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# INTERFACE CONTROL DOCUMENT
# FOR THE
# RPG TO CLASS 1 USER

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**INTERFACE CONTROL DOCUMENT**
**FOR THE RPG TO CLASS 1 USER**
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| Revision C | Added Build 1.2 products. Added Appendix C on Data Transmission Rates. |
| Revision D | Added Build 2.0 products. Added Appendix D on bzip2 compression. |
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# 1 SCOPE

## 1.1 Identification

This document defines the interface connection between the Next Generation Weather Radar (NEXRAD) Radar Product Generation Group (RPG) and a Class 1 User or Radar Products Generator Operator's Position (RPGOP). RPG refers to the RPG equipment, 2830007, Pt 1 and Radar Product Generation Program CPCI-03, 2820003, Part 1.

## 1.2 System Overview

### 1.2.1 RPG

The RPG system is one component of the WSR-88D system. The WSR-88D system is used to gather weather information to be distributed to the National Weather Service (NWS), the Federal Aviation Administration (FAA), the Department of Defense (DOD), and the general public. The RPG may be located with the RDA system in a shelter at the WSR-88D site, or may be located remotely, and communicate with the RDA through a wideband communication link. It is responsible for Base Data Ingest, Product Generation, Product Storage, Hydrometeorological Processing, Product Distribution, and Base Data Distribution.

### 1.2.2 Class 1 Users/RPGOP

The Class 1 user's systems may be located anywhere. They communicate with the RPG via dedicated phone lines or LAN connection. These systems issue product requests to the RPG, receive the products from the RPG, and display the products to an operator.

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## 1.3 Document Overview

This document defines the application layer interface between the RPG and Class 1 users/RPGOP. For this interface, this document identifies applicable standards and defines messages, product format and meaning of the packet codes. This ICD is not intended to serve as a document concerning the applicable standards. That is, the reader is assumed to be generally knowledgeable of the contents, terminology, etc., of the standards. Distribution of this document is unrestricted.
This document is organized in 3 sections and five appendices:

Section 1 provides information regarding the identification, scope, purpose and organization of this document.
Section 2 contains information about documentation relevant to this ICD, including applicable, and information documents.
Section 3 provides an overview of the application interface, operating procedures and message formats.
Appendix A contains a list of abbreviations, acronyms, and selected definitions.
Appendix B contains a detailed description of the Radar Coded Message.
Appendix C contains data transmission characteristics.
Appendix D contains product data compression using BZIP2.
Appendix E contains a description of the Generic Product Format.

# 2 REFERENCE DOCUMENTS

## 2.1 Government Documents

### 2.1.1 Specifications

| | |
|---|---|
| 2830007, Pt 1 | Prime Item Development Specification for |

| | |
|---|---|
| | RPG Equipment (B1, CI-07) |
| 2810000F | WSR-88D System Specification |
| 2820003B,Pt1 | Computer Program Development Specification for Radar Product Generation Program (SRS, CPCI-03) |
| 2620003B | Product Specification Interface Control Document |
| 2620037 | RPG X.25 Protocol Interface Control Document |
| 2620041B | TCP/IP Interface Control Document |
| Source: | ROC Configuration Management<br>WSR-88D Radar Operations Center<br>1313 Halley Circle<br>Norman, OK 73069 |

## 2.2 Non-Government Documents

### 2.2.1 Industry Standards

| **Reference Number** | **Title** |
|---|---|
| IEEE 754-1985 | IEEE Standard for Binary Floating-Point Arithmetic |
| RFC 1832 | XDR: External Data Representation Standard |

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# 3 APPLICATION LAYER

The RPG application layer interface provides Class 1 users or RPGOPs with status messages and meteorological products.

## 3.1 RPG Message and Product Segmentation

RPG transport processing segments each application product larger than 10K bytes into 10K byte blocks of user data to be sent to the Network Layer. Therefore, the RPG application Message Header block is always required to correctly reassemble products larger than 10K bytes, regardless of the underlying network. [Note: 1K byte =1024 bytes].

## 3.2 Operating Procedures

Once the Class 1/RPGOP link is established and logically connected, application level message exchange may proceed. These messages consist of NEXRAD system status messages transmitted to the user, requests for weather product data transmitted from the user to the RPG, and weather product data transmitted from the RPG to the Class 1 user/RPGOP. See RPG X.25 Protocol ICD, 2620037, or RPG TCP/IP, 2620041, for information on establishing the appropriate link.

### 3.2.1 Initial Messages

#### 3.2.1.1 General Status Message

Upon connection, the first Product Data Level message transmitted by the RPG to a Class 1 user/RPGOP is the General Status Message. The General Status Message describes the state of the Radar Acquisition (RDA) and RPG. This data informs the Class 1 user/RPGOP about operational modes, the scan strategy and equipment status of the RDA and RPG. Figure 3-17 provides a graphic representation of this message. Field identifiers are described (in halfword order) along with their respective units and range in this figure. As the state of the NEXRAD system changes over the life of the communications session, the Class 1 user/RPGOP will be kept up to date by transmission of a new General Status Message.

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#### 3.2.1.2 Alert Adaptation Parameters Message

The RPG transmits an Alert Adaptation Parameters Message to the Class 1 user/RPGOP after the initial General Status Message. The Class 1 user/RPGOP will also receive this message if any changes are made to the Alert Thresholds or Product Alert Pairing by the RPG. The Alert Adaptation Parameters Message is shown in Figure 3-20.

### 3.2.2 Requesting Weather Products

Requesting Weather Product Data over a Class 1 user/RPGOP dedicated line is accomplished by the Class 1 user/RPGOP sending a Product Request Message as defined in Figure 3-4. It consists of one Message Header Block, followed by one or more Product Request Blocks. Any available product (except User Alert Message and Free Text Message which may not appear on a routine product list) may be requested either on a one-time or routine basis.

#### 3.2.2.1 Product Distribution and Availability

A Class 1 user/RPGOP may request any valid NEXRAD product. These products may be requested for routine generation or as a one-time product request. All products may not be available to all users due to system degradation, system load shedding, or because of a hardware or software problem.

#### 3.2.2.2 NEXRAD Message Code Definitions

Table II shows the valid message codes for the NEXRAD system. Note that product requests have a message code equal to the product code of the product being transmitted (16 to 299).

#### 3.2.2.3 NEXRAD Weather Product Code Definitions

Table III shows the valid product code for the NEXRAD weather product to be transmitted to the user. Along with the product codes shown, the resolution, range, data level, and type of each product is shown.

#### 3.2.2.4 Product Dependent Header Definitions

Table IIa shows the product dependent halfword definitions for the Product Request message (Figure 3-4). Table V shows the fields that are product dependent for the Product Description Block in Figure 3-6. The products are shown in alphabetical order along with the corresponding message code, content of the product dependent parameter, the halfword location, units, range and accuracy.

#### 3.2.2.5 Requesting One-Time Products

One-time product requests are requested one product per request message. The RPG will transmit the product as it becomes available, based on the parameters specified by the Product Request Block portion of the Product Request Message, and consider the request satisfied.

#### 3.2.2.6 Requesting Routine Products

Routine product requests are requested as a list of products. This is up to a maximum of to 31 for a Class 1 user, 50 for an RPGOP_50 and 90 for RPGOP_90. A Class 1 or RPGOP_50 user may be connected via a x.25 or TCP/IP interface. A RPGOP_90 user is connected via a LAN TCP/IP connection. Routine product request lists have one Message Header Block with the "Number of Blocks" field set to the number-of-products-on-the-list + 1. The Message Header Block is then followed by a Product Request Block for each product on the routine product request list. The products on the routine list will then be sent automatically to the user, up to a maximum of once per volume scan, dependent upon the request parameters in the Product Request Block.

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#### 3.2.2.7 Request Response Message

If the RPG is unable to distribute a product to the user, or receives an invalid message, or request for an invalid product, the RPG will transmit a Request Response message as shown in Figure 3-18. This message describes the error condition, sequence number (if applicable) of the request that generated the response, and the product or message code of the message in question. All of the error conditions of this message nullify the product request for the reasons given in the message, with the exception of "Available Next Volume Scan" and "One-time Request Generation Process Faulted" errors, which inform the Class 1 user/RPGOP that the product will be sent in the next volume scan.

### 3.2.3 Alerting

#### 3.2.3.1 Alert Request Message

Alert areas are defined by the Class 1 user/RPGOP and transmitted to the RPG via the Alert Request Message. The format for the message is shown in Figure 3-5. Alert categories and threshold codes are given in Table IV.

#### 3.2.3.2 Alert Message

The Class 1 User/RPGOP is notified when the alert condition is first detected by the RPG, and when the alert condition ends, via the Alert Message. The Alert Message format is shown in Figure 3-19.

### 3.2.4 External Data Message

External Data Messages are those importing meteorological, hydrometeorological, or other scientific or mathematical information into the RPG from the Class 1 user/RPGOP. In all such messages, the message code will be set to 5 in the Message Header Block (Figure 3-2), though individual messages will vary in content and format. The specific type of external data message will be indicated by the setting of the Block ID in the body of the message block that follows. The format of the message is shown in Figure 3-23.

#### 3.2.4.1 Bias Table Message

This message contains a table of bias adjustment factors and related information determined at the Class 1 user/RPGOP site from rain gage vs. radar-estimated rainfall amounts over various memory timespans. The information is used to perform a mean-field bias adjustment upon precipitation accumulation products in the RPG. The Bias Table Message is indicated by a Message Code of 15. The format of the message is shown in Figure 3-25.

### 3.2.5 Other Messages

#### 3.2.5.1 Product List Message

The Product List Message defined in Figure 3-21 lists all products commanded for generation by the MSCF operator. A Product List Message is requested by sending a Message Header Block (Figure 3-3) to the RPG and setting the message code to 8. This message was removed in Build 12. Request for message code 8 in Build 12 and later, will result in the RPG transmitting General Status Message.

#### 3.2.5.2 Radar Coded Message

The Radar Coded Message (RCM) is produced at the RPG for distribution to users. The format of the RCM is provided in Figure 3-22 and Appendix B. A more complete description of the product can be found in the Product Specification ICD (2620003).

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## 3.3 Message Description

### 3.3.1 Graphic Product Message

The RPG transmits products to the Class 1 User/RPGOP by using the Graphic Product message shown in Figure 3-6. The message consists of several blocks. Not all products require all blocks; however, the blocks are always transmitted in the order shown in Figure 3-6. One Header block and one Product Description block always precede the product. Products consist of one Product Symbology block (Block ID = 1), and zero or one of each of the Graphic Alphanumeric (Block ID = 2), and Tabular Alphanumeric blocks (Block ID = 3). The number of the last two blocks in each message used is product dependent.

#### 3.3.1.1 Product Description Block

The Product Description block for product data transmission is shown in Figure 3-6 (sheets 2, 6, and 7). Many field identifiers in the Product Description block are product dependent and therefore change depending upon the product being transmitted. Refer to Table V for the definitions of these fields and their corresponding products. The Products are listed by product name, in alphabetical order. As shown in Figure 3-6 (sheet 2), halfwords 55-60 contain offsets from the beginning of the message header (halfword 1) to the (-1) divider of each block indicated. If a product being transmitted does not require a block, or the data is not available, the offset to the block in question is set to zero. The first offset (halfword 55-56) is the offset to the Product Symbology block. The second offset (halfword 57-58) is the offset to the (-1) divider of the Graphic Alphanumeric block (Block ID = 2). The third offset is the offset to the Tabular Alphanumeric block (Block ID = 3).

Some products, by virtue of their size, require data compression. If a product is compressed, all product data following the Product Description block are compressed. Product dependent parameters defined within the Product Description block specify the compression method and size of the uncompressed product. The length of message in the Message Header block refers to the size of the compressed product. Refer to Table V for Product Description block definitions for compressed products. Appendix D describes the data compression method.

#### 3.3.1.2 Product Symbology Block

The Product Symbology block is block ID number 1 and is shown in Figure 3-6 (sheets 3 and 8). It is always numbered as 1. If it is available in a product, it will always follow the Product Description block. In general, this block contains display data packets that make up the geographic display of the product. These packets contain vectors, text and special character symbols, map data, radial data, raster data, precipitation data, vector arrow data, wind barb data, and special graphic symbols. The packet formats are defined in Figures 3-7 through 3-15c. The Symbology block may, depending upon the product, have multiple "layers" of packets. This is done only in products that have both image type data, mixed with non-image type data. An example of this is a Combined Moment product. It has reflectivity displayed as an image and vector arrow data that is defined with vector arrow packets. The layers are started with the (-1) divider. The product dependent data identified in Table VI is incorporated into the Product Symbology Block.

#### 3.3.1.3 Graphic Alphanumeric Block

The Graphic Alphanumeric block is block ID number 2. It is the block in which display packets are defined to cause the storm related data to be displayed at the top of the geographic screen to amplify the corresponding graphic displayed symbology. The format of this block is shown graphically in Figure 3-6 (sheets 4 and9). The only products for which this block is formatted are the following:

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| Product Code | Product Name |
|---|---|
| 31 | User Selectable Precipitation |
| 35-38, 95-98 | Composite Reflectivity, Composite Reflectivity Edited for AP |
| 58 | Storm Tracking Information |
| 59 | Hail Index |
| 60 | Mesocyclone |
| 61 | Tornado Vortex Signature |
| 139 | Mesocyclone Rapid Update |
| 141 | Mesocyclone Detection |
| 143 | Tornado Vortex Signature Rapid Update |

The actual data within this block is a series of text packets that format the line data into 5 lines. The number of pages is data dependent. The text packet format used for the attributes is packet number 8 shown in Figure 3-8. Notice that I-start and J-start are defined as 1/4 km from the radar. The Graphic Attributes packets are not geographic, but are actual screen coordinates. Included in the text packet for each page of Attribute data is a series of vector packets to draw the grid lines. The vector packets used are shown in Figure 3-7. The product dependent data identified in Table VII is incorporated into the Graphic Alphanumeric Block.

#### 3.3.1.4 Tabular Alphanumeric Block

The Tabular Alphanumeric block for product data transmission is Block ID number 3. The format of this block is shown graphically in Figure 3-6 (sheets 5 and 10). It is always numbered 3 even though it may not be the third block in the product. The following products have a paired-alphanumeric product that is encoded as Block 3 (Figure 3-6, sheet 7). The paired-alphanumeric product has a

second Header and Product Description block as shown in the figure. The products that have Block ID 3 are as follows:

| Product Code | Product Name | Block 3 Message Code |
|---|---|---|
| 48 | VAD Wind Profile | 100 |
| 58 | Storm Tracking Information | 101 |
| 59 | Hail Index | 102 |
| 60 | Mesocyclone | 103 |
| 61 | Tornado Vortex Signature | 104 |
| 78 | Surface Rainfall Accumulation (1 hour) | 107 |
| 79 | Surface Rainfall Accumulation (3 hours) | 108 |
| 80 | Storm Total Rainfall Accumulation | 109 |
| 132 | Clutter Likelihood Reflectivity | 110 |
| 133 | Clutter Likelihood Doppler | 111 |
| 139 | Mesocyclone Rapid Update | 139 |
| 141 | Mesocyclone Detection | 141 |
| 143 | Tornado Vortex Signature Rapid Update | 143 |
| 171 | Storm Total Accumulation | 171 |

The second header of the alphanumeric product is exactly the same as the header at the beginning of the message, except that the Message Code is as defined above. The Data portion of the alphanumeric product is ASCII text formatted into pages of 17 lines of 80-character data. Each page is separated by the (-1) divider. Alphanumeric products containing this block have it as the last block of the product message. The product dependent data identified in Table VIII is incorporated into the Tabular Alphanumeric Block.

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### 3.3.2 Stand-Alone Tabular Alphanumeric Product Message

Figure 3-16 defines the Stand-Alone Tabular Alphanumeric Product Message. This message is used for products that are completely alphanumeric, and are not paired as described in subsection 3.2.1.4. These products do not contain a symbology block. The Stand-Alone Tabular Alphanumeric Products are: User Alert Message (product 73), Storm Structure (product 62), Free Text Message (product 75), PUP Text Message (product 77) and Supplemental Precipitation Data (product 82). The format of the Product Description block is identical to that for the Graphic Product Message, except the first offset is to the (-1) divider shown in Figure 3-16. The product dependent data identified in Table IX is incorporated into the Stand-Alone Tabular Alphanumeric Product Message.

### 3.3.3 Coordinate System

Three coordinate systems are supported for the expression of weather information:

- Geographic Cartesian
- Polar
- Screen Cartesian
-

A Geographic Cartesian coordinate system with origin at the radar and positive directions of North (up), and East (right) are supported. The coordinate system has a range of ± 512 kilometers with 1/4-kilometer resolution. Specifically, I (right) and J (up) coordinates range from -2048 to +2048 with negative coordinates in two complement forms. Vectors are represented in this coordinate system.
A Polar coordinate system with origin at the radar and 0-degree radial North (up) is supported. The range coordinate covers from 0 to 460 kilometers with 1/4-kilometer resolution. The azimuth coordinate covers 0 to 360 degrees with 0.1-degree resolution. This resolution is necessary to achieve 0.1-degree resolution used system wide. Positive angles are clockwise. Specifically, theta coordinates range from 0 to 360 degrees. Images are represented in the Polar coordinate system. Each point in the display is represented by a display value.
A Screen Cartesian coordinate system with origin at the upper left corner and positive directions of X to the right and Y down are supported. The X coordinate ranges from 0 to 639 pixels and the Y-coordinate ranges from 0 to 511 pixels. X can be expressed in 10 bits and Y in 9 bits. The screen coordinate system is used to identify the location of text on the screen.

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| | MSB HALFWORD LSB | |
|---|---|---|
| MESSAGE HEADER BLOCK | MESSAGE CODE | 01 |
| | DATE OF MESSAGE | 02 |
| | TIME OF MESSAGE (MSW) | 03 |
| | TIME OF MESSAGE (LSW) | 04 |
| | LENGTH OF MESSAGE (MSW) | 05 |
| | LENGTH OF MESSAGE (LSW) | 06 |
| | SOURCE ID | 07 |
| | DESTINATION ID | 08 |
| | NUMBER OF BLOCKS | 09 |

| **HALF WORD** | **FIELDNAME** | **TYPE** | **UNITS** | **RANGE** | **PRECISION/ ACCURACY** | **REMARKS** |
|---|---|---|---|---|---|---|
| 01 | Message Code | INT*2 | N/A | -131 to -16, 0 to +211 | N/A | NEXRAD Message Code defined in Table II |
| 02 | Date of Message | INT*2 | Julian Date | 1 to 32,767 | 1 | Modified Julian Date at time of transmission (number of days since 1 January 1970, where 1=1 January 1970). To obtain actual Julian Date, add 2,440,586.5 to the modified date |
| 03-04 | Time of Message | INT*4 | Seconds | 0 to 86,399 | 1 | Number of seconds after midnight, Greenwich Mean Time (GMT). |
| 05-06 | Length of Message | INT*4 | N/A | 18 to 1329270 | 1 | Number of bytes in message including header |
| 07 | Source ID | INT*2 | N/A | 0 to 999 | 1 | Source (originators') ID of the sender |
| 08 | Destination ID | INT*2 | N/A | 0 to 999 | 1 | Destination ID (receivers') for message transmission |
| 09 | Number Blocks | INT*2 | N/A | 1 to 51 | 1 | Header Block plus the Product Description Blocks in message |

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**Figure 3-3. Message Header**

| | MSB HALFWORD LSB |
|---|---|
| | MESSAGE |

| | | |
|---|---|---|
| | HEADER BLOCK (see Figure 3-3) | |
| PRODUCT REQUEST BLOCK | (-1) DIVIDER | 10 |
| | LENGTH OF BLOCK | 11 |
| | PRODUCT CODE | 12 |
| | FLAG BITS | 13 |
| | SEQUENCE NUMBER | 14 |
| | NUMBER OF PRODUCTS | 15 |
| | REQUEST INTERVAL | 16 |
| | VOLUME SCAN DATE | 17 |
| | VOL SCAN START TIME (MSW) | 18 |
| | VOL SCAN START TIME (LSW) | 19 |
| | PRODUCT DEPENDENT | 20 |
| | " | 21 |
| | " | 22 |
| | " | 23 |
| | " | 24 |
| | " | 25 |

**Figure 3-4. Product Request Message (Sheet 1)**

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| HALFWORD | FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|---|
| 10 | Block Divider | INT*2 | N/A | -1 | N/A | Value of -1 used to delineate the Header from the Product Description Block(s) |
| 11 | Length of Block | INT*2 | N/A | 32 | 1 | Number of bytes in block, including block divider, in the Product Description Block |
| 12 | Product Code | INT*2 | N/A | 16 to 2000 | N/A | Internal NEXRAD product code corresponding to a weather product in Table I |
| 13 | Flag Bits | INT*2 | N/A | 0,1/bit | N/A | Bit # Value Meaning<br>0 1 High Priority<br>0 0 Low Priority<br>1 1 Map Requested<br>(Bit 0=MSB) |
| 14 | Sequence Number | INT*2 | N/A | 1 to 32,767 | 1 | Monotonically increase for tracking of request |
| 15 | Number of Products | INT*2 | N/A | -1, 1 to 9 | 1 | -1 for continuous (RPS) product transmission. 1 to 9 for one-time requests, when Volume Scan Start Time of Product (halfwords 18, 19) is = -1 (equivalent to PUP Repeat Count).<br><br>NOTE: For RPS requests, the number of products requested is determined from the Number of Blocks fields of the Message Header. |
| 16 | Request Interval | INT*2 | N/A | 1 to 9 | 1 | If Volume Scan Start Time of Product is >=0 or -2, |

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| HALFWORD | FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|---|
| | | | | | | then Request Interval is 1. If Volume Scan Start Time of Product is = -1, then the range is 1 to 9 and corresponds to the interval of the number of scans to send the product, where:<br>1 = every volume scan<br>2 = every other volume scan<br>.<br>.<br>.<br>9 = every ninth volume scan |
| 17 | Volume Scan Date of Product* | INT*2 | Julian Date | 0 to 32,767 | 1 | Modified Julian date at beginning of volume scan |
| 18-19 | Volume Scan Start Time of Product* | INT*4 | Second s | -2 to 86,399 | 1 | Seconds after Midnight (Greenwich Mean Time)** or<br>-1 requests current product<br>-2 requests latest available product** |
| 20-25 | Product Dependent | INT*2 | N/A | N/A | N/A | See Table II-A |

**Figure 3-4. Product Request Message (Sheet 2)**

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*Volume scan date is only applicable for one-time product requests that have a Volume Scan Start Time in the range [0, 86399]. If a volume scan date and time are specified, it corresponds to the volume scan start date and time that is searched for that product.
**For one-time product requests, if specifying the volume scan date and time or latest available and the product has elevation parameters then only the specific angle is allowed in the request. The feature described in Note 9 will result in a Request Response Message indicating Invalid Product Parameters.

**Table II. NEXRAD Message Code Definitions**

| MESSAGE CODE | MESSAGE TYPE | FIGURE |
|---|---|---|
| 0,13 | Product Request, Product Request Cancel | 3-4 |
| 1 | Spare | - |
| 2 | General Status | 3-17 |
| 3 | Request Response | 3-18 |
| 4 | Maximum Connection Time Disable Request | N/A |
| 5 | External Data Message | 3-23 |
| 6 | Alert Adaptation Parameter Message | 3-20 |
| 7 | Alert Request Message | 3-5 |
| 8 | Product List | 3-21 |
| 9 | Alert Message | 3-19 |
| 10 | Spare | - |
| 11 | Sign-on Request Message (Dial -up Users) | N/A |
| 12 | Spare | - |
| 14 | Spare | - |
| 15 | Bias Table Message | 3-25 |
| 16 to 111 | Products (See Table III for individual Product Codes) | |
| 112 to 131 | Reserved for future Products | |
| 132-134 | Products (See Table III for Individual Product Codes) | |
| 135 | Reserved for future Product | |
| 136 to 138 | Products (See Table III for Individual Product Codes) | |
| 139-143 | Reserved for future Products | |
| 144-151 | Products (See Table III for Individual Product Codes) | |
| 152 | Reserved for future Products | |
| 153-155 | Super Resolution | |
| 156, 157 | NTDA Products | |
| 158-179 | Dual Polarization Products (See Table III for Individual Product Codes) Codes 167-168, 178 and 179 are reserved for future Dual Pol Base, and QPE products, respectively. | |
| 180-193 | Reserved for future Products | |
| 194 | Base Reflectivity Data Array (DoD Version) | |
| 195-198 | Reserved for future Products | |
| 199 | Base Velocity Data Array (DoD Version) | |
| 200-299 | Reserved for future Products | |
| Negative | Annotations have a negative message code equal in magnitude to that of the Product being annotated | |

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**Table IIa. Product Dependent Halfword Definitions for Product Request Message**

| PRODUCT NAME | MSG CODE(s) | HALF WORD | CONTENT | UNITS | RANGE | ACCURACY /PRECISION |
|---|---|---|---|---|---|---|
| Base Products, ITWS Digital Base Velocity, Clutter Likelihood (Reflectivity and Doppler), Meso Rapid Update, NTDA (EDR and EDC) | 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 93, 94, 99, 132, 133, 139, 156, 157, 194, 199 | • 22 | •Elevation Angle | • Degrees | •-1.0 to 45.0 | •.1, Note 1, 9 |
| Cross Section | 50, 51, 85, 86 | •20<br>•21<br>•22<br>•23 | •Azimuth of Point 1<br>•Range of Point 1<br>•Azimuth of Point 2<br>•Range of Point 2 | •Degree<br>•Nmi<br>•Degree<br>•Nmi | •0 to 359.9<br>•0 to 124.0<br>•Same as Point 1<br>•Same as Point 1 | •.1, Note 1<br>•.1, Note 1<br>•.1, Note 1<br>•.1, Note 1 |
| Storm Relative Mean Radial Velocity Region | 55 | •20<br>•21<br>•22<br>•23<br>•24 | •Azimuth of Window Center<br>•Range of Window Center<br>•Elevation Angle<br>•Storm Speed<br>•Storm Direction | •Degree<br>•Nmi<br>•Degree<br>•Knots<br>•Degrees | •0 to 359.9<br>•0 to 124.0<br>•-1.0 to 45.0<br>•0 to 99.9<br>•0 to 359.9 | •.1, Note 1<br>•.1, Note 1<br>•.1, Note 1,9<br>•.1, Note 1,2<br>•.1, Note 1 |
| Storm Relative Mean Radial Velocity Map | 56 | •22<br>•23<br>•24 | •Elevation Angle<br>•Storm Speed<br>•Storm Direction | •Degree<br>•Knots<br>•Degrees | •-1.0 to 45.0<br>•0 to 99.9<br>•0 to 359.9 | •.1, Note 1,9<br>•.1, Note 1,3<br>•.1, Note 1 |
| VAD | 84 | •22 | •Altitude | •K Feet | •0 to 70 | •1 |
| User Selectable Precipitation (Note 5) | 31 | •20<br>•21 | •End Hour<br>•Time Span | •Hours<br>•Hours | •-1 to 23,<br>•1 to 24 | •1, Note 6<br>•1 |
| User Selectable Layer Composite Reflectivity | 137 | •20<br>•21 | •Bottom Altitude of Layer<br>•Top Altitude of Layer | •K Feet<br>•K Feet | •0 to 69<br>•1 to 70 | •1<br>•1, Note 8 |
| Clutter Filter Control (Note 5) | 34 | •20 | •Bit Map | •N/A | •0,1 bit | •N/A, Note 7 |
| Tornado Vortex Signature Rapid Update | 143 | •22 | •Elevation Angle | •Degrees | •-1.0 to 45.0 | •.1, Note 1,9 |
| Digital Mesocyclone | 149 | •22 | •Elevation Angle | •Degree | •-1.0 to + 45.0 | •.1, Note 1,9 |

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| PRODUCT NAME | MSG CODE(s) | HALF WORD | CONTENT | UNITS | RANGE | ACCURACY /PRECISION |
|---|---|---|---|---|---|---|
| Detection | | | | | | |
| User Selectable Snow Accumulations (Note 5) | 150, 151 | •20<br>•21 | •End Hour<br>•Time Span | •Hours<br>•Hours | •-1 to 23<br>•1 to 30 | •1, Note 6<br>•1 |
| Super Resolution Base Products (R/V/SW) | 153, 154, 155 | •22 | •Elevation Angle | •Degrees | •-1.0 to 45.0 | •.1, Note 1,9 |
| Differential Reflectivity | 158, 159 | 22 | Elevation Angle | Degree | -1.0 to + 45.0 | .1, Note 1,9 |
| Correlation Coefficient | 160, 161 | 22 | Elevation Angle | Degree | -1.0 to + 45.0 | .1, Note 1,9 |
| Specific Differential Phase | 162, 163 | 22 | Elevation Angle | Degree | -1.0 to + 45.0 | .1, Note 1,9 |
| Hydrometeor Classification | 164, 165 | 22 | Elevation Angle | Degree | -1.0 to + 45.0 | .1, Note 1,9 |
| Melting Layer | 166 | 22 | Elevation Angle | Degree | -1.0 to + 45.0 | .1, Note 1,9 |
| Digital User-Selectable Accumulation (Note 5) | 173 | • 20<br>• 21 | • End Time<br>• Time Span | • Mins<br>• Mins | • -1 to 1439<br>• 15 to 1440 | 1, Note 6 |

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**Note 1.** Scaled Integer.
**Note 2.** A value of -1 indicates that the storm motion is that of the storm closest to the window center.
**Note 3.** A value of -1 indicates that the storm motion is that of the vector average of all currently identified storms.
**Note 4.** Defines up to eight user selected elevation angles available in the current scan strategy. Scan strategy may contain 20 cuts. Each elevation cut selection is represented by a unique bit setting. Bit 1 of halfword 23 corresponds to elevation cut #l. Bit 4 of halfword 24 corresponds to elevation cut #20. Bit 0 of halfword 23 is the MSB and is not used.
**Note 5.** One-time requests for this product should use the "latest available" request option. That is, place -2 in the volume scan start time field (halfword 18-19).
**Note 6.** A value of -1 indicates that the end time will be the time of the most recent hourly update.
**Note 7.** This halfword defines the clutter map segment number (both Version 0 and Version 1 of the CFC product) and channel type (Version 0 only). For Version 0, bit 15 (bit 0 = MSB) defines the channel type. If bit 15 is 0, then the surveillance channel map is requested. If bit 15 is 1, then the Doppler channel map is requested. For both Version 0 and 1, bits 14 through 10 specify elevation segment numbers 1 through 5, respectively. Set the bit number of the segment being requested. Segment 1 is the lowest clutter filter map elevation segment, segment 5 is the highest clutter filter map elevation segment. For Version 1, bit 15 is ignored for any CFC product request.
**Note 8.** Minimum layer thickness is 1 K Feet
**Note 9.** Bits 0-12 (bit 0 is LSB) of halfword represents scaled elevation angle. For elevation angles >= 0, the elevation angle is denoted degrees*10. For elevation angles < 0, the angle is denoted 3600 + degrees*10.

Bits 13-15 have special meaning. If bits 13-15 are not set, bits 0-12 denote elevation angle as described above. Bit 15 is reserved for future use and should never be set. If bit 14 is set (bits 15 and

13 not set) and bits 0-12 not set, then all elevation angles of the volume coverage pattern are requested. If bit 14 is set (bits 15 and 13 not set), bits 0-12 may be used to denote elevation angle as described above. In this case, all elevation angles of the volume coverage pattern matching the specified elevation angle are requested. If bit 13 is set (bits 15 and 14 not set), then all elevation angles at or below the angle specified by bits 0-12 are requested. If bit 13 and 14 are set (bit 15 is not set), then 0-12 specifies an elevation cut number. The first N cuts (where N = cut number) are requested.

If the elevation parameter specifies multiple requests, each request counts against the maximum product count specified for the requestor. This check is only done when the request is first received at the RPG.

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**Table III. Message Codes for Products**

| CODE | NTR | PRODUCT NAME | RESOLUTION | RANGE | DATA LEVEL | MESSAGE FORMAT |
|---|---|---|---|---|---|---|
| 16 | 1 | Base Reflectivity | .54 x 1 Nmi x Deg | 124 | 8 | Radial Image |
| 17 | 1 | Base Reflectivity | 1.1 x 1 Nmi x Deg | 248 | 8 | Radial Image |
| 18 | 1 | Base Reflectivity | 2.2 x 1 Nmi x Deg | 248 | 8 | Radial Image |
| 19 | 1 | Base Reflectivity | .54 x 1 Nmi x Deg | 124 | 16 | Radial Image |
| 20 | 1 | Base Reflectivity | 1.1 x 1 Nmi x Deg | 248 | 16 | Radial Image |
| 21 | 1 | Base Reflectivity | 2.2 x 2 Nmi x Deg | 248 | 16 | Radial Image |
| 22 | 2 | Base Velocity | .13 x 1 Nmi x Deg | 32 | 8 | Radial Image |
| 23 | 2 | Base Velocity | .27 x 1 Nmi x Deg | 62 | 8 | Radial Image |
| 24 | 2 | Base Velocity | .54 x 1 Nmi x Deg | 124 | 8 | Radial Image |
| 25 | 2 | Base Velocity | .13 x 1 Nmi x Deg | 32 | 16 | Radial Image |
| 26 | 2 | Base Velocity | .27 x 1 Nmi x Deg | 62 | 16 | Radial Image |
| 27 | 2 | Base Velocity | .54 x 1 Nmi x Deg | 124 | 16 | Radial image |
| 28 | 3 | Base Spectrum Width | .13 x 1 Nmi x Deg | 32 | 8 | Radial Image |
| 29 | 3 | Base Spectrum Width | .27 x 1 Nmi x Deg | 62 | 8 | Radial Image |
| 30 | 3 | Base Spectrum Width | .54 x 1 Nmi x Deg | 124 | 8 | Radial Image |
| 31 | 32 | User Selectable Storm Total Precipitation | 1.1 x 1 Nmi x Deg | 124 | 16 | Radial Image/Geographic Alpha |
| 32 | 33 | Digital Hybrid Scan Reflectivity | .54 x 1 Nmi x Deg | 124 | 256 | Radial Image |
| 33 | 33 | Hybrid Scan Reflectivity | .54 x 1 Nmi x Deg | 124 | 16 | Radial Image |
| 34 | 34 | Clutter Filter Control | 1 x 1.4 Km x Deg (Ver. 0)<br>1 x 1.0 Km x Deg (Ver. 1) | 124 | 8 (Ver. 0)<br>4 (Ver. 1) | Radial Image |
| 35 | 6 | Composite Reflectivity | .54 x .54 Nmi x Nmi | 124 | 8 | Raster Image/Non-geographic Alpha |
| 36 | 6 | Composite Reflectivity | 2.2 x 2.2 Nmi x Nmi | 248 | 8 | Raster Image/Non-geographic Alpha |

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| CODE | NTR | PRODUCT NAME | RESOLUTION | RANGE | DATA LEVEL | MESSAGE FORMAT |
|---|---|---|---|---|---|---|
| 37 | 6 | Composite Reflectivity | .54 x .54 Nmi x Nmi | 124 | 16 | Raster Image/Non-geographic Alpha |
| 38 | 6 | Composite Reflectivity | 2.2 x 2.2 Nmi x Nmi | 248 | 16 | Raster Image/Non-geographic Alpha |
| 39 | | Spare | | | | |
| 40 | | Spare | | | | |
| 41 | 8 | Echo Tops | 2.2 x 2.2 Nmi x Nmi | 124 | 16 | Raster Image |
| 42 | | Spare | | | | |
| 43 | | Spare | | | | |
| 44 | | Spare | | | | |
| 45 | | Spare | | | | |
| 46 | | Spare | | | | |
| 47 | | Spare | | | | |
| 48 | 12 | VAD Wind Profile | 5 Knots | N/A | 5 | Non-geographic Alphanumeric |
| 49 | | Spare | | | 16 | Raster Image/Non-geographic Alphanumeric |
| 50 | 14 | Cross Section (Reflectivity) | .54 Horizontal x .27 Vert Nmi x Nmi | 124 | 16 | Raster Image (Reflectivity) |
| 51 | 14 | Cross Section (Velocity) | .54 Horizontal x .27 Vert Nmi x Nmi | 124 | 16 | Raster Image (Velocity) |
| 52 | | Spare | | | | |
| 53 | | Spare | | | | |
| 54 | ----------Reserved---------- | | | | | |
| 55 | 16 | Storm Relative Mean Radial Velocity | .27 x 1 Nmi x Deg | 27 | 16 | Radial Image (Region) |
| 56 | 16 | Storm Relative Mean Radial Velocity | .54 x 1 Nmi x Deg | 124 | 16 | Radial Image (Map) |
| 57 | 17 | Vertically Integrated Liquid | 2.2 x 2.2 Nmi x Nmi | 124 | 16 | Raster Image |
| 58 | 18 | Storm Tracking Information | N/A | 248 | N/A | Geographic and Non-geographic Alpha |
| 59 | 19 | Hail Index | N/A | 124 | N/A | Geographic and Non-geographic Alpha |
| 60 | 20 | Mesocyclone | N/A | 124 | N/A | Geographic and Non-geographic Alpha |
| 61 | 21 | Tornado Vortex Signature | N/A | 124 | N/A | Geographic and Non-geographic |

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| CODE | NTR | PRODUCT NAME | RESOLUTION | RANGE | DATA LEVEL | MESSAGE FORMAT |
|---|---|---|---|---|---|---|
| | | | | | | Alphanumeric |
| 62 | 22 | Storm Structure | N/A | 248 | N/A | Alphanumeric |
| 63 | 23 | Layer Composite Reflectivity | 2.2 x 2.2 Nmi x Nmi | 124 | 8 Avg | Raster Image (Layer 1 Average) |
| 64 | 23 | Layer Composite Reflectivity | 2.2 x 2.2 Nmi x Nmi | 124 | 8 Avg | Raster Image (Layer 2 Average) |
| 65 | 23 | Layer Composite Reflectivity | 2.2 x 2.2 Nmi x Nmi | 124 | 8 Max | Raster Image (Layer 1 Maximum) |
| 66 | 23 | Layer Composite Reflectivity | 2.2 x 2.2 Nmi x Nmi | 124 | 8 Max | Raster Image (Layer 2 Maximum) |
| 67 | 23 | Layer Composite Reflectivity - AP Removed | 2.2 x 2.2 Nmi x Nmi | 124 | 8 Max | Raster Image |
| 68 | | Spare | | | | |
| 69 | | Spare | | | | |
| 70 | | Spare | | | | |
| 71 | | Spare | | | | |
| 72 | | Spare | | | | |
| 73 | 25 | User Alert Message | N/A | N/A | N/A | Alphanumeric |
| 74 | 26 | Radar Coded Message | 1/16 LFM | 248 | 9 | Alphanumeric |
| 75 | 27 | Free Text Message | N/A | N/A | N/A | Alphanumeric |
| 76 | ---- ----------Reserved for internal PUP use ---------- | | | | | |
| 78 | 28 | Surface Rainfall Accum. (1 hr) | 1.1 x 1 Nmi x Deg | 124 | 16 | Radial Image |
| 79 | 28 | Surface Rainfall Accum. (3 hr) | 1.1 x 1 Nmi x Deg | 124 | 16 | Radial Image |
| 80 | 29 | Storm Total Rainfall Accumulation | 1.1 x 1 Nmi x Deg | 124 | 16 | Radial Image |
| 81 | 30 | Hourly Digital Precipitation Array | 1/40 LFM | 124 | 256/8 | Raster Image / Alphanumeric |
| 82 | 31 | Supplemental Precipitation Data | N/A | N/A | N/A | Alphanumeric |
| 83 | | Spare | | | 9 | |
| 84 | 12 | Velocity Azimuth Display | 5 Knots | N/A | 8 | Non-geographic Alphanumeric |
| 85 | 14 | Cross Section Reflectivity | .54 Horizontal x .27 Vert Nmi x Nmi | 124 | 8 | Raster Image (Reflectivity) |
| 86 | 14 | Cross Section Velocity | .54 Horizontal x .27 Vert Nmi x Nmi | 124 | 8 | Raster Image (Velocity) |
| 87 | | Spare | | | | |

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| CODE | NTR | PRODUCT NAME | RESOLUTION | RANGE | DATA LEVEL | MESSAGE FORMAT |
|---|---|---|---|---|---|---|
| 88 | | Spare | | | | |
| 89 | 23 | Layer Composite Reflectivity | 2.2 x 2.2 Nmi x Nmi | 124 | 8 Avg | raster Image - Layer 3 Average |
| 90 | 23 | Layer Composite Reflectivity | 2.2 x 2.2 Nmi x Nmi | 124 | 8 Max | Raster Image - Layer 3 Maximum |
| 91-92 | | Reserved for internal PUP and RPG Use | | | | |
| 93 | 35 | ITWS Digital Base Velocity | .54 x 1 Nmi x Deg | Lesser of 62 Nmi or 18Kft AGL | 256 | Radial Image |
| 94 | 1 | Base Reflectivity Data Array | .54 x 1 Nmi x Deg | 248 | 256 | Radial Image |
| 95 | 6 | Composite Reflectivity Edited for AP | .54x.54 Nmi x Nmi | 124 | 8 | Raster Image/Non-geographic Alpha |
| 96 | 6 | Composite Reflectivity Edited for AP | 2.2 x 2.2 Nmi x Nmi | 248 | 8 | Raster Image/Non-geographic alpha |
| 97 | 6 | Composite Reflectivity Edited for AP | .54 x .54 Nmi x Nmi | 124 | 16 | Raster Image/Non-geographic Alpha |
| 98 | 6 | Composite Reflectivity Edited for AP | 2.2 x 2.2 Nmi x Nmi | 248 | 16 | Raster Image/Non-geographic Alpha |
| 99 | 2 | Base Velocity Data Array | .13 x 1 Nmi x Deg | 124 | 256 | Radial Image |
| 100 | | Site Adaptable parameters for VAD Wind Profile (Product 48) | | | | |
| 101 | | Storm Track Alphanumeric Block | | | | |
| 102 | | Hail Index Alphanumeric Block | | | | |
| 103 | | Mesocyclone Alphanumeric Block | | | | |
| 104 | | TVS Alphanumeric Block | | | | |
| 105 | | Site Adaptable Parameters for Combined Shear | | | | |
| 106 | | Spare | | | | |

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| CODE | NTR | PRODUCT NAME | RESOLUTION | RANGE | DATA LEVEL | MESSAGE FORMAT |
|---|---|---|---|---|---|---|
| 107 | | Surface Rainfall (1 hr) Alphanumeric Block | | | | |
| 108 | | Surface Rainfall (3 hr) Alphanumeric Block | | | | |
| 109 | | Storm Total Rainfall Accumulation Alphanumeric Block | | | | |
| 110 | | Clutter Likelihood Reflectivity Alphanumeric Block | | | | |
| 111 | | Clutter Likelihood Doppler Alphanumeric Block | | | | |
| 112-131 | | Reserved for Future Products | | | | |
| 132 | 36 | Clutter Likelihood Reflectivity | .54 x 1 Nmi. x Deg | 124 | 11 | Radial Image |
| 133 | 37 | Clutter Likelihood Doppler | .54 x 1 Nmi. x Deg | 124 | 12 | Radial Image |
| 134 | 39 | High Resolution VIL | .54 x 1 Nmi x Deg | 248 | 256 | Radial Image |
| 135 | 41 | Enhanced Echo Tops | .54 x 1 Nmi x Deg | 186 | 199 | Radial Image |
| 136 | 38 | SuperOb | Adaptable, default = 5 km x 6 deg | Adaptable, default = 100 km | N/A | Latitude, Longitude (ICD packet code 27) |
| 137 | 40 | User Selectable Layer Composite Reflectivity | 0.54 Nmi x1Deg | 124 nmi | 16 | Radial image |
| 138 | 29 | Digital Storm Total Precipitation | 1.1Nmi x 1Deg | 124 | 256 | Radial Image |

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| CODE | NTR | PRODUCT NAME | RESOLUTION | RANGE | DATA LEVEL | MESSAGE FORMAT |
|---|---|---|---|---|---|---|
| 139 | 20 | Mesocyclone Rapid Update | N/A | 124 | N/A | Geographic and Non-geographic Alpha |
| 140 | 46 | Gust Front MIGFA | N/A | 38 | N/A | Generic Data Format |
| 141 | 20 | Mesocyclone Detection | N/A | 124 | N/A | Geographic and Non-geographic Alpha |
| 143 | 21 | Tornado Vortex Signature Rapid Update | N/A | 124 | N/A | Geographic and Non-geographic Alphanumeric |
| 144 | 42 | One-hour Snow Water Equivalent | 0.54 x 1 Nmi x Deg | 124 | 16 | Radial Image |
| 145 | 42 | One-hour Snow Depth | 0.54 x 1 Nmi x Deg | 124 | 16 | Radial Image |
| 146 | 43 | Storm Total Snow Water Equivalent | 0.54 x 1 Nmi x Deg | 124 | 16 | Radial Image |
| 147 | 43 | Storm Total Snow Depth | 0.54 x 1 Nmi x Deg | 124 | 16 | Radial Image |
| 149 | 20 | Digital Mesocyclone Detection | N/A | 124 | N/A | Generic Data Format |
| 150 | 44 | User Selectable Snow Water Equivalent | 0.54 x 1 Nmi x Deg | 124 | 16 | Radial Image |
| 151 | 44 | User Selectable Snow Depth | 0.54 x 1 Nmi x Deg | 124 | 16 | Radial Image |
| 152 | | Archive III Status Product | | | | Generic Data Format |
| 153 | 1 | Super Resolution Reflectivity Data Array | 0.13 x 0.5 Nmi x Deg | 248 | 256 | Radial Image |
| 154 | 2 | Super Resolution Velocity Data Array | 0.13 x 0.5 Nmi x Deg | 162 | 256 | Radial Image |
| 155 | 3 | Super Resolution Spectrum Width Data Array | 0.13 x 0.5 Nmi x Deg | 162 | 256 | Radial Image |
| 156 | 47 | Eddy Dissipation Rate | 1.1 x 1 Nmi x Deg | 124 nmi | 64 | Digital Radial Data Array |
| 157 | 47 | Eddy Dissipation Rate Confidence | 1.1 x 1 Nmi x Deg | 124 nmi | 8 | Digital Radial Data Array |
| 158 | 48 | Differential Reflectivity | .54 x 1 Nmi x Deg | 124 | 16 | Radial Image |
| 159 | 48 | Digital Differential Reflectivity | .13 x 1 Nmi x Deg | 162 | 256 | Radial Image |
| 160 | 49 | Correlation Coefficient | .54 x 1 Nmi x Deg | 124 | 16 | Radial Image |
| 161 | 49 | Digital Correlation | .13 x 1 Nmi x Deg | 162 | 256 | Radial Image |

