

Volume 5  
*OGC CDB Radar Cross Section (RCS) Models (Best  
Practice)*

# Open Geospatial Consortium

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## Volume 5: OGC CDB Radar Cross Section (RCS) Models (Best Practice)

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# Table of Contents

|  |    |
|--|----|
| 1. Scope .....   | 6  |
| 2. Conformance .....   | 7  |
| 3. References .....  | 8  |
| 4. Terms and Definitions .....   | 9  |
| 5. Conventions .....   | 10 |
| 5.1. Identifiers .....   | 10 |
| 6. Radar Cross Section Models .....  | 11 |
| 6.1. Functional Description .....  | 12 |
| 6.2. Wave Polarization .....   | 13 |
| 6.3. Wave Parameters .....   | 14 |
| 7. RCS Data Model .....  | 15 |
| 7.1. Radar Cross Section Data Model .....  | 15 |
| 7.2. RCS Data Model .....  | 15 |
| 7.3. RCS Polar Diagram Data Representation using Shapefile .....                                       | 15 |
| 7.3.1. Shapefile Internal Data Structure .....   | 15 |
| 7.3.2. Multi-Variant RCS Model Applicability .....   | 30 |
| 7.3.3. Model's Articulations Effect on RCS Data .....  | 65 |
| Annex A: Conformance Class Abstract Test Suite (Normative): OGC CDB Radar Cross Section<br>(RCS) ..... | 67 |
| A.1. General RCS Implementation .....  | 67 |
| A.2. Shapefile Point Vertices .....  | 67 |
| A.3. Model Signature Significant Angle .....   | 68 |
| A.4. RCS Attributes .....  | 68 |
| A.5. RCS Storage Files .....   | 68 |
| A.6. RCS Storage Files - Variant .....   | 69 |
| Annex B: Revision History .....  | 70 |

## **i. Abstract**

This CDB volume provides all of the information required to store Radar Cross Section (RCS) data within a conformant CDB data store.

Please note that the current CDB standard only provides encoding rules for using Esri Shapefiles for storing RCS models. However, this Best Practice has been modified to change most of the ShapeFile references to “vector data sets” or “vector attributes” and “Point Shapes” to “Point geometries”. This was done in recognition that future versions of the CDB standard and related Best Practices will provide guidance on using other encodings/formats, such as OGC Geography Markup Language (GML).

## **ii. Keywords**

The following are keywords to be used by search engines and document catalogues.

ogcdoc, OGC document, cdb, radar, radar cross section, models, rcs, shapefile

## **iii. Preface**

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. The Open Geospatial Consortium shall not be held responsible for identifying any or all such patent rights.

Recipients of this document are requested to submit, with their comments, notification of any relevant patent claims or other intellectual property rights of which they may be aware that might be infringed by any implementation of the standard set forth in this document, and to provide supporting documentation.

## **iv. Submitting organizations**

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# Chapter 1. Scope

This CDB Best Practice (BP) defines a RCS (Radar Cross-Section) model representation for use by Sensor Simulation client-devices such as Radar and/or Sonar. The BP provides a signature model representing the overall relative reflectivity levels of a given Model Representation when viewed at discrete azimuth and elevation angles. The RCS data is then used in range and aspect calculations for the detection and classification of simulated targets (either static or moving).

For ease of editing and review, the standard has been separated into 16 Volumes, one being a schema repository.

- Volume 0: OGC CDB Companion Primer for the CDB standard (Best Practice).
- Volume 1: OGC CDB Core Standard: Model and Physical Data Store Structure. The main body (core) of the CDB standard (Normative).
- Volume 2: OGC CDB Core Model and Physical Structure Annexes (Best Practice).
- Volume 3: OGC CDB Terms and Definitions (Normative).
- Volume 4: OGC CDB Rules for Encoding CDB Vector Data using Shapefiles (Best Practice).
- Volume 5: OGC CDB Radar Cross Section (RCS) Models (Best Practice).
- Volume 6: OGC CDB Rules for Encoding CDB Models using OpenFlight (Best Practice).
- Volume 7: OGC CDB Data Model Guidance (Best Practice).
- Volume 8: OGC CDB Spatial Reference System Guidance (Best Practice).
- Volume 9: OGC CDB Schema Package: <http://schemas.opengis.net/cdb/> provides the normative schemas for key features types required in the synthetic modeling environment. Essentially, these schemas are designed to enable semantic interoperability within the simulation context (Normative).
- Volume 10: OGC CDB Implementation Guidance (Best Practice).
- Volume 11: OGC CDB Core Standard Conceptual Model (Normative).
- Volume 12: OGC CDB Navoids Attribution and Navoids Attribution Enumeration Values (Best Practice).
- Volume 13: OGC CDB Rules for Encoding CDB Vector Data using GeoPackage (Normative, Optional Extension).
- Volume 14: OGC CDB Guidance on Conversion of CDB Shapefiles into CDB GeoPackages (Best Practice).
- Volume 15: OGC CDB Optional Multi-Spectral Imagery Extension (Normative).

# Chapter 2. Conformance

This Best Practice defines one conformance class.

Conformance with this Best Practice shall be checked using all the relevant tests specified in Annex A (normative) of this document. The framework, concepts, and methodology for testing, and the criteria to be achieved to claim conformance are specified in the OGC Compliance Testing Policies and Procedures and the OGC Compliance Testing web site <sup>[1]</sup>.

All requirements-classes and conformance-classes described in this document are owned by the standard(s) identified.

[1] [www.opengeospatial.org/cite](http://www.opengeospatial.org/cite)



# Chapter 3. References

The following normative documents contain provisions that, through reference in this text, constitute provisions of this document. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the normative document referred to applies.

[R22] [Parsch, A.: AN/APA to AN/APD - Equipment Listing \(2008\)](#)

[R23] [National Resources Canada: Radar Polarimetry - Fundamentals of Remote Sensing \(2015\)](#)

[R24] [Harre, I.: RCS in Radar Range Calculations for Maritime Targets.\(V2.0-20040206\), Bremen, Germany \(2004\)](#)

[R25] [Shengyun, Z.: Decibels relative to a square meter – dBsm \(2007\)](#)

# Chapter 4. Terms and Definitions

This document uses the terms defined in Sub-clause 5.3 of [OGC 06-121r8], which is based on the ISO/IEC Directives, Part 2, Rules for the structure and drafting of International Standards. In particular, the word “shall” (not “must”) is the verb form used to indicate a requirement to be strictly followed to conform to this OGC Best Practice.

See the complete list of CDB Terms and Definitions in [OGC CDB Volume 3: Terms and Definitions](#).

# Chapter 5. Conventions

This section provides details and examples for any conventions used in the document. Examples of conventions are symbols, abbreviations, use of XML schema, or special notes regarding how to read the document.

## 5.1. Identifiers

The normative provisions in this standard are denoted by the URI namespace

```
http://www.opengis.net/spec/cdb/1.0/cdb-radar
```

All requirements that appear in this document are denoted by partial URIs which are relative to the namespace shown above.

For the sake of brevity, the use of “req” in a requirement URI denotes: <http://www.opengis.net/spec/cdb/1.0/cdb-radar/req> An example might be:

req/cdb-radar/storage

All conformance tests that appear in this document are denoted by partial URIs which are relative to the namespace shown above.

