**INTERFACE CONTROL DOCUMENT
FOR THE
TDWR SPG
PRODUCT SPECIFICATION**

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INTRODUCTION

The Product Specification Interface Control Document is an internal engineering document for detail design criteria for the TDWR SPG SS meteorological products.

SCOPE

The product descriptions and the product range/resolution of the 23 March 2008 issue of 2810003, SPG System Specification for the NWS Use of TDWR, form the basis for the product specification. The specifications define special symbols and characters.

Appendix A contains standard and product specific units and dimensions, symbols, abbreviations, parameters and display features. These are also defined in each product specification.

Appendix B contains product display formats. Alphanumeric tabular formats are contained in C.

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1   REFLECTIVITY (R AND DR)

1.1   SS Product Description

"This product shall provide the reflectivity data displayable as an image[1] and formatted as a data array. For the image version, variations of the product shall be organized to provide various areas of coverage and display resolutions, while the data array version will provide the highest resolution available for the entire coverage area. Both versions will be limited to the lowest 70,000 feet AGL of the atmosphere. The product shall be generated for any azimuth scan at a single elevation angle based on user requirements. Each scan shall be updated once per volume scan time.   For the image version, each product shall be available for 16 reflectivity data levels, while 256 reflectivity data levels will be provided in the data array version. Each product shall include annotations for the product name, radar ID, time and date of scan, data level code, elevation angle, maximum data value (dBZ), radar position, radar elevation above MSL, and radar operational mode."

1.2   Display Format

The product is displayable in full- or quarter-screen format (see Appendix B).

1.2.1   Data Levels

For the image version, the range of data level values (dBZ) varies with TDWR SPG system (or agency) adaptation data. The range of reflectivity supported by the RDA is -30 to +80 dBZe.

1.2.2   Color Level Code Tables

The color level code used for display of the image version of reflectivity is AWIPS (or agency) system adaptation data. An examples color table is listed. With the exception of the end points, the lower value of the range is assigned to the individual colors displayed. The range of values for each is also indicated.

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"[1]Defines the form of presentation on a graphic display; not necessarily the form of transmission."

Color Level Codes

16-Level Code	Display dBZ	Range dBZ	Color Levels Code	Color
0	ND	SNR<TH, RF, OR dBZ<5	(00 00 00)	black
1	5	5≤dBZ<10	(9C 9C 9C)	medium gray
2	10	10≤dBZ<15	(76 76 76)	dark gray
3	15	15≤dBZ<20	(FF AA AA)	light pink
4	20	20≤dBZ<25	(EE 8C 8C)	medium pink
5	25	25≤dBZ<30	(C9 70 70)	dark pink
6	30	30≤dBZ<35	(00 FB 90)	light green
7	35	35≤dBZ<40	(00 BB 00)	medium green
8	40	40≤dBZ<45	(FF FF 70)	light yellow
9	45	45≤dBZ<50	(D0 D0 60)	dark yellow
A	50	50≤dBZ<55	(FF 60 60)	light red
B	55	55≤dBZ<60	(DA 00 00)	medium red
C	60	60≤dBZ<65	(AE 00 00)	dark red
D	65	65≤dBZ<70	(00 00 FF)	blue
E	70	70≤dBZ<75	(FF FF FF)	white
F	75	75≤dBZ	(E7 00 FF)	purple

Color Level Codes

8-Level Code	Display dBZ	Range dBZ	Color Levels Code	Color
0	ND	SNR<TH or dBZ<5	00 00 00)	black
1	5	5≤dBZ<18	(FF AA AA)	light pink
2	18	18≤dBZ<30	(C9 70 70)	dark pink
3	30	30≤dBZ<41	(00 BB 00)	medium green
4	41	41≤dBZ<46	(FF FF 70)	light yellow
5	46	46≤dBZ<50	(DA 00 00)	medium red
6	50	50≤dBZ<57	(00 00 FF)	blue
7	57	57≤dBZ	(FF FF FF)	white

1.2.3   Range/Data Resolution

The image products will be available for the range/resolution combinations as indicated.

Coverage Area (nmi Radius)	Resolution (nmi x deg)	Product Center
0 to 48	0.08 x 1	Radar location
0 to 225	0.16 x 1	Radar location

The data array product will be available for the range/resolution combination as indicated.

Coverage Area (nmi Radius)	Resolution (nmi x deg)	Product Center
0 to 48	0.08 x 1	Radar location
0 to 225	0.16 x 1	Radar location

1.3   Annotations

1.3.1   Alphanumeric

Standard Annotations (Appendix A, I(A))
Elevation Angle
Data Level Code
Maximum Data Value Detected

1.3.2   Special Symbols

None defined

1.4   Product Interaction

All overlay products are displayable on this product:
• Hail Index
• Mesocyclone
• Storm Tracking Information
• Tornado Vortex Signature

2   MEAN RADIAL VELOCITY (V AND DV)

2.1   SS Product Description

"This product shall provide the mean radial velocity data both displayable as an image and formatted as a data array. For the image version, the product shall be provided for the area of coverage and display resolution, while the data array version will provide the highest resolution available for the entire radar coverage area. Both versions will be limited to lowest 70,000 feet AGL of the atmosphere. The product shall be generated for any azimuth scan at a single elevation angle based on user requirements. Each scan shall be updated once per volume scan time. For the image version, the product shall include 16 mean radial velocity data levels, while 256 velocity data levels will be provided in the data array version. Each product shall include annotations for the product name, radar ID, time and date of scan, data level code, elevation angle, maximum data value detected (knots, positive and negative), radar position, radar elevation above MSL, and radar operational mode."

2.2   Display Format

The product is displayable in full- or quarter-screen format (see Appendix B).

2.2.1   Data Levels

For the image version, the range of mean radial velocity values will vary with TDWR SPG system (or agency) adaptation data. The data thresholds are site adaptable.
The range of values used is a function of operator option.

2.2.2   Color Level Code Tables

The color level code used for display of the image version of mean radial velocity is AWIPS system (or agency) adaptation data. An example of a currently defined color table is shown. With the exception of end point values the lower value of the velocity range is assigned to the individual colors displayed. The range of values for each is also indicated.

Color Level Codes

16-Level Code	Display knots	Range knots	Color Levels	
			Code	Color
0	ND	SNR<TH	(00 00 00)	black
1	-64	-64≥knots	(00 E0 FF)	light blue
2	-50	-50≥knots>-64	(00 80 FF)	medium blue
3	-36	-36≥knots>-50	(32 00 96)	dark blue
4	-26	-26≥knots>-36	(00 FB 90)	light green
5	-20	-20≥knots>-26	(00 BB 99)	medium green
6	-10	-10≥knots>-20	(00 8F 00)	dark green
7	-1	0≥knots>-10	(CD C9 9F)	light gray
8	0	0≤knots<+10	(76 76 76)	dark gray
9	+10	+10≤knots<+20	(F8 87 00)	medium orange
A	+20	+20≤knots<+26	(FF CF 00)	medium yellow
B	+26	+26≤knots<+36	(FF FF 00)	yellow
C	+36	+36≤knots<+50	(AE 00 00)	dark red
D	+50	+50≤knots<+64	(D0 70 00)	medium brown
E	+64	+64≤knots	(FF 00 00)	bright red
F	RF	RF	(77 00 7D)	dark purple

2.2.3   Range/Data Resolution

The image products will be available for the range/resolution combinations as indicated below.

Coverage Area (nmi Radius)	Resolution (nmi x deg)	Product Center
0 to 48	0.08 x 1	Radar location

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The data array product will be available for the range/resolution as indicated.

Coverage Area (nmi)	Resolution (nmi x deg)	Product Center
0 to 48	0.08 x 1	Radar location

2.3   Annotations

2.3.1   Alphanumeric

Standard Annotations (Appendix A, I(A))
Elevation Angle
Data Level Code
Maximum Data Value Detected (both positive and negative)

2.3.2   Special Symbols

None defined

2.4   Product Interaction

All overlay products are displayable on this product:
• Hail Index
• Mesocyclone
• Storm Tracking Information
• Tornado Vortex Signature.

3   SPECTRUM WIDTH (SW)

3.1   SS Product Description

"This product shall provide the radial velocity spectrum width data displayable as an image. Variations of the product shall be organized to provide various areas of coverage and display resolutions. The product shall be generated for any azimuth scan at a single elevation angle based on user requirements. Each scan shall be updated once per volume scan time. Each product shall be available for 8 spectrum width data levels. Each product shall include annotations for the product name, radar ID, time and date of scan, data level code, elevation angle, maximum data value detected (knots), radar position, radar elevation above MSL, and radar operational mode."

3.2   Display Format

The product is displayable in full- or quarter-screen format (see Appendix B).

3.2.1   Data Levels

The range of spectrum width data values displayed is from 1 to 20 kts. Any levels exceeding 20 kts will be truncated to 20 kts.

3.2.2   Color Level Code Tables

The color level code used for display of spectrum width is AWIPS system (or agency) adaptation data. The currently defined color table for spectrum width is listed.

8-Level Code	Display knots	Range knots	Color Levels Code	Color
0	ND	SNR<TH	(00 00 00)	black
1	0	knots<4	(76 76 76)	dark gray
2	4	4≤knots<8	(9C 9C 9C)	medium gray
3	8	8≤knots<12	(00 BB 00)	medium green
4	12	12≤knots<16	(FF 00 00)	bright red
5	16	16≤knots<20	(D0 70 00)	medium brown
6	20	20≤knots	(FF FF 00)	yellow
7	RF	RF	(77 00 7D)	dark purple

3.2.3   Range/Data Resolution

The products will be available for the range/resolution combination as indicated below.

Coverage Area (nmi Radius)	Resolution (nmi x deg)	Product Center
0 to 48	0.08 x 1	Radar location

3.3   Annotations

3.3.1   Alphanumeric

Standard Annotations (Appendix A, I(A))
Elevation Angle
Data Level Code
Maximum Data Value Detected

3.3.2   <u>Special Symbols</u>

None defined

3.4   Product Interaction

All overlay products are displayable on this product:
• Hail Index
• Mesocyclone
• Severe Weather Probability
• Storm Tracking Information
• Tornado Vortex Signature.

4   DELETED

5   DELETED

6 COMPOSITE REFLECTIVITY (CR)

6.1 SS Product Description

"This product shall provide composite reflectivity data displayable as an image. For each geographical resolution element, this product shall provide the highest reflectivity value above the resolution element available from any elevation angle scan of a volume scan. This product shall be updated once per TDWR SPG mini-volume scan and will use all elevations scanned by TDWR. The product shall be available for both 8 and 16 reflectivity data levels. The product shall include annotations for the product name, radar ID, time and date of scan, data level code, maximum data value (dBZ), radar position, radar elevation above MSL and radar operational mode. In addition, storm information generated by the various meteorological algorithms, e.g. the Storm Cell Identification & Tracking (SCIT) algorithm and Tornado Detection Algorithm (TDA) shall be included as annotations or graphic overlays, or both, as the user selects. When selected, the algorithm generated information shall be provided for all identified storms. When these additional annotations or overlays are selected by the user, they shall be provided routinely until deselected. The information in these optional overlays and annotations shall be updated once per volume scan time."

6.2 Display Format

6.2.1 Graphic Display

The product is displayable in full-screen or quarter-screen format (see Appendix B).

6.2.1.1 Data Display

6.2.1.1.1 Data-Levels

The range of data level values vary with area climatology and season, and is TDWR SPG system (or agency) adaptation data.

6.2.1.1.2 Color Level Code Tables

The color level code used for display of reflectivity is AWIPS (or agency) adaptation data. Currently defined color tables for both 8 and 16 levels are listed in the product specification 1.2.2.

6.2.1.2 Range/Data Resolution

For maximum compatibility with WSR-88D product display systems, the coverage area of this product will match the WSR-88D. However, data beyond 48 nmi will be coded as ND (No Data).

Coverage Area (nmi radius)	Resolution (nmi x nmi)	Product Center
124	0.54 x 0.54	Radar Location
248	2.2 x 2.2	Radar Location

6.2.1.3 Graphic Overlay

Not Applicable

6.2.2 Alphanumeric Display

Not Applicable

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6.3   Annotations

Combined Attribute Table (Configuration 5, Format III, Appendix B)

6.3.1   <u>Alphanumeric</u>

Standard Annotations (Appendix A, I(A))
Data Level Code
Maximum (CR) Data Value Detected

6.3.2   <u>Special Symbols</u>

None defined

6.4   Product Interaction

The following overlay prod Color Levels products are displayable on this product:
• Attribute Tables
• Hail
• Mesocyclone
• Storm Track Information
• Tornado Vortex Signature.

7 DELETED

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8   ECHO TOPS (ET)

8.1   SS Product Description

"This product shall provide the echo tops information displayed as an image. This product shall be produced from the output of the Echo Tops Algorithm. The product shall be updated once per TDWR SPG mini-volume scan time and will use all elevations scanned by TDWR. The product shall be available for 16 altitude range data levels referenced to mean sea level. The product shall include annotations for product name, radar ID, time and date of scan, maximum data value detected (Height in feet, MSL), radar position, radar elevation above MSL, and radar operational mode."

8.2   Display Format

This product is displayable in full- or quarter-screen format (see Appendix B).

8.2.1   Data Levels

The product will be available for 16 altitude range levels. The range of altitude values are 5,000 feet to 70,000 feet in increments of 5,000 feet. The component with the highest altitude of each echo which meets the minimum reflectivity value specified in adaptation data (default value of 18.5 dBZ) will be used as the echo top.

8.2.2   Color Level Code Tables

16-Level Code	Display kft	Range kft MSL	Color Levels Code	Color
0	ND	No Data	(00 00 00)	black
1	0	kft<5	(00 00 00)	black
2	5	5≤kft<10	(76 76 76)	dark gray
3	10	10≤kft<15	(00 E0 FF)	light blue
4	15	15≤kft<20	(00 B0 FF)	lt medium blue
5	20	20≤kft<25	(00 90 CC)	dk medium blue
6	25	25≤kft<30	(32 00 96)	dark blue
7	30	30≤kft<35	(00 FB 90)	light green
8	35	35≤kft<40	(00 BB 00)	medium green
9	40	40≤kft<45	(00 EF 00)	bright green
A	45	45≤kft<50	(FE BF 00)	tan
B	50	50≤kft<55	(FF FF 00)	yellow
C	55	55≤kft<60	(AE 00 00)	dark red
D	60	60≤kft<65	(FF 00 00)	bright red
E	65	65≤kft<70	(FF FF FF)	white
F	70	70≤kft	(E7 00 FF)	purple

8.2.3   Range/Data Resolution

For maximum compatibility with WSR-88D product display systems, the coverage area of this product will match the WSR-88D. However, data beyond 48 nmi will be coded as ND (No Data).

Coverage Area (nmi Radius)	Resolution (nmi x nmi)	Product Center
0 to 124	2.2 x 2.2	Radar Location

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8.3   Annotations

8.3.1   <u>Alphanumeric</u>

Standard Annotations (Appendix A, I(A))
Maximum Data Value Detected
Data Level Code

8.3.2   <u>Special Symbols</u>

None defined

8.4   Product Interaction

The following overlay products are displayable on this product:
• Hail Index
• Mesocyclone
• Storm Tracking Information
• Tornado Vortex Signature.

9   DELETED

10   DELETED

11 DELETED

12 VELOCITY AZIMUTH DISPLAY (VAD), (VWP)

12.1 SS Product Description

"This product shall provide the Velocity Azimuth Display Algorithm derived wind speed and direction. Two versions of the product shall be produced. For the first version, the wind speed and direction at up to 30 altitudes shall be computed and displayed as wind barbs on a height scale. The specific altitude levels at which VAD winds are computed and reported shall be site adaptable in one thousand feet increments. The specific altitudes at which winds are requested shall be used to derive the specific slant range and elevation angle for the VAD algorithm analysis. The use of look up tables relating a specific slant range and elevation angle to a specific wind reporting altitude for computational efficiency is permitted. To facilitate this, off-line processing may be used to generate new look-up tables whenever adaptation parameters are changed or new scanning sequences are invoked. The specific method of computing slant range and elevation angle are subject to Government approval.

Wind speed and direction will be reported to the highest altitude level at which sufficient signal is available for processing by the VAD algorithm. This product will be produced in a tabular format of alphanumeric values and as a stand-alone graphic product. The graphic product will contain the current and up to 10 previous height plots (user selectable) displayed simultaneously on a time versus height scale. This version of the product will include annotations for the product name, radar ID, radar position, radar elevation above MSL, time and date of volume scan, and maximum wind speed and associated direction of most current plot. Altitude levels will be shown referenced to mean sea level. The alphanumeric format will contain all wind data derived by the VAD algorithm for the current volume scan. Upon user request, all site adaptable parameters identified as input to the algorithm used to generate data for this product will be available at the alphanumeric display.

A second version of the VAD winds product shall be produced upon user request. This version shall present the VAD wind analysis for a specific altitude. The data displayed shall consist of the Doppler velocity data used to compute the VAD wind and the best fit function used to determine the horizontal wind speed and direction. The data shall be presented to the user as a graphical plot of the actual Doppler velocity and the best fit function on an orthogonal axis of speed versus azimuth. The vertical axis presented shall be speed, scaled as necessary, to allow all data to be displayed. The Nyquist velocity for the specific scan shall be graphically annotated on the display if the range of the scaled vertical axis is sufficient. The horizontal axis shall be azimuth, scaled from 0-360 degrees with true North as 0/360 degrees. This product shall be available for any wind value included in the most recent time-height cross-section of the VAD Winds Product. This version of the product shall include annotations for the product name, radar ID, radar position, radar elevation above MSL, time and date of volume scan, slant range, elevation angle, wind speed and direction, computed altitude of winds, RMS error, and best fit function in the form $A_1 + V \sin(\theta+\delta)$. (See Algorithm Report.)"

12.2 Display Format

The VWP is displayable in grid Format IVA, Appendix B. The grid is considered to be part of the image and will always be displayed simultaneously with the image.

The grid for the VWP will consist of a vertical scale for altitude in thousands of feet above MSL and a horizontal time scale. The specific altitude levels are site adaptable. The vertical grid scale for the heights will be divided to equally space the number of heights that are selected. It will not be necessarily scaled since the screen is not large enough to accommodate the total interval that is possible to select. The adaptation data may have intervals of varying increments of 1,000. The

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horizontal time scale will accommodate up to 10 previous user selectable height plots (e.g., the last 10 volume scans in addition to the current volume scan).

