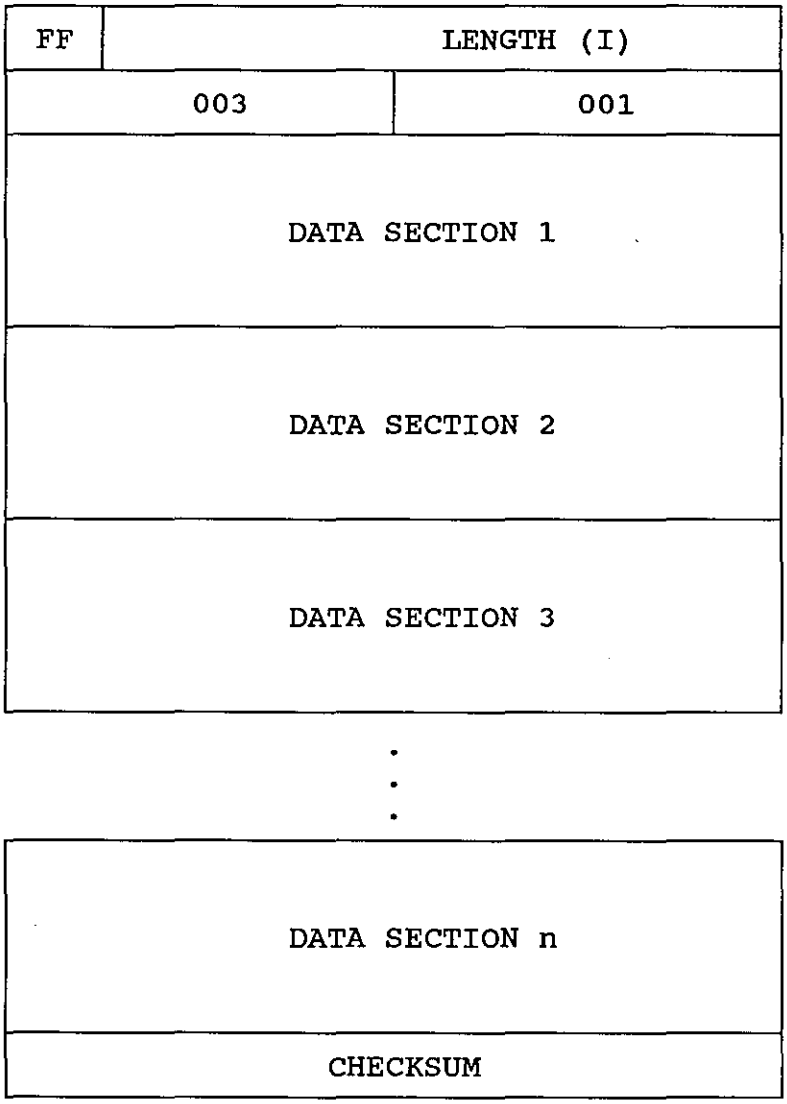
9. UNITS CODE: A code specifying the units of the data elements. Table C2-4 (Appendix C) contains these codes.

10. MULTIPLIER MANTISSA: Integer constant to be multiplied by the element value to.obtain the actual value of the element. Used in conjunction with the multiplier characteristic.

11. MULTIPLIER CHARACTERISTIC: Exponent of 10 to be used with the multiplier mantissa to obtain the true value of the element.

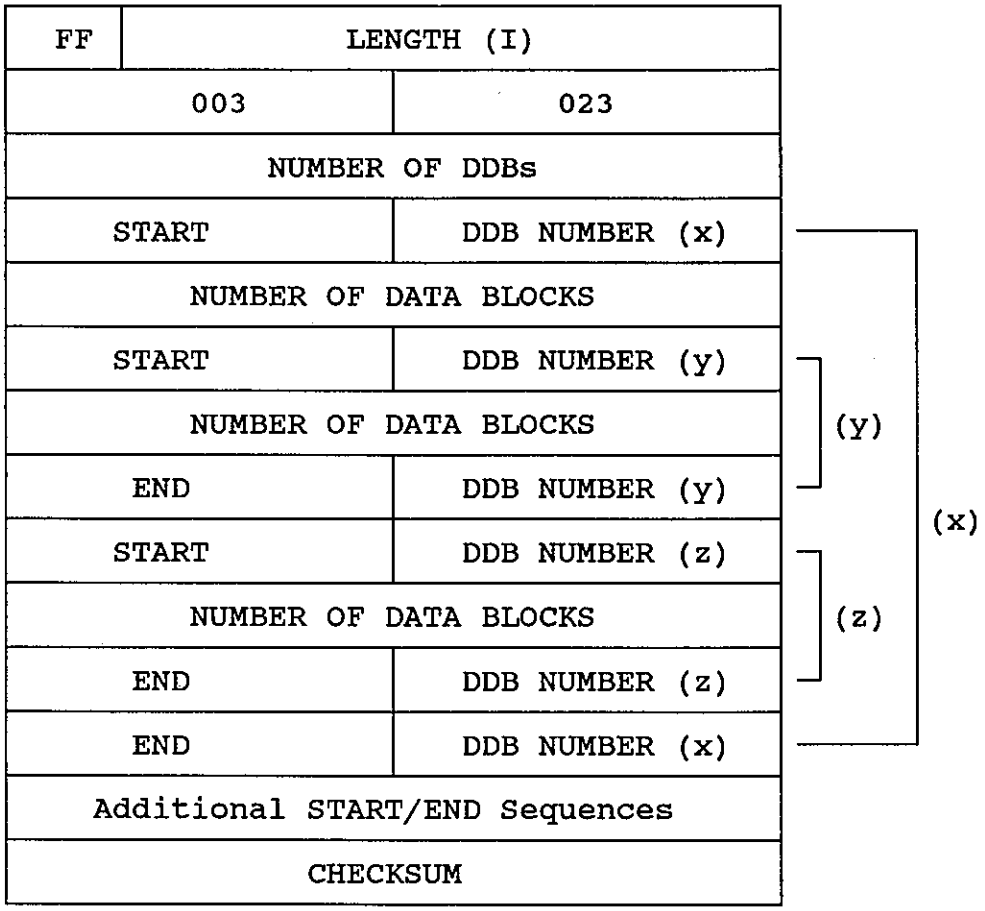
12. ADDITIVE CONSTANT: Integer constant to be added to the element value to obtain the true value of the element.

Figure 6-3 Formatted Binary Data Description Block, Option 2; Mode 3, Submode 22



NOTE: This block is also used for unpacked gridded data.

Figure 6-4 Formatted Binary Data Block; Mode 3, Submode 1



NOTES:

1. NUMBER OF DDBs: The total number of Formatted Binary Data Description Blocks (DDB) (Mode 3, Submode 21) immediately following the Data Sequence Block. (This number also corresponds to the number of Formatted Binary Data Block (Mode 3, Submode 1) types which follow.)

2. START/END: Indicator for DDB sequence start or end. START = 173 (octal) (ASCII left brace). END = 175 (octal) (ASCII right brace). Each START indicator for a sequence (e.g., sequence x, sequence y, etc.) must have a matching END indicator. See Note 1.

3. DDB NUMBER: Relative number identifying this DDB within the total DDB set (e.g., DDB NUMBER two of five. The DDB NUMBER is two; the NUMBER OF DDBs is five).

Figure 6-5. Formatted Binary Sequence Block; Mode 3, Submode 23

NOTES: Figure 6-5 (Cont.)

4. NUMBER OF DATA BLOCKS: The total number of Formatted Binary Data Blocks (Mode 3, Submode 1) included within this sequence (x), (y), (z), etc. The number of data blocks is specified in the NUMBER OF DATA BLOCKS byte pair immediately following the START/DDB NUMBER byte pair for each sequence. The referenced Data Blocks' content correspond to the DDB for this sequence.

5. The START/END sequence is the key to using the Data Sequence Block. Six bytes define each sequence: START (173 octal), DDB NUMBER (x), NUMBER OF DATA BLOCKS, END (175 octal), DDB NUMBER (x). Depending on this six byte ordering for sequences (x), (y), (z), etc., once can describe sequential or nested Data Block repeat patterns. (Describing sequential or nested patterns is like computer program Do Loops.)

6. For example, in Figure 6-5, the START/END sequence (y) and (z) are nested sequentially within START/END sequence (x). Specifically, Figure 6-5 describes sending the first type (x) data block, sequentially followed by a specified number of (y) type data blocks, sequentially followed by a specified number of (z) type data blocks. The data block pattern begins again with the next (x) type data block continuing in the manner previously described until the Data Sequence Block is satisfied. (If desired, and End of Product Block (Mode 1, Submode 2) could immediately terminate the sequence.)

Figure 6-5. (Cont.) Formatted Binary Sequence Block; Mode 3, Submode 23

FF	LENGTH (I)
003	030
SATELLITE SERIES	
SATELLITE ID NUMBER	
START ORBIT 1	START ORBIT 2
START ORBIT 3	START ORBIT 4
END ORBIT NUMBER	
START TIME : DAY OF YEAR	
START TIME:HOUR	START TIME:MINUTE
END TIME:HOUR	END TIME:MINUTE
CHECKSUM	

NOTES:

1. SATELLITE SERIES: Two letter satellite ID in ASCII coded format.

2. SATELLITE ID NUMBER: Two numeric characters in ASCII coded format. This is the numeric code corresponding to SATELLITE SERIES. The following table cross-references SATELLITE SERIES to SATELLITE ID NUMBER:

NOAA SATELLITE SERIES	*Corresponding SATELLITE ID NUMBER*
TN	*01*
NA	*02*
NC	*04*
NE	*06*
NF	*07*
NG	*08*
NH	*09*
NI	*10*
NJ	*11*

Figure 6-6. Satellite Product Definition Block: Mode 3, Submode 30

NOTES: Figure 6-6 (Cont.)

Air Force DMSP S/C ID	NESDIS S/C ID for DMSP SATELLITES
8541	01
9543	02
0542	03

For DMSP satellites, NESDIS S/C ID is inserted in SATELLITE SERIES (word 3) and SATELLITE ID NUMBER (word 4).

3. START ORBIT - 4 Character ASCII.

For TOVS, use the Superswath number from first data record.

For DMSP, use the orbit number from the first data record.

4. END ORBIT NUMBER - 2 Character ASCII (numeric - modulo 100). Use Superswath number (or Orbit Number for DMSP) from last sounding record.

5. START TIME : DAY OF YEAR - Julian Day in two byte integer. Use start date from first sounding record.

6. START TIME : HOUR - One byte integer.

7. START TIME : MINUTE - One byte integer.

8. END TIME : HOUR - One byte integer from last sounding record.

9. END TIME : MINUTE - One byte integer from last sounding record.

Figure 6-6. (Cont.) Satellite Product Definition Block: Mode 3, Submode 30

CHAPTER 7

VECTOR GRAPHIC BLOCKS

7.1. Product Definition Blocks. One of the following product definition blocks (the Vector Graphic Product Definition Block or the Define Graphics Parameters Product Definition Block) must be used to define the product. A product data set contains only one of the Product Definition blocks.

7.1.1. Vector Graphic Product Definition Block. The specific format and information content shall be as shown in Figure 7.1. Most vector graphic data is transmitted so that each point can be registered to its true earth location (latitude/longitude) or to Cartesian coordinates. Specifically, the earth locatable vector graphic data applies to the vector lines (isopleths, geopolitical lines and latitude/longitude lines), data plots, and wind barbs, and line labels. Other data to further describe the product, such as legends, are registered with respect to product locations (e.g., upper left hand corner) rather than to earth locations. This data may include line labels and legends.

7.1.1.1. Product Area. The AREA CODE and SCALE elements define the area of the product to the display device. The AREA CODE shall specify the number and location of the point(s) used to define the product area. When one point is used, the SCALE must also be used for area definition.

7.1.1.2. Registration. Registration to the display device may be accomplished by applying the reference latitudes and longitudes in accordance with the AREA CODE specification. Registration of the product to background information is accomplished through the PI set. If PI=0, the appropriate background data is sent with the product or the product is not geographical in nature. Otherwise background data resident in the receiving system is to be used.

7.1.2. Define Graphics Parameters Product Definition Block. This block shall be formatted as shown in Figure 7-2. This product definition block is similar to the Vector Graphic Product Definition Block except that it contains additional information to allow contouring at the user site. Normalized values of a contour are provided to allow calculation of successive contours.

7.2. Data Description Blocks. No data description blocks are currently used for the Vector Graphic products.

7.3. Data Blocks. The Vector Graphic data blocks shall be formatted as shown in Figures 7-3 through 7-10 defined in the following sections.

7.3.1. Absolute Vectors Block. This block shall be formatted as shown in Figure 7-3. Each block shall contain coordinates of the vector end points that define one line on the product. If the length of the line requires more vectors than can be contained in a single block, additional blocks shall be used with the starting M/N coordinates set to the last M/N coordinate of the proceeding block. One or more data blocks may follow, as required to define all lines on the product.

7.3.2. Relative Vectors Block. This block shall be formatted as shown in Figure 7-4. Each block shall contain vector pairs (with coordinates as specified by the coordinate flag in the product definition block) that define one line on the product. This block is used to transmit lines consisting of only short vectors, i.e., vectors for which the vector deltas can be put in one byte. If the length of the line requires more vectors than can be contained in a single block, additional blocks shall be used with the starting M/N coordinates set to the last M/N coordinate of the proceeding block. One or more data blocks may follow as required, to define all lines on the product.

7.3.3. "Calcomp Pen Command" (CPC) Vectors Block. This block shall be formatted as shown in Figure 7-5. This block contains a series of three bit direction vectors of unit length. If the length of the line requires more vectors than can be contained in a single block, additional blocks shall be used with the starting M/N coordinates set to the last M/N coordinate of the proceeding block. One or more data blocks may follow as required, to define all lines on the product.

7.3.4. Variable Exception Vectors (VEV) Block. This block shall be formatted as shown in Figure 7-6. The format provides a convenient method of packing vector graphic lines to conserve transmission time. Each vector graphic line is defined by a series of vectors whose lengths are given by the Increment Length (IL) and whose directions are given by changes dictated by the VEV data bits. The direction of the first increment in the vector graphic line is given by the initial direction (IDV) element. Starting with the most significant bit in the first byte of the VEV data bits, each bit represents either a trend (continue in the same direction) or an exception movement (change in direction) along successive vector increments. If the bit is zero (0), the movement is along the direction last established as the current trend direction. Initially, this is the direction defined by the initial direction element. For bit zero (0) and all other even numbered bits, if the bit is one, then the movement is turned counterclockwise by a 45 degree increment and the new direction is established as the current trend direction.

For bit one (1), and all successive odd-numbered bits, if the bit is one (1), then movement is turned clockwise 45 degrees and established as the new trend direction. This cycle continues until the bit count indicated by the VEV bit count element is exhausted.

7.3.5. Long/Short Relative Vectors Block. This block shall be formatted as shown in Figure 7-7. Each block shall contain vector pairs that define one line on the product. If the length of the line requires more vectors than can be contained in a single block, additional blocks shall be used with the M and N coordinate set to the end point of the last vector in the proceeding block. One or more additional blocks may follow, as required, to define all lines on the product. This block is used to transmit lines consisting of both vectors that can be put into one byte and vectors that require 16 bits.

7.3.6. Point-Slope Vectors Block. This block shall be formatted as shown in Figure 7-8. This block provides the minimum amount of information to draw a straight line. The information for only one line is sent with each block. One or more additional blocks may follow to define more lines on a product.

7.3.7. Wind Barbs Vectors Block. This block shall be formatted as shown in Figure 7-9. The block is used to transmit wind direction and speed in symbolic form. Multiple wind barbs may be transmitted in a single block. Additional blocks may be used, as required, to transmit all wind barbs associated with a product.

7.3.8. Vector (Arrow) Plot Block. This block shall be formatted as shown in Figure 7-10. This block contains a code for drawing arrows and numerical values at point locations on a product. One or more data blocks may follow to define all arrows on a product.

7.3.9. Center Radius Arc Vector Block. This block shall be formatted as shown in Figure 7-11. Each block contains joined continuous arcs. Each arc consists of a center point, a starting coordinate, and an ending coordinate. Therefore, the radius may vary from arc to arc. Each vector carries a "clockwise" flag which determines whether the arc is drawn clockwise or counter-clockwise from the first coordinate to the second coordinate. Also, each vector contains a "blanking" flag so that selected arcs may remain blank on display.

7.3.10. Curve Vectors Block. This block shall be formatted as shown in Figure 7-12. Each block contains joined continuous arcs. Each arc consists of three coordinate points which must be curve fitted when displayed. Each vector contains a "blanking" flag so that selected arcs may remain blank on display.

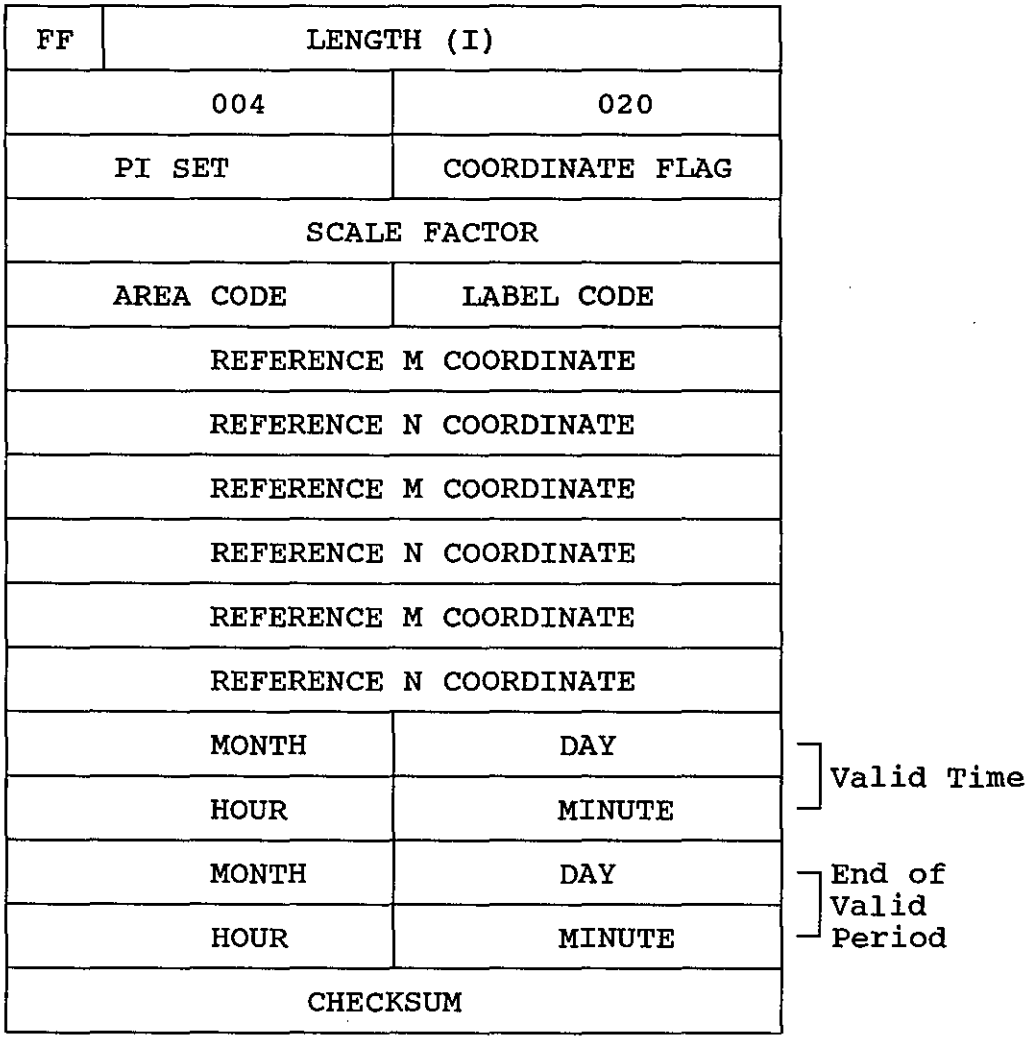


Figure 7-1. Vector Graphic Product Definition Block; Mode 4, Submode 20

NOTES: Figure 7-1:

1. PI SET: The PI SET defines the background projection on which the product is valid. The codes are shown in Table C2-1. If a product is not associated with a background field, PI SET will be zero filled.

2. COORDINATE FLAG: Coordinate System Indicator as follows:

Flag	*M =*	*N =*	
0	*Latitude*	*Longitude*	*(Earth surface grid in latitude and longitude coordinates)*
1	*I*	*J*	*(Cartesian coordinates of the earth's surface)*
2	*X*	*Y*	*(Pixel coordinates of the product background projection)*

3. SCALE FACTOR: The Scale Factor is the real world map scale in millions. The first byte contains the integer part and the second byte contains the fraction.

4. AREA CODE: The AREA CODE is an integer code that defines the relative product reference point(s) and scheme used to define the geographical area and product orientation. The currently defined codes are:

11 - One (1) reference point is used to define the upper left corner of the product.

12 - One (1) reference point is used to define the lower left corner of the product.

13 - One (1) reference point is used to define the center of the product.

21 - Two (2) reference points are used to define the upper left and upper right corners of the product.

22 - Two (2) reference points are used to define the lower left and upper right corners of the product.

23 - Two (2) reference points are used to define the upper left and center of the product.

Figure 7-1. Vector Graphic Product Definition Block; Mode 4, Submode 20

NOTES: Figure 7-1 (Cont.):

24 - Two (2) reference points are used. The first reference point gives the coordinates of the lower left corner of the product in units of the grid from which it was extracted. The second set of reference coordinates will give the maximum horizontal and maximum vertical size of the product in pixels (M maximum and N maximum).

25 - Same as code 24 except the reference point is located at the center of the product.

33 - Three (3) reference points are used to define the upper left, upper right, and lower right corners of the product.

34 - Two (2) reference points are used to define the lower left and upper right corners, respectively, of the product with respect to orientation the product would have if viewed on a display screen, and the third reference point defines the upper right corner of the logical display device.

When only one reference point is required, this block is shortened by two byte pairs; when two reference points are required the block is shortened by one byte pair.

5. LABEL CODE: If LABEL CODE = 0, the label to be used with the product is not a standard label and the label will be sent in an alphanumeric block. For interagency use this field will be zero. If a standard label is to be used, the LABEL CODE will contain a code for that label. Label codes are user definable and unique to each system.

6. Reference Coordinates: The Reference Coordinates uniquely define the boundary and orientation of the product. M and N are determined by the COORDINATE FLAG above. If given in latitude/longitude, values will be in hundredths of a degree. If given in I/J or X/Y coordinates, values will be integers. These reference points will be in the order specified by the area code (e.g., for area code 33, the first point defines the upper left corner, the second the upper right corner and the third the lower right corner.)