For the sake of brevity, the use of “conf” in a requirement URI denotes:

```
http://www.opengis.net/spec/cdb/1.0/cdb-radar/conf
```

# Chapter 6. Radar Cross Section Models

For devices such as Radar, a geometric representation of a model may often provide a level of fidelity which is insufficient or inappropriate for use in simulation. Alternately, it may not be feasible to compute a radar cross-section of the model in real-time. Further, a user may wish to incorporate real-world RCS data into the simulator client-devices in order to further improve simulation fidelity. To this end, this document defines a RCS (Radar Cross-Section) model representation for use by Sensor Simulation client-devices such as Radar and/or Sonar. This model provides a signature model representing the overall relative reflectivity levels of a given Model Representation when viewed at discrete azimuth and elevation angles. The RCS data is then used in range and aspect calculations for the detection and classification of simulated targets (either ground or moving).

The following Section 6 Clauses provide a primer on radar, basic principles of operation and radar cross sections (RCS).

The Radar Cross-Section (RCS) of a target is a measure of the radar reflection characteristics of a target (usually expressed in  $\text{m}^2$ , dBsm, or volts). It is equal to the power reflected back to the radar divided by power density of the wave striking the target. For most targets, the radar cross-section corresponds to the area of the cross section of the sphere that would reflect the same energy back to the radar, if a metal sphere were substituted. A sphere is sometimes used since the RCS of a sphere is independent of frequency if operating in the far field region of the radar (Reference [R24]).

The RCS data unit of measure for the intensity are usually referenced as a normalized ratio in Decibels relative to a square meter (reference [R25]), or otherwise known as dBsm. Another data measure that is linked to the intensity measure is also the ‘phase shift’ angle (in degrees) of the returned energy. It can provide some additional information about the reflective attributes of the elements reflecting back to the radar.

However, the RCS defines the echo at the radar for the model (target) in question, which varies considerably depending on the target’s orientation, its relative distance and size with respect to the simulated radar’s antenna. The viewing angles are shown in the diagram below.



**Figure A-19: Relative Azimuth ( $\alpha$ ) and Elevation ( $\phi$ ) Angles**

RCS curves are normally produced using highly specialized off-line tools which input the model geometry and material attributes (typically an OpenFlight file) and applies physics-based

processing like geometric ray-tracing, optical reflections/refractions, corner detection, material absorption and so on to the geometric data representation of the model. This processing is computationally expensive and is usually performed in non real-time. The end-result of this computation (usually 2D arrays of data points in elevation and azimuth) provides data that can be used more efficiently by simulation modeling such as radar at run-time. Those data curves are stored in a polar-type representation table, which provide specific reflectivity levels given a set of azimuth and elevation aspect angles.

## 6.1. Functional Description

To simulate a target for most modes of operation, the Radar software uses an RCS Polar Diagram as shown below:



**Figure A-20: Polar Diagram of RCS data in Decibels at a given elevation angle**

The polar diagram allows the radar to use an RCS value array (indexed by azimuth/elevation angles) for getting an approximation of the overall RCS of distant targets. The approximated RCS data is a function of the model's materials, geometry, view angles, and multi-paths reflections generated within the model itself.

RCS data can also be depicted more linearly as shown in the following diagram:



**Figure A-21: Linear Diagram of RCS data in Decibels at a given elevation angle**

As can be seen in the example above, relative intensities are much greater when viewing the model directly in front (0° azimuth), from the back (±180° azimuth) and on the sides (-90° and +90°

azimuth).

The RCS data is often characterized by its data resolution and physical modeling parameters. The data resolution determines the angular increments between successive RCS values, and modeling parameters specify the attributes of the physical parameters used to drive the RCS mathematical model computations (such as the Electro-Magnetic properties of the simulated electric field).

Both wavelength and polarization affect how a radar system “sees” the elements in the scene. Therefore, radar using different polarization and wavelength combinations may provide different and complementary information, which can be used to enhance the radar image in a specific way.

## 6.2. Wave Polarization

When computing an RCS model, it is important to consider microwave energy propagation and scattering, and also the polarization of the radiation, which is an important property. For a plane electromagnetic (EM) wave, polarization refers to the locus of the electric field vector in the plane perpendicular to the direction of propagation. The length of the vector represents the amplitude of the wave, and the rotation rate of the vector represents the frequency of the wave. Polarization refers to the orientation and shape of the pattern traced by the tip of the vector (Reference [\[R23\]](#)).



**Figure A-22: Horizontal and Vertical Polarization of a plane of EM wave**

The waveform of the electric field strength (voltage) of an EM wave can be predictable (the wave is polarized) or random (the wave is un-polarized), or a combination of both. In the latter case, the degree of polarization describes the ratio of polarized power to total power of the wave. An example of a fully polarized wave would be a monochromatic sine wave, with a single, constant frequency and stable amplitude.

Many types of radar antennae are designed to transmit and/or receive microwave radiation that is either horizontally (H) or vertically (V) polarized, or a combination of both. A transmitted wave of either polarization can generate a backscattered wave with a variety of polarizations, thus an equal amount of resulting RCS curves.

Polarization type on either transmission or reception mode can be synthesized by using H and V components, with a well-defined relationship between them. For this reason, systems that transmit and receive both of these linear polarizations are commonly used. With these radars, there can be four combinations of transmit and receive polarizations:

- HH - for horizontal transmit and horizontal receive
- VV - for vertical transmit and vertical receive
- HV - for horizontal transmit and vertical receive, and
- VH - for vertical transmit and horizontal receive.

The first two polarization combinations are referred to as “like-polarized” because transmit and receive polarization types are the same. The last two combinations are referred to as “cross-polarized” because transmit and receive polarizations are orthogonal to one another.

Radar systems can have one, two, or all four of these transmit/receive polarization combinations. Examples include the following types of radar systems:

- Single polarized: HH or VV (or possibly HV or VH)
- Dual polarized: HH and HV, VV and VH, or HH and VV
- Alternating polarization: HH and HV, alternating with VV and VH
- Polarimetric: HH, VV, HV, and VH

Both wavelength and polarization affect how a radar system “sees” the elements in the scene. Therefore, radar using different polarization and wavelength combinations may provide different and complementary information, which can be used to enhance the radar image in a specific way.

Therefore, polarization information is an important part of the CDB’s RCS Data representation.

## 6.3. Wave Parameters

In addition to the wave polarization explained above, other physical parameters of the modeled electromagnetic wave are also a contributing factor to the RCS of a target when seen by Radar. Therefore those parameters are available in conjunction with the RCS data curves:

Those parameters are generally as follows:

- Radar Mode (Continuous wave or Pulsed)
- Radiating Frequency
- Antenna Main Lobe Gain
- Antenna Main Lobe Bandwidth
- Antenna Side Lobe 3dB point
- Radar Pulse width (if pulsed radar mode)
- Radar Pulse Repetition Frequency (if pulsed radar mode)

# Chapter 7. RCS Data Model

## 7.1. Radar Cross Section Data Model

The Radar Cross-Section (RCS) of a target is a measure of the radar reflection characteristics of a target (usually expressed in  $\text{m}^2$ , dBsm, or volts). It is equal to the power reflected back to the radar divided by power density of the wave striking the target. For most targets, the radar cross-section corresponds to the area of the cross section of the sphere that would reflect the same energy back to the radar, if a metal sphere were substituted. A sphere is sometimes used since the RCS of a sphere is independent of frequency if operating in the far field region of the radar. The following sections define the requirements for an RCS in a conformant CDB data store.