The altitude levels will be indicated in thousands of feet along the right and left ordinates and the time (hour and minutes) along the abscissa. Full screen display will be used for this product. Wind barb units will be in knots. Direction in both cases will be the direction from which the wind is blowing in degrees.

The VAD product is displayable in grid Format IVB, Appendix B. The grid is considered to be part of the image and will be displayed simultaneously with the image. In addition, the Nyquist Velocity for the specified scan will be graphically annotated on the display if it falls within the range of the scaled vertical axis.

The grid for the VAD product consists of a vertical scale for velocity and a horizontal scale for azimuth. The equation for the FIT function in the form of $A_1 + V \sin(A\varepsilon + \delta)$ will also be displayed. The vertical scale is labeled with velocity values scaled such that all the data fits on the display. The unit for the velocity grid is knots. The horizontal scale is labeled with azimuth in 0 to 360 degrees. True North is 0/360 degrees. The FIT function is defined as above, where A_1, V and δ corresponds to CF1, SPW and -DW-90 as defined in the NEXRAD Algorithm Report.

The velocity values will be plotted as individual points on the orthogonal axis and overlaid with the best fit sine wave function.

12.2.1   Data Levels

For the VWP product, the wind vector flag shaft origin will be plotted to the appropriate elevation (ordinate) and time (abscissa) intersection.

The wind vector will be plotted at the height at which it was observed. If the wind is calm, i.e., sufficient echoes are present but velocities are <5 knots, then a circle 5 pixels in diameter is placed at the appropriate point.

12.2.2   Color Level Code Table

For the VWP Product:
The wind vector color will reflect the RMS code as follows:

5-Level Code	Display RMS/knots	Range RMS/knots	Color Levels Code	Color
1	0	≤knots<4	(00 FF 00)	green
2	4	4≤knots<8	(FF FF 00)	yellow
3	8	8≤knots<12	(FF 00 00)	bright red
4	12	12≤knots<16	(00 E0 FF)	light blue
5	16	16≤knots	(FF 70 FF)	medium purple

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The color level table for the VAD product:

The velocity points will be color coded to the reflectivity value at the same position. The eight-level color table is defined as follows:

8-Level Code	Display dBZ	Range dBZ	Color Levels Code	Color
			(00 00 00)	black
0		Not Used		
1	<5	5>dBZ	(77 77 90)	medium gray
2	5	5≤dBZ<18	(FF AA AA)	light pink
3	18	18≤dBZ<30	(C9 70 70)	dark pink
4	30	30≤dBZ<41	(00 BB 00)	medium green
5	41	41≤dBZ<46	(FF FF 70)	light yellow
6	46	46≤dBZ<50	(DA 00 00)	medium red
7	50	50≤dBZ	(00 00 FF)	blue

12.2.3 Range/Data Resolution

Coverage Area (nmi Radius)	Resolution (nmi x nmi)	Product Center
N/A	Nearest 5 kts	N/A

12.2.4 **Alphanumeric Display**

In the alphanumeric product (tabular format for the alphanumeric screen), if the VAD derived with at a given level is valid (i.e., failed threshold for RMS, symmetry, or number of points), data for that height shall not be included. A three-line header, which includes a title, date, time column labels, and units, shall appear at the top of each VAD Algorithm Output page. Each page contains up to 14 height levels of VAD wind data. However, if there are no valid winds in the volume scan, the VWP product will not contain VAD Algorithm Output page (s). The vertical velocity (W) and divergence (DIV) columns will contain valid data only for constant slant range wind estimates. For all other estimates, these fields shall contain "NA", indicating not applicable.

12.2.4.1 Alphanumeric Screen

The tabular format, display on the alphanumeric screen (i.e. the VWP alphanumeric product), shall include up to 52 VAD derived winds. Namely, the SPG selected altitudes (up to 30), one per elevation at a constant slant range (up to 20), and the low altitude supplemental wind (2). Wind shall be ordered by increasing altitude. The format used is specified in Appendix C.

(a) Altitude above mean sea level in hundreds of feet
(b) Eastward, northward components of the wind in m/s
(c) Upward component of the wind in cm/s
(d) Wind direction in degrees
(e) Wind speed in knots
(f) Scatter between velocity points and the VAD fitted curve in knots
(g) Divergence of the wind in 10 per second
(h) Slant range of the VAD analysis in nautical miles
(i) Elevation angle of the VAD analysis in degrees
(j) Adaptable VAD Parameters

12.3 Annotations

12.3.1 <u>Alphanumeric</u>

<u>For the VWP Product:</u>
Standard Annotations (Appendix A, I(A))
Data Level Code
Maximum Wind Speed (current plot)
Direction of Wind Speed (current plot)
Site Adaptable Parameters
<u>For the VAD Product:</u>
Standard Annotations (Appendix A, I(A))
Slant Range
Elevation Angle
Wind Speed and Direction
Root Mean Square (RMS) Error
Computed Altitude of Wind

12.3.2 <u>Special Symbols</u>

<u>For the VWP Product:</u>
The wind speed and direction will be plotted with the standard meteorological wind barb presentation. The direction will be plotted as a straight line of 20 pixels in length from the direction of the wind.

The vector will terminate at the intersection of the appropriate altitude and time.

Wind direction is plotted to the nearest 5 degrees and speed to the nearest 5 knots. The special symbol for the wind barbs is a flag consisting of lines which are perpendicular and to the left of the wind shaft using the scale as indicated.

   2 barb (5 pixels in length) = 5 knots, example: 270   65 kts
  1 barb (10 pixels in length) = 10 knots
Full triangle (10 pixels in length and 4 pixel base) = 50 knots
Shaft length = 20 pixels

<u>For the VAD Product:</u>
The velocity data will be plotted as single points on the grid of velocity vs. azimuth. The best fit function will be plotted over the field of velocity points as a linked vector in a contrasting color. The span of velocity data displayed on the grid is as follows:

<u>Velocity</u>	<u>Span of Velocity data (grid)</u>
<60 kts	80 kts
60$\leq$100	120
100$\leq$140	160
140$\leq$180	180
>180	400

12.4 Product Interaction
None

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12.5 Comment

All site adaptable parameters identified as input used to generate data for this product will be available at the alphanumeric display upon user request. This data will be formatted in tabular layout showing the parameter name in one column, and value in an adjacent column.

13 DELETED

14 DELETED

15 DELETED

16 DELETED

17 VERTICALLY INTEGRATED LIQUID (VIL)

17.1 SS Product Description

"This product shall provide vertically integrated liquid values displayed as an image. The output of the VIL Algorithm shall be used to produce this product. The product shall be updated once per TDWR SPG mini-volume scan time and will use all elevations scanned by TDWR. The product shall be available for 16 data levels. Each product shall include annotations for product name, radar ID, time and date of volume scan, maximum data value (VIL value,), radar position, radar elevation above MSL, and the radar operational mode.'

17.2 Display Format

The product is displayable in full- or quarter-screen format (see Appendix B).

17.2.1 Data Levels

The VIL values displayed range upwards to a maximum adaptable value (default = 80 Kg/m^2). Values greater than that value are truncated to that value.

17.2.2 Color Level Code Tables

The color level code used for display of VIL is a AWIPS (or agency) system adaptation data. The currently defined color table for VIL is listed.

16-Level Code	Display kg m^{-2}	Range kg m^{-2}	Color Levels Code	Color
0	ND	kg m^{-2}<1	(00 00 00)	black
1	1	1$\leq$kg m^{-2}<5	(9C 9C 9C)	medium gray
2	5	5<kg m^{-2}<10	(76 76 76)	dark gray
3	10	10$\leq$kg m^{-2}15	(FA AA AA)	light pink
4	15	15$\leq$kg m^{-2}<20	(EE 8C 8C)	medium pink
5	20	20$\leq$kg m^{-2}<25	(C9 70 70)	dark pink
6	25	25$\leq$kg m^{-2}<30	(00 FB 90)	light green
7	30	30$\leq$kg m^{-2}<35	(00 BB 00)	medium green
8	35	35$\leq$kg m^{-2}<40	(FF FF 70)	light yellow
9	40	40$\leq$kg m^{-2}<45	(D0 D0 60)	dark yellow
A	45	45$\leq$kg m^{-2}<50	(FF 60 60)	light red
B	50	50$\leq$kg m^{-2}<55	(DA 00 00)	medium red
C	55	55$\leq$kg m^{-2}<60	(AE 00 00)	dark red
D	60	60$\leq$kg m^{-2}<65	(00 00 FF)	blue
E	65	65$\leq$kg m^{-2}<70	(FF FF FF)	white
F	70	70$\leq$kg m^{-2}	(E7 00 FF)	purple

17.2.3 Range/Data Resolution

For maximum compatibility with WSR-88D product display systems, the coverage area of this product will match the WSR-88D. However, data beyond 48 nmi will be coded as ND (No Data).

Coverage Area (nmi radius)	Resolution (nmi x nmi)	Product Center
0 to 124	2.2 x 2.2	Radar location

17.3   Annotations

17.3.1   <u>Alphanumeric</u>

The automated annotations for this product are:
Standard Annotations (Appendix A, I(A))
Data Level Code
Maximum Data Value Detected

17.3.2   <u>Special Symbols</u>

None defined

17.4   Product Interaction

All overlay products are displayable on this product:
• Hail Index
• Mesocyclone
• Storm Tracking Information
• Tornado Vortex Signature.

18   STORM TRACKING INFORMATION (STI)

18.1   SS Product Description

"This product shall provide information concerning the past, present and future positions of each identified storm cell. This product shall be generated from the output of the Storm Cell Tracking and Storm Position Forecast algorithms. It shall be produced in a tabular format of alphanumeric values, as a stand alone graphic product, and in a format for generating graphic overlays to other products. This product shall be updated once per TDWR SPG mini-volume scan time at the end of each mini-volume elevation stop index (SPG configuration data). Each product shall include a standard set of total annotations and number of identified storm cells for which tracking is available. Upon user request, all site adaptable parameters identified as inputs to the algorithm(s) used to generate data for this product shall be available at the alphanumeric display."

18.2   Display Format

Each storm cell identified will be given a unique ID of two characters. The first character will be a capital letter, A through Z, and the second will be a number, 0 through 9. The sequence will be A0, B0, C0,...Z0, A1,...Z9. The sequence is recycled following Z9. When there have not been any storm cells identified in a user specified "number of past volume scans", then the sequence of IDs will be reset so that the next storm cell identified will have the ID A0. See also Appendix A, I(B)(21) for more details on the Storm Cell ID.

18.2.1   <u>Graphic Display</u>

The product is displayable in full- and quarter-screen formats (see Appendix B, Formats I and II).

18.2.1.1   <u>Data Display</u>

The ID will be placed 5 pixels to the right and 5 pixels down from the current centroid positions. The ID will be white (code FF FF FF) and the background in black (code 00 00 00). See also Appendix A, I(B)(2).

When sufficient data is available, the past positions for each volume scan (up to the number of past volume scan minus the current volume scan) will be shown along with the current position and up to four future positions (e.g., +15, +30, +45, +60 min).

The forecast position interval and number of past volumes (or positions) are Unit Radar Committee (URC) level adaptation data and will vary over a range of 5 to 60 minutes (in 5-minute increments) and 5 to 13 volume scans, respectively. The default interval is 15 minutes, and the default number of past volumes (or positions) is 10. The past positions displayed will be the actual centroid positions where each storm cell was identified for up to the specified number of past volume scans (including the current volume scan). Storm cell tracks will consist of past, current and forecast storm cell centroid positions connected by one pixel wide linear segments. The AWIPS operator will have the ability through a menu at the Radar Display Controls window to select whether to display the past and/or forecast tracks and positions.

In the event an identified storm cell's forecast speed is less than a user-specified minimum speed, the storm cell's motion is considered stationary. For stationary storm cells, no past or forecast storm cell positions will be displayed. The minimum storm cell speed is URC level adaptation data and will vary over the range of 0.0 m/s to 10.0 m/s. The default is 2.5 m/s.

Note: See "Special Symbols and Characters" of Appendix A, 1(B(2)) for more details on the Storm Cell Track

The AWIPS operator will have the ability through the Radar Display Controls to select a maximum number of storm cells for display within the current display area (or window). The default is 20 storm cells. When the number of identified storm cells in the current window exceeds the maximum number of cells for display, the storm cells with the largest Cell-based VIL will be selected for display and a message will be displayed in the lower left corner of the screen indicating the number of identified storm cells in the current window which are not displayed. The message will have the same format as in the following example: "4 CELLS IN WINDOW NOT DISPLAYED". If the number of storm cells not displayed in the current window changes, the message will change as well.

18.2.1.2 Range/Data Resolution

Coverage Area (nmi radius)	Resolution (nmi x nmi)	Product Center
0 to 48	N/A	Radar location

18.2.1.3 Graphic Overlay

As a graphic overlay to other products, only the overlay portion of the graphic display product is displayed; that is, the screen right annotations are not displayed. Symbols and characters are described in the data display above.

18.2.2 Alphanumeric Display

18.2.2.1 Alphanumeric Screen

A tabular format (Appendix C) of up to an adaptable number of identified storms cells will be displayable on the alphanumeric display screens. The tabular format will include:

(a) Storm Cell ID
(b) Current storm Position in (AZRAN) degrees and nmi to the nearest integer from the RDA
(c) The Forecast Direction in degrees (to the nearest integer) from which the storm cell is moving
(d) The Forecast Speed of the storm cell in kts to the nearest integer
(e) The azimuth and range forecast position of the storm cell to the nearest integer in degrees and nmi for each forecast interval up to four forecast positions
(f) The forecast error and mean forecast error in nmi to the nearest 0.1 nmi
(g) On the first page, Average Storm Cell Speed in kts to the nearest integer
(h) On the first page, Average Storm Cell Direction in degrees to the nearest integer
(i) Storm Cell Tracking/Forecast Position Adaptable Parameters

By default, all storm cells (entries), up to a maximum of 100, can be displayed in this format. However, the SPG HCI has the capability to limit the number of storm cells included in this format from 7 to 100.

Note: Storm cells which are new (i.e., lack history) shall indicate "NEW" in the Movement field.
Note: If a forecast position(s) for a storm cell can not be determined, then "NO DATA" shall be displayed for that interval in the Forecast Positions field of the alphanumeric display.

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18.2.2.2 Graphic Screen

A tabular format (appendix B, Format III, configuration 1) of all identified storm cells will be displayable on the graphic display screens. The tabular format will include:

(a) Storm Cell ID
(b) Current Storm Position in (AZRAN) degrees and nmi to the nearest integer from the radar
(c) The Forecast Direction in degrees to the nearest integer form which the storm cell is moving
(d) The Forecast Speed of the storm cell in kts to the nearest integer
(e) The forecast error and mean forecast error in nmi to the nearest 0.1 nmi
(f) Maximum reflectivity in dBZ to the nearest integer
(g) Height of the Maximum Reflectivity in kft to the nearest integer

Note: Storm cells which are new (i.e., lack history) shall indicate "NEW" in the Forecast Movement field.

18.3 Annotations

18.3.1 Alphanumeric

Standard Annotations
Total Number of Identified Storms

18.3.2 Special Symbols

Past positions of the storm will be shown as small (5-pixel diameter) white, filled circles and forecast positions as white plus (+) marks of similar size. The current position is a circle (7-pixel diameter) within which is an "X".

The past, current, and forecast position symbols are connected with white line segments.

18.4 Product Interaction

The graphic portion of the product including the tabular format is displayable as an overlay on all geographically based products.

18.5 Comments

All site Storm Cell Tracking/Forecast adaptable parameters identified as inputs to generate data for this product will be available at the alphanumeric display upon user request. This data will be formatted in a tabular layout showing the parameter name in one column and the value in an adjacent column.

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19   HAIL INDEX (HI)

19.1   SS Description

"This product shall provide, for each storm cell identified by the Storm Cell Identification and Tracking algorithm, the Probability of Hail, the Probability of Severe Hail, and the Maximum Expected Hail Size. The hail probabilities and size shown for each storm cell shall be generated by the Hail Algorithm. This product shall be produced in a tabular format of alphanumeric values, as a stand alone graphic product, and in a format for generating graphic overlays to other products. This product shall be updated once per TDWR SPG mini-volume scan time at the end of each mini-volume elevation stop index (SPG configuration data). This product shall include a standard set of annotations. Upon user request, all site adaptable parameters identified as inputs to the algorithm(s) used to generate data for this product shall be available at the alphanumeric display."

19.2   Display Format

The Probabilities of Hail and Severe Hail are computed in 10% increments. The Maximum Expected Hail Size is calculated to the nearest 0.25 inch.

19.2.1   Graphic Display

The product is displayable in full- or quarter-screen formats (See Appendix B, Formats I and II).

19.2.1.1   Data Display

If the Probability of Hail and/or the Probability of Severe Hail for a storm cell meet minimum display adaptable parameters, then a Hail Symbol (see Appendix A, I(A)(6) is placed immediately to the right of the storm cell ID. That position will be 19 pixels to the right and 2 pixels down form the storm cell centroid location. As a graphic overlay to other products, the hail symbol flashes and only the overlay portion of this product is displayed. The operator has the option to stop the flashing of the hail symbol. No hail symbol is displayed if the Probability of Severe Hail and the Probability of Hail are 0%.

The Maximum Expected Hail Size is also displayed in the middle of the Hail Symbol in white to the nearest inch. In this display, if the Maximum Expected Hail Size is less than 0.75 inches, an asterisk will be displayed, and if the size is greater than 4 inches, "4" inches will be displayed.

19.2.1.2   Range/Data Resolution

Coverage Area (nmi radius)	Resolution (nmi x deg)	Product Center
0 to 48	N/A	N/A

19.2.1.3   Graphic Overlay

As a graphic overlay to other products, only the overlay portion of the graphic display product and the attribute table is displayed.

19.2.2 <u>Alphanumeric</u>

19.2.2.1 <u>Alphanumeric Display</u>

In the alphanumeric product (tabular format for the alphanumeric screen), the Hail Attribute Table (see Appendix B, format III, configuration 4), and the combined Attribute Table (see Appendix B, Format III, configuration 5), the following apply: if the Probability of Severe Hail and the Probability of Hail are 0%, then "0.00" inches is displayed; if the Probability of Severe Hail and the Probability of Hail ore greater than 0% and the Maximum Expected Hail Size is less than 0.50 inches, then "<0.50" inches is displayed; if the Maximum Expected Hail Size is greater than 4.00 inches, then the value ">4.00" inches is displayed; if the hail characteristics can not be determined (e.g. storm cell is beyond 124 nmi range) the hail characteristics are labeled 'UNKNOWN'.