7. Valid Time: The Valid Time is the time for which the product is valid. For analysis products, the valid time will be the time the data used to generate the product was observed. For forecast products, the valid time will be either the time in the future for which the forecast is valid or the start of the time period for which the forecast is valid. The End of Valid Period time indicates the termination time of the valid period. If the day element of the End of Valid Period is zero, the product is valid only at the valid time. If not, the product is valid for the period given.

Figure 7-1. Vector Graphic Product Definition Block; Mode 4, Submode 20

FF	LENGTH (I)
004	030
PI SET	COORDINATE FLAG
SCALE FACTOR	
LONGITUDE X (HUNDREDTHS OF DEGREES)	
CONTOUR INTERVAL (I)	
CONTOUR INTERVAL (FRACTION)	
CONTOUR ORIGIN (I)	
CONTOUR ORIGIN (FRACTION)	
M MAXIMUM (I)	
N MAXIMUM (I)	
M CENTER	N CENTER
UNITS CODE	NCHAR (TITLE)
CHARACTER 1	CHARACTER 2

.
.
.

	LAST CHARACTER
CHECKSUM	

Figure 7-2. Define Graphics Parameters Product Definition Block; Mode 4, Submode 30

NOTES: Figure 7-2:

1. PI SET: The PI SET defines the background projection on which the product is valid. Currently defined codes are shown in Table C2-1.

2. COORDINATE FLAG: Coordinate System Indicator as follows:

Flag	M =	N =	
0	Latitude	Longitude	(An earth surface grid in latitude and longitude coordinates.)
1	I	J	(Cartesian coordinates of the earth's surface.)
2	X	Y	(Pixel coordinates of the product background projection.)

3. SCALE FACTOR: The Scale Factor is the real world map scale in millions. The first byte contains the integer part and the second byte contains the fraction.

4. LONGITUDE X: This is the longitude of the meridian perpendicular to the base of the product and extending from the base of the product to the pole. Longitude X may be outside of the product boundaries. Table C2-1 shows the Longitude X for the defined PI Sets (map projection). Longitude X is given in hundredths of degrees and must therefore be multiplied by .01 to obtain the true value.

5. CONTOUR INTERVAL and CONTOUR ORIGIN: The CONTOUR INTERVAL (CI) and CONTOUR ORIGIN (CO) are used to relate the Band Index (BI) value of the first contour in the product to the value of other contours in the product as follows:

$$Value = BI * CI + CO$$

The BI is sent in the Data Block.

6. M,N Maximum: The maximum horizontal and vertical size of the product. The type of coordinates are determined by the COORDINATE FLAG above.

7. M,N CENTER: The coordinates of the center of the product in units of the grid from which the product was originally extracted.

8. UNITS CODE: A code specifying the units of the contours in the product. The list of units is found in Table C2-4.

9. NCHAR: The number of characters in the product title.

10. CHARACTERs 1-n: The ASCII characters that make up the product title.

Figure 7-2. Define Graphics Parameters Product Definition Block; Mode 4, Submode 30

FF	LENGTH (I)
004	001
M COORDINATE	
N COORDINATE	
M COORDINATE (1)	
B	N COORDINATE (1)
M COORDINATE (2)	
B	N COORDINATE (2)

.
.
.

M COORDINATE (n)	
B	N COORDINATE (n)
CHECKSUM	

NOTES:

1. M,N COORDINATE: First set of coordinates of the line. M and N are determined by the COORDINATE FLAG in the Product Definition Block.

2. M,N COORDINATEs (n): Successive coordinates which form the line.

3. B = Blanking Flag: If B=0, pen is up (beam off), and a new line starts. If B=1, pen is down (beam on), and a line is drawn between the coordinate pairs.

Figure 7-3. Absolute Vectors Block; Mode 4, Submode 1

FF	LENGTH (I)	
004		002
M COORDINATE		
N COORDINATE		
DELTA M(1)		DELTA N(1)
DELTA M(2)		DELTA N(2)
DELTA M(3)		DELTA N(3)
.		
.		
.		
.		
DELTA M(n)		DELTA N(n)
CHECKSUM		

NOTES:

1. M,N COORDINATE: Defines vector string starting point. M and N are determined by the COORDINATE FLAG in the Product Definition Block.

2. DELTA M,N Values: Successive values are added algebraically to the last computed M, N coordinate position to produce a series of vectors defining a line. The positive direction for M values is to the right, negative to the left. The positive direction for N values is up, negative is down. Negative values are entered in 2's complement notation.

Figure 7-4. Relative Vectors Block; Mode 4, Submode 2

FF	LENGTH (I)
004	003
M COORDINATE	
N COORDINATE	
VECTOR COUNT (I)	
CPC VECTORS	

.
.
.

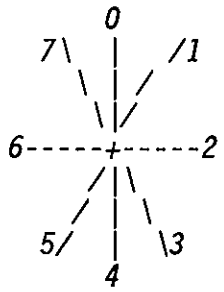
CHECKSUM

NOTES:

1. M,N COORDINATE: Defines vector string starting point. M and N are determined by the COORDINATE FLAG in the Product Definition Block.

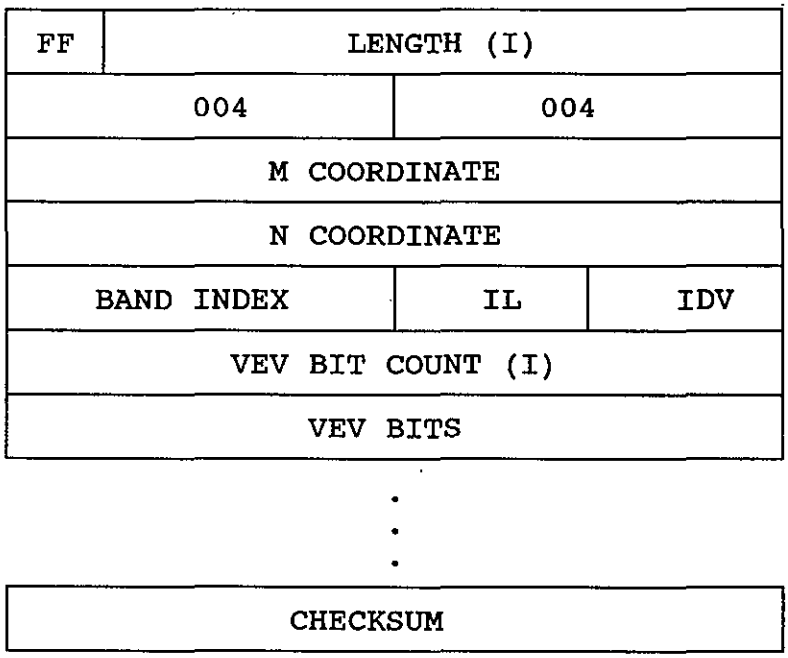
2. VECTOR COUNT: Number of vectors following.

3. CPC Vectors: Successive fields containing values defining the vector direction corresponding to the sketch below. The field width is variable depending on the Define Datawidth/Fieldwidth Block. The data width = 3. If there is no Datawidth/Fieldwidth Block, the default bit configuration is five 3 bit vectors, right justified in one byte pair, with the left bit equal to 0. To end on a byte pair boundary the last two bytes are zero filled if necessary.



4. The vector length is one pixel.

Figure 7-5. CPC Vectors Block; Mode 4, Submode 3



NOTES:

1. M,N COORDINATE: Defines vector string starting point. M and N are determined by the COORDINATE FLAG in the Product Definition Block.

2. BAND INDEX: The BAND INDEX (BI) is the normalized value of a contour or line, where BI = (Value - Origin)/Interval. If BI is not used this field will contain 377 octal (all one bits).

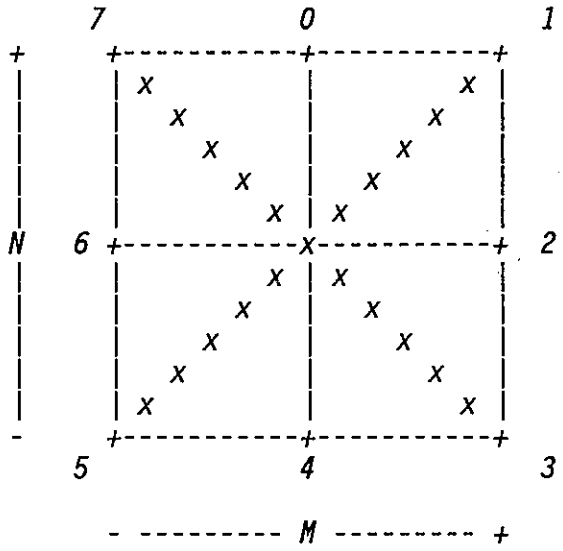
3. IL = Increment Length: IL is the indicator for the incremental vector length (e.g., 1=1 pixel, 2=2, 3=3, ..., 7=7).

Figure 7-6. Variable Exception Vectors (VEV) Block; Mode 4, Submode 4

NOTES Figure 7-6 (Cont.).

4. IDV = Initial Direction Vector: IDV values are 0 through 7 as represented in the sketch below:

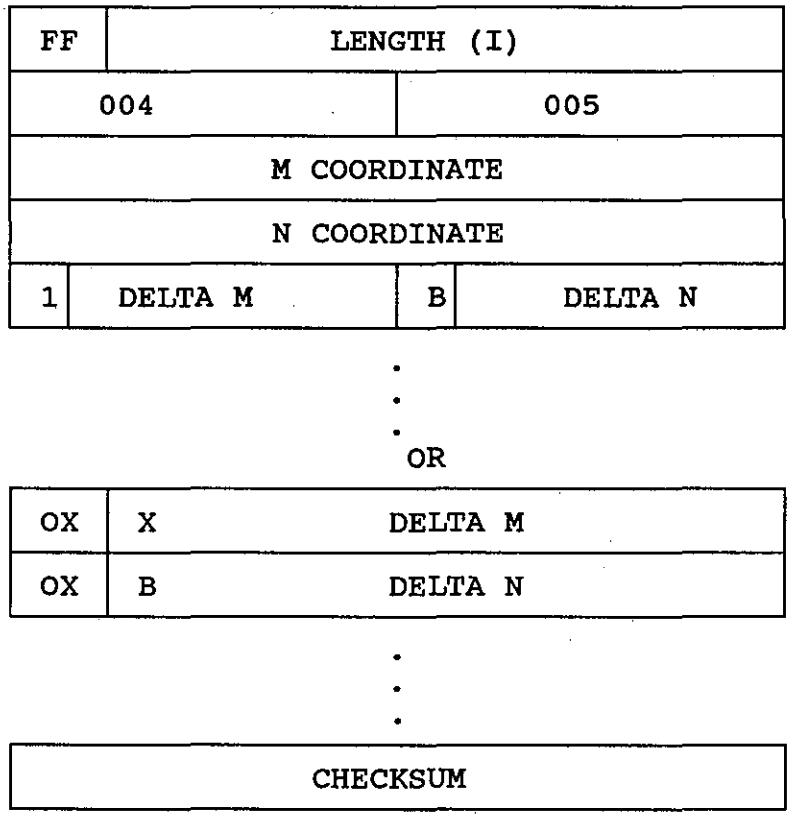
Direction vector definition:



5. VEV BIT COUNT: The number of data bits following.

6. VEV BITS: The string of bits determining the VEV vectors. If this bit string does not fill the last byte pair, the remaining bits are set to zero to end on a byte pair boundary.

Figure 7-6. (Cont.) Variable Exception Vectors (VEV) Block; Mode 4, Submode 4



NOTES:

1. M, N COORDINATE: Defines vector string starting points. M and N are determined by the COORDINATE FLAG in the Product Definition Block.

2. Left-most Bit: If the left-most bit = 1, the DELTA M and N are short (contained in one byte) vector values. If the left-most bit = 0, the DELTA M and N are long (each contained in two bytes) vector values.

3. B = Blanking Flag: If B=1, no line is drawn between coordinate pairs. If B=0, the line is drawn.

4. X: This bit not used.

5. DELTA M, N: Each successive delta value is added algebraically to the last computed M, N coordinate position to produce a series of vectors defining a line. The positive direction for M values is to the right, negative is to the left. The positive direction for N values is up, negative is down. Negative values are entered in two's complement notation.

Figure 7-7. Long/Short Relative Vectors Block; Mode 4, Submode 5

FF	LENGTH (I)	
004		006
M COORDINATE		
N COORDINATE		
VECTOR LENGTH		
SLOPE		OCT
CHECKSUM		

NOTES:

1. M,N COORDINATE: Defines vector string starting point. M and N are defined by the COORDINATE FLAG in the Product Definition Block.

2. VECTOR LENGTH: VECTOR LENGTH is the larger of the absolute values of the delta M and delta N differences for the two points between which the line is to be drawn.

*3. SLOPE: SLOPE is the fractional value of the ratio (shorter delta)/(longer delta). This value is multiplied by 2**12.*

4. OCT: OCT is a four bit field and contains the value for an octant defined in the following sketch:

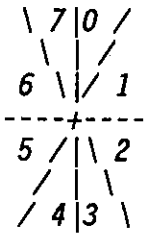


Figure 7-8. Point-Slope Vectors Block; Mode 4, Submode 6

FF	LENGTH (I)			
004			007	
SHAFT LENGTH			UNUSED	
M COORDINATE(1)				
N COORDINATE(1)				
DIRECTION	H	5kt	10 kt	50 kt
M COORDINATE(2)				
N COORDINATE(2)				
DIRECTION	H	5kt	10 kt	50 kt

.
.

M COORDINATE(n)				
N COORDINATE(n)				
DIRECTION	H	5kt	10 kt	50 kt
CHECKSUM				

NOTES:
1. SHAFT LENGTH: Number of pixels for the shaft line (from base to first barb).

2. M,N COORDINATE: Position of the base of the shaft. M and N are determined by the COORDINATE FLAG in the Product Definition Block.

3. DIRECTION: A six bit field containing an integer number in tens of degrees. It specifies the screen direction from which the wind is blowing. (Top of display screen is 0 degrees.)

4. H = HEMISPHERE: A one bit field where H=0 represents the Northern Hemisphere. H=1 represents the Southern Hemisphere.

5. 5Kt: A one bit field indicating the number of five knot flags.

6. 10Kt: A four bit field containing the number of ten knot flags.

7. 50Kt: A four bit field containing the number of fifty knot flags.

Figure 7-9. Wind Barbs Vectors Block; Mode 4, Submode 7

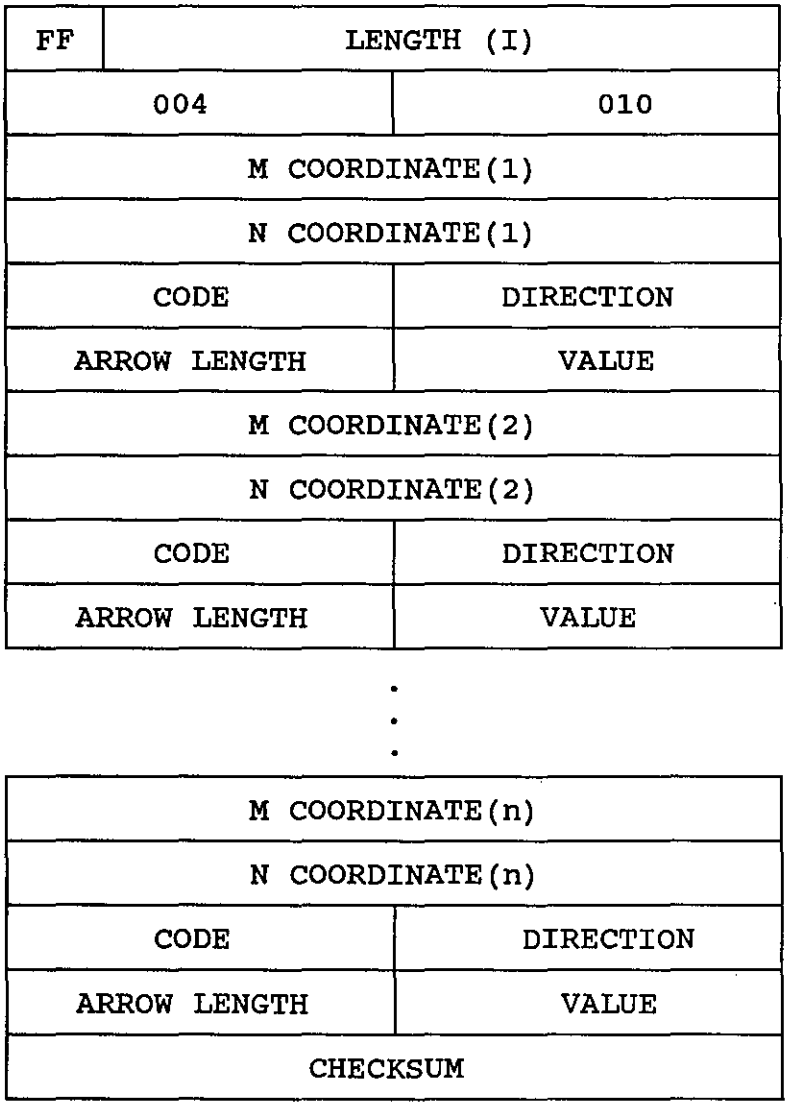


Figure 7-10. Vector (Arrow) Plot Block; Mode 4, Submode 10

NOTES: Figure 7-10:

1. M,N COORDINATE: The coordinate where the arrow and/or value is to be centered. M and N are determined by the COORDINATE FLAG in the Product Definition Block.

2. CODE: An integer value defining the type of information to be plotted. The currently defined codes are:

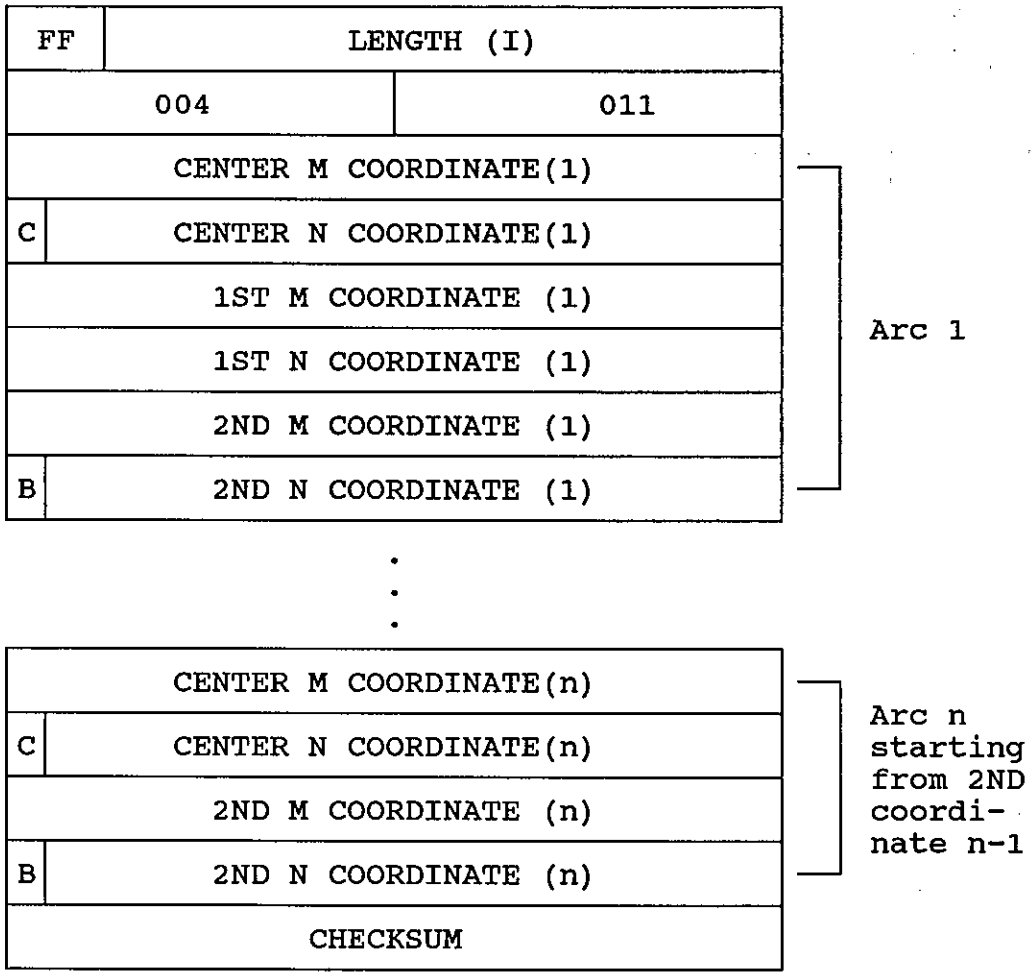
Code		
1	*--o-->*	*Arrow through point M,N*
2	*o-->*	*Arrow from point M,N*
3	*-->o*	*Arrow to point M,N*
4	*-21-->*	*Arrow with VALUE plotted at M,N*
5	*22o-->*	*Arrow from M,N with VALUE plotted left of M,N*
6	*-->o41*	*Arrow to M,N with VALUE plotted to right of M,N*
7	*----->*	*Vector of length (in pixels)*

3. DIRECTION: The arrow direction in tens of degrees, relative to display device screen. (Top of screen is 0 degrees.)

4. ARROW LENGTH: The length of the arrow in pixels for CODEs 1 through 6.

5. VALUE: An integer value to be plotted for CODEs 4, 5 and 6. If CODE = 7, the VALUE contains the length of the vector in pixels.

Figure 7-10. (Cont.) Vector (Arrow) Plot Block; Mode 4, Submode 10



Notes:

1. CENTER M,N COORDINATE: Coordinate of the center point from which the circular arc will be drawn which connects the two end points at the specified coordinates.

2. M,N COORDINATE: logical pairings of these coordinates enable more than one arc to be connected end to end if more than two coordinates (M,N pairs) appear in the block. The minimum entry in the block is one center coordinate and two coordinates following, for the initial arc. For each additional arc which is to be connected to the preceding arc, a center coordinate followed by a single M,N coordinate pair is supplied. The displayed arc will connect the last coordinate with the coordinate just supplied.

