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 beam 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 beam flag so that selected arcs may remain blank on display.

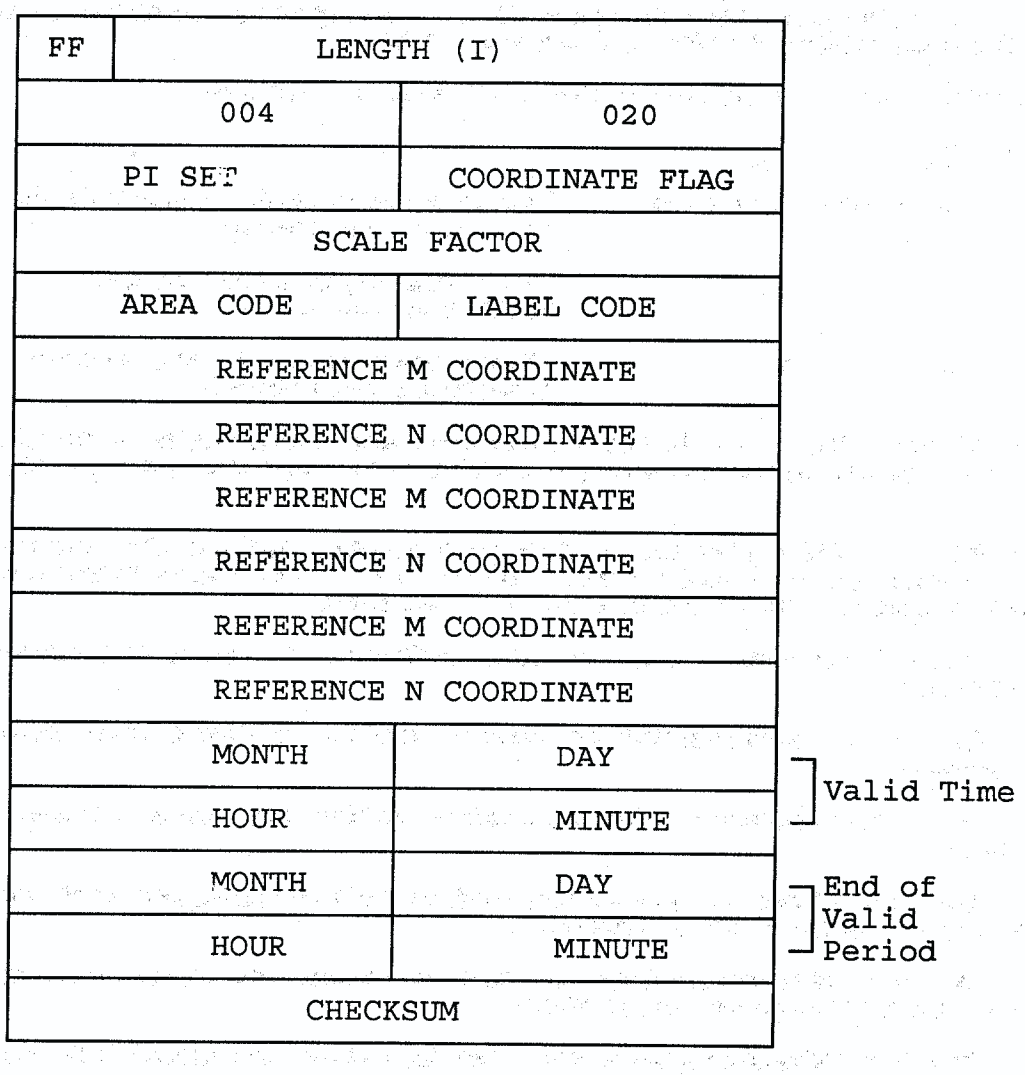


Figure 7-1. Vector Graphic Product Definition Block; Mode 4, Submode 20

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.

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.