By default, all storm cells (entries), up to a maximum of 100, can be displayed in this format. However, the MSCF has the capability to limit the number of storm cells included in this format from 10 to 100.

19.2.2.2 <u>Alphanumeric Screen</u>

The tabular format, displayed on the alphanumeric screen (i.e. the Hail alphanumeric product), includes up to an adaptable number of storm cells identified by the Storm Cell Centroids Algorithm. The format used is specified in Appendix C.

(a) Storm Cell ID
(b) Probability of Severe Hail in percentage
(c) Probability of Hail in percentage
(d) Maximum Expected Hail Size in inches
(e) Adaptable Hail Parameters

19.2.2.3 <u>Graphic Screen</u>

The tabular format, displayed on the graphic screen (i.e. the Hail Attribute Table) includes all storm cells identified by the Storm Cell Centroids Algorithm. The format used is specified in Appendix B, Format III, Configuration 4.

(a) Storm Cell ID
(b) Current Storm Position in (AZRAN) degrees and nmi to the nearest integer from the radar
(c) Probability of Severe Hail in percentage
(d) Probability of hail in percentage
(e) Maximum Expected hail Size in inches
(f) Altitude of 0°C and -20°C environmental temperatures in kft (from adaptation data)
(g) Time and Date of the last change to the Hail Temperature Altitudes

19.3 Annotations

19.3.1 <u>Alphanumeric</u>

Standard Annotations (Appendix A, I(A))

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19.3.2 Special Symbols

The hail symbol is a green isosceles triangle. The triangle can be small (a base of 8 pixels and a height of 12 pixels) or large (a base of 16 pixels and a height of 20 pixels). The size of the triangle and whether the triangle is filled depends upon the Probability of Severe Hail and the Probability of Hail. The following are the rules of display and default settings.

Triangle	Prob. Of Svr. Hail	Prob. Of Hail
Large/Filled	$\geq$50%	N/A
Large/Open	$\geq$30%	N/A
Small/Filled	0%	$\geq$50%
Small/Open	0%	$\geq$30%

However, the probabilities are adaptable parameters at the AWIPS Radar Display Controls window, and the user has the ability to disable the display of one or both of the small and/or large triangles. The Maximum Expected Hail Size will be displayed in the middle of the triangle.

19.4 Product Interaction

The graphic portion of the product including the tabular format is displayable as an overlay to all geographically based products.

19.5 Comments

All site adaptable parameters identified as inputs to generate data for this product will be available at the alphanumeric display upon user request. This data will be formatted in a tabular layout showing the parameter name in one column and the value in an adjacent column.

When ranking of storm cells by hail characteristics, storm cells labeled 'UNKNOWN' are considered of lower rank than those with a Probability of Severe Hail of 0% and a Probability of Hail of 0%.

20   MESOCYCLONE (MD, DMD)

20.1 SS Product Description

"The MD version of this product shall provide information about circulation features generated from the output of the new Mesocyclone Detection Algorithm. This product shall provide information concerning the past and future positions of each tracked circulation feature. This product shall be generated in a format that can be used to generate an alphanumeric tabular display for an identified feature or all simultaneously, a graphic display or a graphic overlay to other products. This product shall be updated once per TDWR SPG mini-volume scan time at the end of each mini-volume elevation stop index (SPG configuration data).   If on a particular volume scan there is no output from the Mesocyclone Detection Algorithm (i.e., no features of any type are identified), a version of the product shall be produced that exhibits the negative condition. This product shall include annotations for the product name, radar ID, date and time of volume scan, radar position, radar elevation above MSL, and radar operational mode."

The DMD version of this product shall be generated to support generation of interactive user displays at an external system (e.g., AWIPS). This product shall be updated once per elevation scan time. The end-of-volume edition shall contain complete algorithm data for the volume scan. The elevation editions shall contain the algorithm data which has been updated since the previous volume edition product. A detection status shall be reported for circulation features that are topped or extrapolated. If on a particular elevation scan there is no output from the Mesocyclone Detection Algorithm (i.e., no features of any type are identified), a version of the product shall be produced that exhibits the negative condition. This product shall include annotations for the product name, radar ID, date and time of volume scan, elevation angle, radar position, radar elevation above MSL, and radar operational mode.

20.2 Display Format

20.2.1 <u>Graphic Display</u>

The products are displayable in full- or quarter-screen format (see Appendix C).

20.2.1.1 <u>Data Display</u>

For the MD version, the graphic display will contain up to 100 MDA detected features, sorted first by strength rank, then by Mesocyclone Strength Index (MSI). The number of features in the product can be reduced by raising the minimum display filter rank and/or the overlap filter, both MDA adaptable parameters.

When sufficient data are available, the past positions of each feature for each volume scan (up to 10 past volume scans) will be shown along with the current position and up to six future positions (at 5 minute intervals).   The past positions will be displayed at the lowest elevation each MDA feature was detected. MDA tracks will consist of past, current and forecast positions connected by linear segments with a width of one pixel. The operator at the external display system (e.g., AWIPS) will have the ability to select whether to display the past and/or forecast tracks and positions and feature IDs.

In the event an identified MDA feature forecast speed is less than 2.5 m/s the feature motion is considered stationary. For stationary MDA features, a single past position will be reported at the current feature center.

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20.2.1.2 Range/Data Resolution

Coverage Area (nmi radius)	Resolution (nmi x nmi)	Product Center
0 to 48	N/A	Radar location

20.2.1.3 Graphic Overlay

As a graphic overlay to other products, it will be possible to display only the image portion of this product; that is, the screen right area annotations will not be displayed when the product is used as an overlay. Each mesocyclone will be identified with the associated storm ID in white. In overlay form, the symbols have pixel priority over all but the TVS symbol. The symbols, which are displayed in yellow, flash when displayed as overlays. The operator will have the option to stop the flashing of the mesocyclone symbol.

For the MRU version, the AWIPS operator will have the option to turn off display of extrapolated features.

For the MD version, circulations strong enough to be classified as mesocyclones will be identified with the Circulation ID (0 to 999) displayed next to the mesocyclone symbol.

20.2.2 Alphanumeric Display

An alphanumeric tabular product version is generated for display on the alphanumeric display. The format to be used is defined in Appendix C.

For the MD version, up to 100 features will be listed from highest to lowest strength rank with Mesocyclone Strength Index (MSI) as a secondary order (highest MSI to lowest MSI).

Except for those parameters indicated with an asterisk above, the elevation edition will contain only parameters updated since the previous volume. A complete time history of MDA information for a feature is available from a collection of DMD volume editions along with the latest DMD elevation edition. All data for an on-going feature can be linked by its Meso ID parameter that remains constant through out the life time of a feature.

20.2.3 DMD Format for External Systems

In the WSR-88D, the DMD product is a rapid update implementation of the MDA, meaning that after each elevation cut of the current volume scan, algorithm output is available to update any MDA results from the previous volume scan. Therefore, it is important to distinguish between products with the Last Elevation Flag set (i.e. a volume edition) and those without the Last Elevation Flag set (i.e. an elevation edition). A volume edition, will contain complete MDA information for the volume scan.   For the TDWR SPG, only volume edition products will be generated after the end of the mini-volume stop elevation index (system configuration data). For the volume edition, the parameters listed below are included for all detected MDA features meeting a minimum strength rank of 1 (up to a maximum of 100 features):

As specified in Figure 3-15b, Note 1, of the *SPG To Class 1 User ICD*, the DMD product is encoded using an API available from the Radar Operations Center. This API also provides functions for those wishing to decode a DMD product, as well as extract product parameters and feature parameters. The DMD product contains up to 100 MDA detected circulation features. All DMD products contain the following three DMD Product Parameters:

DMD Format for External Systems

DMD Product Parameters (One parameter per DMD product)	Units ; Precision or Values
Average Direction of Tracked Features	deg ; 0.1
Average Speed of Tracked Features	m/s ; 0.1
Last Elevation Flag	Values = 0 or 1 if last elevation
Elevation Angle (array)	deg ; 0.1
Elevation Time (array)	s ; 1

MDA Feature Parameters (One parameter per MDA detected circulation)	Units ; Precision or Values
Meso ID*	na ; 1
Detection Status*	Values = "TOP", "EXT", " "
Base Azimuth*	deg ; 0.1
Base Range*	km ; 0.1
Age	s ; 1
Strength Rank	na ; 1
Strength Rank Type	Values = ' ', 'L' or 'S'
MSI	na ; 1
Base Diameter	km ; 0.1
Base Height	km ; 0.1
Depth	km ; 0.1
Storm Relative Depth	percent ; 1
Base Gate-to-Gate Velocity Difference	m/s ; 0.1
Base Shear	m/s/km ; 0.1
Base Rotational Velocity	m/s ; 0,1
Max Rotational Velocity	m/s ; 0.1
Height of Max Rotational Velocity	km ; 0.1
Max Shear	m/s/km ; 0.1
Height of Max Shear	km ; 0.1
0-2 km ARL Convergence	m/s ; 0.1
2-4 km ARL Convergence	m/s ; 0.1
Associated TVS	Values = 'Y', 'N' or 'U'
Associated Storm ID	Values = "A0" through "Z9"
Overlaps Lower Feature	Values = "Y" or "N"
Base on Lowest Elevation	Values = "Y" or "N"
Direction	deg ; 0.1
Speed	m/s ; 0.1
# Past Positions	na ; 1
Past Latitude Position (array)	deg; 0.0001
Past Longitude Position (array)	deg; 0.0001
# Forecast Positions	na ; 1
Forecast Latitude Position (array)	deg; 0.0001
Forecast Longitude Position (array)	deg; 0.0001
Number of 2D Features in this 3D Feature	na ; 1
Tilt Number (array)	na ; 1
2D Height (array)	km ; 0.1
2D Diameter (array)	km ; 1
2D Gate-to-Gate Velocity Difference (array)	m/s ; 1
2D Shear (array)	m/s/km ; 1
2D Rotational Velocity (array)	m/s ; 1
2D Strength Rank (array)	na ; 1

* Always included for all features

20.3 Annotations

20.3.1 <u>Alphanumeric</u>

Standard annotations
All annotations (except for Radar position) with the alphanumeric product format will be included in the message.

20.3.2 <u>Special Symbols</u>

The mesocyclone will be displayed (centered on the location of the mesocyclone at the lowest elevation angle in which it is detected) as a yellow open circle, whose perimeter is 4 pixels thick. The size of the symbol will be proportional to the average of the mesocyclone radial and azimuthal diameters. The minimum size symbol will be a circle having a diameter of 14 pixels.

For the MD version, features having a strength rank 5 or higher will be displayed similar to the legacy Mesocyclone symbol. In addition, if the feature's base was detected on the lowest elevation angle, or its base height was at or below 1 kilometer, the Mesocyclone symbol will contain outward spikes. For MDA features having a strength rank less than 5, the symbol will be similar to the legacy 3D correlated shear symbol. The size of the symbol will be drawn to scale with the base level feature diameter.

The MDA track consists of past, current, and forecast feature positions connected by linear segments one pixel wide. Past positions will be displayed as yellow filled diamond. Forecast positions will be displayed as yellow x cross signs, of similar size.

20.4 Product Interaction
This product is displayable as an overlay on all geographically based products.

20.5 Comments
The current value of the three MDA adaptable parameters will be placed in a corner of the graphic overlay display.   If there are no features, the text "No Circulations" will be placed on the graphic display

21 TORNADO VORTEX SIGNATURE (TVS)

21.1 SS Product Description

"This product shall provide information regarding the existence and location of an identified Tornado Vortex Signature (TVS). This product shall be produced from the output of the Tornado Detection Algorithm. The product shall produce an alphanumeric tabular display and a graphic overlay of the algorithm output data for each identified TVS (and Elevated TVS (ETVS)) signature information when such is identified. This product shall be updated once per TDWR SPG mini-volume scan time at the end of each mini-volume elevation stop index (SPG configuration data). This product shall include annotations for the product name, radar ID, time and date of volume scan, radar position, radar elevation above MSL, and radar operational mode. Upon user request, all site adaptable parameters identified as inputs to the algorithm(s) used to generate data for this product shall be available at the alphanumeric display."

21.2 Display Format

The product has three parts. Geographic and alphanumeric table parts are displayable on the graphic screen. And the alphanumeric table is displayable on the alphanumeric screen. For all three parts, data (described below) will be provided for all detected TVSs and Elevated TVS (ETVS). By default, a maximum of 15 TVSs and 20 ETVSs are detectable; however, these numbers are adaptable at the SPG HCI up to values of 25 TVSs and 25 ETVSs.

Each TVS (and ETVS) is associated with the nearest storm cell within an SPG HCI adaptable distance. If the TVS (or ETVS) is not associated with a storm cell, "??" will be displayed as the Storm Cell ID.

The format to be used is defined in Appendix B.

21.2.1 <u>Graphic Screen</u>

These parts of the product are displayable concurrently as an overlay on all geographically based products. As a graphic overlay to other products, it will be possible to display only the image portion of this product; that is, the screen right area annotations will not be displayed when the product is used as an overlay.

21.2.1.1 <u>Geographic</u>

The graphic display consists of the TVS and ETVS symbols (see Section 21.3.2) The symbols are placed such that the apex of the triangle is centered on the geographic position of the TVS (or ETVS) at the lowest elevation angle where it is found. The symbols flash when displayed as an overlay. The operator will have the option to stop the flashing. Along with each TVS (and ETVS), the Storm Cell ID (see Section 18.2) is displayed in white (Code: FF FF FF) 5 pixels to the right and 5 pixels down from the location of the storm cell centroid. This part of the product is displayable in full- and quarter-screen formats (see Appendix B).

The AWIPS operator will have the ability through the Radar Display Controls to select whether to display the symbols for only TVSs or both TVSs and ETVSs. The default will be to only display TVS symbols.

21.2.1.1.1 <u>Range/Data Resolution</u>

Coverage Area <u>(nmi radius)</u>	Resolution <u>(nmi x nmi)</u>	<u>Product</u> <u>Center</u>

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       0 to 48   N/A   Radar Location

21.2.1.2 Alphanumeric Table

A tabular format is displayable on the graphic screen (i.e. the TVS Attribute Table). The format used is specified in Appendix B, Format III, Configuration 3 and includes the following information about all TVSs and ETVSs.

(a) TYPE - TVS or ETVS
(b) STORM ID - ID of the closest associated Storm Cell
(c) AZ/RAN - Azimuth and range in degrees and nmi to the nearest integer.
(d) AVGDV - Average Delta Velocity in knots to the nearest integer
(e) LLDV - Low-level (base) Delta Velocity in knots to the nearest integer
(f) MDV - Maximum Delta Velocity in knots to the nearest integer
(g) BASE - Base height (of the signature) in kft to the nearest tenths
(h) DPTH - Depth (of the signature) in kft to the nearest integer

TVSs are listed before ETVSs, and both types are ranked by their Low-level Delta Velocity (from greatest to least). (NOTE: If the base is detected on the lowest elevation scan of the volume scan, then the BASE (height) is qualified with '<' respectively. And, if either the base or top are detected on the lowest or highest elevation scan of the volume scan, then the DPTH is also qualified with a '>'.) A brief description of this format can also be found in Appendix A, II(4).

21.2.2 Alphanumeric Screen

A tabular format is displayable on the alphanumeric screen (i.e. the TVS alphanumeric product). The format used is specified in Appendix C and includes the following information about all TVSs and ETVSs (up to an adaptable number):

(a) Feat Type - Feature Type, TVS or ETVS
(b) Feat ID - Feature ID (or number)
(c) Storm ID - Storm Cell ID
(d) AZ/RAN - Azimuth and range in degrees and nmi to the nearest integer
(e) AVGDV - Average Delta Velocity in knots to the nearest integer
(f) LLDV - Low-level (base) Delta Velocity in knots to the nearest integer
(g) MXDV/Hgt - Maximum Delta Velocity in knots to the nearest integer and the Height in kft to the nearest tenths
(h) Depth - Depth (of the signature) in kft to the nearest tenths
(i) Base/Top - Base and Top (of the signature) in kft to the nearest tenths
(j) MXSHR/Hgt - Maximum Shear in m/s/km to the nearest integer and Height in kft to the nearest tenths

TVSs are listed before ETVSs, and both types are ranked by their Low-level Delta Velocity (from greatest to least). (NOTE: If the base or top are detected on the lowest or highest elevation scan of the volume scan, respectively, then the Base/Top (height(s)) is qualified with '<' or '>', respectively. And, if either the base or top are detected on the lowest or highest elevation scan of the volume scan, then the Depth is also qualified with a '>'.) In addition, this part of the product includes all TDA adaptable parameters. The adaptable parameters are formatted in a tabular layout showing the parameter name in one column and the value and units in an adjacent column.

21.3 Annotations

If the TDA found more than the (adaptable) maximum number of TVSs or ETVSs, then the number of TVSs or ETVSs (as appropriate) in the Annotations will be preceded by a '>'.

21.3.1 Graphic Screen

Standard Annotations (Appendix A,I(A))
Number of TVSs and ETVSs
Elevation angle for the TRU version

21.3.2 Alphanumeric Screen

Product Specification
Standard Units and Abbreviations,
Product Name
Date/time of volume scan
RDA ID
Number of TVSs and ETVSs

21.4 Special Symbols

The symbol for a TVS is a red (code: FF 00 00) filled inverted isosceles triangle, and the symbol for
an ETVS is the same except it is unfilled (i.e. only a red triangle outline). The triangle has a base of
10 pixels and a height of 14 pixels.

22 STORM STRUCTURE (SS)

22.1 SS Product Description

"This product shall provide, for each identified storm cell, information regarding the structure of the storm cell. This product shall be produced from and contain the values that are output by the Storm Cell Centroids Algorithm. This product shall be updated once per TDWR SPG mini-volume scan time at the end of each mini-volume elevation stop index (SPG configuration data).   This product shall be produced in a tabular alphanumeric format and shall include annotations for the product name, radar ID, time and date of volume scan, and the total number of identified storm cells. Upon user request, all site adaptable parameters identified as inputs to the algorithm(s) used to generate data for this product shall be available at the alphanumeric display."