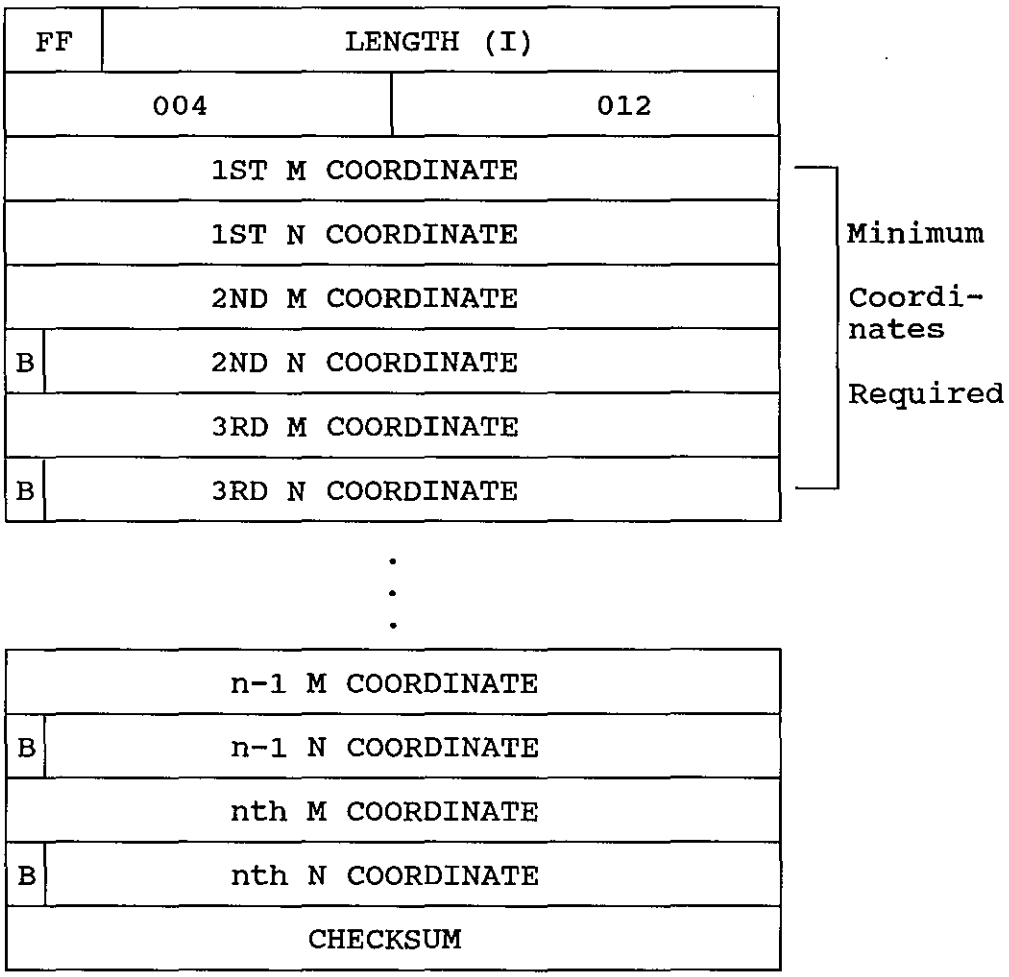
Figure 7-11. Center Radius Arc Vectors Block; Mode 4, Submode 11

Notes: Figure 7-11 (Cont.)

3. C: A single bit flag which indicates whether the arc is to be drawn clockwise or counter-clockwise. If C = 1, the arc will be drawn clockwise. Otherwise, C = 0 and the arc is drawn counter-clockwise.

4. B: A single bit blank vector flag. If B = 1, the arc drawn from the previous coordinate to the coordinate holding B = 1 is left blank (not visible). If B = 0, the arc is displayed normally.

Figure 7-11 (Cont.). Center Radius Arc Vectors Block; Mode 4, Submode 11



Notes:

1. M,N COORDINATE: Coordinate points through which the generated curves must be fitted. A minimum of three coordinate points must appear in the block. If additional coordinates are supplied, continuous curves will be fitted to the points until the nth coordinate is included in the curve.

2. B: A single bit blank vector flag. If B = 1, the section of the curve drawn from the previous coordinate to the coordinate holding B = 1 is left blank (not visible). If B = 0, the curve section between the previous coordinate and the coordinate with B = 0 is displayed normally.

Figure 7-12. Curve Vectors Block; Mode 4, Submode 12

CHAPTER 8

ALPHANUMERIC BLOCKS

8.1. Product Definition Block. This block shall be a variable length block including the LENGTH and CHECKSUM when used. The format shall be as shown in Figure 8-1. This block is optional. An example of an application would be to provide additional routing information for alphanumeric messages.

8.2. Data Description Block. This block is not currently used for alphanumeric data.

8.3. Data Blocks. The Alphanumeric data blocks shall be formatted as shown in Figures 8-2 through 8-5. These blocks are defined in the following paragraphs.

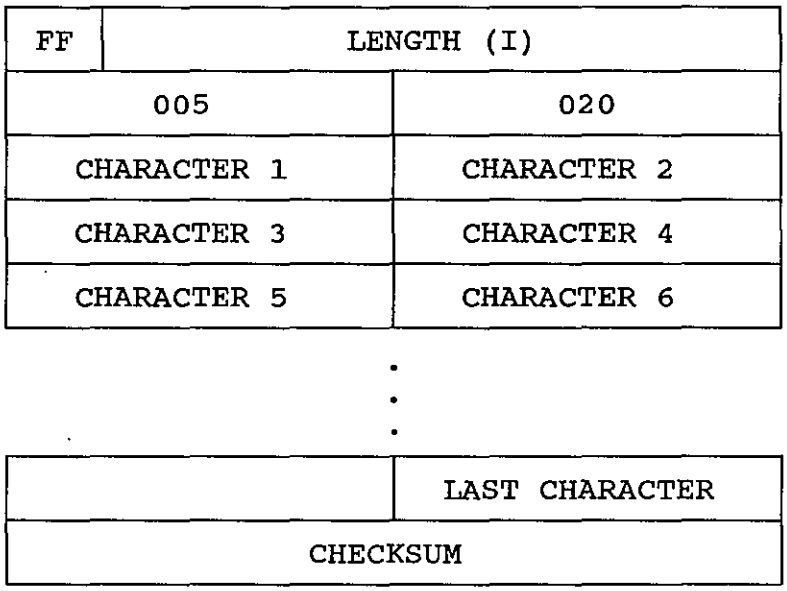
8.3.1. Alphanumeric Characters Block. This block shall be formatted as shown in Figure 8-2. This block is used to transmit textual information to be placed on displayed products (e.g., graphics products). Each block shall transmit one complete string of ASCII characters, including control characters. This block will normally be used to transmit nonstandard product labels/legends or variable information to be placed in a standard label/legend.

8.3.2. Plot Data Block. This block shall be formatted as shown in Figure 8-3. This block is used to transmit alphanumeric characters to be displayed at a specific location on a product in a specified format. Each block may be used to transmit labels for one or more lines on the product. It may be used to transmit weather symbols (such as thunderstorm symbols) that are to be displayed at a specified location on the product. The block may transmit any number of symbols as long as they are all to be displayed in the same size and color. The display format to be used is specified by a plot code. The Plot Process Code options are listed in Table C2-2.

8.3.3. Wind Barbs Data Block. This block shall be formatted as shown in Figure 8-4. The block is used to transmit wind direction and speed observations or forecasts to place a wind barb symbol at the specified location on the product. Multiple wind barbs may be transmitted in a single block. Additional blocks may be used, as required, to transmit all wind barbs associated with a product.

8.3.4. Alphanumeric Data Block. This block shall be formatted as shown in Figure 8-5. The data field shall contain an even number of ASCII characters which comprise all or part of the message text. All man-readable messages not intended for

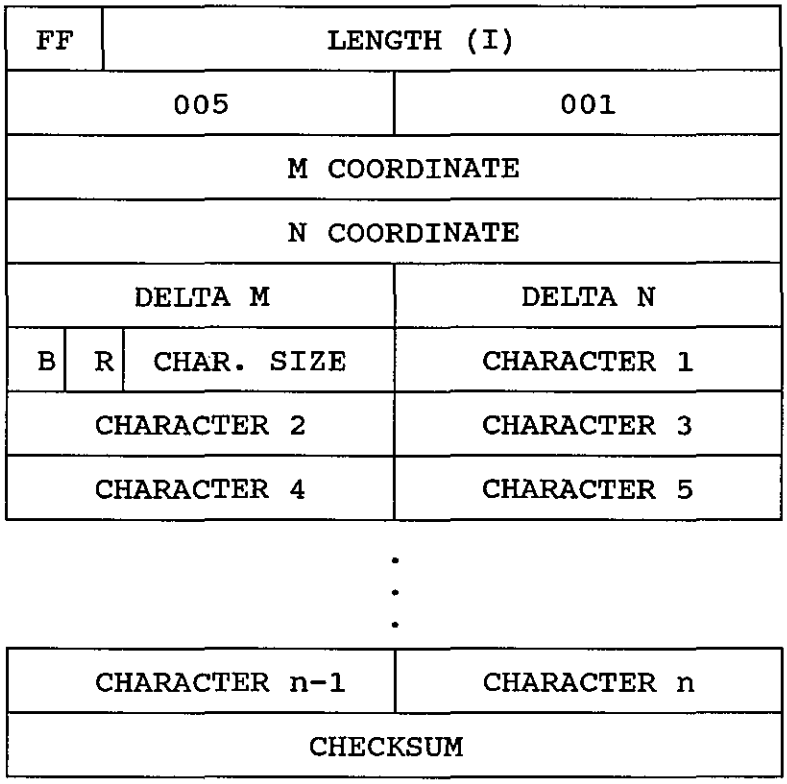
display shall use this block. The block follows the conventions for non-graphic data outlined in Section 2.2.3.2.



NOTES:

1. CHARACTERS: The CHARACTER fields may be used to define additional information concerning the alphanumeric blocks. The block contains an even number of ASCII characters. This block follows the conventions for non-graphic data outlined in Section 2.2.3.2.

Figure 8-1. Alphanumeric Product Definition Block; Mode 5, Submode 20



NOTES: Figure 8.2:

1. M,N COORDINATE: The M and N coordinate element identifies the starting position of the textual string. It references the lower left corner of the first character in the string. M and N are determined by the COORDINATE FLAG in the Product Definition Block.

2. DELTA M, N: The DELTA M and DELTA N identify the start point of the first character in the string at some desired distance from the M and N coordinate element. The distance remains fixed despite whatever zoom value is used.

3. B = Block Mode: The Block Mode is the indicator for the blanking area covered by a character. If B = 1, a rectangular display area is cleared beneath the standard generated character. If B = 0, the character is displayed normally unless R = 1.

4. R = Reverse Block Mode: The Reverse Block Mode is an indicator for reverse video (negative image). R = 0 is for normal image. R = 1 is the same as B = 1, except the display polarity is reversed.

5. CHAR SIZE: Defines the height/width of a character relative to the font size. Zero indicates standard font size of the display device. If the element is non-zero, it represents a multiplicative factor applied to the standard character size, e.g., 0 = 5 x 7, 1 = 10 x 14, 2 = 15 x 21, etc.

Figure 8-2. Alphanumeric Characters Block; Mode 5, Submode 1

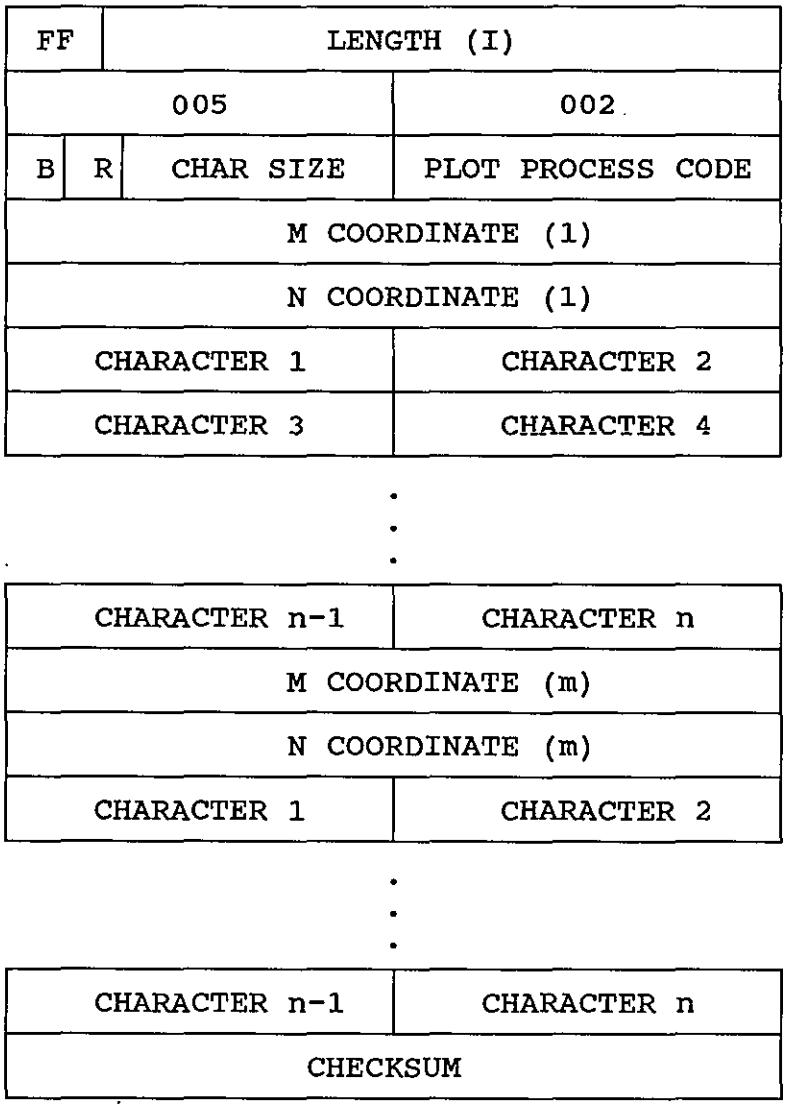


Figure 8-3. Plot Data Block; Mode 5, Submode 2

NOTES: Figure 8.3:

1. B = Block Mode: The Block Mode is the indicator for the blanking area covered by a character. If B = 1, a rectangular display area is cleared beneath the standard generated character. If B = 0, the character is displayed normally unless R = 1.

2. R = Reverse Block Mode: The Reverse Block Mode is an indicator for reverse video (negative image). R = 0 is for normal image. R = 1 is the same as B = 1, except the display polarity is reversed.

3. CHAR SIZE: Defines the height/width of a character relative to the font size. Zero indicates standard font size of the display device. If the element is nonzero, it represents a multiplicative factor applied to the standard character size, e.g., 0 = 5 x 7, 1 = 10 x 14, 2 = 15 x 21, etc.

4. PLOT PROCESS CODE: This octal code specifies the processing required to interpret and display the characters 1 through n contained in the block The PLOT PROCESS CODES are found in Table C2-2.

5. M, N COORDINATE: Specifies the geographical point about which the data is to be plotted. M and N are determined by the coordinate flag in the Product Definition Block.

6. Characters 1 through N: The ASCII character string representing the alphanumeric characters or weather symbols as defined by the Plot Process Code.

Figure 8-3. Plot Data Block; Mode 5, Submode 2

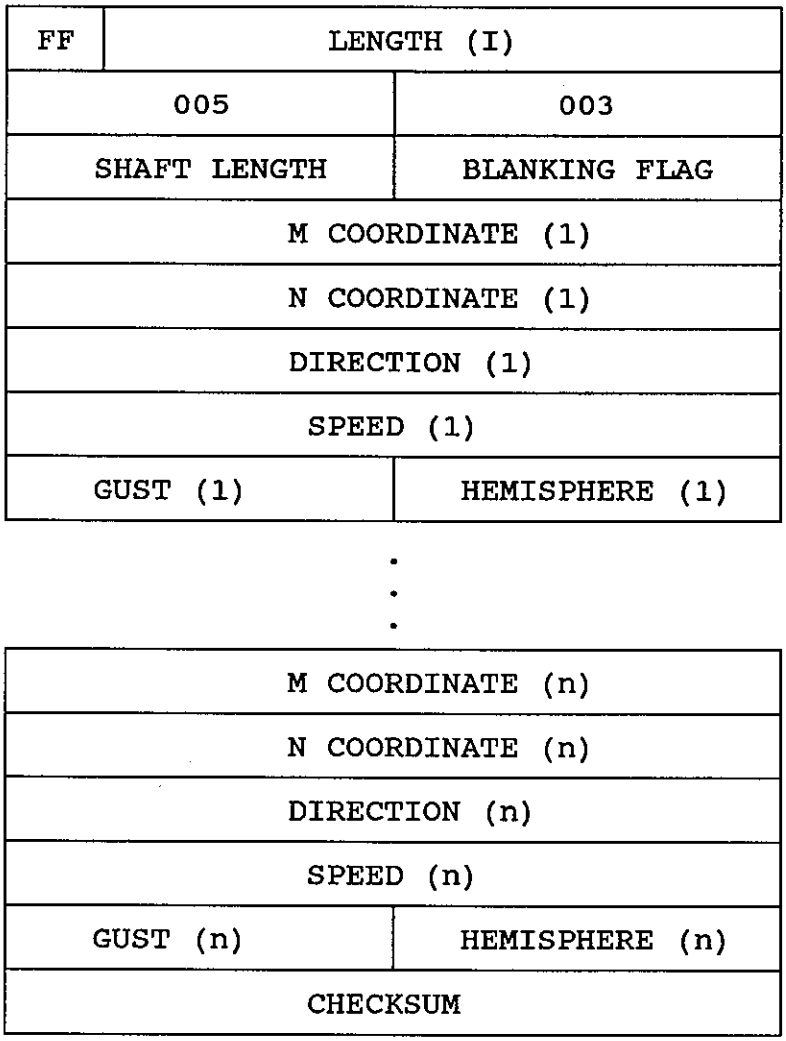


Figure 8-4. Wind Barbs Data Block; Mode 5, Submode 3

NOTES: Figure 8.4:

1. SHAFT LENGTH: The number of pixels for the shaft line (from base to first barb).

2. BLANKING FLAG: An indicator for blanking the area covered by the wind barb font. If left-most bit is set (i.e., a "1") the area is blanked, if the left-most bit is off (i.e., a "0") blanking is not done.

3. M,N COORDINATES: Defines the location of the base of the wind barb shaft. M and N are determined by the COORDINATE FLAG in the Product Definition Block.

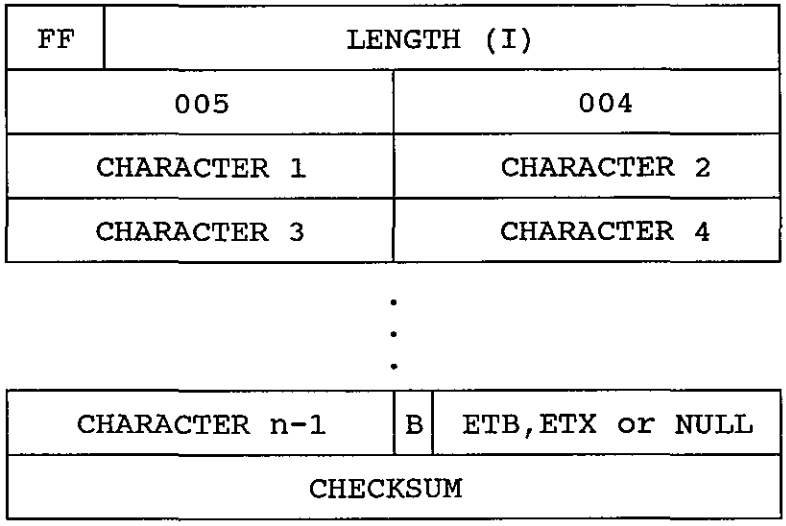
4. DIRECTION: An integer number in whole degrees. It specifies the direction from which the wind is blowing.

5. SPEED: An integer number in whole knots.

6. GUST: An integer number in whole knots.

7. HEMISPHERE: An indicator for Northern or Southern Hemisphere. If the right-most bit is set (1), the wind flags go to the left of the shaft (Southern Hemisphere) as viewed from the head of the shaft. If not set (0), the flags go to the right of the shaft (Northern Hemisphere).

Figure 8-4. Wind Barbs Data Block; Mode 5, Submode 3



NOTES:

1. CHARACTERS: The data field is an even number of ASCII characters (both alphanumeric and control characters).

2. B: The use of this field is optional. It is only used with the ETB/ETX option. See Section 2.2.3.2.B. If B (high order bit) = 1, this byte contains the last character of the data set.

3. ETB, ETX, or Null: If the "Null Termination" option (see Section 2.2.3.2.B) is used, then Null will appear as the only valid termination character for the alphanumeric string. If the ETB/ETX option is used, then the following conventions will apply. The last byte in the block contains the ASCII control character ETB if the block is not the final block in the product data set. The last byte is ASCII control character ETX if the block is the last block in the Product Data Set. See Section 2.2.3.2.

Figure 8-5. Alphanumeric Data Block; Mode 5, Submode 4

CHAPTER 9

RASTER SCAN BLOCKS

9.1. Product Definition Blocks.

9.1.1. Satellite Product Definition Block. This block shall be formatted as shown in Figure 9-1. This block may be used to define all raster scan products that are in the form of visual imagery, i.e., satellite data as opposed to facsimile products.

9.1.2. Pixel Product Definition Block. This block shall be formatted as shown in Figure 9-2. This block shall be used for all non-satellite raster scan products (such as radar or facsimile). This block may also be used for satellite products in addition to, with, or instead of the Satellite Product Definition Block. The data may be packed to conserve transmission time. The algorithm used to pack the data shall be indicated by the pack code.

9.2. Data Description Block. No data description blocks are currently used for raster scan products.

9.3. Data Block. This Raster Scan Data block shall be formatted as shown in Figure 9-3. All raster scan products shall use this format with the XROW, YCOL, and RESOLUTION fields set to one (all bits on) if not used. The origin is 0,0. Pixel data in the data field shall be packed as specified by the pack code and arranged as specified by the pack code in the Product Definition block. The currently defined packing algorithms are described in succeeding sections.

9.3.1. Block Organization.

9.3.1.1. AFGWC Packing Scheme. Each data block shall contain a field giving the row and column location of the first pixel in the block and the resolution of the data, followed by a data field containing the pixel data. Succeeding pixels for the remainder of the scan line proceed as specified by the scan code. For multi-bit deep raster scan products, the pixel data shall consist of a pixel value for each pixel location. For single bit deep raster scan products, the pixel data shall specify state (on or off). The pixel data shall be organized in the data field as a continuous string of bits. The number of bits per pixel shall be specified by the matrix code, i.e., matrix code 01, 11, 21, 41 indicate one bit pixels, 04, 14, 24, 44, represent four bit pixels, etc.

9.3.1.2. National Weather Service Packing Scheme. Products packed in accordance with this scheme shall have the XROW, YCOL, and the resolution elements zero (0) filled. The data field shall be organized such that the pixel data is given in 8-bit bytes and packed within the bytes as follows:

Bit 7 and Bit 6 — These bits are never used.