## 7.2. RCS Data Model

The CDB RCS data is organized so that client-devices can easily retrieve the following information from the RCS model ([Figure 1: Graphical Representation of the 3D Model RCS Vector Data](#)) below:

- The modeling (physical) parameters that were used to generate the RCS polar data.
- The RCS polar representation corresponding to one or more levels of resolution of the RCS polar data.
- The RCS polar representation corresponding to distinct radar mode of operation.
- The RCS polar representation corresponding to a distinct radar model type.

RCS resolution refers to the angular pitch used in gathering RCS data for the model in question. At a given RCS resolution, it is possible to have two or more RCS polar representations due to the fact that the RCS data is computed based on a number of physical modeling properties such as the characteristics of the electromagnetic beam, its frequency, polarization, amplitude and phase. A simulated sensor operating in a given mode of operation, over a given range of frequencies, will require the RCS data closest to this mode. It will therefore need to use the closest matching Polar Diagram from the RCS model data.

## 7.3. RCS Polar Diagram Data Representation using Shapefile

This section provides a detailed description of the content and format of RCS data for a conformant implementation of a CDB data store.

### 7.3.1. Shapefile Internal Data Structure



**Requirement 1**

req/cdb-radar/storage

Within a CDB, the RCS model SHALL be stored as a series of Esri's ShapeFiles in accordance with the Esri Shapefile Specification<sup>[2]</sup>.

This section describes the vector data structure for the representation of RCS model data. This format provides the required flexibility to create and visualize the RCS data including:

- Easy modification of data attributes
- Simple visualization of RCS data in polar form
- Allow irregular steps in azimuth/elevation (X/Y)
- Allow some possibly missing values

RCS data is inherently two-dimensional in nature and is naturally organized as a two-dimensional array of RCS polar values computed at various azimuth and elevation angles from the target. Each element of this array represents the RCS data value over each uniformly distributed azimuth angle and distinct elevation angle.

Therefore, each of such array element can be represented as a "Point" geometry, with the azimuth angle value (X) at a given elevation angle (Y), while at the same time storing the associated attributes such as the RCS, Amplitude or Phase data in the instance attribute database (dbf file) associated to the vector data, currently a Shapefile. Typical azimuth angles would range between -180° and +180°, whereas the elevation angles would cover from -90° to +90°. However, the RCS data set could potentially only cover just a partial range of those angles if data is incomplete for example. This can be visualized in the next diagram, showing RCS values at various azimuth angles corresponding to an elevation angle of 20° with respect to the model (cube). Note that the axis conventions follow those described in Section 6.3, Coordinate Systems.



**Figure 7-1: Graphical Representation of the 3D Model RCS Vector Data**

Partial RCS data is permitted, i.e., it is permitted to cover a sub-region of the RCS polar diagram with only points corresponding to known values.

For example, consider an RCS model consisting of data values in  $5^\circ$  elevation increments and  $2^\circ$  azimuth increments covering the entire aspect angle range of the target. The CDB representation would consist of  $(180^\circ/5^\circ)+1 = 37$  sets of  $(360^\circ/2^\circ)+1 = 181$  points (vertices) for a full target aspect coverage; yielding 6697 point shapes with their attribute data.

#### Requirement 2

req/cdb-radar/storage-vertices

For each of the vector point vertices, the X component SHALL represent the azimuth angle (equivalent to longitude) and the Y component SHALL represent the elevation angle (equivalent to latitude). The RCS value (and other attributes) SHALL be stored in the instance attributes within the DBF file.-azimuth

**Requirement 3**

req/cdb-radar/storage-sig-angle

The eight prescribed values for azimuth and elevation increments SHALL be used for specifying the ModelSignature Significant Angle. The table below shows the correspondence between the ModelSignature LOD level number and the ModelSignature Significant Angle.

**Table 7-1: ModelSignature Significant Angle per LOD**

| ModelSignature LOD level | Significant Angle   | Number of values          |
|--------------------------|---|---------------------------|
| 0                        | $90^\circ \leq \text{Significant angle}$                  | Less than 8               |
| 1                        | $45^\circ \leq \text{Significant angle} < 90^\circ$       | between 8 and 32          |
| 2                        | $22.5^\circ \leq \text{Significant angle} < 45^\circ$     | between 32 and 128        |
| 3                        | $11.25^\circ \leq \text{Significant angle} < 22.5^\circ$  | between 128 and 512       |
| 4                        | $5.625^\circ \leq \text{Significant angle} < 11.25^\circ$ | between 512 and 2048      |
| 5                        | $2.80^\circ \leq \text{Significant angle} < 5.625^\circ$  | between 8192 and 32768    |
| 6                        | $1.40^\circ \leq \text{Significant angle} < 2.80^\circ$   | between 32768 and 131072  |
| 7                        | $0.70^\circ \leq \text{Significant angle} < 1.40^\circ$   | between 131072 and 524288 |

Such a data representation would typically produce the following diagram when viewed in 2D ([Figure 7-2: Polar Diagram of RCS Data in Planar Representation](#)) and 3D ([Figure 7-3: Polar Diagram of RCS Data in Spherical Representation](#)) polar forms (color representing the RCS Intensity attribute):



**Figure 7-2: Polar Diagram of RCS Data in Planar Representation**



**Figure 7-3: Polar Diagram of RCS Data in Spherical Representation**

In addition, specific attributes within the vector data are required to specify other characteristics of

the RCS data, like EM polarization mode and frequency that were used when characterizing the target's RCS signature. Those are the class-level attributes and are described below.

#### Requirement 4

req/cdb-radar/attributes

The data for each distinct RCS representation model SHALL have two different types of attributes: RCS model class attributes and RCS instance attributes as defined below.

1. RCS Model Class-level attribution: These are attributes that can be shared by all of the RCS model instances of the RCS representation. The attributes and their values are logically re-grouped under a classname that stands for the entire attributes specific to the RCS model. All of the classnames are re-grouped into a model.dbf file referred to as the RCS Class Attribute file for the RCS model. (See Section 7.4.1, Directory Structure) Each row of the model.dbf file corresponds to a different classname. The first column of the file is the classname attribute and acts as the primary key to access subsequent table entries; all other columns correspond to the attributes represented by the classname.
2. RCS Instance-level attribution: This is the data that represents a particular instance of the RCS model for a RCS representation. The data is contained in the attribution columns of the model.dbf file that accompanies the RCS's \*.shp file. This \*.dbf file is referred to as the RCS Instance Attribute file of the RCS model. (See Section 7.4.1, Directory Structure) The first column of each row is always the classname attribute. The other columns in a RCS Instance Attribute file are used to describe further the associated shape.

#### Requirement 5

req/cdb-radar/storage-files

In summary, for a single RCS model in the CDB, the data files SHALL consist of:

- One \*.shp main file that provides the geometric aspect (Points) for each data instance of a RCS model.
- Two \*.dbf files (one instance-level on a-per RCS feature basis, and one class-level at the RCS model level) that collectively provide the attribution for all of the possible RCS models of a given RCS Model.
- One \*.shx index file that stores the file offsets and content lengths for each of the records of the main \*.shp file. The only purpose of this file is to provide a simple means for clients to step through the individual records of the \*.shp file (i.e., it contains no CDB modeled data).