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| CODE | NTR | PRODUCT NAME | RESOLUTION | RANGE | DATA LEVEL | MESSAGE FORMAT |
|---|---|---|---|---|---|---|
| | | Coefficient | | | | |
| 162 | 50 | Specific Differential Phase | .54 x 1 Nmi x Deg | 124 | 16 | Radial Image |
| 163 | 50 | Digital Specific Differential Phase | .13 x 1 Nmi x Deg | 162 | 256 | Radial Image |
| 164 | 51 | Hydrometeor Classification | .54 x 1 Nmi x Deg | 124 | 16 | Radial Image |
| 165 | 51 | Digital Hydrometeor Classification | .13 x 1 Nmi x Deg | 162 | 256 | Radial Image |
| 166 | 52 | Melting Layer | .13 x .13 Nmi x Nmi | 124 | N/A | Linked Contour Vectors/Set Color Level |
| 169 | 53 | One Hour Accumulation | 1.1 Nmi X 1 Degree | 124 | 16 | Radial Image |
| 170 | 54 | Digital Accumulation Array | 0.13 Nmi X 1 Degree | 124 | 256 | Radial Image |
| 171 | 55 | Storm Total Accumulation | 1.1 Nmi X 1 Degree | 124 | 16 | Radial Image |
| 172 | 56 | Digital Storm Total Accumulation | 0.13 Nmi X 1 Degree | 124 | 256 | Radial Image |
| 173 | 57 | Digital User-Selectable Accumulation | 0.13 Nmi X 1 Degree | 124 | 256 | Radial Image |
| 174 | 58 | Digital One-Hour Difference Accumulation | 0.13 Nmi X 1 Degree | 124 | 256 | Radial Image |
| 175 | 59 | Digital Storm Total Difference Accumulation | 0.13 Nmi X 1 Degree | 124 | 256 | Radial Image |
| 176 | 60 | Digital Instantaneous Precipitation Rate | 0.13 Nmi X 1 Degree | 124 | 65536 | Generic Radial Product Format |
| 177 | 51 | Hybrid Hydrometeor Classification | 250 m (0.13 Nmi) X 1 Degree | 124 | 256 | Radial Image |
| 178-193 | | Reserved for Future Products | | | | |
| 194 | 1 | Base Reflectivity Data Array (DoD Version) | 0.54 x 1 Nmi X Deg | 124 | 256 | Radial Image |
| 195-198 | | Reserved for Future Products | | | | |
| 199 | 2 | Base Velocity Data Array (DoD | 0.27 x 1 Nmi X Deg | 124 | 256 | Radial Image |

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| CODE | NTR | PRODUCT NAME | RESOLUTION | RANGE | DATA LEVEL | MESSAGE FORMAT |
|---|---|---|---|---|---|---|
| | | Version) | | | | |
| 194-210 | | Reserved for Future Products | | | | |
| 211-220 | | Reserved for Future Products | | | | |
| 221-230 | | Reserved for Future Products | | | | |
| 231-240 | | Reserved for Future Products | | | | |
| 241-250 | | Reserved for Future Products | | | | |
| 251-260 | | Reserved for Future Products | | | | |
| 261-270 | | Reserved for Future Products | | | | |
| 271-280 | | Reserved for Future Products | | | | |
| 281-290 | | Reserved for Future Products | | | | |
| 291-296 | | Reserved for Internal RPG Use. | | | | |
| 297-299 | | Reserved for Internal RPG use | | | | |

Note: For all message codes for products: Units is N/A, Range is 0 to value shown and Accuracy/Precision is 1.1

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| | MSB HALFWORD LSB | |
|---|---|---|
| MESSAGE HEADER BLOCK | MESSAGE HEADER BLOCK (see Figure 3-3) | |
| | (-1) BLOCK DIVIDER | |
| | LENGTH OF BLOCK | |
| | ALERT AREA NUMBER (1 or 2) | |
| | NUMBER OF CATEGORIES | |
| ALERT CATEGORY DEFINITION | ALERT CATEGORY | |
| | THRESHOLD CODE | |
| | PRODUCT REQUEST FLAG | |
| (REPEAT FOR EACH CATEGORY) | .. | |
| | .. | |
| | .. | |
| ALERT GRID | ALERT BOX BITS 0 - 15 | ALERT BOX ROW 1 |
| | ALERT BOX BITS 16 - 31 | |
| | ALERT BOX BITS 32 - 47 | |
| | ALERT BOX BITS 48 - 63 | |
| | .. | |
| | .. | |
| | ALERT BOX BITS 0 - 15 | ALERT BOX ROW 58 |
| | ALERT BOX BITS 16 - 31 | |
| | ALERT BOX BITS 32 - 47 | |
| | ALERT BOX BITS 48 - 63 | |

**Figure 3-5. Alert Request Message (Sheet 1)**

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| FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Block Divider | INT*2 | N/A | -1 | N/A | Integer value of -1 used to delineate the header form the Alert Request Block |
| Length of Block | INT*2 | Bytes | 472 - 532 | 1 | Number of bytes from -1 block divider to the end of this message |
| Alert Area Number | INT*2 | N/A | 1 to 2 | 1 | A maximum of 2 alert areas may be defined per user |
| Number of Categories | INT*2 | N/A | 0 to 10 | 1 | A maximum of 10 alert categories may be defined per message |
| Alert Category | INT*2 | N/A | 1 to 41 | 1 | Alert category (refer to Table IV) |
| Threshold Code | INT*2 | N/A | 1 to 6 | N/A | Parameter dependent threshold code that triggers alert (refer to Table IV) |
| Product Request Flag | INT*2 | N/A | 0 to 1 | N/A | Determines whether a product is requested for the alert when the threshold is met:<br>0 = product not requested<br>1 = product requested |
| Alert Box Bits:<br>0 - 15<br>16 - 31<br>32 - 47<br>48 - 63 | Integer | N/A | 0,1 | N/A | Bits 0-57 correspond to the 58 alert boxes contained in each row of Alert Grid. Bits 58 must be set to zero to facilitate checking of empty rows. Each alert Grid contains 58 rows of 16 x 16 Km alert boxes |

**Figure 3-5. Alert Request Message (Sheet 2)**

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**Table IV. Alert Categories and Threshold Codes**

| ALERT CATEGORY | | THRESHOLD CODES |
|---|---|---|
| | **GRID GROUP** | |
| 1 | Velocity | 1,2,3,4,5,6 |
| 2 | Composite Reflectivity | 1,2,3,4,5,6 |
| 3 | Echo Tops | 1,2,3,4 |
| 4 | Severe Weather Probability | 1,2,3,4,5 |
| 5 | Spare | - |
| 6 | Vertically Integrated Liquid | 1,2,3,4,5,6 |
| | **VOLUME GROUP** | |
| 7 | Velocity Azimuth Display | 1,2,3,4,5,6 |
| 8 | Maximum Size Hail | 1,2,3,4,5,6 |
| 9 | Spare | |
| 10 | Tornado Vortex Signature | 1,2 |
| 11 | Maximum Storm Reflectivity | 1,2,3,4,5,6 |
| 12 | Probability of Hail | 1,2,3,4,5,6 |
| 13 | Probability of Severe Hail | 1,2,3,4,5,6 |
| 14 | Storm Top | 1,2,3,4,5,6 |
| 15 | Maximum 1 Hour Rainfall Accumulation | 1,2,3,4 |
| 16 | MDA Strength Rank | 1,2,3,4,5,6 |
| 17-24 | Spare | - |
| | **FORECAST GROUP** | |
| 25 | Maximum Hail Size | 1,2,3,4,5,6 |
| 26 | Spare | |
| 27 | Tornado Vortex Signature | 1,2 |
| 28 | Maximum Storm Reflectivity | 1,2,3,4,5,6 |
| 29 | Probability of Hail | 1,2,3,4,5,6 |
| 30 | Probability of Severe Hail | 1,2,3,4,5,6 |
| 31 | Storm Top | 1,2,3,4,5,6 |
| 32 | MDA Strength Rank | 1,2,3,4,5,6 |
| 33-41 | Spare | - |

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MSB HALFWORD LSB

| |
|---|
| MESSAGE HEADER BLOCK (see Figure 3-3) |
| PRODUCT DESCRIPTION BLOCK (1) (see Sheet 2, 6, 7) |
| PRODUCT SYMBOLOGY BLOCK (1) (see Sheet 3, 8) |
| GRAPHIC ALPHANUMERIC BLOCK (1) (see Sheet 4, 9) |
| TABULAR ALPHANUMERIC BLOCK (1) (see Sheet 5, 10) |

Note 1: All blocks need not be used. Any blocks that are used must remain in the order shown above.

**Figure 3-6. Graphic Product Message (Sheet 1)**

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| | | MSB HALFWORD LSB | | |
|---|---|---|---|---|
| PRODUCT | 10 | (-1) BLOCK DIVIDER | | |
| DESCRIPTION | 11 | LATITUDE OF RADAR (MSW) | | |
| BLOCK | 12 | LATITUDE OF RADAR (LSW) | | |
| 13 | | LONGITUDE OF RADAR (MSW) | | |
| 14 | | LONGITUDE OF RADAR (LSW) | | |
| 15 | | HEIGHT OF RADAR | | |
| 16 | | PRODUCT CODE | | |
| 17 | | OPERATIONAL MODE | | |
| 18 | | VOLUME COVERAGE PATTERN | | |
| 19 | | SEQUENCE NUMBER | | |
| 20 | | VOLUME SCAN NUMBER | | |
| 21 | | VOLUME SCAN DATE | | |
| 22 | | VOL SCAN START TIME (MSW) | | |
| 23 | | VOL SCAN START TIME (LSW) | | |
| 24 | | PRODUCT GENERATION DATE | | |
| 25 | | PROD GENERATION TIME (MSW) | | |
| 26 | | PROD GENERATION TIME (LSW) | | |
| 27 | | PRODUCT DEPENDENT (P1) | | (SEE TABLE V) |
| 28 | | PRODUCT DEPENDENT (P2) | | (SEE TABLE V) |
| 29 | | ELEVATION NUMBER | | |
| 30 | | PRODUCT DEPENDENT (P3) | | (SEE TABLE V) |
| 31 | | DATA LEVEL 1 THRESHOLD | | (SEE NOTE 1) |
| 32 | | DATA LEVEL 2 THRESHOLD | | |
| 33 | | DATA LEVEL 3 THRESHOLD | | |
| 34 | | DATA LEVEL 4 THRESHOLD | | |
| 35 | | DATA LEVEL 5 THRESHOLD | | |
| 36 | | DATA LEVEL 6 THRESHOLD | | |
| 37 | | DATA LEVEL 7 THRESHOLD | | |
| 38 | | DATA LEVEL 8 THRESHOLD | | |
| 39 | | DATA LEVEL 9 THRESHOLD | | |
| 40 | | DATA LEVEL 10 THRESHOLD | | |
| 41 | | DATA LEVEL 11 THRESHOLD | | |
| 42 | | DATA LEVEL 12 THRESHOLD | | |
| 43 | | DATA LEVEL 13 THRESHOLD | | |
| 44 | | DATA LEVEL 14 THRESHOLD | | |
| 45 | | DATA LEVEL 15 THRESHOLD | | |
| 46 | | DATA LEVEL 16 THRESHOLD | | |
| 47 | | PRODUCT DEPENDENT (P4) | | (SEE TABLE V, NOTE 3) |
| 48 | | PRODUCT DEPENDENT (P5) | | |
| 49 | | PRODUCT DEPENDENT (P6) | | |
| 50 | | PRODUCT DEPENDENT (P7) | | |
| 51 | | PRODUCT DEPENDENT (P8) | | |
| 52 | | PRODUCT DEPENDENT (P9) | | |
| 53 | | PRODUCT DEPENDENT (P10) | | |
| 54 | | VERSION | SPOT BLANK | |
| 55 | | OFFSET TO SYMBOLOGY (MSW) | | |
| 56 | | OFFSET TO SYMBOLOGY (LSW) | | |
| 57 | | OFFSET TO GRAPHIC (MSW) | | |
| 58 | | OFFSET TO GRAPHIC (LSW) | | |
| 59 | | OFFSET TO TABULAR (MSW) | | |
| 60 | | OFFSET TO TABULAR (LSW) | | |

**Figure 3-6. Graphic Product Message (Sheet 2)**

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| | | |
|---|---|---|
| | MSB HALFWORD LSB | |
| PRODUCT | (-1) BLOCK DIVIDER | |
| SYMBOLOGY | BLOCK ID (1) | |
| BLOCK | LENGTH OF BLOCK (MSW) | |
| | LENGTH OF BLOCK (LSW) | |
| | NUMBER OF LAYERS | |
| | (-1) LAYER DIVIDER | |
| | LENGTH OF DATA LAYER (MSW) | |
| | LENGTH OF DATA LAYER (LSW) | |
| | DISPLAY DATA PACKETS | SEE FIGURES 3-7 THRU 3-14 |
| | • . • | |
| | (-1) LAYER DIVIDER | |
| | LENGTH OF DATA LAYER (MSW) | |
| | LENGTH OF DATA LAYER (LSW) | |
| | DISPLAY DATA PACKETS | SEE FIGURES 3-7 THRU 3-14 |

**Figure 3-6. Graphic Product Message (Sheet 3)**

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| | MSB HALFWORD LSB |
|---|---|
| GRAPHIC | BLOCK DIVIDER (-1) |
| ALPHANUMERIC | BLOCK ID (2) |
| BLOCK | LENGTH OF BLOCK (MSW) |
| | LENGTH OF BLOCK (LSW) |
| | NUMBER OF PAGES |
| REPEAT FOR | PAGE NUMBER |
| EACH PAGE | LENGTH OF PAGE |
| | TEXT PACKET 1 |
| | • . . |
| | TEXT PACKET N |

**Figure 3-6. Graphic Product Message (Sheet 4)**

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| | | MSB HALFWORD LSB | |
|---|---|---|---|
| | TABULAR ALPHANUMERIC BLOCK | BLOCK DIVIDER (-1) | SECOND HEADER AND PRODUCT DESCRIPTION BLOCK DATA FORMATTED AS ALPHANUMERIC PRODUCT MESSAGE |
| | | BLOCK ID (3) | |
| | | LENGTH OF BLOCK (MSW) | |
| | | LENGTH OF BLOCK (LSW) | |
| | | MESSAGE HEADER BLOCK (see Figure 3-3) | |
| | | PRODUCT DESCRIPTION BLOCK (see sheet 2) | |
| | | BLOCK DIVIDER (-1) | |
| | | NUMBER OF PAGES | |
| REPEAT FOR EACH PAGE | REPEAT FOR EACH LINE | NUMBER OF CHARACTERS | |
| | | CHARACTER DATA | |
| | | END OF PAGE FLAG (-1) | |

**Figure 3-6. Graphic Product Message (Sheet 5)**

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| HALFWORD | FIELDNAME | TYPE | UNITS | RANGE | PRECISION / ACCURACY | REMARKS |
|---|---|---|---|---|---|---|
| 10 | Block Divider | INT*2 | N/A | -1 | N/A | Integer value of -1 used to delineate the header from the Product Description Block |
| 11 - 12 | Latitude of Radar | INT*4 | Degrees | -90 to +90 | 0.001 | North (+) or South (-) of the Equator |
| 13 - 14 | Longitude of Radar | INT*4 | Degrees | -180 to +180 | 0.001 | East (+) or West (-) of the Prime Meridian |
| 15 | Height of Radar | INT*2 | Feet | -100 to +11000 | 1 | Feet above mean sea level |
| 16 | Product Code | INT*2 | N/A | 16 to 299, -16 to -299 | N/A | Internal NEXRAD product code of weather product being transmitted (Refer to Table III) |
| 17 | Operational Mode | INT*2 | N/A | 0 to 2 | N/A | 0 = Maintenance<br>1 = Clean Air<br>2 = Precipitation/Severe Weather |
| 18 | Volume Coverage Pattern | INT*2 | N/A | 1 to 767 | 1 | RDA volume coverage pattern for the scan strategy being used |
| 19 | Sequence Number | INT*2 | N/A | -13,<br>0 to 32767 | 1 | Sequence number of the request that generated the product (Refer to Figure 3-4). For products generated by an Alert Condition, sequence number = -13 |
| 20 | Volume Scan Number | INT*2 | N/A | 1 to 80 | 1 | Counter, recycles to one (1) every 80 volume scans |

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| HALFWORD | FIELDNAME | TYPE | UNITS | RANGE | PRECISION / ACCURACY | REMARKS |
|---|---|---|---|---|---|---|
| 21 | Volume Scan Date | INT*2 | Julian Date | 1 to 32767 | 1 | Modified Julian Date; integer number of days since 1 Jan 1970 |
| 22 - 23 | Volume Scan Start Time | INT*4 | Seconds GMT | 0 to 86399 | 1 | Number of seconds after midnight, Greenwich Mean Time (GMT) |
| 24 | Generation Date of Product | INT*2 | Julian Date | 1 to 32767 | 1 | Modified Julian Date as above |
| 25 - 26 | Generation Time of Product | INT*4 | Seconds GMT | 0 to 86399 | 1 | Number of seconds after midnight, Greenwich Mean Time (GMT) |
| 27 - 28 | ----------PRODUCT DEPENDENT PARAMETERS 1 AND 2 (SEE TABLE V)---------- | | | | | |
| 29 | Elevation Number | INT*2 | N/A | 0 to 20 | 1 | Elevation number within volume scan for elevation based product 0 for volume-based products. |
| 30 | ----------PRODUCT DEPENDENT PARAMETER 3 (SEE TABLE V)---------- | | | | | |
| 31 - 46 | ----------PRODUCT DEPENDENT (SEE NOTE 1)---------- | | | | | |
| 47 - 53 | ----PRODUCT DEPENDENT PARAMETERS 4 THROUGH 10 (SEE TABLE V, NOTE 3)---------- | | | | | |
| 54 | Version | INT*1 | N/A | 0 to 255 | 1 | If the message is product data, the upper byte is the version number of the product. The original |

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| HALFWORD | FIELDNAME | TYPE | UNITS | RANGE | PRECISION / ACCURACY | REMARKS |
|---|---|---|---|---|---|---|
| | | | | | | format of a product will be version 0. (Note 2) |
| 54 | Spot Blank | INT*1 | N/A | 0 to 1 | 1 | If the message is product data, the lower byte is:<br>1 = Spot Blank ON<br>0 = Spot Blanking if OFF |
| 55 - 56 | Offset to Symbology | INT*4 | Halfwords | 0 to 400000 | 1 | Number of halfwords from the top of message (message code field in header) to the -1 divider of each block listed. If the offset is zero (0), the block is not part of the product in question |
| 57 - 58 | Offset to Graphic | INT*4 | Halfwords | 0 to 400000 | 1 | Same as above to Graphic Block (NOTE: For Product 62, this will point to the Cell Trend data) |
| 59 - 60 | Offset to Tabular | INT*4 | Halfwords | 0 to 400000 | 1 | Same as above to Tabular Block |

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**Figure 3-6. Graphic Product Message (Sheet 6)**

**Note 1.** The Data Level threshold values used to define the color table of products, described in Table III, consist of up to 16 Data Levels. The exceptions to this are products 32, 81, 93, 94, 99, 138, 153, 154, 155, 194 and 199 that may have up to a maximum of 255 equally spaced data levels. Additionally, product 134 (High Resolution VIL) can provide 255 data levels not necessarily with equal spacing. Also, product 135 (High Resolution Enhanced Echo Tops) can provide up to 199 data levels due to using the most significant bit as a “topped” flag.
For products 32, 94, 153, and 194, data level codes 0 and 1 correspond to "Below Threshold" and "Missing", respectively. Data level codes 2 through 255 denote data values starting from the minimum data value in even data increments. The threshold level fields are used to describe the 256 levels as follows:

halfword 31 contains the minimum data value in dBZ * 10
halfword 32 contains the increment in dBZ * 10.
halfword 33 contains the number of levels (0 - 255)

For product 81, data level codes 0 will correspond to no accumulation and data level code 255 will represent data outside the coverage area. Data level codes 1 through 254 denote data values

starting from the minimum data value in even data increments. The threshold level fields are used to describe the 256 levels for product 81 as follows:

halfword 31 contains the minimum data value in dBA*10
halfword 32 contains the increment in dBA * 1000.
halfword 33 contains the number of levels (0 - 255)

For products 93, 99, 154, 155, and 199 data level codes 0 and 1 correspond to "Below Threshold" and "Range Folded", respectively. For products 93, 99, 154, and 199, data levels 2 through 255 denote data values starting from the minimum data value in even data increments. For product 155, data levels 129 through 149 denote data values starting from the minimum data value in even data increments. The threshold level fields are used to describe (up to) 256 levels as follows:

halfword 31 contains the minimum data value in m/s*10
halfword 32 contains the increment in m/s*10
halfword 33 contains the number of levels (0 - 255)

For product 134, data level codes 0 and 1 correspond to “Below threshold” and “flagged data”, respectively. Data level 255 is reserved for future use. Data levels 2 through 254 relate to VIL in physical units (kg m-2) via either a linear or log relationship. Any value of VIL above 80 kg m-2 is set to a data value of 254. The coefficients used in the equations to relate the data values to VIL are float values. The IEEE standard for 32-bit floating point arithmetic (ANSI/IEEE Standard 754-1985) has been adopted and modified to utilize the 16-bit (2 byte short) half words available here to describe the coefficients. Half words 31, 32, 33, 34, and 35 are used for this purpose as follows:

halfword 31 contains the linear scale encoded hex value of 0x5BB4 (short int 23476)
halfword 32 contains the linear offset encoded hex value of 0xC82A (short int -14294)
halfword 33 contains the digital log start value of 20
halfword 34 contains the log scale encoded hex value of 0x54DC (short int 21724)
halfword 35 contains the log offset encoded hex value of 0x593E (short int 22846)

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For Build 9 and beyond, the linear scaling for HRVIL has been modified to provide improved depiction for weak weather signatures. Thus, halfwords 31 and 32 are redefined as follows:

halfword 31 contains the linear scale encoded hex value of 0x59AB (short int 22955)
halfword 32 contains the linear offset encoded hex value of 0x4400 (short int 17408)

The halfword hex values must be decoded to use the equations to convert a digital data value to VIL. For digital values below the value of halfword 33, the linear equation is used:
Digital data value = decoded halfword 31*VIL + decoded halfword 32

For digital data values equal to or greater than the value of halfword 33, the log equation is used:
Digital data value = decoded halfword 34*LN(VIL) + decoded halfword 35

To decode the hex values, a two stage process based on the following methodology is used.
The 32-bit IEEE standard for floating point arithmetic has been modified for a 16 bit short as:

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S | E | E | E | E | E | F | F | F | F | F | F | F | F | F | F |
| 0 | 1 | | | | 5 | 6 | | | | | | | | | 15 |
| | | | | | | | | | | | | | | | |

The top row of the above table describes the designation as S for the one sign bit, E for the 5 exponent bits, and F for the ten fraction bits. The middle row notes the bit number starting with the MSB of 0. The bottom row relates 4 bit sequences to half byte sections.

First, convert the halfword hex value to its binary equivalent. Then, using the S, E, and F bit designations in the above table, build the decimal coefficient values using the guide below:

For E = 0, coefficient value = $(-1)^S * 2 * (0 + (F/2^{10}))$, and
for 0 < E < 255; coefficient value = $(-1)^S * 2^{E-16} * (1 + (F/2^{10}))$

For example, a coefficient value of (Hex) 5BB4, (bit sequence 0101 1011 1011 0100) is interpreted as: $(-1)^0 * 2^{22-16} * (1 + (948/2^{10}))$ which resolves to a float value of 123.25.

For product 135, data level codes 0 and 1 correspond to "Below threshold" and "bad data", respectively. Each echo top byte contains two pieces of information: the echo top in kft and an indication of if it were "topped". The echo top data, thus, are grouped into two sets: 2-71 and 130-199. The second set is the same echo tops set as the first except that the most significant bit is set to 1 to indicate a "topped" value. Each increment represents an increase of 1 kft. Any value of Echo Tops above 70 kft is set to a data value of 1. Half words 31, 32, 33, and 34 are provided to use for extracting the echo top value and "topped" flag:

halfword 31 contains the DATA_MASK 127 or 0x7f (hex) identifying the data bits
halfword 32 contains the DATA_SCALE 1
halfword 33 contains the DATA_OFFSET 2
halfword 34 contains the TOPPED_MASK 128 or 0x80 (hex)

The following relations are used when HREET data are decoded,

```
Value  : Integer HREET altitude, expressing thousands of feet.
Topped : Boolean describing HREET "topped" condition.
Data   : Packed integer HR-EET value.
==     : Equality evaluation.
!=     : Inequality evaluation.
&      : Binary 'AND' operator.
|      : Binary 'OR' operator.
?      : Conditional expression:
         ( A ? B : C ) returns B if A is true, returns C if A is false.
```

Use the following when decoding HREET data elements from NEXRAD product messages,

```
if ( Data == 0 )

  Value is declared below threshold.
  Topped is declared false.

else if ( Data == 1 )

  Value is declared bad.
  Topped is declared false.

else

  Value  = ( ( Data & DATA_MASK ) / DATA_SCALE ) - DATA_OFFSET
  Topped = ( Data & TOPPED_MASK ) != 0
```

If bit 0 (most significant bit) is zero (0), then the low-order byte (bits 8 - 15) is a numeric value.

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Example: A data level value of (Hex) 8401, (bit sequence 1000 0100 0000 0001) is interpreted as: < TH

Except for Products 32, 81, 93, 94, 99, 134, 135, 138, 153, 154, 155, 159 161, 163 and 177 the Data Level Threshold halfwords are coded as follows:
If bit 0 (most significant bit) is set to one (1), then the least significant byte (bits 8-- 15) is interpreted as a code for:

0 = "BLANK"
1 = TH
2 = ND
3 = RF
4 = BI (Biological)
5 = GC (AP/Ground Clutter)
6 = IC (Ice Crystals)
7 = GR (Graupel)
8 = WS (Wet Snow)
9 = DS (Dry Snow)
10 = RA (Light and Moderate Rain)
11 = HR (Heavy Rain)
12 = BD (Big Drops)
13 = HA (Hail and Rain Mixed)
14 = UK (Unknown)

If bits 1, 2, 3, 4, 5, 6 or 7 of the most significant byte are set to 1, then they are interpreted as a code for:
Bit 1 - If set the data field in the least significant byte is scaled by 100, to allow two decimal places of accuracy in some of the Threshold tables.
Bit 2 - If set the data field in the least significant byte is scaled by 20, to allow two decimal places of accuracy in some of the Threshold tables.
Bit 3 - If set the data field in the least significant byte is scaled by 10, to allow for one decimal place of accuracy in some of the threshold tables.

Bit 4 = ">"
Bit 5 = "<"
Bit 6 = "+"
Bit 7 = "-"

For products 159, 161, 163, 170, 172, 173, 174, 175 and 176 data levels that are not used as leading or trailing flag values relate to the data in physical units via a linear relationship.. The Scale and Offset used in the equation (F = (N - OFFSET) / SCALE), where N is the integer data value and F is the resulting floating point value) to relate the integer data values to physical units are ANSI/IEEE Standard 754-1985 floating point values. Halfwords 31 and 32 contain the Scale, and halfwords 33 and 34 contain the Offset. For these products, the physical units and typical values of Scale and Offset are shown in the following table along with the total number of values (including flags) and the number of leading and trailing flags. Leading flags are located at the lowest integer values and trailing flags are located at the highest integer values. The conversion from integer values to meteorological values should always use the Scale and Offset values found in the product header halfwords 31-34, since they could change in future implementations.

| Product Name | Code | Physical Units | Scale (hw31, 32) | Offset (hw33,34) | Maximum Data Value (hw36) | Leading Flags (hw37) | Trailing Flags (hw38) |
|---|---|---|---|---|---|---|---|
| Differentia | 159 | dB | 16.0 | 128.0 | 255 | 2; 0 = below threshold | 0 |

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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| l Reflectivity | | | | | | 1 = range folded | |
| Correlation Coefficient | 161 | Unitless | 300.0 | -60.5 | 255 | 2; 0 = below threshold<br>1 = range folded | 0 |
| Specific Differential Phase | 163 | Deg/km | 20.0 | 43.0 | 243 | 2; 0 = below threshold<br>1 = range folded | 0 |
| Digital Accum Array | 170 | 0.01 inches | Note A | Note A | 255 | 1; 0 = NO_DATA | 0 |
| Digital Storm Total Accum | 172 | 0.01 inches | Note A | Note A | 255 | 1; 0 = NO_DATA | 0 |
| Digital User Selectable Accum | 173 | 0.01 inches | Note A | Note A | 255 | 1; 0 = NO_DATA | 0 |
| Digital One-Hour Difference Accum | 174 | 0.01 inches | Note A | 128.0 | 255 | 1; 0 = NO_DATA in either the PPS or QPE | 0 |
| Digital Storm Total Difference Accum. | 175 | 0.01 inches | Note A | 128.0 | 255 | 1; 0 = NO_DATA in either the PPS or QPE | 0 |
| Digital Instantaneous Precipitation Rate | 176 | Inches/ hour | 1000.0 | 0.0 | 65535 | 0 | 0 |

Note A: Scale and/or Offset values vary for each product, based on the maximum meteorological value reported in the product.

Products 165 and 177 contain enumerated integer values that correspond to hydrometeor classifications as indicated in the following table:

| Data Level | Displayed Code | Hydrometeor Classification |
|---|---|---|
| 0 | ND | Below Threshold |
| 10 | BI | Biological |
| 20 | GC | Anomalous Propagation/Ground Clutter |
| 30 | IC | Ice Crystals |
| 40 | DS | Dry Snow |
| 50 | WS | Wet Snow |
| 60 | RA | Light and/or Moderate Rain |
| 70 | HR | Heavy Rain |
| 80 | BD | Big Drops (rain) |
| 90 | GR | Graupel |
| 100 | HA | Hail, possibly with rain |

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| | | |
|---|---|---|
| 140 | UK | Unknown Classification |
| 150 | RF | Range Folded |

For product 138, data level code 0 corresponds to no accumulation and data level codes 1 through 255 denote accumulation values in units of hundredths-of-inches ( .01"), in even data increments, with data level code 1 being the first non-zero accumulation value. The threshold level fields are used to describe the 256 levels for product code 138 as follows:

Halfword 31 contains the minimum data value ( i.e., 0)
Halfword 32 contains the increment in .01" units
Halfword 33 contains the number of levels ( 0 - 255)

The Data Level threshold values used to define the color table of products, described in Table III, consist of up to 16 Data Levels. The exceptions to this are products 32, 81, 93, 94, 99, 156 and 157 that may have up to a maximum of 255 equally spaced data levels.

…

For product 156, halfwords 31, 32, 33 and 34 contain parameters for decoding the digital (encoded) EDR, "DEDR", to EDR via a linear scale as follows:

halfword 31 contains the linear scale factor (increment) in units of $m^{2/3}\ s^{-1}$ * 1000
halfword 32 contains the linear offset in units of $m^{2/3}\ s^{-1}$ * 1000
halfword 33 contains the total number of data levels (currently 64)
halfword 34 contains the number of leading data flags (currently 1)

Thus, DEDR = 0 represents flagged data and EDR = (halfword 31 / 1000) * DEDR + (halfword 32 / 1000) for DEDR values from 1 to 63.

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For product 157, halfwords 31, 32, 33 and 34 contain parameters for decoding the digital (encoded) EDC, "DEDC", to EDC via a linear scale as follows:

halfword 31 contains the linear scale factor (increment)
halfword 32 contains the linear offset
halfword 33 contains the number of data levels (currently 8)
halfword 34 contains the number of leading data flags (currently 0)

Thus, EDC = (halfword 31 / 1000) * DEDC + (halfword 32 / 1000) for DEDC values from 0 to 7.

**Note 2.** Products with Version Numbers

| PRODUCT NAME | PRODUCT CODE | VERSION | REMARKS |
|---|---|---|---|
| Composite Reflectivity | 35,36,37,38 | 1 | Version 1 was introduced in Build 9. The only change is to the combined attributes table. The legacy MESO column data was replaced with data from the Mesocyclone Detection Algorithm (MDA). The MDA data in the table is the strength rank of the closest (within 20 km) MDA feature to the SCIT storm cell, or the word "NONE." |
| Composite Reflectivity Edited for AP | 95,96,97,98 | 1 | Version 1 was introduced in Build 9. The only change is to the combined attributes table. The legacy MESO column data was |

| PRODUCT NAME | PRODUCT CODE | VERSION | REMARKS |
|---|---|---|---|
| | | | replaced with data from the Mesocyclone Detection Algorithm (MDA). The MDA data in the table is the strength rank of the closest (within 20 km) MDA feature to the SCIT storm cell, or the word "NONE." |
| STI | 58 | 1 | |
| Hail Index | 59 | 1 | |
| Tornado Vortex Signature | 61 | 1 | |
| Layer Composite Reflectivity - AP removed | 67 | 1 | |
| Radar Coded Message | 74 | 1 | |
| Surface Rainfall Accumulation (1 hr) | 78 | **1** | |
| Surface Rainfall Accumulation (3 hr) | 79 | 1 | |
| Storm Total Rainfall Accumulation | 80 | **1** | |
| Hourly Digital Precipitation Array | 81 | 2 | |
| Supplemental Precipitation Data | 82 | 1 | |
| Digital Hybrid Scan Reflectivity | 32 | 2 | |
| High Resolution VIL | 134 | 1 | |
| Digital Storm Total | 138 | 2 | |
| Clutter Filter Control | 34 | 2 | Version 1 of the CFC product was introduced in Build 7. The new product was necessary due to changes in the clutter filtering scheme used by the Open RDA system in which the clutter channel information (Doppler vs. Surveillance) was removed. |
| Digital Mesocyclone Detection | 149 | 1 | |
| Mesocyclone Detection | 141 | 1 | |

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**Note 3.** For products which are compressed, halfword 51 (P8) denotes the compression method:

halfword 51 contains 0 if no compression is applied
halfword 51 contains 1 if the data are compressed using bzip2 (refer to Appendix D for details)

And halfwords 52 (P9) and 53 (P10) denote the size of the uncompressed product, in bytes, excluding the sizes of the Message Header block and Product Description blocks:

halfword 52 contains size of uncompressed product (MSW), in bytes
halfword 53 contains size of uncompressed product (LSW), in bytes

If the product size less the product header and product description block is less than 1000 bytes, halfword 51 contains 0.

**Figure 3-6. Graphic Product Message (Sheet 7)**

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PRODUCT SYMBOLOGY BLOCK

| FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Block Divider | INT*2 | N/A | -1 | N/A | Integer value of -1 used to delineate the Product Description from the Product Symbology Block |
| Block ID | INT*2 | N/A | 1 | N/A | Constant value of 1 which identifies this block |
| Length of Block | INT*4 | Bytes | 1 to 400000 | 1 | Length of block in bytes (includes preceding divider and block id) |
| Number of Layers | INT*2 | N/A | 1 to 18 | 1 | Number of data layers contained in this block (see Note 2) |
| Layer Divider | INT*2 | N/A | -1 | N/A | Integer value of -1 used to delineate one data layer from another |
| Length of Data Layer | INT*4 | N/A | 1 to 400000 | 1 | Length of data layer (in bytes) not including layer divider and length field |
| Display Data Packets | N/A | N/A | N/A | N/A | See Figures 3-7 through 3-14 |

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Note 2. The various layers are different types of data formats. An example would be the combined moment product. One layer is reflectivity data in radial packets, another layer contains the vector arrow packets that define the velocity and spectrum width data. The length of the layer does not include the divider or the length word.

**Figure 3-6. Graphic Product Message (Sheet 8)**

GRAPHIC ALPHANUMERIC BLOCK

| FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Block Divider | INT*2 | N/A | -1 | N/A | Integer value of -1 used to delineate the Graphic Alphanumeric Block |
| Block ID | INT*2 | N/A | 2 | N/A | Constant value of 2 which identifies this block |
| Length of Block | INT*4 | Bytes | 1 to 65535 | 1 | Length of block in bytes (includes preceding divider and block id) from the divider to the end of message |
| Number of Pages | INT*2 | N/A | 1 to 48 | 1 | Total number of pages |
| Page Number | INT*2 | N/A | 1 to 48 | 1 | Current page number |
| Length of Page | INT*2 | Bytes | 4 to 1360 | 1 | Number of bytes in Text Packet 1 through Text Packet N |
| Text Packet (N) | N/A | N/A | N/A | N/A | The format of these text packets are Packet Code 8, shown in Figure 3-8b, and Packet Code 10, shown in Figure 3-8 |

**Figure 3-6. Graphic Product Message (Sheet 9)**

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TABULAR ALPHANUMERIC BLOCK (see Note 3)

| FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Block Divider | INT*2 | N/A | -1 | N/A | Integer value of -1 used to delineate the Tabular Alphanumeric Block |
| Block ID | INT*2 | N/A | 3 | N/A | Constant value of 3 which identifies this block |
| Length of Block | INT*4 | Bytes | 1 to 65535 | 1 | Length of block in bytes from the divider to the end of message |
| ---------- SECOND MESSAGE HEADER BLOCK ---------- | | | | | |
| ---------- SECOND PRODUCT DESCRIPTION BLOCK ---------- | | | | | |
| Block Divider | INT*2 | N/A | -1 | N/A | Integer value of -1 used to delineate the data from the Product Description Block |
| Number of Pages | INT*2 | N/A | 1 to 48 | 1 | Total number of pages |
| Number of Characters | INT*2 | N/A | 0 to 80 | 1 | Number of characters in a line |
| Character Data | CHAR | 8 Bit ASCII | ASCII Character Set | N/A | Characters are ASCII when the MSB is set to zero. When the MSB is set to one, the remaining 7 bits define the special symbol |
| End of Page Flag | INT*2 | N/A | -1 | N/A | Integer value of -1 to delineate the end of page |

**Note 3.** Tabular Alphanumeric Block must be the last block in a product message. Maximum lines per page = 17. Alphanumeric Products containing RPG Site Adaptable Parameters must have the Site Adaptable Parameters formatted as the last page(s) of the Product.

**Figure 3-6. Graphic Product Message (Sheet 10)**

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**Table V. Product Dependent Halfword Definition for Product Description Block**

| PRODUCT NAME | MSG CODE | HWORD# | CONTENT | UNITS | RANGE | ACCUR/PREC |
|---|---|---|---|---|---|---|
| Archive III Status Product | 152 | 51 | Compression Method | N/A | 0 or 1 | 1 |
| Archive III Status Product | 152 | 52 | Uncompressed Product Data Size (MSW) | Bytes | 120 to 500000 | 1 |
| Archive III Status Product | 152 | 53 | Uncompressed Product Data Size (LSW) | | | 1 |
| Base Reflectivity | 16-21 | 30 | Elevation Angle | Degree | -1.0 to +45.0 | .1 |
| Base Reflectivity | 16-21 | 47 | Max Reflectivity | dBZ | -32 to +95, (-33) | 1, Note 6 |
| Base Reflectivity | 16-21 | 51 | Cal. Constant (MSB) | | | |
| Base Reflectivity | 16-21 | 52 | " " (LSB) | dB (Real*4) | -50.0 to +50.0, Note 14<br>-198.0 to +198.0, Note 15 | N/A, Note 2 |
| Base Reflectivity Data Array | 94 | 30 | Elevation Angle | Degree | -1.0 to +45.0 | .1 |
| Base Reflectivity Data Array | 94 | 47 | Max Reflectivity | dBZ | -32 to +95, (-33) | 1, Note 6 |
| Base Reflectivity Data Array | 94 | 51 | Compression Method | N/A | 0 or 1 | 1 |
| Base Reflectivity Data Array | 94 | 52 | Uncompressed Product Data Size (MSW) | Bytes | 120 to 188000 | 1 |
| Base Reflectivity Data Array | 94 | 53 | Uncompressed Product Data Size (LSW) | | | 1 |
| Base Reflectivity Data Array (DoD Version) | 194 | 30 | Elevation Angle | Degree | -1.0 to +45.0 | .1 |
| Base Reflectivity Data Array (DoD Version) | 194 | 47 | Max Reflectivity | dBZ | -32 to +95, (-33) | 1, Note 6 |
| Base Reflectivity Data Array (DoD Version) | 194 | 51 | Compression Method | N/A | 0 or 1 | 1 |
| Base Reflectivity Data Array (DoD Version) | 194 | 52 | Uncompressed Product Data Size (MSW) | Bytes | 120 to 188000 | 1 |
| Base Reflectivity Data Array (DoD Version) | 194 | 53 | Uncompressed Product Data Size (LSW) | | | 1 |

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| PRODUCT NAME | MSG CODE | HWORD# | CONTENT | UNITS | RANGE | ACCUR/PREC |
|---|---|---|---|---|---|---|
| Base Spectrum Width | 28-30 | 30 | Elevation Angle | Degree | -1.0 to +45.0 | .1, Note 1 |
| Base Spectrum Width | 28-30 | 47 | Max Spectrum Width | Knots | 0 to 19 | 1 |
| Base Velocity | 22-27 | 30 | Elevation Angle | Degree | -1.0 to +45.0 | .1, Note 1 |
| Base Velocity | 22-27 | 47 | Max Neg. Velocity | Knots | -247 to 0 | 1 |
| Base Velocity | 22-27 | 48 | Max Pos. Velocity | Knots | 0 to 245 | 1 |
| Base Velocity Data Array | 99 | 30 | Elevation Angle | Degree | -1.0 to +45.0 | .1, Note 1 |
| Base Velocity Data Array | 99 | 47 | Max Neg. Velocity | Knots | -247 to 0 | 1 |
| Base Velocity Data Array | 99 | 48 | Max Pos. Velocity | Knots | 0 to 245 | 1 |
| Base Velocity Data Array | 99 | 51 | Compression Method | N/A | 0 or 1 | 1 |
| Base Velocity Data Array | 99 | 52 | Uncompressed Product Data Size (MSW) | Bytes | 120 to 372000 | 1 |
| Base Velocity Data Array | 99 | 53 | Uncompressed Product Data Size (LSW) | | | 1 |
| Base Velocity Data Array (DoD Version) | 199 | 30 | Elevation Angle | Degree | -1.0 to +45.0 | .1, Note 1 |
| Base Velocity Data Array (DoD Version) | 199 | 47 | Max Neg. Velocity | Knots | -247 to 0 | 1 |
| Base Velocity Data Array (DoD Version) | 199 | 48 | Max Pos. Velocity | Knots | 0 to 245 | 1 |
| Base Velocity Data Array (DoD Version) | 199 | 51 | Compression Method | N/A | 0 or 1 | 1 |
| Base Velocity Data Array (DoD Version) | 199 | 52 | Uncompressed Product Data Size (MSW) | Bytes | 120 to 372000 | 1 |
| Base Velocity Data Array (DoD Version) | 199 | 53 | Uncompressed Product Data Size (LSW) | | | 1 |
| Clutter Filter Control | 34 | 27 | Channel/Segment Bit Map | N/A | 0,1 Bit | N/A , Note 8 |
| Clutter Filter Control | 34 | 28 | CMD Generated Clutter Bypass Map | N/A | 0 or 1 | N/A, Note 17 |
| Clutter Filter Control | 34 | 48 | Bypass Map Date | Julian Date | 1 to 32767 | 1 |

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| PRODUCT NAME | MSG CODE | HWORD# | CONTENT | UNITS | RANGE | ACCUR/PREC |
|---|---|---|---|---|---|---|
| Clutter Filter Control | 34 | 49 | Bypass Map Time | Minutes | 0 to 1439 | 1 |
| Clutter Filter Control | 34 | 50 | Notchwidth Map Date, Note 13 | Julian Date | 1 to 32767 | 1 |
| Clutter Filter Control | 34 | 51 | Notchwidth Map Time, Note 13 | Minutes | 0 to 1439 | 1 |
| Clutter Likelihood Reflectivity | 132 | 30 | Elevation Angle | Degree | -1.0 to +45.0 | 1 |
| Clutter Likelihood Doppler | 133 | 30 | Elevation Angle | Degree | -1.0 to +45.0 | 1 |
| Composite Reflectivity | 35 - 38 | 47 | Max Reflectivity | dBZ | -32 to +95, (-33) | 1, Note 6 |
| Composite Reflectivity | 35 - 38 | 51 | Cal. Constant (MSB) | | | |
| Composite Reflectivity | 35 - 38 | 52 | Cal Constant (LSB) | dB (Real*4) | -50.0 to +50.0, Note 14<br>-198.0 to +198.0, Note 15 | N/A, Note 2 |
| Composite Reflectivity Edited for AP | 95 - 98 | 47 | Max Reflectivity | dBZ | -32 to 95, (-33) | 1, Note 6 |
| Composite Reflectivity Edited for AP | 95 - 98 | 51 | Cal Constant (MSB) | | | |
| Composite Reflectivity Edited for AP | 95 - 98 | 52 | Cal Constant (LSB) | dB (Real*4) | -50.0 to +50.0, Note 14<br>-198.0 to +198.0, Note 15 | N/A,Note2 |
| Cross Section (Vel) | 51 & 86 | 47 | Azimuth point one | Degree | 0.0 to 359.9 | .1, Note 1 |
| Cross Section (Vel) | 51 & 86 | 48 | Range point one | Nmi | 0.0 to 124.0 | .1, Note 1 |
| Cross Section (Vel) | 51 & 86 | 49 | Azimuth point two | Degree | 0,0 to 359.9 | .1, Note 1 |
| Cross Section (Vel) | 51 & 86 | 50 | Range point two | Nmi | 0.0 to 124.9 | .1, Note 1 |
| Cross Section (Reflect) | 50 & 85 | 47 | Azimuth point one | Degree | 0.0 to 359.9 | .1, Note 1 |
| Cross Section (Reflect) | 50 & 85 | 48 | Range point one | Nmi | 0.0 to 124.0 | .1, Note 1 |
| Cross Section (Reflect) | 50 & 85 | 49 | Azimuth point two | Degree | 0.0 TO 359.9 | .1, Note 1 |
| Cross Section (Reflect) | 50 & 85 | 50 | Range point two | Nmi | 0.0 to 124.0 | .1, Note 1 |

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| PRODUCT NAME | MSG CODE | HWORD# | CONTENT | UNITS | RANGE | ACCUR/PREC |
|---|---|---|---|---|---|---|
| Cross Section (Reflect) | 50 & 85 | 51 | Cal. Constant (MSB) | | | |
| Cross Section (Reflect) | 50 & 85 | 52 | " " (LSB) | dB (Real*4) | -50.0 to +50.0, Note 14<br>-198.0 to +198.0, Note 15 | N/A, Note 2 |
| Digital Hybrid Scan Reflect | 32 | 47 | Max Reflectivity | dBZ | -32 to +95, (-33) | 1, Note 6 |
| Digital Hybrid Scan Reflect | 32 | 48 | Date of Scan | Julian Date | 1 to 32767 | 1 |
| Digital Hybrid Scan Reflect | 32 | 49 | Avg. Time of Hybrid Scan | Minutes | 0 to 1439 | 1 |
| Digital Hybrid Scan Reflect | 32 | 51 | Compression Method | N/A | 0 or 1 | 1 |
| Digital Hybrid Scan Reflect | 32 | 52 | Uncompressed Product Data Size (MSW) | Bytes | 120 to 86000 | 1 |
| Digital Hybrid Scan Reflect | 32 | 53 | Uncompressed Product Data Size (LSW) | | | 1 |
| Digital Mesocyclone Detection | 149 | 27 | Adaptation Data setting for Minimum Reflectivity Threshold | dBZ | -25 to 35 | 1 |
| Digital Mesocyclone Detection | 149 | 30 | Elevation Angle | Degree | -1.0 to + 45.0 | .1 |
| Digital Mesocyclone Detection | 149 | 51 | Compression Method | N/A | 0 or 1 | 1 |
| Digital Mesocyclone Detection | 149 | 52 | Uncompressed Product Data Size (MSW) | Bytes | 120 to 300000 | 1 |
| Digital Mesocyclone Detection | 149 | 53 | Uncompressed Product Data Size (LSW) | | | 1 |
| Digital Storm Total Precipitation | 138 | 27 | Beg. Date of Rainfall | Julian Date | 1 to 32767 | 1 |
| Digital Storm Total Precipitation | 138 | 28 | Beg. Time of Rainfall | Minutes | 0 to 1439 | 1 |
| Digital Storm | 138 | 30 | Mean-field Bias | N/A | 0.0 to 99.99 | .01, Note 1 |