22.2 Display Format

22.2.1 Graphic Display

This product does not have a graphic component. However, Trend data is available with this product. The contents and format of the Trend Data are delineated in packet codes 21 and 22 of the Interface Control Document for SPG/Class 1 User (2620063).

22.2.2 Alphanumeric Display

This product is displayable only on the applications terminal in tabular alphanumeric format (see Appendix C). The alphanumeric tabular format, displayed on the alphanumeric screen includes the following information for up to an adaptable number of storm cells identified by the Storm Cell Centroids Algorithm.

(a) Storm Cell ID
(b) Current Storm Position in (AZRAN) degrees and nmi to the nearest integer from the RDA
(c) Storm base in kft
(d) Storm top in kft
(e) Cell Based VIL in kg/m^2
(f) Maximum Reflectivity in dBZ
(g) Height of Maximum Reflectivity in kft
(h) Number of Storm Cells
(i) Adaptable Parameters for all SCIT algorithms
By default, all storm cells (entries), up to a maximum of 100, can be displayed in this format. However, the SPG HCI has the capability to limit the number of storm cells included in this format from 10 to 100.

22.2.2.1 Range/Data Resolution

Coverage Area (nmi radius)	Resolution (nmi x nmi)	Product Center
0 to 48	N/A	Radar location

22.3

22.4   Annotations

22.4.1   <u>Alphanumeric</u>

Standard annotations (Appendix A, I(A))
Number of Storms detected

22.4.2   <u>Special Symbols</u>

None defined

22.5   Product Interaction

None

22.6   Comments

All site adaptable parameters identified as inputs to generate data for this product will be available at the alphanumeric display upon user request. This data will be formatted in a tabular layout showing the parameter name in one column and the value in an adjacent column.

23   DELETED

24 DELETED

25 DELETED

26 DELETED

27 FREE TEXT MESSAGE (PTM, FTM)

27.1 SS Product Description

"This product shall provide a capability for defining an alphanumeric message for one-time transmission to specific TDWR SPG interface(s). The product shall be generated by an operator through the SPG HCI or AWIPS for transmission to the SPG's users or by the AWIPS operator for transmission to the AWIPS's users. Messages may be designated to be transmitted to a specific or several SPG interfaces. Product shall include radar ID, date, and time that the message was completed."

27.2 Display Format

A prose style paragraphed statement or message

27.3 Annotations

Standard annotations as applicable

27.4 Product Interaction

None

28 SURFACE RAINFALL ACCUMULATION (OHP, THP)

28.1 SS Product Description

"These products shall provide 1-hour and 3-hour rainfall accumulation maps displayed as an image. The 1-hour map shall be updated every volume scan time and the 3-hour map shall be updated once per hour. These products shall be available for 16 accumulated precipitation data levels. Each product shall include annotations for the product name, radar ID, date and ending time (TSavgcur* or clock hour as appropriate) of the rainfall rate integration, maximum data value, radar position, radar elevation above MSL, radar operational mode, mean-field bias in the radar estimate of the precipitation rate (Bcur*), and the effective (Gage-Radar Pair) sample size associated with the bias estimate (GRPcur*)."

28.2 Display Format

These products are displayable in full-screen format or quarter-screen format (see Appendix B).

28.2.1 <u>Data Levels</u>

The product will contain 16 data levels. The data level code may vary with operational mode and with SPG HCI (or agency) system adaptation data. The data thresholds are also site adaptable.

28.2.2 <u>Color Level Code Table</u>

			Color Levels	
16-Level Code	Display Inches	Range Inches	Code	Color
0	ND	in=0.0	(00 00 00)	black
1	>0.00	0.0<in<0.1	(AA AA AA)	gray
2	0.10	0.1≤in<0.25	(76 76 76)	dark gray
3	0.25	0.25≤in<0.5	(00 FF FF)	cyan
4	0.50	0.5≤in<.075	(00 AF AF)	dark cyan
5	0.75	0.75≤in<1.0	(00 FF 00)	green
6	1.00	1.0≤in<1.25	(00 8F 00)	dark green
7	1.25	1.25≤in<1.5	(FF 00 FF)	magenta
8	1.50	1.5≤in<1.75	(AF 32 7D)	dark magenta
9	1.75	1.75≤in<2.0	(00 00 FF)	blue
A	2.00	2.0≤in<2.5	(32 00 96)	dark blue
B	2.50	2.5≤in<3.0	(FF FF 00)	yellow
C	3.00	3.0≤in<4.0	(FF AA 00)	orange
D	4.00	4.0≤in<6.0	(FF 00 00)	bright red
E	6.00	6.0≤in<8.0	(AE 00 00)	dark red
F	8.00	8.0≤in	(FF FF FF)	white

- - - - - - - - - - -
*See Algorithm Report

28.2.3 <u>Range/Data Resolution</u>

The resolution of the graphic products is 1.1-nmi (range) by 1 deg (azimuth) out to a range of 124 nmi.

28.3 Annotations

28.3.1 <u>Alphanumeric</u>

Standard Annotations
Date and End Time of Rainfall Integration
Maximum Data Value
Radar Bias Estimate (mean bias for 3-hour product)
Effective G-R Pair Sample Size (mean for 3-hour product)
Missing Periods
Gage Adjustment Bias Flag

28.3.1.1 <u>(OHP) Paired Alphanumeric</u>

See Section 29.3.1.1 for complete list of adaptation data. [Note: THP paired alphanumeric product contains no adaptation data list.]

28.3.2 <u>Special Symbols</u>

None

28.4 Product Interaction

The following overlay products are displayable on this product:

• Hail Index
• Mesocyclone
• Storm Tracking Information
• Tornado Vortex Signature.

28.5 Comment

All site adaptable parameters identified as inputs to generate data for this product will be available at the alphanumeric display upon user request. This data will be formatted in a tabular layout showing the parameter name in one column and the value in an adjacent column.

29   STORM TOTAL RAINFALL ACCUMULATION (STP AND DSP)

29.1   SS Product Description

"This product shall provide rainfall accumulation data, both displayed as an image and formatted as non-displayable, digital data. The product format and content of the image version (STP) shall be the same as the surface Rainfall Accumulation Product except the time period shall be a variable and shall equal the period of continuous rainfall in the radar area of coverage. This product shall include annotations for product name, radar ID, maximum data value detected, radar position, times and dates of the beginning and end (TSavgcur* or clock hour as appropriate) of the rainfall rate integration, radar position, radar elevation above MSL, radar operational mode, the mean-field bias in the radar estimate of the precipitation rate (Bcur*), and the effective (Gage-Radar Pair) sample size associated with the bias estimate (GRPcur*)."

"The digital version of this product (DSP) shall be available for 256 data levels at each sample bin location of a 1 degree by 2 kilometer polar grid, extending to a range of 230 kilometers (124 nautical miles). The digital version is provided to support processing external to the TDWR SPG system. It shall be updated every volume scan and will include the same annotations as the graphical version of the product (listed above)."

29.2   Display Format

The image version of this product is displayed in full-screen format or quarter-screen format (see Appendix B). It will be formatted as an image radial product. The digital version is non-displayable.

29.2.1   Data Levels

In the image version of the product, the storm total precipitation is displayed in 16 data levels. The data level code may vary with operational mode and with TDWR SPG (or agency) system adaptation data. The data thresholds are site adaptable.

The digital version of the product will contain 256 data levels on an automatically- adjustable, linear scale based on the maximum storm accumulation. Level code 0 will correspond to no accumulation and level codes 1 through 255 will indicate accumulations, with a minimal step of .01 inches. For every multiple of 2.55 inches exceeded, the scale will increment by a corresponding integer multiple. That is, if the maximum accumulation exceeds 2.55 inches, the scale will become .02 inches; if the maximum exceeds 5.10 inches, the scale will become .03 inches, etc. The scale (as integer multiple of .01 inches) will be included in the product header.

The digital data will be compacted on a radial basis.
*See NEXRAD Algorithm Report

29.2.2   Color Level Code Tables (for the image version of the product):

Color Levels

16-Level Code	Display Inches	Range Inches	Code	Color
0	ND	in=0.0	(00 00 00)	black
1	>0.00	0.0<in<0.3	(AA AA AA)	gray
2	0.3	0.3≤in<0.6	(76 76 76)	dark gray
3	0.6	0.6≤in<1.0	(00 FF FF)	cyan
4	1.0	1.0≤in<1.5	(00 AF AF)	dark cyan
5	1.5	1.5≤in<2.0	(00 FF 00)	green
6	2.0	2.0≤in<2.5	(00 8F 00)	dark green
7	2.5	2.5≤in<3.0	(FF 00 FF)	magenta
8	3.0	3.0≤in<4.0	(AF 32 7D)	dark magenta
9	4.0	4.0≤in<5.0	(00 00 FF)	blue
A	5.0	5.0≤in<6.0	(32 00 96)	dark blue
B	6.0	6.05≤in<8.0	(FF FF 00)	yellow
C	8.0	8.0≤in<10.0	(FF AA 00)	orange
D	10.0	10.0≤in<12.0	(FF 00 00)	bright red
E	12.0	12.0≤in<15.0	(AE 00 00)	dark red
F	15.0	15.0≤in	(FF FF FF)	white

29.2.3   Range/Data Resolution

The resolution of both the graphic and digital versions of this product is 1.1 nmi (range) by 1 deg (azimuth), out to a range of 124 nmi.

29.3   Annotations, Both versions of the product will contain the following:

29.3.1   Alphanumeric

Standard Annotations
Beginning/Ending Date and Time of Rainfall Rate Integration
Maximum Data Value
Radar Bias Estimate
Effective G-R Pair Sample Size
Gage Adjustment Bias Flag

29.3.1.1   (STP) Paired and (DSP) Digital Alphanumeric:

Precipitation Status Message, Including:
Current Date Precip Function Ran
Current Time Precip Function Ran
Last Date Precip Detected
Last Time Precip Detected
Current Precip Category
Last Precip Category

Adaptation Data, including:

(**Enhanced Preprocessing Algorithm**)
Width of the Radar Beam
Blockage Threshold
Clutter Threshold
Weight Threshold
Full Hybrid Scan Threshold
Low Refl. Threshold
Rain Detection Refl. Threshold
Rain Detection Area Threshold
Rain Detection Time Threshold
Z-R Multiplicative Coefficient
Z-R Power Coefficient
Minimum Reflectivity to Convert to Rate
Maximum Reflectivity to Convert to Rate
Number Exclusion Zones
(**Rate Algorithm**)
Range Cut-Off
Range Effect Coefficient #1
Range Effect Coefficient #2
Range Effect Coefficient #3
Minimum Precip. Rate
Maximum Precip. Rate
(**Accumulation Algorithm**)
Threshold Elapsed Time to Restart
Maximum Time for Interpolation
Minimum Time in Hourly Period
Threshold Hourly Outlier
Ending time Gage Accumulation
Maximum Period Accumulation Value
Maximum Hourly Accumulation Value
(**Adjustment Algorithm**)
Time bias Estimation
Threshold Number of Gage-Radar Pairs
Reset Bias Value
Longest Allowable Lag (Hours)
Bias Applied Flag

The following alphanumeric data only applies to the DSP product.

Selected Supplemental Data, including:

Average Scan Date
Average Scan Time
Flag Zero Hybrid
Flag Rain Detected
Flag Reset Storm Total
Flag Precip. Begin
Last Date Rain
Last Time Rain
Total No. of Blockage Bins Rejected
Total No. of Clutter Bins Rejected
Total Bins Smoothed
Percent of Hybrid Scan Filled
Highest Elevation Angle (degree)
Rain Area
Spot Blanking Status

Bias-Related Fields, including:
Time (secs) Bias Value Last Updated Locally
Date (modified Julian) Bias Value Last Updated Locally
Time (secs) of Last Update of Local Bias Table
Date (modified Julian) of Last Update of Local Bias Table
Observation Time (secs) of Latest Bias Table
Observation Date (modified Julian) of Latest Bias Table
Generation Time (secs) of Latest Bias Table
Generation Date (modified Julian) of Latest Bias Table
Mean- Field Bias Estimate
Effective G-R Pair Sample Size
Memory Span (Hours) used in Bias Estimate

29.3.2   Special Symbols
None

29.4   Product Interaction
The following overlay products are displayable on the graphic version of this product:
• Hail Index
• Mesocyclone
• Storm Tracking Information
• Tornado Vortex Signatures.

29.5   Comment
All site adaptable parameters identified as inputs to generate data for this product will be available at the alphanumeric display upon user request. This data will be formatted in a tabular layout showing the parameter name in one column and the value in an adjacent column.

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30 HOURLY DIGITAL PRECIPITATION ARRAY (DPA)

30.1 SS Product Description

"The product shall provide hourly running total digital radar-rainfall estimates in an array format (not display oriented) to support processing performed external to the TDWR SPG System. This product shall be available for 256 data levels for each array element. Each product shall include annotations for product name, radar ID, date and ending time (TSavcur* or clock hour as appropriate) of the rainfall rate integration, radar position, the radar operational mode, the maximum data value, the mean-field bias in the radar estimate of the precipitation rate (Bcur*), and the effective (Gage-Radar Pair) sample size associated with the bias estimate (GRPcur*)."

30.2 Display Format

This is not a displayable product.

30.2.1 Data Levels

The accumulation data will be compacted-in the 1/40-LFM grid in a maximum of 256 levels, while the rate data will be compacted in the 1/4 LFM grid with a maximum of 8 levels. These levels are defined as follows:

8-Level

Code	Display	Range (in/hr)
0	0.0	0.0<in/hr<0.1
1	0.1	0.1<in/hr<0.3
2	0.3	0.3<in/hr<0.5
3	0.5	0.5<in/hr<1.0
4	1.0	1.0<in/hr<2.0
5	2.0	2.0<in/hr<4.0
6	4.0	4.0<in/hr
7	ND	

30.2.2 Color Level Code Tables

Not Applicable

30.2.3 Range/Data Resolution

The Adjusted Accumulation data ranges from -6 to 25.625 dBA and is reported in .125 dBA increments, where level codes 0 and 255 represent no accumulation and data outside the coverage area, respectively. Level codes 1 through 254 represent data values of -6 dBA to 25.625 dBA in 0.125 dBA increments. Rate data ranges from 0 to over 4 inches/hour in variable increments of rate. (Refer to para. 30.2.1.)

- - - - - - - - - -
*See Algorithm Report

30.3 Annotations

30.3.1 <u>Alphanumeric</u>

Standard Annotations
Maximum Data Value
Supplemental Data, including:
End Date and End Time Hourly Accumulation
Total No. of Blockage Bins Rejected
Total No. of Clutter Bins Rejected
Number of Bins Smoothed
Percent of Hybrid Scan Bins Filled
Highest Elevation Angle used in Hybrid Scan
Total Hybrid Scan Rain Area
Number of Bad Scans in Current Hour
Radar Bias Estimate
Effective G-R Pair Sample Size
Current Volume Coverage Pattern Number
Current Operational (Weather) Mode
Missing Periods (Begin Date; Begin Time; End Date; End Time)
Adaptation Data, including:
(Enhanced Preprocessing Algorithm)
Width of the Radar Beam
Blockage Threshold
Clutter Threshold
Weight Threshold
Full Hybrid Scan Threshold
Low Refl. Threshold
Rain Detection Refl. Threshold
Rain Detection Area Threshold
Rain Detection Time Threshold
Z-R Multiplicative Coefficient
Z-R Power Coefficient
Minimum Reflectivity to convert to Rate
Maximum Reflectivity to convert to Rate
Number Exclusion Zones
(Rate Algorithm)
Range Cut-Off
Range Effect Coefficient #1
Range Effect Coefficient #2
Range Effect Coefficient #3
Minimum Precip. Rate
Maximum Precip. Rate
(Accumulation Algorithm)
Threshold Elapsed Time to Restart
Maximum Time for Interpolation
Minimum Time in Hourly Period
Threshold Hourly Outlier
Ending Time Gage Accumulation
Maximum Period Accumulation Value

Maximum Hourly Accumulation Value
(Adjustment Algorithm)
Time Bias Estimation
Threshold Number of Gage-Radar Pairs
Reset Bias Value
Longest Allowable Lag (Hours)
Bias Applied Flag

30.3.2   <u>Special Symbols</u>

None

30.4   Product Interaction

None

31 SUPPLEMENTAL PRECIPITATION DATA (SPD)

31.1 SS Product Description

"This product shall provide selected supplemental data generated or collected during the operation of the precipitation processing subsystem algorithm. This product shall also provide the complete table of mean-field, gage-radar Bias values evaluated at different memory timespans (hours), received from AWIPS. This product shall be updated once per volume scan time.

This product shall be produced in a tabular alphanumeric format. This product shall include annotations for product name, radar ID, radar position, date and time of volume scan, maximum data value, radar elevation above MSL, and radar operational mode."

31.2 Display Format

31.2.1 Graphic Display

This product does not have a graphic component.

31.2.2 Alphanumeric Display

This product is displayable only on the alphanumeric screen in tabular alphanumeric format (see Appendix C).

31.3 Annotations

31.3.1   <u>Alphanumeric</u>

Standard Annotations
(Part I----Supplemental Precipitation Data):
Site Adaptation-RPG ID Number
Volume Scan Date and Time
Volume Coverage Pattern
Operational (Weather) Mode
Bias Applied Flag
Bias Estimate
Effective # Gage-Radar Pairs
Memory Span (Hours) used in Bias Estimate
Average Scan Date (Last Bias Update)
Average Scan Time (Last Bias Update)
Total No. of Blockage Bins Rejected
Total No. of Clutter Bins Rejected
Total No. of Final Bins Smoothed
Hybrid Scan Percent Bins Filled
Hybrid Scan Highest Elevation used
Hybrid Scan Total Rain Area
Begin Missing Period Date
Begin Missing Period Time
End Missing Period Date
End Missing Period Time
(Part II----Gage-Radar Mean Field Bias Table):
Average Scan Date (Last Bias Update)
Average Scan Time (Last Bias Update)
Bias Applied Flag (Yes/No)
Memory Span (Hours) (per evaluation timespan)
Effective # Gage-Radar Pairs (per evaluation timespan)
Average Gage Value (per evaluation timespan)
Average Radar Value (per evaluation timespan)
Mean-Field Bias Value (per evaluation timespan)

31.3.2   <u>Special Symbols</u>
None

31.4   Product Interaction
None

32   USER SELECTABLE RAINFALL ACCUMULATION (USP)

32.1   SS Product Description

"This product shall provide a rainfall accumulation map displayed as an image, for a user selected accumulation period. The product format and content shall be the same as the Surface Rainfall Accumulation (SS 28) and Storm Total Rainfall Accumulation (SS 29) products, except the accumulation period shall be of variable duration (in whole clock hours), ranging from a beginning to an ending time specified by the user. The product will usually be generated by request, but may also be generated routinely for limited, designated periods. One of these periods shall be the Default Period, which will span a 24 hour period from 1200z of the previous day to 1200z of the present day.