Bit 5 and Bit 4 — These two bits determine the type of data described in the byte as follows:

- 00 = Number of consecutive pixels in the line in the ON (white) state.
- 01 = Number of consecutive pixels in the OFF (black) state.
- 10 = Unpacked pixel data.
- 11 = Recorder control character.

Bit 3 thru Bit 0 — These bits contain the pixel count, unpacked pixel data, or the control character's lower half. For pixel count, the bits give the number of pixels OFF or ON in groups of four pixels, as indicated by bits 2 and 3. For unpacked pixel data, they give the state (ON and OFF) of the next four pixels in the scan line. If the byte contains the end-of-scan (EOS) control character, bits 4 through 7 are off. If the byte contains the end-of-map (EOM) character, bits 4 and 5 are off and bits 6 and 7 are on.

One byte of the packed pixel data stream can represent, at most, sixty (4*15) pixels of all white or all black data (i.e., UU001111 or UU011111). If bits two and three are the same in two, and at most three, consecutive bytes (e.g., two or three bytes containing UUOO, or two or three bytes containing UU01), then the pixel count in the second byte represents multiples of sixteen, and the third, if present, represents multiples of sixteen squared. For example:

UU001010 UU000101 UU000001 = 10 + (5 * 16) + (1 * 256) = 346 groups = 1384 white pixels (346*4)

UU000111 UU010011 UU011100 UU110000 = 7 groups of white, 3 + (12 * 16) groups of black, and end of scan = 28 white pixels, 1780 black pixels and end of scan

Each block will contain one or more scan lines of the product (or partial lines) as required to fill the data block. Each complete scan line will be followed by an end-of-scan (EOS) sequence (UU110000). If a scan line is not completed before the last byte of a data block, the scan information will continue in the next block and the data shall be treated as if it had been in the same block. If an EOS is encountered before the end of a scan line, then the remainder of the scan line is white, and the next byte begins the next scan line. The final EOS for the product will be followed by an end-of-map (EOM) sequence (UU110011). If the EOM sequence is reached before the end of a data block, the remainder of the block will be filled with EOM sequences and the next block will be the End of Product block.

9.3.2. Block Length.

9.3.2.1. Air Force Global Weather Central (AFGWC) Packing Scheme. Data blocks will be of fixed length for a given product as determined by the number of pixels required to define one complete scan line of the product. Data block length shall be variable from one product to another depending on the size of the product. For example, one product may be a 512 x 512 bit array and another may be a 1024 x 1024 x 6 array.

9.3.2.2 National Weather Service Packing Scheme. Data blocks will be of fixed length for a given product. For example, NWS pixel products are blocked into 960 byte strings. Each block may contain any number of complete or partial scan lines as required to fill the block. Data block length will be variable from one product to another.

FF	LENGTH (I)
006	020
PI SET	GI SET
SATELLITE ID	
LONGITUDE X	
RESOLUTION CODE	DATA TYPE
X MAX	
Y MAX	
ENHANCE MAX	ENHANCE MIN
ENHANCE ID	LENGTH (MM)
X CENTER	Y CENTER
LATITUDE	
LONGITUDE	
NCHAR	CHARACTER 1
CHARACTER 2	CHARACTER 3
CHARACTER 4	CHARACTER 5

.
.
.

CHARACTER n-1	CHARACTER n
CHECKSUM	

Figure 9-1. Satellite Product Definition Block; Mode 6, Submode 20

NOTES: Figure 9-1:

1. PI SET: The PI SET defines the background projection on which the product is valid. The currently defined codes are shown in Table C2-1. If a product is not associated with a background, PI SET will be zero (0) filled.

2. GI SET: The Grid Indicator defines the grid on which the data is valid. Currently defined codes are shown in Table C2-3. If a product is not associated with a GI SET, this field will be zero (0) filled.

3. SATELLITE IDENTIFICATION: Two ASCII characters that identify the satellite from which the product was produced. The first character identifies the agency. Currently assigned values are:

A - Air Force
E - European
I - Indian
J - Japan
N - NOAA
R - Russian
S - NASA
V - Navy

The second byte may contain a letter or number to designate a specific satellite.

4. LONGITUDE X: This is the longitude of the meridian perpendicular to the base of the product and extending from the base of the product to the pole. Longitude X may be outside of the product boundaries. Table C2-1 shows the Longitude X for the defined PI Sets (map projection).

5. RESOLUTION CODE: This element specifies the resolution of the satellite data in the product in tenths of nautical miles, i.e., the resolution must be multiplied by .1 to obtain the actual value.

6. DATA TYPE: An integer code that specifies the type of satellite data contained in the product. The currently defined codes are:

0 = Visual (VIS) only
1 = Infrared (IR) only
2 = Alternating lines of IR/VIS both day or both night
3 = Alternating bytes IR/VIS both day or both night
4 = Alternating lines of night and day both IR or both VIS
5 = Alternating bytes of night and day both IR or both VIS

7. XMAX and YMAX: The maximum horizontal (XMAX) and vertical (YMAX) size of the product in pixels.

Figure 9-1. Satellite Product Definition Block; Mode 6, Submode 20

NOTES: Figure 9-1 (Cont.):

8. ENHANCE MAX and MIN: The limits of the gray scale referenced by ENHANCE ID.

9. ENHANCE ID: An enhancement identification which points to a table of gray scales or an algorithm. Some values are common for interagency use and some are user defined.

10. LENGTH: Length of each scan line in the product in tens of minutes of arc, i.e., length must be multiplied by ten to obtain the actual value.

11. X,Y CENTER: The coordinates of the center of the product in units of the grid from which the product was extracted.

12. LATITUDE and LONGITUDE: The latitude and longitude of the center of the product in hundredths of degree, i.e., latitude and longitude must be multiplied by .01 to obtain the actual value.

13. NCHAR: The number of characters contained in the product title that follows.

14. CHARACTERs 1-n: The ASCII characters that make up the product title.

Figure 9-1. Satellite Product Definition Block; Mode 6, Submode 20

FF	LENGTH (I)
006	030
PI SET	MATRIX CODE
SCAN CODE	PACK CODE
CHECKSUM	

NOTES: Figure 9.2:

1. PI SET: The PI SET defines the background projection on which the product is valid. The currently defined codes are shown in Table C2-1. If a product is not associated with a background, PI SET will be zero (0) filled.

2. MATRIX CODE: A code defining the dimensions of the pixel array being sent in the product. Currently defined codes are:

01 - 512 x 512 x 1
02 - 512 x 512 x 2
03 - 512 x 512 x 3
04 - 512 x 512 x 4
05 - 512 x 512 x 5
06 - 512 x 512 x 6
07 - 512 x 512 x 7
10 - 512 x 512 x 8

11 - 1024 x 1024 x 1
12 - 1024 x 1024 x 2
13 - 1024 x 1024 x 3
14 - 1024 x 1024 x 4
15 - 1024 x 1024 x 5
16 - 1024 x 1024 x 6
17 - 1024 x 1024 x 7
20 - 1024 x 1024 x 8

21 - 2048 x 2048 x 1
22 - 2048 x 2048 x 2
23 - 2048 x 2048 x 3
24 - 2048 x 2048 x 4
25 - 2048 x 2048 x 5
26 - 2048 x 2048 x 6
27 - 2048 x 2048 x 7
30 - 2048 x 2048 x 8

41 - 4096 x 4096 x 1
42 - 4096 x 4096 x 2
43 - 4096 x 4096 x 3
44 - 4096 x 4096 x 4
45 - 4096 x 4096 x 5
46 - 4096 x 4096 x 6
47 - 4096 x 4096 x 7
50 - 4096 x 4096 x 8

63 - 1728 x n x 1 where n is dependent on the size of the product. In this case the number of data blocks must be counted during processing to determine n.

0 - M x N x 1 where M and N are dependent on the size of the product. In this case, M will be specified by the resolution element in the data block and the number of data blocks must be counted during processing to determine N.

Figure 9-2. Pixel Product Definition Block; Mode 6, Submode 30

NOTES: Figure 9.2: Pixel Product Definition Block; Mode 6, Submode 30

3. SCAN CODE: Used to indicate the order in which the raster scan pixels are arranged in the data block. The currently used scan codes are:

1 - Data are arranged in the data block such that pixels are defined row by row (raster scan) from the upper left corner.

2 - Data are arranged in the data block such that the pixels are defined row by row (bottom up raster scan) from the lower left corner.

4. PACK CODE: A code defining the algorithm which was used to pack the product. Currently defined codes are:

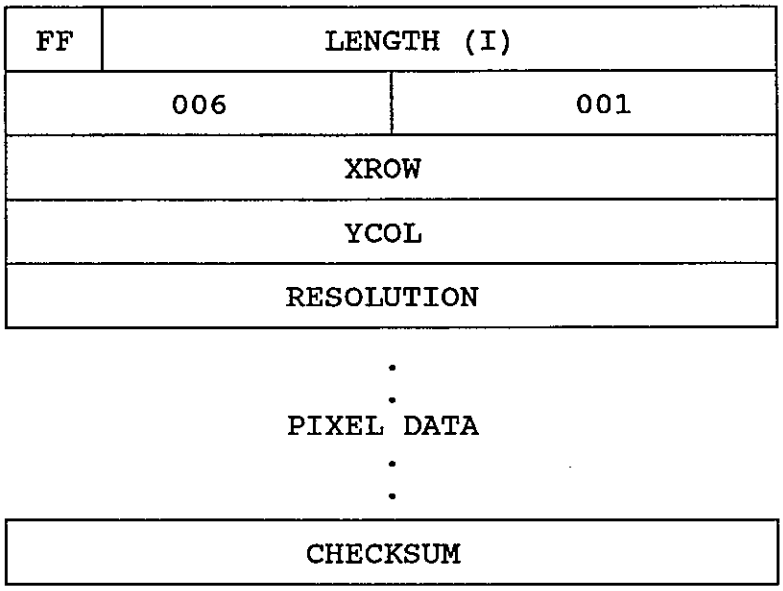
0 - Pixels are unpacked, i.e., each byte contains one pixel.

1 - Pixels are packed in accordance with the AFGWC packing scheme. See Section 9.3.1.1.

2 - Pixels are packed as specified by the Define Datawidth/Fieldwidth block. See Mode 1, Submode 5.

128 - Pixels are packed in accordance with the National Weather Service See Section 9.3.1.2.

Figure 9-2. Pixel Product Definition Block; Mode 6, Submode 30



NOTES:

1. XROW and YCOL: The row and column number, within the product, where the first pixel in the data block is located. For example, 0,0 specifies the first pixel is in row 0, column 0 while 36,492 specifies the first pixel is in row 36, column 492. This location is referenced to the scan direction indicated by the scan code, i.e., for top down scan sequence, 0,0 specifies the upper left corner while 36,492 specifies the 36th row from the top and the 492nd column from the left.

2. RESOLUTION: The number of pixels per scan line.

3. PIXEL DATA: The value, or state, of each pixel in the scan line.

Figure 9-3. Raster Scan Data Block; Mode 6, Submode 1

CHAPTER 10

GRIDDED DATA BLOCKS

10.1. Product Definition Block. The Gridded Data Product Definition Block shall be formatted as shown in Figure 10-1. Gridded data may be transmitted in packed or unpacked format, and as latitude/ longitude or I/J grid data, as determined by the product originator.

10.2. Data Description Block. The data description block for unpacked Gridded Data products shall be in the format shown for Formatted Binary Data products in Figure 6-2. No data description block is used for packed Gridded Data products. The following conventions shall apply to the Gridded Data data description block when used.

10.2.1. Length and Arrangement of Block. Each element being transmitted in the data block shall be described in the ninth through twentieth bytes and succeeding twelve byte sections. The sections shall be in the same order as the elements appear in the element sets of the data block. The length of the data description block shall be sufficient to describe one or more elements, as required by the originator of the product.

10.3. Data Blocks. Due to the significant differences in formal requirements for packed and unpacked Gridded Data products, different data blocks are used.

10.3.1. Unpacked Gridded Data Block. The unpacked Gridded Data data block(s) for both latitude/longitude Gridded Data products and I/J Gridded Data products shall be formatted as shown for Formatted Binary Data in Figure 6-4. The data field of the block shall be formatted as specified in Section 10.2.1 The data field within the data block shall contain element sets aligned end-to-end as shown in Figure 6-4.

10.3.2. Band Index Data Block. This block applies to packed Gridded Data products. Each data block will be used to transmit all grid points in a product for each parameter (e.g., temperature, pressure). One or more additional data blocks may be transmitted sequentially to define all parameters in the product. Blocks shall be formatted as shown in Figure 10-3.

10.3.2.1. Data Unpacking Method. In order to discuss unpacking the data, the method and terms involved in packing the scaled integer grid value must be defined. One constant is chosen and included for each type of data field. This constant is divided into each grid value during the packing process in order to reduce the number of least significant digits. Use of

this Multiplier Constant (termed MC in the explanation) produces a value called the Band Index (BI). Thus for any given grid point value (GV):

$$BI=(GV)/MC$$

A first order difference value is then calculated between consecutive Band Index Values:

$$\text{Delta } BI_n = BI_{n+1} - BI_n$$

Note that BI_1 and Delta BI_1 are given in the Gridded Data Product Definition Block. Now second order derivatives are computed from the first order differences:

$$\text{Delta}^2 \text{ BI} = \text{Delta } BI_{n+1} - \text{Delta } BI_n$$

The data part of the data block consists entirely of Delta^2 BI ...., $\text{Delta}^2 BI_{p-2}$ for a data field with p data points. During packing, the Delta BI computed between the last element of each row and the first element of the next row is computed using the next element directly above rather than beginning at the left side of the next row. Therefore, the scanning computation proceeds left-to-right for the 1st, 3rd, ..., rows and right-to-left for the 2nd, 4th, ..., rows. Decoding grid point value n, then, is done as:

$$GV_n = (BI_{n-1} + \text{Delta } BI_{n-2} + \text{Delta}^2 BI_{n-2}) * MC$$

10.4. Grid Conventions. The three key agencies capable of producing gridded products in accordance with these formats are National Weather Service, the Air Force, and the Navy. Each uses the same basic grid system but employs different (I,J) indexing conventions. Thus, it is important to know the originator of the gridded product, the specific grid being employed, and its relative indexing convention. This information must be used to properly interpret data related to or defined by COORDINATE FLAG = 1 (see Figures 7-1, 7-2, and 10-1). The designation of the COORDINATE FLAG determines the units for all coordinate data in data blocks that follow it. The originator of the product can be determined from the FILE INDICATOR in the Product Identification Block. Specific details concerning gridded products and indexing conventions should be obtained from the agency originating the product.

FF	LENGTH (I)	
007	020	
PI SET	GI SET	
SCALE FACTOR		
COORDINATE FLAG	UNITS CODE	
SCALE EXPONENT	MULTIPLIER CONST.	
FIRST BAND INDEX VALUE		
FIRST DELTA BI IN FIELD		
NUMBER OF COLUMNS		
NUMBER OF ROWS		
* REFERENCE M COORDINATE/M MAXIMUM		
* REFERENCE N COORDINATE/N MAXIMUM		
* I START		
* J START		
MONTH	DAY	Product Valid Time
HOUR	MINUTE	
MONTH	DAY	End of Product Valid Time
HOUR	MINUTE	
I POLE		
J POLE		
RE/D		
LONGITUDE X		
* REF. CODE/GML	SCAN CODE	
CHECKSUM		

* indicates fields are redefined when COORDINATE FLAG = 2

Figure 10-1. Gridded Data Product Definition Block; Mode 7, Submode 20

NOTES: Figure 10.1:

1. PI SET: The PI SET defines the background projection on which the product is valid. The currently defined codes are shown in Table C2-1 (Appendix C). If a product is not associated with a background, PI SET will be zero (0) filled.

2. GI SET: The Grid Indicator defines the grid on which the data is valid. Currently defined codes are shown in Table C2-3. If a product is not associated with a GI SET, the field will be zero (0) filled.

3. SCALE FACTOR and SCALE FACTOR FRACTION: The real world map scale in millions. The first byte contains the integer part, the second byte contains the fraction.

4. COORDINATE FLAG: Coordinate System Indicator as follows:

Flag	*M =*	*N =*	
0	*Latitude*	*Longitude*	*(An earth surface grid in latitude and longitude coordinates.)*
1	*I*	*J*	*(Cartesian coordinates of the earth's surface.)*
2	*X*	*Y*	*(Pixel coordinates of the product background projection.)*

5. UNITS CODE: A code specifying the units of the data elements. The list of units codes is found in Table C2-4 (Appendix C).

*6. SCALE EXPONENT: The number of binary digits scaling which the unpacked integer carries. For example, the Fortran statement GV = FLOAT(IGRID(J)/2**SE will convert an unpacked grid value from IGRID(J) into the real parameter value GV.*

*7. MULTIPLIER CONSTANT (MC): The value that each grid value has been divided by to reduce the number of least significant digits. For Example, if SE = Scale Exponent, and MC = Multiplier Constant, the FORTRAN statement GV = FLOAT(IGRID(J)/2**SE)*MC will convert an unpacked grid value from IGRID(J) into the real parameter GV.*

*8. FIRST BAND INDEX VALUE (BI): This is the Band Index Value at the first grid point. BI(1) = FIX(GV(1)/FLOAT(MC))/2**SE. In other words, the value of the first grid point is modified by the Multiplier Constant and Scale Exponent to reduce the number of bits required to store the number in integer format.*

Figure 10-1. (Cont.) Gridded Data Product Definition Block; Mode 7, Submode 20

NOTES: Figure 10.1 (Cont.):

9. FIRST DELTA BI IN FIELD (DI): The difference between the first two BI's.
Delta BI(1) = BI(2) - BI(1).
The variables BI, MC and SE are described in Notes 6, 7, and 8. The theory is described in Section 10.3.2.1. When unpacking the grid, the value (GV) of the first grid point is given by the FORTRAN statement:
*GV(1) = FLOAT(BI/2**SE)*MC*
and the first DELTA BI value is given by the FORTRAN statement:
*DBI(1) = FLOAT(D1/2**SE)*MC.*
The second grid point is
GV(2) = GV(1) + DBI(1).
The second DELTA BI value is
*DBI(2) = DBI(1) + FLOAT(D2BI(1)/2**SE)*MC.*
The third grid point is
GV(3) = GV(2) + DBI(2).
From then on
*DBI(n-1) = DBI(n-2) + FLOAT(D2BI(n-2)/2**SE)*MC and*
GV(n) = GV(n-1) + DBI(n-1)
where DBI is the computed DELTA BI value and D2BI is the DELTA squared BI value from Mode 7, Submode 1.

10. NUMBER OF COLUMNS: The number of horizontal grids in the grid data area.

11. NUMBER OF ROWS: The number of vertical grids in the grid data area.

12. REFERENCE M and N COORDINATE/M and N MAXIMUM: For COORDINATE FLAG = 0 or 1, these reference coordinates shall specify the first grid point for which data is transmitted and may represent any point in the grid system, usually one of the four corners. M and N are determined by the REFERENCE CODE. For COORDINATE FLAG = 2, these reference coordinates specify the M and N maximum pixel values respectively of the graphic background area within which the data grid is to be superimposed. See Figure 10-2.

13. ISTART, JSTART: For COORDINATE FLAG = 0 or 1, these values designate the starting grid coordinate of the first grid point in the first row. If COORDINATE FLAG = 2, ISTART will be the number of pixels from the left edge of the displayable graphic area to the left-most column of the gridded data field. JSTART will be the number of pixels from the bottom edge of the graphic area to the lower-most row of the gridded field. See Figure 10-2. The grid points proceed row-wise left-to-right NCOLS, then to the next row above and proceed right-to-left and so on up to NROWS.

14. Product/End of Product Valid Time. The Product Valid Time is the time for which the transmitted data is valid or the start time of the valid period. If the 'DAY' element of the End of Product Valid Time is zero (0), the product is valid only at the Product Valid Time. For observed data, the valid time approximates, or may be identical to, the product generation time.

Figure 10-1. (Cont.) Gridded Data Product Definition Block; Mode 7, Submode 20

NOTES: Figure 10.1 (Cont.):

15. IPOLE/JPOLE: For Polar Stereographic projections, the IPOLE/JPOLE fields define the horizontal and vertical grid distances respectively, from the pole to the lower left corner of the product. For Mercator projections, the IPOLE defines the East-West grid system distance from the Greenwich meridian to the meridian that passes through the lower left corner of the product, and JPOLE defines the North-South grid system from the equator to the bottom of the product. For both Polar Stereographic and Mercator projections, the IPOLE/JPOLE grid distances are the number of grid mesh intervals for the product's mesh indicated by the GI Set code.

*16. RE/D: For gridded products on polar stereographic background projections, this specifies the effective number of grid lengths from the pole to the equator on the plane of the projection. It is derived by dividing the distance from the pole to the equator by the length. The grid length depends on the product's grid mesh, indicated by the GI Set code. For gridded products on Mercator background projections, RE/D will be set to zero. The actual entry is scaled by 2**6.*

17. LONGITUDE X: This is the longitude of the meridian perpendicular to the base of the product and extending from the base of the product to the pole. Longitude X may be outside of the product boundaries. Table C2-1 shows the Longitude X for the defined PI Sets (map projection).

18. REFERENCE CODE: If COORDINATE FLAG = 0 or 1, this code indicates where, in the grid, the reference coordinates are located. The currently used reference codes are:

1 - Reference coordinates are located in the upper left corner of the grid.
2 - Reference coordinates are located in the lower left corner of the grid.