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

NOTES: Figure 7-1 (Cont.):

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. (Cont.) Vector Graphic Product Definition Block; Mode 4, Submode 20

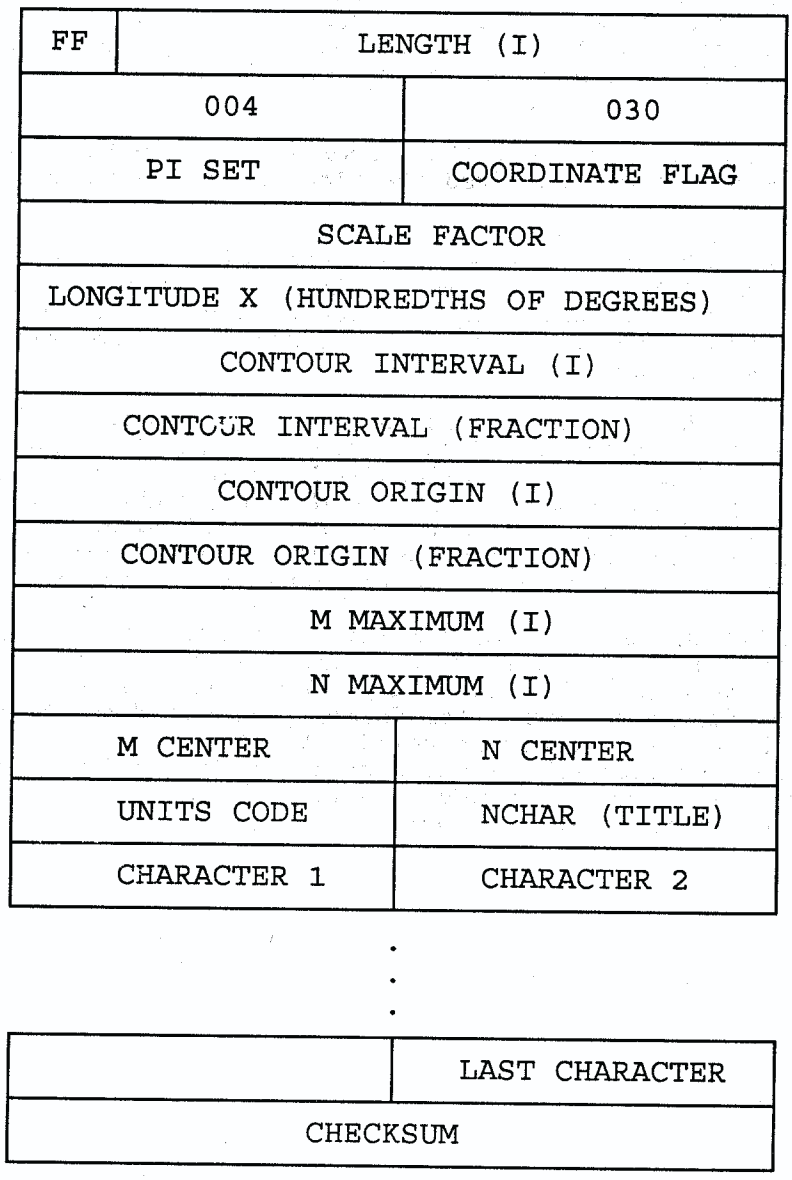


Figure 7-2. Define Graphics Parameters Product Definition Block; Mode 4, Submode 30

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.

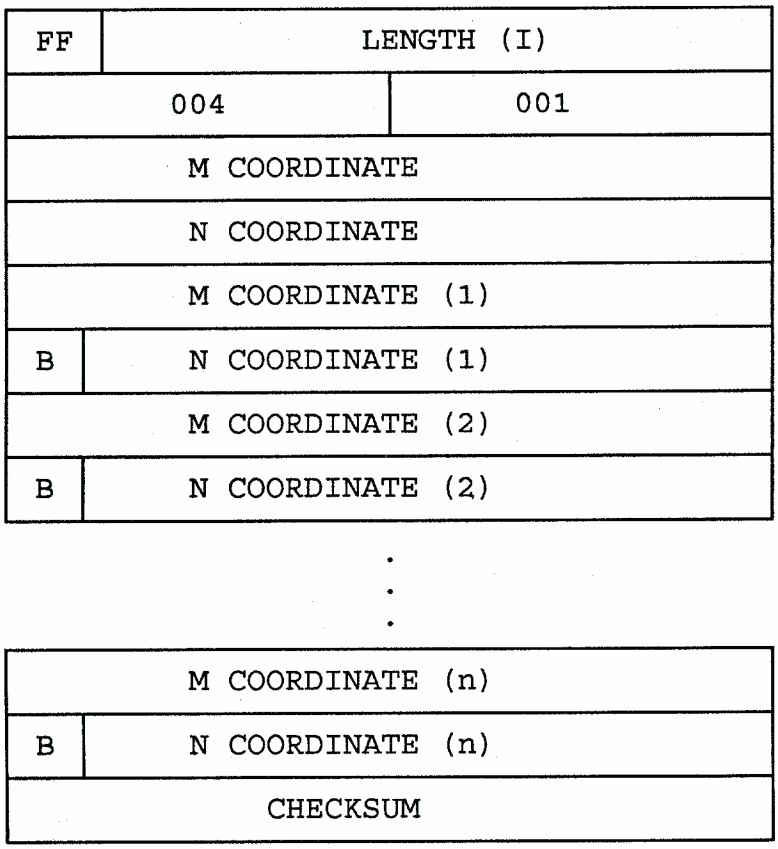
7. M,N CENTER: The coordinates of the center of the product in units of the grid from which the product was originally extracted.