## RCS Model Class-Level Attributes

Many attributes within the vector data are required to specify the physical modeling parameters corresponding to those used to produce the RCS data. These include, for instance, the electromagnetic (EM) polarization mode and the frequency that were used when characterizing the target's RCS signature.

The CDB RCS model representation offers a comprehensive set of class attributes that are described below. Please note that these attributes are an elaborate set of fields to indicate in which physical environment the RCS data were computed and does not necessarily reflect a precise operating mode of a particular radar.

A description of the attribute information follows below. (The reader should keep in mind that the 10-character limitation of attribute names is imposed by the dBASE III+ file format used by the Shapefile .DBF data format).

**Table 7-2: XML Tags for Hot Spots**

| Attribute | Format | Description   | Values  | Units                   |
|-----------|--------|---|---|-------------------------|
| CLASSNAME | STRING | Unique string identifying the RCS model class attribute characteristics | Uniquely identifiable character string for the class name | String of 32 characters |
| VERSION   | STRING | String representing the version level of the RCS Data                   | XX.YY.ZZ  | String of 8 characters  |
| PROD_DAY  | INT    | Number representation of the computation day                            | DD  | N/A                     |
| PROD_MTH  | INT    | Number representation of the computation month                          | MM  | N/A                     |
| PROD_YEA  | INT    | Number representation of the computation year                           | YYYY  | N/A                     |

|           |        |   |  |                         |
|-----------|--------|---|--|-------------------------|
| CLASS_TYP | INT    | Level of Classification                 | 0 – 999<br>0 : UNKNOWN<br>1 : UNCLASSIFIED<br>2 : SECRET<br>3 : TOP SECRET<br>4 : DECLASSIFIED<br>999: OTHER   | Enumerated              |
| DAT_SRC_T | INT    | Data from which RCS was derived         | 0 - 999<br>0 : UNKNOWN<br>100 : OPENFLIGHT<br>200 : EMPIRICAL<br>300 : THIRD-PARTY TOOL<br>400 : US Air Force<br>401 : US Army<br>402 : US Navy<br>999 : OTHER | Enumerated              |
| RCS_VARI  | STRING | Radar Model Variant (e.g., “AN/APG-65”) | 7.3.2, Multi-Variant RCS Model Applicability   | String of 10 characters |
| 3RD_PARTY | INT    | 3rd party tool used for RCS Production  | 0 - 999<br>0 : UNKNOWN<br>100 : RADBASE<br>200 : XPATCH<br>300 : MATHLAB/SIMULINK<br>999 : OTHER   | Enumerated              |

|          |        |   |   |            |
|----------|--------|---|---|------------|
| POL_TYPE | INT    | Polarization Mode of RF emission used to characterize RCS | 0- 999<br>0 : UNKNOWN<br>1 : LINEAR<br>2 : CIRCULAR<br>3 : ELLIPTICAL<br>4 : SINGLE HH<br>5 : SINGLE HV<br>6 : SINGLE VV<br>7 : SINGLE VH<br>8 : DUAL HH-HV<br>9 : DUAL VV-VH<br>10 : DUAL HH-VV<br>11 :<br>ALTERNATING<br>HH-HV<br>12 :<br>ALTERNATING VV-<br>VH<br>13 :<br>POLARIMETRIC<br>HH<br>14 :<br>POLARIMETRIC<br>VV<br>15 :<br>POLARIMETRIC<br>HV<br>16 :<br>POLARIMETRIC<br>VH<br><br>999: OTHER | Enumerated |
| EX_AMPL  | DOUBLE | Transmitted Ex-component amplitude level                  |   | INTENS_TY  |
| EY_AMPL  | DOUBLE | Transmitted Ey-component amplitude level                  |   | INTENS_TY  |
| EX_PHASE | DOUBLE | Transmitted Ex-component phase                            |   | ANGL_TYP   |
| EY_PHASE | DOUBLE | Transmitted Ey-component phase                            |   | ANGL_TYP   |



|           |        |                                    |   |            |
|-----------|--------|------------------------------------|---|------------|
| EX_FREQ   | DOUBLE | Transmitted Ex-component frequency |   | FREQU_TY   |
| EY_FREQ   | DOUBLE | Transmitted Ey-component frequency |   | FREQU_TY   |
| INTENS_TY | INT    | RCS Value units                    | 0 – 999<br><br>0 : UNKNOWN<br>1 : DB<br>2 : DBSM<br>3 : VOLTS<br>4 : SURFACE<br>5 : M2<br><br>999: OTHER          | N/A        |
| ANGL_TYP  | INT    | RCS Angular Value units            | 0 : UNKNOWN<br><br>1 : DEGREES<br>2 : RADIANS<br><br>3 : GRADIANS<br><br>4 : STERADIANS                           | N/A        |
| FREQU_TY  | INT    | RCS Frequency Value units          | 0 : UNKNOWN<br><br>1 : HERTZ<br>2 : KILOHERTZ<br>3 : MEGAHERTZ<br>4 : GIGAHERTZ<br>5 : TERAHERTZ<br>6 : PETAHERTZ | N/A        |
| TGT_TY    | INT    | Target Mode Value units            | 0 : UNKNOWN<br><br>1 : NORMAL<br>2 : SLIGHTLY DAMAGED<br>3 : DAMAGED<br>4 : DESTROYED                             | Enumerated |

|           |        |   |   |            |
|-----------|--------|---|---|------------|
| TIME_TY   | INT    | Time Value units                                  | 0 : UNKNOWN<br><br>1 : SECONDS<br>2 : MILLI-SECONDS<br>3 : MICRO-SECONDS  | Enumerated |
| RF_TY     | INT    | RF Emission Mode Type                             | 0 : UNKNOWN<br><br>1 : CONTINUOUS WAVE<br>2 : PULSED  | Enumerated |
| LENGTH_TY | INT    | Length Value units                                | 0 – 999<br><br>0 : UNKNOWN<br><br>1 : NANOMETER<br><br>2 : MICRON<br><br>3 : MILLIMETER<br><br>4 : CENTIMETER<br><br>5 : METER<br><br>6 : KILOMETER<br><br>999: OTHER | N/A        |
| RF_FREQ   | DOUBLE | Frequency of RF emission used to characterize RCS |   | FREQ_TY    |
| TGT_SS    | DOUBLE | Significant size of input Source Model Data       |   | LENGTH_TY  |
| MLOBEGAIN | DOUBLE | Antenna Main Lobe Gain                            |   | INTENS_TY  |
| MLOBEBW   | DOUBLE | Antenna Main Lobe Bandwidth                       |   | ANGL_TYP   |
| SLOBE3DB  | DOUBLE | Antenna Side Lobe 3dB Point                       |   | ANGL_TYP   |
| RF_PWIDTH | DOUBLE | RF Pulse Width                                    |   | TIME_TY    |