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| PRODUCT NAME | MSG CODE | HWORD# | CONTENT | UNITS | RANGE | ACCUR/PREC |
|---|---|---|---|---|---|---|
| Total Precipitation | | | | | | |
| Digital Storm Total Precipitation | 138 | 47 | Max Rainfall | Inches | 0 to 51.00, Note 12 | .01 to .20, Note 12 |
| Digital Storm Total Precipitation | 138 | 48 | End Date of Rainfall | Julian Date | 1 to 32767 | 1 |
| Digital Storm Total Precipitation | 138 | 49 | End Time of Rainfall | Minutes | 0 to 1439 | 1 |
| Digital Storm Total Precipitation | 138 | 50 | Sample Size (No. G-R Pairs) | N/A | .00 to 9999.99 | .01, Note 1 |
| Digital Storm Total Precipitation | 138 | 51 | Compression Method | N/A | 0 or 1 | 1 |
| Digital Storm Total Precipitation | 138 | 52 | Uncompressed Product Data Size (MSW) | Bytes | 120 to 300000 | 1 |
| Digital Storm Total Precipitation | 138 | 53 | Uncompressed Product Data Size (LSW) | | | 1 |
| Echo Tops Product | 41 | 47 | Max Echo | 1000 Feet | 0 to 70 | 1, Note 5 |
| Free Text Message | 75 | 47 | RPG ID Number | N/A | 0 to 999 | 1 |
| Gust Front MIGFA | 140 | 49 | Detection count | N/A | 0 - 1000 | 1 |
| Hail Index | 59 | -- | -- | -- | -- | -- |
| High Resolution Enhanced Echo Tops | 135 | 30 | AVSET termination elevation angle Otherwise = 0 | Degree | -1.0 to +45.0 | .1, Note 1 |
| High Resolution Enhanced Echo Tops | 135 | 47 | Maximum echo top height in volume | kft | 0 to 70 | 1 |
| High Resolution Enhanced Echo Tops | 135 | 48 | Number of artifact edited radials in volume | unitless | 0 to 10000 | 1 |
| High Resolution Enhanced Echo Tops | 135 | 49 | Echo Tops reflectivity factor threshold | dBZ | -32 to 95 | 1 |
| High Resolution Enhanced Echo Tops | 135 | 50 | Number of spurious points removed | unitless | 0 to 10000 | 1 |
| High Resolution Enhanced Echo Tops | 135 | 51 | Compression Method | N/A | 0 or 1 | 1 |
| High Resolution | 135 | 52 | Uncompressed | Bytes | 764 - 126870 | 1 |

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| PRODUCT NAME | MSG CODE | HWORD# | CONTENT | UNITS | RANGE | ACCUR/PREC |
|---|---|---|---|---|---|---|
| Enhanced Echo Tops | | | Product Data Size (MSW) | | | |
| High Resolution Enhanced Echo Tops | 135 | 53 | Uncompressed Product Data Size (LSW) | | | 1 |
| High Resolution Vertically Integ. Liq | 134 | 30 | AVSET termination elevation angle Otherwise = 0 | Degree | -1.0 to +45.0 | .1, Note 1 |
| High Resolution Vertically Integ. Liq | 134 | 47 | Max Digital VIL | unitless | 0 to 254 | 1 |
| High Resolution Vertically Integ. Liq | 134 | 48 | Number of artifact edited radials in volume | unitless | 0 to 10000 | 1 |
| High Resolution Vertically Integ. Liq | 134 | 51 | Compression Method | N/A | 0 or 1 | 1 |
| High Resolution Vertically Integ. Liq | 134 | 52 | Uncompressed Product Data Size (MSW) | Bytes | 770 - 167910 | 1 |
| High Resolution Vertically Integ. Liq | 134 | 53 | Uncompressed Product Data Size (LSW) | | | 1 |
| Hourly Dig.Precip Array | 81 | 47 | Max Rainfall Accum. | dBA | -6.0 to 25.625 | .001, Note 1 |
| Hourly Dig. Precip Array | 81 | 48 | Mean-field Bias | N/A | 0.01 to 99.99 | .01, Note 1 |
| Hourly Dig. Precip Array | 81 | 49 | Effective No. G-R Pairs (Sample Size) | N/A | 0.00 to 9999.99 | .01, Note 1 |
| Hourly Dig. Precip Array | 81 | 50 | Rainfall End Date | Julian Date | 1 to 32767 | 1 |
| Hourly Dig. Precip Array | 81 | 51 | Rainfall End Time | Minutes | 0 to 1439 | 1 |
| Hybrid Scan Reflectivity | 33 | 47 | Max Reflectivity | dBZ | -32 to 95, (-33) | 1, Note 6 |
| Hybrid Scan Reflectivity | 33 | 48 | Date of Scan | Julian Date | 1 to 32767 | 1 |
| Hybrid Scan Reflectivity | 33 | 49 | Avg. Time of Scan | Minutes | 0 to 1439 | 1 |
| ITWS Digital Base Velocity | 93 | 30 | Elevation Angle | Degree | -1.0 to +45.0 | .1, Note 1 |
| ITWS Digital Base Velocity | 93 | 47 | Max Neg. Velocity | Knots | -123 to 0 | 1 |
| ITWS Digital Base Velocity | 93 | 48 | Max Pos. Velocity | Knots | 0 to 122 | 1 |
| ITWS Digital Base Velocity | 93 | 50 | Velocity Precision Code | N/A | 1 or 2 | 1, Note 11 |
| Lyr 1 | 63 | 47 | Max Reflectivity | dBZ | -32 to +95 | 1 |

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| PRODUCT NAME | MSG CODE | HWORD# | CONTENT | UNITS | RANGE | ACCUR/PREC |
|---|---|---|---|---|---|---|
| Comp.Reflect (avg) | | | | | | |
| Lyr 1 Comp.Reflect (avg) | 63 | 48 | Bottom of layer | 1000 Feet | 0 | Note 5 |
| Lyr 1 Comp.Reflect(avg) | 63 | 49 | Top of layer | Feet | 6000 to 58000 | 1 |
| Lyr 1 Comp.Reflect(avg) | 63 | 51 | Cal. Constant (MSB) | | | |
| Lyr 1 Comp.Reflect(avg) | 63 | 52 | " " (LSB) | dB (Real*4) | -50.0 to +50.0, Note 14<br>-198.0 to +198.0, Note 15 | N/A, Note 2 |
| Lyr 1 Comp.Reflect(max) | 65 | 47 | Max Reflectivity | dBZ | -32 to +95 | 1 |
| Lyr 1 Comp.Reflect(max) | 65 | 48 | Bottom of layer | 1000 Feet | 0 | Note 5 |
| Lyr 1 Comp.Reflect(max) | 65 | 49 | Top of layer | 1000 Feet | 6 to 58 | 1 |
| Lyr 1 Comp.Reflect(max) | 65 | 51 | Cal. Constant (MSB) | | | |
| Lyr 1 Comp.Reflect(max) | 65 | 52 | " " (LSB) | dB (Real*4) | -50.0 to +50.0, Note 14<br>-198.0 to +198.0, Note 15 | N/A, Note 2 |
| Lyr 2 Comp.Reflect(avg) | 64 | 47 | Max Reflectivity | dBZ | -32 to +95 | 1 |
| Lyr 2 Comp.Reflect(avg) | 64 | 48 | Bottom of layer | 1000 Feet | 6 to 58 | 1 |
| Lyr 2 Comp.Reflect(avg) | 64 | 49 | Top of layer | 1000 Feet | 12 to 64 | 1 |
| Lyr 2 Comp.Reflect(avg) | 64 | 51 | Cal. Constant (MSB) | | | |
| Lyr 2 Comp.Reflect(av | 64 | 52 | " " (LSB) | dB (Real*4) | -50.0 to +50.0, Note | N/A, Note 2 |

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| PRODUCT NAME | MSG CODE | HWORD# | CONTENT | UNITS | RANGE | ACCUR/PREC |
|---|---|---|---|---|---|---|
| g) | | | | | 14<br>-198.0 to +198.0, Note 15 | |
| Lyr 2 Comp.Reflect(max) | 66 | 47 | Max Reflectivity | dBZ | -32 to +95 | 1 |
| Lyr 2 Comp.Reflect(max) | 66 | 48 | Bottom of layer | 1000 Feet | 6 to 58 | 1 |
| Lyr 2 Comp.Reflect(max) | 66 | 49 | Top of layer | 1000 Feet | 12 to 64 | 1 |
| Lyr 2 Comp.Reflect(max) | 66 | 51 | Cal. Constant (MSB) | | | |
| Lyr 2 Comp.Reflect(max) | 66 | 52 | " " (LSB) | dB (Real*4) | -50.0 to +50.0, Note 14<br>-198.0 to +198.0, Note 15 | N/A, Note 2 |
| Lyr 1 Comp Ref-AP (max) | 67 | 47 | Max Reflectivity | dBZ | -32 to +95 | 1 |
| Lyr 1 Comp Ref-AP (max) | 67 | 48 | Bottom of layer | 1000 Feet | 0 | Note 5 |
| Lyr 1 Comp Ref-AP (max) | 67 | 49 | Top of layer | 1000 Feet | 6 to 58 | 1 |
| Lyr 1 Comp Ref-AP (max) | 67 | 51 | Cal. Constant (MSB) | | | |
| Lyr 1 Comp Ref-AP (max) | 67 | 52 | Cal. Constant (LSB) | dB (Real*4) | -50.0 to +50.0, Note 14<br>-198.0 to +198.0, Note 15 | N/A, Note 2 |
| Lyr 3 Comp.Reflect (avg) | 89 | 47 | Max Reflectivity | dBZ | -32 to +95 | 1 |
| Lyr 3 Comp.Reflect (avg) | 89 | 48 | Bottom of layer | 1000 Feet | 12 to 64 | 1 |
| Lyr 3 Comp.Reflect (avg) | 89 | 49 | Top of layer | 1000 Feet | 18 to 70 | 1 |
| Lyr 3 Comp.Reflect (avg) | 89 | 51 | Cal. Constant (MSB) | | | |
| Lyr 3 | 89 | 52 | " " | dB | -50.0 to | N/A, Note 2 |

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| PRODUCT NAME | MSG CODE | HWORD# | CONTENT | UNITS | RANGE | ACCUR/PREC |
|---|---|---|---|---|---|---|
| Comp.Reflect (avg) | | | (LSB) | (Real*4) | +50.0, Note 14<br>-198.0 to +198.0, Note 15 | |
| Lyr 3 Comp.Reflect (max) | 90 | 47 | Max Reflectivity | dBZ | -32 to +95 | 1 |
| Lyr 3 Comp.Reflect (max) | 90 | 48 | Bottom of layer | 1000 Feet | 12 to 64 | 1 |
| Lyr 3 Comp.Reflect (max) | 90 | 49 | Top of layer | 1000 Feet | 18 to 70 | 1 |
| Lyr 3 Comp.Reflect (max) | 90 | 51 | Cal. Constant (MSB) | | | |
| Lyr 3 Comp.Reflect (max) | 90 | 52 | Cal. Constant (LSB) | dB (Real*4) | -50.0 to +50.0, Note 14<br>-198.0 to +198.0, Note 15 | N/A, Note 2 |
| Mesocyclone | 60 | -- | -- | --- | | |
| Mesocyclone Rapid Update | 139 | 30 | Elevation Angle | Degree | -1.0 to +45.0 | .1 |
| Mesocyclone Detection | 141 | 27 | Adaptation Data setting for Minimum Reflectivity Threshold | dBZ | -25 to 35 | 1 |
| Mesocyclone Detection | 141 | 28 | Adaptation Data setting for Overlap Display Filter | N/A | 0 or 1 | 0 = overlap filter OFF<br>1 = overlap filter ON |
| Mesocyclone Detection | 141 | 30 | Adaptation Data setting for Minimum Display Filter Strength Rank | N/A | 1 to 5 | 1 |
| One-hour Snow Water Equivalent | 144 | 27 | Length of Missing Periods | Minutes | 0 to 32767 | 1 |
| One-hour Snow Water Equivalent | 144 | 30 | Use RCA Flag | N/A | 0 or 1 | 1 |
| One-hour Snow Water Equivalent | 144 | 47 | Maximum Value | Inches | 0.001 to 32.767 | 0.001, Note 1 |
| One-hour Snow | 144 | 48 | Starting Date | Julian | 1 to 32767 | 1 |

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| PRODUCT NAME | MSG CODE | HWORD# | CONTENT | UNITS | RANGE | ACCUR/PREC |
|---|---|---|---|---|---|---|
| Water Equivalent | | | | Date | | |
| One-hour Snow Water Equivalent | 144 | 49 | Starting Time | Minutes | 0 to 1439 | 1 |
| One-hour Snow Water Equivalent | 144 | 50 | Ending Date | Julian Date | 1 to 32767 | 1 |
| One-hour Snow Water Equivalent | 144 | 51 | Ending Time | Minutes | 0 to 1439 | 1 |
| One-hour Snow Water Equivalent | 144 | 52 | Azimuth of Max. | Degrees | 0 to 359 | 1 |
| One-hour Snow Water Equivalent | 144 | 53 | Range to Max. | Nmi | 0 to 124 | 1 |
| One-hour Snow Depth | 145 | 27 | Length of Missing Periods | Minutes | 0 to 32767 | 1 |
| One-hour Snow Depth | 145 | 30 | Use RCA Flag | N/A | 0 or 1 | 1 |
| One-hour Snow Depth | 145 | 47 | Maximum Value | Inches | 0.01 to 327.67 | 0.01, Note 1 |
| One-hour Snow Depth | 145 | 48 | Starting Date | Julian Date | 1 to 32767 | 1 |
| One-hour Snow Depth | 145 | 49 | Starting Time | Minutes | 0 to 1439 | 1 |
| One-hour Snow Depth | 145 | 50 | Ending Date | Julian Date | 1 to 32767 | 1 |
| One-hour Snow Depth | 145 | 51 | Ending Time | Minutes | 0 to 1439 | 1 |
| One-hour Snow Depth | 145 | 52 | Azimuth of Max | Degrees | 0 to 359 | 1 |
| One-hour Snow Depth | 145 | 53 | Range to Max. | Nmi | 0 to 124 | 1 |
| PUP Text Message | 77 | 47 | PUP ID Number | N/A | 0 to 32767 | 1 |
| PUP Text Message | 77 | 49 | User Designation | N/A | 0 to 47 | 1, Note 5 |
| Storm Mean Radial Vel. | 55 | 27 | Azimuth of Window | Degree | 0.0 to 359.9 | .1, Note 1 |
| Storm Mean Radial Vel. | 55 | 28 | Range of Window | Nmi | 0.0 to 124.0 | .1, Note 1 |
| Storm Mean Radial Vel. | 55 | 30 | Elevation Angle | Degree | -1.0 to +45.0 | .1, Note 1 |
| Storm Mean Radial Vel. | 55 | 47 | Max Neg. Velocity | Knots | -247 to 0 | 1 |
| Storm Mean Radial Vel. | 55 | 48 | Max Pos. Velocity | Knots | 0 to +245 | 1 |

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| PRODUCT NAME | MSG CODE | HWORD# | CONTENT | UNITS | RANGE | ACCUR/PREC |
|---|---|---|---|---|---|---|
| Storm Mean Radial Vel. | 55 | 49 | Motion Source Flag | N/A | -1 = Algorithm | 1 |
| Storm Mean Radial Vel. | 55 | 50 | Height of Phenomena | 1000 Ft AGL | 0 to 70 | 1 |
| Storm Mean Radial Vel. | 55 | 51 | Storm Speed | Knots | 0.0 to 99.9 | .1, Note 1 |
| Storm Mean Radial Vel. | 55 | 52 | Storm Direction | Degree | 0.0 to 359.9 | .1, Note 1 |
| Storm Mean Radial Vel. | 55 | 53 | Alert Category | N/A | See Table IV | 1, Note 7 |
| Storm Mean Radial Vel. | 56 | 30 | Elevation Angle | Degree | -1.0 to +45.0 | .1, Note 1 |
| Storm Mean Radial Vel. | 56 | 47 | Max Neg. Velocity | Knots | -247 to 0 | 1 |
| Storm Mean Radial Vel. | 56 | 48 | Max Pos. Velocity | Knots | 0 to +245 | 1 |
| Storm Mean Radial Vel. | 56 | 49 | Motion Source Flag | N/A | -1 = Algorithm | 1 |
| Storm Mean Radial Vel. | 56 | 51 | Avg Speed of Storms | Knots | 0.0 to 99.9 | .1, Note 1 |
| Storm Mean Radial Vel. | 56 | 52 | Avg Dir. of Storms | Degree | 0.0 to 359.9 | .1, Note 1 |
| Storm Structure | 62 | -- | -- | -- | | |
| Storm Total Rainfall Accum. | 80 | 47 | Max Rainfall | Inches | 0.0 to 327.6 | .1, Note 1 |
| Storm Total Rainfall Accum. | 80 | 48 | Beg. Date Rainfall | Julian Date | 1 to 32767 | 1 |
| Storm Total Rainfall Accum. | 80 | 49 | Beg. Time Rainfall | Minutes | 0 to 1439 | 1 |
| Storm Total Rainfall Accum. | 80 | 50 | End Date Rainfall | Julian date | 1 to 32767 | 1 |
| Storm Total Rainfall Accum. | 80 | 51 | End Time Rainfall | Minutes | 0 to 1439 | 1 |
| Storm Total Rainfall Accum. | 80 | 52 | Mean-field Bias | N/A | 0.01 to 99.99 | .01, Note 1 |
| Storm Total Rainfall Accum. | 80 | 53 | Effective No. G-R Pairs (Sample Size) | N/A | 0.00 to 9999.99 | .01, Note 1 |
| Storm Total Snow Depth | 147 | 27 | Length of Missing Periods | Minutes | 0 to ?? | 1 |
| Storm Total Snow Depth | 147 | 30 | Use RCA Flag | N/A | 0 or 1 | 1 |
| Storm Total Snow Depth | 147 | 47 | Maximum Value | Inches | 0.0 to 3276.7 | 0.1, Note 1 |
| Storm Total Snow Depth | 147 | 48 | Starting Date | Julian Date | 1 to 32767 | 1 |
| Storm Total Snow Depth | 147 | 49 | Starting Time | Minutes | 0 to 1439 | 1 |
| Storm Total Snow Depth | 147 | 50 | Ending Date | Julian Date | 1 to 32767 | 1 |

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| PRODUCT NAME | MSG CODE | HWORD# | CONTENT | UNITS | RANGE | ACCUR/PREC |
|---|---|---|---|---|---|---|
| Storm Total Snow Depth | 147 | 51 | Ending Time | Minutes | 0 to 1439 | 1 |
| Storm Total Snow Depth | 147 | 52 | Azimuth of Max. | Degrees | 0 to 359 | 1 |
| Storm Total Snow Depth | 147 | 53 | Range to Max. | Nmi | 0 to 124 | 1 |
| Storm Total Snow Water Equivalent | 146 | 27 | Length of Missing Periods | Minutes | 0 to 32767 | 1 |
| Storm Total Snow Water Equivalent | 146 | 30 | Use RCA Flag | N/A | 0 or 1 | 1 |
| Storm Total Snow Water Equivalent | 146 | 47 | Maximum Value | Inches | 0.00 to 327.67 | 0.01, Note 1 |
| Storm Total Snow Water Equivalent | 146 | 48 | Starting Date | Julian Date | 1 to 32767 | 1 |
| Storm Total Snow Water Equivalent | 146 | 49 | Starting Time | Minutes | 0 to 1439 | 1 |
| Storm Total Snow Water Equivalent | 146 | 50 | Ending Date | Julian Date | 1 to 32767 | 1 |
| Storm Total Snow Water Equivalent | 146 | 51 | Ending Time | Minutes | 0 to 1439 | 1 |
| Storm Total Snow Water Equivalent | 146 | 52 | Azimuth of Max. | Degrees | 0 to 359 | 1 |
| Storm Total Snow Water Equivalent | 146 | 53 | Range to Max. | Nmi | 0 to 124 | 1 |
| Storm Track | 58 | 47 | Total Number of Storms | N/A | 0 to 100 | 1 |
| SuperOb | 136 | 27 | Base Time | Minutes | 0 to 1439 | 1 |
| SuperOb | 136 | 28 | Time Radius | Minutes | 5 to 90 | 1 |
| SuperOb | 136 | 47 | SuperOb Cell Range Size | Km | 1 to 10 | 1 |
| SuperOb | 136 | 48 | SuperOb Cell Azimuth Size | Degrees | 2 to 12 | 1 |
| SuperOb | 136 | 49 | Maximum Range | Km | 60 to 230 | 1 |
| SuperOb | 136 | 50 | Minimum Number of Samples | N/A | 20 to 200 | 1 |
| SuperOb | 136 | 51 | Compression Method | N/A | 0 or 1 | 1 |
| SuperOb | 136 | 52 | Uncompressed Product Data | Bytes | 120 - 1409856 | 1 |

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| PRODUCT NAME | MSG CODE | HWORD# | CONTENT | UNITS | RANGE | ACCUR/PREC |
|---|---|---|---|---|---|---|
| | | | Size (MSW) | | | |
| SuperOb | 136 | 53 | Uncompressed Product Data Size (LSW) | | | 1 |
| Super Resolution Digital Base Reflectivity | 153 | 30 | Elevation Angle | Degree | -1.0 to +45.0 | .1 |
| Super Resolution Digital Base Reflectivity | 153 | 47 | Max Reflectivity | dBZ | -32 to +95, (-33) | 1, Note 6 |
| Super Resolution Digital Base Reflectivity | 153 | 51 | Compression Method | N/A | 0 or 1 | 1 |
| Super Resolution Digital Base Reflectivity | 153 | 52 | Uncompressed Product Data Size (MSW) | Bytes | 120 to 1329150 | 1 |
| Super Resolution Digital Base Reflectivity | 153 | 53 | Uncompressed Product Data Size (LSW) | | | |
| Super Resolution Digital Base Velocity | 154 | 30 | Elevation Angle | Degree | -1.0 to +45.0 | .1 |
| Super Resolution Digital Base Velocity | 154 | 47 | Max Neg. Velocity | Knots | -247 to 0 | 1 |
| Super Resolution Digital Base Velocity | 154 | 48 | Max Pos. Velocity | Knots | 0 to 245 | 1 |
| Super Resolution Digital Base Velocity | 154 | 51 | Compression Method | N/A | 0 or 1 | 1 |
| Super Resolution Digital Base Velocity | 154 | 52 | Uncompressed Product Data Size (MSW) | Bytes | 120 to 868350 | 1 |
| Super Resolution Digital Base Velocity | 154 | 53 | Uncompressed Product Data Size (LSW) | | | |
| Super Resolution Digital Base | 155 | 30 | Elevation Angle | Degree | -1.0 to +45.0 | .1 |

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| PRODUCT NAME | MSG CODE | HWORD# | CONTENT | UNITS | RANGE | ACCUR/PREC |
|---|---|---|---|---|---|---|
| Spectrum Width | | | | | | |
| Super Resolution Digital Base Spectrum Width | 155 | 47 | Max Spectrum Width | Knots | 0 to 19 | 1 |
| Super Resolution Digital Base Spectrum Width | 155 | 51 | Compression Method | N/A | 0 or 1 | 1 |
| Super Resolution Digital Base Spectrum Width | 155 | 52 | Uncompressed Product Data Size (MSW) | Bytes | 120 to 868350 | 1 |
| Super Resolution Digital Base Spectrum Width | 155 | 53 | Uncompressed Product Data Size (LSW) | | | |
| Surface Rainfall Accum | 78 & 79 | 47 | Max Rainfall | Inches | 0.0 to 189.0 | .1, Note 1 |
| Surface Rainfall Accum | 78 & 79 | 48 | Mean-field Bias | N/A | 0.01 to 99.99 | .01, Note 1 |
| Surface Rainfall Accum | 78 & 79 | 49 | Effective No. G-R Pairs (Sample Size) | N/A | 0.00 to 9999.99 | .01, Note 1 |
| Surface Rainfall Accum | 78 & 79 | 50 | Rainfall End Date | Julian Date | 1 to 32767 | 1 |
| Surface Rainfall Accum | 78 & 79 | 51 | Rainfall End Time | Minutes | 0 to 1439 | 1 |
| TVS | 61 | 47 | Total Number of TVS | N/A | -25 to 25 | 1, Note 5 |
| TVS | 61 | 48 | Total Number of ETVS | N/A | -25 to 25 | 1, Note 5 |
| Tornado Vortex Signature Rapid Update | 143 | 30 | Elevation angle | degree | -1.0 to +45.0 | .1 |
| Tornado Vortex Signature Rapid Update | 143 | 47 | Total Number of TVS | N/A | -25 to 25 | 1, Note 5 |
| Tornado Vortex Signature Rapid Update | 143 | 48 | Total Number of ETVS | N/A | -25 to 25 | 1, Note 5 |
| Turbulence Detection Algorithm (NTDA) | 156, 157 | 27 | Elevation start time in seconds since volume start | Second | 0 to 32767 | 1 |
| Turbulence Detection Algorithm (NTDA) | 156, 157 | 28 | Elevation end time in seconds since volume start | Second | 0 to 32767 | 1 |
| Turbulence Detection | 156, 157 | 30 | Target elevation angle | Degree | -1.0 to +45.0 | 0.1, Note 1 |

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| PRODUCT NAME | MSG CODE | HWORD# | CONTENT | UNITS | RANGE | ACCUR/PREC |
|---|---|---|---|---|---|---|
| Algorithm (NTDA) | | | | | | |
| Turbulence Detection Algorithm (NTDA) | 156, 157 | 47 | Minimum elevation angle | Degree | -1.00 to +45.00 | 0.01, Note 1 |
| Turbulence Detection Algorithm (NTDA) | 156, 157 | 48 | Mean elevation angle | Degree | -1.00 to +45.00 | 0.01, Note 1 |
| Turbulence Detection Algorithm (NTDA) | 156, 157 | 49 | Maximum elevation angle | Degree | -1.00 to +45.00 | 0.01, Note 1 |
| User Alert Message | 73 | -- | -- | -- | | |
| User Selectable Layer Composite Reflectivity | 137 | 27 | Requested Bottom Altitude of Layer | K Feet | 0 to 69 | 1 |
| User Selectable Composite Reflectivity | 137 | 28 | Requested Top Altitude of Layer | K Feet | 1 to 70 | 1 |
| User Selectable Layer Composite Reflectivity | 137 | 47 | Max Reflectivity | dBZ | -32 to 95 | 1 |
| User Selectable Composite Reflectivity | 137 | 48 | Actual bottom Altitude of Layer (adjusted to correct request errors). | K Feet | 0 to 69 | 1 |
| User Selectable Layer Composite Reflectivity Maximum | 137 | 49 | Actual top Altitude of Layer (adjusted to correct request errors). | K Feet | 1 to 70 | 1 |
| User Selectable Precip. | 31 | 27 | End Hour | Hours | 0 to 23 | 1 |
| User Selectable Precip. | 31 | 28 | Time Span | Hours | 1 to 24 | 1 |
| User Selectable Precip. | 31 | 30 | Null Product Flag | N/A | 0 to 1 | 1, Note 9 |
| User Selectable Precip. | 31 | 47 | Max Rainfall | Inches | 0.0 to 327.6 | .1, Note 1 |

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| PRODUCT NAME | MSG CODE | HWORD# | CONTENT | UNITS | RANGE | ACCUR/PREC |
|---|---|---|---|---|---|---|
| User Selectable Precip. | 31 | 48 | Beg. Date Rainfall | Julian Date | 1 to 32767 | 1 |
| User Selectable Precip. | 31 | 49 | Beg. Time Rainfall | Minutes | 0 to 1439 | 1 |
| User Selectable Precip. | 31 | 50 | End Date Rainfall | Julian Date | 1 to 32767 | 1 |
| User Selectable Precip. | 31 | 51 | End Time Rainfall | Minutes | 0 to 1439 | 1 |
| User Selectable Precip. | 31 | 52 | Average Mean-field Bias | N/A | 0.01 to 99.99 | .01, Note 1 |
| User Selectable Precip. | 31 | 53 | Average Effective No. G-R Pairs (Sample Size) | N/A | 0.00 to 9999.99 | .01, Note 1 |
| User Selectable Snow Depth | 151 | 27 | End Hour | Hours | 0 to 23 | 1 |
| User Selectable Snow Depth | 151 | 28 | Time Span | Hours | 1 to 30 | 1 |
| User Selectable Snow Depth | 151 | 30 | Use High Scale Flag/ Use RCA Flag | N/A | 0, 1, 256, or 257 | 1 Note 16 |
| User Selectable Snow Depth | 151 | 47 | Maximum Value | Inches | 0.00 to 327.67 or 0.0 to 3276.7 | 0.01 or 0.1, Note 1 and Note 16 |
| User Selectable Snow Depth | 151 | 48 | Starting Date | Julian Date | 1 to 32767 | 1 |
| User Selectable Snow Depth | 151 | 49 | Starting Hour | Minutes | 0 to 1439 | 1, Note 22 |
| User Selectable Snow Depth | 151 | 50 | Ending Date | Julian Date | 1 to 32767 | 1 |
| User Selectable Snow Depth | 151 | 51 | Ending Hour | Minutes | 0 to 1439 | 1, Note 22 |
| User Selectable Snow Depth | 151 | 52 | Azimuth of Max. | Degrees | 0 to 359 | 1 |
| User Selectable Snow Depth | 151 | 53 | Range to Max. | Nmi | 0 to 124 | 1 |
| User Selectable Snow Water Equivalent | 150 | 27 | End Hour | Hours | 0 to 23 | 1 |
| User Selectable Snow Water Equivalent | 150 | 28 | Time Span | Hours | 1 to 30 | 1 |
| User Selectable Snow Water Equivalent | 150 | 30 | Use High Scale Flag/ Use RCA Flag | N/A | 0, 1, 256, or 257 | 1 Note 16 |
| User Selectable Snow Water Equivalent | 150 | 47 | Maximum Value | Inches | 0.000 to 32.767 or 0.00 to 327.67 | 0.001 or 0.01, Note 1 and Note 16 |

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| PRODUCT NAME | MSG CODE | HWORD# | CONTENT | UNITS | RANGE | ACCUR/PREC |
|---|---|---|---|---|---|---|
| User Selectable Snow Water Equivalent | 150 | 48 | Starting Date | Julian Date | 1 to 32767 | 1 |
| User Selectable Snow Water Equivalent | 150 | 49 | Starting Hour | Minutes | 0 to 1439 | 1, Note 22 |
| User Selectable Snow Water Equivalent | 150 | 50 | Ending Date | Julian Date | 1 to 32767 | 1 |
| User Selectable Snow Water Equivalent | 150 | 51 | Ending Hour | Minutes | 0 to 1439 | 1, Note 22 |
| User Selectable Snow Water Equivalent | 150 | 52 | Azimuth of Max. | Degrees | 0 to 359 | 1 |
| User Selectable Snow Water Equivalent | 150 | 53 | Range to Max. | Nmi | 0 to 124 | 1 |
| VAD Wind Profile | 48 | 47 | Max Speed (Horiz) | Knots | 0 to 350 | 1, Note 5 |
| VAD Wind Profile | 48 | 48 | Direct of Max Speed | Degree | 0 to 359 | 1, Note 1 & 5 |
| VAD Wind Profile | 48 | 49 | Alt of Max Speed | Feet/10 | 00.00 to 70.00 | .01, Note 5 |
| Velocity Az. Display | 84 | 47 | Wind Speed (Horiz) | Knots | 0 to 350 | 1, Note 5 |
| Velocity Az. Display | 84 | 48 | Wind Direct(Horiz) | Degree | 0 to 359 | 1, Note 1 & 5 |
| Velocity Az. Display | 84 | 30 | Wind Alt (Horiz) | 1000 Feet | 0 to 70 | 1 |
| Velocity Az. Display | 84 | 49 | Elevation Angle | Degree | -1.0 to +45.0 | .1, Note 1 & 5 |
| Velocity Az. Display | 84 | 50 | Slant Range | Nmi | 0.0 to 124.0 | .1, Note 1 & 5 |
| Velocity Az. Display | 84 | 51 | RMS Error | Knots | 0 to 29 | 1, Note 5 |
| Vertically Integ. Liq | 57 | 47 | Max VIL | Kg/Sq. meter | 0 to 200 | 1 |
| Differential Reflectivity | 158,159 | 30 | Elevation Angle | Degree | -1.0 to +45.0 | .1, Note 1 |
| Differential Reflectivity | 158,159 | 47 | Minimum Differential Reflectivity | dB | -7.9 to +7.9 | .1 |
| Differential Reflectivity | 158,159 | 48 | Maximum Differential Reflectivity | dB | -7.9 to +7.9 | .1 |
| Correlation Coefficient | 160,161 | 30 | Elevation Angle | Degree | -1.0 to +45.0 | .1, Note 1 |

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| PRODUCT NAME | MSG CODE | HWORD# | CONTENT | UNITS | RANGE | ACCUR/PREC |
|---|---|---|---|---|---|---|
| Correlation Coefficient | 160,161 | 47 | Minimum Correlation Coefficient | N/A | 0.2 to 1.05 | .00333 |
| Correlation Coefficient | 160,161 | 48 | Maximum Correlation Coefficient | N/A | 0.2 to 1.05 | .00333 |
| Specific Differential Phase | 162,163 | 30 | Elevation Angle | Degree | -1.0 to +45.0 | .1, Note 1 |
| Specific Differential Phase | 162,163 | 47 | Minimum Specific Differential Phase | Deg/km | -2.0 to +10.6 | .05 |
| Specific Differential Phase | 162,163 | 48 | Maximum Specific Differential Phase | Deg/km | -2.0 to +10.6 | .05 |
| Hydrometeor Classification | 164,165 | 30 | Elevation Angle | Degree | -1.0 to +45.0 | .1, Note 1 |
| Hydrometeor Classification | 164 | 47 | Mode Filter Size | N/A | 1 to 15 | 1 |
| Melting Layer | 166 | 30 | Elevation Angle | Degree | -1.0 to +45.0 | .1, Note 1 |
| One Hour Accum | 169 | 30 | Null Product Flag | N/A | 0 or 1 | 1, Note 9, Note 19 |
| One Hour Accum | 169 | 47 | Max Accum | Inches | 0.0 to 100.0 | .1, Note 1 |
| One Hour Accum | 169 | 48 | Ending Date of Accumulation | Julian Date | 1 to 32767 | 1 |
| One Hour Accum | 169 | 49 | Ending Time of Accumulation | Minutes | 0 to 1439 | 1 |
| One Hour Accum | 169 | 50 | Mean-field Bias | N/A | 0.01 to 99.99 | .01, Note 1, Note 18 |
| One Hour Accum | 169 | 51 | Sample Size (Effective No. Gage/Radar Pairs) | N/A | 0.00 to 9999.99 | .01, Note 1, Note 18 |
| One Hour Accum | 169 | 54 | Product Version Number | N/A | 1 to 32767 | 1 |
| Digital Accum Array | 170 | 30 | Null Product Flag | N/A | 0 or 1 | 1, Note 9, Note 19 |
| Digital Accum Array | 170 | 47 | Max Accum | Inches | 0.0 to 100.0 | .1, Note 1 |
| Digital Accum Array | 170 | 48 | Ending Date of Accumulation | Julian Date | 1 to 32767 | 1 |
| Digital Accum Array | 170 | 49 | Ending Time of Accumulation | Minutes | 0 to 1439 | 1 |
| Digital Accum Array | 170 | 50 | Mean-field Bias | N/A | 0.01 to 99.99 | .01, Note 1, Note 18 |
| Digital Accum Array | 170 | 54 | Product Version Number | N/A | 1 to 32767 | 1 |

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| PRODUCT NAME | MSG CODE | HWORD# | CONTENT | UNITS | RANGE | ACCUR/PREC |
|---|---|---|---|---|---|---|
| | | | | | | |
| Storm Total Accum | 171 | 27 | Start Date of Accumulation | Julian Date | 1 to 32767 | 1 |
| Storm Total Accum | 171 | 28 | Start Time of Accumulation | Minutes | 0 to 1439 | 1 |
| Storm Total Accum | 171 | 30 | Null Product Flag | N/A | 0 or 1 | 1, Note 9, Note 19 |
| Storm Total Accum | 171 | 47 | Max Accum | Inches | 0.0 to 100.0 | .1, Note 1 |
| Storm Total Accum | 171 | 48 | Ending Date of Accumulation | Julian Date | 1 to 32767 | 1 |
| Storm Total Accum | 171 | 49 | Ending Time of Accumulation | Minutes | 0 to 1439 | 1 |
| Storm Total Accum | 171 | 50 | Mean-field Bias | N/A | 0.01 to 99.99 | .01, Note 1, Note 18 |
| Storm Total Accum | 171 | 51 | Sample Size (Effective No. Gage/Radar Pairs) | N/A | 0.00 to 9999.99 | .01, Note 1, Note 18 |
| Storm Total Accum | 171 | 54 | Product Version Number | N/A | 1 to 32767 | 1 |
| Digital Storm Total Accum | 172 | 27 | Start Date of Accumulation | Julian Date | 1 to 32767 | 1 |
| Digital Storm Total Accum | 172 | 28 | Start Time of Accumulation | Minutes | 0 to 1439 | 1 |
| Digital Storm Total Accum | 172 | 30 | Null Product Flag | N/A | 0 or 1 | 1, Note 9, Note 19 |
| Digital Storm Total Accum | 172 | 47 | Max Accum | Inches | 0 to 100.00 | .1 |
| Digital Storm Total Accum | 172 | 48 | Ending Date of Accumulation | Julian Date | 1 to 32767 | 1 |
| Digital Storm Total Accum | 172 | 49 | Ending Time of Accumulation | Minutes | 0 to 1439 | 1 |
| Digital Storm Total Accum | 172 | 50 | Mean-field Bias | N/A | 0.0 to 99.99 | .01, Note 1, Note 18 |
| Digital Storm Total Accum | 172 | 54 | Product Version Number | N/A | 1 to 32767 | 1 |
| Digital User Selectable Accum | 173 | 27 | End Time | Minutes | 0 to 1439 | 1 |
| Digital User Selectable Accum | 173 | 28 | Time Span Minutes | Minutes | 15 to 1440 | 1 |
| Digital User Selectable Accum | 173 | 30 | Missing Period Flag (high byte) & Null Product Flag (low byte) | N/A | 0 or 1 in either or both of the bytes | 1, Note 9, Note 19, Note 21 |
| Digital User | 173 | 47 | Max Accum | Inches | 0.0 to 327.6 | .1, Note 1 |

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| PRODUCT NAME | MSG CODE | HWORD# | CONTENT | UNITS | RANGE | ACCUR/PREC |
|---|---|---|---|---|---|---|
| Selectable Accum | | | | | | |
| Digital User Selectable Accum | 173 | 48 | End Date | Julian Date | 1 to 32767 | 1 |
| Digital User Selectable Accum | 173 | 49 | Start Time | Minutes | 0 to 1440 | 1 |
| Digital User Selectable Accum | 173 | 50 | Mean-field Bias | N/A | 0.01 to 99.99 | .01, Note 1, Note 18 |
| Digital User Selectable Accum | 173 | 54 | Product Version Number | N/A | 1 to 32767 | 1 |
| Digital One-Hour Difference | 174 | 47 | Max Accum Difference | Inches | -100.0 to 100.0 | .1, Note 1 |
| Digital One-Hour Difference | 174 | 48 | Ending Date of Accumulation | Julian Date | 1 to 32767 | 1 |
| Digital One-Hour Difference | 174 | 49 | Ending Time of Accumulation | Minutes | 0 to 1439 | 1 |
| Digital One-Hour Difference | 174 | 50 | Min Accum Difference | Inches | -100.0 to 100.0 | .1, Note 1 |
| Digital One-Hour Difference | 174 | 54 | Product Version Number | N/A | 1 to 32767 | 1 |
| Digital Storm Total Difference | 175 | 27 | Start Date of Accumulation | Julian Date | 1 to 32767 | 1 |
| Digital Storm Total Difference | 175 | 28 | Start Time of Accumulation | Minutes | 0 to 1439 | 1 |
| Digital Storm Total Difference | 175 | 30 | Null Product Flag | N/A | 0 or 1 | 1, Note 9, Note 19 |
| Digital Storm Total Difference | 175 | 47 | Max Accum Difference | Inches | -100.0 to 100.0 | .1, Note 1 |
| Digital Storm Total Difference | 175 | 48 | Ending Date of Accumulation | Julian date | 1 to 32767 | 1 |
| Digital Storm Total Difference | 175 | 49 | Ending Time of Accumulation | Minutes | 0 to 1439 | 1 |
| Digital Storm Total Difference | 175 | 50 | Min Accum Difference | Inches | -100.0 to 100.0 | .1, Note 1 |
| Digital Storm Total Difference | 175 | 54 | Product Version Number | N/A | 1 to 32767 | 1 |
| Digital Instantaneous Precipitation Rate | 176 | 27 | Hybrid Rate Scan Date | Julian date | 1 to 32767 | 1 |
| Digital Instantaneous Precipitation | 176 | 28 | Hybrid Rate Scan Time | Minutes | 0 to 1439 | 1 |

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| PRODUCT NAME | MSG CODE | HWORD# | CONTENT | UNITS | RANGE | ACCUR/PREC |
|---|---|---|---|---|---|---|
| Rate | | | | | | |
| Digital Instantaneous Precipitation Rate | 176 | 30 | Precipitation Detected Flag (high byte) & Gage Bias to be Applied Flag (low byte) | N/A | 0 or 1 | N/A, Note 18 |
| Digital Instantaneous Precipitation Rate | 176 | 47 | Maximum Instantaneous Precipitation Rate | in/hr | 0 to 65535 | 1, Note 1, Note 20 |
| Digital Instantaneous Precipitation Rate | 176 | 48 | Hybrid Rate Percent Bins Filled | Percent | 0.01 - 100.00 | .01%, Note 1 |
| Digital Instantaneous Precipitation Rate | 176 | 49 | Highest Elev. Used | Degrees | 0.5 - 19.5 | 0.1°, Note 1 |
| Digital Instantaneous Precipitation Rate | 176 | 50 | Mean-field Bias | N/A | 0.01 to 99.99 | .01, Note 1, Note 18 |
| Digital Instantaneous Precipitation Rate | 176 | 54 | Product Version Number | N/A | 1 to 32767 | 1 |
| Hybrid Hydrometeor Classification | 177 | 47 | Mode Filter Size | N/A | 1 to 15 | 1 |
| Hybrid Hydrometeor Classification | 177 | 48 | Hybrid Rate Percent Bins Filled | Percent | 0.01 - 100.00 | .01%, Note 1 |
| Hybrid Hydrometeor Classification | 177 | 49 | Highest Elev. Used | Degrees | 0.5 - 19.5 | 0.1°, Note 1 |
| Hybrid Hydrometeor Classification | 177 | 54 | Product Version Number | N/A | 1 to 32767 | 1 |

**Note 1.** Scaled Integer, precision column defines scaling.
**Note 2.** Real*4 represents one fullword (32 bits) of real data, where the values are in IEEE-754-1985 floating point representation.
**Note 3.** Corresponds to MSB of bit map as defined in Table II- A.
**Note 4.** Corresponds to LSB of bit map as defined in Table II- A.

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| **Note 5.** | Msg Code | Halfword | Description |
|---|---|---|---|
| Echo Tops Product | 41 | 47 | Value of zero altitude indicates "No Echos Detected |
| PUP Text Message | 77 | 49 | User designation is set by the RPGOP only, where: 0 = Send message to all dedicated users; >0 = Send message to the user on specific line identified. |
| Layer Products | 63-67, 89-90 | 48 | Value of zero layer bottom indicates "Surface" |
| VAD Wind Profile | 48 | 49 | Altitude value of -9999 indicates ("Wind Barbs") non-valid altitude, speed and direction which are displayed as blanks |
| Velocity Azimuth | 84 | 47 | Wind speed value of -9999 Display indicates non-valid speed and direction. Speed and direction are displayed as blanks |
| | | 50 | Slant range value of -9999 indicates non-valid slant range and elevation angle. Values of slant range and elevation angle are displayed as blanks |
| | | 51 | RMS value of -9999 indicates non-valid RMS. Value of RMS is displayed as blanks. |
| TVS | 61 | 47 | A negative value indicates that the Total Number of TVSs identified by the algorithm exceeded the Maximum number of TVSs in adaptation data. Those with the higher Low-level Delta Velocity were retained. |
| TVS | 61 | 48 | A negative value indicates that the Total Number of ETVSs identified by the algorithm exceeded the Maximum number of ETVSs in adaptation data. Those with the higher Low-level Delta Velocity were retained. |
| Storm Mean Radial Velocity | 55-56 | 47 | A maximum negative velocity of -999 indicates a non-valid maximum negative velocity. Values are displayed as asterisks. |
| | | 48 | A maximum positive velocity of -777 indicates a non-valid maximum positive velocity. Values are displayed as asterisks. |

**Note 6.** Value enclosed in parentheses of range column is a code to indicate data is unavailable.
**Note 7.** Applicable only to products generated as a result of an Alert.
**Note 8.** This halfword defines the clutter map channel type (Version 0 only) and segment number (Version 0 and Version 1). For Version 0, bit 15 (LSB) defines the channel type. If bit 15 is 0, then it is a clutter filter control product for the surveillance channel. If bit 15 is 1, then it is the Doppler channel clutter filter control product. For both Version 0 and Version 1, bits 14 through 10 specify elevation segment numbers 1 through 5, respectively. Segment 1 is the lowest elevation clutter filter map, segment 5 is the upper elevation clutter filter map.
**Note 9.** If flag is set, the product is null i.e., rainfall data to build product was unavailable.
**Note 11.** Velocity Precision Code indicates the quantization of the base velocity data used to create this product. A value of 1 denotes 0.5 m/s and 2 denotes 1.0 m/s. Regardless of the value of this code, product 93 is formatted as if the precision is always 0.5 m/s.
**Note 12.** The value entered for the upper limit of the Digital Storm Total ( DSP) Max Rainfall value is a theoretical limit; the actual upper limit has no bound, as the DSP data values are adjusted (

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scaled ) to fit within the range ( 0 - 255), based upon the Max Rainfall value. The Accuracy/Precision increases according to the scaling ( i.e., .01, .02, etc. ) and also has no, actual upper limit.
Note 13: The Legacy RDA system created the "Notchwidth Map". The Open RDA system uses a different clutter filtering scheme that makes the "Notchwidth" terminology obsolete. The Open RDA system calls this map the "Clutter Filter Map".
**Note 14.** Applies to Legacy RDA systems only.
**Note 15.** Applies to Open RDA systems only.
**Note 16.** Two flags are stored in this halfword. The high byte contains the High Scale Flag; the low byte contains the Use RCA flag. Counting bit 0 as the most significant bit, the High Scale Flag is in bit 7 and the Use RCA flag is in bit 15. If the High Scale Flag is set, the maximum value in halfword 47 for the User Selectable Snow Water Equivalent (msg code 150) must be divided by 100 and User Selectable Snow Depth (msg code 151) must be divided by 10. If the High Scale Flag is not set, the maximum value in halfword 47 is divided by 1000 and 100 for the User Selectable Water Equivalent and the User Selectable Snow Depth, respectively.
**Note 17.** A value of 0 indicates the Clutter Bypass Map used for the product was generated by the Radar System Test off-line software. A value of 1 indicates the Clutter Bypass Map used for the product was generated by the Clutter Mitigation Decision (CMD) algorithm.
**Note 18.** Gage bias is not being implemented for dual-polarization QPE products at this time. However, gage bias and its associated adaptable parameters will be implemented in the future. These parameters are used as placeholders.
**Note 19.** If the null product flag is non-zero, this means there are no accumulations present in the product for the reasons given below. This will also be indicated textually in the Product Symbology Block.

1: "No accumulation available. Threshold: 'Elapsed Time to Restart' [TIMRS] xx minutes exceeded."

2: "No precipitation detected during the specified time span."