The default version of the product may be generated any time following the completion of the first volume scan to start after 1200z each day, up to 6 hours later. The period of accumulation shall be defined by the operator via two parameters: the Ending Hour (ranging from 0 to 23z), and the Time Span (ranging form 1 to 24 whole clock hours prior to the Ending Hour.) No more than 30 hours of rainfall data prior to the most recent clock-hour will be required to generate this product.
If a requested product cannot be generated due to an error condition, a message will be displayed explaining why, and the available hours of precipitation accumulation in the precipitation data base will be listed.

"This product shall include annotations for product name, radar ID, maximum data value detected, radar position, times and dates of the beginning and end (clock hour) of the rainfall rate integration, radar position, radar elevation above MSL, radar operational mode, the mean-field bias in the radar estimate of the precipitation rate (Bcur*), and the effective (Gage-Radar Pair) sample size associated with the bias estimate (GRPcur*)."

32.2   Display Format

The product is displayed in full-screen or quarter-screen format (see Appendix B).

32.2.1   Data Levels

The User Selectable Rainfall Accumulation is displayed in 16 data levels on one of two possible scales, based on the maximum data value detected: one scale corresponding to that presently in use for the Surface Rainfall Accumulation products (OHP & THP); the other scale corresponding to that presently in use for the Storm Total Rainfall Accumulation product (STP). The scale used for the User Selectable product will switch automatically between the two, with the OHP & THP scale in effect unless the product maximum data value exceeds the lower limit of the maximum data level (e.g. 8 inches), in which case the STP scale will be invoked. Each data level code may vary with TDWR SPG (or agency) system adaptation data.
*See Algorithm Report

32.2.2   Color Level Code Tables

See sections 28.2.2 and 29.2.2.

32.2.3   Range/Data Resolution

The resolution of this graphic product is 1.1 nmi (range) by 1 deg (azimuth) out to a range of 124 nmi.

32.2.4 <u>Alphanumeric Display</u>

32.2.4.1 <u>Graphic Screen</u>

A tabular format (Appendix B, Format III, Configuration 6) will be displayable on the graphic display screens. The tabular format will include:

(a) Gage Bias Flag
(b) Number of Hours in product
(c) End Times
(d) Bias
(e) Hours Included Flag

32.3 Annotations

32.3.1 **<u>Standard Annotations</u>**

Beginning/ending Date and Time of Rainfall Rate Integration
Maximum Data Value
Radar Bias Estimate
Effective G-R Pair Sample Size
Gage Adjustment Bias Flag

32.3.2 <u>Special Symbols</u>

None

32.4 Product Interaction

The following overlay products are displayable on this product:
• Hail Index
• Mesocyclone
• Storm Tracking Information
• Tornado Vortex Signatures.

33 HYBRID SCAN REFLECTIVITY (HSR) AND DIGITAL HYBRID SCAN REFLECTIVITY (DHR)

33.1 SS Product Description

"This product shall provide radar-reflectivity values for the composite Hybrid Scan*, both displayed as an image and formatted as non-displayable digital data. This product shall be assembled from the TDWR low-PRF long range surveillance scan and yielding a representative reflectivity value at every sample bin location of a 1 degree by 1 kilometer polar grid, out to a range of 230 kilometers (124 nautical miles). This digital data is provided to support processing performed external to the TDWR SPG System, and is not display oriented. This product shall be updated once every volume scan time.

The digital version of this product shall be available for 256 data levels at each sample bin location. Each digital product shall include annotations for the product name, radar ID, date and time of the scan (TSavcur*), radar position, radar elevation above MSL, radar operational mode, and the maximum data value (dBZ).

The image version of this product shall represent the Reflectivity data . Each product shall include annotations for the product name, radar ID, time and date of scan, data level code, maximum data value (dBZ), radar position, radar elevation above MSL, and radar operational mode."

33.2 Display Format

The image version of this product is displayed in full-screen format or quarter-screen format (see Appendix B). It will be formatted as an image radial product. The digital version is not a displayable product.

33.2.1 <u>Data Levels</u>

The 256 data levels of the digital product cover a range of reflectivity from -30.0 to 80.0 dBZ, in .5 dBZ increments. Level codes 0 and 1 correspond to "Below Threshold" and "Range Folded", respectively, while level codes 2 through 255 correspond to the reflectivity data itself.
The image version of this product shall contain 16 data levels. The range of Reflectivity supported by the RDA is -30 to +80 dBZe.

33.2.2 <u>Color Level Code Tables</u>

For the digital version of this product, the color table is not applicable. The graphic version of this product color level codes shall be identical to that used by the 16 data level base Reflectivity defined in product specification 1.2.2.

33.2.3 <u>Range/Data Resolution</u>

The Hybrid Scan extends to a range of 124 nmi, on a 230 x 360 (.54 nmi x 1 degree-resolution) polar grid.

33.3 Annotations

33.3.1 <u>Digital Alphanumeric</u>

Standard Annotations
Time and Date of the Scan (Tsavcur*)
Spot Blanking Status

Maximum Data Value
Precipitation Status Message, including:
Curent Date Precip Function Ran
Current Time Precip Function Ran
Last Date Precip Detected
Last Time Precip Detected
Current Precip Category
Last Precip Category
Adaptation Data, including:
(Enhanced Preprocessing Algorithm)
Width of the Radar Beam
Blockage Threshold
Clutter Threshold
Weight Threshold
Full Hybrid Scan Threshold
Low Refl. Threshold
Rain Detection Refl. Threshold
Rain Detection Area Threshold
Rain Detection Time Threshold
Z-R Multiplicative Coefficient
Z-R Power Coefficient
Minimum Reflectivity to convert to Rate
Maximum Reflectivity to convert to Rate
Number Exclusion Zones
(Rate Algorithm)
Range Cut-Off
Range Effect Coefficient #1
Range Effect Coefficient #2
Range Effect Coefficient #3
Minimum Precip. Rate
Maximum Precip. Rate
(Accumulation Algorithm)
Threshold Elapsed Time to Restart
Maximum Time for Interpolation
Minimum Time in Hourly Period
Threshold Hourly Outlier
Ending Time Gage Accumulation
Maximum Period Accumulation Value
Maximum Hourly Accumulation Value
(Adjustment Algorithm)
Time Bias Estimation
Threshold Number of Gage-Radar Pairs
Reset Bias Value
Longest Allowable Lag (Hours)
Bias Applied Flag
Selected Supplemental Data, including:
Average Scan Date
Average Scan Time
Flag Zero Hybrid
Flag Rain Detected
Flag Reset Storm Total

Flag Precip. Begin
Last Date Rain
Last Time Rain
Total No. of Blockage Bins Rejected
Total No. of Clutter Bins Rejected
Total Bins Smoothed
Percent of Hybrid Scan Filled
Highest Elevation Angle (degree)
Rain Area
Spot Blanking Status
Bias-Related Fields, including:
Time (secs) Bias Value Last Updated Locally
Date (modified Julian) Bias Value Last Updated Locally
Time (secs) of Last Update of Local Bias Table
Date (modified Julian) of Last Update of Local Bias Table
Observation Time (secs) of Latest Bias Table
Observation Date (modified Julian) of Latest Bias Table
Generation Time (secs) of Latest Bias Table
Generation Date (modified Julian) of Latest Bias Table
Mean-Field Bias Estimate
Effective G-R Pair Sample Size
Memory Span (Hours) used in Bias Estimate
Precipitation Status Message, including:
Current Date Stamp
Current Time Stamp
Date Last Precip Detected
Time Last Precip Detected
Current Precip Category
Last Precip Category

33.3.2   Graphic Alphanumeric

Standard Annotations (Appendix A, I(A))

33.4   Product Interaction

Product interaction for the image version of this product is identical to the base Reflectivity defined in product specification 1.4.
- - - - -
*See NEXRAD Algorithm Report

34 DELETED

35 DELETED

36 DELETED

37 DELETED

38   DELETED

39 DELETED

40   USER SELECTABLE LAYER COMPOSITE REFLECTIVITY (ULR)

40.1 SSS Product Description

"This product shall be provided on a 1 degrees by 1 kilometer polar grid, out to a range of 90 kilometers (48 nautical miles). For each resolution element, this product shall provide the maximum reflectivity value above the resolution element of sample bins intersecting the layer from any elevation angle scan of a volume scan. At most ten layers shall be available per volume. The altitude limits of each layer shall be specified by user product request. No layer shall be less than 1,000 ft thick. Each layer product shall be updated on a volume scan basis. Sixteen data levels shall be available for each product, including one for data below minimum Signal-to-Noise threshold and one for unavailable data. Data is unavailable at a given range resolution element to gaps between elevation scans or if the given resolution element lies above the layer or below the layer. Each product shall contain annotations for product name, radar ID, date and time of volume scan, maximum data value detected, radar position, radar elevation above MSL, and radar operational mode."

40.2 Display Format

40.2.1 Data Level

This product shall contain 16 displayable levels (4 bits) as follows: the first data level shall depict data below the signal - to- noise ratio threshold; the second data level shall depict data which is unavailable due to gaps in the Volume coverage Pattern; the third data level shall contain all data greater than signal-to-noise threshold and less than -5 dBZ; the last data level shall contain all data greater or equal to 55 dBZ; the remaining twelve data levels shall depict reflectivity values greater or equal to -5 dBZ to less than 55 dBZ, at increments to 5 dBZ.

40.2.2 Color Level Code Tables

16-Level Code	Display dBZ	Range dBZ	Code	Color
0	>TH	SNR<TH or dBZ <-32	TBD	TBD
1	ND	ND	TBD	TBD
2	>-5	-32<=dBZ<-5	TBD	TBD
3	-5	-5<=dBZ<0	TBD	TBD
4	0	0<=dBZ<5	TBD	TBD
5	5	5<=dBZ<10	TBD	TBD
6	10	10<=dBZ<15	TBD	TBD
7	15	15<=dBZ<20	TBD	TBD
8	20	20<=dBZ<25	TBD	TBD
9	25	25<=dBZ<30	TBD	TBD
10	30	30<=dBZ<35	TBD	TBD
11	35	35<=dBZ<40	TBD	TBD
12	40	40<=dBZ<45	TBD	TBD
13	45	45<=dBZ<50	TBD	TBD
14	50	50<=dBZ<55	TBD	TBD
15	55	55<=dBZ	TBD	TBD

40.2.3 Range/Data Resolution

The product coverage area is 360 degrees x 48 nm. The resolution is 1 degree x 0.54 nm. The product is centered at the radar location.

40.3 Annotations

40.3.1 <u>Alphanumeric</u>

Standard Annotation (Appendix A).
Data Level Codes
Maximum Data Value Detected
Requested Altitudes of the Layer Bottom and (to correct request errors as described below)

To permit product generation, invalid product request parameters (i.e., ICD non-compliance such as layer altitude outside of 0 or 70k ft, or minimum thickness less than 1k ft) shall be modified according to the following rules: (A) If the layer bottom altitude is less than 0k ft, generate a product based on a layer bottom altitude of 0k ft; (B) If the layer top altitude is greater than 70k ft, generate a product based on a layer top altitude of 70k ft; (C) If the layer thickness is zero, generate a product based on the top altitude being 1k ft higher than the layer bottom altitude; (D) If the layer top (bottom) altitude are both above (below) the valid altitude limits, generate a product with the layer top (bottom) altitude set to 70k ft (0k ft) and with the other altitude set to 1k ft lower (higher); (E) If the layer top altitude is less than the layer bottom altitude, switch the limits so that the layer depth is greater than zero.

40.3.2 <u>Special Symbols</u>

None defined.

41 DELETED

42   DELETED

43 DELETED

44 DELETED

45 ARCHIVE III STATUS PRODUCT (ASP)

45.1 SS Product Description

Section 3.7.1.6.3 states "The capability shall (1) be provided to detect, record, and display all status and error messages."

The ASP product contains an adaptable number of hours of SPG status log messages. The product (by default) is generated every eight hours at 00:00, 08:00, and 16:00 GMT. The product contains all SPG status log messages since the last product was generated.

This product shall include annotations for the product name, radar ID, date and time of volume scan, elevation angle, radar position, radar elevation above MSL, and radar operational mode.

45.2 ASP Format for External Systems

The product is formatted according to the Generic Product Format (GPF) packet description and encoded using External Data Representation (XDR). See the SPG to Class 1 User ICD for more information about GPF and XDR.

45.3 Annotations

45.3.1 <u>Alphanumeric</u>

Standard annotations

46 DELETED

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APPENDIX A

Annotations, Symbols, Abbreviations, and Display Features

I. Annotations

(A) Standard Annotations

Every color Graphic product and most alphanumeric products will have, as a minimum, the following automated annotations (except as otherwise noted in specific product descriptions):

• Product Specification

• Standard Units, Annotations, Symbols, Abbreviations, and Display Features

• Product name

• Date/time of elevation, volume or azimuth scan

• RDA ID

• RDA Position (A/N Location)

• RDA elevation above MSL (feet)

• Operational mode.

(B) Special Symbols and Characters

The following special symbols and characters will be used in each product display as appropriate. Any further refinement for particular product will be made in the product specification.

(1) Storm ID

Each identified storm will be given a unique ID of two characters. The first character will be a capital letter, A through Z, and the second will be a number, 0 through 9. The sequence will be A0, B0, C0,...Z0, A1, B1, C1,...Z1, A2,...Z9. The sequence is recycled following Z9. When there has not been any storm cells identified in a user specified "number of past volume scans", then the sequence of IDs will be reset so that the next storm cell identified will have the ID A0. The ID will be white (code FF FF FF) and the background in black (code 00 00 00).

(2) Storm Cell Track

The storm cell track consists of past, current, and forecast storm cell centroid positions connected by one pixel wide linear segments. Past positions will be displayed as white filled (5-pixel diameter) circles.

Current positions will be displayed as a circle (7-pixel diameter) with an "X" inside the circle. Forecast positions will be displayed as a circle (7-pixel diameter) of white plus signs, 1 pixel wide, of similar size. Forecast interval is a user agency or NEXRAD system option. This product specification uses a 15-minute default value.

For stationary cells, no past or forecast storm cell positions will be displayed. Instead, stationary storm cells shall be denoted by a circle (12-pixel diameter) concentric with the current position symbol.

(3) RDA Position

The associated RDA symbol will be displayed as a white open 1 pixel circle which is 5 pixels in diameter and is centered on the RDA location.

(4) Mesocyclone

The mesocyclone will be displayed (centered on the location of the mesocyclone at the lowest elevation angle in which it is detected) as a yellow open circle, whose perimeter is 4 pixels thick. The size of the symbol will be proportional to the average of the mesocyclone radial and azimuthal diameters. The minimum size symbol will be a circle having a diameter of 14 pixels. See section 20.3.2 for MD and DMD special symbol product requirements.

(6) Hail

The hail symbol is a green isosceles triangle. The triangle can be small (a base of 8 pixels and height of 12 pixels) or large (a base of 16 pixels and a height of 20 pixels). The size of the triangle and whether the triangle is filled depends upon the Probability of Severe Hail and the Probability of Hail. The following are the rules of display and default settings.

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Triangle	Probability of Severe Hail	Probability of Hail
Large/Filled	≥50%	N/A
Large/Open	≥30%	N/A
Small/Filled	0%	≥50%
Small/Open	0%	≥30%

However, the probabilities are adaptable parameters at the AWIPS, and the user has the ability to disable the display of one or both of the small and/or large triangles. The Maximum Expected Hail Size will be displayed in the middle of the triangle.

(7) TVS

The TVS symbol is an inverted red-filled isosceles triangle, and the symbol for an Elevated TVS (ETVS) is the same except it is unfilled. The triangle has a base of 7 pixels and a height of 12 pixels.

II. Standard and Product Specific Annotation Display

The annotations are automated, entered and displayed on the 128 by 512 pixel screen right area in white except where specified. All alphanumeric characters will fit into a 7 by 9 pixel area and the number of characters in a single horizontal line will not exceed 18 characters assuming standard spacing between them.

In addition:

(1) The radar position which will be displayed at its actual location as described (I.B.3) on the graphic display. In addition, the RDA latitude and longitude will be displayed in the screen right area.

(2) The Data Level Code colors will be displayed as specified in the Color Level Code Tables.

(3) Storm ID, Storm Track, TVS, mesocyclone and hail overlays are all to be overlaid on a number of other products. They may be overlaid individually or in combination on a displayed product. To ensure readability when displayed in combination, a placement algorithm is required that will allow the symbols to be placed in close proximity with the storm to which the phenomena apply without interference between symbols and without interference with the image.

The following rules apply to the algorithm:

• Storm ID - will be placed 5 pixels east and 5 pixels to the south of the storm centroid for all products and overlays.

• Storm Track - will be displayed as indicated on the Storm Track Information product.

• TVS - The apex of the symbol will be placed on any product at the position corresponding to the TVS (or ETVS) position at the lowest elevation angle where it is detected.

•   Mesocyclone - will be overlaid on any product at a position corresponding to its position at the lowest elevation angle where it is detected.

• Hail symbol - will be placed to the right of the storm ID.

Pixel color precedence, in the event that some symbols overlay each other, or the imagery is specified in AWIPS adaptation Data. The current precedence follows:

• TVS
• Mesocyclone
• Storm track information and storm ID
• Hail

Background Map (background or foreground) and imagery have the lowest precedence and which one is the absolute lowest depends on whether the background maps are in the foreground or background.

(4)   Display of Storm Attribute Data

Storm attribute data is obtained as direct output of the following algorithms: mesocyclone, hail, TVS detection, storm cell segments, storm cell centroids, storm cell tracking, and storm position forecast. These will be displayed on the upper portion (*52* by 512 pixel area) of the graphic display area. This storm attribute section has been designed into the graphic display Format III (Appendix B). In each of the configurations only a limited number of storm cells can be accommodated, and, therefore, to obtain attribute information on remaining storm cells, paging is necessary. The data content and format have been configured for five different attribute data sets which are listed below.