|           |        |  |  |           |
|-----------|--------|--|--|-----------|
| RF_PRF    | DOUBLE | RF Pulse Repetition Frequency  |  | FREQU_TY  |
| RCS_AVG_I | DOUBLE | RCS Intensity Average (or mean) Value. This represents the arithmetic mean of the RCS table.   |  | INTENS_TY |
| RCS_AVG_A | DOUBLE | RCS Amplitude Average (or mean) Value. This represents the arithmetic mean of the RCS table.   |  | INTENS_TY |
| RCS_AVG_P | DOUBLE | RCS Phase Shift Average (or mean) Value. This represents the arithmetic mean of the RCS table. |  | ANGL_TYP  |
| RCS_NML_I | DOUBLE | Approximated RCS Intensity Value for 'Normal' state  |  | INTENS_TY |
| RCS_NML_A | DOUBLE | Approximated RCS Amplitude Value for 'Normal' state  |  | INTENS_TY |
| RCS_NML_P | DOUBLE | Approximated RCS Phase Shift Value for 'Normal' state  |  | ANGL_TY   |
| RCS_SD_I  | DOUBLE | Approximated RCS Intensity Value for 'Slightly Damaged' state                                  |  | INTENS_TY |
| RCS_SD_A  | DOUBLE | Approximated RCS Amplitude Value for 'Slightly Damaged' state                                  |  | INTENS_TY |
| RCS_SD_P  | DOUBLE | Approximated RCS Phase Shift Value for 'Slightly Damaged' state                                |  | ANGL_TY   |

|           |        |   |  |           |
|-----------|--------|---|--|-----------|
| RCS_DMG_I | DOUBLE | Approximated RCS Intensity Value for 'Damaged' state  |  | INTENS_TY |
| RCS_DMG_A | DOUBLE | Approximated RCS Amplitude Value for 'Damaged' state  |  | INTENS_TY |
| RCS_DMG_P | DOUBLE | Approximated RCS Phase Shift Value for 'Damaged' state  |  | ANGL_TY   |
| RCS_DST_I | DOUBLE | Approximated RCS Intensity Value for 'Destroyed' state  |  | INTENS_TY |
| RCS_DST_A | DOUBLE | Approximated RCS Amplitude Value for 'Destroyed' state  |  | INTENS_TY |
| RCS_DST_P | DOUBLE | Approximated RCS Phase Shift Value for 'Destroyed' state  |  | ANGL_TY   |
| RCS_FLU_I | DOUBLE | RCS Intensity Fluctuation (or Variance); the mean of all squared deviations from the mean for all RCS values. |  | N/A       |
| RCS_FLU_A | DOUBLE | RCS Amplitude Fluctuation (or Variance); the mean of all squared deviations from the mean for all RCS values. |  | N/A       |

|           |        |  |   |           |
|-----------|--------|--|---|-----------|
| RCS_FLU_P | DOUBLE | RCS Phase Fluctuation (or Variance); the mean of all squared deviations from the mean for all RCS values.  |   | N/A       |
| RCS_SCINT | DOUBLE | This value specifies a level of scintillation to be added to the simulated radar signature when model parts are being articulated.   | 7.3.3, Model's Articulations Effect on RCS Data | INTENS_TY |
| RCS_FLASH | DOUBLE | RCS Intensity of Target when viewed directly at 0° (face) or 180° (back) degrees azimuth. This “face” value is sometimes necessary when viewpoint turns around target and gets a “flash” at those specific angles. |   | INTENS_TY |
| EQ_SPH_RD | DOUBLE | Radius of an approximated equivalent metallic sphere substituting the model  |   | LENGTH_TY |
| MAX_VAL_I | DOUBLE | RCS Table Max Intensity Value  |   | INTENS_TY |
| MAX_VAL_A | DOUBLE | RCS Table Max Amplitude Value  |   | INTENS_TY |
| MAX_VAL_P | DOUBLE | RCS Table Max Phase Shift Value  |   | ANGL_TY   |
| MIN_VAL_I | DOUBLE | RCS Table Min Intensity Value  |   | INTENS_TY |

|           |        |  |  |           |
|-----------|--------|--|--|-----------|
| MIN_VAL_A | DOUBLE | RCS Table Min Amplitude Value              |  | INTENS_TY |
| MIN_VAL_P | DOUBLE | RCS Table Min Phase Shift Value            |  | ANGL_TY   |
| AZ_SSANGL | DOUBLE | Azimuth smallest significant delta angle   | Smallest azimuth angle increment found in data   | ANGL_TYP  |
| EL_SSANGL | DOUBLE | Elevation smallest delta significant angle | Smallest elevation angle increment found in data | ANGL_TYP  |
| AZ_LSANGL | DOUBLE | Azimuth largest significant delta angle    | Smallest azimuth angle increment found in data   | ANGL_TYP  |
| EL_LSANGL | DOUBLE | Elevation largest significant delta angle  | Smallest elevation angle increment found in data | ANGL_TYP  |

### RCS Instance-Level Attribute Data

The data for an entire RCS model itself is stored as a series of Point geometries, each representing the RCS data values with respect to the model's center for the corresponding azimuth and elevation angles as represented by the point X and Y coordinates. The \*.dbf portion of the vector data set provides the instance attribute information for each of the RCS Point. A description of the attribute information follows below:

**ShapeType** = POINT

Values:

X coordinate is the Azimuth angle of the RCS sample

Y coordinate is the Elevation angle of the RCS sample

NOTE:The RCS of the model when viewed at +90° elevation (top view) is significantly different than the one at -90° elevation (bottom view), so there should be  $(180/EL\_STEP)+1$  point values to cover all elevations. The azimuth, which has the same RCS value for +180° and -180° will cover  $(360/AZ\_STEP)$  point values.

**Table 7-3: RCS Instance Attribute Fields**

| ATTRIBUTE | TYPE   | DESCRIPTION   | VALUES                  | UNITS |
|-----------|--------|---|-------------------------|-------|
| CLASSNAME | STRING | Unique string referring to the RCS model class attribute name | String of 32 characters |       |

|          |        |                     |  |          |
|----------|--------|---------------------|--|----------|
| RCS_INTE | DOUBLE | RCS Intensity Level |  | INTEN_TY |
| RCS_AMPL | DOUBLE | RCS Amplitude Level |  | INTEN_TY |
| RCS_PHAS | DOUBLE | RCS Phase           |  | ANGL_TYP |

**Figure 7-4: UML Representation of the 3D Model RCS Vector Data Structure**  


For a given RCS curve in a vector data set, an attribute “CLASSNAME” indicates which type of sensor application the curve data is derived for, and under which resolution the data was produced. Therefore, the single vector data set of the Model can regroup all sensor data pertaining to various RCS signature types and resolutions for a given RCS Model. Consider the next example. The vector data format therefore should not preclude the capability to support multiple RCS curves simultaneously for a given model.



**Figure 7-5: Example of RCS Vector Data**

### 7.3.2. Multi-Variant RCS Model Applicability

|                      |  |
|----------------------|--|
| <b>Requirement 6</b> | req/cdb-radar/rcs-vari   |
|                      | Each variant of the RCS model in the vector data set SHALL have a 10-character string attribute called “RCS_VARI”. The string may contain the specific Radar model number (and possibly its frequency band L-Band, S-Band, X-Band, Ku-Band) for which this RCS variant applies to. The suggested string convention for this field is as described in reference <a href="#">[R22]</a> . |

For example: The “AN/APG-65” Radar model name represents a Pulse Doppler X-Band Multi-Mode Radar manufactured by Raytheon (Hughes) and used in F/A-18, AV-8B+ aircraft.