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. (Cont.) Define Graphics Parameters Product Definition Block; Mode 4, Submode 30



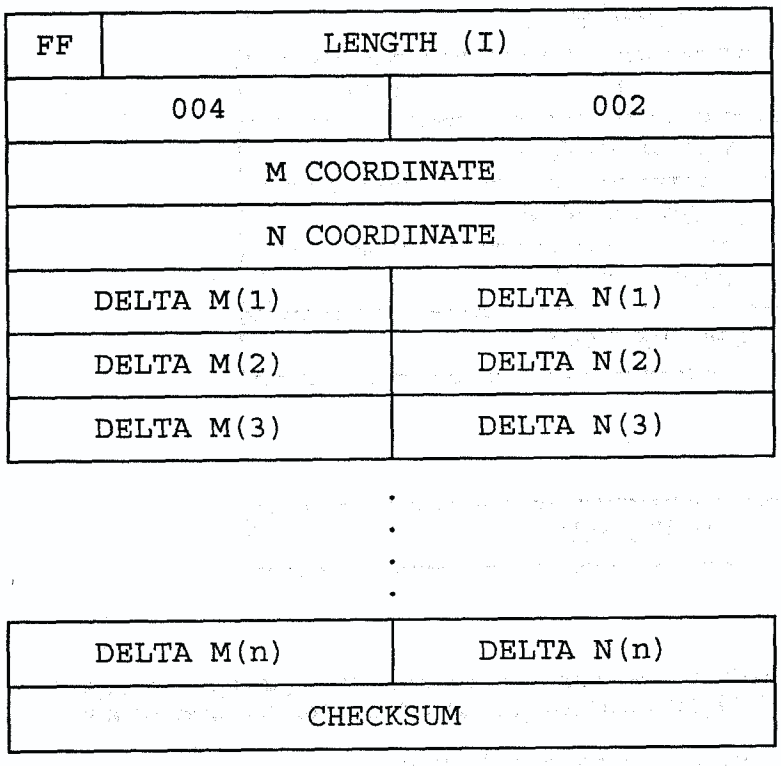
NOTES:

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 = Beam 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

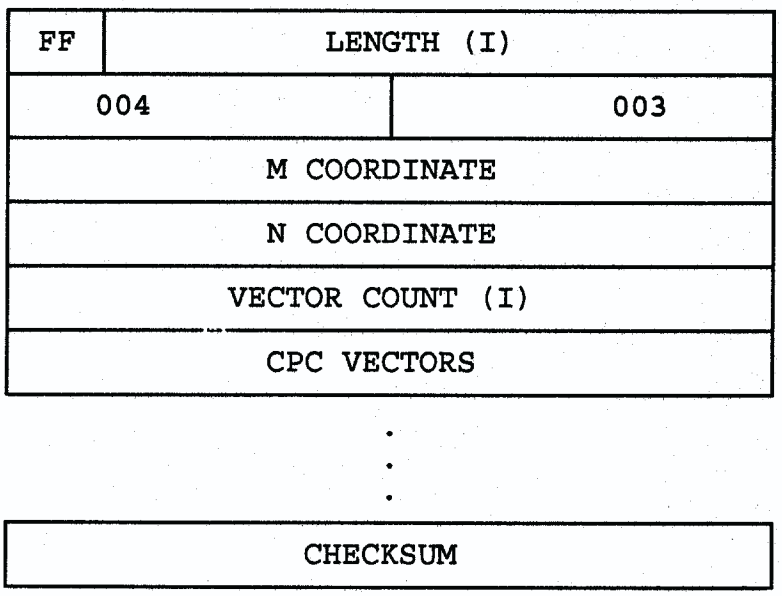


NOTES:

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

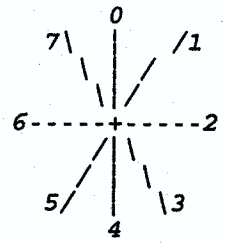


NOTES:

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

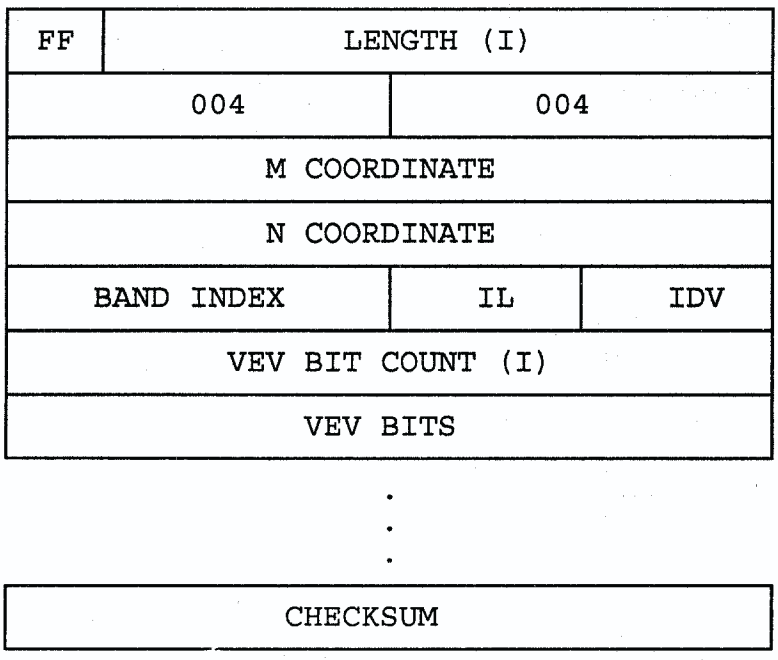
2. VECTOR COUNT: Number of vectors following.

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).

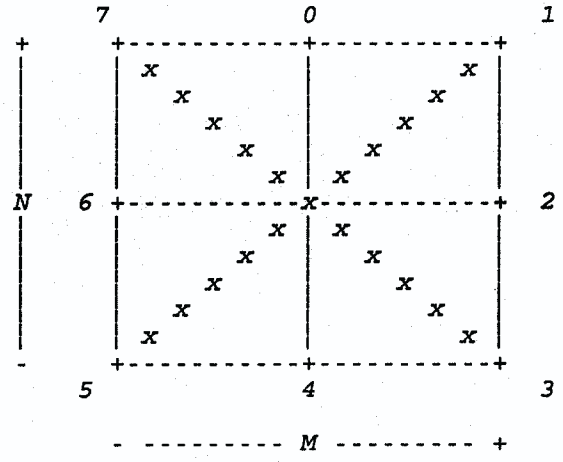
3. IL = Increment Length: IL is the indicator for the incremental vector length (e.g., 1=1 pixel, 2=2, 3=3, ..., 7=7).

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:

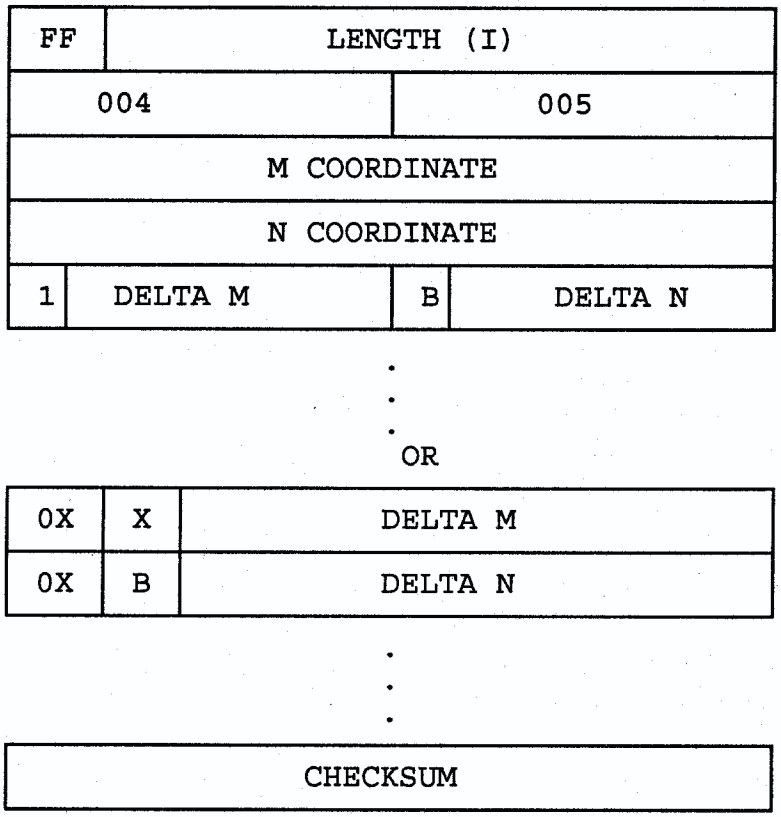
Direction vector definition:



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 = Beam 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:

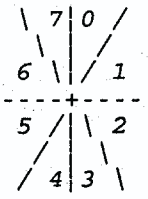


Figure 7-8. Point-Slope Vectors Block; Mode 4, Submode 6

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

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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

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:

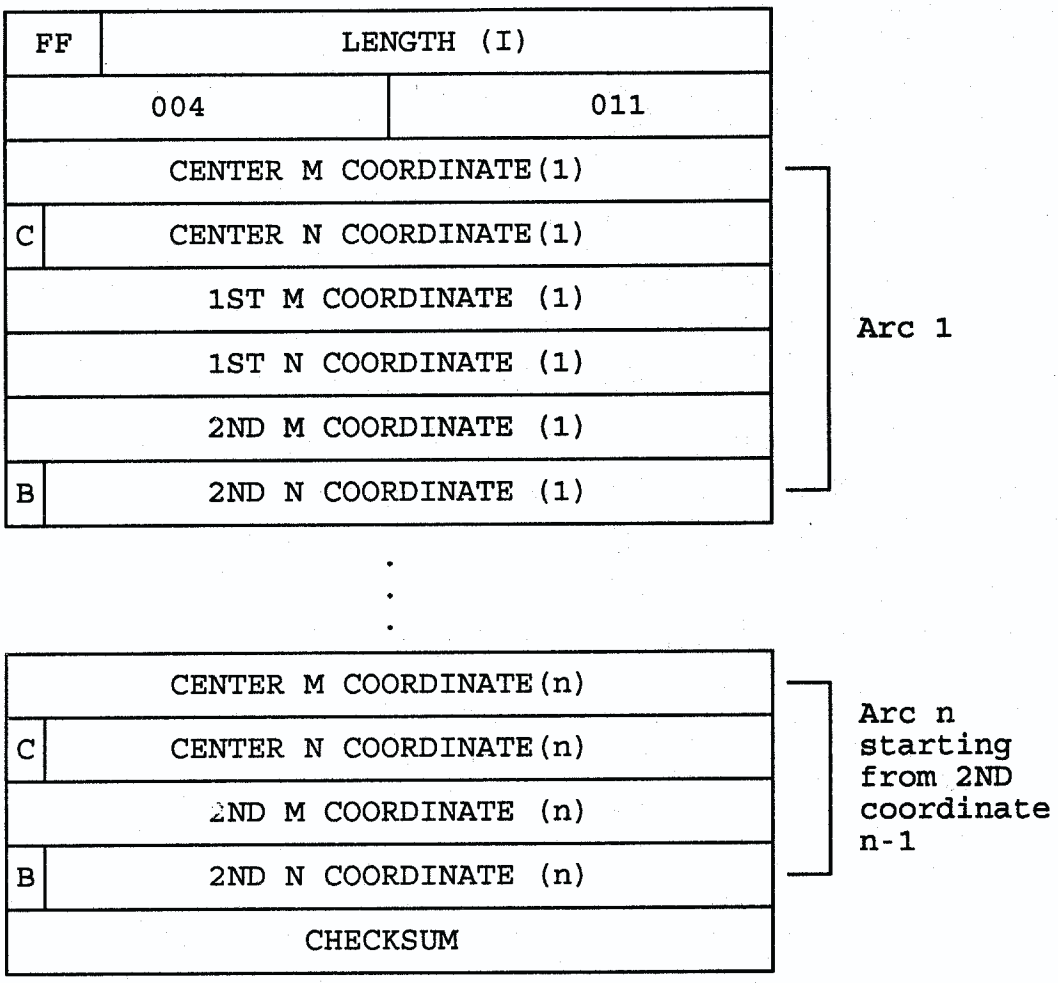
Code		
1	--o-->	Arrow through point M,N
2	o-->	Arrow from point M,N
3	-->o	Arrow to point M,N
4	-21-->	Arrow with VALUE plotted at M,N
5	22o-->	Arrow from M,N with VALUE plotted left of M,N
6	-->o41	Arrow to M,N with VALUE plotted to right of M,N
7	----->	Vector of length (in pixels)