Configuration 1 is applied to the Storm Tracking Information (STI) and includes data on storm ID, storm cell centroid position (AZRAN), forecast speed and direction of the storm cell ("NEW" is indicated during first volume scan storm cell is detected); forecast error and mean forecast error; maximum reflectivity in dBZ and its height. The table outline for the STI attribute data shall be cyan. When STI is displayed as a stand alone product, the annotations will be displayed. When it is overlaid on other products which include an attribute table, the STI table replaces the overlaid product's table. By default, all storm cells (entries), up to a maximum of 100, can be displayed in this format. However, the MSCF has the capability to limit the number of storm cells included in this format from 6 to 100.

Configuration 2C, associated with the Mesocyclone Detection (MD) product closely follows the Mesocyclone product. Differences are described in section 20.2.2. The table outline for the MD attribute data shall be yellow. Due to a limit of 6 pages, only the strongest 36 MDA features are included in the Attribute Data. The MD product is a stand alone product as well as an overlay product and the manner in which Configuration 2C is handled is the same as that of Configuration 1.

Configuration 3 is applied to the TVS product, which is a stand alone product and overlay or annotation to other products. For each TVS and Elevated TVS (ETVS) the following attributes are listed: type (TVS or ETVS), storm cell ID, (base) position (AZ/RAN), average delta velocity, low-level (base) delta velocity, maximum delta velocity, base height, and depth. (NOTE: If the base is detected on the lowest elevation scan of the volume scan, then the base (height) is qualified with '<' respectively. And, if either the base or top are detected on the lowest or highest elevation scan of the volume scan, then the depth is also qualified with a '>'.) The table outline for the TVS attribute data shall be red. The manner in which the configuration data and the image data are handled when overlaid on other products (including other overlay products) is the same as that of Configurations l and 2.

Configuration 4 is applied to the Hail Index product, which is a stand alone product or an overlay to other products. The attribute data set of Configuration 4 includes the storm cell ID, storm cell centroid position (AZRAN), the probability of severe hail, the probability of hail, the maximum expected hail size, the user selectable hail temperature altitudes (MSL) (of the 0º C and -20º C environmental temperatures), and the time and date of the last change to the hail temperature altitudes. The table outline for the Hail attribute data shall be green. The manner in which Configuration 4 is displayed is the same as that described for Configuration 1. By default, all storm cells (entries), up to a maximum of 100, can be displayed in this format. However, the SPG HCI has the capability to limit the number of storm cells included in this format from 6 to 100.

Configuration 5 is displayable only with the composite reflectivity products. The information displayed includes storm ID; storm cell centroid position (AZRAN) (to the nearest degree/nmi); TVS (TVS, ETVS, or NONE); mesocyclone (MESO, 3DCO, UNCO, or NONE); probability of severe hail (%), probability of hail (%), and maximum expected hail size (to the nearest quarter inch); cell-based VIL (to the nearest kg/m**2); maximum reflectivity (to the nearest dBZ) and its height (AGL) size (to the nearest tenths kft); storm tops (to the nearest tenths kft); and forecast speed and direction (to the nearest degree/nmi) of the storm cell ("NEW" is indicated during first volume scan storm cell is detected). If both a TVS and ETVS are associated with the same storm cell, then "TVS" will be displayed. The storm cells will be ranked in the following order: TVSs, ETVSs, MESOs, 3-D Correlated Shears, 2-D Uncorrelated Shears, POSH, POH, and Cell-based VIL. TVSs or ETVSs which are not associated with a storm cell will not be included in this table. The table outline for the combined attribute data shall be orange. (NOTE: The Storm Top (TOP) data is qualified with '>' if the storm top was detected on the highest elevation scan of the Volume Coverage Pattern.) By default, all storm cells (entries), up to a maximum of 100, can be displayed in this format. However, the SPH HCI has the capability to limit the number of storm cells included in this format from 4 to 100.

The maximum number of storm cells whose attributes are included is adaptable at the SPH HCI.

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Notes:

(1)All overlay products may be overlaid on each other or other geographic products.

(2)All complete attribute data sets for each of the overlay products are also available as a tabular output on the A/N screen.

(3)Any overlay may be defined in AWIPS adaptation data as a default overlay on any geographic product.

(4)Magnification of an individual storm or limited area requires special handling of the attribute data display. Any of the Attribute Tables may be accessed. However, to obtain specific attribute data for the magnified storm (or area), paging of the data may be required until the specific storm attribute data appears.

III. Summary Tables

(l) Units

Table I, Parameter Standard Dimensions, specifies where applicable, the units and resolutions of the parameters that will be used in the product display design.

(2)Product Parameters

Table II, Product Parameters, lists those parameters which define each of the SS products and their variations.

(3)Standard Abbreviations

The standard abbreviations to be used on the graphic display are contained in Table III.

IV.Product Display Formats

The 640 by 512 pixel display screen has been partitioned into two major areas. The status and annotation area is defined as the 128 by 512 pixel area on the extreme right of the display screen. The remaining 512 by 512 pixel area is identified as the "graphic display area."

Two basic graphic area formats (Appendix B) have been identified; they are:

(1)Format I - Full screen display (512 by 512 pixels) with a 52 by 512 pixel area available in the upper portion of the screen for displaying storm attribute data and the remaining 460 by 512 pixel area reserved only for image display.

(2)Format II - Quarter screen display with the 512 by 512 pixel area partitioned into four quarter screens, 256 by 256 pixels each. Each quarter screen reserves the lower 56 by 256 pixel area for color level code and product name display; the remainder is used for imagery.

TABLE I. PARAMETER STANDARD DIMENSIONS FOR DISPLAY

PARAMETER	CHARACTERS	UNITS
Altitude	HHHHH	feet
Base/Tops	XX.X	10^3 feet
Date (Calendar)	MM:DD:YY	month, day, year
Date Level Code	XX.X	(integer)
Display Center Coordinate:		
Azimuth/Range (AZRAN)	DDD/XXX	degrees/nmi (integer)
Latitude/Longitude	DDMMSS/DDDMMSS	degrees, minutes/seconds
Diameter	XX.X	nmi
Direction of storm motion	DDD	degrees (integer)
Elevation Angle	DD.D	degrees and tenths
Error, Variance	XX.X	kts
Mean Radial Velocity	XX	kts (integer)
Orientation/Rotation	XX.X/.XXX	degrees/radians
Radar elevation above MSL	HHHH	feet
Range	XXX	nmi (integer)
RDA	XXXX	alphabetical identifier
Reflectivity	XX	dBZ (integer)
Resolution	X.XX	nmi
Speed of storm motion	XX.X	kts
Time (GMT)	HH:MM:SS	hour, min, sec
Velocity Spectrum Width	XX	kts (integer)
Wind direction	DDD	degrees (integer)
Wind speed	XX	kts (integer)

TABLE II. PRODUCT PARAMETERS

		RPG	SCREEN SELECT	RANGE/ RESOL.	DATA LEVELS	ELEV. ANGLE	LAYER OR ALTITUDE	DISPLAY CENTER		ALPHA TABULAR	ALPHA ANNOTATE	OVER-LAY	STAND-ALONE GRAPHIC	
NTR1	BASE REFLECTIVITY	X	X	X	X	X								
NTR2	MEAN RADIAL VELOCITY	X	X		X	X								
NTR3	SPECTRUM WIDTH	X	X			X							X	
NTR4	Deleted													
NTR5	Deleted													
NTR6	COMPOSITE REFLECTIVITY	X	X	X	X								X	
NTR7	Deleted													
NTR8	ECHO TOPS	X	X										X	
NTR9	Deleted													
NTR10	Deleted													
NTR11	Deleted													
NTR12	VELOCITY AZIMUTH DISPLAY	X	X				ALTITUDE						X	
NTR13	Deleted													
NTR14	Deleted													
NTR15	Deleted													
NTR16 a)	Deleted													
NTR16 b)	Deleted													
NTR17	VERTICALLY INTEGRATED LIQUID	X	X										X	
NTR18	STORM TRACKING INFORMATION	X	X							X	X	X	X	
NTR19	HAIL INDEX	X	X							X	X	X	X	
NTR20	MESOCYCLONE	X	X							X	X	X	X	
NTR21	TORNADO VORTEX SIGNATURE	X	X							X	X	X	X	
NTR22	STORM STRUCTURE	X	X							X				
NTR23	Deleted													
NTR24	Deleted													
NTR25	Deleted													
NTR26	Deleted													
NTR27	FREE TEXT MESSAGE	X								X				
NTR28	SURFACE RAINFALL ACCUMULATION	X		X									X	
NTR29	STORM TOTAL RAINFALL ACCUMULATION	X		X									X	
NTR30	HOURLY DIGITAL PRECIPITATION ARRAY	X								X				
NTR31	SUPPLEMENTAL PRECIPITATION DATA	X								X				
NTR 32	USER SELECTABLE RAINFALL ACCUMULATION	X	X										X	
NTR 33	HYBRID SCAN REFLECTIVITY													
a)	DIGITAL HYBRID SCAN REFLECTIVITY	X												
b)	HYBRID SCAN REFLECTIVITY	X	X	X	X	X				X				
NTR34	Deleted													
NTR35	Deleted													
NTR36	Deleted													

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		RPG	SCREEN SELECT	RANGE/ RESOL.	DATA LEVELS	ELEV. ANGLE	LAYER OR ALTITUDE	DISPLAY CENTER		ALPHA TABULAR	ALPHA ANNOTATE	OVER- LAY	STAND- ALONE GRAPHIC	
NTR37	Deleted													
NTR38	Deleted													
NTR39	Deleted													
NTR40	USER SELECTABLE LAYER COMPOSITE REFLECTIVITY	X	X					LAYER					X	
NTR41	Deleted													
NTR42	Deleted													
NTR43	Deleted													
NTR44	Deleted													

NOTE: ALL PRODUCTS ARE GENERATED (AS FREQUENTLY AS ONE PER MINUTE) BASED ON

1) ROUTINE PRODUCT SETS (RPS) LISTS

2) RPG PRODUCT GENERATION AND DISTRIBUTION LIST

3) ONE-TIME PRODUCT REQUEST

4) TDWR SPG SCAN STRAGEGY: SURFACE ELEVATION SCAN IS REPEATED EVERY 60 SECONDS; ALOFT SCANS ARE REPEATED EVERY 3 MINUTES; LOW-PRF SURVEILLANCE SCAN AND 1 DEGREE ELEVATION SCAN IS REPEATED JUST ONCE PER 6 MINUTE VOLUME SCAN.

      NOTES: A) RANGE SELECTION IS SYNONYMOUS WITH RESOLUTION SELECTION.

TABLE III. STANDARD ABBREVIATIONS

Operational Mode	Display Annotations
Precipitation Mode	A

SS Products	Abbreviations
Composite Reflectivity	CR
Echo Tops	ET
Free Text Message	FTM
Hail Index	HI
Hourly Digital Precipitation Array	DPA
Hybrid Scan Reflectivity	HSR
Mean Radial Velocity	V
Mesocyclone Detection	MD
Digital Mesocyclone Detection	DMD
One-Hour Rainfall Accumulation	OHP
PUP Text Message	PTM
Reflectivity	R
Spectrum Width	SW
Storm Structure	SS
Storm Total Rainfall Accumulation	STP
Storm Tracking Information	STI
Supplemental Precipitation Data	SPD
Three-Hour Rainfall Accumulation	THP
Tornado Vortex Signature	TVS
User Selectable Layer Composite Reflectivity	ULR
Velocity Azimuth Display	VAD
Vertical Wind Profile	VWP
Vertically Integrated Liquid	VIL

Above Ground level	AGL
Alphanumeric	A/N
Advanced Weather Interactive Processing System	AWIPS
Azimuth	AZ
Azimuth/Range	AZRAN
Center Point	C/P
Cathode Ray Tube	CRT
Centered	CTRD
10 log (Rainfall Accumulation/mm)	dBA
10 log (Equivalent Reflectivity)	dBZ
degree	deg
Diameter	DIAM
Digital Video Integrator and Processor	DVIP
Elevation	ELEV
Elevated TVS	ETVS
Error	ERR
Feature	FEAT
Federal Meteorological Handbook	FMH
feet	ft
Forecast	FCST

Greenwich Mean Time	GMT
height	Hgt
Human Computer Interface	HCI
Identification Number	ID
Interface Control Document	ICD
Interval	INT
kilofeet	Kft
knots	kts
Limited Fine Mesh	LFM
Maximum Reflectivity	MAX Z
Maximum Spectrum Width	MAX WIDTH
Maximum Velocity	MAX VEL
Mean Sea Level	MSL
National Weather Service	NWS
nautical miles	nmi
NEXRAD Technical Requirements	NTR
Next Generation Weather Radar	NEXRAD
No Data	ND
Not Applicable	N/A
Orientation	ORI
Overhang	OVH
Overlay	OVLA
Positive	YES
Principle User Processor	PUP
Probable	PBL
Radar Data Acquisitions	RDA
Radar Product Generation	RPG
Radial	RAD
Range Folding	RF
Root Mean Square	RMS
Rotation	ROT
Routine Product Set	RPS
second(s)	s
Signal-to-Noise Ratio	SNR
Supplemental Product Generator	SPG
System Specification	SS
Storm	STM
Surface	SFC
Terminal Doppler Weather Radar	TDWR
To Be Determined	TBD
Unknown	UNK
Variance	VAR
Video Integrated Processor	VIP
Volume	VOL

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* A complete listing of alert abbreviations used in the UAM appears in section 8.3.1 of PUP/RPGOP
User's Manual.

APPENDIX B

Graphic Display Formats
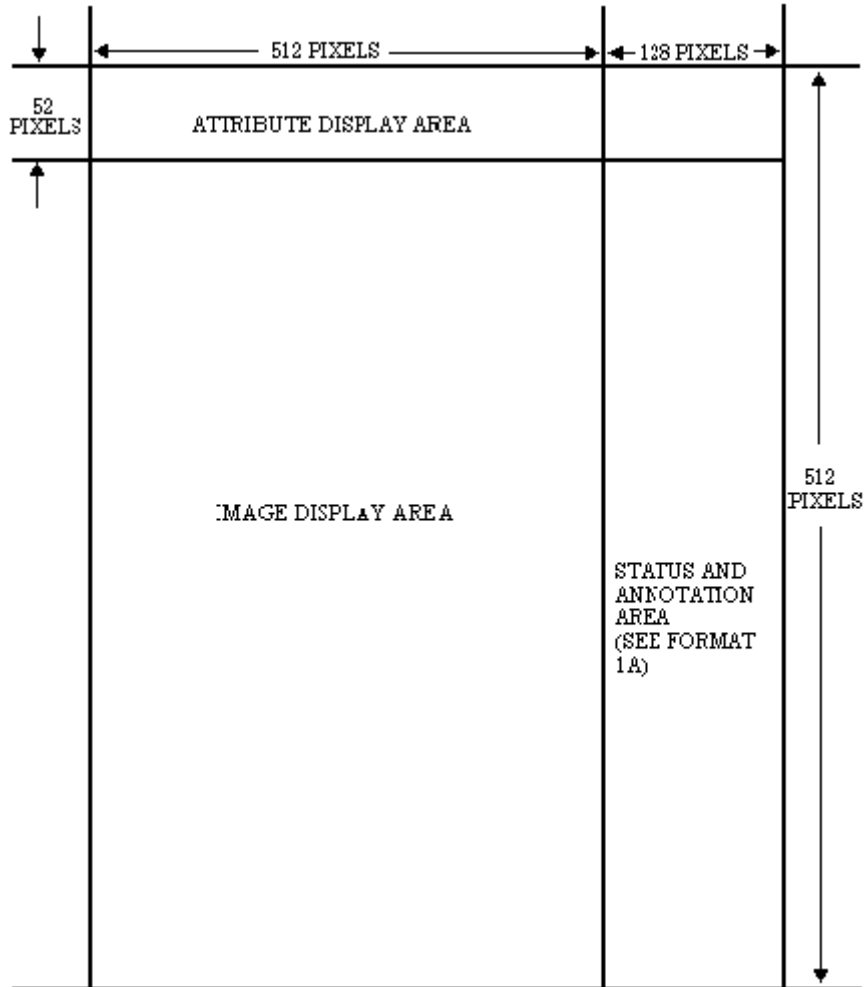
FORMAT (FULL SCREEN DISPLAY)
Format I. Full Screen

CONF 1

STORM	ID	XX	
AZ	RAN	XXX XXX	
FCST	MVT	XXXXX.XX	
TRACK	ERR	XX.X XX.X	
DBZM	HGT	XX.X XX.X	

NTR 18 STORM TRACKING INFORMATION
NOTE: STORMS ARE ORDERED ACCORDING TO: 1) CELL-BASED VIL AND 2) MAXIMUM REFLECTIVITY

CONF 2C

CIR	STMID	XXX	XX	
SR	LLRV	XXa	XXX	
AZ	RAN	XXX	XXX	
HGT	MXRV	XX	XX	
BASE	DPTH	<XX	>XX	

NTR 20 MESOCYCLONE DETECTION

NOTE: CIRCULATIONS LISTED FROM HIGHEST TO LOWEST STRENGTH RANK.

CONF 3A

TYPE STM ID	XXXX	XX	
AZ RAN	XXX	XXX	
AVGDV	XXX		
LLDV MDV	XXX	XXX	
BASE DEPTH	XXX.X	XX	

NTR 21   TVS
    TYPES ARE 1. TVS
            2. ETVS (Elevated TVS)
NOTE: TVSs are listed before ETVSs, and both types are ordered by Low-level Delta Velocity (from highest to lowest).

CONF 4

STORM	ID	XX	
AZ	RAN	XXX XXX	
POSH/POH		XXX/XXX	
MAX HAIL SIZE		XX.XX	

NTR 19 HAIL
NOTE: STORMS ARE ORDERED ACCORDING TO: 1) PROBABILITY OF SEVERE HAIL AND 2) PROBABILITY OF HAIL

0/-20 C TEMP ALT XX.X/XX.X KFT(MSL) - LAST CHANGE   HH/MM DD/MM/YY

CONF 5

STM ID	AZ/RAN	TVS	MDA	POSH/POH/MX SIZE	VIL	DBZM HGT	TOP	FCST MVMT	
XX	XXX/XXX	XXX	XXX	XXX/XXX/XX.XX	XX	XX XX.X	XX.XX	XXX/XXX	COMBINED
									ATTRIBUTE
									TABLE

NOTE: STORM CELLS ORDERED: TVSs, ETVS, MESOs (by strength rank if meeting Minimum Display Filter strength rank), POSH, POH, AND CELL-BASED VIL. MDA column contains "NONE" if no MDA feature is associated with the storm cell, otherwise the 2-digit strength rank is displayed.
NOTE: THE STORM CELL TOP(TOP) DATA IS QUALIFIED WITH '>' IF THE CELL WAS DETECTED ON THE HIGHEST ELEVATION SCAN OF THE VOLUME COVERAGE PATTERN.