**Table 7-4: Radar Model Numbers AN/APA - Airborne Radar Auxiliary Assemblies**

| Model Number | Description   |
|--------------|---|
| AN/APA-1     | Indicator Unit (Remote Repeater Scope) used with US Navy ASB radar  |
| AN/APA-2     | Radar Antenna Equipment   |
| AN/APA-3     | Radar Antenna Equipment   |
| AN/APA-4     | Radar Alarm Unit  |
| AN/APA-5     | Auxiliary Electronic Bombsight Equipment; used in P-2   |
| AN/APA-6     | Panoramic Radio Receiving Set; used with AN/APR-9 and AN/APR-14   |
| AN/APA-7     | Movie-Camera Photo Set  |
| AN/APA-8     | Video Amplifier; used with AN/APS-2   |
| AN/APA-9     | ECM Equipment; used in P2V-5  |
| AN/APA-10    | Panoramic Radio Receiving Set; used with AN/SPR-2   |
| AN/APA-11    | Panoramic Radio Receiving Set (Pulse Analyzer); used in B-52 EW pod, RC-121C, P2V-5, PBM-5S used with AN/APR-9 and AN/APR-14; |
| AN/APA-12    | Sector Scan Antenna Adapter; used with AN/APS-2   |
| AN/APA-13    | Component of AN/APS-15  |
| AN/APA-14    | Component of AN/APS-15  |
| AN/APA-15    | Elevation Stabilizer; used with AN/APS-15   |
| AN/APA-16    | Auxiliary Electronic Bombsight Equipment used in PBX-6A   |



|           |  |
|-----------|--|
| AN/APA-17 | 250-1000 MHz Broadband Direction Finding Radar (used with search receivers); manufactured by Hoffman Radio Corp., Aviola   |
| AN/APA-19 | Bombing Aid  |
| AN/APA-21 | Radar Bombing Compensating Unit  |
| AN/APA-23 | Automatic Tape Recorder; manufactured by Gamewell; used with AN/APR-1/2/4/5/6  |
| AN/APA-24 | 50-280 MHz Direction Finding Radar (used with search receivers); manufactured by Heyer Products used in P4M-1Q   |
| AN/APA-25 | Radar Direction Finding Antenna Unit   |
| AN/APA-26 | S-Band Attenuator  |
| AN/APA-27 | Automatic Search & Jam Tuning Adapter  |
| AN/APA-28 | Multiple Indicator Equipment (6 displays); used with AN/APQ-13   |
| AN/APA-29 | Bombing Altitude Control Unit  |
| AN/APA-33 | Multiple Indicator Equipment (4 displays); used with AN/APQ-7  |
| AN/APA-35 | Radar Signal Recording Camera Unit   |
| AN/APA-36 | Remote Repeater Scope (modified AN/APA-1); used with AN/APQ-13   |
| AN/APA-38 | Panoramic Radio Receiving Set; used in PBM-5S  |
| AN/APA-39 | Radar Identification Unit  |
| AN/APA-40 | Bombing/Navigation System used with AN/APS-15; used in B-17  |
| AN/APA-42 | Bombing/Navigation System; used with AN/APS-23; used in XB-48 (see AN/APA-59)  |
| AN/APA-43 | Airborne Searchlight Control   |
| AN/APA-44 | Ground Position Indicator System; manufactured by Bell Telephone Lab; used with AN/ASB-3 and AN/APS-23/27/31 used in B-45 (together with AN/APS-23 to form AN/APQ-24), RB-66 |
| AN/APA-45 | Radar Antenna Tilt Stabilizer Unit   |
| AN/APA-48 | Radar Homing Equipment, 140-300 MHz; manufactured by RRL   |
| AN/APA-49 | Radar Bombing Ground Position Indicator  |
| AN/APA-50 | Low Altitude Rocket Bombing Unit   |

|           |  |
|-----------|--|
| AN/APA-51 | Radar Indicator Unit   |
| AN/APA-52 | X-Band TACAN Doppler Navaid; used in F-8, SB-29  |
| AN/APA-54 | Radar Recorder Group (SHORAN); used in B-57  |
| AN/APA-55 | Radar Adapter Unit   |
| AN/APA-56 | Radar Display Console; used with AN/APS-45/95; used in EC-121  |
| AN/APA-57 | Ground Position Indicator Group; used in AF-2W, P-2, S-2; replaced by AN/ASA-13                                |
| AN/APA-58 | Ground Position Computer   |
| AN/APA-59 | Bombing/Navigation Computer "SRC-1"; manufactured by Sperry; used in B-36, XB-48                               |
| AN/APA-60 | Autopilot  |
| AN/APA-61 | Radar Bombing Navigational Computer  |
| AN/APA-62 | Panoramic Receiver   |
| AN/APA-63 | Autopilot  |
| AN/APA-64 | Radar Signal Analyzer used in P2V-4  |
| AN/APA-66 | Radar Monitor  |
| AN/APA-69 | Direction Finding Radar Set; used in RB-57D, A-1, C-47, P-2, P-5, S-2, RC-121C, Z-1, ZPK                       |
| AN/APA-70 | Direction Finder Group; used with AN/APR-9; used in AF-2W, P-2, S-2, TBM-3S                                    |
| AN/APA-72 | Signal Analyzer; used in E-2   |
| AN/APA-74 | Pulse Analyzer Group; manufactured by Loral; used in EB-66, A-3, EC-47, P-2, P-5, Z-1, ZPK; replaced AN/APA-11 |
| AN/APA-80 | Control & Guidance Monitoring Group; used in AUM-N-2, HSL-1, P-2, P-5, S-2                                     |
| AN/APA-81 | Ground Position Indicator Group; used with AN/APS-20; used in AF-2W, EC-121                                    |
| AN/APA-82 | Direction Finder Group; used in B-52, C-130, C-133, C-135  |
| AN/APA-84 | Radar Intercept Targeting Computer; used with APG-37; used in F-86D/K  |
| AN/APA-85 | Control-Indicator Group; used with AN/APS-42 used in R6D-1   |
| AN/APA-89 | Coder Group; used in A-3, UH-1E  |

|            |  |
|------------|--|
| AN/APA-90  | Indicator Group; used with AN/APW-11; used in B-57, B-66   |
| AN/APA-91  | used with AN/APS-33  |
| AN/APA-92  | ECM Set  |
| AN/APA-94  | Signal Analyzer  |
| AN/APA-95  | Doppler Navigation Computer  |
| AN/APA-106 | Bomb Damage Evaluation Group; used with AN/APQ-24; used in B-50D                                   |
| AN/APA-109 | Radar Control; manufactured by Westinghouse  |
| AN/APA-113 | used with AN/APS-62  |
| AN/APA-122 | Radar Set  |
| AN/APA-125 | Radar Display; used with AN/APS-80/82, AN/ASA-47; used in P-2H, P-3A, P-5, E-1                     |
| AN/APA-126 | Doppler Equipment; used in A-7   |
| AN/APA-127 | Sparrow Missile Fire Control System; manufactured by Raytheon; used in F-3, F-4B/C                 |
| AN/APA-128 | Sparrow Missile Radar Set Group; manufactured by Raytheon; used with AN/AWG-7; used in XF8U-3, F-4 |
| AN/APA-138 | Radar Display; used with AN/AWG-7; used in XF8U-3  |
| AN/APA-141 | Radar Set; used in B-52G/H   |
| AN/APA-143 | Rotodome Antenna Group; manufactured by Dalmo Victor; used with AN/APS-96; used in E-2A/B          |
| AN/APA-144 | Signal Analyzer Group; used in EA-1F, EC-121M, P-3A  |
| AN/APA-150 | Station Keeping System; used in SH-34J   |
| AN/APA-153 | Cable Breakout Adapter Set; manufactured by AC Spark Plug; used with AN/APS-104                    |
| AN/APA-157 | Continuous Wave Illuminator (for AIM-7 targeting); manufactured by Raytheon; used in F-4B/C        |
| AN/APA-159 | Radar Set Group; manufactured by Hazeltine; used in EC-121D/H                                      |
| AN/APA-160 | Test Adapter; manufactured by Sperry; used with AN/APN-42  |
| AN/APA-161 | Station Keeping System used in ASW helicopters   |