3: "No accumulation data available for the specified time span."

4: "No precipitation detected since hh:mmZ. Threshold: 'Time Without Precipitation for Resetting Storm Totals' [RAINT] is xx minutes" or "No precipitation detected since RPG startup."

5: "No precipitation detected since hh:mmZ" or "No precipitation detected since RPG startup."

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**Note 20.** Halfword 47 of Digital Instantaneous Precipitation Rate contains the Maximum Rainfall Rate in thousandths of an inch, with values ranging from 0 to 65535, and should be treated like an **unsigned** short integer data type.
**Note 21.** In the Digital User Selectable Accum product only, the Null Product Flag is stored in the least significant byte of the halfword. The Missing Period Flag will be stored in the most significant byte of the halfword.
**Note 22.** Until enough hours have elapsed to generate the User Selectable Snow Water Equivalent and Snow Depth products, the minutes will be rounded to the nearest starting and ending hours requested by the user. After the products can be generated, the starting and ending hours will reflect the actual times used to generate the products. These times may deviate from the whole hour by as much as half the volume scan interval.

Table VI. Product Dependent Definition for Product Symbology Block

| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| VAD WIND PROFILE | Altitude | Kft | 1 to 70 | 1 | |
| | Volume Scan Start Time | N/A | Hours: 00 to 23<br>Minutes: 00 to 59 | 1 | |
| VELOCITY AZIMUTH DISPLAY | Velocity | Kts | +/-200, +/-100, +/-80, +/-60, +/-40 | 1 | |
| | Azimuth | Degrees | 1 to 360 | 1 | |
| | Best Fit Function in the form<br><br>$A_1$+ VSIN(AZ + δ)<br>Where:<br>A = Harmonic Coefficient (Fourier #1)<br><br>V = SQRT[CF2²+CF3²}<br><br>with CF2 and CF3 corresponding to Harmonic Coefficient (Fourier #2 & #3) & = - Horizontal Wind Direction - 90° | Kts<br><br>Kts<br><br>Degrees | -39 to 39<br><br>0 to +247<br><br>0 to 359 | 1<br><br>1<br><br>1 | |
| REFLECTIVITY CROSS SECTION | Azimuth | Degrees | 0 to 359 | 1 | |
| | Range | nmi | 0 to 124 | 1 | |
| | Max Reflectivity | dBZ | -32 to 95(-999)* | 1 | () *Value Indicates Data |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| | | | | | Not Available |
| | Height of Max Reflectivity | Kft | 0 to 70 (71)* | 1 | () *Value Indicates Data Not Available |
| | Max Reflectivity Position:<br>· Azimuth<br>· Range | •Degrees<br>•nmi | •0 to 359<br>•0 to 124 | •1<br>•1 | |
| VELOCITY CROSS SECTION | Azimuth | Degrees | 0 to 359 | 1 | |
| | Range | nmi | 0 to 124 | 1 | |
| | Max Velocity | Kts | 0 to 245 | 1 | |
| | Height of Max Velocity | Kft | 0 to 70 (71)* | 1 | ( ) * Value Indicates data not available |
| | Max Velocity Position:<br>· Azimuth<br>· Range | •Degrees<br>•nmi | •0 to 359<br>•0 to 124 | •1<br>•1 | |
| | Min Velocity | Kts | -247 to 0 | 1 | |
| | Height of Min Velocity | Kft | 0 to 70 (71)* | | () *Value Indicates Data Not Available |
| | Min Velocity Position:<br>• Azimuth<br>• Range | •Degrees<br>•nmi | •0 to 359<br>•0 to 124 | •1<br>•1 | |
| USER SELECTABLE PRECIPITATION | Status | Alphanumeric | - Product Not Generated: Unable To Read Data from Database | N/A | Status messages will be sent only if error conditions |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| | | | - Product Not Generated: Illegal Times in Product Request<br>- Product Not Generated: Insufficient Accumulation Date In Hourly Database<br>- Hours Available for Request | | occur |
| ONE-HOUR SNOW WATER EQUIVALENT AND ONE-HOUR SNOW DEPTH | Status | Alphanumeric | - Data not available because: No buffer space for product<br>- Data not available because: Product too big for existing buffer<br>- Data not available because: Insufficient data for hourly accumulations | N/A | Status messages will be sent only if error conditions occur |
| STORM TOTAL SNOW WATER EQUIVALENT AND STORM TOTAL SNOW DEPTH | Status | Alphanumeric | - Data not available because: First volume of accumulations<br>- Data not available | N/A | Status messages will be sent only if error conditions occur |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| | | | because: No buffer space for product<br>- Data not available because: Product too big for existing buffer<br>- Data not available because: First volume scan of accumulations | | |
| USER SELECTABLE SNOW WATER EQUIVALENT AND USER SELECTABLE SNOW DEPTH | Status | Alphanumeric | - Data not available because: No buffer space for product<br>- Data not available because: Product too big for existing buffer<br>- Data not available because: Insufficient number of hourly accumulations<br>- Data not available because: Current hour is not the requested end hour | N/A | Status messages will be sent only if error conditions occur |
| Digital User - Selectable Accumulation | Status | Alphanumeric | - No precipitation detected during the specified time span<br><br>- No accumulation | N/A | Status messages will be sent only if error conditions occur |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| | | | data available for the specified time span | | |
| Storm-Total Accumulation | Status | Alphanumeric | - No precipitation detected since dd/mm/yy hh:mm Z. Threshold: 'Time Without Precipitation for Resetting Storm Totals'" " [RAINT] is mm minutes<br><br>- No precipitation detected since RPG startup. Threshold: 'Time Without Precipitation for Resetting Storm Totals'" " [RAINT] is mm minutes | N/A | Status messages will be sent only if error conditions occur |
| Digital Storm-Total Accumulation | Status | Alphanumeric | - No precipitation detected since dd/mm/yy hh:mm Z. Threshold: 'Time Without Precipitation for Resetting Storm Totals'" " [RAINT] is | N/A | Status messages will be sent only if error conditions occur |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| | | | mm minutes<br><br>- No precipitation detected since RPG startup. Threshold: 'Time Without Precipitation for Resetting Storm Totals'" " [RAINT] is mm minutes | | |
| Digital Storm-Total Difference | Status | Alphanumeric | - No precipitation detected since dd/mm/yy hh:mm Z. Threshold: 'Time Without Precipitation for Resetting Storm Totals'" " [RAINT] is mm minutes<br><br>- No precipitation detected since RPG startup. Threshold: 'Time Without Precipitation for Resetting Storm Totals'" " [RAINT] is mm minutes | N/A | Status messages will be sent only if error conditions occur |
| One-Hour Accumulation | Status | Alphanumeric | - No precipitation detected since dd/mm/yy hh:mm Z.<br><br>- No precipitation detected since RPG startup. | N/A | Status messages will be sent only if error conditions occur |
| Digital Accumulation Array | Status | Alphanumeric | - No precipitation detected since | N/A | Status messages will be sent only if |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| | | | dd/mm/yy hh:mm Z.<br><br>- No precipitation detected since RPG startup. | | error conditions occur |
| All Dual-Polarization Accumulation Products | Status | Alphanumeric | - No accumulation available. Threshold: 'Elapsed Time to Restart' [TIMRS] (mm minutes) exceeded | N/A | Status messages will be sent only if error conditions occur |
| All Dual-Polarization Accumulation Products | Status | Alphanumeric | - Product unavailable - unknown reason nn | N/A | "Default" status messages will be sent only if error conditions occur and if error condition is unknown |

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**Table VII. Product Dependent Definition for Graphic Alphanumeric Block**

| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY/ PRECISION | REMARKS |
|---|---|---|---|---|---|
| COMPOSITE REFLECTIVITY OR COMPOSITE REFLECTIVITY EDITED FOR AP | Storm Cell ID | Alphanumeric | A0 through Z0, then A1 through Z1, then A2...Z9. | N/A | The sequence is recycled following Note 1 |
| | Storm Position:<br>· Azimuth<br>· Range | <br>•Degrees<br>•nmi | <br>•0 to 360<br>•0 to 248 | <br>•1<br>•1 | Note 1 |
| | Maximum Reflectivity | dBZ | 0 to 95 | 1 | Note 1 |
| | Height of Maximum Reflectivity | Kft | 0.0 to 70.0 | 0.1 | Note 1 |
| | Cell-Based VIL | $kg/m^2$ | 0 to 120 | 1 | Note 1 |
| | Storm Top | Kft | 0.00 to 70.00 | 0.1 | If the storm top was identified at the highest elevation, the value is qualified with ">", Note 1 |
| | Forecast Movement<br>· Storm Direction<br>· Storm Speed | Alphanumeric or<br>• Degrees<br>• Kts | New or<br>• 0 to 360<br>• 0 to 999 | <br>• 1<br>• 1 | Newly identified storm cells are labeled "NEW". Note 1 |
| | MDA Strength Rank | Alphanumeric | NONE, 1 to 25 | 1 | |
| | TVS Feature Type | Alphanumeric | NONE, TVS or ETVS | N/A | If both a TVS and ETVS are associated with the same storm cell, then "TVS" will be displayed. Note 1 |
| | Hail Characteristics | Alphanumeric or | UNKNOWN or | | If the maximum expected hail size |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY/ PRECISION | REMARKS |
|---|---|---|---|---|---|
| | · Probability of Hail (POH)<br>· Probability of Severe Hail (POSH)<br>· Maximum Expected Hail Size | • Percent<br>• Percent<br>• Inches | • 0 to 100<br>• 0 to 100<br>• 0.00 and 0.50 to 4.00 | • 10<br>• 10<br>• 0.25 | exceeds 4.0 inches, the hail size is labeled ">4.00".<br><br>If the Probability of Hail and the Probability of Severe Hail are greater the 0% and the maximum expected hail size is less than 0.50 inches, the hail size is labeled "<0.50".<br><br>If the Hail Characteristics cannot be determined, the Hail Characteristics are labeled "UNKNOWN". Note 1 |
| ECHO TOPS | Status | Alphanumeric | No Echoes Detected | N/A | This status message will be sent only if the Echo Tops Grid is all zeroes. |
| HAIL INDEX | Storm Cell ID | Alphanumeric | A0 through Z0, then A1 through Z1, then A2...Z9 | N/A | The sequence is recycled following Z9, (See Note 1) |
| | Storm Position<br>• Azimuth<br>• Range | • Degrees<br>• Nmi | • 0 to 360<br>• 0 to 248 | • 1<br>• 1 | Note 1 |
| | Hail Characteristics:<br><br>-Probability of Hail (POH) | Alphanumeric or Percent | UNKNOWN or 0 to 100 | 10 | If maximum expected hail size exceeds 4.0 inches, the hail size is labeled ">4.00". |
| | -Probability of Severe Hail (POSH) | Percent | 0 to 100 | 10 | If the Probability of Severe hail is greater than 0% and the maximum |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY/ PRECISION | REMARKS |
|---|---|---|---|---|---|
| | | | | | expected hail size is less than 0.50 inches, the hail size is labeled "<0.50". |
| | -Maximum Expected Hail Size | Inches | 0.00 and 0.50 to 4.00 | 0.25 | If the Hail Characteristics cannot be determined, the Hail Characteristics are labeled "UNKNOWN" Note 1 |
| | Hail Temperature Altitudes (MSL)<br>• 0 Degree Celsius | Kft | 0.0 to 70.0 | .1 | Note 1 |
| | • -20 Degree Celsius | Kft | 0.0 to 70.0 | .1 | |
| | Time of last change to Hail Temperature Altitude | N/A | Hours: 00 to 23<br>Minutes: 00 to 59 | N/A | Note 1 |
| | Date of last change to Hail Temperature Altitudes | N/A | Months: 01 to 12<br>Days: 01 to 31<br>Years: 00 to 99 | N/A | Note 1 |
| STORM TRACKING INFORMATION | Storm Cell ID | Alphanumeric | A0 through Z0, then A1 through Z1, then A2....Z9 | N/A | The sequence is recycled following Z9.<br>Note 1 |
| | Storm Position<br>· Azimuth<br>· Range | <br>Degrees<br>nmi | <br>0 to 360<br>0 to 248 | <br>1<br>1 | Note 1 |
| | Forecast Movement<br>· Direction<br>· Speed | Alphanumeric or Degrees<br>Kts | NEW or 0 to 360<br>0.0 to 999 | 1<br>0.1 | Newly identified storm cells are labeled "NEW" Note 1 |
| | Forecast Error<br>· Error<br>· Mean | <br>nmi<br>nmi | <br>0.0 to 99.9<br>0.0 to 99.9 | <br>0.1<br>0.1 | Note 1 |
| | Maximum Reflectivity | dBZ | 0 to 95 | 1 | Note 1 |
| | Height of | Kft | 0.0 to 70.0 | 0.1 | Note 1 |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY/ PRECISION | REMARKS |
|---|---|---|---|---|---|
| | Maximum Reflectivity | | | | |
| MESOCYCLONE | Storm Cell ID | Alphanumeric | A0 through Z0, then A1 through Z1, then A2 through Z9 | N/A | The sequence is recycled following Z9<br>Note 1 |
| | Vortex Type | Alphanumeric | 3D Correlated Shear (3 DC SHR), Mesocyclone (MESO) | N/A | |
| | Mesocyclone Position:<br>· Azimuth<br>· Range | • Degrees<br>• nmi | • 0 to 360<br>• 0 to 124 | • 1<br>• 1 | |
| | Mesocyclone Base Value | Kft | 0.0 to 33.1 | 0.1 | |
| | Mesocyclone Top Value | Kft | 0.0 to 33.1 | 0.1 | |
| | Diameter (Radial) | nmi | 0.0 to 99.9 | 0.1 | |
| | Diameter (Azimuthal) | nmi | 0.0 to 99.9 | 0.1 | |
| MESOCYCLONE RAPID UPDATE | Storm Cell ID | Alphanumeric | A0 through Z0, then A1 through Z1, then A2 through Z9 | N/A | The sequence is recycled following Z9<br>Note 1 |
| | Feature Status | Alphanumeric | New (NEW), Extrapolated (EXT), Persistent (PER), Increasing (INC) | N/A | NEW: Feature new this volume scan; EXT: Feature from previous scan with extrapolated position; PER: found in both |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY/ PRECISION | REMARKS |
|---|---|---|---|---|---|
| | | | | | previous and current volume; INC: Like PER but with increasing shear and/or Vortex Type. |
| | Vortex Type | Alphanumeric | 3D Correlated Shear (3 DC SHR), Mesocyclone (MESO) | N/A | "^" displayed when Vortex Type from current volume |
| | Mesocyclone Position:<br>• Azimuth<br>• Range | •Degrees<br>• nmi | • 0 to 360<br>• 0 to 124 | • 1<br>• 1 | "^" displayed when position from current volume |
| | Mesocyclone Base Value | Kft | 0.0 to 33.1 | 0.1 | "^" displayed when Base or Top from current volume |
| | Mesocyclone Top Value | Kft | 0.0 to 33.1 | 0.1 | "^" displayed when Base or Top from current volume |
| | Diameter (Radial) | nmi | 0.0 to 99.9 | 0.1 | "^" displayed when Diameter from current volume |
| | Diameter (Azimuthal) | nmi | 0.0 to 99.9 | 0.1 | "^" displayed when Diameter from current volume |
| MESOCYCLONE DETECTION | Circulation ID | N/A | 0 through 999 | N/A | The sequence is recycled following 999. Note 2 |
| | Associated SCIT Storm ID | N/A | A0 through Z0, then A1 through Z1, then A2...Z9 | N/A | Closest SCIT identified storm cell ID. |
| | Strength Rank | N/A | 1 to 25 | 1 | If the strength rank was computed by the Low-Top or |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY/ PRECISION | REMARKS |
|---|---|---|---|---|---|
| | | | | | Shallow method, an L or S will also be displayed. |
| | Low Level (base) Rotational Velocity | Kts | 0 to 129 | 1 | |
| | Position:<br>• Azimuth<br>• Range | • Degrees<br>• nmi | • 0 to 360<br>• 0 to 124 | 1 | Base 2D feature component |
| | Height of Maximum Rotational Velocity (ARL) | Kft | 0 to 33 | 1 | |
| | Maximum Rotational Velocity | Kts | 0 to 129 | 1 | |
| | Base Height (ARL) | Kft | 0 to 33 | 1 | If the Base is on the lowest elevation scan or below 1km, then the height is preceded by a "<" in the display. |
| | Depth | Kft | 0 to 33 | 1 | If the Base is on the lowest elevation scan or below 1km, then the Depth is preceded by a ">" in the display. |
| TORNADO VORTEX SIGNATURE (TVS) | Feature Type | Alphanumeric | TVS or ETVS | N/A | |
| | Storm Cell ID | Alphanumeric | A0 through Z0, then A1 through Z1. then A2...Z9. "??" is displayed if the TVS feature is not associated | N/A | The sequence is recycled following Z9 |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY/ PRECISION | REMARKS |
|---|---|---|---|---|---|
| | | | with a storm cell. | | |
| | TVS Feature Position:<br>· Azimuth<br>· Range | • Degrees<br>• nmi | • 0 to 359<br>• 0 to 124 | • 1<br>• 1 | |
| | Average Delta Velocity | kts | 0 to 494 | 1 | |
| | Low-level Delta Velocity | kts | 0 to 494 | 1 | |
| | Maximum Delta Velocity | kts | 0 to 494 | 1 | |
| | Base | kft | 0.0 to 70.0 | 0.01 | If the Base is on the lowest elevation scan, then it is preceded by a "<" in the display. |
| | Depth | kft | 0 to 70 | 1 | If the base or top is on the lowest or highest elevation scan, then the Depth is preceded by a "<" or ">" in the display, respectively |
| TORNADO VORTEX SIGNATURE RAPID UPDATE | Feature Type | Alphanumeric | TVS or ETVS | N/A | See Note 1 |
| | Storm Cell ID | Alphanumeric | A0 through Z0, then A1 through Z1, then A2,…, Z9, or ?? is displayed if the TVS feature is not associated with a storm cell. | N/A | The sequence is recycled following Z9<br>Note 1 |
| | Feature Status | Alphanume | New | N/A | NEW: Feature is |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY/ PRECISION | REMARKS |
|---|---|---|---|---|---|
| | | ric | (NEW), Extrapolated (EXT), Persistent (PER), Increasing (INC) | | new in this volume scan;<br>EXT: Feature from previous volume scan with extrapolated position;<br>PER: Feature found in both previous and current volume scan;<br>INC:<br>Like PER but with increasing in either LLDV, feature type, or depth. |
| | Feature Position:<br>・Azimuth<br>・Range | <br>• Degree<br>• nmi | <br>• 0 to 360<br>• 0 to 124 | <br>• 1<br>• 1 | See Note 1 |
| | Average Delta Velocity | kts | 0 to 494 | 1 | See Note 1 |
| | Low Level (base) Delta Velocity | kts | 0 to 494 | 1 | See Note 1 |
| | Maximum Delta Velocity | kts | 0 to 494 | 1 | See Note 1 |
| | Base Height | kft | 0.0 to 70.0 | 0.01 | If the Base is on the lowest elevation scan, then it is preceded by a "<" in the display.<br><br>See Note 1 |
| | Depth | kft | 0 to 70 | 1 | If the base or top is on the lowest or highest elevation scan, then the Depth is preceded by a "<" or ">" in the display, respectively.<br><br>See Note 1 |
| USER SELECTABLE PRECIPITATION | Gage Bias Flag | N/A | Applied/Not Applied | N/A | |
| | Number of Hours in Product | N/A | 1 to 24 | 0/1 | |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY/ PRECISION | REMARKS |
|---|---|---|---|---|---|
| | End Times | Hours | 00 to 23 | 0/1 | |
| | Bias Estimate | N/A | 0.00 to 99.99 | 0.01 | |
| | Hour Included Flag | N/A | Yes or No | N/A | |

Note 1: "^" displayed when the attribute(s) is (are) updated to the current detection
Note 2: When no mesocyclones are detected this negative condition will be indicated by the absence of this data block from the product.

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**Table VIII. Product Dependent Definition for Tabular Alphanumeric Block**

| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| VAD WIND PROFILE | Site Adaptable Parameters | See Remarks | See Remarks | See Remarks | 2820003 Pt1, Table A-16 VAD |
| | ALT | 100ft | 0 to 700 | 1 | |
| | U | m/s | -127.0 to 126.0 | 0.1 | |
| | V | m/s | -127.0 to 126.0 | 0.1 | |
| | W | cm/s | -999.9 to 9999.9 | 0.1 | |
| | DIR | degrees | 0 to 360 | 1 | |
| | SPD | knots | 0 to 999 | 1 | |
| | RMS | knots | 0 to 30.0 | 0.1 | |
| | DIV | 10/s | -99.9999 to 999.9999 | 0.0001 | |
| | SRNG | nm | 0.0 to 124.00 | 0.01 | |
| | ELEV | degrees | -1.0 to 45.0 | 0.1 | |
| STORM TRACKING INFORMATION | Radar ID | N/A | 0 to 999 | 1 | |
| | Volume Scan Start Date | N/A | Months: 1 to 12<br>Days: 1 to 31<br>Years: 0 to 99 | N/A | |
| | Volume Scan Start Time | N/A | Hours: 0 to 23<br>Minutes: 0 to 59<br>Seconds: 0 to 59 | N/A | |
| | Number of Storm Cells | N/A | 0 to 100 | 1 | |
| | Average Storm Cell Motion<br>· Speed | kts | 0 to 99 | 1 | Only on first page of Alphanumeric Product |
| | • Direction | degrees | 0 to 360 | 1 | |
| | Storm Cell ID | Alphanumeric | A0 through | N/A | The sequence is recycled following |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| | | | Z0, then A1 through Z1, then A2....Z9 | | Z9 Note 1 |
| | Current Position:<br>· Azimuth | Degrees | 0 to 360 | 1 | Note 1 |
| | · Range | nmi | 0 to 24 | 1 | |
| | Forecast Movement<br>· Direction | Alphanumeric or Degrees | 0 to 359 | 1 | Note 1 |
| | • Speed | Kts | 0 to 999 | 1 | |
| | Forecast Error | nmi | 0.0 to 99.0 | 0.1 | Note 1 |
| | Mean Forecast Error | nmi | 0.0 to 99.0 | 0.1 | Note 1 |
| | The Azimuth and Range Position for each forecast interval up to four forecast intervals | Alphanumeric or Degree Nmi | NO DATA or 0 to 360 0 to 248 | 1 | Note 1 |
| | Site Store Cell Tracking/Forecast Position Adaptable Parameters | See Remarks | See Remarks | See Remarks | 2820003, Pt1, Table A-6 Storm Cell Tracking |
| MESOCYCLONE | Radar ID | N/A | 0 to 999 | 1 | |
| | Volume Scan Start Date | N/A | Months: 1 to 12<br>Days: 1 to 31<br>Years: 0 to 99 | N/A | |
| | Volume Scan Start Time | N/A | Hours: 0 to 23<br>Minutes: 0 to 59<br>Seconds: 0 to 59 | N/A | |
| | Number of Storm Cells | N/A | 0 to 100 | 1 | |
| | Feature ID | Alphanumeric | 0 through 20 | 1 | |
| | Storm Cell ID | Alphanumeric | A0 through Z0, then A1 | N/A | The sequence is recycled followed Z9 |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| | | | through Z1, then A2....Z9 | | |
| | Feature Type | Alphanumeric | Uncorrelated Shear (UNC SHR), 3D Correlated Shear (3DC SHR), Mesocyclone (MESO) | N/A | |
| | Mesocyclone Position: · Azimuth | Degrees | 0 to 360 | 1 | |
| | • Range | nmi | 0 to 124 | 1 | |
| | Mesocyclone Height | Kft | 0.0 to 33.1 | 0.1 | |
| | Mesocyclone Base Value | Kft | 0.0 to 33.1 | 0.1 | |
| | Mesocyclone Top Value | Kft | 0.0 to 33.1 | 0.1 | |
| | Diameter (Radial) | nmi | 0 to 124 | 0.1 | |
| | Diameter (Azimuthal) | nmi | 0 to 780 | 0.1 | |
| | Maximum Shear (tangential) | E-3/sec | 0 to 999 | 1 | |
| | Site Adaptable Parameters | See Remarks | See Remarks | See Remarks | 2820003, Pt1, Table A-17 Mesocyclone Detection |
| TORNADO VORTEX SIGNATURE (TVS) | Radar ID | N/A | 0 to 999 | 1 | |
| | Volume Scan Start Date | N/A | Months: 1 to 12 Days: 1 to 31 Years: 0 to 99 | N/A | |
| | Volume Scan Start Time | N/A | Hours: 0 to 23 Minutes: 0 to 59 Seconds: 0 to 59 | N/A | |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| | Number of TVSs | N/A | 0 to 25 | 1 | If the TDA identified more than the (adaptable) maximum number of TVSs, then the number will be preceded by a ">" |
| | Number of ETVSs | N/A | 0 to 25 | 1 | If the TDA identified more than the (adaptable) maximum number of ETVSs, then the number will be preceded by a ">" |
| | Feature Type | Alphanumeric | TVS or ETVS | N/A | |
| | Feature ID | N/A | 01 through 25 | 0/1 | TVSs and ETVSs are numbered independently |
| | Storm Cell ID | Alphanumeric | A0 through Z0, then A1 through Z1, then A2....Z9, or ?? | N/A | The sequence is recycled following Z9. "??" is displayed if the TVS or ETVS is not associated with a storm cell |
| | Position: -Azimuth | Degrees | 0 to 359 | 1 | |
| | -Range | Nmi | 0 to 124 | 1 | |
| | Average Delta Velocity | kts | 0 to 494 | 1 | |
| | Low-level Delta Velocity | kts | 0 to 494 | 1 | |
| | Maximum Delta Velocity | kts | 0 to 494 | 1 | |
| | Height of the Maximum Delta Velocity | kft | 0.0 to 70.0 | 0.1 | |
| | Depth | kft | 0.0 to 70.0 | 0.1 | If the base or top is on the lowest or highest elevation scan, respectively then the Depth is preceded by a ">" in the display |
| | Base | kft | 0 to 70 | 1 | If the base is on the lowest |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| | | | | | elevation scan, then it is preceded by a "<" in the display |
| | Top | kft | 0.0 to 70.0 | .1 | |
| | Maximum Shear | m/s/km (or E-3/sec) | 0 to 999 | 1 | |
| | Height of the Maximum Shear | kft | 0.0 to 70.0 | 0.1 | |
| | Site Adaptable Parameters | See Remarks | See Remarks | See Remarks | 2820003, Pt1, Table A-18 TDA |
| HAIL INDEX | Radar ID | N/A | 0 to 999 | 1 | |
| | Volume Scan Start Date | N/A | Months: 1 to 12<br>Days: 1 to 31<br>Years: 0 to 99 | N/A | |
| | Volume Scan Start Time | N/A | Hours: 0 to 23<br>Minutes: 0 to 59<br>Seconds: 0 to 59 | N/A | |
| | Number of Storm Cells | N/A | 0 to 100 | 1 | |
| | Storm Cell ID | Alphanumeric | A0 through Z0, then A1 through Z1, then A2...Z9 | N/A | The sequence is recycled following Z9<br>Note 1 |
| | Hail Characteristics<br>· Probability of Hail (POH)<br>· Probability of Severe Hail (POSH)<br>· Maximum Expected Hail Size | Alphanumeric<br><br>Percent<br><br>Percent<br><br>Inches | UNKNOWN or<br><br>0 to 100<br><br>0 to 100<br><br>0.00 and 0.50 to 4.00 | N/A | If the maximum expected hail size exceeds 4.00 inches, the hail size is labeled ">4.00".<br><br>If the Probability of Hail and the Probability of Severe Hail are greater than 0% |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| | | | | | and the maximum expected hail size is less than 0.50 inches, the hail is labeled "<50.0".<br><br>If the Hail Characteristics cannot be determined, the Hail Characteristics are labeled "UNKNOWN".<br><br>Note 1 |
| | Site Adaptable Parameters | See Remarks | See Remarks | See Remarks | 2820003, Pt1, Table A-8 Hail |
| SURFACE RAINFALL ACCUMULATION - ONE HOUR | Mean-field Bias Estimate | N/A | 0.01 to 99.99 | 0.01 | |
| | Effective No. G-R Pairs (Sample Size) | N/A | 0.00 to 9999.99 | 0.01 | |
| | Memory Span used in Bias Estimate | Hours | 0.001 to 10**7 | 0.001 | |
| | Most Recent Bias Source | N/A | N/A | N/A | AWIPS Site ID of location providing bias (WFO or RFC) |
| | Site Adaptable Parameters | See Remarks | See Remarks | See Remarks | TBD<br>Information is only provided if the product is not labeled 'BAD SCAN'. |
| SURFACE RAINFALL ACCUMULATION - THREE HOUR | The following information is provided for up to three hourly intervals is: | | | | |
| | Interval Ending Date | N/A | Months: 1 to 12<br>Days: 1 to 31<br>Years: 00 to 99 | N/A | |
| | Interval Ending Time | N/A | Hours: 0 to 23<br>Minutes: 0 to 59 | N/A | |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| | Adjusted | N/A | Y/N | N/A | |
| | Mean-field Bias Estimates | N/A | 0.01 to 99.99 | 0.01 | Note 2 |
| | Effective No. G-R Pairs (Sample Sizes) | N/A | 0.00 to 9999.99 | 0.01 | Note 2 |
| | Memory Spans used in Bias Estimates | Hours | 0.001 to 10**7 | 0.001 | Note 2 |
| | Most Recent Bias Source | N/A | N/A | N/A | AWIPS Site ID of location providing bias (WFO or RFC) |
| | Scan Type | N/A | 1 = Ends at Clock Hour<br>2 = Ends at Gage Time<br>3 = Both | N/A | Note 2 |
| STORM TOTAL RAINFALL ACCUMULATION | Mean of Bias Estimates Computed During Accumulation Period | N/A | 0.01 to 99.99 | 0.01 | |
| | Mean of G-R Pair Sample Sizes used in Bias Estimates During Accumulation Period | N/A | 0.00 to 9999.99 | 0.01 | |
| | Mean of Memory Spans used in Bias Estimates During Accumulation Period | Hours | 0.001 to 10**7 | 0.001 | |
| | Most Recent Bias Source | N/A | N/A | N/A | AWIPS Site ID of location providing bias (WFO or RFC) |
| | Site Adaptable Parameters | See Remarks | See Remarks | See Remarks | TBD<br>Information is only provided if the product is not labeled 'BAD SCAN'. |
| CLUTTER LIKELIHOOD REFLECTIVITY | Site Adaptable Parameters | See Remarks | See Remarks | See Remarks | TBD |
| CLUTTER | Site Adaptable | See | See | See | TBD |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| LIKELIHOOD DOPPLER | Parameters | Remarks | Remarks | Remarks | |
| MESOCYCLONE RAPID UPDATE | Radar ID | N/A | 0 to 999 | 1 | |
| | Volume Scan Start Date | N/A | Months: 1 to 12 Days: 1 to 31 Years: 0 to 99 | N/A | |
| | Volume Scan Start Time | N/A | Hours: 0 to 23 Minutes: 0 to 59 Seconds: 0 to 59 | N/A | |
| | Elevation | Degrees | 0.0 to 20.0 | 0.1 | |
| | Feature Status | Alphanumeric | New (NEW), Extrapolated (EXT), Persistent (PER), Increasing (INC) | N/A | NEW: Feature new this volume scan; EXT: Feature from previous scan with extrapolated position; PER: found in both previous and current volume; INC: Like PER but with increasing shear and/or Vortex Type. |
| | Storm Cell ID | Alphanumeric | A0 through Z0, then A1 through Z1, then A2....Z9 | N/A | The sequence is recycled followed Z9 |
| | Feature Type | Alphanume | Uncorrela | N/A | " displayed when |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| | | ric | ted Shear (UNC SHR), 3D Correlated Shear (3DC SHR), Mesocyclone (MESO) | | Feature Type from current volume |
| | Mesocyclone Position:<br>•Azimuth<br>•Range | •Degrees<br>•nmi | •0 to 360<br>• 0 to 124 | •1<br>• 1 | "^" displayed when Position from current volume |
| | Mesocyclone Height | Kft | 0.0 to 33.1 | 0.1 | "^" displayed when Height from current volume |
| | Mesocyclone Base Value | Kft | 0.0 to 33.1 | 0.1 | "^" displayed when Base or Top from current volume |
| | Mesocyclone Top Value | Kft | 0.0 to 33.1 | 0.1 | "^" displayed when Base or Top from current volume |
| | Diameter (Radial) | nmi | 0 to 124 | 0.1 | "^" displayed when Diameter from current volume |
| | Diameter (Azimuthal) | nmi | 0 to 780 | 0.1 | "^" displayed when Diameter from current volume |
| | Maximum Shear (tangential) | E-3/sec | 0 to 999 | 1 | |
| MESOCYCLONE DETECTION | Radar ID | N/A | 0 to 999 | 1 | Note 5. |
| | Volume Scan Start Date | N/A | Months: 1 to 12<br>Days: 1 to 31<br>Years: 0 to 99 | N/A | |
| | Volume Scan Start Time | N/A | Hours: 0 to 23<br>Minutes: 0 to 59<br>Seconds: 0 to 59 | N/A | |
| | Average Motion:<br>• Direction<br>• Speed | • Degrees<br>• Kts | • 0 to 360<br>• 0 to 129 | 1<br>1 | Average of all MDA detected circulations regardless of |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| | | | | | whether they meet minimum display thresholds. |
| | Circulation ID | N/A | 0 through 999 | N/A | The sequence is recycled following 999 |
| | Position:<br>• Azimuth<br>• Range | <br>• Degrees<br>• nmi | <br>• 0 to 360<br>• 0 to 124 | <br>1<br>1 | Base 2D feature component |
| | Strength Rank | N/A | 1 to 25 | 1 | If the strength rank was computed by the Low-Top or Shallow method, an L or S will also be displayed. |
| | Associated SCIT Storm ID | N/A | A0 through Z0, then A1 through Z1, then A2...Z9 | N/A | Closest SCIT identified storm cell ID. |
| | Low Level (base) Rotational Velocity | Kts | 0 to 129 | 1 | |
| | Low Level (base) Gate-to-Gate Velocity Difference | Kts | 0 to 129 | 1 | |
| | Base Height (ARL) | Kft | 0 to 33 | 1 | If the Base is on the lowest elevation scan or below 1km, then the height is preceded by a "<" in the display. |
| | Depth | Kft | 0 to 33 | 1 | If the Base is on the lowest elevation scan or below 1km, then the Depth is preceded by a ">" in the display. |
| | Storm Relative Depth Percentage | Percent | 0 to 100 | 1 | Based on the average depth of the ten SCIT identified storm cells having the highest cell based VIL. |
| | Maximum | Kts | 0 to 129 | 1 | |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| | Rotational Velocity | | | | |
| | Height of Maximum Rotational Velocity (ARL) | Kft | 0 to 33 | 1 | |
| | TVS | N/A | Y or N | N/A | Y if a TVS is detected within 2 km of Position |
| | Motion | deg/kts | 0 to 360 deg<br>0 to 99 kts | 1 deg<br>1 kt | Motion of this MDA detection or blanks if detection not tracked. |
| | Mesocyclone Strength Index | N/A | 0 to 99999 | 1 | See MDA AEL. |
| TORNADO VORTEX SIGNATURE RAPID UPDATE (TRU) | Radar ID | N/A | 0 to 999 | 1 | |
| | Volume Scan Start Date | N/A | Months: 1 to 12<br>Days: 1 to 31<br>Years: 0 to 99 | N/A | |
| | | | | | |
| | Volume Scan Start Time | N/A | Hours: 0 to 23<br>Minutes: 0 to 59<br>Seconds: 0 to 59 | N/A | |
| | Number of TVSs | N/A | 0 to 25 | 1 | If the TRU identifies more than the (adaptable) maximum number of TVSs, then the number will be preceded by a ">" |
| | Number of ETVSs | N/A | 0 to 25 | 1 | If the TRU identifies more than the (adaptable) maximum number of ETVSs, then the number will be preceded by a ">" |
| | Elevation | degree | -1.0 to | 0.1 | |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| | | | 45.0 | | |
| | Feature Status | Alphanumeric | New (NEW), Extrapolated (EXT), Persistent (PER), Increasing (INC) | N/A | NEW: Feature is new in this volume scan;<br>EXT: Feature from previous volume scan with extrapolated position;<br>PER: Feature found in both previous and current volume scan;<br>INC:<br>Like PER but with increasing in either LLDV, feature type, or depth. |
| | Feature Type | Alphanumeric | TVS or ETVS | N/A | See Note 3 |
| | Storm Cell ID | Alphanumeric | A0 through Z0, then A1 through Z1, then A2....Z9, or ?? | N/A | The sequence is recycled following Z9. "??" is displayed if the TVS or ETVS is not associated with a storm cell |
| | Position:<br>• Azimuth<br>• Range | <br>• Degrees<br>• Nmi | <br>• 0 to 359<br>• 0 to 124 | <br>• 1<br>• 1 | See Note 3 |
| | Average Delta Velocity | kts | 0 to 494 | 1 | See Note 3 |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| | Low-level (base) Delta Velocity | kts | 0 to 494 | 1 | See Note 3 |
| | Maximum Delta Velocity | kts | 0 to 494 | 1 | See Note 3 |
| | Height of the Maximum Delta Velocity | kft | 0.0 to 70.0 | 0.1 | See Note 3 |
| | Depth | kft | 0.0 to 70.0 | 0.1 | If the base or top is on the lowest or highest elevation scan, respectively then the Depth is preceded by a ">" in the display.<br><br>See Note 3 |
| | Base Height | kft | 0 to 70 | 1 | If the base is on the lowest elevation scan, then it is preceded by a "<" in the display.<br><br>See Note 3 |
| | Top Height | kft | 0.0 to 70.0 | .1 | See Note 3 |
| | Maximum Shear | m/s/km (or E-3/sec) | 0 to 999 | 1 | See Note 3 |
| | Height of the Maximum Shear | kft | 0.0 to 70.0 | 0.1 | See Note 3 |
| One-hour Snow Water Equivalent and One-hour Snow Depth | RPG Name | N/A | N/A | N/A | |
| | Date | Month/Day /Year | Months: 1 to 12<br>Days: 1 to 31<br>Years: 00 to 99 | N/A | |
| | Time | Hours and Minutes UTC | Hours: 0 to 23<br>Minutes 0 to 59 | N/A | |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| | Starting Date | Month/Day /Year | Months: 1 to 12 Days: 1 to 31 Years: 00 to 99 | N/A | |
| | Starting Time | Hours and Minutes UTC | Hours: 0 to 23 Minutes 0 to 59 | N/A | |
| | Ending Date | Month/Day /Year | Months: 1 to 12 Days: 1 to 31 Years: 00 to 99 | N/A | |
| | Ending Time | Hours and Minutes UTC | Hours: 0 to 23 Minutes 0 to 59 | N/A | |
| | Maximum Snow Accumulation | Inches | 0 to 10**7 | 0.001 for Snow Water Equivalent and 0.01 for Snow Depth | |
| | Azimuth of Maximum Value | Degrees | 0 to 359 | 1 | |
| | Range to Maximum Value | Nmi | 0 to 124 | 1 | |
| | Range/height Correction Applied | N/A | "Static" or "Used RCA" | | |
| | Missing Time | Minutes | 0 to 60 | 1 | |
| | Site Adaptable Parameters and Configuration Parameters | N/A | N/A | N/A | Page 2 |
| Storm Total Snow Water Equivalent and Storm Total Snow Depth | RPG Name | N/A | N/A | N/A | |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| | | | | | |
| | Date | Month/Day/ Year | Months: 1 to 12 Days: 1 to 31 Years: 00 to 99 | N/A | |
| | Time | Hours and Minutes UTC | Hours: 0 to 23 Minutes 0 to 59 | N/A | |
| | Starting Date | Month/Day/ Year | Months: 1 to 12 Days: 1 to 31 Years: 00 to 99 | N/A | |
| | Starting Time | Hours and Minutes UTC | Hours: 0 to 23 Minutes 0 to 59 | N/A | |
| | Ending Date | Month/Day/ Year | Months: 1 to 12 Days: 1 to 31 Years: 00 to 99 | N/A | |
| | Ending Time | Hours and Minutes UTC | Hours: 0 to 23 Minutes 0 to 59 | N/A | |
| | Maximum Snow Accumulation | Inches | 0 to 10**7 | 0.01 for Snow Water Equivalent and 0.1 for Snow Depth | |
| | Azimuth of Maximum Value | Degrees | 0 to 359 | 1 | |
| | Range to Maximum Value | Nmi | 0 to 124 | 1 | |
| | Range/height | N/A | "Static" or | | |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| | Correction Applied | | "Used RCA" | | |
| | Missing Time | Minutes | 0 to 32767 | 1 | |
| | Site Adaptable Parameters and Configuration Parameters | N/A | N/A | N/A | Page 2 |
| User Selectable Snow Water Equivalent and User Selectable Snow Depth | RPG Name | N/A | N/A | N/A | |
| | Date | Month/Day/ Year | Months: 1 to 12 Days: 1 to 31 Years: 00 to 99 | N/A | |
| | Time | Hours and Minutes UTC | Hours: 0 to 23 Minutes 0 to 59 | N/A | |
| | Starting Date | Month/Day/ Year | Months: 1 to 12 Days: 1 to 31 Years: 00 to 99 | N/A | |
| | Starting Time | Hours and Minutes UTC | Hours: 0 to 23 Minutes 0 to 59 | N/A | |
| | Ending Date | Month/Day/ Year | Months: 1 to 12 Days: 1 to 31 Years: 00 to 99 | N/A | |
| | Ending Time | Hours and Minutes UTC | Hours: 0 to 23 Minutes 0 to 59 | N/A | |
| | Maximum Snow Accumulation | Inches | 0 to 10**7 | 0.01 for Snow Water Equivalent and 0.1 for Snow | |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| | | | | Depth | |
| | Azimuth of Maximum Value | Degrees | 0 to 359 | 1 | |
| | Range to Maximum Value | Nmi | 0 to 124 | 1 | |
| | Range/height Correction Applied | N/A | "Static" or "Used RCA" | | |
| | Site Adaptable Parameters and Configuration Parameters | N/A | N/A | N/A | Page 2 |
| STORM TOTAL ACCUMULATION | Radar ID | N/A | 4-digit alpha | N/A | Radar ICAO |
| | Volume Scan Date | N/A | Months:1 to 12 Days: 1 to 31 Years: 0 to 99 | N/A | |
| | Volume Scan Time | N/A | Hours: 0 to 23 Minutes: 0 to 59 | N/A | |
| | Volume Coverage Pattern | N/A | 1 to 1000 | 1 | |
| | Operational (Weather) Mode | N/A | A, B, or M | N/A | |
| | Gage Bias Applied | N/A | Yes or No | N/A | Note 4 |
| | Mean of Bias Estimates Computed During Accumulation Period | N/A | 0.01 to 99.99 | 0.01 | Note 4 |
| | Mean of G-R Pair Sample Sizes used in Bias Estimates During Accumulation Period | N/A | 0.00 to 9999.99 | 0.01 | Note 4 |
| | Mean of Memory Spans used in Bias Estimates During Accumulation Period | Hours | 0.001 to 10**7 | 0.001 | Note 4 |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| | Date/Time Last Bias Update | N/A | Months:1 to 12<br>Days: 1 to 31<br>Years: 0 to 99<br>Hours: 0 to 23<br>Minutes: 0 to 59 | N/A | Note 4 |
| | Hybrid Rate Percent Bins Filled | Percentage | 0.00 - 100.00 | 0.01 | |
| | Highest Elev. Used | Degrees | 0.5 - 19.5 | 0.1 | |
| | Total Rain Area (Km**2) | $km^2$ | 0.0 - 169,190.0 | 0.1 | |
| | Site Adaptable Parameters | See Remarks | See Remarks | See Remarks | Information is always provided. |

**Note 1:** Tabular Alphanumeric Block will display an adaptable number of storm cells**.**
**Note 2:** This will be repeated each hour in the product.
**Note 3:** "^" displayed when the attribute(s) is (are) updated to the current detection.
**Note 4.** Gage bias is not being implemented for dual-polarization QPE products at this time. However, gage bias and its associated adaptable parameters will be implemented in the future. These parameters are used as placeholders.
**Note 5:** When no mesocyclones are detected this negative condition will be indicated by the absence of this data block from the product.