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.

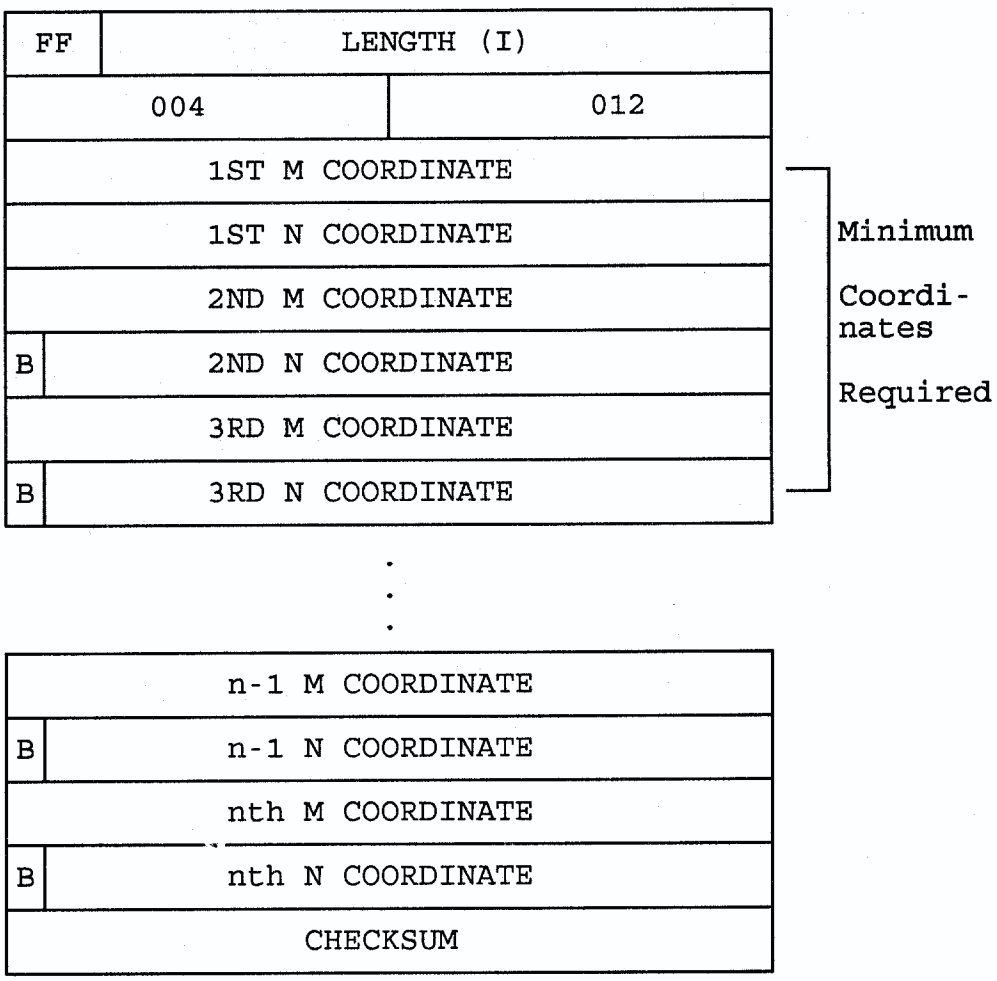
Figure 7-11. Center Radius Arc Vectors Block; Mode 4, Submode 11

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