|            |  |
|------------|--|
| AN/APA-162 | Map Matcher  |
| AN/APA-164 | Rotodome; used with AN/APS-111; used in E-2A/B   |
| AN/APA-165 | Intercept Computer (for AIM-9 firing); manufactured by Raytheon; used with AN/APQ-109 used in F-4D |
| AN/APA-167 | used with AN/APG-53  |
| AN/APA-170 | Radar Set  |
| AN/APA-171 | Rotodome Antenna Group; used with AN/APS-120, AN/APX-76; used in E-2C                              |
| AN/APA-172 | Control Indicator Group; used with AN/APS-120, AN/APX-76; used in E-2C                             |
| AN/APA-173 | Test Bench   |

#### AN/APB - Airborne Bombing Radars

| Model Number | Description                 |
|--------------|-----------------------------|
| AN/APB-1     | Radar Beacon                |
| AN/APB-2     | Bombing Radar; used in B-58 |

#### AN/APD - Airborne Direction Finding and Surveillance Radars

| Model Number | Description  |
|--------------|--|
| AN/APD-1     | Homing Radar; used in TBF/TBM  |
| AN/APD-2     | Radar Direction Finding Set; used with AN/APR-1 and AN/APA-48  |
| AN/APD-4     | D/E/F-Bamd Radar Direction Finding System; manufactured by ITT; used in RB-47H, B-52, EB-66C                       |
| AN/APD-5     | Reconnaissance Radar   |
| AN/APD-7     | Radar Surveillance System; manufactured by Westinghouse; used in OV-1D, RA-5C                                      |
| AN/APD-8     | Side-Looking Reconnaissance Radar; manufactured by Westinghouse; proposed for RF-111A                              |
| AN/APD-9     | Radar Set  |
| AN/APD-10    | Side-Looking Reconnaissance and Mapping Radar; used in F-4, RF-4B/C, CP-140;<br><br>special tests in NC-141, C-130 |

|            |   |
|------------|---|
| AN/APD-11  | Side-Looking Radar Reconnaissance Set; part of AN/UPD-6; used in RF-4E  |
| AN/APD-12  | I/J-band Side-Looking Reconnaissance System; manufactured by Lockheed Martin;<br><br>part of AN/UPD-8 and AN/UPD-9; used in Israeli RF-4B |
| AN/APD-13  | QUICK LOOK Electronic Intelligence Subsystem; manufactured by Systems & Electronics; used in "Guardrail" RC-12                            |
| AN/APD-14  | SAROS (SAR for Open Skies) Radar System; manufactured by Sandia; part of AN/UPD-8; used in OC-135   |
| AN/APD-501 | Maritime Patrol Radar; used in Lancaster (Canada)   |

#### **AN/APG - Airborne Fire Control Radars**

| <b>Model Number</b> | <b>Description</b>   |
|---------------------|--|
| AN/APG-1            | S-Band Intercept Radar used in P-61B   |
| AN/APG-2            | S-Band Intercept & Gun Laying Radar used in P-61                               |
| AN/APG-3            | Tail Gun Laying Radar; manufactured by General Electric used in B-29 and B-36B |
| AN/APG-4            | L-Band Low Altitude Torpedo Release Radar "Sniffer" used in TBM                |
| AN/APG-5            | S-Band Gun Laying/Range-Finding Radar used in B-17, B-24 and F-86A (AN/APG-5C) |
| AN/APG-6            | L-Band Low Altitude Bomb Release Radar "Super Sniffer" (improved AN/APG-4)     |
| AN/APG-7            | Glide Bomb Control Radar "SRB" (Seeking Radar Bomb)                            |
| AN/APG-8            | S-Band Turret Fire Control Radar used in B-29B                                 |
| AN/APG-9            | L-Band Low Altitude Bomb Release Radar (improved AN/APG-6)                     |
| AN/APG-10           | Weapons System Radar   |
| AN/APG-11           | L-Band Toss Bombing Radar  |
| AN/APG-12           | L-Band Low Altitude Bomb Release Radar (improved AN/APG-9)                     |

|           |   |
|-----------|---|
| AN/APG-13 | S-Band Nose Gun Laying Radar "Falcon"; manufactured by General Electric used with 75mm nose gun of B-25H  |
| AN/APG-14 | S-Band Gun Sight Radar used in B-29   |
| AN/APG-15 | S-Band Tail Gun Radar used in B-29B, PB4Y   |
| AN/APG-16 | X-Band Gun Laying Radar (modification of AN/APG-2) used in B-32, XB-48  |
| AN/APG-17 | S-Band Low Altitude Bomb Release Radar (improved AN/APG-4)  |
| AN/APG-18 | X-Band Turret Control Radar (improved AN/APG-5); manufactured by Martin used with "S-4" gunfight  |
| AN/APG-19 | X-Band Fire Control Radar; manufactured by Martin (improved AN/APG-8 and -18)   |
| AN/APG-20 | S-Band Low Altitude Bomb Release Radar (improved AN/APG-6)  |
| AN/APG-21 | Ground-Ranging Radar  |
| AN/APG-22 | X-Band Gun Sight Radar; manufactured by Raytheon used with Mk.18/23 Lead-Computing Gun Sights   |
| AN/APG-23 | Weapons System Radar used in B-36A  |
| AN/APG-24 | Weapons System Radar used in B-36B  |
| AN/APG-25 | X-Band Gun Tracking Radar used in F-100   |
| AN/APG-26 | Weapons System Tracking Radar; manufactured by Westinghouse used in F3D   |
| AN/APG-27 | Tail Gun Radar used in XB-46 and XB-48  |
| AN/APG-28 | Intercept Radar (modified AN/APG-1) used in F-82F   |
| AN/APG-29 | Night/All-Weather Fighter Fire-Control Radar (for Type D-1 Fire-Control System)   |
| AN/APG-30 | X-Band Fire Control Radar; manufactured by Sperry used in B-45, B-57, F-4E, F-8A, F-84E, F-86A (final blocks only), F-86E/F, F-100, FJ-2, F2H-2 |
| AN/APG-31 | Gun Laying Radar; manufactured by Raytheon used in B-57   |
| AN/APG-32 | X-Band Tail Turret Autotrack Radar; manufactured by General Electric used in B-36D/F, B-47E   |