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| | MSB HALFWORD LSB<br>No Value | |
|---|---|---|
| | PACKET CODE (=6) | |
| | LENGTH OF DATA BLOCK (BYTES) | |
| DATA BLOCK | I STARTING POINT | 1/4 Km or Screen Coordinates |
| | J STARTING POINT | |
| | END I VECTOR NUMBER 1 | |
| | END J VECTOR NUMBER 1 | |
| | END I VECTOR NUMBER 2 | |
| | END J VECTOR NUMBER 2 | |
| | • | |
| | • | |

**Figure 3-7 Linked Vector Packet - Packet Code 6 (Sheet 1)**

| | MSB Uniform Value LSB | |
|---|---|---|
| | PACKET CODE (=9) | |
| | LENGTH OF DATA BLOCK (BYTES) | |
| | VALUE (LEVEL) OF VECTOR | |
| DATA BLOCK | I STARTING POINT | 1/4 Km Screen Coordinates |
| | J STARTING POINT | |
| | END I VECTOR NUMBER 1 | |
| | END J VECTOR NUMBER 1 | |
| | END I VECTOR NUMBER 2 | |
| | END J VECTOR NUMBER 2 | |
| | • | |
| | • | |

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**Figure 3-7 Linked Vector Packet - Packet Code 9 (Sheet 2)**

No Value

| FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Packet Code | INT*2 | N/A | 6 | N/A | Packet Type 6 |
| Length of Block | INT*2 | Bytes | 1 to 32767 | 1 | Number of bytes in block not including self or packet code |
| I Starting Point | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | I coordinate for vector starting point |
| J Starting Point | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | J coordinate for vector starting point |
| End I Vector Number 1 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | I coordinate for vector end point 1 |
| End J Vector Number 1 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | J coordinate for vector end point 1 |
| End I Vector Number 2 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | I coordinate for vector end point 2 |
| End J Vector Number 2 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | J coordinate for vector end point 2 |

Uniform Value

| FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Packet Code | INT*2 | N/A | 9 | N/A | Packet Type 9 |
| Length of Block | INT*2 | Bytes | 1 to 32767 | 1 | Number of bytes in block not including self or packet code |
| Value (Level) of Vector | INT*2 | N/A | 0 to 15 | 1 | Color Level of Vector |
| I Starting Point | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | I coordinate for vector starting point |
| J Starting Point | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | J coordinate for vector starting point |
| End I Vector Number 1 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | I coordinate for vector end point 1 |
| End J Vector Number 1 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | J coordinate for vector end point 1 |
| End I Vector Number 2 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | I coordinate for vector end point 2 |
| End J Vector Number 2 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | J coordinate for vector end point 2 |

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**Figure 3-7. Linked Vector Packet - Packet Code 9 (Sheet 3)**

| | MSB | HALFWORD<br>No Value | LSB | |
|---|---|---|---|---|
| | PACKET CODE (=7) | | | |
| | LENGTH OF DATA BLOCK (BYTES) | | | |
| | BEGINNING I | VECTOR 1 | | 1/4 KM |
| | BEGINNING J | VECTOR 1 | | OR |
| DATA | END I | VECTOR 1 | | SCREEN COORDINATES |
| BLOCK | END J | VECTOR 1 | | |
| | BEGINNING I | VECTOR 2 | | |
| | BEGINNING J | VECTOR 2 | | |
| | END I | VECTOR 2 | | |
| | END J | VECTOR 2 | | |
| | • | • | | |

**Figure 3-8. Unlinked Vector Packet - Packet Code 7 (Sheet 1)**

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| | MSB Uniform Value LSB | | |
|---|---|---|---|
| | PACKET CODE (=10) | | |
| | LENGTH OF DATA BLOCK (BYTES) | | |
| | VALUE (LEVEL) OF VECTORS | | |
| | BEGINNING I | VECTOR 1 | 1/4 KM |
| | BEGINNING J | VECTOR 1 | OR |
| DATA | END I | VECTOR 1 | SCREEN COORDINATES |
| BLOCK | END J | VECTOR 1 | |
| | BEGINNING I | VECTOR 2 | |
| | BEGINNING J | VECTOR 2 | |
| | END I | VECTOR 2 | |
| | END J | VECTOR 2 | |
| | • | • | |

**Figure 3-8. Unlinked Vector Packet - Packet Code 10 (Sheet 2)**

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No Value

| FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Packet Code | INT*2 | N/A | 7 | N/A | Packet Type 7 |
| Length of Block | INT*2 | Bytes | 1 to 32767 | 1 | Number of bytes in block not including self or packet code |
| Begin I Vector 1 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | I coordinate for vector starting point 1 |
| Begin J Vector 1 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | J coordinate for vector starting point 1 |
| End 1 Vector 1 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | I coordinate for vector end point 1 |
| End J Vector 1 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | J coordinate for vector end point 1 |
| Begin I Vector 2 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | I coordinate for vector starting point 2 |
| Begin J Vector 2 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | J coordinate for vector starting point 2 |
| End I Vector 2 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | I coordinate for vector end point 2 |
| End J Vector 2 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | J coordinate for vector end point 2 |

**Figure 3-8. Unlinked Vector Packet - Packet Code 7 (Sheet 3)**

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Uniform Value

| FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Packet Code | INT*2 | N/A | 10 | N/A | Packet Type 10 |
| Length of Block | INT*2 | Bytes | 1 to 32767 | 1 | Number of bytes in block not including self or packet code |
| Value (Level) of Vector | INT*2 | N/A | 0 to 15 | 1 | Color Level of Vector |
| Begin I Vector 1 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | I coordinate for vector starting point 1 |
| Begin J Vector 1 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | J coordinate for vector starting point 1 |
| End 1 Vector 1 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | I coordinate for vector end point 1 |
| End J Vector 1 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | J coordinate for vector end point 1 |
| Begin I Vector 2 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | I coordinate for vector starting point 2 |
| Begin J Vector 2 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | J coordinate for vector starting point 2 |
| End I Vector 2 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | I coordinate for vector end point 2 |
| End J Vector 2 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | J coordinate for vector end point 2 |

**Figure 3-8. Unlinked Vector Packet - Packet Code 10 (Sheet 4)**

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| MSB | HALFWORD Linked Vectors | | LSB | |
|---|---|---|---|---|
| 0 | E | 0 | 3 | Packet Codes /OP Flags |
| 8 | 0 | 0 | 0 | Initial Point Indicator |
| I | | | | |
| J | | | | |
| LENGTH =# VECTORS x 4 | | | | |
| I1 | | | | |
| J1 | | | | |
| I2 | | | | |
| J2 | | | | |

| MSB | HALFWORD Set Color Levels | | LSB | |
|---|---|---|---|---|
| 0 | 8 | 0 | 2 | Packet Codes |
| 0 | 0 | 0 | 2 | Color Value Indicator |
| VALUE (LEVEL) OF CONTOUR | | | | |

| MSB | HALFWORD Linked Vectors | | LSB | |
|---|---|---|---|---|
| 3 | 5 | 0 | 1 | Packet Codes /OP Flags |
| LENGTH =# VECTORS x 8 | | | | |
| I | | | | |
| J | | | | |
| I1 | | | | |
| J1 | | | | |
| I | | | | |
| J | | | | |
| I2 | | | | |
| J2 | | | | |

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**Figure 3-8a Contour Vector Packet - Packet Codes 0E03, 0802 and 3501 (Sheet 1)**

Set Color Levels:

| FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Packet Code | INT*2 | N/A | 0802 (Hex) | N/A | Packet Type X'0802' |
| Color Value Indicator | INT*2 | N/A | 0002 (Hex) | N/A | Indicates that color value is present in this packet |
| Value (Level) of Contour | INT*2 | N/A | 0 to 15 | 1 | Color Level of Contour |

Linked Contour Vectors:

| FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Packet Code | INT*2 | N/A | 0E03 (Hex) | N/A | Packet Type X'0E03' |
| Initial Point Indicator | INT*2 | N/A | 8000 (Hex) | N/A | Indicates that initial point is present in this packet |
| I Starting point | INT*2 | Km/4 | -2048 to +2047 | 1 | I coordinate for vector starting point |
| J Starting Point | INT*2 | Km/4 | -2048 to +2047 | 1 | J coordinate for vector starting point |
| Length of vectors | INT*2 | Bytes | 4 to 32764 | Multiples of 4 | Length to follow in bytes (where length = # of vectors X4) |
| End I Vector Number 1 | INT*2 | Km/4 | -2048 to +2047 | 1 | I coordinate for vector end point 1 |
| End J Vector Number 1 | INT*2 | Km/4 | -2048 to +2047 | 1 | J coordinate for vector end point 1 |
| End I Vector Number 2 | INT*2 | Km/4 | -2048 to +2047 | 1 | I coordinate for vector end point 2 |
| End J Vector Number 2 | INT*2 | Km/4 | -2048 to +2047 | 1 | J coordinate for vector end point 2 |
| . . . | | | | | |
| . . . | | | | | |

**Figure 3-8a Contour Vector Packet - Packet Codes 0802 and 0E03 (Sheet 2)**

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Unlinked Contour Vectors:

| FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Packet Code | INT*2 | N/A | 3501 (Hex) | N/A | Packet Type X'3501' |
| Length of Vectors | INT*2 | Bytes | 8 to 32760 | Multiples of 8 | Length to follow in bytes (where length = # of vectors X 8) |
| Begin I Vector 1 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | I coordinate for vector starting point 1 |
| Begin J Vector 1 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | J coordinate for vector starting point 1 |
| End 1 Vector 1 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | I coordinate for vector end point 1 |
| End J Vector 1 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | J coordinate for vector end point 1 |
| Begin I Vector 2 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | I coordinate for vector starting point 2 |
| Begin J Vector 2 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | J coordinate for vector starting point 2 |
| End I Vector 2 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | I coordinate for vector end point 2 |
| End J Vector 2 | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | J coordinate for vector end point 2 |

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**Figure 3-8a Contour Vector Packet - Packet Code 3501 (Sheet 3)**

| | MSB HALFWORD Write Text (No Value) LSB | | |
|---|---|---|---|
| | PACKET CODE (=1) | | |
| | LENGTH OF DATA BLOCK (BYTES) | | |
| DATA BLOCK | I STARTING POINT | | 1/4 KM Screen Coordinates |
| | J STARTING POINT | | |
| | CHARACTER 1 | CHARACTER 2 | |
| | CHARACTER 3 | CHARACTER 4 | |
| | • | • | |
| | • | • | |
| | CHARACTER N-1 | CHARACTER N | |

**Figure 3-8b. Text and Special Symbol Packets - Packet Code 1 (Sheet 1)**

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| | MSB HALFWORD Write Text (Uniform Value) LSB | | |
|---|---|---|---|
| | PACKET CODE (=8) | | |
| | LENGTH OF DATA BLOCK (BYTES) | | |
| DATA BLOCK | VALUE OF TEXT STRING | | |
| | I START | | 1/4 KM Screen Coordinates |
| | J START | | |
| | CHARACTER 1 | CHARACTER 2 | |
| | CHARACTER 3 | CHARACTER 4 | |
| | • | • | |
| | • | • | |
| | CHARACTER N-1 | CHARACTER N | |

**Figure 3-8b. Text and Special Symbol Packets - Packet Code 8 (Sheet 2)**

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| | MSB | HALFWORD<br>Write Special Symbols (No Value) | LSB | |
|---|---|---|---|---|
| | PACKET CODE (=2) | | | |
| | LENGTH OF DATA BLOCK (BYTES) | | | |
| DATA BLOCK | I STARTING POINT | | | 1/4 KM Screen Coordinates |
| | J STARTING POINT | | | |
| | CHARACTER 1 | CHARACTER 2 | | |
| | CHARACTER 3 | CHARACTER 4 | | |
| | • | • | | |
| | • | • | | |
| | CHARACTER N-1 | CHARACTER N | | |

**Figure 3-8b. Text and Special Symbol Packets - Packet Code 2 (Sheet 3)**

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Write Text (No Value)

| FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Packet Code | INT*2 | N/A | 1 | N/A | Packet Type 1 |
| Length of Block | INT*2 | Bytes | 1 to 32767 | 1 | Number of bytes in block not including self or packet code |
| I Starting Point | INT*2 | Km/4 or Pixels | -2408 to +2047 | 1 | I coordinate for text starting point |
| J Starting Point | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | J coordinate for text starting point |
| Character 1 to N | Char | 8 bit ASCII | ASCII Character Set | N/A | Characters are ASCII |

Write Text (Uniform Value)

| FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Packet Code | INT*2 | N/A | 8 | N/A | Packet Type 8 |
| Length of Block | INT*2 | Bytes | 1 to 32767 | 1 | Number of bytes in block not including self or packet code |
| Value (Level) of Text | INT*2 | N/A | 0 to 15 | 1 | Color Level of text |
| I Starting Point | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | I coordinate for text starting point |
| J Starting Point | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | J coordinate for text starting point |
| Character 1 to N | Char | 8 bit ASCII | ASCII Character Set | N/A | Characters are ASCII |

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**Figure 3-8b. Text and Special Symbol Packets - Packet Code 1 (Sheet 4)**

Write Special Symbols (No Value)

| FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Packet Code | INT*2 | N/A | 2 | N/A | Packet Type 2 |
| Length of Block | INT*2 | Bytes | 1 to 32767 | 1 | Number of bytes in block not including self or packet code |
| I Starting Point | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | I coordinate for special symbol starting point (Note 1) |
| J Starting Point | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | J coordinate for special symbol starting point (Note 1) |
| Character 1 to N | Char | 8 bit ASCII | ASCII Character Set | N/A | Characters are ASCII |

**Note 1:** I, J for special symbols are at the center of the symbol and at the upper left corner of the symbol for text.

**Note 2:** The special symbol characters in use are: !(21), "(22), #(23), $(24), %(25) to report past storm cell position, current storm cell position, forecast storm cell position, past MDA position, and forecast MDA position, respectively. Where, the number in parenthesis is the 8-bit hexadecimal value for the ASCII character. The appearance of the special symbols (e.g., filled circles, plus marks, X within a circle) is described in the Product Specification ICD (2620003), sections 18.3.2 and 20.3.2.

**Figure 3-8b. Text and Special Symbol Packets - Packet Code 2 (Sheet 5)**

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| MSB | HALFWORD Linked Vectors | | LSB |
|---|---|---|---|
| 0 | E | 2 | 3 |
| 8 | 0 | 0 | 0 |
| I | | | |
| J | | | |
| LENGTH = # VECTORS X 4 | | | |
| I1 | | | |
| J1 | | | |
| I2 | | | |
| J2 | | | |

| MSB | HALFWORD Text | | LSB |
|---|---|---|---|
| 4 | E | 0 | 0 |
| 0 | C | 2 | 3 |
| 8 | 0 | 0 | 0 |
| X | | | |
| Y | | | |
| LENGTH OF C's | | | |
| C1 | | C2 | |
| C3 | | C4 | |

| MSB | Unlinked Vectors | | LSB |
|---|---|---|---|
| 3 | 5 | 2 | 1 |
| LENGTH # X 8 | | | |
| I | | | |
| J | | | |
| I1 | | | |
| J1 | | | |
| I | | | |
| J | | | |
| I2 | | | |
| J2 | | | |

| MSB | Special Symbols | | LSB |
|---|---|---|---|
| 4 | E | 0 | 1 |
| 0 | C | 2 | 3 |
| 8 | 0 | 0 | 0 |
| X | | | |
| Y | | | |
| LENGTH OF C's | | | |
| C1 | | C2 | |
| C3 | | C4 | |

**Figure 3-9. Map Message Packet - Packet Codes 0E23, 4E00, 3521 and 4E01 (Sheet 1)**

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| HALF WORD | FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|---|
| 61 | Block Divider | INT*2 | N/A | -1 | N/A | Integer -1, Block Divider |
| 62 | Map ID | INT*2 | N/A | 132 to 198 | 1 | Message code for appropriate map from Table II |
| 63 | Data Format | INT*2 | N/A | 1 | N/A | Integer 1 for RAMTEK format |
| 64 | Number of Data Pieces | INT*2 | N/A | 1, 17 | 1 | Integer number of map segments; 1 = low resolution, 17 = high and low resolution |
| 65-66 | Total Byte Count | INT*4 | Bytes | 1 to 409600 | 1 | Number of bytes in data pieces |
| 67 | Map Piece 1 Location | INT*2 | N/A | 1 to 32767 | 1 | Map file sector number on RPG disk; offset from the beginning of map file to first piece of data on the disk |
| 68-69 | Byte Length of Map Piece 1 | INT*4 | Bytes | 1 to 81920 | 1 | The length of piece 1 in bytes |
| 70-117 | Note 1 | Note 1 | Note 1 | Note 1 | Note 1 | Comparable to halfwords 67-69 for map piece 2 to 17; only when the high resolution map is included |
| 118-127 | Alignment Filler | INT*2 | N/A | 0 | N/A | Zero filled to halfword 128 from first byte of the message |
| 129 | Map Data Piece 1 | Note 1 | Note 1 | Note 1 | Note 1 | Low resolution - contain packets shown in Sheet 1 of this figure |
| | Map Data Piece 2 | Note 1 | Note 1 | Note 1 | Note 1 | High resolution if included, contains packet shown in Sheet 1 of this figure |
| | • | | | | | |
| | • | | | | | |
| | • | | | | | |
| | Map Data Piece 17 | | | | | |

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Note 1. Data pieces will be in the formats shown for: Linked Vectors (No Value), Unlinked Vectors (No Value),
Write Text (No Value), and Write Special Symbols (No Value). The first 8 bytes will be replaced by the code shown in sheet 1 of this figure. The upper left corner of area of coverage is 0,0 and the resolution is 1/8 Km.

**Figure 3-9. Map Message Packet - Packet Codes 0E23, 4E00, 3521 and 4E01 (Sheet 2)**

| | MSB HALFWORD | | | LSB | |
|---|---|---|---|---|---|
| | A | F | 1 | F | PACKET CODE |
| | INDEX OF FIRST RANGE BIN | | | | |
| | NUMBER OF RANGE BINS | | | | |
| | I CENTER OF SWEEP | | | | |
| | J CENTER OF SWEEP | | | | |
| | SCALE FACTOR (230 / # OF RANGE BINS) | | | | |
| | NUMBER OF RADIALS | | | | |
| REPEAT FOR EACH RADIAL | NUMBER OF RLE HALFWORDS IN RADIAL | | | | |
| | RADIAL START ANGLE | | | | |
| | RADIAL ANGLE DELTA | | | | |
| | RUN (0) | COLOR CODE (0) | RUN (1) | COLOR CODE (1) | |
| | RUN (2) | COLOR CODE (2) | RUN (3) | COLOR CODE (3) | |
| | • ·· | | | | |
| | • ·· | | | | |
| | RUN (N) | COLOR CODE (N) | 0000 | 0000 | |

**Figure 3-10. Radial Data Packet (16 Data Levels) - Packet Code AF1F (Sheet 1)**

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Sectors or "Windows" Products will use this format with sufficient data to fill the requested area.

| FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Packet Code | INT*2 | N/A | AF1F (Hex) | N/A | Packet Type X'AF1F' |
| Index of First Range Bin | INT*2 | N/A | 0 to 460 | 1 | Location of first range bin |
| Number of Range Bins | INT*2 | N/A | 1 to 460 | 1 | Number of range bins comprising a radial |
| I Center of Sweep | INT*2 | Km/4 | -2048 to +2047 | 1 | I coordinate of center of sweep |
| J Center of Sweep | INT*2 | Km/4 | -2048 to +2047 | 1 | J coordinate of center of sweep |
| Scale Factor | Scaled Integer | Pixels | .001 to 8.000 | .001 | Number of pixels per range bin |
| Number of Radials | INT*2 | N/A | 1 to 400 | 1 | Total number of radials in products |
| Number of RLE Halfwords in Radial | INT*2 | Halfword | 1 to 230 | 1 | Number of RLE (Run Length Encoded) 16-bit halfwords per radial |
| Radial Start Angle | Scaled Integer | Degrees | 0.0 to 359.9 | .1 | Starting angle at which radial data was collected; Scan is always in Clockwise direction |
| Radial Angle Delta | Scaled Integer | Degrees | 0.0 to 2.0 | .1 | Radial angle data |
| Run(0) | 4 Bit INT | N/A | 0 to 15 | 1 | 4-bit run code |
| Color Code(0) | 4 Bit INT | N/A | 0 to 15 | 1 | 4-bit color level |

**Figure 3-10. Radial Data Packet (16 Data Levels) - Packet Code AF1F (Sheet 2)**

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| | MSB HALFWORD | | | LSB | |
|---|---|---|---|---|---|
| | B | A | 0 | F or 7 | PACKET CODE / OP FLAGS |
| | 8 | 0 | 0 | 0 | |
| | 0 | 0 | C | 0 | |
| | I COORDINATE START | | | | |
| | J COORDINATE START | | | | |
| | X SCALE INT | | | | |
| | X SCALE FRACTIONAL | | | | |
| | Y SCALE INT | | | | |
| | Y SCALE FRACTIONAL | | | | |
| | NUMBER OF ROWS | | | | |
| | PACKING DESCRIPTOR | | | | |
| REPEAT FOR EACH ROW | NUMBER OF BYTES IN THIS ROW | | | | |
| | RUN (0) | COLOR CODE (0) | RUN (1) | COLOR CODE (1) | |
| | RUN (2) | COLOR CODE (2) | RUN (3) | COLOR CODE (3) | |
| | • .. | | | | |
| | • .. | | | | |
| | RUN (N) | COLOR CODE (N) | 0000 | 0000 | |

**Figure 3-11. Raster Data Packet - Packet Codes BA0F and BA07 (Sheet 1)**

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| FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Packet Code | INT*2 | N/A | BA0F (Hex) or BA07 (Hex) | N/A | Packet Type X 'BA0F' or X'BA07' |
| Packet Code | INT*2 | N/A | 8000 (Hex) | N/A | Packet Type X'8000' |
| Packet Code | INT*2 | N/A | 00C0 (Hex) | N/A | Packet Type X'00C0' |
| I Coordinate Start | INT*2 | Km/4 | -2048 to +2047 | 1 | Starting location of data |
| J Coordinate Start | INT*2 | Km/4 | -2048 to +2047 | 1 | Starting location of data |
| X Scale INT | INT*2 | N/A | 1 to 67 | 1 | Scaling factor for grid |
| X Scale Fractional | N/A | N/A | N/A | N/A | Reserved for internal PUP use |
| Y Scale INT | INT*2 | N/A | 1 to 67 | 1 | Scaling factor for grid |
| Y Scale Fractional | N/A | N/A | N/A | N/A | Reserved for internal PUP use |
| Number of Rows | INT*2 | N/A | 1 to 464 | 1 | Number of rows in layer |
| Packing Descriptor | INT*2 | N/A | 2 | N/A | Defines packing format 2 |
| Number of Bytes in this Row | INT*2 | Bytes | 2 to 920 | 1 | Number of bytes in this row not including self |
| Run(0) | 4 Bit INT | N/A | 0 to 15 | 1 | 4-bit run code |
| Color Code(0) | 4 Bit INT | N/A | 0 to 15 | 1 | 4-bit color level |

**Figure 3-11. Raster Data Packet - Packet Codes BA0F and BA07 (Sheet 2)**

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| | MSB HALFWORD LSB | |
|---|---|---|
| | PACKET CODE (=17) | |
| | SPARE | |
| | SPARE | |
| | NUMBER OF LFM BOXES IN ROW | |
| | NUMBER OF ROWS | |
| REPEAT FOR EACH ROW | NUMBER OF BYTES IN ROW | |
| | RUN (0) | LEVEL (01) |
| | RUN (1) | LEVEL (1) |
| | •<br>•<br>• | •<br>•<br>• |
| | RUN (N) | LEVEL (N) |

**Figure 3-11a. Digital Precipitation Data Array Packet - Packet Code 17 (Sheet 1)**

| FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Packet Code | INT*2 | N/A | 17 | N/A | Packet Type 17 |
| Spares | N/A | N/A | N/A | N/A | |
| Number of LFM Boxes in Row | INT*2 | N/A | 131 | 1 | Number of boxes in each row |
| Number of Rows | INT*2 | N/A | 131 | 1 | Total number of rows |
| Number of Bytes in Row | INT*2 | N/A | 2 to 262 | 1 | Number of bytes in this row |
| Run(0) | 1 Byte | N/A | 0 to 255 | 1 | 8-bit run code |
| Level(0) | 1 Byte | N/A | 0 to 255 | 1 | 8-bit data level code. See Note 1 of Figure 3-6 |

**Figure 3-11a. Digital Precipitation Data Array Packet - Packet Code 17 (Sheet 2)**

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| | MSB HALFWORD | | | LSB |
|---|---|---|---|---|
| | PACKET CODE (=18) | | | |
| | SPARE | | | |
| | SPARE | | | |
| | NUMBER OF LFM BOXES IN ROW | | | |
| | NUMBER OF ROWS | | | |
| REPEAT FOR EACH ROW | NUMBER OF BYTES IN ROW | | | |
| | RUN (0) | LEVEL (0) | RUN (1) | LEVEL (1) |
| | RUN (2) | LEVEL (2) | RUN (3) | LEVEL (3) |
| | ••• | | | |
| | ••• | | | |
| | | | | |
| | RUN (N) | LEVEL (N) | 0000 | 0000 |

**Figure 3-11b. Precipitation Rate Data Array Packet - Packet Code 18 (Sheet 1)**

| FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Packet Code | INT*2 | N/A | 18 | N/A | Packet Type 18 |
| Spares | N/A | N/A | N/A | N/A | |
| Number of LFM Boxes in Row | INT*2 | N/A | 13 | 1 | Number of boxes in each row |
| Number of Rows | INT*2 | N/A | 13 | 1 | Total number of rows |
| Number of Byes in Row | INT*2 | N/A | 2 to 14 | 1 | Number of bytes in this row |
| Run(0) | 4-Bit INT | N/A | 0 to 15 | 1 | 4-bit run code |
| Level(0) | 4-Bit INT | N/A | 0 to 15 | 1 | 4-bit data level code |

**Figure 3-11b. Precipitation Rate Data Array Packet - Packet Code 18 (Sheet 2)**

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| | MSB HALFWORD LSB | |
|---|---|---|
| | PACKET CODE (=16) | |
| | INDEX OF FIRST RANGE BIN | |
| | NUMBER OF RANGE BINS | |
| | I CENTER OF SWEEP | |
| | J CENTER OF SWEEP | |
| | RANGE SCALE FACTOR | |
| | NUMBER OF RADIALS | |
| REPEAT FOR EACH RADIAL | NUMBER OF BYTES IN RADIAL | |
| | RADIAL START ANGLE | |
| | RADIAL DELTA ANGLE | |
| | LEVEL (0) | LEVEL (1) |
| | LEVEL (2) | LEVEL (3) |
| | • | • |
| | • | • |
| | LEVEL (N-1) | LEVEL (N) |

**Figure 3-11c. Digital Radial Data Array Packet - Packet Code 16 (Sheet 1)**

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| FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Packet Code | INT*2 | N/A | 16 | N/A | Packet Type 16 |
| Index of First Range Bin | INT*2 | N/A | 0 to 230 | 1 | Location of first range bin |
| Number of Range Bins | INT*2 | N/A | 0 to 1840 | 1 | Number of range bins comprising a radial |
| I Center of Sweep | INT*2 | Km/4 | -2048 to +2047 | 1 | I coordinate of center of sweep |
| J Center of Sweep | INT*2 | Km/4 | -2048 to +2047 | 1 | J coordinate of center of sweep |
| Range Scale Factor | Scaled Integer | N/A | .001 to 1.000 | .001 | Cosine of elevation angle for elevation based products. For volume based products the value 1.00. |
| Number of Radials | INT*2 | N/A | 1 to 720 | 1 | Total number of radials in product (Note 1) |
| Number of Bytes in Radial | INT*2 | N/A | 1 to 1840 | 1 | Number of bytes of 8-bit data level values per radial |
| Radial Start Angle | Scaled Integer | Degrees | 0.0 to 359.9 | .1 | Starting angle at which radial data was collected; Scan is always clockwise |
| Radial Delta Angle | Scaled Integer | Degrees | 0.0 to 2.0 | .1 | Delta angle from previous radial |
| Level (0) | 1 Byte | N/A | 0 to 255 | 1 | 8-bit data level code. (See Note 1 of Figure 3-6) |

Note 1: The RPG clips radials to 70 kft. This could result in an odd number of bins in a radial. However, the radial will always be on a halfword boundary, so the number of bytes in a radial may be number of bins in a radial + 1.

**Figure 3-11c. Digital Radial Data Array Packet - Packet Code 16 (Sheet 2)**

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| | | MSB HALFWORD LSB |
|---|---|---|
| DATA BLOCK | REPEAT FOR EACH ARROW | PACKET CODE (=5) |
| | | LENGTH OF DATA BLOCK (BYTES) |
| | | I COORDINATE |
| | | J COORDINATE |
| | | DIRECTION OF ARROW |
| | | ARROW LENGTH |
| | | ARROW HEAD LENGTH |
| | | • • • |

| FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Packet Code | INT*2 | N/A | 5 | N/A | Packet Type 5 |
| Length of Block | INT*2 | Bytes | 1 to 32767 | 1 | Number of bytes in block not including self or packet code |
| I Coordinate Point | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | Coordinate where the arrow and/or value is to be centered |
| J Coordinate Point | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | Coordinate where the arrow and/or value is to be centered |
| Direction of Arrow | INT*2 | Degrees | 0 to 359 | 1 | Arrow direction in 1-degree steps: points with wind field |
| Arrow Length | INT*2 | Pixels | 1 to 512 | 1 | Number of pixels in arrow |
| Arrow Head Length | INT*2 | Pixels | 1 to 512 | 1 | Number of pixels in arrow head |

**Figure 3-12. Vector Arrow Data Packet - Packet Code 5**

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| | | MSB HALFWORD LSB |
|---|---|---|
| DATA BLOCK | REPEAT FOR EACH BARB | PACKET CODE (=4) |
| | | LENGTH OF DATA BLOCK (BYTES) |
| | | VALUE |
| | | X COORDINATE |
| | | Y COORDINATE |
| | | DIRECTION OF WIND |
| | | WIND SPEED |
| | | • • • |

| FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Packet Code | INT*2 | N/A | 4 | N/A | Packet Type 4 |
| Length of Block | INT*2 | Bytes | 1 to 32767 | 1 | Number of bytes in block not including self or packet code |
| Value | INT*2 | N/A | 1 to 5 | 1 | Color level of wind barb (reflects the RMS value associated with the computed velocity) |
| X Coordinate | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | Coordinate where the value starts |
| Y Coordinate | INT*2 | Km/4 or Pixels | -2048 to +2047 | 1 | Coordinate where the value starts |
| Direction of Wind | INT*2 | Degrees | 0 to 359 | 1 | Points into wind |
| Wind Speed | INT*2 | Knots | 0 to 195 | 1 | Magnitude of wind |

**Figure 3-13. Wind Barb Data Packet - Packet Code 4**

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| | MSB HALFWORD LSB |
|---|---|
| | PACKET CODE (=3 or 11) |
| MESOCYCLONE | LENGTH OF BLOCK (BYTES) |
| REPEAT FOR EACH SYMBOL | I POSITION |
| | J POSITION |
| | RADIUS OF MESOCYCLONE |

| | MSB HALFWORD LSB |
|---|---|
| | PACKET CODE (=12 or 26) |
| TVS or ETVS | LENGTH OF BLOCK (BYTES) |
| REPEAT FOR EACH SYMBOL | I POSITION |
| | J POSITION |

| | MSB HALFWORD LSB |
|---|---|
| | PACKET CODE (=13) |
| HAIL POSITIVE (FILLED) | LENGTH OF BLOCK (BYTES) |
| REPEAT FOR EACH SYMBOL | I POSITION |
| | J POSITION |

| | MSB HALFWORD LSB |
|---|---|
| | PACKET CODE (=14) |
| HAIL PROBABLE | LENGTH OF BLOCK (BYTES) |
| REPEAT FOR EACH SYMBOL | I POSITION |
| | J POSITION |

**Figure 3-14. Special Graphic Symbol Packet - Packet Code 3 or 11, 12 or 26, 13 and 14 (Sheet 1)**

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| | MSB HALFWORD LSB | |
|---|---|---|
| STORM ID | PACKET CODE (=15) | |
| | LENGTH OF BLOCK (BYTES) | |
| REPEAT FOR EACH SYMBOL | I POSITION | |
| | J POSITION | |
| | CHARACTER 1 | CHARACTER 2 |

| | MSB HALFWORD LSB |
|---|---|
| HDA HAIL | PACKET CODE (=19) |
| | LENGTH OF BLOCK (BYTES) |
| REPEAT FOR EACH SYMBOL | I POSITION |
| | J POSITION |
| | PROB. OF HAIL |
| | PROB. OF SEVERE HAIL |
| | MAX HAIL SIZE |

| | MSB HALFWORD LSB |
|---|---|
| SCIT PAST/ FORECAST DATA | PACKET CODE (=23 or 24) |
| | LENGTH OF BLOCK (BYTES) |
| | DISPLAY DATA PACKETS |
| | • |
| | • |

| | MSB HALFWORD LSB |
|---|---|
| STI CIRCLE | PACKET CODE (=25) |
| | LENGTH OF BLOCK (6 BYTES) |
| | I POSITION |
| | J POSITION |
| | RADIUS OF CIRCLE |

**Figure 3-14. Special Graphic Symbol Packet - Packet Codes 15, 19, 23, 24 and 25 (Sheet 2)**

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| FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Packet Code | INT*2 | N/A | 3, 11 to 15, 19, 23 to 26 | N/A | Packet Type (Note 1) |
| Length of Block | INT*2 | Bytes | 1 to 32767 | 1 | Number of bytes in block not including self or packet code |
| I Position | INT*2 | Km/4 | -2048 to +2047 | 1 | I starting coordinate |
| J Position | INT*2 | Km/4 | -2048 to +2047 | 1 | J starting coordinate |
| Radius of Mesocyclone | INT*2 | Km/4 | -2048 to +2047 | 1 | A radius of 0 indicates that no mesocyclone is present and I, J coordinates are set to 0,0. |
| Character 1 | Char | 8-bit ASCII | A to Z | N/A | First character of Storm ID |
| Character 2 | Char | 8-bit ASCII | 0 to 9 | N/A | Second character of Storm ID |
| Probability of Hail | INT*2 | N/A | 0 to 100, -999 | 10 | Probability in Percent (Note 2) |
| Probability of Severe Hail | INT*2 | N/A | 0 to 100, -999 | 10 | Probability in Percent (Note 2) |
| Max Hail Size | INT*2 | Inches | 0 to 4 | 1 | Maximum expected hail size |
| Display Data Packet | INT*2 | N/A | N/A | N/A | Past or forecast position data for a Single storm cell. Consists of packet code 2, (Figure 3-8b), packet code 6*(Figure 3-7) or packet code 25 (Figure 3-14) |
| Radius of STI Circle | INT*2 | Pixels | 1 to 512 | 1 | Radius of circle |

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Note 1.A packet code of 11 indicates 3-D correlated shear. Packet code 23 for past position data, packet code 24 for forecast position data, and packet code 25 for current position. Packet code 12 is for TVS position data and packet code 261 is for ETVS position data.
Note 2.A value of -999 indicates that these cells are beyond the maximum range for algorithm processing.

**Figure 3-14. Special Graphic Symbol Packet - Packet Codes 3, 11, 12, 13, 14, 15, 19, 23, 24, 25 and 26 (Sheet 3)**

| | MSB HALFWORD LSB |
|---|---|
| | PACKET CODE (=20) |
| | LENGTH OF BLOCK (BYTES) |
| REPEAT FOR EACH SYMBOL | I POSITION |
| | J POSITION |
| | POINT FEATURE TYPE |
| | POINT FEATURE ATTRIBUTE |

| FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Packet Code | INT*2 | N/A | 20 | N/A | Packet Type (Note 1) |
| Length of Block | INT*2 | Bytes | 8 to 32760 | 1 | Number of bytes in block not including self or packet code |
| I Position | INT*2 | Km/4 | -2048 to +2047 | 1 | I starting coordinate |
| J Position | INT*2 | Km/4 | -2048 to +2047 | 1 | J starting coordinate |
| Point Feature Type | INT*2 | N/A | 1 to 4, 5 to 8, 9-11 | 1 | 1 = mesocyclone (extrapolated)<br>2 = 3-D correlated shear (extrapolated)<br>3 = mesocyclone (persistent, new, or increasing)<br>4 = 3-D correlated shear (persistent, increasing, or new)<br>5 = TVS (extrapolated)<br>6 = ETVS (extrapolated)<br>7 = TVS (persistent, new, or increasing)<br>8 = ETVS (persistent, new, or increasing)<br>9 = MDA Circulation with Strength Rank >= 5 AND with a Base Height <= 1 km ARL or with its Base on the lowest elevation angle.<br>10 = MDA Circulation with Strength Rank >= 5 AND with a Base Height > 1 km ARL AND that Base is not on the lowest elevation angle.<br>11 = MDA Circulation with Strength Rank < 5 |
| Point Feature Attribute | INT*2 | Type dependent, see remarks. | Type dependent, see remarks. | Type dependent, see remarks. | For feature types 1-4, 9, 10, 11, radius in km/4 |

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**Figure 3-14. Special Graphic Symbol Packet - Packet Code 20 (Sheet 4)**

| | MSB HALFWORD | LSB |
|---|---|---|
| | PACKET CODE (=21) | |
| | LENGTH OF BLOCK (BYTES) | |
| | CELL ID C1 | CELL ID C2 |
| | I POSITION | |
| | J POSITION | |
| REPEAT FOR EACH TREND CODE | TREND CODE | |
| | # VOLUMES | LATEST VOL PTR |
| | VOL. 1 TREND DATA | |
| | •<br>• | |
| | VOL N TREND DATA | |

| FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Packet Code | INT*2 | N/A | 21 | N/A | Packet Type 21 |
| Length of Block | INT*2 | Bytes | 12 to 198 | 1 | Number of bytes to follow in this packet |
| Cell ID C1 | 8 bit ASCII | N/A | A to Z | N/A | First character of cell ID |
| Cell ID C2 | 8 bit ASCII | N/A | 0 to 9 | N/A | Second character of cell ID |
| I Position | INT*2 | Km/8 | -4096 to +4095 | 1 | Cell I coordinate at latest Volume Scan |
| J Position | INT*2 | Km/8 | -4096 to +4095 | 1 | Cell J coordinate at latest Volume Scan |
| Trend Code | INT*2 | N/A | 1 to 8 | 1 | Indicates trend data type to follow:<br>1 = cell top<br>2 = cell base<br>3 = max. ref. hgt.<br>4 = prob. hail<br>5 = prob. svr. hail<br>6 = cell based VIL<br>7 = max. ref.<br>8 = centroid hgt. |

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**Figure 3-15. Cell Trend Data Packet - Packet Code 21 (Sheet 1)**

| FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| # Volumes | INT*1 | N/A | 1 to 10 | 1 | Number of volume scans of trend data for this trend code in the circular list |
| Latest Vol PTR | INT*1 | N/A | 1 to 10 | 1 | Pointer to the latest volume scan in the circular list |
| Vol 1 Trend Data | INT*2 | Note 1 | Note 1 | Note 1 | Trend data for each scan in the circular list |
| • | | | | | |
| • | | | | | |
| • | | | | | |
| Vol N Trend Data | | | | | |

| TREND CODE | UNITS | SCALE FACTOR | SCALED RANGE | PRECISION | REMARKS |
|---|---|---|---|---|---|
| 1 | Feet | /100 | 0 to 1700 | 100 Feet | Note 2 |
| 2 | Feet | /100 | 0 to 1700 | 100 Feet | Note 2 |
| 3 | Feet | /100 | 0 to 700 | 100 Feet | |
| 4 | Percent | 1 | 0 to 100 | 10 Percent | Note 3 |
| 5 | Percent | 1 | 0 to 100 | 10 Percent | Note 3 |
| 6 | kg/m**2 | 1 | 0 to 100 | 1 kg/m**2 | |
| 7 | dBZ | 1 | 0 to 75 | 1 dBZ | |
| 8 | Feet | /100 | 0 to 700 | 100 Feet | |

Note 1: The following defines the units, scale factor, range and precision for each trend code:
Note 2: If the value is over 700, then 1000 has been added to denote that the CELL TOP (BASE) was detected on the highest (lowest) elevation scan.
Note 3:Flag values of -999 denote that an UNKNOWN value (i.e. the cell is outside the maximum hail processing range).

**Figure 3-15. Cell Trend Data Packet - Packet Code 21 (Sheet 2)**

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| | | |
|---|---|---|
| | PACKET CODE (=22) | |
| CELL TREND | LENGTH OF BLOCK (BYTES) | |
| VOLUME SCAN | # VOLUMES | LATEST VOL PTR |
| TIMES | VOL TIME 1 | |
| | •<br>• | |
| | VOL TIME N | |

| FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Packet Code | INT*2 | N/A | 22 | N/A | Packet Type 22 |
| Length of Block | INT*2 | Bytes | 4 to 22 | 1 | Number of bytes to follow in this packet |
| # Volumes | INT*2 | N/A | 1 to 10 | 1 | Number of cell trend volume scan times in the circular list |
| Latest Vol PTR | INT*2 | N/A | 1 to 10 | 1 | pointer to the latest cell trend volume scan time in the circular list |
| Vol Time 1 | INT*2 | Minutes | 0 to 1439 | 1 | Circular list of cell trend volume scan times in minutes after midnight (seconds are truncated) |
| •<br>•<br>Vol Time N | | | | | |

**Figure 3-15a. Cell Trend Volume Scan Times - Packet Code 22**

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| | MSW HALFWORD LSB |
|---|---|
| | PACKET CODE (=27) |
| | LENGTH OF PACKET (MSW) |
| | LENGTH OF PACKET (LSW) |
| | ELEVATION ANGLE |
| REPEAT FOR EACH SUPEROB CELL WITH AN AVERAGE RADIAL VELOCITY | LATITUDE (MSW) |
| | LATITUDE (LSW) |
| | LONGITUDE (MSW) |
| | LONGITUDE (LSW) |
| | HEIGHT |
| | AVERAGE RADIAL VELOCITY |
| | STD OF THE AVERAGE RADIAL VELOCITY |
| | TIME DEVIATION |
| | AVERAGE AZIMUTH |

**Figure 3-15b. SuperOb Wind Data Packet - Packet Code 27 (Sheet 1)**

Packet 27 would be used in the Product Symbology Block. Each packet would represent a complete elevation scan. Multiple packets would be contained in a single data layer. If there is no data in the elevation scan, the packet "Length of Block" would be set to 2 bytes. There could be more packets than elevation angles in the VCPs since a mixture of VCPs result in reporting all the elevation angles which are separated by 0.35 degrees.

Maximum packet size is based on full data coverage extending out to 100 km range and with spatial parameters of 2 degrees by 1 km is 324002 bytes. However, default adaptable parameters (5 km by 6 degrees) result in a maximum packet size of 21602 bytes.

A SuperOb-cell is defined as a region bounded by adaptable range and azimuth limits (default 6 degrees by 10 km). The geographic center-point of cells are positioned at an azimuth and range at a multiples of ½ of the cell dimensions (e.g., 0 deg/5km, 0 deg/15km, … 6deg/5 km,… 354deg/95km). However, the position of the average radial velocity (i.e., latitude, longitude, height, and azimuth) is the average of the radar bin positions used in the average radial velocity computation.

The product is generated once an hour (default) at 30 minutes past the hour regardless of the position of the antenna with the VCP.

What if the radar data stops before the end of the time period, complete product at the scheduled time?

If the radar is down for the full hour, don't need to generate a product.

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| FIELDNAME | TYPE | UNITS | RANGE | PRECISION /ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Packet Code | INT*2 | N/A | 27 | N/A | Packet Code 27 |
| Packet Length (MSW) | INT*4 | Bytes | 2 to 324002 | 1 | Number of bytes to follow in this packet |
| Elevation Angle | INT*2 | Degrees | -1.0 to +45.0 | 0.1 | Angle of the Elevation Scan |
| Latitude (MSW)<br>----------<br>Latitude (LSW) | INT*4 | Degrees | -90 to +90 | 0.001 | North (+) or South (-) of the Equator of the cell |
| Longitude (MSW)<br>----------<br>Longitude (LSW) | INT*4 | Degrees | -180 to +180 | 0.001 | East (+) or West (-) of the Prime Meridian of the cell |
| Height | INT*2 | Meters | -100 to 21336 | 1 | Height above sea level of the cell |
| AVG Radial Velocity | INT*2 | Meters/ Second | -127 to +126 | 0.01 | Mean radial velocity for the cell |
| Standard Dev. of Ave. Radial Velocity | INT*2 | Meters/ Second | 0 to 255 | 1 | Standard deviation of mean velocity |
| Time Deviation | INT*2 | Seconds | -5400 to +5400 | 1 | Deviation from Base Time of the average time of all velocity samples in the SuperOb cell |
| Azimuth Average | INT*2 (Note 1) | Degrees | 0 to 359 | 0.01 | Average azimuth angle of all velocity samples in the SuperOb cell. |

Note 1: The Azimuth Average is an unsigned 16-bit value.

**Figure 3-15b. SuperOb Wind Data Packet -- Packet Code 27 (Sheet 2)**

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| | |
|---|---|
| | PACKET CODE (=28, 29) |
| | RESERVED (=0) |
| GENERIC | LENGTH OF DATA (BYTES) (MSHW) |
| DATA | LENGTH OF DATA (BYTES) (LSHW) |
| PACKET | START OF SERIALIZED DATA |
| | SERIALIZED DATA HALFWORD 1 |
| | •<br>• |
| | SERIALIZED DATA HALFWORD N |

| FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Packet Code | INT*2 | N/A | 28 or 29 | N/A | Packet Type 28 or Packet Type 29 |
| Reserved | INT*2 | N/A | 0 | N/A | See Note 1 |
| Length of Serialized Data (MSHW) | INT*2 | Bytes | 0 to maximum 2-byte integer value | 1 | Number of bytes to follow in this packet (most significant halfword). |
| Length of Serialized Data (LSHW) | INT*2 | Bytes | 0 to maximum 2-byte integer value | 1 | Number of bytes to follow in this packet (least significant halfword). |
| Serialized Data | N/A | N/A | N/A | N/A | Serialized data returned from Generic Data Packet serializing function. See Note 2. |

Note 1: Reserved for future use. Should be set to 0.
Note 2: The serialized data is encoded using External Data Representation (XDR). The XDR Standard is defined in Request For Comments (RFC) 1832. The deserialized data format is defined by Generic Product Format described in Appendix E.