CONF 6

GAGE BIAS - APPLIED								
XX OF YY HOURS IN PRODUCT								
END TIMES	XXZ							
BIAS	Y.YY							
HOURS INCLUDED?	YES/NO							

NTR 32 USP

GENERAL NOTES: 1 ALL HORIZONTAL AND VERTICAL LINES SEPARATING THE PARAMETERS ARE ONE PIXEL WIDE.
          2 LETTER SIZES (ALL A/N) FIT INTO A 7 X 9 PIXEL AREA.

Format III. Attribute Area

VWP GRID

NOTE 1:THE NUMBER OF PIXELS BETWEEN HORIZONTAL HEIGHT LINES IS A FUNCTION
OF THE NUMBER OF MSCF SELECTED HEIGHTS (THE MINIMUM NUMBER IS 14 PIXELS)
Format IVA VWP Grid

VAD WIND ANALYSIS GRID
Format IVb. VAD Grid

APPENDIX C

Alphanumeric Tabular Formats
- Storm Tracking
- Hail Index
- Mesocyclone
- TVS
- Storm Structure
- Supplementary Precipitation Data
- Hourly Digital Precipitation Array
- Digital Hybrid Scan Reflectivity
- Precipitation Adaptation Data
- Wind Profile adaptable Parameter

STORM POSITION/FORECAST

RADAR ID: nnn   DATE/TIME MM:DD:YY:/HH:MM:SS   NUMBER OF STORMS nnn

	CURRENT POSITION			FORECAST POSITION			ERROR
STORM ID	AZRAN (DEG/NM)	MOVEMENT (KEG/KTS)	15 MIN (DEG/NM)	30 MIN (DEG/NM)	45 MIN (DEG/NM)	60 MIN (DEG/NM)	FAST/MEAN (NM)
XX	XXX/XXX	XXX/XXX	XXX/XXX	XXX/XXX	XXX/XXX	XXX/XXX	XX.X/XX.X

NOTE: STORMS ARE ORDERED ACCORDING TO: 1) MAXIMUM CELL-BASED VIL AND 2) MAXIMUM REFLECTIVITY.

NOTE: THE NUMBER OF STORM CELLS DISPLAYED FROM THE TOP OF THE ORDERED LIST IS ADAPTABLE AT THE MSCF.

Format I. Storm Tracking

STORM CELL TRACKING/FORECAST ADAPTATION DATA

XXX	(DEG)	DEFAULT (DIRECTION)	X.X	(M/S)	THRESH (MINIMUM SPEED)
XX.X	(KTS)	DEFAULT (SPEED)	XX	(KM)	ALLOWABLE ERROR
XX	(MIN)	TIME (MAXIMUM)	XX	(MIN)	FORECAST INTERVAL
XX		NUMBER OF PAST VOLUMES	X		NUMBER OF INTERVALS
XX.X	(M/S)	CORRELATION SPEED	XX	(MIN)	ERROR INTERVAL

SCIT REFLECTIVITY MEDIAN FILTER

X.X	(KM)	FILTER KERNEL SIZE	X.X	THRESH (FILTER FRACTION)
XXX		REFLECTIVITY FILTERED		

Format I. Storm Tracking

HAIL

RADAR ID	DATE/TIME	NUMBER OF STORM CELLS
nnn	MM:DD:YY/HH:MM:SS	nnn

STORM ID	PROBABILITY OF SEVERE HAIL (%)	PROBABILITY OF HAIL (%)	MAX EXPECTED HAIL SIZE (IN)
XX	XXX	XXX	XX.XX

NOTE: STORMS ARE ORDERED ACCORDING TO: 1) PROBABILITY OF SEVERE HAIL AND 2) PROBABILITY OF HAIL.

NOTE: THE NUMBER OF STORM CELLS DISPLAYED FROM THE TOP OF THE ORDERED LIST IS ADAPTABLE AT THE MSCF.

Format II. Hail Index

HAIL DETECTION ADAPTATION DATA

XX.X	(KFT)	HEIGHT (0 DEG CELSIUS)	\	X.XXX	(KM)	POH HEIGHT DIFFERENCE #1
XX.X	(KFT)	HEIGHT (-20 DEG CELSIUS)	\	X.XXX	(KM)	POH HEIGHT DIFFERENCE #2
X.XE-XX		HKE COEFFICIENT #1	\	X.XXX	(KM)	POH HEIGHT DIFFERENCE #3
XXX		HKE COEFFICIENT #2	\	X.XXX	(KM)	POH HEIGHT DIFFERENCE #4
XX.X		HKE COEFFICIENT #3	\	X.XXX	(KM)	POH HEIGHT DIFFERENCE #5
XX.X		POSH COEFFICANT	\	X.XXX	(KM)	POH HEIGHT DIFFERENCE #6
XX	(%)	POSH OFFSET	\	X.XXX	(KM)	POH HEIGHT DIFFERENCE #7
.XX		SHI HAIL SIZE COEFFICIENT	\	X.XXX	(KM)	POH HEIGHT DIFFERENCE #8
.X		SHI HAIL SIZE EXPONENT	\	X.XXX	(KM)	POH HEIGHT DIFFERENCE #9
XX	(DBZ)	THR HKE REF WGT LOWER LIM	\	X.XXX	(KM)	POH HEIGHT DIFFERENCE #10
XX	(DBZ)	THR HKE REF WGT UPPER LIM	\	XX	(DBZ)	THR MIN REFLECTIVITY POH
XX	(%)	THRESH(RCM PROBABLE HAIL)	\	XX	(1%)	THRESH(RCM POSITIVE HAIL)
XX.X	10E2 J/M**2/S)	WTSM COFFICIENT	\	-XX.X	(10E5 J/MS)	WTSM OFFSET
XXX	(KM)	MAX HAIL PROCESSING RANGE	\			

Format II Hail Index

MESOCYCLONE DETECTION ALGORITHM

	RADAR ID:	DATE: MM/DD/YY		Avg dir/spd: XXX/XXX
	NNN	TIME: HH:MM:SS		

CIRC ID	AZRAN deg/nm	SR	STM ID	|-LOW LEVEL-| RV DV BASE		|--DEPTH--| kft STMREL%		|- MAX RV-| kft kts	TVS	MOTION deg/kts	MSI
XXX	XXX/XXX	XXa	XX	XX XX	<XX	>XX	XX	XX XX	X	XXX/XXX	XXXXX

Format IIIc. Mesocyclone Detection (Sheet 1 of 1)

C-3

TORNADO VORTEX SIG

RADAR ID			DATE/TIME				NUMBER OF TVS/ETVS		NNN/NNN	
NNN			MM:DD:YY/HH:MM:SS							
Feat	Feat	Storm	AZ/RAN	AVGDV	LLDV	MXDV/Hgt	Depth	Base/Top	MXSHR/Hgt	
Type	ID	ID	(deg,nm)	(kt)	(kt)	(kt,kft)	(kft)	(kft)	(m/s/km,kft)	
HHHH	XX	HH	XXX/XXX	XXX	XXX	XXX/XX.X	XXX.X	XXX.X/XXX.X	XXX/XX.X	
HHHH	XX	HH	XXX/XXX	XXX	XXX	XXX/XX.X	XXX.X	XXX.X/XXX.X	XXX/XX.X	
HHHH	XX	HH	XXX/XXX	XXX	XXX	XXX/XX.X	XXX.X	XXX.X/XXX.X	XXX/XX.X	
HHHH	XX	HH	XXX/XXX	XXX	XXX	XXX/XX.X	XXX.X	XXX.X/XXX.X	XXX/XX.X	
HHHH	XX	HH	XXX/XXX	XXX	XXX	XXX/XX.X	XXX.X	XXX.X/XXX.X	XXX/XX.X	
HHHH	XX	HH	XXX/XXX	XXX	XXX	XXX/XX.X	XXX.X	XXX.X/XXX.X	XXX/XX.X	

TORNADO VORTEX SIGNATURE ADAPTATION PARAMETERS

0(DBZ)	. . .MIN REFLECTIVITY	2.5(KM)	. . .CIRCULATION RADIUS #1
11(M/S)	. . .VECTOR VELOCITY DIFFERENCE	4.0(KM)	. . .CIRCULATION RADIUS #2
100(KM)	. . .MAX PATTERN VECTOR RANGE	80(KM)	. . .CIRCULATION RADIUS RANGE
10.0(KM)	. . .MAX PATTERN VECTOR HEIGHT	600	. . . .. MAX # OF 2D FEATURES
2500	. . .MAX # OF PATTERN VECTORS	3	. . . . .MIN # OF 2D FEAT/ 30 FEATURE
11(M/S)	. . .DIFFERENTIAL VELOCITY #1	1.5(KM)	. . . MIN 3D FEATURE DEPTH
15(M/S)	. . .DIFFERENTIAL VELOCITY #2	25(M/S)	. . .MIN 3D FEAT LOW-LVL DELTA VEL
20(M/S)	. . .DIFFERENTIAL VELOCITY #3	36(M/S)	. . MIN TVS DELTA VELOCITY
25(M/S)	. . .DIFFERENTIAL VELOCITY #4	35	. . . . .MAX # OF 3D FEATURES
30(M/S)	. . .DIFFERENTIAL VELOCITY #5	15	. . . . .MAX # OF TVSS
35(M/S)	. . .DIFFERENTIAL VELOCITY #6	20	. . . . .MAX # OF ELEVATED TVSS
3	. . .MIN # OF VECTORS/ 2D FEATURE	0.6(KM)	. . . .MIN TVS BASE HEIGHT
0.5(KM)	. . .2D VECTOR RADIAL DISTANCE	1.0(DEG)	. . . MIN TVS ELEVATION
1.5(DEG)	. . .2D VECTOR AZIMUTHAL DIST	3.0(KM)	. . . .MIN AVG DELTA VELOCITY HGT
4.0(KM/KM)	. . .2D FEATURE ASPECT RATIO	20.0(KM)	. . . MAX STORM ASSOCIATION DIST

Format IV. TVS

STORM STRUCTURE
RADAR ID NNN   DATE/TIME MM:DD:YY/HH:MM:SS   NUMBER OF STORMS NNN

STORM ID	AZ/RAN (DEG,NM)	BASE KFT	TOP KFT	CELL BASED VIL KG/M**2	MAX REF DBZ	HEIGHT KFT
XX	XXX/XXX	XX.X	XXX.X	XXX	XX	XX.X

NOTE: The Storm Cell Top (TOP) and Storm Cell Base are the height above ground level (AGL).
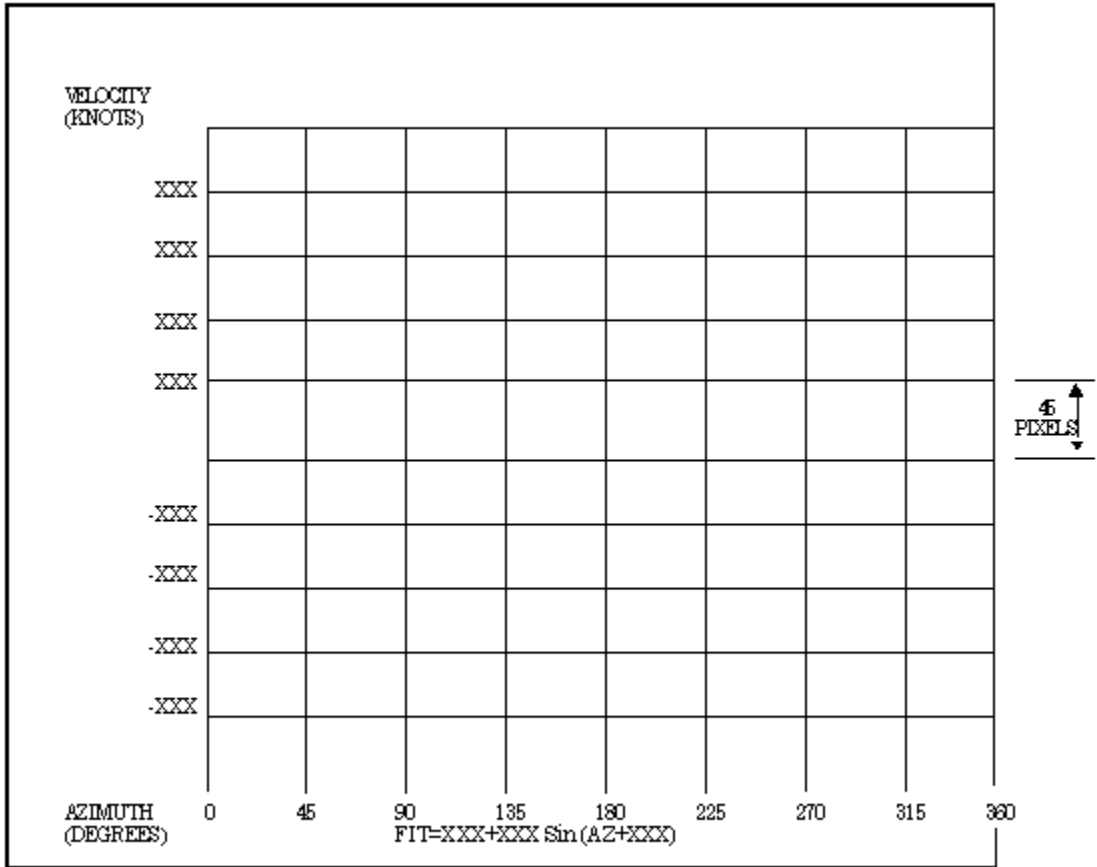NOTE: The Storm Top (TOP) data is qualified with '>' if the cell was detected on the highest elevation scan of the Volume Coverage Pattern.
NOTE: The Storm Cell Base (BASE) data is qualified with '<' if the cell was detected on the lowest elevation scan of the Volume Coverage Pattern.
NOTE: Will display the 40 most intense Storm Cells
NOTE: Storm Cells ordered according to Cell-based VIL and secondly Maximum Reflectivity

Format V. Storm Structure

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SUPPLEMENTAL PRECIPITATION DATA - RDA ID XXXXX   MM/DD/YY HH:MM
VOLUME COVERAGE PATTERN = XXX   MODE = X
           GAGE BIAS APPLIED   - {YES,NO}
                 BIAS ESTIMATE   - {XXXXX.XX}
                 EFFECTIVE # G/R PAIRS   - {XXXXX.XX}
                 MEMORY SPAN (HOURS)   - {XXXXX.XX}
                 DATE/TIME LAST BIAS UPDATE - {MM/DD/YY HH:MM}
TOTAL NO. OF BLOCKAGE BINS REJECTED   - {XXXXXXXX}
                 CLUTTER BINS REJECTED   - {XXXXXXXX}
                 FINAL BINS SMOOTHED   - {XXXXXXXX}

HYBRID SCAN PERCENT BINS FILLED   -{XXXXX.XX}
           HIGHEST ELEV. USED (DEG)   -{XXXXX.XX}
           TOTAL RAIN AREA (KM**2)   -{XXXXX.X}
MISSING PERIODS: NONE or {MM/DD/YY HH:MM mm/dd/yy hh:mm}

Format VI SPD (Sheet 1 of 2)

GAGE-RADAR MEAN FIELD BIAS TABLE
LAST BIAS UPDATE TIME:MM/DD/YY HH:MMBIAS APPLIED? {YES/NO}

MEMORY SPAN (HOURS)	EFFECTIVE NO. G-R PAIRS	AVG. GAGE VALUE (MM)	AVG. RADAR VALUE (MM)	MEAN-FIELD BIAS
XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX
XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX
XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX
XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX
XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX
XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX
XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX
XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX
XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX
XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX	XXXXXXX.XXX

Format VI. SPD (sheet 2 of 2)

DATA FORMAT: (TIME(HH:MM), VALUE(INCHES), DURATION(MINUTES)
GAGE ID: XXXX TYPE: {ACC;INC} LAT: XX.XX LON: XXX.XX AZ: XXX.X RNG: XXX.X #RPTS: XX