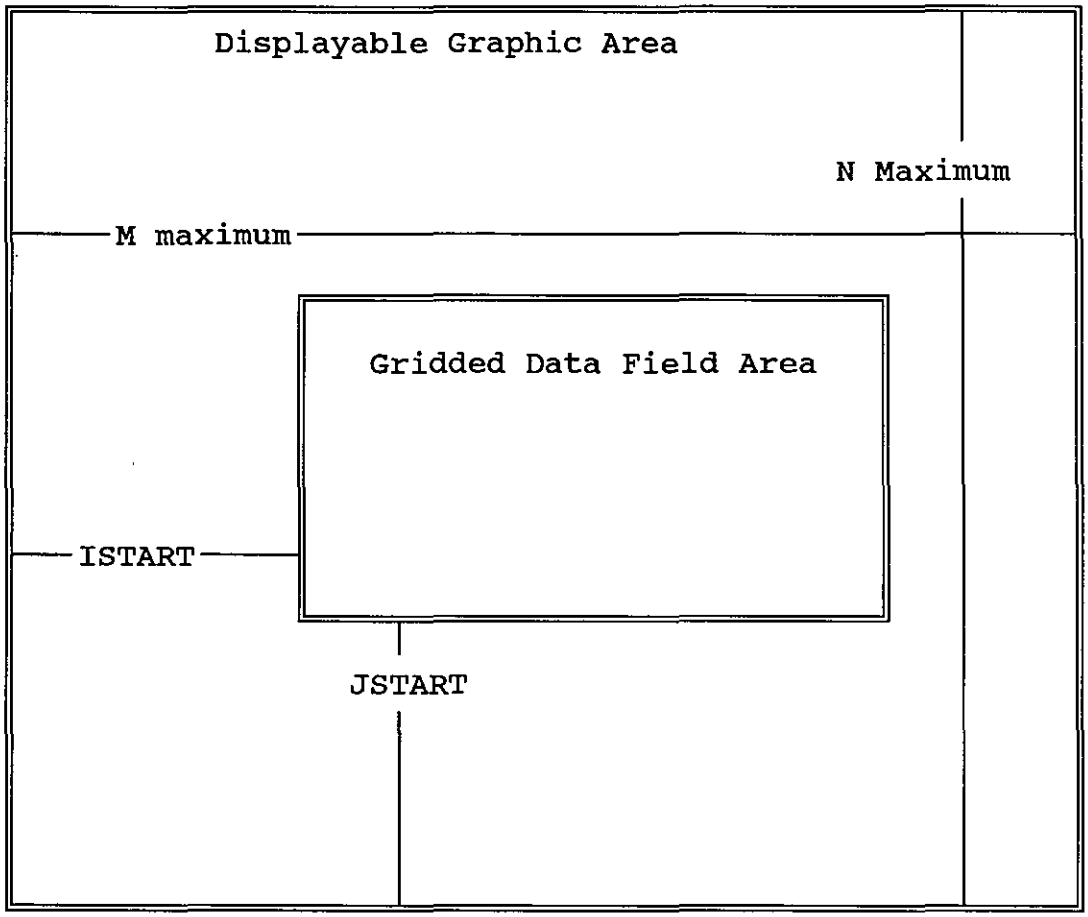
If COORDINATE FLAG = 2, this single byte field will specify the GRID MESH LENGTH (GML) of the grid field. GML is defined to be the number of pixels between adjacent grid points along all columns and rows. All pixel distances reference the displayable graphic area.

19. SCAN CODE: This code is used to indicate the order in which the data for the grid points appear in the data block. The currently used scan codes are:

1 - Data are arranged in the data block such that the grid is defined row by row (raster scan) from the upper left corner.

2 - Data are arranged in the data block such that the grid is defined row by row (bottom up raster scan) from the lower left corner.

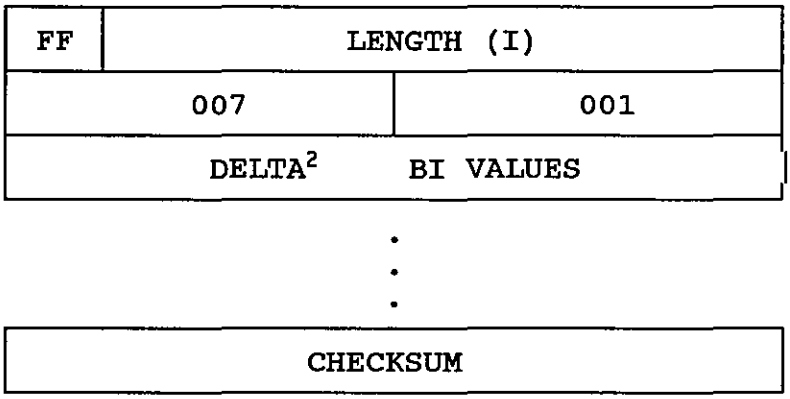
Figure 10-1. (Cont.) Gridded Data Product Definition Block; Mode 7, Submode 20



Notes:

M Maximum and N Maximum, as used here, are encoded in the Gridded Data Product Definition Block as the Reference M and N coordinate, respectively. These values represent the width and height, respectively, of the entire graphic display area in pixels. Two parameters may link the pixel resolution (size) with actual distance on the earth's surface. The first is PI SET, which may define the Displayable Graphic Area (M Maximum by N Maximum) as being a precise geographical background. The second link is the SCALE FACTOR, which defines the Displayable Graphic Area in terms of an actual map scale. Note that when COORDINATE FLAG is 2, the ISTART, JSTART, REFERENCE M, REFERENCE N, and REFERENCE CODE (GML) are all given in terms of pixel values.

Figure 10-2. Gridded Data Definition Block Parameters when COORDINATE FLAG = 2



NOTES:

1. DELTA² BI VALUES: These values are the second derivative of the Band Index Values. The field width is set by the Define Datawidth/Fieldwidth Block (Mode 1, Submode 5). The default is 8 bits (one byte).

Figure 10-3. Band Index Data Block; Mode 7, Submode 1

APPENDIX A

TERMS, DEFINITIONS AND STANDARD VALUES

SECTION 1 - GLOSSARY

SECTION 2 - MNEMONICS

APPENDIX A - SECTION 1

Glossary

Accuracy	The degree of conformity of a measured or calculated value to some recognized standard or specified value.
Analysis	The process of interpreting and collating independent data to obtain a comprehensive definition of the state of the environment.
Block	A string of records, a string of words, or a character string, formed for technical or logic reasons to be treated as an entity.
Byte	Eight contiguous bits (an octet).
Call Letters	A location identifier expressed as a string of alphabetic characters.
Code	A set of items, such as abbreviations, numbers, or string of alphanumeric characters, that represent the members of another set of items. For example, the PI SET is a code that represents the geographical background to be used with a product. The term is also used to describe a string of alphanumeric characters whose structure conveys meaningful information as in weather reporting codes.
Decode	To convert data by reversing the effect of encoding.
Element	The smallest intelligible component of a product, e.g., wind speed, wind direction, a four character mnemonic that defines a parameter, symbol, etc.
Element Set	A collection of two or more elements related to a component of a product, e.g., a weather observation (report), group of vectors describing a graphic line, etc.
Environment	A general term describing three physical areas: the terrestrial environment (the earth itself), the atmospheric environment (the area above the surface of the earth where weather phenomena occur), and the space environment (the area extending from approximately the bottom of the ionosphere to the sun).

Encode	To convert data by the use of a code or a code character set in such a manner that reconversion to the original form is possible.
Field	A bounded collection of data. This term will normally be used with a descriptive adjective that defines the nature of the field, e.g., Gridded Data Field, product identification field, etc.
File Time	The date and time (zulu) a message is made available for transmission purposes.
Flag	A bit, combination of bits, or a character, used to indicate a class of information, a step in a program, or some classification of a value (commonly used for branching).
Forecast	A prediction of the future state of the environment.
Grid	A system of uniformly spaced points referenced to the physical surface of the earth. A grid may be in the form of uniformly spaced latitude and longitude points with the spacing expressed in degrees or in the form of an array of points with rows designated by an integer (I), columns designated by an integer (J), and spacing expressed in nautical miles, kilometers, or some other appropriate linear distance. The latter form of grid is usually referred to as an I/J grid.
I/J Grid	I/J Grid is an array of points in a mapped representation of the earth surface and spaced at a uniform interval in the map. The points are referenced by an integer row number (I) and column number (J). There is a unique algorithm for reference to latitude/longitude from I/J depending on the map transformation formula (i.e., polar stereographic, mercator, Lambert conformal, etc.) and there is an algorithm for determining the true earth distance between grid points (which will in general vary over the map).
Image	The visual depiction of information (e.g., a satellite picture or a vector graphic product displayed on a CRT).
Level	A surface above the surface of the earth defined by the locus of points of equal atmospheric pressure. It is used in connection with upper air data which is reported at altitudes dependent on

	the atmospheric pressure. A level is therefore a surface on which the pressure is everywhere the same.
Location Identifier	A number, or string, of A/N characters that identifies a geographic location (a shorthand notation for name of the location). Location identifiers are assigned by several different organizations (WMO, ICAO, etc.).
Model	An automated set of analysis or forecast algorithms that simulates the dynamics of the environment.
Observation	A collection of information describing weather conditions at a specified location within a specified area.
Octet	Eight contiguous bits (byte).
Precision	A measure of the ability to distinguish between nearly equal values. The degree of mutual agreement between individual measurements, namely repeatability and reproducibility.
Product	A collection of information (element sets) that completely defines a bounded group of related information.
Record	A collection of related data or words treated as a unit, e.g., a synoptic observation.
Rounding	When a figure is to be rounded to fewer digits than the total number available, the procedure should be as follows: a. When the first digit discarded is less than five, the last digit retained should not be changed. b. When the first digit discarded is five or greater, the last figure retained should be increased by one unit.
Set	A finite or infinite number of objects of any kind, or entities, (of components) or concepts, that have a given property or properties in common.

APPENDIX A - SECTION 2

MNEMONICS

Table A2-1 Symbol, Element, and Line Mnemonics

Use Code:

1 = Formatted binary or satellite element mnemonic (appearing in Mode 3/Submode 21 or 30).

2 = Formatted binary data block symbol mnemonic (appearing in Mode 3/ Submode 1).

3 = Vector graphic line mnemonic (appearing in Mode 1/Submode 4).

4 = Vector graphic symbol mnemonic (appearing in Mode 5/Submode 2).

5 = Gridded element mnemonic (appearing in Mode 3/Submode 21).

6 = Formatted binary element mnemonic (appearing in Mode 3/Submode 22).

Mnemonic	Use	Description
A	2,4	Hail
ABA	6	Antenna Beam Azimuth
ABE	6	Antenna Beam Elevation
ABN	6	Antenna Beam Notation
AC	2,4	Altocumulus
ACC	4	Anticyclonic Circulation Center
ACC	2,4	Altocumulus Castellanus (USAF only)
ACS	2/4	Altocumulus Standing Lenticular
ACZ	3	Anticyclonic Wind Shear Zone
AGE	1,5	Snow Age
AH1-AH6	3	Arrowhead Style (6 styles)
ALB	1	Surface albedo
ALT	1,5	Altimeter Setting
AMI	6	Acquisition Mode Identification
AMX	1,5	Amount of Obscuration
ANC	4	Anticyclonic Circulation Center (USAF only)
AOA	3	Axis of Advection
AS	2,4	Altostratus
AUX	3	Auxiliary Upper Level Contour
AW	2,4	Hail Shower
AZR	1,5	Hail Diameter
BC	1	Barometric Characteristic
BC0-BC8	2,4	Barometric Characteristic Trace Code
BD	2,4	Blowing Dust/Sand
BDP	5	Boundary Layer Dewpoint Depression

BDS	*2,4*	*Dust Storm/Sand Storm*
BKN	*2,4*	*Broken (Sky Condition)*
BLK	*1*	*WMO Block Number*
BPOS	*1*	*Beam position*
BS	*2,4*	*Blowing Snow*
BSH	*2,4*	*Blowing Snow-High*
BSIZ	*1*	*Box and mini-box sizes for Sounding data*
BSL	*2,4*	*Blowing Snow-Low*
B11	*3*	*Ceiling less than 1,000 ft and/or Visibility less than 1 mile (area outline)*
CAL	*1*	*ICAO Call Letters*
CAM	*2,4*	*Cloud Amount Missing*
CAT	*3*	*Clear Air Turbulence Outline*
CA0-CA9	*2,4*	*Cloud Amount*
CB	*2,4*	*Cumulonimbus*
CB3	*2,4*	*Cumulonimbus without Anvil*
CB9	*2,4*	*Cumulonimbus with Anvil*
CC	*2,4*	*Cirrocumulus*
CCT	*3,5*	*Climatological Temperature*
CCW	*?*	*Climatological Wind*
CDB	*1,3,5*	*Cloud Base*
CDP	*4*	*Cold Pool*
CDT	*1,3,5*	*Cloud Top*
CFA	*3*	*Cold Front-Aloft*
CFG	*3*	*Cold Frontogenesis*
CFS	*3*	*Cold Front-Surface*
CFX	*3*	*Cold Frontolysis*
CHA	*1,5*	*High Cloud Amount*
CHH	*1,5*	*High Cloud Height*
CHT	*1*	*High Cloud Type*
CI	*2,4*	*Cirrus*
CIG	*1,3,5*	*Ceiling Height*
CLA	*1,5*	*Low Cloud Amount*
CLH	*1,5*	*Low Cloud Height*
CLQ	*6*	*Integrated Cloud Liquid*
CLR	*2,4*	*Clear (Sky Condition)*
CLT	*1*	*Low Cloud Type*
CMA	*1,5*	*Middle Cloud Amount*
CMH	*1,5*	*Middle Cloud Height*
CMT	*1*	*Middle Cloud Height*
CS	*2,4*	*Cirrostratus*
CT	*1*	*Cloud Type*
CTA	*1,5*	*Total Cloud Amount (USAF only)*
CTR	*1*	*Counter*
CU	*2,4*	*Cumulus*
CVA	*3*	*Thunderstorm or Convective Area Outline*
CVG	*3*	*Convergence Area Outline*
CYC	*4*	*Cyclonic Circulation Center*
C1A	*1,5*	*First Cloud Layer Amount*
C1B	*1,5*	*Contrail Base 1*
C1C	*1,5*	*Contrail Top 1*

C1H	1,5	First Cloud Layer Height
C1T	1	First Cloud Layer Type
C2A	1,5	Second Cloud Layer Amount
C2B	1,5	Contrail Base 2
C2C	1,5	Contrail Top 2
C2H	1,5	Second Cloud Layer Height
C2T	1	Second Cloud Layer Type
C3A	1,5	Third Cloud Layer Amount
C3H	1,5	Third Cloud Layer Height
C3T	1	Third Cloud Layer Type
C33	3	Ceiling less than 3,000 ft and/or Visibility less than 3 miles (area outline)
D	2,4	Dust/Sand - Slight
DAY	1	Day of the Month
DD	2,4	Dust Devil
DFG	6	Digitally Filtered Ground clutter removal gates
DIP	6	Data Integration Period
DIR	1,5,6	Wind Direction
DIV	3,5	Divergence
DL1-DL7	3	Dashed Line (seven colors)
DPD	1,3,5	Dewpoint Depression
DPT	1,3,5,6	Dewpoint Temperature
DRY	3	Dry Line
DVL	3,5	D-Value
D10	3	Ceiling less than 10,000 ft (area outline)
ELV	6	Elevation (msl meters)
EPT	5	Equivalent Potential Temperature
F	2,4	Fog/Ice Fog
FGD	6	Radial distance to center of first radar gate (meters)
FGH	6	Height (vertical) to center of first gate (meters)
FLAG	1	Flag
FNL	2,4	Funnel Cloud
FPH	2,4	Fog during past hour
GF	2,4	Ground Fog
GMH	6	Geometric heights
GPH	1,3,5,6	Geopotential Height
GST	1	Wind Gust
H	2,4	Haze
HGT	1,3,5	Altitude (Height)
HI	4	High Pressure/Height Center
HR	1,6	Hour
HSS	3	Horizontal Speed Shear
HTF	3	Height Fall Area Outline
I	3	Icing
ICE	3	Ice Cover
ICG	3	Icing Area Outline

ICL	4	Clear Icing - Light
ICM	4	Clear Icing - Moderate
ICS	4	Clear Icing - Severe
ICT	4	Clear Icing - Trace
ID	1	Identification of DMSP satellite
IDT	6	Instrument Dwell Time
IF	2,4	Ice Fog (USAF only)
IML	4	Mixed Icing - Light
IMM	4	Mixed Icing - Moderate
IMS	4	Mixed Icing - Severe
IMT	4	Mixed Icing - Trace
INS	4	Shear/Instability Line
IP	2,4	Ice Pellets
IPW	2,4	Ice Pellet Shower
IPZ	2,4	Ice Prisms
IRL	4	Rime Icing - Light
IRM	4	Rime Icing - Moderate
IRS	4	Rime Icing - Severe
IRT	4	Rime Icing - Trace
JLH	1	Julian Hour
K	2,4	Smoke
L	2,4	Drizzle/Moderate Drizzle
L+	2,4	Heavy Drizzle
L-	2,4	Light Drizzle
LAT	1,6	Latitude
LES	3	Less than 2/8 Cloud Cover (area outline)
LO	4	Low Pressure/Height Center
LON	1,6	Longitude
LPH	2,4	Drizzle during past hour
LTG	2,4	Lightning
L1A-L4A	1	Cloud Amount Layer 1-4 (4 layers) (USAF only)
L1H-1	1	Cloud Height Layer 1-4 (4 layers) (USAF only)
L1T-L4T	1	Cloud Type Layer 1-4 (4 layers) (USAF only)
MDV	3,5	Medium Range D-Value
MN	1,6	Minute
MNS	4	Minus Sign
MO	6	
MON	1	Month
MW1-MW3	1	Maximum Wind Level 1-3 (3 levels)
NRG	6	Number of Range Gates
NS	2,4	Nimbostratus
NSA	6	Number of Spectral Averages
NUL	6	Null, or fields to be ignored
OBS	2,4	Obscured (Sky Condition)
OFA	3	Occluded Front-Aloft
OFS	3	Occluded Front-Surface

OFX	3	Occluded Frontolysis
OPF	6	Center operating frequency
OVC	2,4	Overcast (Sky Condition)
OVV	3,5	Omega/Vertical Velocity
OZ	1	Ozone
PC3	1	Pressure Characteristic - 3 hr
PKG	1	Peak Gust
PLS	4	Plus Sign
PNN	6	Processing Node Name
PP	1,3	Barometric tendency (3-hour pressure change)
PPP	1,3	Sea Level Pressure
PPW	1,5,6	Precipitable Water
PRP	6	Pulse Repetition Period
PRS	1,5,6	Pressure
PRST	1	Tropopause Pressure
PVA	3	Positive Vorticity Advection Line
PWB	2,4	Past Weather - Blowing Dust or Snow
PWF	2,4	Past Weather - Fog
PWL	2,4	Past Weather - Drizzle
PWR	2,4	Past Weather - Rain
PWS	2,4	Past Weather - Snow
PWT	2,4	Past Weather - Thunderstorm
PWW	2,4	Past Weather - Showers
PWX	1	Past Weather
QPF	3,5	Quantitative Precipitation Forecast
QQ1-QQ9	4,6	Special Symbol 1-9 (defined by originator of product)
R	2,4	Rain/Moderate Rain
R+	2,4	Heavy Rain
R-	2,4	Light Rain
RAM	6	Radar Acquisition Mode
RDG	3	Ridge Axis
REV #	1	Orbit number
RMV	6	Radar Mean Velocity
RNL	6	Radar Noise Level estimate
RPH	2,4	Rain During Past Hour
RPW	6	Radar Pulse Width
RS	2,4	Rain and Snow Mixed
RSD	6	Radar Spectral Data values
RSI	6	Radar Sampling Interval
RSN	6	Radar Site Name
RSP	6	Radar Signal Power
RSW	2,4	Showers of Rain and Snow Mixed
RVV	6	Radar velocity variance
RW	2,4	Rain Showers
R06	1,3,5	6-Hour Precipitation Amount
R24	1,3,5	24-Hour Precipitation Amount
S	2,4	Snow/Moderate Snow

S+	*2,4*	*Heavy Snow*
S-	*2,4*	*Light Snow*
SC	*2,4*	*Stratocumulus*
SCID	*1*	*Satellite ID*
SCT	*2,4*	*Scattered (Sky Condition)*
SD	*1*	*Ship Direction (USAF Only)*
SDD	*1*	*Ship Direction*
SDP	*4*	*Subtropical Depression*
SD0-SD8	*2,4*	*Ship Direction 0-8 (9 values: becalmed & 8 points of compass clockwise from NE)*
SEC	*1*	*Second*
SFA	*3*	*Stationary Front - Aloft*
SFG	*3*	*Stationary Frontogenesis*
SFS	*3*	*Stationary Front - Surface*
SFX	*3*	*Stationary Frontolysis*
SG	*2,4*	*Snow Grains (USAF only)*
SGR	*2,4*	*Snow Grains*
SKY	*1,5*	*Sky Cover (Total Cloud Amount)*
SL1-SL7	*3*	*Solid Line 1-7 (7 colors)*
SNO	*3,5*	*Snow Depth*
SNR	*6*	*Signal-to-noise ratios*
SOA	*3*	*Stationary Occluded Front - Aloft*
SOS	*3*	*Stationary Occluded Front - Surface*
SOX	*3*	*Stationary Occluded Frontolysis*
SPD	*1,3,5,6*	*Wind Speed*
SPH	*2,4*	*Snow During Past Hour*
SPL	*6*	*Minimum signal power used in scaling*
SPW	*6*	*Maximum signal power used in scaling*
SQL	*2,4*	*Squalls*
SRN	*6*	*Software Revision Number*
SRP	*6*	*Standard Reporting Period*
SSN	*4*	*Subtropical Storm - Northern Hemisphere*
SSS	*1,3,5*	*Sea Surface Temperature*
ST	*2,4*	*Stratus*
STF	*3,5*	*Stream Function Value*
STM	*3,5*	*Streamline*
STN	*1*	*WMO Station Number*
SV	*1*	*Ship Speed (USAF only)*
SVH	*6*	*Maximum spectral value over all spectra*
SVL	*6*	*Minimum spectral value over all spectra*
SVV	*1*	*Ship Speed*
SW	*2,4*	*Snow Showers*
SWT	*1,3,5*	*SWEAT Index*
SO6	*1,3,5*	*6-Hour Snowfall Amount*
T	*2,4*	*Thunderstorm*
TA	*2,4*	*Thunderstorm with Hail*
TBB	*6*	*Brightness temperatures*
TBL	*4*	*Turbulence - Light*
TBM	*4*	*Turbulence - Moderate*
TBS	*4*	*Turbulence - Severe*
TCN	*4*	*Tropical Cyclone - Northern Hemisphere*

TCS	4	Tropical Cyclone - Southern Hemisphere
TCU	2,4	Towering Cumulus
TDA	6	Number of time domain averages (coherent averages)
TDP	4	Tropical Depression
TMP	1,3,5,6	Temperature
TMPB	1	Brightness Temperature
TMPM	1	Mean Temperature
TMPS	1	Skin (surface) temperature
TMPT	1	Tropopause temperature
TPH	2,4	Thunderstorm During Past Hour
TP1-TP3	1,3	Tropopause Level 1-3 (3 levels)
TPP	6	Tropopause height
TRO	3	Trough Axis
TRP	4	Triple Point
TRS	2,4	Thunderstorm with Rain and Snow Mixed
TRW	2,4	Thunderstorm with Rainshower
TR7	3	700 mb Temperature Ridge
TSD	6	Time Series Data
TSP	6	Number of time series points (= FFT points)
TSN	4	Tropical Storm - Northern Hemisphere
TSS	4	Tropical Storm - Southern Hemisphere
TSW	2,4	Thunderstorm with Snowshower
TTN	1,3,5	Minimum Temperature
TTX	1,3,5	Maximum Temperature
TXT	6	Informational text messages
UWC	5,6	U Wind Component
VGS	6	Vertical inter-range gate spacing (center to center)
VGW	6	Vertical range gate width (meters)
VIS	1,3,5	Visibility
VMC	4	Vorticity Maximum
VRT	3,5	Vorticity
VWC	5,6	V Wind Component
WBC	4	Wind Barb - 100 knots
WBI	4	Wind Barb - 1 or 2 knots
WBL	4	Wind Barb - 50 knots .
WBV	4	Wind Barb - 5 knots
WBX	4	Wind Barb - 10 knots
WDM	2,4	Wind Direction Missing
WET	3	Non-Convective or Intermittent Precipitation (area outline)
WFA	3	Warm Front-Aloft
WFG	3	Warm Frontogenesis
WFS	3	Warm Frontolysis
WFX	3	Warm Frontolysis
WMP	4	Warm Pool
WMIX	1	Water vapor mixing ratio
WNC	2,4	Calm Wind

WPH	*2,4*	*Showers During Past Hour*
WSM	*2,4*	*Wind Speed Missing*
WVD	*1*	*Wave Direction*
WVH	*1*	*Wave Height*
WW1	*1,5*	*Primary Present Weather*
WW2	*1,5*	*Secondary Present Weather*
WW34	*1,5*	*Tertiary Present Weather*
WWC	*6*	*W (vertical) wind component*
XTRA	*1*	*Spare elements or field (some data elements not returned by every satellite*
YR	*1*	*Year*
ZANL	*1*	*Zenith angle, local*
ZANS	*1*	*Zenith angle, solar*
ZL	*2,4*	*Freezing Drizzle*
ZPH	*2,4*	*Freezing Precipitation During Last Hour*
ZR	*2,4*	*Freezing Rain*
ZZ1-ZZ9	*1,3,5,6*	*Special Parameter 1-9 (9 parameters)*

Table A2-2. Data Block Data Code with Corresponding Mnemonics

NOTE: Formatted binary products originating from the USAF do not use mnemonics in the formatted binary data block (Use Code 2 in Table A2-1). Certain formatted binary element mnemonics use a binary data block code, making data binary in Mode 3/Submode 1. The following shows the element description mnemonic (which could appear in Mode 3/Submode 21), the data block data code (which could then appear in Mode 3/Submode 1), and the mnemonic to which that data code corresponds.