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**Figure 3-15c Generic Data Packet - Packet Codes 28 and 29 (Sheet 1)**

MSB HALFWORD LSB

| MESSAGE HEADER BLOCK |
|---|

| | | |
|---|---|---|
| | | (see Figure 3-3) |
| | | PRODUCT DESCRIPTION BLOCK (see sheets 2, 6, & 7 of Figure 3-6) |
| | | BLOCK DIVIDER (-1) |
| | | NUMBER OF PAGES |
| REPEAT FOR EACH PAGE | REPEAT FOR EACH LINE | NUMBER OF CHARACTERS |
| | | CHARACTER DATA |
| | | END OF PAGE FLAG (-1) |

| FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Block Divider | INT*2 | N/A | -1 | N/A | Integer value of -1, used to delineate this block from the header |
| Number of Pages | INT*2 | N/A | 1 to 48 | 1 | Total number of page |
| Number of Characters | INT*2 | N/A | 0 to 80 | 1 | Number of characters in line |
| Character Data to N | Char | 8 bit ASCII | ASCII Character Set | N/A | Characters are ASCII |
| End of Page Flag | INT*2 | N/A | -1 | N/A | Integer value of -1, to delineate end of page |

**Figure 3-16. Stand-Alone Tabular Alphanumeric Product Message**

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**Table IX. Product Dependent Definition for Stand-Alone Tabular Alphanumeric Block**

| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| STORM STRUCTURE | Radar ID | N/A | 0 to 999 | N/A | |
| | Volume Scan Start Date | N/A | Months: 1 to 12<br>Days: 1 to 31<br>Years: 0 to 99 | N/A | |
| | Volume Scan Start Time | N/A | Hours: 0 to 23<br>Minutes: 0 to 59<br>Seconds: 0 to 59 | N/A | |
| | Number of Storms Cells | N/A | 0 to 100 | 1 | |
| | Storm Cell ID | Alphanumeric | A0 through Z0, then A1 through Z1, then A2 ...Z9 | N/A | The sequence is recycled following Z9 Note 1 |
| | Storm Positions:<br>· Azimuth<br>· Range | • Degrees<br>• nmi | • 0 to 360<br>• 0 to 248 | • 1<br>• 1 | Note 1 |
| | Storm Base | Kft | 0.0 to 70.0 | 0.1 | If the storm base was identified at the lowest elevation, the value is qualified with "<". Note 1 |
| | Storm Top | Kft | 0.0 to 70.0 | 0.1 | If the storm top was identified at the highest elevation, the value is qualified with ">". Note 1 |
| | Cell Based VIL | $kg/m^2$ | 0 to 120 | 1 | Note 1 |
| | Maximum Reflectivity | dBZ | 0 to 95 | 1 | Note 1 |
| | Height of Maximum Reflectivity | Kft | 0.0 to 70.0 | 0.1 | Note 1 |
| | Site Adaptable Parameters | See Remarks | See Remarks | See Remarks | See Table LXVIII, Site Adaptation Data in Radar Product Generation Program, 2820003, Pt1. |
| USER ALERT MESSAGE | Radar ID | N/A | 0 to 999 | N/A | |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| | Volume Scan Start Date | N/A | Months: 1 to 12<br>Days: 1 to 31<br>Years: 0 to 99 | N/A | |
| | Volume Scan Start Time | N/A | Hours: 0 to 23<br>Minutes: 0 to 59<br>Seconds: 0 to 59 | N/A | |
| | Alert Area | N/A | 1 or 2 | 1 | |
| | Position:<br>· Azimuth<br>· Range | <br>Degrees<br>nmi | <br>0.0 to 359.9<br>0.0 to 250.0 | <br>0.1<br>0.1 | Position is the alert grid box center for grid based alerts, feature base center for mesocyclone and TVS alerts, not applicable for VAD and 1 HR rainfall alerts, and Storm cell centroid for all other alerts. |
| | Alert Category | N/A | See Table IV | 1 | |
| | Alert Threshold | See Remarks | See Remarks | See Remarks | See Table LXVIII, Site Adaptation Data in Radar Product Generation Program, 2820003, Pt1 |
| | Exceeding Value | See Remarks | See Remarks | See Remarks | See Table LXVIII, Site Adaptation Data in Radar Product Generation Program, 2820003, Pt1 |
| | Storm Cell ID | Alphanumeric | A0 through Z0, then A1 through Z1, then A2....Z9 | N/A | Storm ID sequence is recycled following Z9 |
| | Forecast Movement<br>· Direction<br>· Speed | <br>Degrees<br>Kts | " " or<br>0 to 360<br>0 to 999 | <br>1<br>1 | " " indicates that the information is unavailable since alert is not |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| | | | | | related to a storm ID. |
| FREE TEXT MESSAGE | Message Text | ASCII | All ASCII Characters | N/A | |
| PUP TEXT MESSAGE | Message Text | ASCII | All ASCII Characters | N/A | |
| SUPPLEMENTAL PRECIPITATION DATA | Radar ID | N/A | 0 to 999 | N/A | |
| | Average Scan Date | N/A | Months: 1 to 12<br>Days: 1 to 31<br>Years: 0 to 99 | N/A | |
| | Average Scan Time | N/A | Hours: 0 to 23<br>Minutes: 0 to 59 | N/A | |
| | No. Blockage Bins Rejected | N/A | 0 to 99999 | 1 | |
| | No. Clutter Bins Rejected | N/A | 0 to 99999 | 1 | |
| | No. Bins Smoothed | N/A | 0 to 99999 | 1 | |
| | Percent Hybrid Scan Filled | % | 90.00 to 100.00 | 0.01 | |
| | Highest Elev. Angle used in Hybrid Scan | Deg | 0.50 to 19.50 | 0.01 | |
| | Hybrid Scan Rain Area | Km**2 | 0.0 to 999999.9 | 0.1 | |
| | Mean-field Bias Estimate | N/A | .01 to 99.99 | .01 | |
| | Effective # Gage-Radar Pairs (Sample Size) | N/A | 0.00 to 9999.99 | .01 | |
| | Memory Span used in Bias Estimate | Hours | .001 to 10**7 | .001 | |
| | Bias Applied Flag | Alphanumeric | Yes or No | N/A | |
| | Begin Missing Period Date | N/A | Months: 1 to 12<br>Days: 1 to 31<br>Years: 0 to 99 | N/A | |
| | Begin Missing Period Time | N/A | Hours: 0 to 23<br>Minutes: 0 to 59 | N/A | |
| | End Missing Period Date | N/A | Months: 1 to 12<br>Days: 1 to 31<br>Years: 0 to 99 | N/A | |
| | End Missing Period Time | N/A | Hours: 0 to 23<br>Minutes: 0 to 59 | N/A | |
| | Volume Coverage Pattern | N/A | 1 to 1000 | | |

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| PRODUCT NAME | CONTENT | UNITS | RANGE | ACCURACY / PRECISION | REMARKS |
|---|---|---|---|---|---|
| | Operational (Weather) Mode | N/A | A, B or M | N/A | |
| | Average Scan Date (Last Bias Update) | N/A | Months: 1 to 12<br>Days: 1 to 31<br>Years: 0 to 99 | N/A | |
| | Average Scan Time (Last Bias Update) | N/A | Hours: 0 to 23<br>Minutes: 0 to 59 | N/A | |
| | Memory Span, per evaluation timespan | Hours | 0.001 to 10**7 | .001 | |
| | Effective # Gage-Radar Pairs, per evaluation timespan | N/A | 0.000 to 9999.999 | .001 | |
| | Average Gage Value, per evaluation timespan | mm | 0.000 to 99.999 | .001 | |
| | Average Radar Value, per evaluation timespan | mm | 0.000 to 99.999 | .001 | |
| | Mean-field Bias Estimate, per evaluation timespan | N/A | 0.001 to 99.999 | .001 | |

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| | MSB HALFWORD LSB |
|---|---|
| | MESSAGE HEADER BLOCK<br>(see Figure 3-3) |
| GENERAL 10<br>STATUS<br>BLOCK | (-1) BLOCK DIVIDER |
| 11 | LENGTH OF BLOCK |
| 12 | MODE OF OPERATION |
| 13 | RDA OPERABILITY STATUS |
| 14 | VOLUME COVERAGE PATTERN |
| 15 | NUMBER OF ELEVATION CUTS |
| 16 | ELEVATION 1 |
| 17 | ELEVATION 2 |
| . | . |
| • | • |
| 35 | ELEVATION 20 |
| 36 | RDA STATUS |
| 37 | RDA ALARMS |
| 38 | DATA TRANSMISSION ENABLE |
| 39 | RPG OPERABILITY STATUS |
| 40 | RPG ALARMS |
| 41 | RPG STATUS |
| 42 | RPG NARROWBAND STATUS |
| 43 | REFLECT. CALIB. CORR. |
| 44 | PRODUCT AVAILABILITY |
| 45 | SUPER RESOLUTION CUTS |
| 46 | CLUTTER MITIGATION DECISION STATUS |
| 47 | SPARE |
| 48 | RDA BUILD NUMBER |
| 49 | RDA CHANNEL NUMBER |
| 50 | RESERVED |
| 51 | RESERVED |
| 52 | BUILD VERSION |

**Figure 3-17. General Status Message (Sheet 1)**

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| HALFWORD | FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|---|
| 10 | Block Divider | INT*2 | N/A | -1 | N/A | Integer -1, block divider |
| | | | | | | |
| 11 | Length of Block | INT*2 | Bytes | 82 | 1 | Number of bytes to follow |
| | | | | | | |
| 12 | Mode of Operation | INT*2 | N/A | 0 to 2 | N/A | Where:<br><br>0 = Maintenance Mode<br>1 = Clear Air Mode<br>2 = Precipitation/Severe Weather Mode |
| | | | | | | |
| 13 | RDA Operability Status | Integer | N/A | 0,1/Bit | Bit 15=LSB | Where: |
| | | | | | Bit 15=1 | Automatic Calibration Disabled |
| | | | | | Bit 14=1 | Online |
| | | | | | Bit 13=1 | Maintenance Action Required |
| | | | | | Bit 12=1 | Maintenance Action Mandatory |
| | | | | | Bit 11=1 | Commanded Shutdown |
| | | | | | Bit 10=1 | Inoperable |
| | | | | | Bit 9 | Spare |
| | | | | | Bit 8=1 | Wideband Disconnect |
| | | | | | Bits 7-0 | Spare |
| | | | | | Bits 15-10, 8=0 | Indeterminate: if all bits are zero, then the RPG determines the status |
| | | | | | | |
| 14 | Volume Coverage Pattern | INT*2 | N/A | 1 to 767 | 1 | RDA Volume Coverage Pattern for the scan strategy being used |
| | | | | | | |
| 15 | Number of Elevation Cuts | INT*2 | N/A | 1 to 20 | 1 | Maximum elevation cuts = 20 |

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| HALFWORD | FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|---|
| | | | | | | |
| 16<br>.<br>.<br>. | Elevation 1 | Scaled Integer | Degrees | -1.0 to +45.0 | .1 | Elevation angle elevation 1 |
| | | | | | | |
| 35 | Elevation 20 | Scaled Integer | Degrees | -1.0 +45.0 | .1 | Elevation angle for elevation 20. NOTE: If the number of elevation cuts N, is less than 20, then elevations N+1 through 20 are zeros |
| | | | | | | |
| 36 | RDA Status | Integer | N/A | 0,1/Bit | Bit 15=LSB | Where: |
| | | | | | Bit 15 | Spare |
| | | | | | Bit 14=1 | Startup |
| | | | | | Bit 13=1 | Standby |
| | | | | | Bit 12=1 | Restart |
| | | | | | Bit 11=1 | Operate |
| | | | | | Bit 10=1 | Spare |
| | | | | | Bit 9=1 | Off-line Operate |
| | | | | | Bit 8-0 | Spares |
| | | | | | Bits 14-9=0 | Indeterminate; if all bits are zero, then the RPG cannot determine the status |
| | | | | | | |
| 37 | RDA Alarms | Integer | N/A | 0,1/Bit, Note 1 | Bit 15=LSB | Where: |
| | | | | | Bit 15=1 | Indeterminate; the RPG cannot determine the alarms present |
| | | | | | Bit 14=1 | Tower/Utilities |
| | | | | | Bit 13=1 | Pedestal |
| | | | | | Bit 12=1 | Transmitter |
| | | | | | Bit 11=1 | Receiver/Signal Processor |
| | | | | | Bit 10=1 | RDA Control |
| | | | | | Bit 9=1 | RDA Communications |
| | | | | | Bit 8=1 | Spare |
| | | | | | Bit 7=1 | Spare |
| | | | | | Bits 6-0 | Spares |
| | | | | | Bits 15-7=0 | No Alarms; if all bits are zero, then there are no alarms present |

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| HALFWORD | FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|---|
| | | | | | | |
| 38 | Data Transmission Enabled | Integer | N/A | 0,1/Bit | Bit 15=LSB | Where: |
| | | | | | Bit 15=1 | Spare |
| | | | | | Bit 14=1 | None |
| | | | | | Bit 13=1 | Reflectivity |
| | | | | | Bit 12=1 | Velocity |
| | | | | | Bit 11=1 | Spectrum Width |
| | | | | | Bit 10=1 | Dual Pol Data Expected |
| | | | | | Bits 9-0 | Spares |
| | | | | | | |
| 39 | RPG Operability Status | Integer | N/A | 0,1/Bit | Bit 15=LSB | Where: |
| | | | | | Bit 15=1 | Loadshed |
| | | | | | Bit 14=1 | On-line |
| | | | | | Bit 13=1 | Maintenance Action Required |
| | | | | | Bit 12=1 | Maintenance Action Mandatory |
| | | | | | Bit 11=1 | Commanded Shutdown |
| | | | | | Bits 10 to 0 | Spares |
| | | | | | | |
| 40 | RPG Alarms | Integer | | N/A | Bit 15=LSB | Where: |
| | | | | | Bit 15=1 | No Alarms |
| | | | | | Bit 14=1 | Node Connectivity |
| | | | | | Bit 13=1 | Spare |
| | | | | | Bit 12=1 | RPG Control Task Failure |
| | | | | | Bit 11=1 | Data Base Failure |
| | | | | | Bit 10=1 | Spare |
| | | | | | Bit 9=1 | RPG Input Buffer Loadshed (Wideband) |
| | | | | | Bit 8=1 | Spare |
| | | | | | Bit 7=1 | Product Storage Loadshed |
| | | | | | Bit 6=1 | Spare |
| | | | | | Bit 5=1 | Spare |
| | | | | | Bit 4=1 | Spare |
| | | | | | Bit 3=1 | RPG/RPG Intercomputer Link Failure |
| | | | | | Bit 2=1 | Redundant Channel Error |
| | | | | | Bit 1=1 | Task Failure |
| | | | | | Bit 0=1 | Media Failure |

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| HALFWORD | FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|---|
| | | | | | | |
| 41 | RPG Status | Integer | N/A | 0,1/Bit | Bit 15=LSB | Where: |
| | | | | | Bit 15=1 | Restart |
| | | | | | Bit 14=1 | Operate |
| | | | | | Bit 13=1 | Standby |
| | | | | | Bit 12=1 | Spare |
| | | | | | Bit 11=1 | Test Mode |
| | | | | | Bit 10-0 | Spares |
| | | | | | | |
| 42 | RPG Narrowband Status | Integer | N/A | 0,1/Bit | Bit 15=LSB | Where: |
| | | | | | Bit 15=1 | Commanded Disconnect |
| | | | | | Bit 14=1 | Narrowband Loadshed |
| | | | | | Bit 13-0 | Spares |
| | | | | | | |
| 43 | Horizontal Channel Reflectivity Calibration Correction | Fixed Point, Scaled Integer | dB/4 | -792 to +792 (-198 dB to +198 dB) | .25/ 1 | Reflectivity Calibration Correction (difference from adaptation data) |
| | | | | | | |
| 44 | Product Availability | Integer | N/A | 0,1/Bit | Bit 15=LSB | Where: |
| | | | | | Bit 15=1 | Product Availability |
| | | | | | Bit 14=1 | Degraded Availability |
| | | | | | Bit 13=1 | Not Available |
| | | | | | | |
| 45 | Super Resolution Elevation Cuts | Integer | N/A | 0,1/Bit | Bit 15 = LSB Bit 15 = Elev 1 | Bit field indicating which elevation cuts have super resolution enabled. |
| | | | | | | |
| 46 | Clutter Mitigation Decision Status | Integer | N/A | 0,1/Bit | Bit 15 = LSB | Where: |
| | | | | | Bit 15 = 0 | Disabled |
| | | | | | Bit 15 = 1 | Enabled |
| | | | | | Bits 14-10 | Bit field indicating which elevation segments have Clutter Mitigation Decision enabled. |

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| HALFWORD | FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|---|
| | | | | | | |
| 47 | Vertical Channel Reflectivity Calibration Correction | Fixed Point, Scaled Integer | dB/4 | -792 to + 792 (-198 dB to + 198 dB) | .25/1 | Reflectivity Calibration Correction (difference from adaptation data) |
| | | | | | | |
| 48 | RDA Build Number | Fixed Point, Scaled Integer | N/A | 0 to 999, Note 2 | N/A | RDA major and minor build version information |
| | | | | | | |
| 49 | RDA Channel Number | Integer | N/A | 0,1,2 | N/A | 0 = NWS single thread<br>1 = RDA 1<br>2 = RDA 2<br>for NWS redundant or FAA redundant |
| | | | | | | |
| 50-51 | Reserved | | | | | Halfword 50 & 51 are applicable to dial-up (Class II, Class IV, and Class V [RFC]) user only |
| | | | | | | |
| 52 | Build Version | Scaled Integer | N/A | 10 to 32767 | | RPG Build Version |

Note 1: RDA Alarms reflect the controlling channel.
Note 2: For Legacy RDA systems, this value will be 0. For Open RDA systems, the Build Version format is XX.Y where XX indicates the major build version and Y indicates the minor build version. This information is stored in scaled integer format. For example, Build 7.0 equals a value of 70. Build 99.9 equals a value of 999.

**Figure 3-17. General Status Message (Sheet 2)**

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| | MSB HALFWORD LSB |
|---|---|
| | MESSAGE HEADER BLOCK (see Figure 3-3) |
| 10 | BLOCK DIVIDER (-1) |
| REQUEST 11 RESPONSE BLOCK | LENGTH OF BLOCK |
| 12 | ERROR CODE (MSW) |
| 13 | (LSW) |
| 14 | SEQUENCE NUMBER |
| 15 | PRODUCT/MESSAGE CODE |
| 16 | ELEVATION ANGLE |
| 17 | VOLUME SCAN DATE |
| 18-19 | VOLUME SCAN START TIME |
| 20-24 | SPARES (7 HALFWORDS) |

**Figure 3-18. Request Response Message (Sheet 1)**

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| HALFWORD | FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|---|
| 10 | Block Divider | INT*2 | N/A | -1 | N/A | Integer -1, Block Divider |
| 11 | Length of Block | INT*2 | Bytes | 26 | 1 | Number of bytes to follow |
| 12-13 | Error Code | Integer | N/A | 0,1/Bit | Bit 31=LSB | Where: |
| | | | | | Bit 0=1 | No Such Message Code |
| | | | | | Bit 1=1 | No Such Product Code |
| | | | | | Bit 2=1 | Product Not Generated (Not Available in Data Base) |
| | | | | | Bit 3=1 | One-Time Request Generation Process Faulted |
| | | | | | Bit 4=1 | Narrowband Loadshed |
| | | | | | Bit 5=1 | Illegal Request |
| | | | | | Bit 6=1 | RPG Memory Loadshed |
| | | | | | Bit 7=1 | RPG CPU Loadshed (Note 1) |
| | | | | | Bit 8=1 | Unavailability of Slots (Real-Time, Replay or Customized) |
| | | | | | Bit 9=1 | Failure (Task Failed) |
| | | | | | Bit 10=1 | Unavailable (Task Not Loaded Upon Startup) |
| | | | | | Bit 11=1 | Available Next Volume Scan |
| | | | | | Bit 12=1 | Moment Disabled |
| | | | | | Bit 13 | Bit 13 is Reserved and Not Applicable to Associated PUPS |
| | | | | | Bit 14 | Spare |
| | | | | | Bit 15 | Aborted Volume Scan (Note 2) |
| | | | | | Bit 16 | Invalid Product Parameters |
| | | | | | Bit 17 | Product Not Generated (Data Sequence Error) Note |

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| HALFWORD | FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|---|
| | | | | | | 3 |
| | | | | | Bit 18 | Task Failure (Self-Terminated) |
| | | | | | Bits 19-31 | Spares |
| 14 | Sequence Number | INT*2 | N/A | -13, 0 to 32767 | 1 | Sequence number of request that caused response |
| 15 | Product/Message Code | INT*2 | N/A | -16 to -299, 16 to 299 | N/A | Product/Message code as defined in Table II, that caused response |
| 16 | Elevation Angle | Scaled Integer | Degrees | -1.0 to +45.0 | .1 | Elevation angle of radar for requested product |
| 17 | Volume Scan Date | INT*2 | Julian Date | 1 to 32767 | 1 | Modified Julian Date; integer number of days since Jan. 1, 1970 |
| 18-19 | Volume Scan Start Time | INT*4 | Seconds GMT | 0 to 86399 | 1 | Number of seconds after midnight, Greenwich Mean Time (GMT) |
| 20-24 | Spares | | | | | |

Note 1: The RPG has not implemented the CPU Loadshed functionality that will generate an alarm.
Note 2: The following conditions will cause ABORTED VOLUME SCAN: Commanded VCP Restart (either via operator command or Mode Deselection) or Unexpected Start of Volume Scan.
Note 3: Product Not Generated (Data Sequence Error) is caused when VCP number changes unexpectedly, Azimuth Tolerance Exceeded in the initial elevation cut of volume, RDA Elevation Number Changes Unexpectedly, or Start of Elevation Y Expected, But Start Of Elevation received. In addition, any sequence error encountered during task processing …e.g. the task is not processing radial messages fast enough and its input buffers are lost at the expense of new input buffers.

**Figure 3-18. Request Response Message (Sheet 2)**

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| | MSB HALFWORD LSB | |
|---|---|---|
| | MESSAGE HEADER BLOCK (see Figure 3-3) | |
| 10 | BLOCK DIVIDER (-1) | |
| 11 | ALERT STATUS | |
| 12 | ALERT AREA NUMBER | |
| 13 | ALERT CATEGORY | |
| 14 | THRESHOLD CODE | |
| 15 | THRESHOLD VALUE (MSW) | |
| 16 | THRESHOLD VALUE (LSW) | |
| 17 | EXCEEDING VALUE (MSW) | |
| 18 | EXCEEDING VALUE (LSW) | |
| 19 | GRID BOX AZIMUTH | |
| 20 | GRID BOX RANGE | |
| 21 | STORM CELL ID C1 | STORM CELL ID C2 |
| 22 | VOLUME SCAN NUMBER | |
| 23 | VOLUME SCAN DATE | |
| 24 | VOLUME SCAN START TIME (MSW) | |
| 25 | VOLUME SCAN START TIME (LSW) | |

**Figure 3-19. Alert Message (Sheet 1)**

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| HALF WORD | FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|---|
| 10 | Block Divider | INT*2 | N/A | -1 | N/A | Integer value of -1, used to delineate the header from the Alert Message Block |
| 11 | Alert Status | INT*2 | N/A | 1 to 2 | N/A | 1 = First Time Alert<br>2 = Alert Ended |
| 12 | Alert Area Number | INT*2 | N/A | 1 to 2 | N/A | Area number of alert as defined per user |
| 13 | Alert Category | INT*2 | N/A | 1 to 41 | N/A | Alert category number as defined by Table IV |
| 14 | Threshold Code | INT*2 | N/A | 1 to 6 | N/A | Parameter dependent threshold code that triggers alert (Refer to Table IV) |
| 15-16 | Threshold Value | INT*4 | - | - | - | Parameter dependent data value corresponding to the user defined threshold code (Refer to Table LXVIII in 2820003, Pt1) |
| 17-18 | Exceeding Value | INT*4 | - | - | - | Parameter dependent data value (maximum detected) which triggered the alert (Refer to Table LXVIII in 2820003, Pt1) |
| 19 | Grid Box Azimuth | Scaled Integer | Degrees | 0.0 to 359.9 | .1 | Identifies the location of the grid box that triggered the alert. This halfword has no meaning for a cancelled alert. |
| 20 | Grid Box Range | Scaled Integer | Nmi | 0.0 to 186.0 | .1 | Identifies the location of the grid box that triggered the alert. This halfword has no meaning for a canceled alert. |
| 21 | Storm ID C1 | Char | 8-bit ASCII | A to Z, blank | N/A | First character of Storm Cell ID associated with alert, when applicable (A-Z) |
| 21 | Storm ID C2 | Char | 8-bit ASCII | 0 to 9, blank | N/A | Second character of Storm Cell ID |
| 22 | Volume Scan Number | INT*2 | N/A | 1 to 80 | 1 | Identifies the volume scan when alert was triggered |
| 23 | Volume Scan Date | INT*2 | Julian Date | 1 to 32767 | 1 | Identifies the volume scan date when the |

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| HALF WORD | FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|---|
| | | | | | | alert was triggered or canceled. (Modified Julian Date: integer number of days since Jan 1970.) |
| 24-25 | Volume Scan Time | INT*4 | Seconds GMT | 0 to 86399 | 1 | Identifies the volume scan when the alert was time triggered or canceled. (Number of seconds after midnight, Greenwich Mean Time (GMT).) |

**Figure 3-19. Alert Message (Sheet 2)**

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| MSB | HALFWORD LSB |
|---|---|
| | MESSAGE HEADER BLOCK (see Figure 3-3) |
| 10 | BLOCK DIVIDER (-1) |
| 11 | LENGTH OF BLOCK |
| REPEAT FOR 12 | ALERT GROUP |
| EACH ALERT 13 | ALERT CATEGORY |
| CATEGORY 14 | NUMBER OF ALLOWABLE THRESHOLDS |
| (MAX = 41) 15 | THRESHOLD 1 |
| . | . |
| • | • |
| • | • |
| 20 | THRESHOLD 6 |
| 21 | PRODUCT ID |

**Figure 3-20. Alert Adaptation Parameters Message (Sheet 1)**

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| HALF WORD | FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|---|
| 10 | Block Divider | INT*2 | N/A | -1 | N/A | Integer value of -1, used to delineate the header from the Alert Adaptation Data Parameters |
| 11 | Length of Block | INT*2 | Bytes | 820 | 1 | Number of bytes to follow from -1 divider to end of block |
| 12 | Alert Group | INT*2 | N/A | 0 to 3 | 1 | 1 = Grid Group<br>2 = Volume Group<br>3 = Forecast Group |
| 13 | Alert Category | INT*2 | N/A | 0 to 41 | 1 | Alert category number as defined by Table IV |
| 14 | Number of Allowable Thresholds | INT*2 | N/A | 0 to 6 | 1 | Parameter dependent threshold code that triggers alert (refer to Table IV) |
| 15-20 | Threshold Value | INT*2 | - | - | - | Parameter dependent data value corresponding to the user defined threshold code (refer to Table LVIII in 2820003, Pt1) |
| 21 | Product Code | INT*2 | N/A | 0, 16 to 299 | 1 | Product Code as defined in Table III for product alert pairing, with the following exceptions:<br><br>Product Code of 91 corresponds to SWR(43), SWV(44), SWW(45), and SWS(46);<br><br>Product code of 92 corresponds to SWR(43), SRR(55), SWW(45), and SWS(46). |

NOTE: The RPG transmits the Alert Adaptation Parameters Message upon Narrowband link connection, or if any changes are mad to either Product Alert Pairing or Alert Thresholds. Zero in range denotes spares.

**Figure 3-20. Alert Adaptation Parameters Message (Sheet 2)**

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| MSB | HALFWORD LSB | |
|---|---|---|
| | MESSAGE HEADER BLOCK (see Figure 3-3) | |
| PRODUCT LIST MESSAGE BLOCK 10 | (-1) BLOCK DIVIDER | |
| 11 | LENGTH OF BLOCK | |
| 12 | NUMBER OF PRODUCTS | |
| 13 | RESERVED | |
| REPEAT FOR EACH PRODUCT 14 | PRODUCT CODE | |
| 15 | ELEVATION | PRODUCT DEPENDENT (SEE TABLE X) |
| 16 | PARAMETER 1 | |
| 17 | PARAMETER 2 | |
| 18 | PARAMETER 3 | |
| 19 | PARAMETER 4 | |
| 20 | DISTRIBUTION CLASS | |

**Figure 3-21. Product List Message (Sheet 1)**

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| HALF WORD | FIELDNAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|---|
| 10 | Block Divider | INT*2 | N/A | -1 | N/A | Integer -1, block divider |
| 11 | Length of Block | INT*2 | Bytes | 4 to 8408 | 1 | Number of bytes in block from -1 divider to end of the block. |
| 12 | Number of Products | INT*2 | N/A | 0 to 600 | 1 | Number of Products on list |
| 13 | Reserved | - | - | - | - | Reserved for dial-up users |
| 14 | Product Code | INT*2 | N/A | 16 to 299 | 1 | Internal NEXRAD product code from Table III |
| 15 | Elevation | Scaled Integer | Degrees | -1.0 to +45.0 | .1 | Elevation of product |
| 16 | Parameter 1 | - | - | - | - | Product dependent (Refer to Table X) |
| 17 | Parameter 2 | - | - | - | - | Product dependent (Refer to Table X) |
| 18 | Parameter 3 | - | - | - | - | Product dependent (Refer to Table X) |
| 19 | Parameter 4 | - | - | - | - | Product dependent (Refer to Table X) |
| 20 | Distribution Class | INT*2 | N/A | 0 to 20 | 1 | Distribution class for individual products:<br>0 = Available for one-time product request<br>1 = Repeat every volume scan<br>2 = Repeat every other volume scan<br>9<br>9<br>20 = Repeat every 20th volume scan |

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**Figure 3-21. Product List Message (Sheet 2)**

**Table X. Product List Message Parameter Definition**

| Product Name (see Note 1) | Message Code | Slice | Parameter 1 (see Note 2) | Parameter 2 (see Note 2) | Parameter 3 (see Note 2) | Parameter 4 (see Note 2) |
|---|---|---|---|---|---|---|
| Base Products | 16-30 | Elevation | N/A | N/A | N/A | N/A |
| User Selectable Layer Reflectivity | 137 | N/A | Bottom Altitude of Layer | Top Altitude of Layer | N/A | N/A |
| Cross Section | 50, 51, 85, 86 | N/A | Azimuth of Point 1 | Range of Point 1 | Azimuth of Point 2 | Range of Point 2 |
| Storm Relative Mean Radial Velocity Region | 55 | Elevation | Azimuth of Window Center | Range of Window Center | Storm Speed | Storm Direction |
| Storm Relative Mean Radial Velocity Map | 56 | Elevation | N/A | N/A | Storm Speed | Storm Direction |
| Velocity Azimuth Display | 84 | Altitude | N/A | N/A | N/A | N/A |
| Mesocyclone Rapid Update | 139 | Elevation | N/A | N/A | N/A | N/A |
| Tornado Vortex Signature Rapid Update (TRU) | 143 | Elevation | N/A | N/A | N/A | N/A |
| User Selectable Snow Water Equivalent and User Selectable Snow Depth | 150, 151 | N/A | End Hour | Time Span | N/A | N/A |
| Differential Reflectivity | 158-159 | Elevation | N/A | N/A | N/A | N/A |
| Correlation Coefficient | 160-161 | Elevation | N/A | N/A | N/A | N/A |
| Specific Differential Phase | 162-163 | Elevation | N/A | N/A | N/A | N/A |
| Hydrometeor Classification | 164-165 | Elevation | N/A | N/A | N/A | N/A |
| Melting Layer | 166 | Elevation | N/A | N/A | N/A | N/A |
| Digital User Selectable Accumulation | 173 | N/A | End Time | Time Span | N/A | N/A |

Note l: The units, range and accuracy/precision for the above parameters are identical to the parameters listed in Table II- -A.
Products that are completely defined by (message) product code (Slice and Parameters 1- -4 are N/A) are as follows: 32-- 41, 47, 48, 57- -75, 78-- 83 and 87-- 90.
Note 2: For Parameters 1-4, if parameter is N/A, the value is undefined.

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**THE RADAR CODED MESSAGE**

| MSB HALFWORD LSB | |
|---|---|
| MESSAGE HEADER BLOCK (see Figure 3-3) | MESSAGE CODE = 74 |
| PRODUCT DESCRIPTION BLOCK (Figure 3-6, Sheets 2, 6, & 7) | |
| RADAR CODED MESSAGE HEADER (see Appendix B) | BLOCK 3,TABULAR ALPHANUMERIC BLOCK |
| RADAR ENCODED MESSAGE DATA BLOCK | |

**Figure 3-22. Radar Coded Message**

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| MSB HALFWORD LSB | |
|---|---|
| Message Header Block (See Figure 3-3) | |
| Block Divider (-1) | |
| Block ID | |
| Spare | |
| Compression Type | |
| Decompressed Size (MSW) | |
| Decompressed Size (LSW) | |
| Data Packets | See Figures 3-7 through 3-15c |

| Field Name | Type | Units | Range | Accuracy/Precision | Remarks |
|---|---|---|---|---|---|
| Block Divider | INT*2 | N/A | -1 | N/A | Integer value of -1 used to delineate this block from the Message Header block |
| Block ID | INT*2 | N/A | 4 | N/A | Value of 4 indicates Environmental Data from 40-km RUC Model. See Note 1. |
| Spare | INT*2 | N/A | N/A | N/A | Spare |
| Compression Type | INT*2 | N/A | 0 to 2 | 1 | 0 = No compression, 1 = bzip2, 2 = zlib |
| Decompressed Size | INT*4 | Bytes | 0 to 2147483647 | 1/1 | Size of decompressed data packets. |

Note 1. For messages containing data from a source external to RPG (as indicated by Message Code 5 in Message Header), Block ID indicates specific type of External Data.

**Figure 3-23. External Data Message**

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| | MSB HALFWORD LSB |
|---|---|
| | Message Header Block (See Figure 3-3) |
| | Block Divider (-1) |
| | Block ID (1) |
| | Version Number |
| | Block Length |
| | AWIPS Site ID (MSW) |
| | AWIPS Site ID (LSW) |
| | Radar ID (MSW) |
| | Radar ID (LSW) |
| | Observation Time: Year |
| | Observation Time: Month |
| | Observation Time: Day |
| | Observation Time: Hour |
| | Observation Time: Minute |
| | Observation Time: Second |
| | Generation Time: Year |
| | Generation Time: Month |
| | Generation Time: Day |
| | Generation Time: Hour |
| | Generation Time: Minute |
| | Generation Time: Second |
| | No. Rows (in Bias Table) |
| | Bias Table Row n: Memory Span (MSW) |
| REPEAT | Bias Table Row n: Memory Span (LSW) |
| | Bias Table Row n: No. G-R Pairs (MSW) |
| FOR | Bias Table Row n: No. G-R Pairs (LSW) |
| | Bias Table Row n: Avg. Gage (MSW) |
| EACH | Bias Table Row n: Avg. Gage (LSW) |
| | Bias Table Row n: Avg. Radar (MSW) |
| ROW | Bias Table Row n: Avg. Radar (LSW) |
| | Bias Table Row n: Mean Field Bias (MSW) |
| (MEMORY SPAN) | Bias Table Row n: Mean Field Bias (LSW) |

**Figure 3-25. Bias Table Message (Sheet 1)**

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| Field Name | Type | Units | Range | Acc/Prec | Remarks |
|---|---|---|---|---|---|
| Block Divider | INT*2 | N/A | -1 | N/A | Integer value of -1 used to delineate this block from the Message Header block |
| Block ID | INT*2 | N/A | 1 | N/A | Value of 1 indicates "Bias Table" type of Environmental Data[1] |
| Version Number | INT*2 | N/A | 0 to 99 | 1 | Initial=0, then 1, 2... |
| Block Length | INT*2 | N/A | 70 to 270 | 1 | Length of block in bytes (from -1 divider to end of block) |
| AWIPS Site ID (MSW)/ AWIPS Site ID (LSW) | CHAR*4 | N/A | N/A | N/A | ID of AWIPS site (RFC or WFO) which originally computed the mean field bias (leading blank +3 chars) |
| Radar ID (MSW) / Radar ID (LSW) | CHAR*4 | N/A | N/A | N/A | ID of destination radar (leading blank +3 chars) |
| Observation Time: Year | INT*2 | N/A | 1970-2099 | 1 | Ending date/time of Gage-Radar accum. period in Bias Table |
| Observation Time: Month | INT*2 | N/A | 1-12 | 1 | " |
| Observation Time: Day | INT*2 | N/A | 1-31 | 1 | " |
| Observation Time: Hour | INT*2 | N/A | 0-23 | 1 | " |
| Observation Time: Minute | INT*2 | N/A | 0-59 | 1 | " |
| Observation Time: Second | INT*2 | N/A | 0-59 | 1 | " |
| Generation Time: Year | INT*2 | N/A | 1970-2099 | 1 | Date/time of generation of Bias Table (will be later than Obs.time) |
| Generation Time: Month | INT*2 | N/A | 1-12 | 1 | " |
| Generation Time: Day | INT*2 | N/A | 1-31 | 1 | " |
| Generation Time: Hour | INT*2 | N/A | 0-23 | 1 | " |
| Generation Time: Minute | INT*2 | N/A | 0-59 | 1 | " |
| Generation Time: Second | INT*2 | N/A | 0-59 | 1 | " |
| No. Rows (in Table) | INT*2 | N/A | 2-12 | 1 | No. Memory Spans evaluated (default: 10) |
| Memory Span (MSW) / | Log, then Scaled | Hours | .001 - 1. x 10**7 | .001 | Period of Gage-Radar Analysis |

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| Field Name | Type | Units | Range | Acc/Prec | Remarks |
|---|---|---|---|---|---|
| Memory Span (LSW) | Int[2] | | | | |
| No. G-R Pairs (MSW) / No. G-R Pairs (LSW) | Scaled Integer | N/A | .001 - 1. x 10**5 | .001 | Effective sample size (No. Gage-Radar Pairs) |
| Avg. Gage (MSW) / Avg. Gage (LSW) | Scaled Integer | mm | 0.00-254.00 | .001 | Avg. Hourly Gage Accum. |
| Avg. Radar (MSW) / Avg. Radar (LSW) | Scaled Integer | mm | 0.00-254.00 | .001 | Avg. Hourly Radar Accum. |
| Bias (MSW) / Bias (LSW) | Scaled Integer | N/A | .01-100.00 | .001 | Mean-field Bias (Avg. Gage/Avg. Radar ratio) |

[1] For messages containing Environmental Data from external source to RPG (as indicated by Message Code 15 in Message Header), Message Block ID indicates specific type of Environmental Data.

[2] First take (natural) logarithm, then scale by 1000.

**Figure 3-25. Bias Table Message (Sheet 2)**

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APPENDIX A. GLOSSARY

| **Acronym/ Abbreviation** | **Description** |
|---|---|
| A | Address Sequence |
| ABM | Asynchronous Balanced Mode |
| ACCUM | Accumulation |
| ADAPT | Adaptation |
| ADM | Asynchronous Disconnect Mode |
| ALT | Altitude |
| ANSI | American National Standards Institute |
| ARO | Asynchronous Respond Opportunity |
| ASCII | American Standard Code for Information Interchange |
| AZ | Azimuth |
| BA | Balanced, Asynchronous Balanced Mode (Same as ABM) |
| Beg | Beginning |
| Bit | Binary Digit |
| Block | A related set of bytes containing control information or data. A block is a component of a message. |
| bps | Bits per second |
| C | Control Sequence |
| Cal | Calibration |
| CALIB | Calibration |
| CCITT | Consultative Committee International Telephone and Telegraph |
| Char | Character |
| CKT | Circuit |
| CLIN | Contract Line Item Number |
| CM | Cubic Meters |
| Comp | Composite |
| Const | Constant |
| CPC | Calcomp Pen Command |
| CPCI | Computer Program Configuration Item |
| CPU | Central Processor Unit |
| CRC | Cyclical Redundancy Checking |
| dBZ | Reflectivity, in decibels |
| DCE | Data Circuit-Terminating Equipment |
| deg | Degree |
| Dig | Digital |
| Dir | Direction |
| DISC | Disconnect |
| DM | Disconnected Mode |
| DTE | Data Terminal Equipment |
| EIA | Electronic Industries Association |
| Err | Error |
| Ext | External |
| F or Flag | Flag Sequence |
| FCS | Frame Check Sequence |
| Flg | Flag |

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| Acronym/ Abbreviation | Description |
|---|---|
| Frame | A segment of a bit stream bounded by a uniquely recognizable bit sequence and containing a specified number of bits or bytes of data. |
| FRMR | Frame Reject |
| GFS | General Format Specifier |
| GMT | Greenwich Mean Time |
| Halfword | Two bytes (16 bits) |
| Header | A set of bits or bytes contained in a bounded segment of information which provides a label or control information to the remaining contents of the segment. |
| Hgt | Height |
| Hword | Halfword (16 bits) |
| I | Information |
| I-field | Information field |
| I-frame | Information frame |
| ICD | Interface Control Document |
| ID | Identification |
| IEB | Industrial Electronics Bulletin |
| INT*2 | One halfword of integer data in standard 2' s compliment format |
| INT*4 | One fullword (32 bits) of integer data in standard 2's compliment format |
| Int | Integer |
| Integ | Integrated |
| Integer | Bit stream of 1s and 0s, represented as an integer number, not formatted in 2's compliment format (i.e., 32,768 integer code would represent setting the MSB of a halfword). |
| ISO | International Organization for Standardization |
| ITS | Information Transfer State |
| kg | Kilogram |
| km | Kilometer |
| kfs | Kilofeet |
| kts | Knots |
| LAPB | Link Access Procedure, Balanced |
| LCG | Logical Channel Group |
| LDS | Logically Disconnected State |
| LFM | Limited Fine Mesh |
| Liq | Liquid |
| LSB | Least Significant Bit |
| LSW | Least Significant Word |
| MAX | Maximum |
| Message | The complete set of information transported from the source to the destination. A message may be a product, product request, data, data request, or NEXRAD control information. |
| MSB | Most Significant Bit |
| Msg | Message |
| MSL | Mean Sea Level |
| MSW | Most Significant Word |

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| Acronym/ Abbreviation | Description |
|---|---|
| N(r) | Receive sequence variable |
| N(s) | Send sequence variable |
| NMI | Nautical Mile |
| N/A | Not Applicable |
| NAVAIDS | Navigational Aids |
| Neg | Negative |
| NEXRAD | Next Generation Weather Radar |
| Num | Number |
| NTR | NEXRAD Technical Requirements |
| OP | Operation |
| OS | Operating System |
| OSI | Open Systems Interconnection |
| PDB | Product Description Block |
| Pos | Positive |
| Prec | Precipitation |
| Prob | Probability |
| Product | A collection of information that is self contained and provides a complete representation of a graphical image or an alphanumeric message. |
| PUP | Principal User Processor Group |
| PVC | Permanent Virtual Circuit |
| RAD | Radial |
| RCM | Radar Coded Message |
| RDA | Radar Data Acquisition Group |
| Real*4 | One fullword (32 bits) of real data, where the MSB is the Sign-bit, followed by a 7 bit Exponent and a 24 bit Mantissa |
| Reflect | Reflectivity |
| Reflect.Calib.Corr. | Reflectivity Calibration Correction |
| REJ | Reject |
| RES | Resolution |
| RFC | River Forecast Center |
| RGDAC | Rain Gage Data Acquisition Computer |
| RLE | Run Length Encoded |
| RMS | Root Mean Square |
| RNR | Receiver Not Ready |
| RPG | Radar Product Generation Group |
| RPGOP | Radar Product Generator Operational Position |
| RR | Receiver Ready |
| SABM | Set Asynchronous Balanced Mode |
| Scaled Integer | Integer values with an assumed decimal point whose position is defined by the precision of the item |
| SCN | Specification Change Notice |
| Sec | Second |
| SD | Snow Depth |
| sq | Square |
| Spd | Speed |
| SPR | Software Problem Report |

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| Acronym/ Abbreviation | Description |
|---|---|
| SR | Signaling Rate Selector |
| SW | Spectrum Width |
| SWE | Snow Water Equivalent |
| SWP | Severe Weather Probability |
| TAB | Tabular |
| TM | Test Mode |
| Turb | Turbulence |
| TWA | Two-Way Alternate Transmission |
| TWS | Two-Way Simultaneous Transmission |
| UA | Unnumbered Acknowledgment |
| UCP | Unit Control Position |
| UI | Unnumbered Frame |
| VAD | Velocity Azimuth Display |
| Var | Variation |
| Vel | Velocity |
| VIL | Vertically Integrated Liquid |
| VME | Versa Module Eurocard |
| VMECS | Versa Module Eurocard Communication Subsystem |
| Wd | Width |
| ZBID | Zero-Bit Insertion and Deletion |

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## APPENDIX B. RADAR CODED MESSAGE

RADAR CODED MESSAGE CODE

The Radar Coded Message, as described in Item 26, Appendix E of the NTR, NEXRAD Products, will be composed of the following three parts, preceded by a communications header: Part A (Reflectivity), Part B (VAD Winds) and Part C (Remarks). In the groups below, capital letters represent the fixed part of the group, and small letters represent variables. The message will be encoded as follows:

Header

The header is encoded as follows:

| | |
|---|---|
| cccc | Value is 1234. It is no longer the communications node (PUP site identifier). |
| ROBUU | The product category for unedited radar coded message. |
| sidd | Four-letter RDA site identifier. |

Part A: Reflectivity

Part A of the Radar Coded Message (RCM) contains a tabular listing of alphanumerics. Data in the Radar Coded Message are located with respect to a polar stereographic grid. The local grid at each antenna site is designed to be a subset of the National Radar Grid so that data may be readily composited.

The National Radar Grid has a resolution of LFM (Limited Fine Mesh model) which is 47.625 km at 60 degrees north latitude. The vertical axis of the grid is parallel to the 105 degrees west longitude meridian.

At each site, a local grid is chosen having 25 rows and 25 columns, with the antenna site located within the central box. The 25 rows and columns of the grid are assigned letters A through Y, so that the box containing the antenna site is always box NM. Box AA is at the upper left. As shown in Figure D-1, each box is further subdivided to form an overall 1/16-LFM grid.

The RCM is based on the 256-level, .54 nmi x 1 degree Composite or Hybrid Scan Reflectivity product but contains only nine data level categories; six for data within 124 nmi and one for missing or below threshold data and two for data beyond 124 nmi. Hybrid Scan Reflectivity data is used for the region within 124 nmi of the radar and Composite Reflectivity data is used for the region outside of 124 nmi. For data beyond 124 nmi, a separate threshold is provided for which: (a) all data above that threshold are labeled as level eight, and (b) all data below that threshold are labeled as level nine.

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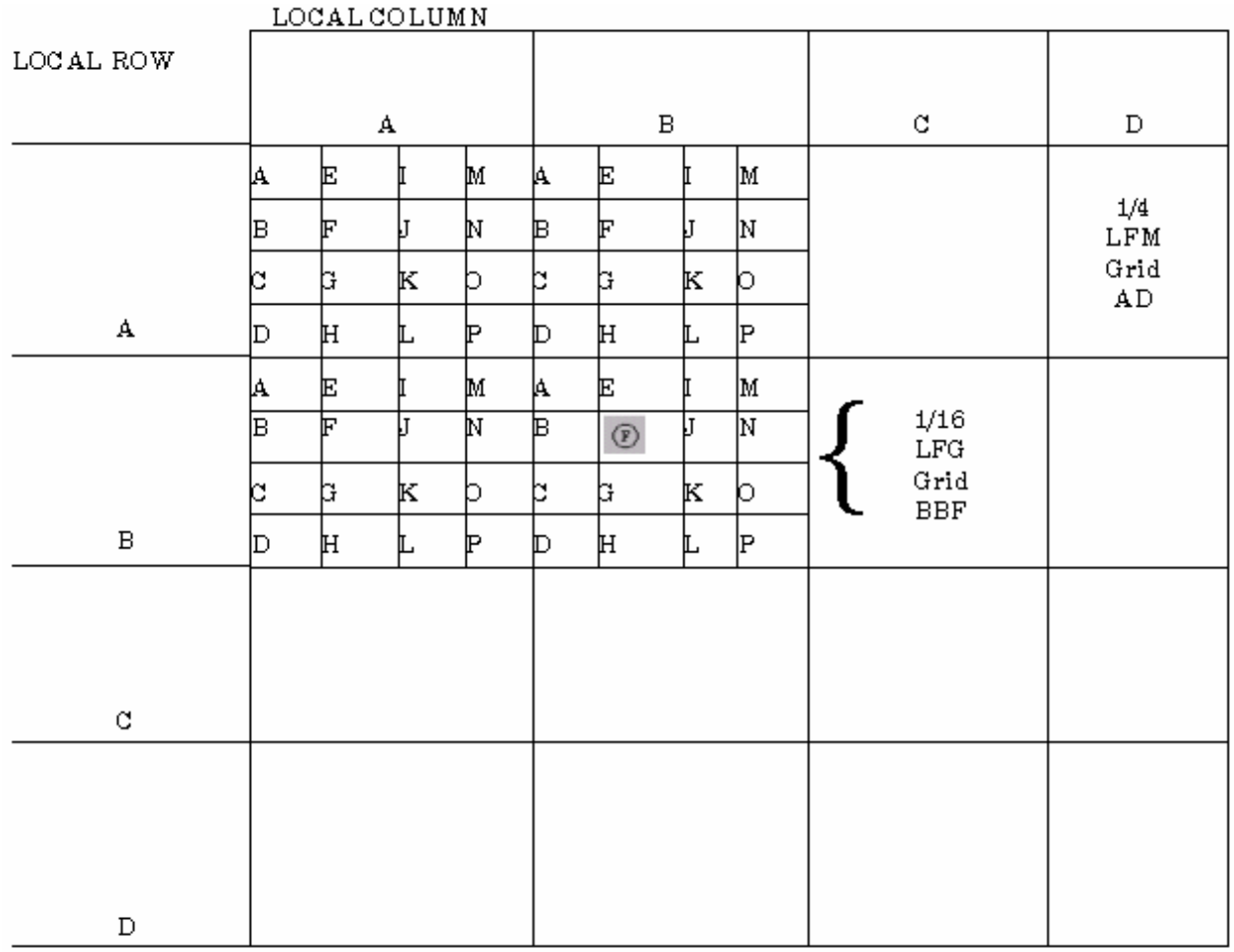


**Figure B-1. 1/16 Limited Fine Mesh Model Grid**

Within the tabular listing, data are provided for the maximum echo top. The height, and the position where provided, are derived from the Echo Tops product. The listing also shows the locations of the largest centroids within 124 nmi of the radar using the 1/16-LFM grid and provides the forecast centroid speed and direction, as available from the Storm Position Forecast algorithm. Part A of the message is encoded as follows:

| **/NEXRAA** | **Part A indicator.** |
|---|---|
| sidd | Four letter RDA site identifier. |
| ddmmyytttt | The day (dd) of the month (mm), the year (yy) and the time (tttt) to the nearest minute in Greenwich Mean Time (GMT). |
| UNEDITED | Status of message. The "edited" version no longer exists. |
| RADNE | A group to encode no reportable reflectivity intensity values shall be provided; i.e., field NInnnn is zero. |
| RADOM | A group to encode radar down for maintenance shall be provided. |
| /MDnnnn | A group of six characters to encode operational mode shall be provided. See Appendix I of the NTR. Choices are PCPN and CLAR. (Example: /MDPCPN) |
| /SCnnnn | A group of six characters to encode scan strategy shall be provided. Refer to Appendix I of NTR. Choices are 1405 (14 scans in 5 minutes), 0906, 0510, 1404, 0907, etc. (Example: /SC1405) |

| /NEXRAA | Part A indicator. |
|---|---|
| /NInnnn: | The total number (nnnn) of intensities (NI) reported in the following field (gggi) shall be encoded. (Example: /NI0144:) |
| gggi | Reflectivity intensity shall be mapped onto the 1/16 LFM grid. Encode locations and intensities by a series of groups made up of three letters (1/16 LFM followed by the maximum intensity of the designated grid box). The three letters (in order) shall be row, column, and sub-grid. The numbers following represent intensities in succeeding sub-grid boxes in that row; that is, encode each 1/16 LFM grid box from west to east, starting with the northern-most row with data, followed by the next southern row, etc. In the interest of compacting the message, successive intensities of different or similar values may be listed after a single location as long as the intensities are continuous. When succeeding sub-grid boxes contain the same intensity value, the number of succeeding boxes with the same value may be designated by a letter of the alphabet; that is, if four succeeding 1/16 LFM grid boxes (a total of five boxes) are at level 2, they could be coded as GGG2D. The "2D" may also be followed by different intensity values. Location/intensity groups shall be separated by a comma. (Example: ABF112D33l, BCA1211) |
| /MThhh:ggg | The location and height (MSL) of the maximum echo top (MT) within 230 km radius of the radar shall be encoded using the three-letter grid designator (ggg) and assigning the height coinciding with echo top product in hundreds of feet (hhh). (Example: /MT320:NLB) |
| /NCENnn: | The total number (nn) of centroids (NCEN) reported in this portion of the message shall be encoded. This number shall correspond to the corrected centroids below. (Example: /NCEN04:) |
| Cnnggg dddfff | The centroid (C) number (nn), location (grid box) (ggg), direction from which it is moving (in 1-degree increments) (ddd), and its speed (fff) in knots, shall be encoded. Successive groups shall be separated by commas. If, during editing, data are deleted in a grid box that contains a centroid, this group shall be corrected by deleting this centroid. (Example: C03QMB240012) |
| /ENDAA(C/R) | A group to indicate the end of Part A. |

The following is a summary example of the components of Part A:

/NEXRAA sidd ddmmyytttt UNEDITED
/MDnnnn /SCnnnn /NInnnn:
gggiii. . .i,gggiii...1
/MThhh:ggg
/NCENnn: Cnnggg dddfff, Cnnggg dddfff
/ENDAA

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Part B: VAD Winds

Part B of the RCM contains a single profile of the horizontal wind information derived from the output of the VAD algorithm. Part B of the message is encoded as follows:

| **/NEXRBB** | **Part B indicator.** |
|---|---|
| sidd | Four letter RDA site identifier. |
| ddmmyytttt | The day (dd) of the month (mm), the year (yy), and the time (tttt), to the nearest minute, in GMT. |
| VADNA | The optional entry VADNA shall be encoded for instances when no VAD wind data available for the last 15 minutes, if appropriate. |
| hhhcdddfff | Coded heights (hhh) in hundreds of feet MSL; confidence 3 level, using RMS for the coded height; wind direction (ddd) and wind speed (fff), in knots, shall coincide with those derived from the VAD Winds product. The confidence level shall be encoded as a single letter in accordance with the following: |
| | A = RMS of 2 kts; B = RMS of 4 kts;<br>C = RMS of 6 kts; D = RMS of 8 kts;<br>E = RMS of 10 kts; F = RMS of 12 kts;<br>G = RMS of greater than<br>or equal to 14 kts. |

Wind direction and speed, as output from the VAD Algorithm, shall be reported at up to 19 heights, in feet MSL. Default heights are:

| | | | |
|---|---|---|---|
| 1,000 | 6,000 | 12,000 | 25,000 |
| 2,000 | 7,000 | 14,000 | 30,000 |
| 3,000 | 8,000 | 16,000 | 35,000 |
| 4,000 | 9,000 | 18,000 | 50,000 |
| 5,000 | 10,000 | 20,000 | |

(Example: 080C240060)

/ENDBB (C/R) End of Part B indicator.