Variable Description	Format	Range	Units	Default
(PPS ADAPTATION DATA)	{ADAP(nn)}			
Beam Width	{XXXXX.XX}	0.8 - 1.0	DEG	0.9
Blockage Threshold	{XXXXX.XX}	0.0 - 100.0	%	50.0
Clutter Threshold	{XXXXX.XX}	0 - 100	%	50
Weight Threshold	{XXXXX.XX}	0.0 - 100.0	%	50.0
Full Hybrid Scan Threshold	{XXXXX.XX}	90.0 - 100.0	%	99.7
Low Refl. Threshold	{XXXXX.XX}	-40.0 - -20.0	DBZ	-32.0
Rain Detection Refl. Threshold	{XXXXX.XX}	10.0 - 30.0	DBZ	20.0
Rain Detection Area Threshold	{XXXXX.XX}	0 - 82800	KM**2	80
Rain Detection Time Threshold	{XXXXX.XX}	0 - 1440	MIN	60
Z-R Mult. Coef.	{XXXXX.XX}	30.0 - 3000.0	--	300.0
Z-R Power Coef.	{XXXXX.XX}	1.0 - 2.5	--	1.4
Min Refl. to convert to Rate	{XXXXX.XX}	-32.0 - 20.0	DBZ	0.0
Max Refl. to convert to Rate	{XXXXX.XX}	50.0 - 90.0	DBZ	70.0
Number Exclusion Zones	{XXXXX.XX}	0 - 20	--	0
Range Cut-Off	{XXXXX.XX}	0 - 230	KM	230
Range Effect Coeff. #1	{XXXXX.XX}	0.0 - 3.0	dBR	0.0
Range Coeff. Coeff. #2	{XXXXX.XX}	1.0 - 10.0	dBR	1.0
Range Coeff. Coeff. #3	{XXXXX.XX}	0.0 - 1.0	dBR	0.0
Min Precip. Rate for inclusion	{XXXXX.XX}	0.0 - 10.0	MM/HR	0.0
Max Precip. Rate allowed	{XXXXX.XX}	50.0 - 1600.0	MM/HR	103.8
Thresh. Elapsed Time to Restart	{XXXXX.XX}	45 - 60	MINS	60
Max. Time for Interpolation	{XXXXX.XX}	15 - 60	MINS	30
Min. Time in Hourly Period	{XXXXX.XX}	0 - 60	MINS	54
Threshold Hourly Outlier	{XXXXX.XX}	50 - 800	MM	400
End Time Gage Accumulation	{XXXXX.XX}	0 - 59	MINS	0
Max Period Accum Value	{XXXXX.XX}	50 - 400	MM	400
Max Hourly Accum Value	{XXXXX.XX}	50 - 1600	MM	800
Time Bias Estimation	{XXXXX.XX}	50 - 59	MINS	50
Thresh. No. Gage-Radar Pairs	{XXXXX.XX}	6 - 30	-	10
Reset Bias Value	{XXXXX.XX}	0.5 - 2.0	-	1.0
Longest Allowable Lag	{XXXXX.XX}	100 - 1000	HOURS	168
Bias Applied Flag	{T or F}	T - F	-	F
(BIAS TABLE DATA)	{BIAS(nn)}			
(Same as Appendix C, Format VI, SPD, sheet 2)				
(PPS SUPPLEMENTAL DATA)	{SUPL(nn)}			
Rate Scan 1	Date: {XXXXXXX} Time: {XXXXX}			
. . . . . .				
. . . . . .				
Rate Scan nn	Date: {XXXXXXX} Time: {XXXXX}			
(Note: nn can range from 2 to 16)				
Hourly Accumulation End Date	{XXXXXXXX}			
Hourly Accumulation End Time	{XXXXXXXX}			
Total No. of Blockage Bins Rejected	{XXXXXXXX}			
Total No. of Clutter Bins Rejected	{XXXXXXXX}			
Total Bins Smoothed	{XXXXXXXX}			
Percent of Hybrid Scan Bins Filled	{XXXXX.XX}			
Highest Elevation Angle Used	{XXXXX.XX}			
Total Hybrid Scan Rain Area	{XXXXXX.X}			
Number of Bad Scans in Hour	{XXXXXXXX}			
Bias Estimate	{XXXXX.XX}			
Effective No. Gage-Radar Pairs	{XXXXX.XX}			
Memory Span (Hours)	{XXXXX.XX}			
Current Volume Coverage Pattern	{XXXXXXXX}			
Current Operational (Weather) Mode	{XXXXXXXX}			
No Missing Periods in Current Hour				

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NOTE 1: The alphanumeric data package of the DPA product (#81) is contained in the last layer of the product, which can range from layer #2 to layer #18, depending on the number of layers of RLE-formatted Rate Scans which precede it (i.e., 0-16). It is formatted using Text and Special Symbols Packet Code 1: Write Text (No Value). (See RPG/Associated PUP ICD for details.) It contains two "sub-layers" of information: Adaptation Data and Supplemental Data. Each sub-layer is preceded by an 8-character field containing a mnemonic for the data type followed by the number of elements of that type to follow (i.e., "ADAP(nn)", then "SUPL(nn)").

NOTE 2: The Adaptation Data sub-layer contains **values only** (i.e., no preceding descriptive information), but the values are always **listed** in the **exact order** seen above. Each value is given in a field of 8 ASCII characters, as seen in the "Format" column (which, alone, contains the entire contents of the Adaptation Data sub-layer of the product). The meaning of each field can be ascertained from the additional columns, above.

NOTE 3: The Supplemental Data sub-layer contains values along with preceding descriptive information. Up to 80 ASCII characters are used for the description and value of each field. The number in parentheses following the mnemonic "SUPL" (e.g., 27) refers to the number of elements of information to follow.

Format VII. DPA

Variable Description	Format	Range	Units	Default
(PRECIP STATUS MESSAGE DATA)	{PSM (nn)}			
Current Precip Function Ran	{XXXXXXXX}	0 - 99999	JULIAN DAYS	--
Current Time Precip Function Ran	{XXXXXXXX}	0 - 86399	SEC	--
Last Date Precip Detected	{XXXXXXXX}	0 - 99999	JULIAN DAYS	--
Last Time Precip Detected	{XXXXXXXX}	0 - 86399	SEC	--
Last Precip Category	{XXXXXXXX}	0, 1 or 2	--	--
Previous Precip Category	{XXXXXXXX}	0, 1 or 2	--	--
(PPS ADAPTATION DATA)	{ADAP (nn) }			
Beam Width	{XXXXX.XX}	0.8 - 1.0	DEG	0.9
Blockage Threshold	{XXXXX.XX}	0.0 - 100.0	%	50.0
Clutter Threshold	{XXXXX.XX}	0 - 100	%	50
Weight Threshold	{XXXXX.XX}	0.0 - 100.0	%	50.0
Full Hybrid Scan Threshold	{XXXXX.XX}	90.0 - 100.0	%	99.7
Low Refl. Threshold	{XXXXX.XX}	-40.0 - -20.0	DBZ	-32.0
Rain Detection Refl. Threshold	{XXXXX.XX}	10.0 - 30.0	DBZ	20.0
Rain Detection Area Threshold	{XXXXX.XX}	0 - 82800	KM**2	80
Rain Detection Time Threshold	{XXXXX.XX}	0 - 1440	MINS	60
Z-R Mult. Coef.	{XXXXX.XX}	30.0 - 3000.0	--	300.0
Z-R Power Coef.	{XXXXX.XX}	1.0 - 2.5	--	1.4
Min Refl. to convert to Rate	{XXXXX.XX}	-32.0 - 20.0	DBZ	0.0
Max Refl. to convert to Rate	{XXXXX.XX}	50.0 - 90.0	DBZ	70.0
Number Exclusion Zones	{XXXXX.XX}	0 - 20	--	0
Range Cut-Off	{XXXXX.XX}	0 - 230	KM	230
Range Effect Coeff. #1	{XXXXX.XX}	0.0 - 3.0	dBR	0.0
Range Coeff. Coeff. #2	{XXXXX.XX}	1.0 - 10.0	dBR	1.0
Range Coeff. Coeff. #3	{XXXXX.XX}	0.0 - 1.0	dBR	0.0
Min Precip. Rate for inclusion	{XXXXX.XX}	0.0 - 10.0	MM/HR	0.0
Max Precip. Rate allowed	{XXXXX.XX}	50.0 - 1600.0	MM/HR	103.8
Thresh. Elapsed Time to Restart	{XXXXX.XX}	45 - 60	MINS	60
Max. Time for Interpolation	{XXXXX.XX}	15 - 60	MINS	30
Min. Time in Hourly Period	{XXXXX.XX}	0 - 60	MINS	54
Threshold Hourly Outlier	{XXXXX.XX}	50 - 800	MM	400
End Time Gage Accumulation	{XXXXX.XX}	0- 59	MINS	0
Max Period Accum Value	{XXXXX.XX}	50 - 400	MM	400
Max Hourly Accum Value	{XXXXX.XX}	50 - 1600	MM	800
Time Bias Estimation	{XXXXX.XX}	50 - 59	MINS	50
Thresh. No. Gage-Radar Pairs	{XXXXX.XX}	6 - 30	--	10
Reset Bias Value	{XXXXX.XX}	0.5 - 2.0	--	1.0
Longest Allowable Lag	{XXXXX.XX}	100-1000	HOURS	168
Bias Applied Flag	{ T or F }	T - F	--	F
SUPPLEMENTAL DATA (EPRE ALG))	{SUPL(nn)}			
Average Scan Date	{XXXXXXXX}	0 - 99999	JULIAN DAYS	--
Average Scan Time	{XXXXXXXX}	0 - 86399-	SEC	-
Flag Zero Hybrid	{XXXXXXXX}	0 or 1	--	--
Flag Rain Detected	{XXXXXXXX}	0 or 1	--	--
Flag Reset Storm Total	{XXXXXXXX}	0 or 1	--	--
Flag Precip Begin	{XXXXXXXX}	0 or 1	--	--
Last Date Rain	{XXXXXXXX}	0 - 99999	JULIAN DAYS	--
Last Time Rain	{XXXXXXXX}	0 - 86399	SEC	--

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Total No. of Blockage Bins Rejected	{XXXXXXX}	0 - 82800	--	--
Total No. of Clutter Bins Rejected	{XXXXXXX}	0 - 82800	--	--
Total Bins Smoothed	{XXXXXXX}	0 - 82800	--	--
Percent of Hybrid Scan Bins Filled	{XXXXX.XX}	9.0 - 100.0	%	--
Highest Elevation Angle Used	{XXXXX.XX}	0.5 - 19.5	DEG	--
Total Hybrid Scan Rain Area	{XXXXX.XX}	0.0 - 99999	KM**2	--
Spot Blanking Volume Status	{XXXXXXX}	0 or 1	--	--
(BIAS-RELATED FIELDS)	{BIAS(nn)}			
Time Bias Value Last Updated Locally	{XXXXXXX}	0-86399	SEC	--
Date Bias Value Last Updated Locally	{XXXXXXX}	0-99999	JULIAN DAYS	
Time of Last Update of Local Bias Table	{XXXXXXX}	0-99999	SEC	
Date of Last Update of Local Bias Table	{XXXXXXX}	0-86399	JULIAN DAYS	--
Observation Time of Latest Bias Table	{XXXXXXX}	0-86399	SEC	
Observation Date of Latest Bias Table	{XXXXXXX}	0-99999	JULIAN DAYS	--
Generation Time of Latest Bias Table	{XXXXXXX}	0-86399	SEC	
Generation Date of Last Bias Table	{XXXXXXX}	0-99999	JULIAN DAYS	--
Mean-Field Bias Estimate	{XXX.XXXX}	.0001-99.9999		
Effective G-R Pair Sample Size	{XXXXX.XX}	0.00-999.99	---	
Memory Span used in Bias Estimate	{XXXXXXX}	0.001-10.**7	--	

NOTE 1: The alphanumeric data package of the DHR product (#32) and the DSP product (#138) is contained in the last (i.e., 2nd) layer of the product. It is formatted using Text and Special Symbols Packet Code 1: Write Text (No Value). (See RPG/Associated PUP ICD for details.) It contains four "sub-layers" of information: Precipitation Status Message parameters, Adaptation Data, Supplemental Data (Precipitation Preprocessing Algorithm only), and Bias-related parameters. Each sub-layer is preceded by an 8-character field containing a mnemonic for the data type followed by the number of elements of that type to follow (i.e., "PSM (nn)", followed by "ADAP(nn)", "SUPL(nn)" and "BIAS(nn)").

NOTE 2: The alphanumeric data sub-layer contains **values only** (i.e., no preceding descriptive information), but the values are always **listed** in the **exact order** seen above. Each value is given in a field of 8 ASCII characters, as seen in the "Format" column (which, alone, contains the entire contents of the alphanumeric data sub-layer of the product). The meaning of each field can be ascertained from the additional columns, above.

Format VIII. DHR and DSP

RADAR HALF POWER BEAM WIDTH. . . . . 0.90 DEG
MAXIMUM ALLOWABLE PERCENT OF BEAM BLOCKAGE. . . . . 50.00 %
MAXIMUM ALLOWABLE PERCENT LIKELIHOOD OF CLUTTER. 50.00
PERCENT OF BEAM REQUIRED TO COMPUTE AVERAGE POWER. 50.00
PERCENT OF HYBRID SCAN NEEDED TO BE CONSIDERED FULL. 99.70
LOW REFLECTIVITY THRESHOLD (dBZ) FOR BASE DATA . . . . -32.00 DBZ
REFLECTIVITY (dBZ) REPRESENTING SIGNIFICANT RAIN 20.00
AREA WITH REFLECTIVITY EXCEEDING SIGNIFICANT RAIN THRESHOLD 80.00 KM**2
THRESHOLD TIME WITHOUT RAIN FOR RESETTING STP 60.00
MINUTES
REFLECT-TO-PRECIP RATE CONVERSION MULTIPLICATIVE 300.00
COEFFICIENT
REFLECT-TO-PRECIP RATE CONVERSION POWER COEFFICIENT. 1.40
MIN DBZ FOR CONVERTING TO PRECIP RATE (VIA TABLE LOOKUP) . . . . . 0.00 DBZ
MAX DBZ FOR CONVERTING TO PRECIP RATE (VIA TABLE LOOKUP). . . . 70.00 DBZ
NUMBER OF EXCLUSION ZONES 0.00

Format IX Precipitation Adaptation Data (sheet 1 of 4)

RANGE BEYOND WHICH TO APPLY RANGE-EFFECT CORRECTION . . . . 230.00 KM
1ST COEFFICIENT OF RANGE-EFFECT FUNCTION . . . . 0.00 DBR
2ND COEFFICIENT OF RANGE-EFFECT FUNCTION 1.00
3RD COEFFICIENT OF RANGE-EFFECT FUNCTION 0.00
MIN RATE SIGNIFYING PRECIPITATION . . . . 0.00 MM/Hr
MAX PRECIPITATION RATE . . . . 103.80 MM/Hr

Format IX Precipitation Adaptation Data (sheet 2 of 4)

REINITIALIZATION TIME LAPSE THRESHOLD (FOR ACCUM PROCESS) . . 60.00 MINUTES
MAX TIME DIFFERENCE BETWEEN SCANS FOR INTERPOLATION. . . . . 30.00 MINUTES
MIN TIME NEEDED TO ACCUMULATE HOURLY TOTALS. . . . . 54.00 MINUTES
THRESHOLD FOR HOURLY OUTLIER ACCUMULATION. . . . . 400.00 MM
HOURLY GAGE ACCUMULATION SCAN ENDING TIME. . . . . 0.00 MINUTES
MAX ACCUMULATION PER SCAN-TO-SCAN PERIOD. . . . . 400.00 MM
MAX ACCUMULATION PER HOURLY PERIOD. . . . . 800.00 MM

Format IX Precipitation Adaptation Data (sheet 3 of 4)

MINUTES AFTER CLOCK HOUR WHEN BIAS IS UPDATED. . . . . 50.00   MINUTES
THRESHOLD # OF GAGE/RADAR PAIRS NEEDED TO SELECT BIAS FROM 10.00
TABLE. . . . .
RESET VALUE OF GAGE/RADAR BIAS ESTIMATE. 1.00
LONGEST AVAILABLE LAG FOR USE OF BIAS FROM BIAS TABLE. . . . . . . 168.00 HOURS
BIAS FLAG FALSE

Format IX Precipitation Adaptation Data (sheet 4 of 4)

VAD Algorithm Output MM/DD/YY HH:MM

ALT	U	V	W	DIR	SPD	RMS	DIV	SRNG	ELEV
100ft	m/s	m/s	cm/s	deg	kts	kts	E - 3/s	nm	deg
XXX	XXX.X	XXX.X	XXX.X	XXX	XXX	XX.X	XXX.XXXX	XXX.XX	XX.X
XXX	XXX.X	XXX.X	XXX.X	XXX	XXX	XX.X	XXX.XXXX	XXX.XX	XX.X
XXX	XXX.X	XXX.X	XXX.X	XXX	XXX	XX.X	XXX.XXXX	XXX.XX	XX.X
XXX	XXX.X	XXX.X	XXX.X	XXX	XXX	XX.X	XXX.XXXX	XXX.XX	XX.X
XXX	XXX.X	XXX.X	XXX.X	XXX	XXX	XX.X	XXX.XXXX	XXX.XX	XX.X
XXX	XXX.X	XXX.X	XXX.X	XXX	XXX	XX.X	XXX.XXXX	XXX.XX	XX.X
XXX	XXX.X	XXX.X	XXX.X	XXX	XXX	XX.X	XXX.XXXX	XXX.XX	XX.X
XXX	XXX.X	XXX.X	XXX.X	XXX	XXX	XX.X	XXX.XXXX	XXX.XX	XX.X
XXX	XXX.X	XXX.X	XXX.X	XXX	XXX	XX.X	XXX.XXXX	XXX.XX	XX.X
XXX	XXX.X	XXX.X	XXX.X	XXX	XXX	XX.X	XXX.XXXX	XXX.XX	XX.X
XXX	XXX.X	XXX.X	XXX.X	XXX	XXX	XX.X	XXX.XXXX	XXX.XX	XX.X
XXX	XXX.X	XXX.X	XXX.X	XXX	XXX	XX.X	XXX.XXXX	XXX.XX	XX.X
XXX	XXX.X	XXX.X	XXX.X	XXX	XXX	XX.X	XXX.XXXX	XXX.XX	XX.X
XXX	XXX.X	XXX.X	XXX.X	XXX	XXX	XX.X	XXX.XXXX	XXX.XX	XX.X

Note: The column labels are described as follows:
ALT- Altitude above mean sea level in hundreds of feet;
U, V - Eastward, northward components of the wind in m/s;
W- Upward component of the wind in cm/s;
DIR - Standard wind direction in degrees;
SPD - Standard wind speed in knots;
RMS - Scatter between velocity points and the VAD fitted curve in knots;
DIV- Divergence of the wind in 10 per second;
SRNG - Slant range of the VAD analysis in nautical miles;
ELEV - Elevation angle of the VAD analysis in degrees;

Format X for VAD Wind Data to VWP Tabular Alphanumeric Block (TAB) (Sheet 1 of 3)

VAD Algorithm Output MM/DD/YY HH:MM
ADAPTABLE PARAMETERS - WIND PROFILE

VAD ANALYSIS SLANT RANGE	16.2	NMI
BEGINNING AZIMUTH ANGLE	0.0	DEGREE
ENDING AZIMUTH ANGLE	0.0	DEGREE
NUMBER OF PASSES	2	
RMS THRESHOLD	9.7	KNOTS
SYMMETRY THRESHOLD	13.6	KNOTS
DATA POINTS THRESHOLD	25	

Format X   Wind Profile Adaptable Parameters   (Sheet 2 of 3)

ALTITUDES   SELECTED

2000	3000	4000	5000	6000	7000
8000	9000	10000	11000	12000	13000
14000	15000	16000	17000	18000	19000
20000	21000	22000	24000	25000	26000
28000	30000	35000	40000	45000	50000

OPTIMUM SLANT RANGE   16.2

Format X Wind Profile Adaptable Parameters   (Sheet 3 of 3)