	Data Description Mnemonic	Data Block Data Code	Corresponding Mnemonic
Barometric Characteristic	*BC*		
0 - Rising then falling		*160*	*BC0*
1 - Rising then steady		*161*	*BC1*
2 - Rising		*162*	*BC2*
3 - Falling or steady, then rising		*163*	*BC3*
4 - Steady		*164*	*BC4*
5 - Falling then rising		*165*	*BC5*
6 - Falling then steady		*166*	*BC6*
7 - Falling		*167*	*BC7*
8 - Steady or rising, then falling		*168*	*BC8*
Cloud Amount Total	*CTA*		
M - Missing		*149*	*CAM*
0 - No Clouds (Airways clear)		*150*	*CA0,CLR*
1 - One tenth		*151*	*CA1*
2 - Two to three tenths (Airways scattered)		*152*	*CA2,SCT*
3 - Four tenths		*153*	*CA3*
4 - Five tenths		*154*	*CA4*
5 - Six tenths		*155*	*CA5*
6 - Seven to eight tenths (Airways broken)		*156*	*CA6,BKN*
7 - Nine tenths		*157*	*CA7*
8 - Ten tenths (Airways overcast)		*158*	*CA8,OVC*
9 - Obscured		*159*	*CA9,OBS*

Present Weather

Present Weather (primary)	*WW1*
Present Weather (secondary)	*WW2*
Present Weather (tertiary)	*WW3*

No Weather Reportable	*000*	
Smoke	*004*	*K*
Haze	*005*	*H*
Dust/Sand	*006*	*D*
Blowing Dust/Sand	*007*	*BD*
Dust Devil	*008*	*DD*
Lightning	*013*	*LTG*
Thunderstorm	*017*	*T*
Squalls	*018*	*SQL*
Funnel Cloud	*019*	*FNL*
Drizzle during past hour	*020*	*LPH*
Rain during past hour	*021*	*RPH*
Snow during past hour	*022*	*SPH*
Freezing precipitation during last hour	*024*	*ZPH*
Showers during past hour	*025*	*WPH*
Fog during past hour	*028*	*FPH*
Thunderstorm during past hour	*029*	*TPH*
Dust Storm/Sand Storm	*031*	*BDS*
Blowing Snow	*038*	*BS*
Ground Fog	*044*	*GF*
Fog	*045*	*F*
Ice Fog	*049*	*IF*
Drizzle, light	*051*	*L-*
Drizzle, moderate	*053*	*L*
Drizzle, heavy	*055*	*L+*
Freezing Drizzle	*056*	*ZL*
Rain, light	*061*	*R-*
Rain, moderate	*063*	*R*
Rain, heavy	*065*	*R+*
Freezing Rain	*066*	*ZR*
Rain and Snow Mixed	*068*	*RS*
Snow, light	*071*	*S-*
Snow, moderate	*073*	*S*
Snow, heavy	*075*	*S+*
Ice Prisms	*076*	*IPZ*
Snow Grains	*077*	*SG, SGR*
Ice Pellets	*079*	*IP*
Rain Showers	*080*	*RW*
Showers of Rain and Snow Mixed	*083*	*RSW*
Snow Showers	*085*	*SW*
Ice Pellet Shower	*087*	*IPW*
Hail Shower	*089*	*AW*
Thunderstorm with Rainshower	*093*	*TRW*
Thunderstorm with Snowshower	*094*	*TSW*
Thunderstorm with Rain and Snow Mixed	*095*	*TRS*
Thunderstorm with Hail	*096*	*TA*

Cloud Type

Cloud Type Layer 1	*L1T*		
Cloud Type Layer 2	*L2T*		
Cloud Type Layer 3	*L3T*		
Cloud Type Layer 4	*L4T*		

Cloud Type (layer 1 - 4) Codes

Cumulus (low cloud 1,8)	*111*	*CU*
Towering Cumulus (low cloud 2)	*112*	*TCU*
Cumulonimbus without Anvil (low cloud 3)	*113*	*CB,CB3*
Stratocumulus (low cloud 4,5)	*114*	*SC*
Stratus (low cloud 6,7)	*116*	*ST*
Cumulonimbus with Anvil (low cloud 9)	*119*	*CB,CB9*
Altostratus (middle cloud 1)	*121*	*AS*
Nimbostratus (middle cloud 2)	*122*	*NS*
Altocumulus (middle Cloud 3,5,6,7,9)	*123*	*AC*
Altocumulus Standing Lenticular (middle cloud 4)	*124*	*ACS*
Altocumulus Castellanus (middle cloud 8)	*128*	*ACC*
Cirrus (high cloud 1,2,3,4)	*131*	*CI*
Cirrostratus (high cloud 5,6,7,8)	*135*	*CS*
Cirrocumulus (high cloud 9)	*139*	*CC*

Past Weather	*PWX*		
Blowing dust or snow		*103*	*PWB*
Fog		*104*	*PWF*
Drizzle		*105*	*PWL*
Rain		*106*	*PWR*
Snow		*107*	*PWS*
Showers		*108*	*PWW*
Thunderstorm		*109*	*PWT*

Ship Direction	*SD*		
Becalmed		*170*	*SD0*
NE		*171*	*SD1*
E		*172*	*SD2*
SE		*173*	*SD3*
S		*174*	*SD4*
SW		*175*	*SD5*
W		*176*	*SD6*
NW		*177*	*SD7*
N		*178*	*SD8*

Missing Wind Direction	*186*	*WDM*
Missing Wind Speed	*188*	*WSM*

MNEMONICS

Table A2-3. Other Mnemonics Used in this Report

AFGWC	*Air Force Global Weather Central*
ANSI	*American National Standards Institute*
ASCII	*American Standard Code for Information Interchange*
AWS	*Air Weather Service*
A/N	*Alphanumeric*
BI	*Band Index*
CPC	*Calcomp Pen Command*
CPU	*Central Processing Unit*
DB	*Data Blocks*
DDB	*Data Description Block*
EOM	*End of Map*
EOS	*End of Scan*
ETB	*End of Text Block*
ETX	*End of Text*
FAA	*Federal Aviation Administration*
FF	*Flag (2-bit indicator)*
GI	*Grid Indicator*
GMT	*Greenwich Mean Time*
GV	*Grid Value*
H	*Hemisphere*
ICAO	*International Civil Aviation Organization*
IDV	*Initial Direction (Vector)*
I/J	*Cartesian Coordinate Set (reference earth surface)*
IL	*Increment Length (Vector)*
IPOLE/JPOLE	*Grid Coordinates of the North or South Pole*
LAT/LON	*Latitude/Longitude Coordinates*
MC	*Multiplier Constant*
M/N	*Generalized Coordinate Set*
NIST	*National Institute of Standards and Technology*
NCHAR	*Number of Characters (in product title)*
NWS	*National Weather Service*
OCT	*Octant*

PDB	*Product Definition Block*
PI	*Projection (map) Indicator*
PI SET	*Projection Indicator Set. A code that defines the background geographic projection on which the transmitted product is valid. The PI SET provides the means by which products can be registered to geography.*
RE/D	*Effective Number of Grid Points from Pole to Equator*
VEV	*Variable Exception Vector*
WMO	*World Meteorological Organization*
XMAX	*Maximum Horizontal Size*
XROW/YCOL	*Pixel Coordinates for Scan Lines*
X/Y	*Pixel Coordinate Set (reference display area)*
YMAX	*Maximum Vertical Size*
Z	*Greenwich Mean Time (GMT)*
Z	*Zoom Disable Indicator*

APPENDIX B

REFERENCES

1. Standard Telecommunication Procedures for Weather Data Exchange. FCM-S3-1989, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Federal Coordinator for Meteorological Services and Supporting Research: Washington, D.C., July 1989

2. AFOS Handbook Series, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service: Washington, D.C.

3. Location Identifiers. 7350.5Y, U.S. Department of Transportation, Federal Aviation Administration, Air Traffic Operations Service: Washington, D.C.

4. NOAA/NWS Location Identifiers. Communications Handbook No. 5, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service: Washington, D.C.

5. Binary Universal Form for data Representation (WMO Code FM 94 BUFR), 1988, World Meteorological Organization: Geneva, Switzerland.

6. The Storage of Weather Product Information and the Exchange of Weather Product Messages in Gridded Binary Form (WMO Code FM 92-VIII Ext.), 1989, World Meteorological Organization: Geneva, Switzerland.

7. AWIPS/NOAAPORT Interface Control Document, February 1990, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service: Washington, D.C.

APPENDIX C

CODE TABLES

SECTION 1 GENERAL

SECTION 2 METEOROLOGICAL PROGRAM CODES

APPENDIX C - SECTION 1

GENERAL

Table C1-1. Standard ASCII Code

Octal	Hexadecimal	Mnemonic	Meaning
000	00	NUL	Null
001	01	SOH	Start of Heading
002	02	STX	Start of Text
003	03	ETX	End of Text
004	04	EOT	End of Transmission
005	05	ENQ	Enquiry
006	06	ACK	Acknowledge
007	07	BEL	Bell
010	08	BS	Backspace
011	09	HT	Horizontal Tabulation
012	0A	LF	Line Feed
013	0B	VT	Vertical Tabulation
014	0C	FF	Form Feed
015	0D	CR	Carriage Return
016	0E	SO	Shift Out
017	0F	SI	Shift In
020	10	DLE	Data Link Escape
021	11	DC1	Device Control 1
022	12	DC2	Device Control 2
023	13	DC3	Device Control 3
024	14	DC4	Device Control 4
025	15	NAK	Negative Acknowledge
026	16	SYN	Synchronous Idle
027	17	ETB	End of Transmission Block
030	18	CAN	Cancel
031	19	EM	End of Medium
032	1A	SUB	Substitute
033	1B	ESC	Escape
034	1C	FS	File Separator
035	1D	GS	Group Separator
036	1E	RS	Record Separator
037	1F	US	Unit Separator

040	20	SP	Space (nonprinting)
041	21	!	Exclamation Point
042	22	"	Quotation Marks (Diaeresis)
043	23	#	Number Sign (Note 1)
044	24	$	Dollar Sign
045	25	%	Percent Sign
046	26	&	Ampersand
047	27	'	Apostrophe (Closing single quote, Acute Accent)
050	28	(	Opening Parenthesis
051	29	)	Closing Parenthesis
052	2A	*	Asterisk
053	2B	+	Plus
054	2C	,	Comma (Cedilla)
055	2D	-	Hyphen (Minus)
056	2E	.	Period (Decimal Point)
057	2F	/	Slant
060	30	0	Digit
061	31	1	Digit
062	32	2	Digit
063	33	3	Digit
064	34	4	Digit
065	35	5	Digit
066	36	6	Digit
067	37	7	Digit
070	38	8	Digit
071	39	9	Digit
072	3A	:	Colon
073	3B	;	Semicolon
074	3C	<	Less Than
075	3D	=	Equals
076	3E	>	Greater Than
077	3F	?	Question Mark
100	40	@	Commercial At (Note 1)
101	41	A	Upper Case Latin Letter
102	42	B	Upper Case Latin Letter
103	43	C	Upper Case Latin Letter
104	44	D	Upper Case Latin Letter
105	45	E	Upper Case Latin Letter
106	46	F	Upper Case Latin Letter
107	47	G	Upper Case Latin Letter

110	48	H	Upper Case Latin Letter
111	49	I	Upper Case Latin Letter
112	4A	J	Upper Case Latin Letter
113	4B	K	Upper Case Latin Letter
114	4C	L	Upper Case Latin Letter
115	4D	M	Upper Case Latin Letter
116	4E	N	Upper Case Latin Letter
117	4F	O	Upper Case Latin Letter
120	50	P	Upper Case Latin Letter
121	51	Q	Upper Case Latin Letter
122	52	R	Upper Case Latin Letter
123	53	S	Upper Case Latin Letter
124	54	T	Upper Case Latin Letter
125	55	U	Upper Case Latin Letter
126	56	V	Upper Case Latin Letter
127	57	W	Upper Case Latin Letter
130	58	X	Upper Case Latin Letter
131	59	Y	Upper Case Latin Letter
132	5A	Z	Upper Case Latin Letter
133	5B	[	Opening Bracket (Note 1)
134	5C	\	Reverse Slant (Note 1)
135	5D	]	Closing Bracket (Note 1)
136	5E	^	Circumflex (Note 1)
137	5F	_	Underline
140	60	'	Opening Single Quotation Mark (Grave Accent) (Note 1)
141	61	a	Lower Case Latin Letter
142	62	b	Lower Case Latin Letter
143	63	c	Lower Case Latin Letter
144	64	d	Lower Case Latin Letter
145	65	e	Lower Case Latin Letter
146	66	f	Lower Case Latin Letter
147	67	g	Lower Case Latin Letter
150	68	h	Lower Case Latin Letter
151	69	i	Lower Case Latin Letter
152	6A	j	Lower Case Latin Letter
153	6B	k	Lower Case Latin Letter
154	6C	1	Lower Case Latin Letter
155	6D	m	Lower Case Latin Letter
156	6E	n	Lower Case Latin Letter
157	6F	o	Lower Case Latin Letter

160	*70*	*p*	*Lower Case Latin Letter*
161	*71*	*q*	*Lower Case Latin Letter*
162	*72*	*r*	*Lower Case Latin Letter*
163	*73*	*s*	*Lower Case Latin Letter*
164	*74*	*t*	*Lower Case Latin Letter*
165	*75*	*u*	*Lower Case Latin Letter*
166	*76*	*v*	*Lower Case Latin Letter*
167	*77*	*w*	*Lower Case Latin Letter*
170	*78*	*x*	*Lower Case Latin Letter*
171	*79*	*y*	*Lower Case Latin Letter*
172	*7A*	*z*	*Lower Case Latin Letter*
173	*7B*	*{*	*Opening Brace (Note 1)*
174	*7C*	*|*	*Vertical Line (Note 1)*
175	*7D*	*}*	*Closing Brace (Note 1)*
176	*7E*		*Tilde (Note 1)*
177	*7F*	*DEL*	*Delete*

NOTE 1: Should be checked for international exchange.

APPENDIX C - Section 2

METEOROLOGICAL PROGRAM CODES

Table C2-1. Projection Indicator (PI) Set Codes

NOTES:

1. Projection reference latitudes are 60N for Northern Hemisphere polar stereographic and 22.5N and 22.5S for Mercator.

2. Projection (polar stereographic, Mercator), Longitude X (except Mercator), and ASCII Descriptor for the LAWC PI Set Codes will be determined by mutual agreement between the exchanging agencies controlling the weather information systems involved in the data exchange.

3. The following linear size ratios apply for polar stereographic;

Hemispheric = 6:1
Continental/Oceanic = 3:1
Regional Window = 2:1
Subwindow = 1:1

4. The following linear size ratios apply for Mercator:

Tropical Continental/Ocean = 3:1
Regional Window = 2:1
Subwindow = 1:1

5. Lower left corner points are in units of the USAF AFGWC whole mesh Satellite Global Data Base (SGDB) grid. The area coverage of the hemispheric projections are always 49 x 49 whole mesh SGDB grid points. The Continental/Ocean are always 25 x 25. The Regional are always 17 x 17. The Subwindows are 9 x 9. The SGDB grid point values can be converted to NMC and FNOC whole mesh grid point values.

PI SET CODE	DESCRIPTION	PROJECTION	LONG X	LOWER LEFT CORNER POINT ROW	COLUMN	ASCII DES-CRIPTOR
00	No Background					
1	N. Hemisphere US	Polar Stereographic	80W	9	57	XW
2	N. Hemisphere Europe	Polar Stereographic	10E	57	57	XN

3	N. Hemisphere Pacific	Polar Stereographic	170W	9	9	XP
4	N. Hemisphere Asia	Polar Stereographic	100E	57	9	XE
5	S. Hemisphere	Polar Stereographic	100E	9	57	XS
6 - 9 (Not Assigned)						
10	Cont/Ocean N. America	Polar Stereographic	80W	17	57	NA
11	Cont/Ocean Atlantic (US)	Polar Stereographic	80W	29	53	NT
12	Cont/Ocean Atlantic (Europe)	Polar Stereographic	10E	53	53	EW
13	Cont/Ocean Eurasia	Polar Stereographic	10E	57	36	AS
14	Cont/Ocean N.W. Pacific	Polar Stereographic	170W	9	9	PQ
15	Cont/Ocean N.E. Pacific	Polar Stereographic	170W	9	25	PN
16	Cont/Ocean Far East	Polar Stereographic	100E	33	9	FE
17 - 30 (Not Assigned)						
31	Regional Window Caribbean	Mercator		69	19	CA
32	Regional Window Tropical Hawaiian Islands	Mercator		47	19	TR
33	Regional Window Marianas	Mercator		31	19	MY
34	Regional Window S.E. Asia	Mercator		25	19	ID
35 - 39 (Not Assigned)						
40	Regional Window CONUS	Polar Stereographic	80W	21	55	US

41	Regional Window East US	Polar Stereographic	80W	25	57	UE
42	Regional Window West US	Polar Stereographic	80W	17	57	UW
43	Regional Window North US	Polar Stereographic	80W	17	49	UN
44	Regional Window Canada	Polar Stereographic	80W	25	49	CN
45	Regional Window Europe	Polar Stereographic	10E	52	39	EU
46	Regional Window East Asia	Polar Stereographic	100E	33	12	JN
47	Regional Window Alaska	Polar Stereographic	170W	18	27	AQ
48	Regional Window Hawaii	Polar Stereographic	170W	7	31	PA
49	Regional Window Azores	Polar Stereographic	10E	49	50	AZ
50 - 59 (Not Assigned)						
60	Tropical Cont/Ocean Indian Ocean	Mercator		9	27	IO
61	Tropical Cont/Ocean W. Pacific	Mercator		31	27	PW
62	Tropical Cont/Ocean E. Pacific	Mercator		53	27	PZ
63	Tropical Cont/Ocean W. Hemisphere	Mercator		63	27	SA
64	Tropical Cont/Ocean Atlantic	Mercator		73	27	ST
65	Tropical Cont/Ocean Africa	Mercator		90	27	AF
66 - 69 (Not Assigned)						
70	Subwindow US (N.W.)	Polar Stereographic	80W	21	47	UM

71	Subwindow US (West)	Polar Stereographic	80W	19	50	UA
72	Subwindow US (Mountain)	Polar Stereographic	80W	22	50	UC
73	Subwindow US (S.W.)	Polar Stereographic	80W	22	53	UX
74	Subwindow US (N. Central)	Polar Stereographic	80W	25	50	UD
75	Subwindow US (S. Central)	Polar Stereographic	80W	25	53	UL
76	Subwindow US (East)	Polar Stereographic	80W	28	52	UO
77	Subwindow US (N.E.)	Polar Stereographic	80W	31	51	UP
78	Subwindow US (S.E.)	Polar Stereographic	80W	28	55	UF
79	Subwindow US (N.E. Pacific)	Polar Stereographic	80W	18	45	UB
80	Subwindow W. Europe	Polar Stereographic	10E	48	38	UK
81	Subwindow Iceland	Polar Stereographic	10E	44	40	IL
82	Subwindow Spain	Polar Stereographic	10E	51	40	SP
83	Subwindow Italy	Polar Stereographic	10E	51	36	IY
84	Subwindow Turkey	Polar Stereographic	10E	51	31	TU
85	Subwindow USSR	Polar Stereographic	10E	45	32	RS
86 - 89 (Not Assigned)						
90	Subwindow Alaska	Polar Stereographic	170W	22	31	AK
91	Subwindow Alaska (Arctic)	Polar Stereographic	170W	26	27	AC