The following is a summary example of the components of Part B:

/NEXRBB sidd 2812881330 (C/R)
hhhcdddfff ,hhhcdddfff ,hhhcdddfff
/ENDBB (C/R)

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Part C: Remarks

Part C of the Radar Coded Message contains remarks in an alphanumeric format. Automatically generated remarks provide information on the locations of tornadic vortex signatures, mesocyclones, centroids, storm tops and hail indices. Part C is encoded as follows:

| **/NEXRCC** | **Part C indicator.** |
|---|---|
| sidd | Four letter RDA site identifier. |
| ddmmyytttt | The day (dd) of the month (mm), the year (yy) and the time (tttt) to the nearest minute in GMT. |
| /NTVSnn: | The total number (nn) of Tornado Vortex Signatures (NTVS) detected by the TVS algorithm and reported in Part C shall be encoded (Example: /NTVSO3:). |
| TVSnnggg | The location (ggg) and number identifier (nn) of each Tornado Vortex Signature (TVS) shall be encoded using the three-letter grid box designator (Example: TVS02NLB). |
| /NMESnn: | The total number (nn) of mesocyclones that meet or exceed the Minimum Display Filter Strength Rank threshold (default = strength rank 5) detected by the Mesocyclone Detection algorithm and reported in Part C shall be encoded (Example: /NMESO02:). |
| Mrrggg: | The location (ggg) and strength rank (rr) of each mesocyclone that meets or exceeds the Minimum Display Filter Strength Rank threshold (M) shall be encoded using the three-letter grid box designator (Example: M05JLC). |
| /NCENnn: | The total number (nn) of centroids (NCEN) reported in Part C shall be encoded (Example: /NCENO8:). |
| Cnnggg ShhhHi | The height (hhh) in hundreds of feet (Above Ground Level - AGL), of the storm top(s), as derived from the Storm Cell Centroids algorithm, for each centroid identified in Part A to include location (ggg) shall be encoded. The centroid identifier number (nn) is the same as given in Part A. The hail (H) index (I), as provided by the Hail algorithm, is also given as one of the four following data levels: |
| | N - no hail (Probability of Severe Hail(POSH) = <30%<br>P - possible or probable hail (50%>POSH>=30%<br>H - hail (POSH >= 50%<br>U - unknown<br><br>(Example: C04QQD S440HP). |

The following is a summary example of the components of Part C:

/NEXRCC sidd 2812881330 (C/R)
/NTVSnn: TVSnnggg,TVSnnggg,TVSnnggg
/NMESnn: Mnnggg,Mnnggg,Mnnggg
/NCENnn: Cnnggg ShhhHi,Cnnggg ShhhHi,Cnnggg ShhhHi
/UNEDITED:int

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## APPENDIX C. DATA TRANSMISSION CHARACTERISTICS

**Table XI. Application Data Sizes**

| **Typical Maximum Application Data Size Estimates (Note 1)** | | |
|---|---|---|
| **Product Code** | **Mnemonic** | **Message Size All VCPs** |
| 0 | Prod. Req. | For RPS list =.05 x # of prod on list. For OTR = .05 |
| 2 | GSM | .124 |
| 3 | Request Resp. | .048 |
| 4 | Max. Connect | .028 |
| 6 | Alert Adapt. | .064 |
| 7 | Alert Req. | .550 |
| 8 | Prod. List | .026 + (.014 x # of prod on list) |
| 9 | Alert | .05 |
| 11 | Sign On | .036 |
| 12 | Request PUP Status | .018 |
| 13 | Prod. Req. Cancel | .05 |
| 14 | PUP Status | .1 |
| NOTE 1: All product sizes are estimated maximum based on Build 4.0 testing and sizes are given in Kilobytes where (1 Kilobyte = 1024 bytes). | | |

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## Table XII. VCP 11 Product Size

| PRODUCT CODE | PRODUCT MNEMONIC | ELEVATION | MIN SIZE (Bytes) | MAX SIZE (Bytes) | AVERAGE SIZE (Bytes) | MEDIAN SIZE (Bytes) |
|---|---|---|---|---|---|---|
| 16 | R | 0.5 | 18968 | 19340 | 19170 | 19200 |
| 16 | R | 1.5 | 17342 | 18026 | 17647 | 17649 |
| 16 | R | 2.4 | 16528 | 17084 | 16819 | 16897 |
| 16 | R | 3.4 | 14894 | 15594 | 15332 | 15304 |
| 16 | R | 4.3 | 13668 | 14436 | 14029 | 14024 |
| 17 | R | 0.5 | 16170 | 16510 | 16358 | 16400 |
| 17 | R | 1.5 | 14046 | 14814 | 14408 | 14388 |
| 17 | R | 2.4 | 12550 | 13052 | 12833 | 12884 |
| 17 | R | 3.4 | 10882 | 11486 | 11241 | 11266 |
| 18 | R | 0.5 | 10756 | 11150 | 10958 | 10940 |
| 18 | R | 1.5 | 9636 | 10130 | 9873 | 9844 |
| 18 | R | 2.4 | 8504 | 8988 | 8765 | 8810 |
| 18 | R | 3.4 | 7706 | 8220 | 7990 | 8016 |
| 19 | R | 0.5 | 29130 | 29864 | 29634 | 29674 |
| 19 | R | 1.5 | 27240 | 29048 | 28066 | 27862 |
| 19 | R | 2.4 | 25510 | 26980 | 26197 | 26036 |
| 19 | R | 3.4 | 22830 | 24200 | 23443 | 23538 |
| 19 | R | 4.3 | 19546 | 22420 | 20802 | 20416 |
| 20 | R | 0.5 | 22650 | 22938 | 22772 | 22744 |
| 20 | R | 1.5 | 19974 | 21018 | 20413 | 20310 |
| 20 | R | 2.4 | 17486 | 18278 | 17880 | 17842 |
| 20 | R | 3.4 | 15136 | 16042 | 15571 | 15566 |
| 21 | R | 0.5 | 14166 | 14360 | 14238 | 14211 |
| 21 | R | 1.5 | 12828 | 13196 | 12987 | 12977 |
| 21 | R | 2.4 | 11300 | 11580 | 11456 | 11474 |
| 21 | R | 3.4 | 10218 | 10572 | 10371 | 10348 |
| 22 | V | 0.5 | 19348 | 22158 | 21053 | 21173 |
| 22 | V | 1.5 | 13556 | 14220 | 13881 | 13858 |
| 22 | V | 2.4 | 12236 | 12938 | 12441 | 12370 |
| 22 | V | 3.4 | 11672 | 12302 | 11970 | 11948 |
| 23 | V | 0.5 | 17582 | 19530 | 18723 | 18786 |
| 23 | V | 1.5 | 13310 | 13920 | 13651 | 13663 |
| 23 | V | 2.4 | 12524 | 13038 | 12720 | 12684 |
| 23 | V | 3.4 | 12186 | 12568 | 12305 | 12278 |
| 24 | V | 0.5 | 16208 | 17562 | 17019 | 17222 |
| 24 | V | 1.5 | 13210 | 13660 | 13438 | 13448 |
| 24 | V | 2.4 | 12830 | 13630 | 13198 | 13114 |
| 24 | V | 3.4 | 12040 | 12660 | 12373 | 12474 |
| 24 | V | 4.3 | 11440 | 11700 | 11601 | 11612 |
| 25 | V | 0.5 | 24624 | 26006 | 25339 | 25558 |
| 25 | V | 1.5 | 17368 | 19570 | 18630 | 18798 |
| 25 | V | 2.4 | 17388 | 18582 | 17913 | 17730 |
| 25 | V | 3.4 | 16586 | 17406 | 16991 | 16990 |
| 25 | V | 4.3 | 15680 | 16696 | 16186 | 16146 |
| 26 | V | 0.5 | 23160 | 24180 | 23809 | 23897 |
| 26 | V | 1.5 | 17974 | 20228 | 19162 | 19227 |
| 26 | V | 2.4 | 18670 | 19896 | 19292 | 19328 |

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| PRODUCT CODE | PRODUCT MNEMONIC | ELEVATION | MIN SIZE (Bytes) | MAX SIZE (Bytes) | AVERAGE SIZE (Bytes) | MEDIAN SIZE (Bytes) |
|---|---|---|---|---|---|---|
| 26 | V | 3.4 | 18110 | 19006 | 18522 | 18344 |
| 27 | V | 0.5 | 20532 | 21612 | 21206 | 21278 |
| 27 | V | 1.5 | 17980 | 19294 | 18483 | 18420 |
| 27 | V | 2.4 | 18614 | 18960 | 18733 | 18636 |
| 27 | V | 3.4 | 17122 | 17606 | 17376 | 17450 |
| 27 | V | 4.3 | 15862 | 16240 | 16011 | 15946 |
| 28 | SW | 0.5 | 34794 | 36780 | 36112 | 36486 |
| 28 | SW | 1.5 | 27902 | 30820 | 29331 | 29444 |
| 28 | SW | 2.4 | 26578 | 30824 | 29083 | 29582 |
| 28 | SW | 3.4 | 26538 | 29228 | 28146 | 28614 |
| 29 | SW | 0.5 | 32464 | 33820 | 33199 | 33173 |
| 29 | SW | 1.5 | 28452 | 30564 | 29706 | 29690 |
| 29 | SW | 2.4 | 28704 | 31362 | 30148 | 30408 |
| 29 | SW | 3.4 | 27994 | 30068 | 29170 | 29482 |
| 30 | SW | 0.5 | 26132 | 27070 | 26640 | 26764 |
| 30 | SW | 1.5 | 24322 | 25108 | 24749 | 24892 |
| 30 | SW | 2.4 | 24882 | 25422 | 25186 | 25146 |
| 30 | SW | 3.4 | 23496 | 24122 | 23784 | 23832 |
| 30 | SW | 4.3 | 20960 | 22640 | 21958 | 22024 |
| 31 | USP | | 280 | 280 | 280 | 280 |
| 32 | DHR | | 40046 | 43286 | 41685 | 41738 |
| 33 | HSR | | 27466 | 28324 | 28044 | 28094 |
| 35 | CR | | 31862 | 32846 | 32288 | 32285 |
| 36 | CR | | 11060 | 11286 | 11176 | 11177 |
| 37 | CR | | 43324 | 44956 | 43854 | 43572 |
| 38 | CR | | 12542 | 12792 | 12648 | 12664 |
| 41 | ET | | 3180 | 3334 | 3243 | 3244 |
| 48 | VWP | | 11532 | 11938 | 11820 | 11864 |
| 50 | RCS | | 636 | 1944 | 1300 | 1329 |
| 51 | VCS | | 1326 | 2004 | 1525 | 1370 |
| 55 | SRR | | 1680 | 2112 | 1892 | 1889 |
| 56 | SRM | 0.5 | 18812 | 20544 | 19704 | 19787 |
| 56 | SRM | 1.5 | 17138 | 18590 | 17925 | 18060 |
| 56 | SRM | 2.4 | 16710 | 19224 | 18012 | 18093 |
| 56 | SRM | 3.4 | 15768 | 18390 | 16967 | 16722 |
| 56 | SRM | 4.3 | 14690 | 17126 | 15910 | 15708 |
| 57 | VIL | | 2392 | 2504 | 2443 | 2444 |
| 58 | STI | | 11078 | 18642 | 15575 | 15956 |
| 59 | HI | | 11676 | 12026 | 11831 | 11826 |
| 60 | M | | 3626 | 4928 | 4371 | 4452 |
| 61 | TVS | | 3028 | 3428 | 3178 | 3178 |
| 62 | SS | | 12696 | 17176 | 14948 | 14914 |
| 63 | LRA | | 3000 | 3192 | 3086 | 3090 |
| 64 | LRA | | 3052 | 3288 | 3165 | 3152 |
| 65 | LRM | | 3234 | 3424 | 3305 | 3281 |
| 66 | LRM | | 2932 | 3002 | 2955 | 2948 |
| 67 | APR | | 3030 | 3214 | 3122 | 3096 |
| 73 | UAM | | 782 | 5380 | 2061 | 1438 |
| 74 | RCM | | 2710 | 2780 | 2760 | 2780 |

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| PRODUCT CODE | PRODUCT MNEMONIC | ELEVATION | MIN SIZE (Bytes) | MAX SIZE (Bytes) | AVERAGE SIZE (Bytes) | MEDIAN SIZE (Bytes) |
|---|---|---|---|---|---|---|
| 78 | OHP | | 5734 | 12696 | 11233 | 11988 |
| 79 | THP | | 12278 | 12278 | 12278 | 12278 |
| 80 | STP | | 17486 | 18112 | 17782 | 17746 |
| 81 | DPA | | 2592 | 10984 | 8012 | 8538 |
| 82 | SPD | | 2834 | 2834 | 2834 | 2834 |
| 84 | VAD | | 3828 | 6702 | 5914 | 6176 |
| 89 | LRA | | 2236 | 2386 | 2315 | 2308 |
| 90 | LRM | | 3004 | 3086 | 3055 | 3050 |
| 93 | DBV | 0.5 | 44558 | 44558 | 44558 | 44558 |
| 93 | DBV | 1.5 | 44558 | 44558 | 44558 | 44558 |
| 93 | DBV | 2.4 | 44558 | 44558 | 44558 | 44558 |
| 93 | DBV | 3.4 | 36650 | 36650 | 36650 | 36650 |
| 93 | DBV | 4.3 | 29270 | 29350 | 29327 | 29350 |
| 94 | DR | 0.5 | 45422 | 49361 | 47540 | 47424 |
| 94 | DR | 1.5 | 41268 | 45532 | 43257 | 43074 |
| 94 | DR | 2.4 | 34849 | 38184 | 36276 | 36106 |
| 94 | DR | 3.4 | 29339 | 34208 | 31659 | 31529 |
| 94 | DR | 4.3 | 24316 | 30184 | 27288 | 27518 |
| 95 | CRE | | 24032 | 28696 | 27745 | 28246 |
| 96 | CRE | | 6574 | 11118 | 10340 | 10938 |
| 97 | CRE | | 31520 | 36152 | 34731 | 35074 |
| 98 | CRE | | 7946 | 12504 | 11700 | 12284 |
| 99 | DV | 0.5 | 84409 | 94614 | 87733 | 87238 |
| 99 | DV | 1.5 | 79320 | 86532 | 81680 | 80620 |
| 99 | DV | 2.4 | 77767 | 87576 | 81842 | 81522 |
| 99 | DV | 3.4 | 74043 | 85500 | 78812 | 78969 |
| 99 | DV | 4.3 | 64770 | 79918 | 72260 | 73260 |
| 132 | CLR | 0.5 | 38626 | 40314 | 39584 | 39568 |
| 132 | CLR | 1.5 | 39252 | 40008 | 39594 | 39596 |
| 132 | CLR | 2.4 | 33556 | 34138 | 33871 | 33836 |
| 132 | CLR | 3.4 | 29284 | 30054 | 29717 | 29872 |
| 132 | CLR | 4.3 | 24890 | 27272 | 26082 | 25944 |
| 133 | CLD | 0.5 | 31492 | 32390 | 31928 | 32074 |
| 133 | CLD | 1.5 | 30546 | 31892 | 31424 | 31416 |
| 133 | CLD | 2.4 | 29900 | 31218 | 30582 | 30604 |
| 133 | CLD | 3.4 | 29400 | 30902 | 30141 | 30194 |
| 133 | CLD | 4.3 | 26886 | 29438 | 28336 | 28240 |
| 134 | DVL | | 46993 | 47780 | 47439 | 47437 |
| 135 | EET | | 24167 | 24855 | 24543 | 24523 |
| 136 | SO | | 126736 | 138016 | 132376 | 132376 |
| 137 | ULR | | 15140 | 23998 | 19750 | 19720 |
| 138 | DSP | | 44676 | 44676 | 44676 | 44676 |
| 139 | MRU | 0.5 | 1320 | 5030 | 3559 | 3786 |
| 139 | MRU | 1.5 | 2834 | 5122 | 3912 | 4076 |
| 139 | MRU | 2.4 | 2846 | 5204 | 4040 | 4146 |
| 139 | MRU | 3.4 | 2916 | 5214 | 4221 | 4228 |
| 139 | MRU | 4.3 | 2950 | 5628 | 4346 | 4240 |
| 139 | MRU | 5.3 | 2950 | 5708 | 4352 | 4272 |
| 139 | MRU | 6.2 | 2950 | 5708 | 4430 | 4782 |

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| PRODUCT CODE | PRODUCT MNEMONIC | ELEVATION | MIN SIZE (Bytes) | MAX SIZE (Bytes) | AVERAGE SIZE (Bytes) | MEDIAN SIZE (Bytes) |
|---|---|---|---|---|---|---|
| 139 | MRU | 7.5 | 2950 | 5730 | 4467 | 4826 |
| 139 | MRU | 8.7 | 2950 | 5730 | 4495 | 4848 |
| 139 | MRU | 10.0 | 2950 | 5730 | 4500 | 4848 |
| 139 | MRU | 12.0 | 2950 | 5730 | 4501 | 4848 |
| 139 | MRU | 14.0 | 2950 | 5730 | 4501 | 4848 |
| 139 | MRU | 16.7 | 2950 | 5730 | 4501 | 4848 |
| 139 | MRU | 19.5 | 2094 | 4816 | 3601 | 3786 |
| 141 | MD | | 120 | 3120 | 2030 | 2022 |
| 143 | TRU | 0.5 | 120 | 1870 | 1438 | 1558 |
| 143 | TRU | 1.5 | 120 | 1870 | 1438 | 1558 |
| 143 | TRU | 2.4 | 120 | 1870 | 1528 | 1558 |
| 143 | TRU | 3.4 | 120 | 1870 | 1549 | 1662 |
| 143 | TRU | 4.3 | 120 | 1870 | 1552 | 1662 |
| 143 | TRU | 5.3 | 120 | 1870 | 1552 | 1662 |
| 143 | TRU | 6.2 | 120 | 1870 | 1552 | 1662 |
| 143 | TRU | 7.5 | 120 | 1870 | 1552 | 1662 |
| 143 | TRU | 8.7 | 120 | 1870 | 1552 | 1662 |
| 143 | TRU | 10.0 | 120 | 1870 | 1552 | 1662 |
| 143 | TRU | 12.0 | 120 | 1870 | 1552 | 1662 |
| 143 | TRU | 14.0 | 120 | 1870 | 1552 | 1662 |
| 143 | TRU | 16.7 | 120 | 1870 | 1552 | 1662 |
| 143 | TRU | 19.5 | 120 | 1870 | 1438 | 1558 |
| 144 | OSW | | 2836 | 30442 | 21748 | 29077 |
| 145 | OSD | | 2836 | 28706 | 20813 | 27721 |
| 146 | SSW | | 15496 | 22940 | 19808 | 20308 |
| 147 | SSD | | 15538 | 20266 | 18197 | 18516 |
| 149 | DMD | 0.5 | 3103 | 4417 | 3659 | 3607 |
| 149 | DMD | 1.5 | 3354 | 4798 | 4153 | 4201 |
| 149 | DMD | 2.4 | 4081 | 5830 | 4970 | 4986 |
| 149 | DMD | 3.4 | 4338 | 6524 | 5439 | 5426 |
| 149 | DMD | 4.3 | 4605 | 6869 | 5646 | 5650 |
| 149 | DMD | 5.3 | 4665 | 7169 | 5888 | 5879 |
| 149 | DMD | 6.2 | 4674 | 7450 | 6076 | 6190 |
| 149 | DMD | 7.5 | 4656 | 7671 | 6209 | 6295 |
| 149 | DMD | 8.7 | 4658 | 7859 | 6287 | 6470 |
| 149 | DMD | 10.0 | 4675 | 7851 | 6363 | 6573 |
| 149 | DMD | 12.0 | 4918 | 7997 | 6417 | 6690 |
| 149 | DMD | 14.0 | 4900 | 7982 | 6464 | 6740 |
| 149 | DMD | 16.7 | 4869 | 8169 | 6496 | 6746 |
| 149 | DMD | 19.5 | 4935 | 8155 | 6478 | 6622 |
| 150 | USW | | 3082 | 3082 | 3082 | 3082 |
| 151 | USD | | 3082 | 3082 | 3082 | 3082 |

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## Table XIII. VCP 12 Product Size

| PRODUCT CODE | PRODUCT MNEMONIC | ELEVATION | MIN SIZE (Bytes) | MAX SIZE (Bytes) | AVERAGE SIZE (Bytes) | MEDIAN SIZE (Bytes) |
|---|---|---|---|---|---|---|
| 16 | R | 0.5 | 14334 | 17910 | 16264 | 16475 |
| 16 | R | 0.9 | 12086 | 17910 | 15164 | 15242 |
| 16 | R | 1.3 | 10036 | 16314 | 12527 | 12003 |
| 16 | R | 1.8 | 9904 | 11094 | 10610 | 10820 |
| 17 | R | 0.5 | 12746 | 13846 | 13257 | 13302 |
| 17 | R | 0.9 | 11158 | 13846 | 12623 | 12826 |
| 17 | R | 1.3 | 9704 | 13090 | 11247 | 11182 |
| 17 | R | 1.8 | 8776 | 9960 | 9409 | 9490 |
| 18 | R | 0.5 | 8158 | 8710 | 8589 | 8617 |
| 18 | R | 0.9 | 7122 | 8710 | 8143 | 8027 |
| 18 | R | 1.3 | 6534 | 7896 | 7398 | 7516 |
| 18 | R | 1.8 | 6158 | 6978 | 6571 | 6554 |
| 18 | R | 2.4 | 5754 | 6426 | 6098 | 6066 |
| 19 | R | 0.5 | 16950 | 22954 | 20172 | 20489 |
| 19 | R | 0.9 | 13654 | 22954 | 18257 | 18199 |
| 19 | R | 1.3 | 11152 | 18940 | 14268 | 13337 |
| 19 | R | 1.8 | 10978 | 12204 | 11746 | 11844 |
| 19 | R | 2.4 | 11196 | 12550 | 11881 | 12006 |
| 20 | R | 0.5 | 14472 | 17398 | 15874 | 15848 |
| 20 | R | 0.9 | 12400 | 17398 | 14774 | 14779 |
| 20 | R | 1.3 | 10360 | 15132 | 12450 | 12124 |
| 20 | R | 1.8 | 9404 | 10552 | 10081 | 10192 |
| 20 | R | 2.4 | 8934 | 10070 | 9551 | 9758 |
| 21 | R | 0.5 | 9486 | 10838 | 10085 | 10049 |
| 21 | R | 0.9 | 8308 | 10838 | 9439 | 9412 |
| 21 | R | 1.3 | 6890 | 9338 | 8164 | 8151 |
| 21 | R | 1.8 | 6518 | 7328 | 6966 | 6998 |
| 22 | V | 0.5 | 28006 | 35776 | 29280 | 28917 |
| 22 | V | 0.9 | 18934 | 35776 | 25629 | 28025 |
| 22 | V | 1.3 | 16914 | 28270 | 20763 | 21068 |
| 22 | V | 1.8 | 17074 | 20626 | 19317 | 19692 |
| 23 | V | 0.5 | 23410 | 32676 | 25994 | 25384 |
| 23 | V | 0.9 | 16638 | 32676 | 22893 | 23487 |
| 23 | V | 1.3 | 15430 | 24450 | 18582 | 18384 |
| 23 | V | 1.8 | 15100 | 17278 | 16412 | 16484 |
| 24 | V | 0.5 | 17936 | 22346 | 19335 | 18902 |
| 24 | V | 0.9 | 13856 | 22346 | 17552 | 17936 |
| 24 | V | 1.3 | 13508 | 17746 | 15273 | 15309 |
| 24 | V | 1.8 | 13372 | 14898 | 14263 | 14382 |
| 25 | V | 0.5 | 32152 | 34528 | 33610 | 33762 |
| 25 | V | 0.9 | 23996 | 34528 | 30744 | 31027 |
| 25 | V | 1.3 | 21398 | 29902 | 26948 | 28221 |
| 25 | V | 1.8 | 20028 | 28042 | 25449 | 26298 |
| 26 | V | 0.5 | 27238 | 31100 | 29223 | 29247 |
| 26 | V | 0.9 | 20308 | 31100 | 26517 | 26848 |
| 26 | V | 1.3 | 18754 | 26458 | 22823 | 23413 |
| 26 | V | 1.8 | 17014 | 22482 | 20598 | 21048 |

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| PRODUCT CODE | PRODUCT MNEMONIC | ELEVATION | MIN SIZE (Bytes) | MAX SIZE (Bytes) | AVERAGE SIZE (Bytes) | MEDIAN SIZE (Bytes) |
|---|---|---|---|---|---|---|
| 27 | V | 0.5 | 20340 | 22658 | 21313 | 21271 |
| 27 | V | 0.9 | 16258 | 22658 | 19749 | 20340 |
| 27 | V | 1.3 | 15814 | 19796 | 17901 | 18246 |
| 27 | V | 1.8 | 14758 | 18038 | 16853 | 17146 |
| 28 | SW | 0.5 | 41934 | 45846 | 43111 | 42965 |
| 28 | SW | 0.9 | 33398 | 45846 | 39751 | 41463 |
| 28 | SW | 1.3 | 27394 | 40992 | 34293 | 34691 |
| 28 | SW | 1.8 | 26558 | 35890 | 30736 | 31534 |
| 29 | SW | 0.5 | 33158 | 42384 | 36340 | 36009 |
| 29 | SW | 0.9 | 26630 | 42384 | 32991 | 33368 |
| 29 | SW | 1.3 | 23024 | 34350 | 27821 | 27829 |
| 29 | SW | 1.8 | 21692 | 27626 | 24309 | 24820 |
| 30 | SW | 0.5 | 23708 | 27834 | 25188 | 25017 |
| 30 | SW | 0.9 | 19952 | 27834 | 23347 | 23808 |
| 30 | SW | 1.3 | 18374 | 24248 | 20763 | 20842 |
| 30 | SW | 1.8 | 17526 | 20768 | 19051 | 19382 |
| 31 | USP | | 280 | 376 | 283 | 280 |
| 32 | DHR | | 85716 | 85716 | 85716 | 85716 |
| 33 | HSR | | 12012 | 17660 | 15034 | 15320 |
| 35 | CR | | 25204 | 28052 | 26587 | 26688 |
| 36 | CR | | 7570 | 9584 | 8863 | 8891 |
| 37 | CR | | 29696 | 33646 | 31438 | 31530 |
| 38 | CR | | 8298 | 10276 | 9526 | 9655 |
| 41 | ET | | 1866 | 1998 | 1936 | 1936 |
| 48 | VWP | | 5578 | 11200 | 9097 | 9436 |
| 56 | SRM | 0.5 | 19522 | 22448 | 20705 | 20438 |
| 56 | SRM | 0.9 | 16556 | 22448 | 19376 | 19588 |
| 56 | SRM | 1.3 | 15882 | 19588 | 17656 | 17626 |
| 56 | SRM | 1.8 | 14678 | 17892 | 16566 | 16774 |
| 57 | VIL | | 1506 | 1684 | 1583 | 1573 |
| 58 | STI | | 4550 | 10940 | 8981 | 9309 |
| 59 | HI | | 5594 | 8914 | 7386 | 6942 |
| 60 | M | | 3400 | 5450 | 4342 | 4205 |
| 61 | TVS | | 2112 | 2928 | 2384 | 2112 |
| 62 | SS | | 5758 | 9850 | 8355 | 8302 |
| 63 | LRA | | 1744 | 1850 | 1789 | 1784 |
| 64 | LRA | | 1684 | 1836 | 1755 | 1747 |
| 65 | LRM | | 2544 | 2992 | 2751 | 2738 |
| 66 | LRM | | 1970 | 2150 | 2083 | 2092 |
| 67 | APR | | 2196 | 2506 | 2338 | 2343 |
| 74 | RCM | | 1800 | 2010 | 1919 | 1940 |
| 78 | OHP | | 5734 | 11064 | 8020 | 5734 |
| 79 | THP | | 5816 | 5816 | 5816 | 5816 |
| 80 | STP | | 8940 | 10490 | 9750 | 9794 |
| 81 | DPA | | 2592 | 8316 | 5036 | 2592 |
| 82 | SPD | | 2834 | 2834 | 2834 | 2834 |
| 84 | VAD | | 6444 | 7070 | 6759 | 6742 |
| 89 | LRA | | 1524 | 1648 | 1589 | 1591 |
| 90 | LRM | | 1810 | 1994 | 1921 | 1934 |

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| PRODUCT CODE | PRODUCT MNEMONIC | ELEVATION | MIN SIZE (Bytes) | MAX SIZE (Bytes) | AVERAGE SIZE (Bytes) | MEDIAN SIZE (Bytes) |
|---|---|---|---|---|---|---|
| 93 | DBV | 0.5 | 43582 | 44070 | 43948 | 43948 |
| 93 | DBV | 0.9 | 43582 | 44070 | 43950 | 43948 |
| 93 | DBV | 1.3 | 42362 | 44070 | 43624 | 43460 |
| 93 | DBV | 1.8 | 42606 | 44070 | 43830 | 43948 |
| 93 | DBV | 2.4 | 43704 | 44314 | 43840 | 43826 |
| 94 | DR | 0.5 | 168376 | 168376 | 168376 | 168376 |
| 94 | DR | 0.9 | 167910 | 168376 | 168367 | 168376 |
| 94 | DR | 1.3 | 148238 | 168376 | 160095 | 167910 |
| 94 | DR | 1.8 | 133782 | 138390 | 137637 | 138006 |
| 95 | CRE | | 21324 | 23260 | 22464 | 22470 |
| 96 | CRE | | 7176 | 9248 | 8437 | 8426 |
| 97 | CRE | | 23576 | 25416 | 24651 | 24709 |
| 98 | CRE | | 7696 | 9786 | 8944 | 8933 |
| 99 | DV | 0.5 | 329806 | 333510 | 332584 | 332584 |
| 99 | DV | 0.9 | 329806 | 333510 | 332601 | 332584 |
| 99 | DV | 1.3 | 320546 | 333510 | 330126 | 328880 |
| 99 | DV | 1.8 | 322398 | 333510 | 331695 | 332584 |
| 132 | CLR | 0.5 | 27318 | 32188 | 29678 | 29818 |
| 132 | CLR | 0.9 | 25394 | 32188 | 28400 | 28330 |
| 132 | CLR | 1.3 | 20480 | 29256 | 24734 | 24823 |
| 132 | CLR | 1.8 | 19978 | 22830 | 21673 | 21972 |
| 133 | CLD | 0.5 | 26450 | 30698 | 28209 | 28172 |
| 133 | CLD | 0.9 | 23532 | 30698 | 26660 | 26490 |
| 133 | CLD | 1.3 | 21860 | 27762 | 24314 | 24223 |
| 133 | CLD | 1.8 | 21214 | 24406 | 22660 | 23022 |
| 134 | DVL | | 10149 | 16880 | 13274 | 12788 |
| 135 | EET | | 11061 | 12394 | 11968 | 12042 |
| 136 | SO | | 42247 | 114620 | 78433 | 78433 |
| 137 | ULR | | 17190 | 21468 | 20033 | 20220 |
| 138 | DSP | | 44676 | 44676 | 44676 | 44676 |
| 139 | MRU | 0.5 | 120 | 3622 | 2501 | 2858 |
| 139 | MRU | 0.9 | 120 | 3704 | 2565 | 2863 |
| 139 | MRU | 1.3 | 828 | 3786 | 2686 | 2868 |
| 139 | MRU | 1.8 | 992 | 3786 | 2797 | 2898 |
| 139 | MRU | 2.4 | 992 | 3848 | 2884 | 2950 |
| 139 | MRU | 3.1 | 992 | 3900 | 3040 | 3152 |
| 139 | MRU | 4.0 | 992 | 4052 | 3162 | 3266 |
| 139 | MRU | 5.1 | 1982 | 4086 | 3326 | 3522 |
| 139 | MRU | 6.4 | 1982 | 4168 | 3343 | 3535 |
| 139 | MRU | 8.0 | 1982 | 4172 | 3395 | 3618 |
| 139 | MRU | 10.0 | 1982 | 4172 | 3396 | 3618 |
| 139 | MRU | 12.5 | 1982 | 4172 | 3396 | 3618 |
| 139 | MRU | 15.6 | 1982 | 4172 | 3396 | 3618 |
| 139 | MRU | 19.5 | 1816 | 3970 | 2834 | 2908 |
| 141 | MD | | 136 | 1890 | 1347 | 1562 |
| 143 | TRU | 0.5 | 120 | 1454 | 564 | 120 |
| 143 | TRU | 0.9 | 120 | 1454 | 564 | 120 |
| 143 | TRU | 1.3 | 120 | 1454 | 564 | 120 |
| 143 | TRU | 1.8 | 120 | 1454 | 581 | 120 |

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| PRODUCT CODE | PRODUCT MNEMONIC | ELEVATION | MIN SIZE (Bytes) | MAX SIZE (Bytes) | AVERAGE SIZE (Bytes) | MEDIAN SIZE (Bytes) |
|---|---|---|---|---|---|---|
| 143 | TRU | 2.4 | 120 | 1558 | 688 | 120 |
| 143 | TRU | 3.1 | 120 | 1558 | 739 | 120 |
| 143 | TRU | 4.0 | 120 | 1558 | 764 | 120 |
| 143 | TRU | 5.1 | 120 | 1558 | 846 | 1454 |
| 143 | TRU | 6.4 | 120 | 1558 | 846 | 1454 |
| 143 | TRU | 8.0 | 120 | 1558 | 846 | 1454 |
| 143 | TRU | 10.0 | 120 | 1558 | 846 | 1454 |
| 143 | TRU | 12.5 | 120 | 1558 | 846 | 1454 |
| 143 | TRU | 15.6 | 120 | 1558 | 846 | 1454 |
| 143 | TRU | 19.5 | 120 | 1454 | 564 | 120 |
| 144 | OSW | | | | | |
| 145 | OSD | | | | | |
| 146 | SSW | | | | | |
| 147 | SSD | | | | | |
| 150 | USW | | | | | |
| 151 | USD | | | | | |

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## Table XIV. VCP 121 Product Size

| PRODUCT CODE | PRODUCT MNEMONIC | ELEVATION | MIN SIZE (Bytes) | MAX SIZE (Bytes) | AVERAGE SIZE (Bytes) | MEDIAN SIZE (Bytes) |
|---|---|---|---|---|---|---|
| 16 | R | 0.5 | 19000 | 21078 | 20347 | 20572 |
| 16 | R | 1.5 | 14868 | 16966 | 15787 | 15794 |
| 16 | R | 2.4 | 13812 | 15806 | 14530 | 14246 |
| 16 | R | 3.3 | 12804 | 14232 | 13271 | 13108 |
| 16 | R | 4.3 | 11138 | 12576 | 11524 | 11286 |
| 17 | R | 0.5 | 16200 | 17862 | 17235 | 17352 |
| 17 | R | 1.5 | 12102 | 13690 | 12716 | 12680 |
| 17 | R | 2.4 | 10562 | 11946 | 10983 | 10782 |
| 17 | R | 3.3 | 9130 | 10046 | 9439 | 9329 |
| 18 | R | 0.5 | 10828 | 11984 | 11454 | 11454 |
| 18 | R | 1.5 | 8068 | 9328 | 8568 | 8452 |
| 18 | R | 2.4 | 7136 | 8242 | 7527 | 7399 |
| 18 | R | 3.3 | 6430 | 7320 | 6743 | 6647 |
| 19 | R | 0.5 | 29606 | 31364 | 30437 | 30389 |
| 19 | R | 1.5 | 21412 | 25180 | 22656 | 22456 |
| 19 | R | 2.4 | 19350 | 22626 | 20322 | 20175 |
| 19 | R | 3.3 | 16830 | 19332 | 17704 | 17587 |
| 19 | R | 4.3 | 14052 | 16238 | 14678 | 14629 |
| 20 | R | 0.5 | 22930 | 24272 | 23478 | 23474 |
| 20 | R | 1.5 | 15986 | 18486 | 16671 | 16483 |
| 20 | R | 2.4 | 13674 | 15722 | 14248 | 14137 |
| 20 | R | 3.3 | 11522 | 13078 | 12087 | 12047 |
| 21 | R | 0.5 | 14824 | 15526 | 15137 | 15084 |
| 21 | R | 1.5 | 10556 | 12000 | 11076 | 10964 |
| 21 | R | 2.4 | 9042 | 10424 | 9481 | 9292 |
| 21 | R | 3.3 | 7944 | 8986 | 8345 | 8257 |
| 22 | V | 0.5 | 35428 | 37400 | 36741 | 36966 |
| 22 | V | 1.5 | 37930 | 43412 | 41496 | 42378 |
| 22 | V | 2.4 | 37478 | 44076 | 41640 | 42316 |
| 22 | V | 3.3 | 32110 | 36538 | 35167 | 35647 |
| 23 | V | 0.5 | 33194 | 36608 | 35389 | 35834 |
| 23 | V | 1.5 | 34302 | 38874 | 37267 | 38014 |
| 23 | V | 2.4 | 29684 | 32268 | 31129 | 31358 |
| 23 | V | 3.3 | 26036 | 27300 | 26792 | 26867 |
| 24 | V | 0.5 | 28486 | 34022 | 31882 | 32096 |
| 24 | V | 1.5 | 27138 | 29298 | 28559 | 28720 |
| 24 | V | 2.4 | 23584 | 25044 | 24418 | 24454 |
| 24 | V | 3.3 | 20454 | 21392 | 20844 | 20786 |
| 25 | V | 0.5 | 30218 | 34504 | 32270 | 32626 |
| 25 | V | 1.5 | 33698 | 37098 | 35396 | 35306 |
| 25 | V | 2.4 | 34930 | 39890 | 37855 | 37850 |
| 25 | V | 3.3 | 29874 | 33892 | 32511 | 32666 |
| 25 | V | 4.3 | 22224 | 24418 | 23863 | 24024 |
| 26 | V | 0.5 | 31330 | 32690 | 32244 | 32338 |
| 26 | V | 1.5 | 30868 | 33680 | 32468 | 32778 |
| 26 | V | 2.4 | 27166 | 29544 | 28513 | 28664 |
| 26 | V | 3.3 | 23366 | 25192 | 24494 | 24638 |

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| PRODUCT CODE | PRODUCT MNEMONIC | ELEVATION | MIN SIZE (Bytes) | MAX SIZE (Bytes) | AVERAGE SIZE (Bytes) | MEDIAN SIZE (Bytes) |
|---|---|---|---|---|---|---|
| 27 | V | 0.5 | 26180 | 28324 | 27324 | 27475 |
| 27 | V | 1.5 | 23322 | 25192 | 24500 | 24458 |
| 27 | V | 2.4 | 21488 | 22894 | 22110 | 22108 |
| 27 | V | 3.3 | 18848 | 19862 | 19283 | 19269 |
| 27 | V | 4.3 | 15842 | 16316 | 16062 | 16045 |
| 28 | SW | 0.5 | 47334 | 49068 | 48380 | 48566 |
| 28 | SW | 1.5 | 50052 | 51760 | 51040 | 51091 |
| 28 | SW | 2.4 | 46296 | 50662 | 49232 | 49494 |
| 28 | SW | 3.3 | 39916 | 42890 | 41781 | 41834 |
| 29 | SW | 0.5 | 46510 | 48272 | 47474 | 47544 |
| 29 | SW | 1.5 | 42784 | 44180 | 43440 | 43484 |
| 29 | SW | 2.4 | 35054 | 36218 | 35478 | 35366 |
| 29 | SW | 3.3 | 29676 | 30994 | 30313 | 30309 |
| 30 | SW | 0.5 | 37188 | 39302 | 38642 | 38798 |
| 30 | SW | 1.5 | 31842 | 32788 | 32388 | 32395 |
| 30 | SW | 2.4 | 26792 | 28284 | 27515 | 27404 |
| 30 | SW | 3.3 | 22624 | 24240 | 23223 | 23060 |
| 31 | USP | | 280 | 10268 | 2390 | 424 |
| 32 | DHR | | 85716 | 85716 | 85716 | 85716 |
| 33 | HSR | | 28506 | 30548 | 29206 | 29218 |
| 35 | CR | | 35338 | 40224 | 39068 | 39712 |
| 36 | CR | | 8064 | 12580 | 12136 | 12482 |
| 37 | CR | | 50212 | 55822 | 54019 | 54448 |
| 38 | CR | | 10296 | 14968 | 14547 | 14644 |
| 41 | ET | | 2744 | 3274 | 2933 | 2857 |
| 42 | M | | 2112 | 2798 | 2472 | 2552 |
| 48 | VWP | | 9218 | 10388 | 9516 | 9453 |
| 50 | RCS | | 636 | 1614 | 1121 | 1179 |
| 51 | VCS | | 1132 | 1594 | 1303 | 1221 |
| 55 | SRR | | 2122 | 2796 | 2443 | 2369 |
| 56 | SRM | 0.5 | 24536 | 30380 | 28649 | 28911 |
| 56 | SRM | 1.5 | 22184 | 26874 | 26167 | 26348 |
| 56 | SRM | 2.4 | 20340 | 23852 | 23072 | 23167 |
| 56 | SRM | 3.3 | 17870 | 20710 | 19572 | 19626 |
| 56 | SRM | 4.3 | 15208 | 17222 | 16324 | 16343 |
| 57 | VIL | | 2128 | 2608 | 2278 | 2208 |
| 58 | STI | | 10438 | 18062 | 14424 | 14080 |
| 59 | HI | | 10962 | 11700 | 11231 | 11204 |
| 61 | TVS | | 2112 | 2112 | 2112 | 2112 |
| 62 | SS | | 10840 | 16580 | 13560 | 13416 |
| 63 | LRA | | 3228 | 3476 | 3329 | 3334 |
| 64 | LRA | | 2574 | 2786 | 2671 | 2678 |
| 65 | LRM | | 3924 | 4564 | 4191 | 4107 |
| 66 | LRM | | 2684 | 3154 | 2926 | 2930 |
| 67 | APR | | 3792 | 4348 | 4030 | 3975 |
| 73 | UAM | | 782 | 4066 | 975 | 975 |
| 74 | RCM | | 2990 | 3200 | 3057 | 3060 |
| 78 | OHP | | 5734 | 13600 | 12359 | 12629 |
| 79 | THP | | 5816 | 12278 | 8476 | 10122 |

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| PRODUCT CODE | PRODUCT MNEMONIC | ELEVATION | MIN SIZE (Bytes) | MAX SIZE (Bytes) | AVERAGE SIZE (Bytes) | MEDIAN SIZE (Bytes) |
|---|---|---|---|---|---|---|
| 80 | STP | | 15394 | 17308 | 16478 | 16486 |
| 81 | DPA | | 2592 | 14418 | 11339 | 12628 |
| 82 | SPD | | 2834 | 2834 | 2834 | 2834 |
| 84 | VAD | | 1948 | 6924 | 5265 | 6616 |
| 89 | LRA | | 1860 | 1980 | 1925 | 1906 |
| 90 | LRM | | 2312 | 2434 | 2379 | 2383 |
| 93 | DBV | 0.5 | 43338 | 43338 | 43338 | 43338 |
| 93 | DBV | 1.5 | 43338 | 43338 | 43338 | 43338 |
| 93 | DBV | 2.4 | 43338 | 43338 | 43338 | 43338 |
| 93 | DBV | 3.3 | 36462 | 36462 | 36462 | 36462 |
| 93 | DBV | 4.3 | 28710 | 28710 | 28710 | 28710 |
| 94 | DR | 0.5 | 166046 | 166046 | 166046 | 166046 |
| 94 | DR | 1.5 | 146110 | 146520 | 146141 | 146110 |
| 94 | DR | 2.4 | 120510 | 120510 | 120510 | 120510 |
| 94 | DR | 3.3 | 101966 | 101966 | 101966 | 101966 |
| 94 | DR | 4.3 | 85830 | 85830 | 85830 | 85830 |
| 95 | CRE | | 29602 | 34454 | 33637 | 33930 |
| 96 | CRE | | 7762 | 12250 | 11819 | 12158 |
| 97 | CRE | | 38892 | 44804 | 43287 | 43392 |
| 98 | CRE | | 9740 | 14418 | 13898 | 14210 |
| 99 | DV | 0.5 | 327954 | 327954 | 327954 | 327954 |
| 99 | DV | 1.5 | 327954 | 327954 | 327954 | 327954 |
| 99 | DV | 2.4 | 327954 | 327954 | 327954 | 327954 |
| 99 | DV | 3.3 | 329806 | 329806 | 329806 | 329806 |
| 99 | DV | 4.3 | 330732 | 330732 | 330732 | 330732 |
| 132 | CLR | 0.5 | 38556 | 39948 | 39126 | 39031 |
| 132 | CLR | 1.5 | 33508 | 35584 | 34302 | 34254 |
| 132 | CLR | 2.4 | 28910 | 31358 | 29713 | 29489 |
| 132 | CLR | 3.3 | 25222 | 27538 | 25898 | 25674 |
| 133 | CLD | 0.5 | 40872 | 42364 | 41705 | 41718 |
| 133 | CLD | 1.5 | 36092 | 37724 | 36993 | 37047 |
| 133 | CLD | 2.4 | 31362 | 33842 | 32195 | 31942 |
| 133 | CLD | 3.3 | 27052 | 29594 | 27671 | 27296 |
| 134 | DVL | | 37074 | 43265 | 38816 | 37963 |
| 135 | EET | | 25329 | 28548 | 26031 | 25667 |
| 136 | SO | | 30561 | 67536 | 53762 | 63190 |
| 137 | ULR | | 14198 | 27482 | 19552 | 18898 |
| 138 | DSP | | 44676 | 44676 | 44676 | 44676 |
| 139 | MRU | 0.5 | 120 | 1402 | 980 | 1156 |
| 139 | MRU | 1.5 | 120 | 1402 | 1014 | 1156 |
| 139 | MRU | 2.4 | 120 | 2224 | 1227 | 1279 |
| 139 | MRU | 3.3 | 120 | 2224 | 1234 | 1279 |
| 139 | MRU | 4.3 | 120 | 2224 | 1256 | 1279 |
| 139 | MRU | 6.0 | 120 | 2224 | 1268 | 1320 |
| 139 | MRU | 9.9 | 120 | 2224 | 1268 | 1320 |
| 139 | MRU | 14.6 | 120 | 2224 | 1268 | 1320 |
| 139 | MRU | 19.5 | 120 | 1402 | 1008 | 1156 |
| 141 | MD | | 136 | 136 | 136 | 136 |
| 143 | TRU | 0.5 | 120 | 1454 | 171 | 120 |

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| PRODUCT CODE | PRODUCT MNEMONIC | ELEVATION | MIN SIZE (Bytes) | MAX SIZE (Bytes) | AVERAGE SIZE (Bytes) | MEDIAN SIZE (Bytes) |
|---|---|---|---|---|---|---|
| 143 | TRU | 1.5 | 120 | 1454 | 171 | 120 |
| 143 | TRU | 2.4 | 120 | 1454 | 171 | 120 |
| 143 | TRU | 3.3 | 120 | 1454 | 171 | 120 |
| 143 | TRU | 4.3 | 120 | 1454 | 171 | 120 |
| 143 | TRU | 6.0 | 120 | 1454 | 171 | 120 |
| 143 | TRU | 9.9 | 120 | 1454 | 171 | 120 |
| 143 | TRU | 14.6 | 120 | 1454 | 171 | 120 |
| 143 | TRU | 19.5 | 120 | 120 | 120 | 120 |
| 144 | OSW | | | | | |
| 145 | OSD | | | | | |
| 146 | SSW | | | | | |
| 147 | SSD | | | | | |
| 150 | USW | | | | | |
| 151 | USD | | | | | |
| 152 | ASP | | TBD | TBD | TBD | TBD |

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**Table XV. X-25 Bandwidth Estimation for an Example Class 1 User RPS List (See Note 1)**

| Product Code | Product Name | Elevation | Estimated Size (bytes) | With X.25 Overhead (Note 2) | Total | With Satcom X.25 Overhead (Note 3) | Satcom Total |
|---|---|---|---|---|---|---|---|
| 2 | GSM | | 124 | 8 | 132 | 8 | 132 |
| 19 | R | .5 | 29250 | 1832 | 31082 | 784 | 30034 |
| 19 | R | 1.5 | 29250 | 1832 | 31082 | 784 | 30034 |
| 19 | R | 2.4 | 29250 | 1832 | 31082 | 784 | 30034 |
| 19 | R | 3.4 | 29250 | 1832 | 31082 | 784 | 30034 |
| 26 | V | .5 | 24250 | 1520 | 25770 | 704 | 24954 |
| 27 | V | 1.5 | 21750 | 1360 | 23110 | 664 | 22414 |
| 27 | V | 3.4 | 21750 | 1360 | 23110 | 664 | 22414 |
| 27 | V | 6.2 | 21750 | 1360 | 23110 | 664 | 22414 |
| 27 | V | | 21750 | 1360 | 23110 | 664 | 22414 |
| 33 | HSR | | 28250 | 1768 | 30018 | 768 | 29018 |
| 37 | CR | | 45250 | 2832 | 48082 | 1352 | 46602 |
| 56 | SRM | .5 | 20750 | 1304 | 22054 | 648 | 21398 |
| 56 | SRM | 1.5 | 20750 | 1304 | 22054 | 648 | 21398 |
| 56 | SRM | 2.4 | 20750 | 1304 | 22054 | 648 | 21398 |
| 56 | SRM | 3.4 | 20750 | 1304 | 22054 | 648 | 21398 |
| 56 | SRM | 4.3 | 20750 | 1304 | 22054 | 648 | 21398 |
| 56 | SRM | 7.5 | 20750 | 1304 | 22054 | 648 | 21398 |
| 57 | VIL | | 2750 | 176 | 2926 | 48 | 2798 |
| 58 | STI | | 19500 | 1224 | 20724 | 472 | 19972 |
| 59 | HI | | 11750 | 736 | 12486 | 344 | 12094 |
| 60 | M | | 5750 | 360 | 6110 | 96 | 5846 |
| Total Bytes Transferred per 5 Minute Scan | | | | | 495872 | - | |
| Total Bits Transferred in 300 Second Scan | | | | | 3966976 | - | |
| Bandwidth Required in Bits per second (bps) | | | | | 13223.25 | - | |
| Total Bytes Transferred per 5 Minute Scan | | | | | | | 480104 |
| Total Bits Transferred in 300 Second Scan | | | | | | | 3840832 |
| Bandwidth Required in Bits per second (bps) | | | | | | | 12802.77 |

Note 1: Assumption is VCP 11, which uses a 5 minute (300 sec) scan strategy. This example calculation would be typical of estimating bandwidth for a Class 1 user. The Class 1 user has a dedicated connection and should send a Routine Product Set (RPS) list request dependent upon VCP or precipitation detection. This example does not account for the initial connection data exchanges, e.g. Product codes 6, 7, and 8 or Class 1 (e.g. PUP) status exchanges. Nor does the example include overhead attributed to protocol acknowledgements.

Note 2: If product size is < 10240 bytes, then data packet overhead is calculated as follows:

Let P = Product Size, X.25/LAPB/Flag Overhead = 8 bytes

[dividend of (P ÷ 128) + 1] x 8 bytes

If product size is > 10240 bytes or multiple of 10240 bytes, then data packet overhead is calculated:

80 x [dividend of (P ÷ 10240)] x [((Remainder of (P ÷10240)) ÷ 128) + 1] x 8 bytes

Note 3: If product size is < 10240 bytes, then data packet overhead is calculated as follows:

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Let P = Product Size, X.25/LAPB/Flag Overhead = 8 bytes

[dividend of (P ÷ 512) + 1] x 8 bytes

If product size is > 10240 bytes or multiple of 10240 bytes, then data packet overhead is calculated:

40 x [dividend of (P ÷ 10240)] x [((Remainder of (P ÷ 10240)) ÷ 512) + 1] x 8 bytes

**Bandwidth Estimation Example**

The estimated transfer rates for an example Class 1 user RPS list are tabulated below. The estimates only include routine products and not additional one time request (OTR). As indicated in Note 1, this example is for the worse case coverage pattern. VCP 11 is a 14 elevation scan strategy completed in 5 minutes (300 seconds). Omitted in estimates is the additional payload of protocol acknowledgements. The estimate does include calculation for both the default NEXRAD X.25 configuration of 128 byte data packets and the communications option packet size of 512 bytes for each data packet. Reference section 7.1 Ten Kilobyte Segmentation of 2620040, ICD for RPG X.25 Protocol for more detail on the 10240 byte product segmentation. The X.25/LAPB overhead consists of: 3 bytes for X.25 + 4 bytes for LAPB + 1 byte for the inter-frame flag.

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## Table XVI. - VCP 211 Product Sizes

| PRODUCT CODE | PRODUCT MNEMONIC | ELEVATION | MIN SIZE (Bytes) | MAX SIZE (Bytes) | AVERAGE SIZE (Bytes) | MEDIAN SIZE (Bytes) |
|---|---|---|---|---|---|---|
| 39 | R | 1.5 | 13340 | 16328 | 15428 | 15828 |
| 39 | R | 2.4 | 13686 | 16520 | 15456 | 15698 |
| 39 | R | 3.3 | 13236 | 16942 | 15373 | 15596 |
| 39 | R | 4.3 | 12502 | 16450 | 14927 | 15296 |
| 28 | R | 0.5 | 14332 | 15928 | 15017 | 15121 |
| 28 | R | 1.5 | 10690 | 12322 | 11658 | 11885 |
| 28 | R | 2.4 | 10482 | 12474 | 11688 | 11897 |
| 28 | R | 3.3 | 10310 | 12468 | 11684 | 11954 |
| 29 | R | 4.3 | 10194 | 12096 | 11424 | 11650 |
| 39 | R | 0.5 | 15338 | 16780 | 16018 | 16068 |
| 39 | R | 1.5 | 11020 | 12736 | 12148 | 12302 |
| 39 | R | 2.4 | 9924 | 11486 | 10920 | 11024 |
| 37 | R | 3.3 | 8890 | 10806 | 10106 | 10198 |
| 37 | R | 4.3 | 7854 | 9980 | 9189 | 9382 |
| 28 | R | 0.5 | 12716 | 13950 | 13391 | 13477 |
| 28 | R | 1.5 | 9356 | 10304 | 9878 | 9937 |
| 28 | R | 2.4 | 8242 | 9132 | 8746 | 8823 |
| 28 | R | 3.3 | 7332 | 8354 | 7961 | 8077 |
| 29 | R | 4.3 | 6522 | 7676 | 7225 | 7356 |
| 28 | R | 0.5 | 9892 | 10864 | 10387 | 10411 |
| 28 | R | 1.5 | 7508 | 8326 | 7969 | 8034 |
| 28 | R | 2.4 | 6694 | 7686 | 7317 | 7393 |
| 28 | R | 3.3 | 6336 | 7410 | 6949 | 7067 |
| 29 | R | 4.3 | 5638 | 6860 | 6395 | 6504 |
| 28 | R | 0.5 | 8484 | 9310 | 8890 | 8882 |
| 28 | R | 1.5 | 6566 | 7086 | 6806 | 6809 |
| 28 | R | 2.4 | 5812 | 6424 | 6153 | 6212 |
| 28 | R | 3.3 | 5374 | 5950 | 5696 | 5749 |
| 29 | R | 4.3 | 4786 | 5522 | 5232 | 5284 |
| 39 | SW | 0.5 | 39028 | 47066 | 41744 | 40978 |
| 37 | SW | 1.5 | 22946 | 33990 | 28308 | 28046 |
| 37 | SW | 2.4 | 14076 | 21188 | 17735 | 17758 |
| 37 | SW | 3.3 | 12980 | 18858 | 15716 | 15398 |
| 37 | SW | 4.3 | 13062 | 17818 | 14913 | 14338 |
| 28 | SW | 0.5 | 35404 | 42236 | 38301 | 38077 |
| 28 | SW | 1.5 | 18430 | 25802 | 21467 | 21030 |
| 28 | SW | 2.4 | 13584 | 19014 | 15584 | 15223 |
| 29 | SW | 3.3 | 13402 | 17810 | 15204 | 14948 |
| 29 | SW | 4.3 | 13814 | 17298 | 15073 | 14906 |
| 39 | SW | 0.5 | 25088 | 29366 | 26522 | 25654 |
| 39 | SW | 1.5 | 15972 | 20440 | 18091 | 18068 |
| 39 | SW | 2.4 | 12430 | 15966 | 14127 | 13932 |
| 39 | SW | 3.3 | 12154 | 14942 | 13482 | 13442 |
| 37 | SW | 4.3 | 11988 | 13928 | 12789 | 12758 |
| 39 | V | 0.5 | 28664 | 35648 | 31199 | 30642 |
| 37 | V | 1.5 | 19884 | 25530 | 22480 | 22104 |
| 37 | V | 2.4 | 15996 | 20588 | 17998 | 17944 |

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| PRODUCT CODE | PRODUCT MNEMONIC | ELEVATION | MIN SIZE (Bytes) | MAX SIZE (Bytes) | AVERAGE SIZE (Bytes) | MEDIAN SIZE (Bytes) |
|---|---|---|---|---|---|---|
| 37 | V | 3.3 | 15498 | 19208 | 16971 | 16534 |
| 37 | V | 4.3 | 13158 | 18368 | 16450 | 16284 |
| 28 | V | 0.5 | 27228 | 38210 | 31015 | 29361 |
| 28 | V | 1.5 | 19306 | 26684 | 22335 | 22418 |
| 28 | V | 2.4 | 15836 | 19640 | 17648 | 17430 |
| 29 | V | 3.3 | 15914 | 18104 | 16764 | 16618 |
| 29 | V | 4.3 | 13080 | 17156 | 16274 | 16248 |
| 28 | V | 0.5 | 26238 | 31782 | 28561 | 28170 |
| 28 | V | 1.5 | 16748 | 21198 | 18317 | 17895 |
| 28 | V | 2.4 | 14712 | 17730 | 15888 | 15527 |
| 29 | V | 3.3 | 15040 | 17798 | 16055 | 15730 |
| 29 | V | 4.3 | 15082 | 17272 | 16155 | 16188 |
| 28 | V | 0.5 | 25982 | 35150 | 29308 | 27940 |
| 28 | V | 1.5 | 17126 | 22718 | 19210 | 18948 |
| 28 | V | 2.4 | 15032 | 17658 | 16228 | 16137 |
| 29 | V | 3.3 | 15226 | 17084 | 16048 | 15838 |
| 29 | V | 4.3 | 15344 | 17416 | 16387 | 16412 |
| 39 | V | 0.5 | 20354 | 24284 | 21727 | 21184 |
| 39 | V | 1.5 | 15326 | 18000 | 16374 | 16238 |
| 39 | V | 2.4 | 13156 | 15626 | 14229 | 14028 |
| 39 | V | 3.3 | 13258 | 14982 | 14003 | 13824 |
| 39 | V | 4.3 | 12134 | 14190 | 13558 | 13628 |
| 39 | V | 0.5 | 20606 | 26248 | 22318 | 21440 |
| 37 | V | 1.5 | 15358 | 19172 | 16750 | 16692 |
| 37 | V | 2.4 | 13162 | 15510 | 14152 | 14142 |
| 37 | V | 3.3 | 13078 | 14560 | 13700 | 13722 |
| 37 | V | 4.3 | 12088 | 13876 | 13349 | 13336 |
| 37 | CR | | 31432 | 34754 | 33057 | 32713 |
| 35 | CR | | 24428 | 26228 | 25312 | 25174 |
| 38 | CR | | 6732 | 10084 | 7184 | 7041 |
| 36 | CR | | 6052 | 6196 | 6136 | 6140 |
| 41 | ET | | 2080 | 2234 | 2161 | 2171 |
| 59 | HI | | 3560 | 8916 | 5617 | 5607 |
| 48 | VSP | | 6742 | 11546 | 10897 | 11458 |
| 63 | LRA | | 2142 | 2364 | 2293 | 2310 |
| 64 | LRA | | 2046 | 2230 | 2118 | 2114 |
| 65 | LRM | | 2744 | 2960 | 2876 | 2883 |
| 66 | LRM | | 2236 | 2454 | 2345 | 2351 |
| 60 | M | | 2112 | 2388 | 2136 | 2112 |
| 67 | APR | | 2698 | 2922 | 2829 | 2839 |
| 62 | SS | | 4926 | 9710 | 6959 | 6852 |
| 58 | STI | | 3466 | 11240 | 6561 | 6113 |
| 31 | USP | | 520 | 16428 | 6230 | 520 |
| 32 | DHR | | 29653 | 32666 | 30982 | 30742 |
| 33 | HSR | | 18122 | 19608 | 18609 | 18490 |
| 39 | SRM | 0.5 | 19346 | 24414 | 21628 | 21290 |
| 39 | SRM | 1.5 | 15702 | 18484 | 16570 | 16402 |
| 39 | SRM | 2.4 | 13250 | 16438 | 14595 | 14346 |
| 39 | SRM | 3.3 | 13420 | 15594 | 14374 | 14262 |

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| PRODUCT CODE | PRODUCT MNEMONIC | ELEVATION | MIN SIZE (Bytes) | MAX SIZE (Bytes) | AVERAGE SIZE (Bytes) | MEDIAN SIZE (Bytes) |
|---|---|---|---|---|---|---|
| 39 | SRM | 4.3 | 12696 | 15092 | 14044 | 14092 |
| 28 | SRR | 0.5 | 11214 | 15692 | 12913 | 12374 |
| 28 | SRR | 1.5 | 8936 | 12224 | 9881 | 9602 |
| 28 | SRR | 2.4 | 7938 | 10270 | 8859 | 8595 |
| 29 | SRR | 3.3 | 7602 | 9696 | 8497 | 8296 |
| 29 | SRR | 4.3 | 6856 | 9014 | 8296 | 8392 |
| 61 | TVS | | 2112 | 2112 | 2112 | 2112 |
| 51 | VCS | | 1628 | 1718 | 1670 | 1670 |
| 50 | RCS | | 1490 | 1556 | 1526 | 1530 |
| 57 | VIL | | 1670 | 1868 | 1783 | 1780 |
| 28 | DBV | 0.5 | 44070 | 44070 | 44070 | 44070 |
| 28 | DBV | 1.5 | 44070 | 44070 | 44070 | 44070 |
| 28 | DBV | 2.4 | 44070 | 44070 | 44070 | 44070 |
| 29 | DBV | 3.3 | 36870 | 36870 | 36870 | 36870 |
| 29 | DBV | 4.3 | 28950 | 28950 | 28950 | 28950 |
| 32 | DR | 0.5 | 31931 | 35059 | 33479 | 33728 |
| 32 | DR | 1.5 | 22152 | 24610 | 23090 | 22967 |
| 33 | DR | 2.4 | 18843 | 21128 | 19944 | 19815 |
| 33 | DR | 3.3 | 19446 | 20637 | 20139 | 20095 |
| 33 | DR | 4.3 | 17449 | 20041 | 19212 | 19442 |
| 32 | DV | 0.5 | 77061 | 87291 | 82648 | 83138 |
| 33 | DV | 1.5 | 52250 | 60582 | 55679 | 55362 |
| 33 | DV | 2.4 | 40554 | 49827 | 44335 | 43866 |
| 33 | DV | 3.3 | 45061 | 47971 | 46152 | 46113 |
| 33 | DV | 4.3 | 42894 | 47465 | 44823 | 44634 |
| 78 | OHP | | 5734 | 11070 | 9075 | 10414 |
| 79 | THP | | 5816 | 9070 | 6900 | 5816 |
| 80 | STP | | 8448 | 11010 | 10255 | 10314 |
| 81 | DPA | | 2592 | 9342 | 6914 | 8614 |
| 82 | SPD | | 2834 | 2834 | 2834 | 2834 |
| 84 | VAD | | 5396 | 6846 | 6094 | 6112 |
| 85 | RCS | | 1488 | 1540 | 1518 | 1522 |
| 86 | VCS | | 1632 | 1712 | 1672 | 1676 |
| 89 | LRA | | 1520 | 1618 | 1561 | 1566 |
| 90 | LRM | | 1848 | 2096 | 2005 | 2010 |
| 97 | CRE | | 30854 | 32906 | 31885 | 31998 |
| 95 | CRE | | 24100 | 25840 | 24784 | 24666 |
| 98 | CRE | | 6822 | 8718 | 7039 | 6974 |
| 96 | CRE | | 5986 | 7800 | 6157 | 6096 |
| 74 | RCM | | 1940 | 2290 | 2173 | 2220 |
| 39 | CLR | 0.5 | 30326 | 33624 | 31654 | 31070 |
| 37 | CLR | 1.5 | 24974 | 26820 | 25647 | 25388 |
| 37 | CLR | 2.4 | 22610 | 24240 | 23366 | 23210 |
| 37 | CLR | 3.3 | 22774 | 23564 | 23233 | 23244 |
| 37 | CLR | 4.3 | 21616 | 23152 | 22458 | 22410 |
| 39 | CLD | 0.5 | 30764 | 33752 | 32226 | 31798 |
| 37 | CLD | 1.5 | 24166 | 26242 | 25168 | 25070 |
| 37 | CLD | 2.4 | 21450 | 24170 | 22445 | 22326 |
| 37 | CLD | 3.3 | 22402 | 23534 | 22820 | 22772 |

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| PRODUCT CODE | PRODUCT MNEMONIC | ELEVATION | MIN SIZE (Bytes) | MAX SIZE (Bytes) | AVERAGE SIZE (Bytes) | MEDIAN SIZE (Bytes) |
|---|---|---|---|---|---|---|
| 37 | CLD | 4.3 | 21818 | 23308 | 22510 | 22508 |
| 134 | DVL | | 23572 | 26483 | 25262 | 25340 |
| 135 | EET | | 10162 | 12049 | 11223 | 11422 |
| 136 | SO | | 105782 | 108860 | 107170 | 106869 |
| 137 | ULR | | 21048 | 21870 | 21402 | 21338 |
| 138 | DSP | | 44628 | 44628 | 44628 | 44628 |
| 39 | MRU | 0.5 | 120 | 828 | 174 | 120 |
| 39 | MRU | 1.5 | 120 | 828 | 192 | 120 |
| 39 | MRU | 2.4 | 120 | 828 | 192 | 120 |
| 39 | MRU | 3.3 | 120 | 828 | 192 | 120 |
| 39 | MRU | 4.3 | 120 | 992 | 233 | 120 |
| 140 | GFM | | 248 | 2580 | 993 | 248 |
| 141 | MD | | 120 | 120 | 120 | 120 |
| 39 | TRU | 0.5 | 120 | 120 | 120 | 120 |
| 39 | TRU | 1.5 | 120 | 120 | 120 | 120 |
| 39 | TRU | 2.4 | 120 | 120 | 120 | 120 |
| 39 | TRU | 3.3 | 120 | 120 | 120 | 120 |
| 39 | TRU | 4.3 | 120 | 120 | 120 | 120 |
| 144 | OSW | | 2836 | 21556 | 15304 | 20462 |
| 145 | OSD | | 2836 | 24756 | 16519 | 21854 |
| 146 | SSW | | 2836 | 17304 | 15065 | 15710 |
| 147 | SSD | | 2836 | 16850 | 14692 | 15236 |
| 32 | DMD | 0.5 | 736 | 1841 | 1000 | 1052 |
| 33 | DMD | 1.5 | 748 | 2291 | 1144 | 1064 |
| 33 | DMD | 2.4 | 760 | 2454 | 1344 | 1403 |
| 33 | DMD | 3.3 | 772 | 2427 | 1381 | 1427 |
| 33 | DMD | 4.3 | 780 | 2430 | 1377 | 1428 |
| 150 | USW | | 3082 | 3082 | 3082 | 3082 |
| 151 | USD | | 3082 | 3082 | 3082 | 3082 |

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## APPENDIX D. PRODUCT DATA COMPRESSION USING BZIP2

In order to decompress products having been compressed using bzip2, the libbzip2 library, version 1.0.1 or higher, is required. The source code can be found at the official home page (URL): **http://sources.redhat.com/bzip2**. This web site contains complete instructions on building the libbzip2 library on a wide range of computer architectures and operating systems. Detailed documentation of the various library functions is also provided.
Within libbzip2, the library function that should be used to decompress the data is:

```
BZ2_bzBuffToBuffDecompress( char *dest,
    unsigned intdestLen,
    char *source,
    unsigned intsourceLen,
    intsmall,
    int verbosity).
```

The destination buffer "dest" holds the decompressed product. The destination buffer size "destLen" must be at least as large as the sum of the Message Header block, Product Description block and the compressed product data size given by the Product Dependent Parameters (see Table V). The source "source" points to the compressed product data immediately following the Product Description block. The source length "sourceLen" is the total product size (defined in the Message Header block), less the size of the Message Header and Product Description blocks. Depending on the architecture, "small" can either be 0 (normal case) or non-zero. By specifying a non-zero value for "small", the library requires less memory utilization at the expense of increased decompression time. The verbosity level can take on any value from 0 to 4 inclusive with higher values denoting greater verbosity.
After the product is decompressed, the products Message Header and Product Description blocks can be prepended to the decompressed product data.

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## APPENDIX E. GENERIC PRODUCT FORMAT

The Generic Product Format is designed to be a flexible, platform independent data format wherein the information describing the data is contained in the data itself. Information for each product that typically has been included in this interface control document such as the parameter's definition, type, range, precision and scaling, is encoded in the data structures defined in this appendix.
The first item within the deserialized data will be the Product Description data structure (for packet 28 data) or the External Data Description data structure (for packet 29 data). The Product Description data structure is defined in Figure E-1. The External Data Description data structure is defined in Figure E-1b. Additional product data is determined by the values of "Parameter List" and "Component List". The Parameter List is defined in Figure E-2. The possible Component List data structures are defined in Figures E-3 through E-11.

The following conventions will be used for describing data structure element types:

| | |
|---|---|
| Byte/Char | One byte (8 bits) |
| INT*2 | 2 byte, signed integer data |
| INT*4 | 4 byte, signed integer data |
| UINT*4 | 4 byte, unsigned integer data |
| REAL*4 | 4 byte, floating point data adhering to IEEE-754-1985 standard |
| String | NULL (0) terminated array of ASCII coded characters, each character occupying 1 byte |
| Pointer | Contains the address of a data item. Size is architecture dependent. |

| |
|---|
| NAME |
| DESCRIPTION |
| CODE |
| TYPE |
| GENERATION TIME |
| RADAR NAME |
| RADAR LATITUDE |
| RADAR LONGITUDE |
| RADAR HEIGHT |
| VOLUME SCAN START TIME |
| ELEVATION SCAN START TIME |
| ELEVATION ANGLE |
| VOLUME SCAN NUMBER |
| OPERATIONAL MODE |
| VOLUME COVERAGE PATTERN |
| ELEVATION NUMBER |
| SPARE |
| SPARE |
| NUMBER OF PARAMETERS |
| PARAMETER LIST |
| NUMBER OF COMPONENTS |
| COMPONENT LIST |

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**Figure E-1. Product Description Data Structure (Sheet 1)**

| FIELD NAME | TYPE | UNITS | RANGE | PRECISION/ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Name | String | N/A | N/A | N/A | Product name |
| Description | String | N/A | N/A | N/A | Product description (may contain version information) |
| Code | INT*4 | N/A | See Table II | N/A | Product code |
| Type | INT*4 | N/A | 1 to 7 | 1/1 | 1=Volume, 2=Elevation, 3=Time, 4=On Demand, 5=On Request, 6=Radial, 7=External |
| Generation Time | UINT*4 | Seconds | 0 to 4294967295 | 1/0.5 | Product generation time. See Note 1. |
| Radar Name | String | N/A | N/A | N/A | Null or empty string indicates the radar name is not applicable |
| Radar Latitude | REAL*4 | Degrees | -90.0 to +90.0 | N/A | Only applicable if radar name specified. |
| Radar Longitude | REAL*4 | Degrees | -180.0 to +180.0 | N/A | Only applicable if radar name specified. |
| Radar Height | REAL*4 | Meters | 30 to 3350 | N/A | Meters above mean sea level. |
| Volume Scan Start Time | UINT*4 | Seconds | 0 to 4294967295 | 1/0.5 | Volume scan start time. See Note 1. |
| Elevation Scan Start Time | UINT*4 | Seconds | 0 to 4294967295 | 1/0.5 | Used only if type is equal to 2. See Note 1. |
| Elevation Angle | REAL*4 | Degrees | -1.0 to +45.0 | N/A | Angle of elevation scan |
| Volume Scan Number | INT*4 | N/A | 1 to 80 | N/A | Counter, recycles to 1 |

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| FIELD NAME | TYPE | UNITS | RANGE | PRECISION/ACCURACY | REMARKS |
|---|---|---|---|---|---|
| | | | | | after 80 volume scans. |
| Operational Mode | INT*2 | N/A | 1 to 3 | N/A | 1=Test, 2=Clear Air, 3=Precipitation |
| Volume Coverage Pattern | INT*2 | N/A | 0 to 999 | N/A | Volume coverage pattern (VCP) number |
| Elevation Number | INT*2 | N/A | 1 to 20 | N/A | Elevation number within the VCP. Only used if type is equal to 2. |
| Spare | INT*2 | N/A | N/A | N/A | Spare (reserved for future compression type) |
| Spare | INT*4 | N/A | N/A | N/A | Spare (reserved for future decompressed size) |
| Number of Parameters | INT*4 | N/A | 0 to 1000 | N/A | Number of product specific parameters |
| Parameter List | Pointer to Structure | N/A | N/A | N/A | See Note 2 |
| Number of Components | INT*4 | N/A | 0 to 1000 | N/A | Number of product specific components |
| Component List | Pointer to Structure | N/A | N/A | N/A | See Note 3 |

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**Figure E-1. Product Description Data Structure (Sheet 2)**

**Note 1.** Specified in number of seconds elapsed since midnight GMT January 1, 1970 (Unix Time).
**Note 2.** Product Parameter data structure defined in Figure E-2.
**Note 3.** When the product contains multiple detected events, this is an array of pointers to Event Component data structures (see Figure E-10). A product can have any number of events. If there is only one event, this is an array of pointers, each of which points to one of the following product component structure types: Radial Component (Figure E-3), Grid Component (Figure E-5), Area Component (Figure E-6), Text Component (Figure E-8), or Table Component (Figure E-9). A product can have any number of components of mixed types.

| |
|---|
| NAME |
| DESCRIPTION |
| CODE |
| TYPE |
| GENERATION TIME |
| SPARE (MSW) |
| SPARE (LSW) |
| SPARE (MSW) |
| SPARE (LSW) |
| SPARE (MSW) |
| SPARE (LSW) |
| SPARE (MSW) |
| SPARE (LSW) |
| NUMBER OF PARAMETERS |
| PARAMETER LIST |
| NUMBER OF COMPONENTS |
| COMPONENT LIST |

**Figure E-1b. External Data Description Data Structure (Sheet 1)**

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| FIELD NAME | TYPE | UNITS | RANGE | PRECISION/ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Name | String | N/A | N/A | N/A | Product name |
| Description | String | N/A | N/A | N/A | Product description (may contain version information) |
| Code | INT*4 | N/A | See Table II | N/A | Product code |
| Type | INT*4 | N/A | 7 | 1/1 | Product type = External |
| Generation Time | UINT*4 | Seconds | 0 to 4294967295 | 1/0.5 | Product generation time. See Note 1. |
| Spare | INT*4 | N/A | N/A | N/A | Spare |
| Spare | INT*4 | N/A | N/A | N/A | Spare |
| Spare | INT*2 | N/A | N/A | N/A | Spare |
| Spare | INT*2 | N/A | N/A | N/A | Spare (reserved for future compression type) |
| Spare | INT*4 | N/A | N/A | N/A | Spare (reserved for future decompressed size) |
| Number of Parameters | INT*4 | N/A | 0 to 1000 | N/A | Number of product specific parameters |
| Parameter List | Pointer to Structure | N/A | N/A | N/A | See Note 2 |
| Number of Components | INT*4 | N/A | 0 to 1000 | N/A | Number of product specific components |
| Component List | Pointer to Structure | N/A | N/A | N/A | See Note 3 |

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**Figure E-1b. External Data Description Data Structure (Sheet 2)**

**Note 1**. Specified in number of seconds elapsed since midnight GMT January 1, 1970 (Unix Time).
**Note 2**. Product Parameter data structure defined in Figure E-2.
**Note 3**. When the product contains multiple detected events, this is an array of pointers to Event Component data structures (see Figure E-10). A product can have any number of events. If there is only one event, this is an array of pointers, each of which points to one of the following product component structure types: Radial Component (Figure E-3), Grid Component (Figure E-5), Area Component (Figure E-6), Text Component (Figure E-8), or Table Component (Figure E-9). A product can have any number of components of mixed types.

| PARAMETER ID |
|---|

| PARAMETER ATTRIBUTES |
|---|

**Figure E-2. Product Parameter Data Structure (Sheet 1)**

| FIELD NAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Parameter ID | String | N/A | N/A | N/A | Parameter identifier |
| Parameter Attributes | String | N/A | N/A | N/A | See Notes 1, 2. |

**Figure E-2. Product Parameter Data Structure (Sheet 2)**

**Note 1.** Format description of the ASCII-text parameter attributes:

1. The attributes are represented by an ASCII string. The string consists of a number of sections terminated by ";", each of which specifies an applicable attribute. ";" after the last section is optional. Each section must be in the form of "attribute name = attribute description" where "attribute name" must be one of the following: "name", "type", "unit", "range", "value", "default", "accuracy", "description", "conversion" and "exception". The attribute name is case-insensitive. That is, for example, "name", "Name" and "NAME" are all valid and identical. "attribute description" is a character string that describes the value of the attribute as explained in the following.
2. Attribute description:

"name": The name of the parameter. An example is "name = 2D feature altitude".

"type": One of the following type names: "int", "short", "byte" (4-byte, 2-byte and 1-byte integer respectively), "bit" (1-bit data), "float", "double" (4-byte and 8-byte IEEE floating point numbers respectively), "string" (ASCII character string), "unit", "ushort" and "ubyte" (unsigned versions of int, short and byte). An example is "type = int". If type is not specified, "int" is assumed. The type name is case-insensitive.

"unit": The physical unit of the data value. Standard unit names are to be defined. Examples are "unit = meter" and "unit = percent".

"range": The set of all valid values for the parameter. The range can be specified with one of the following three formats:

a. Single interval specification defined by "[min, max]" where "min" and "max" are respectively the minimum and maximum values. "[" and "]" can be replaced by "(" and ")" respectively if the boundary is not inclusive. Unlimited boundary is specified by "-". Examples are "range = [1, 2]", "range = (1, 2]", "range = [1., -)", "range = [A, Z]" (character string type), and "range = (-, -)".

b. A list of valid values: { v1, v2, ...}. Examples are "range = {1, 2, 3}" and "range = {reflectivity, velocity, spectrum width}.

c. A named method that checks the range. The method name is

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enclosed by "<" and ">". The method must be described elsewhere.

"value" and "default": A value or a list of values separated by ",". Examples are "value = 1", "value = 1.0, 2., 3.0" and "value = Yes, No".

"accuracy": The accuracy of the data. [max_error] is used for the absolute maximum error and (max_error) for the relative maximum error.

"description": A text description of the data.

"conversion": The way to convert binary data stored externally. The conversion can be specified with one of the following formats:

a. Format [scale, offset] is used for scale-offset type of conversion: value = data * scale + offset. An example is "conversion = [2., 64.]".

b. Format {valueMap, data1, value1, data2, value2, ...} for data mapping conversions. Where "valueMap" is a reserved key word. "data1", "data2" ... are the data and "value1", "value2" ... are the values to convert to. An example is "conversion = {valueMap, 1, -5., 2, 0., 3, 50., 4, 100.}".

c. Format <method> is used for named conversion method. The method must be described elsewhere.
Elements of binary data array are assumed to be stored one after another in the local byte order for types other than "bit" and "string". For type "bit", we assume that the elements are stored in a byte array each of which holds 8 elements. The first bit element is stored in the left-most bit in the bytes. For type "string", elements are null-terminated strings and stored one after another with the null terminator.

"exception": A list of the exceptional data values and their meanings. An example is "exception = 0, below threshold, 1, missing data". Standard vocabulary for describing exceptional values needs to be established in the future.

3. When characters ";", "=" and "," are used for formatting purpose, characters "space", "tab" and "line return" surrounding them are insignificant. That is, for example, "name = short", "name=short" and "name  =short" are all identical. Non-formatting use of ";" and "," are allowed if no ambiguity is introduced. In case of ambiguity, "\" can be used in front of characters ";" and "," to indicate that they are not interpreted as formatting characters. The part of "Attribute description" is case-sensitive except otherwise specified.

**Note 2.**

Component parameters are either definitive or descriptive. Definitive component parameters are required and predefined. Examples are:

The dimension size (number of grid points) for each dimension.

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The location of the origin and the coordinate orientation for certain grids.

For equally spaced grid, the step size for each dimension.

The altitude of a geo-area if the altitude is relevant.

The definitive component parameters must be predefined so the user of the product can interpret and display the data product-independently.

Descriptive component parameters, on the other hand, provide additional descriptions of the product component. Examples are the data field name, the intensity of the event, the forecast position and so on.

| |
|---|
| RADIAL COMPONENT TYPE (=1) |
| NUMBER OF COMPONENT PARAMETERS |
| COMPONENT PARAMETER LIST |
| NUMBER OF RADIALS |
| RADIAL DATA |

**Figure E-3. Radial Component Data Structure (Sheet 1)**

| FIELD NAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Radial Component Type | INT*4 | N/A | 1 | N/A | Radial component type |
| Description | String | N/A | N/A | N/A | Component Description |
| Number of Component Parameters | INT*4 | N/A | 1 to 1000 | N/A | Number of component parameters |
| Component Parameter List | Pointer to Structure | N/A | N/A | N/A | See Figure E-2 |
| Number of Radials | INT*4 | N/A | 0 to 800 | N/A | Number of radials in a radar elevation sweep |
| Radial Data | Pointer to Structure | N/A | N/A | N/A | See Figure E-4 |

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**Figure E-3. Radial Component Data Structure (Sheet 2)**

| |
|---|
| AZIMUTH |
| WIDTH |
| BIN SIZE |
| RANGE TO FIRST BIN |
| BIN VALUES |

**Figure E-4. Radial Information Data Structure (Sheet 1)**

| FIELD NAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Azimuth | REAL*4 | Degrees | 0.0 to 360.0 | N/A | Azimuth of |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | the leading edge of the radial |
| Width | REAL*4 | Degrees | 0.0 to 2.0 | N/A | Radial width or separation |
| Bin Size | REAL*4 | Meters | 0.0 to 1000.0 | N/A | Range extent of each bin |
| Range to First Bin | REAL*4 | Meters | 1000.0 to 460000.0 | N/A | Range to the center of the first bin |
| Bin Values | Structure | N/A | N/A | N/A | See Figure E-11 |

**Figure E-4. Radial Information Data Structure (Sheet 2)**

| |
|---|
| GRID COMPONENT TYPE (=2) |
| NUMBER OF DIMENSIONS |
| DIMENSIONS |
| GRID TYPE |
| NUMBER OF COMPONENT PARAMETERS |
| COMPONENT PARAMETER LIST |
| GRID DATA |

**Figure E-5. Grid Component Data Structure (Sheet 1)**

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| FIELD NAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Grid Component Type | INT*4 | N/A | 2 | N/A | Grid component type |
| Number of Dimensions | INT*4 | N/A | 1 to 4 | N/A | Number of grid dimensions |
| Dimensions | Pointer to INT*4 | N/A | N/A | N/A | Grid dimensions, ordered from fastest changing to slowest. |
| Grid Type | INT*4 | N/A | 1 to 4 | N/A | 1=Array, 2=Equally spaced, 3=Lat/Lon, 4=Polar |
| Number of Component Parameters | INT*4 | N/A | 1 to 1000 | N/A | Number of component parameters |
| Component Parameter List | Pointer to Structure | N/A | N/A | N/A | See Figure E-2. See Note 1. |
| Grid Data | Structure | N/A | N/A | N/A | See Figure E-11. |

**Figure E-5. Grid Component Data Structure (Sheet 2)**

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**Note 1.** Grid origin and dimension sizes are defined by component parameters. For equally spaced dimensions, we use component parameters for specifying the step sizes. For each unequally spaced grid dimension, we use an additional 1-D grid component to specify the grid pointer locations in that dimension.

| |
|---|
| AREA COMPONENT TYPE (=3) |
| NUMBER OF COMPONENT PARAMETERS |
| COMPONENT PARAMETER LIST |
| AREA TYPE |
| NUMBER OF POINTS |
| LIST OF POINTS |

**Figure E-6. Area Component Data Structure (Sheet 1)**

| FIELD NAME | TYPE | UNITS | RANGE | PRECISION/ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Area Component Type | INT*4 | N/A | 3 | N/A | Area component type |
| Number of Component Parameters | INT*4 | N/A | 1 to 1000 | N/A | Number of component parameters |
| Component Parameter List | Pointer to Structure | N/A | N/A | N/A | See Figure E-2 |
| Area Type | INT*4 | N/A | 1 to 131075 | N/A | 0x00001=Point (Lat/Lon), 0x00002=Area (Lat/Lon), 0x00003=Polyline (Lat/Lon), 0x10001=Point (X/Y), 0x10002=Area (X/Y), 0x10003=Polyline (X/Y), 0x20001=Point (Az/Ran), 0x20002=Area (Az/Ran), 0x20003=Polyline (Az/Ran) |
| Number of Points | INT*4 | N/A | 1 to 10000 | N/A | Number of data points |
| List of Points | Pointer to Structure | N/A | N/A | N/A | See Figure E-7a, E-7b, and E-7c. |

**Figure E-6. Area Component Data Structure (Sheet 2)**

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| |
|---|
| LATITUDE |
| LONGITUDE |

**Figure E-7a. Geographic Location Data Structure (Sheet 1)**

| FIELD NAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Latitude | REAL*4 | Degrees | -90.0 to +90.0 | N/A | Latitude location of data point |
| Longitude | REAL*4 | Degrees | -180.0 to +180.0 | N/A | Longitude location of data point |

**Figure E-7a. Geographic Location Data Structure (Sheet 2)**

| |
|---|
| X COORDINATE |
| Y COORDINATE |

**Figure E-7b. X/Y Location Data Structure (Sheet 1)**

| FIELD NAME | TYPE | UNITS | RANGE | PRECISION/ACCURACY | REMARKS |
|---|---|---|---|---|---|
| X Coordinate | REAL*4 | km | N/A | N/A | X-coordinate of data |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | point (See Note 1) |
| Y Coordinate | REAL*4 | km | N/A | N/A | Y-coordinate of data point (See Note 1) |

**Figure E-7b. X/Y Location Data Structure (Sheet 2)**

**Note 1.** The default unit for the X/Y location structure is kilometers (km). If a different unit is required, it must be specified in the component parameters.

| |
|---|
| AZIMUTH |
| RANGE |

**Figure E-7c. Az/Ran Location Data Structure (Sheet 1)**

| FIELD NAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Azimuth | REAL*4 | Degrees | N/A | N/A | Azimuth of data point |
| Range | REAL*4 | km | N/A | N/A | Range of data point (See Note 1) |

**Figure E-7c. Az/Ran Location Data Structure (Sheet 2)**

**Note 1.** The default unit for range is kilometers. If a different unit is required, it must be specified in the component parameters.

| |
|---|
| TEXT COMPONENT TYPE (=4) |
| NUMBER OF COMPONENT PARAMETERS |
| COMPONENT PARAMETER LIST |
| TEXT |

**Figure E-8. Text Component Data Structure (Sheet 1)**

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| FIELD NAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Text Component Type | INT*4 | N/A | 4 | N/A | Text component type |
| Number of Component Parameters | INT*4 | N/A | 1 to 1000 | N/A | Number of component parameters |
| Component Parameter List | Pointer to Structure | N/A | N/A | N/A | See Figure E-2 |
| Text | String | N/A | N/A | N/A | ASCII string |

**Figure E-8. Text Component Data Structure (Sheet 2)**

| |
|---|
| TABLE COMPONENT TYPE (=5) |
| NUMBER OF COMPONENT PARAMETERS |
| COMPONENT PARAMETER LIST |
| TITLE |
| NUMBER OF COLUMNS |

| |
|---|
| NUMBER OF ROWS |
| COLUMN LABELS |
| ROW LABELS |
| ENTRIES |

**Figure E-9. Table Component Data Structure (Sheet 1)**

| FIELD NAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Table Component Type | INT*4 | N/A | 5 | N/A | Table component type |
| Number of Component Parameters | INT*4 | N/A | 1 to 1000 | N/A | Number of component parameters |
| Component Parameter List | Pointer to Structure | N/A | N/A | N/A | See Figure E-2 |
| Title | String | N/A | N/A | N/A | ASCII string |
| Number of Columns | INT*2 | N/A | 1 to 32768 | N/A | Number of columns in table |
| Number of Rows | INT*2 | N/A | 1 to 32768 | N/A | Number of rows in table |
| Column Labels | Pointer to Structure | N/A | N/A | N/A | See Figure E-12. |
| Row Labels | Pointer to Structure | N/A | N/A | N/A | See Figure E-12. |
| Entries | Structure | N/A | N/A | N/A | See Figure E-12. |

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**Figure E-9. Table Component Data Structure (Sheet 2)**

| |
|---|
| EVENT COMPONENT TYPE (=6) |
| NUMBER OF EVENT PARAMETERS |
| EVENT PARAMETER LIST |
| NUMBER OF COMPONENTS |
| COMPONENT LIST |

**Figure E-10. Event Component Data Structure (Sheet 1)**

| FIELD NAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Event Component Type | INT*4 | N/A | 6 | N/A | Event component type |
| Number of Event | INT*4 | N/A | 1 to 10000 | N/A | Number of event |

| | | | | | |
|---|---|---|---|---|---|
| Parameters | | | | | parameters |
| Event Parameter List | Pointer to Structure | N/A | N/A | N/A | See Figure E-2. |
| Number of Components | INT*4 | N/A | 1 to 1000 | N/A | Number of components |
| Component List | Pointer | N/A | N/A | N/A | See Note 1. |

**Figure E-10. Event Component Data Structure (Sheet 2)**

**Note 1.** An array of pointers each of which points to one of the product component structures. An event can have any number of components of mixed types. Possible types are Radial Component (Figure E-3), Grid Component(Figure E-5), Area Component (Figure E-6), Text Component (Figure E-8), and Table Component (Figure E-9).

| |
|---|
| ATTRIBUTES |
| DATA |

**Figure E-11. Binary Data Data Structure (Sheet 1)**

| FIELD NAME | TYPE | UNITS | RANGE | PRECISION/ ACCURACY | REMARKS |
|---|---|---|---|---|---|
| Attributes | String | N/A | N/A | N/A | See Figure E-2 Note 1. Attribute "type" is required. |
| Data | Pointer | N/A | N/A | N/A | See Note 1. |

**Figure E-11. Binary Data Data Structure (Sheet 2)**

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**Note 1.** The data is fully described by "Attributes". The attributes are used to interpret the data.

For Grid Component data (see Figure E-5), the gridded data are stored as a 1-dimensional array with the index of the first dimension varying the fastest.

For Table Component data, "Entries" is an "Number of Rows" X "Number of Columns" array with the row index varying the fastest.

| |
|---|
| TEXT STRING |

**Figure E-12. String Data Structure (Sheet 1)**

| FIELD NAME | TYPE | UNITS | RANGE | PRECISION/AC CURACY | REMARKS |
|---|---|---|---|---|---|
| Text String | String | N/A | N/A | N/A | ASCII coded characters terminated with a null character |

**Figure E-12. String Data Structure (Sheet 2)**