92	*Subwindow Alaska (NW Canada)*	*Polar Stereographic*	*170W*	*26*	*35*	*AY*
93	*Subwindow Alaska (Gulf)*	*Polar Stereographic*	*170W*	*18*	*35*	*GA*
94	*Subwindow Alaska (Bering Sea)*	*Polar Stereographic*	*170W*	*18*	*27*	*LU*
95 - 99 (Not Assigned)						
100	*Subwindow Hawaii*	*Polar Stereographic*	*170W*	*7*	*34*	*HW*
101	*Subwindow Hawaii (NW)*	*Polar Stereographic*	*170W*	*16*	*31*	*HF*
102	*Subwindow Hawaii (NE)*	*Polar Stereographic*	*170W*	*16*	*39*	*HG*
103	*Subwindow Hawaii (E)*	*Polar Stereographic*	*170W*	*7*	*39*	*HH*
104	*Subwindow Hawaii (W)*	*Polar Stereographic*	*170W*	*7*	*31*	*HI*
105 - 109 (Not Assigned)						
110	*Subwindow Korea*	*Polar Stereographic*	*100E*	*30*	*15*	*KO*
111	*Subwindow Japan*	*Polar Stereographic*	*100E*	*27*	*17*	*JP*
112	*Subwindow Okinawa*	*Polar Stereographic*	*100E*	*28*	*12*	*EC*
113	*Subwindow Asia (E USSR)*	*Polar Stereographic*	*100E*	*33*	*20*	*MK*
114	*Subwindow Asia (NW Pacific)*	*Polar Stereographic*	*100E*	*25*	*20*	*JH*
115	*Subwindow Asia (W Cen Pacific)*	*Polar Stereographic*	*100E*	*25*	*12*	*JK*
116	*Subwindow Asia (China)*	*Polar Stereographic*	*100E*	*33*	*12*	*CI*
117 - 119 (Not Assigned)						

120	*Subwindow Lajes*	*Polar Stereographic*	*10E*	*49*	*46*	*LJ*
121	*Subwindow Lajes (NW Atlantic)*	*Polar Stereographic*	*10E*	*41*	*50*	*NF*
122	*Subwindow Lajes (Iceland)*	*Polar Stereogrphic*	*10E*	*41*	*42*	*GL*
123	*Subwindow Lajes (NE Atlantic)*	*Polar Stereographic*	*10E*	*49*	*42*	*PO*
124	*Subwindow Lajes (NC Atlantic)*	*Polar Stereographic*	*10E*	*49*	*50*	*AX*
125 - 129 (Not Assigned)						
130	*Subwindow Panama*	*Mercator*		*72*	*14*	*PM*
131	*Subwindow Gulf of Mexico*	*Mercator*		*70*	*12*	*GX*
132	*Subwindow Tropical Hawaii*	*Mercator*		*51*	*13*	*HT*
133	*Subwindow Guam*	*Mercator*		*35*	*14*	*GM*
134	*Subwindow S. China Sea*	*Mercator*		*27*	*14*	*SS*
135	*Subwindow Philippine Sea*	*Mercator*		*32*	*11*	*PH*
136 - 149 (Not Assigned)						
150	*LAWC #1*					
151	*LAWC #2*					
152	*LAWC #3*					
153 - 255 (Not Assigned)						

APPENDIX C - Section 2

METEOROLOGICAL PROGRAM CODES

Table C2-2. Plot Process Codes

Code Value Octal	*Meaning*
0	*The character data within the block represent alphanumeric characters to be displayed as a label or character string. The label or string is to be placed with the lower left corner of the first character at the location specified by the M,N Coordinate. There shall be only one M,N Coordinate pair and one set of alphanumeric characters in the plot data block.*
1	*The character data within the block are to be interpreted as mnemonics for weather symbols to be displayed on the product. Each symbol is to be placed with the lower left corner of the symbol at the location specified by the M,N coordinate. Each mnemonic will be four ASCII characters in length, left justified and blank filled, and the data plot block may contain any number of coordinates and mnemonics (511 is the maximum due to the 4096-byte block length restriction). The weather symbol mnemonics and their definition are shown in Table A2-1.*
2	*Multiple sets of coordinates and character data will appear in the plot data block (see Appendix F, Example 8.) In the first set, M COORDINATE (1) is set to the displayable rotation angle of the character data which appears in the other data sets of character data. Rotation of the data for display is done in a clockwise manner. N COORDINATE (1) in the first set gives the font justification of the displayable symbols. Justification values are assigned as follows:* *0 Default device justification* *1 Top/left* *2 Center/left* *3 Bottom/left* *4 Top/center* *5 Center/center* *6 Bottom/center* *7 Top/right* *8 Center/right* *9 Bottom/right* *The four ASCII Characters in the first character string designate the character font definition set which will be used to display the characters given in the other character strings. These set designations are listed in Table C2-10. Each character string starting with the second is terminated with Null (if the Null Termination option is used) or ETX. See Section 2.2.3.2.B.*

Example 8 in Appendix F illustrates the use of the Plot Data Block using Plot Process Code 2.

APPENDIX C - Section 2

METEOROLOGICAL PROGRAM CODES

Table C2-3. Grid Indicator (GI) Set Codes

NOTES:

1. Grids are defined for every regional window background map (see Table C2-2). The last two digits of the GI Set Code are identical to the PI Set Code (31-49) for the corresponding regional window background map. The hundred digit in the GI Set Code gives the grid mesh (e.g., Whole Mesh = 0, 1/2 Mesh = 1, 1/8 Mesh = 2).

2. The array size for each GI Set Code is given in USAF AFGWC Satellite Global Data Base mesh units (whole, half, eighth). These units can be converted to NMC and FNOC corresponding mesh units.

3. Projection reference latitudes are 60N for Northern Hemisphere polar stereographic and 22.5N and 22.5S for Mercator. The Mesh Lengths are true at these latitudes.

4. See AFGWC/TN - 79/003, Map Projections and Grid Systems for Meteorological Applications, March 1981, for a complete discussion of grid systems and their relation to various map projections.

5. Knowing the mesh size, the location of the pole on that grid mesh, and the grid point of the lower left corner of the product, one can determine IPOLE/ JPOLE as used in Mode 7/Submode 20.

GI SET CODE	GRID MESH	DESCRIPTION	ARRAY SIZE	MESH LENGTH
031	Whole	Caribbean	17 x 17	3.71 degrees
032	Whole	Tropical Hawaiian Islands	17 x 17	3.71 degrees longitude
033	Whole	Marianas	17 x 17	3.71 degrees longitude
034	Whole	S. E. Asia	17 x 17	3.71 degrees longitude
035 - 039 (Not Assigned)				
040	Whole	Continental US	17 x 17	381 km
041	Whole	East US	17 x 17	381 km
042	Whole	West US	17 x 17	381 km
043	Whole	North US	17 x 17	381 km

044	Whole	Canada	17 x 17	381 km
045	Whole	Europe	17 x 17	381 km
046	Whole	Asia	17 x 17	381 km
047	Whole	Alaska	17 x 17	381 km
048	Whole	Hawaii	17 x 17	381 km
049	Whole	Azores	17 x 17	381 km
050 - 130 (Not Assigned)				
131	1/2	Caribbean	33 x 33	1.86 degrees longitude
132	1/2	Tropical Hawaiian Islands	33 x 33	1.86 degrees longitude
133	1/2	Marianas	33 x 33	1.86 degrees longitude
134	1/2	S.E. Asia	33 x 33	1.86 degrees longitude
135 - 139 (Not Assigned)				
140	1/2	Continental US	33 x 33	190.5 km
141	1/2	East US	33 x 33	190.5 km
142	1/2	West US	33 x 33	190.5 km
143	1/2	North US	33 x 33	190.5 km
144	1/2	Canada	33 x 33	190.5 km
145	1/2	Europe	33 x 33	190.5 km
146	1/2	Asia	33 x 33	190.5 km
147	1/2	Alaska	33 x 33	190.5 km
148	1/2	Hawaii	33 x 33	190.5 km
149	1/2	Azores	33 x 33	190.5 km
150 - 230 (Not Assigned)				
231	1/8	Caribbean	129 x 129	.464 degrees longitude
232	1/8	Tropical Hawaiian Islands	129 x 129	.464 degrees longitude

233	1/8	Marianas	129 x 129	.464 degrees longitude
234	1/8	Philippines	129 x 129	.464 degrees longitude
235 - 239 (Not Assigned)				
240	1/8	Continental US	129 x 129	47.62 km
241	1/8	East US	129 x 129	47.62 km
242	1/8	West US	129 x 129	47.62 km
243	1/8	North US	129 x 129	47.62 km
244	1/8	Canada	129 x 129	47.62 km
245	1/8	Europe	129 x 129	47.62 km
246	1/8	Asia	129 x 129	47.62 km
247	1/8	Alaska	129 x 129	47.62 km
248	1/8	Hawaii	129 x 129	47.62 km
249	1/8	Azores	129 x 129	47.62 km
250 - 256 (Not Assigned)				

Table C2-4. UNITS CODE (OCTAL)

NOTES:

1. * = Multiplied by

2. ** = Raised to the power of

3. / = Divided by or per

4. Unit symbols shown in the symbol column are the preferred International Standard symbols which correspond to the Federal and American National Standards. Non ISO symbols correspond to practice that does not conflict with ISO, ANSI, and Federal practice.

5. Code units 15, 43, 46, and 74 have not been changed to conform with the ISO, ANSI, Federal and DOD standards and practice. These will probably by changed in future editions of this document to conform with metric practice.

CODE	UNITS	SYMBOL	
0	Degrees Fahrenheit	°F	
1	Degrees Kelvin	°K	
2	Degrees Celsius	°C	
3	Meters	m	
4	Meters per Second	m/s	
5	Knots	Kts	
6	Miles per Hour	mph	
7	Hectopascals (Millibars)	hPa	(mbar)
10	Centimeters	cm	
11	Meters per Second Squared	m/s^2	(m/s**2)
12	Feet	ft	
13	Geopotential Meter	m_{gp}	
14	Seconds	s	
15	Gram-calories per square centimeter per day	$g.cal/cm^2/d$	(g*cal/cm**2/d)
16	Nautical Miles per Day	NM/d	
17	Centimeters per Second	cm/s	
20	Probability Code		
21	Hectopascals per Second	hPa/s	(mbar/s)
22	Per Second	1/s	
23	Dimensionless		
24	Percent	%	
25	Meters Squared per Second	m^2/s	(m**2/s)
26	Kilograms per Square Meter	kg/m^2	(kg/m**2)
27	Kilograms per Square Meter per Second	$kg/m^2/s$	(kg/m**2/s)

CODE	UNITS	SYMBOL	
30	Hectopascals per Meter	hPa/m	(mbar/m)
31	Percent per Meter	%/m	
32	Degrees Kelvin per Meter	°K/m2	
33	Watts per Square Meter	W/m^2	(W/m**2)
34	Degrees Kelvin per Second	°K/s	
35	Degrees per 10 (Compass)	°/10	
36	Degrees Celsius per 10^4 Square Kilometers	$°C/10^4\ km^2$	(oC/10**4 km**2)
37	Degrees (Compass Direction)	°	
40	Centimeters Squared per Second	cm^2/s	(cm**2/s)
41	Degrees Celsius per 100 feet (Gradient)	°C/100ft	
42	Degrees Celsius per 100 Km (horizontal gradient)	°C/100 km	
43	Gram-Calories per Square Centimeter per hour	$g.cal/cm^2/h$	(g*cal/cm**2/h)
44	Refractive N Units		
45	Meters Squared per 3 times 10^{15}	$m^2/3.10^{15}$	(m**2/3*10**15)
46	Microbars Per Second	ubar/s	
47	Millimeters	mm	
50	Kilometers	km	
51	Inches	in	
52	Yards	yd	
53	Statute Miles	mi	
54	Nautical Miles	NM	
55	Degrees of Latitude or Longitude	Lat, Lon	
56	Eights		
57	Square Kilometers	km^2	(km**2)
60	Square Statute Miles	mi^2	(mi**2)
61	Mean Solar Minutes	min	
62	Mean Solar Hours	h	
63	Mean Solar Days	d	
64	Months	mo	
65	Years	yr	
66	Per Second times 10 to the minus fifth power	$1/s.10^{-5}$	(1/s)*10**-5
67	Kilometers per Hour	km/h	
70	Degrees of Latitude or Longitude per Day	Lat/d, Lon/d	
71	Grams	g	
72	Kilograms	kg	
73	Grams per Cubic Centimeter	g/cm^3	(g/cm**3)
74	Langleys	ly	
75	Grams per Kilogram	g/kg	
76	Millimeters per Hour	mm/h	
77	Dobson units	m atm-cm	

CODE UNITS	SYMBOL
100 = Degrees of Latitude * 100	Lat.100
101 = Degrees of Longitude * 100	Lon.100
102 = Number of micro-seconds	$s/(10^6)$
103 = Velocity Variance	$(cm/s)^2$
104 = Velocity	cm/s
105 = Per degree Kelvin	$1/^{\circ}K$

APPENDIX C - SECTION 2

METEOROLOGICAL PROGRAM CODES

Table C2-5. Data Representation Codes

CODE (Octal)	*DEFINITION*
0	*Two's complement integer (Scaled by a multiplier characteristic power of 10)*
1	*IEEE Floating point*
2	*ASCII (7 bit ANSI X3.4-1977)*
3	*Two's complement integer (Scaled by a multiplier characteristic power of 2)*

APPENDIX C - SECTION 2

METEOROLOGICAL PROGRAM CODES

Table C2-6. Fonts

Font	*Description*
NWS1	*AFOS Standard Character Set, Programmer's Reference Guide, Graphic Display Module, Publication No. WDL-TR7676A, Environmental Systems, Ford Aerospace and Communications Corp.*
NWS2	*AFOS Special Character Set, Programmer's Reference Guide, Graphic Display Module, Publication No. WDL-TR7676A, Environmental Systems, Ford Aerospace and Communications Corp.*

APPENDIX D

PRODUCT IDENTIFIER NUMBERS

APPENDIX D

PRODUCT IDENTIFIER NUMBERS

Table D-1. File Indicators

Number	*Description*
000 to 100	*Determined by interagency agreement.*
101 to 107	*Assigned to Air Force*
110 to 115	*Assigned to NWS*
116 to 123	*Assigned to FAA*
124 to 132	*Assigned to Navy*
133 to 176	*Not Assigned*
177	*Internal Use Only*
200 to 377	*Not Assigned*

APPENDIX D

PRODUCT IDENTIFIER NUMBERS

Table D-2. Catalog Numbers

Catalog Numbers are assigned by the USAF Communications Command, Carswell AFB, TX. Unique Catalog Numbers are assigned to each different product. The AFCC maintains a Catalog Number/WMO Abbreviated Heading cross-reference.

The length and need for continual updates preclude the duplication of Catalog Numbers in this document. Please contact the AFCC directly for this information.

APPENDIX E

LOCATION IDENTIFIERS

1. Location Identifiers. 7350.5Y, U.S. Department of Transportation, Federal Aviation Administration, Air Traffic Operations Service: Washington, D.C.

2. NOAA/NWS Location Identifiers. Communications Handbook No. 5, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service: Washington, D.C.

APPENDIX F

EXAMPLES

No. 1 - Vector Graphic Product Structure

No. 2 - Alphanumeric Product

No. 3 - Surface Formatted Binary Product

No. 4 - Upper Air Formatted Binary Product

No. 5 - Unpacked Gridded Data Product

No. 6 - Plot Data Block Using Plot Process Code 2

APPENDIX F

Example No. 1 - Vector Graphic Product Structure

		NOTES
Mode 01, Submode 01	Product Identification Block	1
Mode 04, Submode 20	Vector Graphic Product Definition Block	2
Mode 01, Submode 04	Define Plot Parameters Block	3
Mode 04, Submode 02	Relative Vectors Block for Temperature Contour 1	4
.		
.		
.		
Mode 04, Submode 02	Relative Vectors Block for Temperature Contour n	4
Mode 05, Submode 03	Line Labels Character Block for Temperature Contours 1-n	5
Mode 01, Submode 04	Define Plot Parameters Block	6
Mode 04, Submode 02	Relative Vectors Block for Pressure Contour 1	7
.		
.		
.		
Mode 04, Submode 02	Relative Vectors Block for Pressure Contour m	7
Mode 05, Submode 03	Line Labels Character Block for Pressure Contours 1-m	8
Mode 01, Submode 04	Define Plot Parameters Block	9
Mode 04, Submode 02	Relative Vectors Block for Cold Front	10

Example No. 1 (Cont.). Vector Graphic Product Structure

		NOTES
Mode 05, Submode 03	Line Labels Character Block for Cold Front	11
Mode 01, Submode 04	Define Plot Parameters Block	12
Mode 05, Submode 06	Wind Barbs Data Plot	13
Mode 01, Submode 04	Define Plot Parameters Block	14
Mode 05, Submode 02	Data Plot Block for Station 1	15

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Mode 05, Submode 02	Data Plot Block for Station 1	15
Mode 01, Submode 04	Define Plot Parameters Block	16
Mode 05, Submode 05	Weather Symbols Block	17
Mode 01, Submode 04	Define Plot Parameters Block	18
Mode 05, Submode 01	Alphanumeric Characters Block for line 1	19

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Mode 05, Submode 01	Alphanumeric Characters Block for line k	19
Mode 01, Submode 02	End Of Product Block	20

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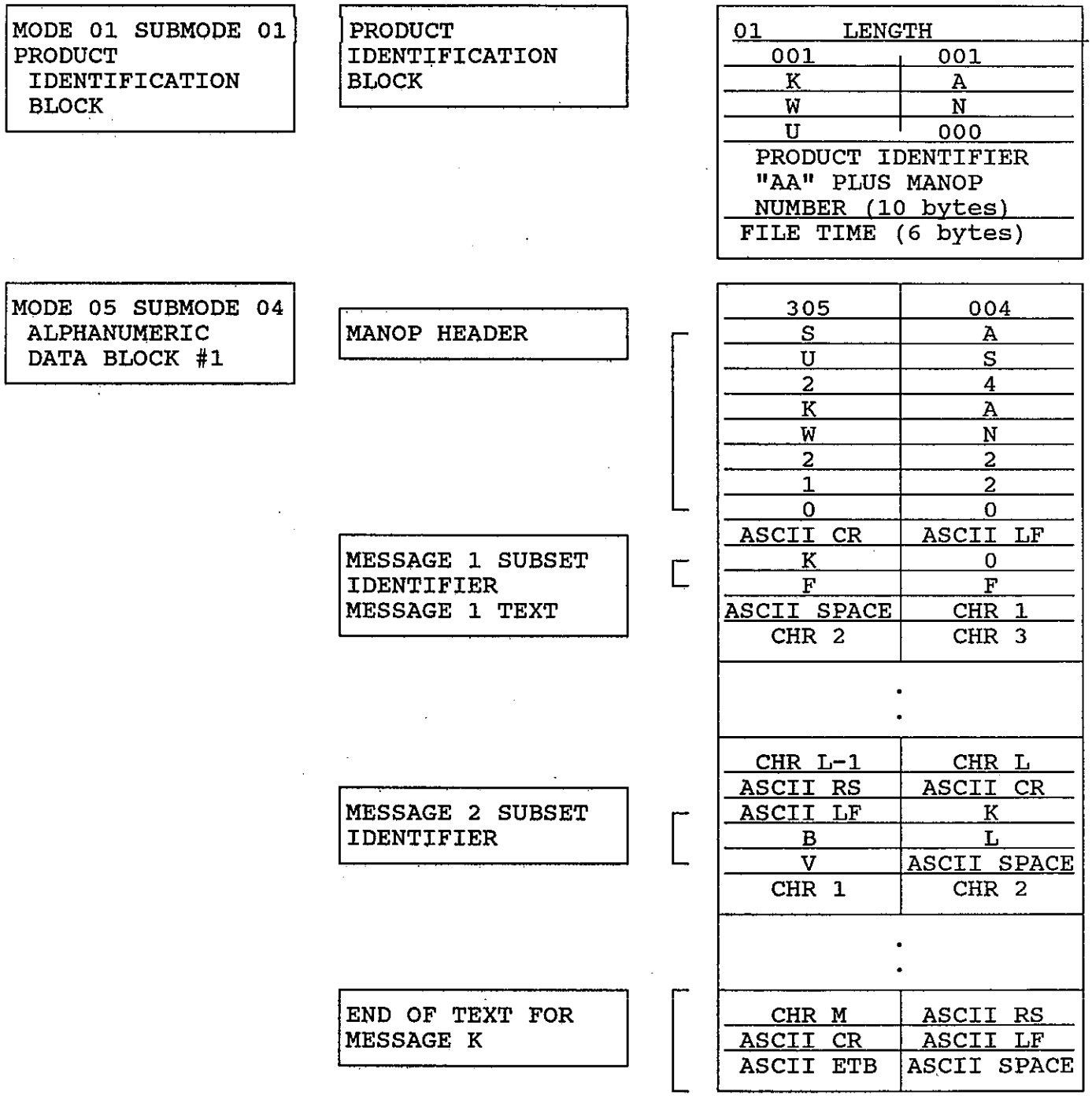
Example No. 1 (Cont.). Vector Graphic Product Structure

NOTES:

1. *Identifies the product.*
2. *Gives product related information.*
3. *Set up parameters for plotting temperature contours, e.g., line character - dashed, line color - red.*
4. *Transmits vectors defining temperature contours 1-n.*
5. *Transmits labels to be associated with temperature contours.*
6. *Set up parameters for plotting pressure contours, e.g., line character - solid, line color - blue.*
7. *Transmits vectors defining pressure contours 1-m.*
8. *Transmits labels to be associated with pressure contours.*
9. *Set up parameters for plotting cold front, e.g., line character - symbolic, line color - blue.*
10. *Transmits vectors defining cold front line.*
11. *Transmits labels to be associated with cold front.*
12. *Set up parameters for plotting wind barbs, e.g., line character - reset, line color - green.*
13. *Transmits wind barbs.*
14. *Set up parameters for plotting station plots, e.g., line color - orange.*
15. *Transmits data plots for stations 1-l.*
16. *Set up parameters for plotting weather symbols, e.g., line color - red.*
17. *Transmits weather symbols to be plotted.*
18. *Set up parameters for plotting product legend, e.g., line color - black.*
19. *Transmits data for product legend.*
20. *Termination for product.*

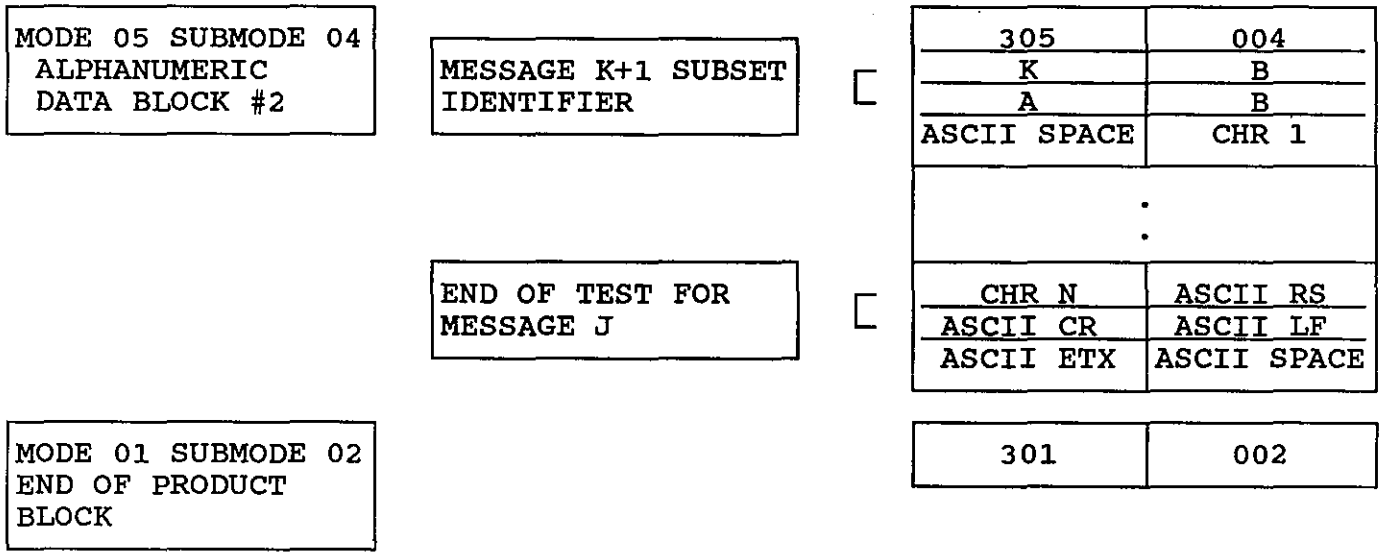
APPENDIX F

Example No. 2 - Alphanumeric Product



NOTE: New Mode 05 Submode 04 required because next message would cause block length to exceed 4096 characters.

Example No. 2 (Cont.) - Alphanumeric Product



Example No. 3 Surface Formatted Binary Product

MODE 01 SUBMODE 01
PRODUCT IDENTIFICATION BLOCK

PRODUCT IDENTIFICATION BLOCK

01 LENGTH	
001	001
K	G
W	C
U	000
G	F
S	A
U	S
0	1
ASCII SPACE	ASCII SPACE
1982	
2	5
12	00

MODE 03 SUBMODE 21
FORMATTED BINARY DATA DESCRIPTION BLOCK

FIXED DATA DESCRIPTORS

01 LENGTH	
003	021
K=# OF ELEMENTS PER SET	# OF BYTES IN ELEMENT SET
M = # OF ELEMENT SETS	

ELEMENT #1 DESCRIPTION

C	A
L	ASCII SPACE
4	4
0	23 (octal)
0	0
0	

ELEMENT #2 DESCRIPTORS

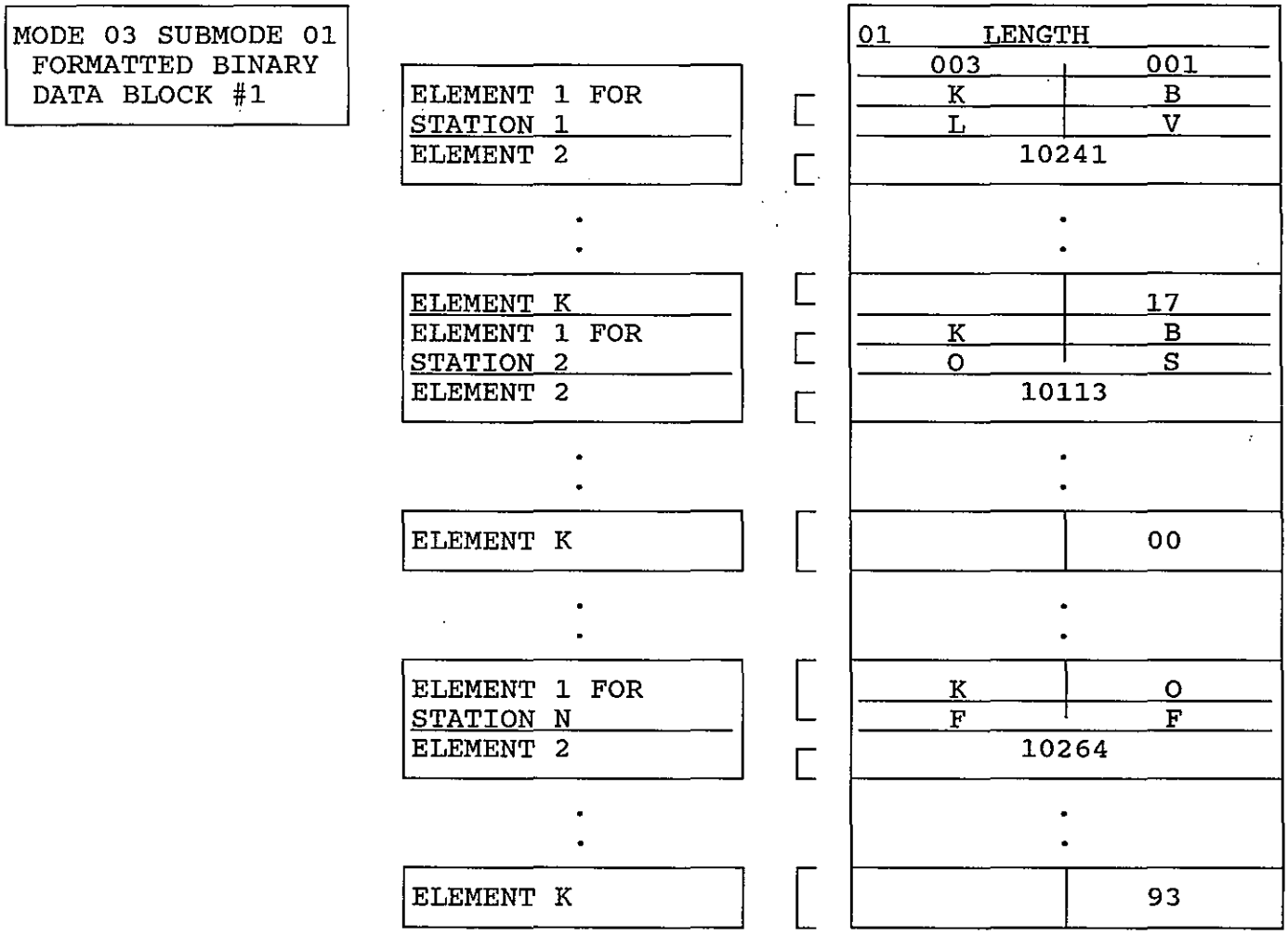
P	P
P	ASCII SPACE
10 (octal)	2
0	7
1	-1
0	

.
.

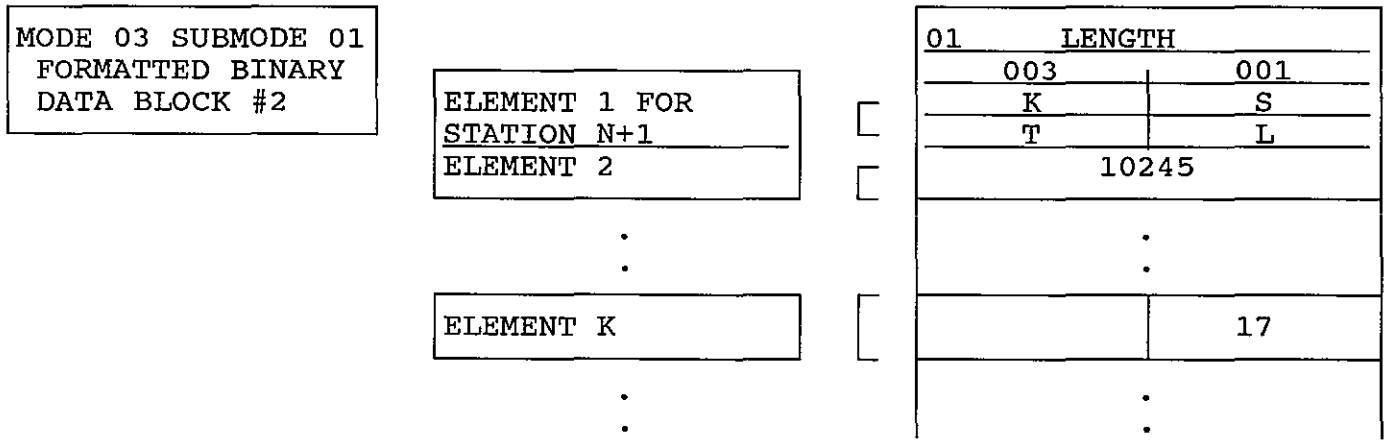
ELEMENT #K DESCRIPTORS

W	W
1	ASCII SPACE
START BYTE	2
0	23 (octal)
0	0
0	

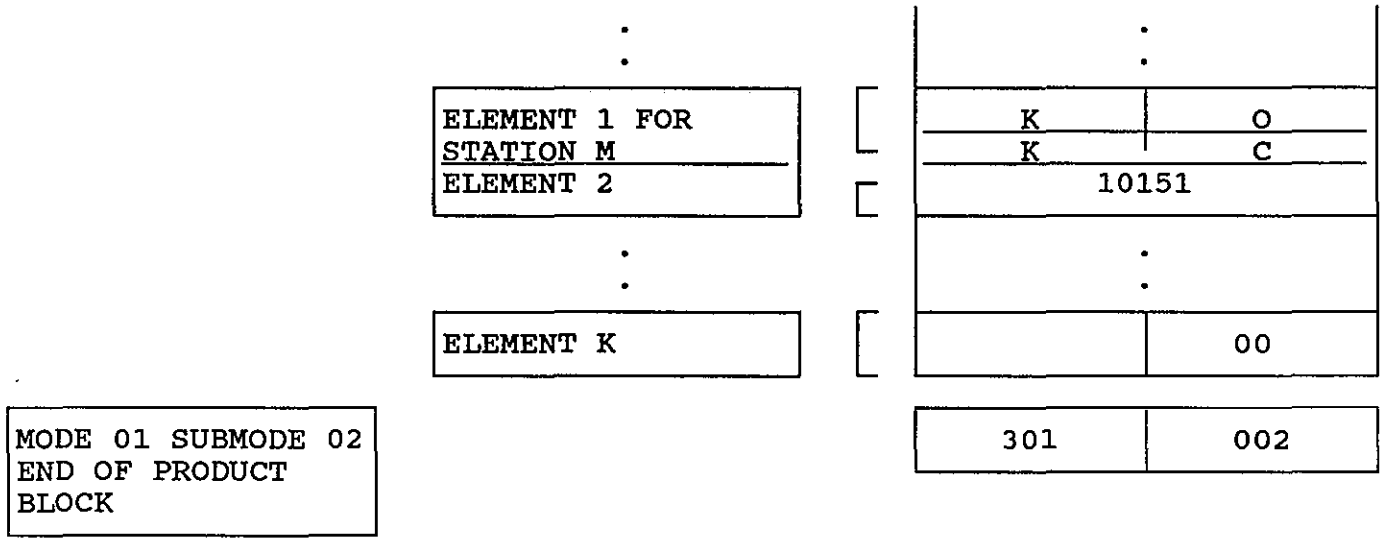
Example No. 3 (Cont.) - Surface Formatted Binary Product



Note: New Mode 03 Submode 01 required because next set of data would cause block length to exceed 4096 bytes.



Example No. 3 (Cont.) - Surface Formatted Binary Product



Example No. 4 Upper Air Formatted Binary Product

MODE 01 SUBMODE 01
PRODUCT
IDENTIFICATION
BLOCK

PRODUCT
IDENTIFICATION
BLOCK

01	LENGTH
001	001
K	G
W	C
U	000
G	F
U	W
U	S
0	4
ASCII SPACE	ASCII SPACE
1982	
6	20
12	00

MODE 03 SUBMODE 20
PRODUCT
DEFINITION
BLOCK

01	LENGTH
003	020
ASCII SPACE	ASCII SPACE
ASCII SPACE	ASCII SPACE
72	
202	

MODE 03 SUBMODE 21
FORMATTED BINARY
DATA DESCRIPTION
BLOCK

FIXED DATA
DESCRIPTORS

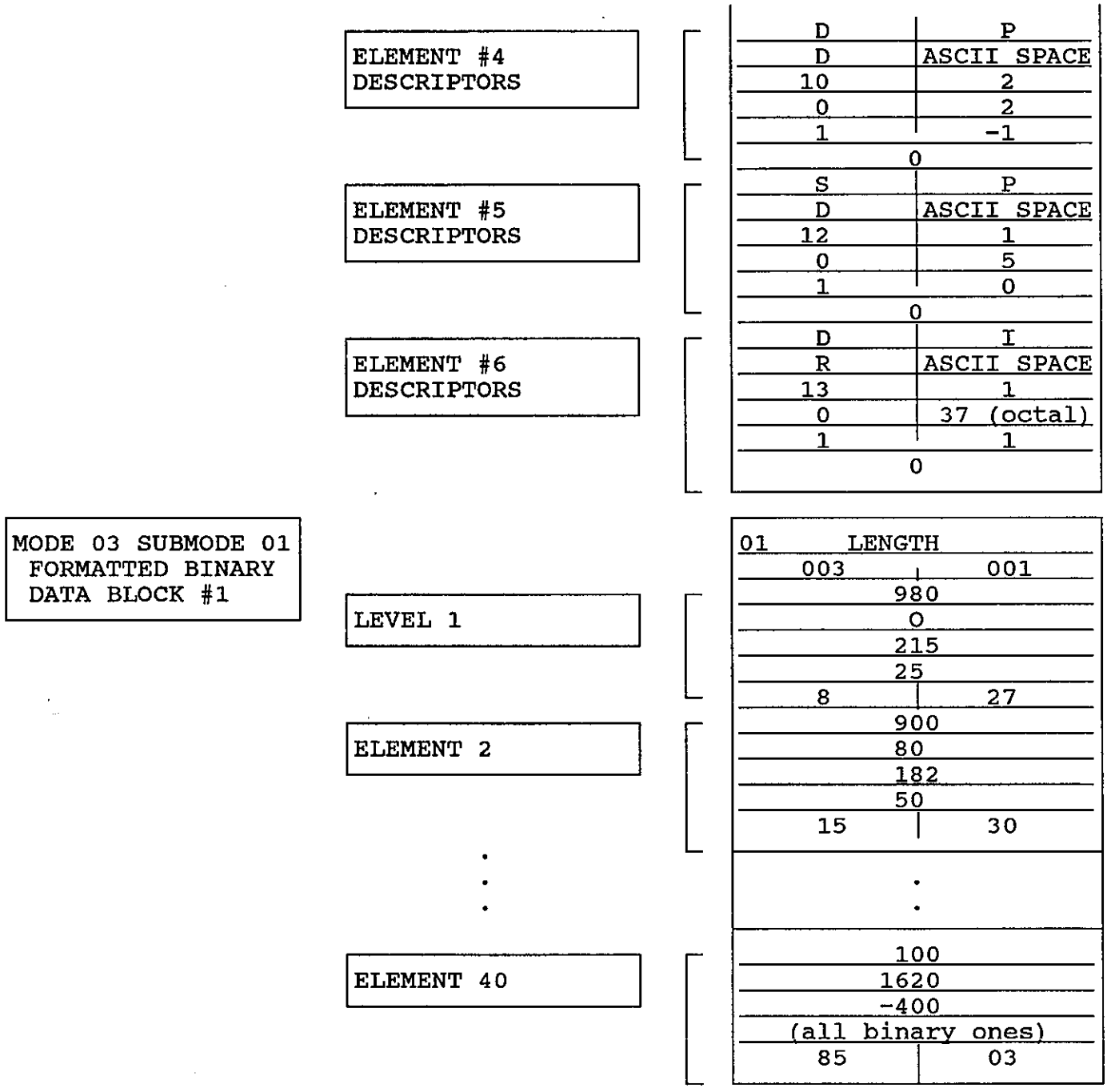
ELEMENT #1
DESCRIPTORS

ELEMENT #2
DESCRIPTORS

ELEMENT #3
DESCRIPTORS

01	LENGTH
003	021
6	10
40	
P	R
S	ASCII SPACE
4	2
0	7
1	0
0	
G	P
H	ASCII SPACE
6	2
0	13 (octal)
1	1
0	
T	M
P	ASCII SPACE
8	2
0	2
1	-1
0	

Example No. 4 (Cont.) Upper Air Formatted Binary Product



Example No. 4 (Cont.) Upper Air Formatted Binary Product

MODE 03 SUBMODE 21
FORMATTED BINARY
DATA DESCRIPTION
BLOCK

REPORTED
SIGNIFICANT
LEVEL DATA

01	LENGTH
003	021
3	6
1	
M	W
1	ASCII SPACE
4	2
0	13 (octal)
1	1
0	
T	P
1	ASCII SPACE
6	2
0	13 (octal)
1	1
0	
P	P
W	ASCII SPACE
8	2
0	51 (octal)
1	-2
0	

MODE 03 SUBMODE 01
FORMATTED BINARY
DATA BLOCK #1

ELEMENT #1
ELEMENT #2
ELEMENT #3

01	LENGTH
003	001
885	
1176	
255	

MODE 01 SUBMODE 02
END OF PRODUCT
BLOCK

301	002

Example No. 5 Unpacked Gridded Data Product

MODE 01 SUBMODE 01
PRODUCT
IDENTIFICATION
BLOCK

PRODUCT
IDENTIFICATION
BLOCK

01	LENGTH
001	001
K	G
W	C
U	000
G	X
P	G
N	A
4	5
T	A
FILE TIME (6 BYTES)	

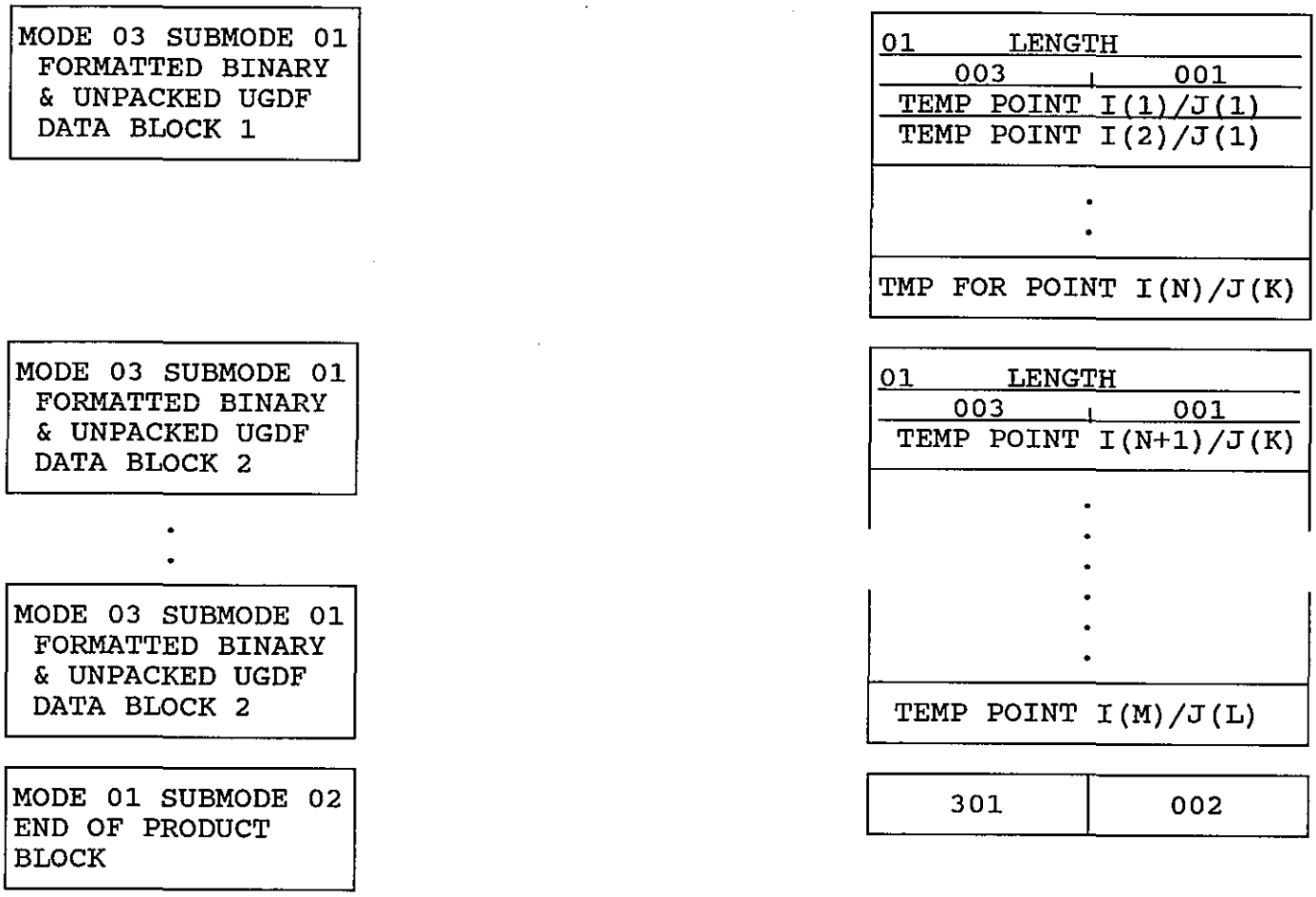
MODE 07 SUBMODE 20
GRIDDED PRODUCT
DEFINITION
BLOCK

01	LENGTH
007	020
011	141
SCALE FACTOR	
001	002
ZERO FILLED	ZERO FILLED
ZERO FILLED	
ZERO FILLED	
NUMBER OF COLUMNS (M)	
NUMBER OF ROWS (L)	
REFERENCE I COORDINATE	
REFERENCE J COORDINATE	
BEGIN VALID PERIOD (4 BYTES)	
END VALID PERIOD (4 BYTES)	
I POLE	
J POLE	
RE/D	
LONGITUDE X	
002	002

MODE 03 SUBMODE 21
FORMATTED BINARY
& UNPACKED UGDF
DATA DESCRIPTION
BLOCK

01	LENGTH
003	021
001	002
# OF ELEMENT SETS (MxL)	
T	M
P	ASCII SPACE
004	002
ZERO FILLED	002
001	-001
000	

Example No. 5 (Cont.) Unpacked Gridded Data Product



APPENDIX F

Example No. 6 Plot Data Block Using Plot Process Code 2

MODE 05 SUBMODE 02 ALPHANUMERIC DATA BLOCK FOR PRODUCT REQUEST

01 LENGTH	
005	002
B¦R¦CHR SIZ	2
M COORD (1)	= ROT ANGLE
N COORD (1)	= FONT JUST
FONT CH SET	CHR 2
CHR 3	CHR 4
M COORDINATE (2)	
N COORDINATE (2)	
CHR 1	CHR 2
.	
.	
CHR n-1	CHR n
M COORDINATE (n)	
N COORDINATE (n)	
CHR 1	CHR 2
.	
.	
CHR n-1	CHR n
CHECKSUM	