|           |   |
|-----------|---|
| AN/APG-33 | X-Band Fire Control Radar; manufactured by Hughes used in TB-25K, F-94A/B, F-89A  |
| AN/APG-34 | Computing Radar Gunfight used in F-104C   |
| AN/APG-35 | Radar used in F3D   |
| AN/APG-36 | Search Radar used in F2H-2N, F-86D (replaced by AN/APG-37)  |
| AN/APG-37 | Search Radar; manufactured by Hughes used in F-86D/K/L, F2H-4   |
| AN/APG-39 | Gun Laying Radar used in B-47E  |
| AN/APG-40 | Fire Control Radar; manufactured by Hughes used in TB-25M, F-94C, F-89D, CF-100 (Canada)                                |
| AN/APG-41 | Tail Gun Radar (twin radomes); manufactured by General Electric used in B-36H   |
| AN/APG-43 | Continuous Wave Interception Radar; manufactured by Raytheon  |
| AN/APG-45 | Fire-Control Radar (miniaturized AN/APG-30); manufactured by General Electric; intended for patrol aircraft gun turrets |
| AN/APG-46 | Fire-Control Radar; tested in A-6A  |
| AN/APG-48 | Airborne Fire-Control System Mk.22  |
| AN/APG-50 | Intercept Radar used in F-4   |
| AN/APG-51 | Intercept Radar; manufactured by Hughes used in F3H-2, F3D  |
| AN/APG-53 | Weapons System Radar; manufactured by Stewart-Warner used in A-4  |
| AN/APG-55 | Pulse Doppler Intercept Radar; manufactured by Westinghouse   |
| AN/APG-56 | Fire Control Radar (similar to AN/APG-30) used in F-86 (only Australian models with A-4 gun sight)                      |
| AN/APG-57 | Fire-Control Radar; manufactured by Gould   |
| AN/APG-59 | Pulse-Doppler Gunnery Radar; manufactured by Westinghouse; part of AN/AWG-10 used in F-4J                               |
| AN/APG-60 | Doppler Radar; part of AN/AWG-11 used in F-4K   |
| AN/APG-61 | Fire-Control Radar; part of AN/AWG-12 used in F-4M  |

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| AN/APG-63 | Pulse Doppler X-Band Fire Control Radar (AN/APG-63(V)2 is an AESA variant); manufactured by Raytheon (Hughes) used in F-15A/B/C/D/H/K                                     |
| AN/APG-64 | Fire-Control Radar (development of AN/APG-63); not produced   |
| AN/APG-65 | Pulse Doppler X-Band Multi-Mode Radar; manufactured by Raytheon (Hughes) used in F/A-18A/B, F-4 ICE/Peace Ikarus 2000, AV-8B+ (upgraded)                                  |
| AN/APG-66 | Pulse Doppler X-Band Multi-Mode Radar; manufactured by Northrop Grumman (Westinghouse) used in F-16A/B, F-4EJ (Japan), Hawk 200 (UK)                                      |
| AN/APG-67 | Pulse Doppler X-Band Multi-Mode Radar; manufactured by Lockheed Martin (General Electric) (Model G-200) used in F-20, A-50 (Korea), F-5-2000 (Taiwan), Ching Kuo (Taiwan) |
| AN/APG-68 | Pulse Doppler X-Band Multi-Mode Radar (improved AN/APG-66); manufactured by Northrop Grumman (Westinghouse) used in F-16C/D-30/40/50                                      |
| AN/APG-69 | Radar Set; manufactured by Emerson used in F-5E, AV-8?  |
| AN/APG-70 | Pulse Doppler X-Band Multi-Mode Radar (upgrade of AN/APG-63); manufactured by Raytheon (Hughes) used in F-15C/D/E   |
| AN/APG-71 | Pulse Doppler X-Band Multi-Mode Radar; manufactured by Raytheon (Hughes) used in F-14D  |
| AN/APG-73 | Pulse Doppler X-Band Multi-Mode Radar (upgrade of AN/APG-65); manufactured by Raytheon (Hughes) used in F/A-18C/D/E/F   |
| AN/APG-74 | Pod-mounted Radar System; manufactured by Northrop Grumman (Norden)   |
| AN/APG-76 | Pulse Doppler Ku-Band Multi-Mode Radar; manufactured by Northrop Grumman (Norden) used in F-4E (Israel); tested in pod with F-16, S-3B                                    |
| AN/APG-77 | Pulse Doppler X-Band AESA (Active Electronically Scanned Array) Multi-Mode Radar; manufactured by Northrop Grumman/Raytheon used in F/A-22A                               |



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| AN/APG-78  | Fire Control Radar "Longbow"; manufactured by Northrop Grumman & Lockheed Martin used on mast in AH-64D, RAH-66, underwing on AH-1W/Z                       |
| AN/APG-79  | AESA (Active Electronically Scanned Array) Multi-Mode Radar (based on AN/APG-73); manufactured by Raytheon used in F/A-18E/F/G as replacement for AN/APG-73 |
| AN/APG-80  | "Agile Beam Radar" AESA (Active Electronically Scanned Array) Multi-Mode Radar (based on AN/APG-68); manufactured by Northrop Grumman; intended for F-16E/F |
| AN/APG-81  | AESA (Active Electronically Scanned Array) Radar planned for F-35   |
| AN/APG-501 | X-Band Ranging Radar used in F-86   |
| AN/APG-T1  | Radar Training Set for AN/APG-1   |

#### AN/APN - Airborne Navigation Radars

| Model Number | Description  |
|--------------|--|
| AN/APN-1     | Radio Altimeter (improved AN/ARN-1) used in P-61, C-119, B-32, C-121, H-19, P-5, AF-2W, AD-5, F2H-2/2N/2P, F3D, F6F-5N, F9F, XF10F-1, P2V-4, PB4Y-2, PBM-5S, PBV-6A, R5C-1, R5D-2, R6D-1, SB2C-5, TBM-3S |
| AN/APN-2     | "Rebecca" Radio Beacon used with AN/PPN-1, AN/TPN-2  |
| AN/APN-3     | SHORAN used with AN/CPN-2 used in B-45A  |
| AN/APN-4     | LORAN; manufactured by Philco used in B-29, B-32, C-47, C-54, C-117, C-121, P2V-4, PBM-5S, PBV-6A, PB4Y-2, R4Q-1, R6D-1  |
| AN/APN-5     | Radar Beacon Navigation Aid used in F-86   |
| AN/APN-6     | S-Band Beacon used with AN/PPN-10, AN/PPN-11   |
| AN/APN-7     | LORAN S-Band Beacon used with AN/APS-2   |
| AN/APN-8     | Radar Beacon   |
| AN/APN-9     | LORAN; manufactured by RCA used in B-29, B-32, RC-121, C-97 replaced AN/APN-4  |
| AN/APN-10    | "Rebecca" Interrogation Set  |
| AN/APN-11    | X-Band Beacon used with AN/APS-3/4/6/10/15/31/33 used in B-47, KC-97, XS-1   |

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| AN/APN-12 | Rendezvous Radar (or 160-230 MHz "Rebecca" Interrogator) used in B-47, C-97  |
| AN/APN-13 | S-Band Beacon (improved AN/APN-7)  |
| AN/APN-14 | Navigation Aid   |
| AN/APN-15 | Low Level Altimeter Set; manufactured by Sperry used in B-52, CH-3C  |
| AN/APN-16 | Radar Beacon   |
| AN/APN-18 | Radar Beacon   |
| AN/APN-19 | "Rosebud" S-Band Beacon used in F-82D  |
| AN/APN-20 | Radar Beacon   |
| AN/APN-21 | Radar Beacon   |
| AN/APN-22 | Radar Altimeter; manufactured by Electronic Assistance Corp used in A-3, B-66, C-119, RC-121, C-130, RF-101C, OV-1, AD-5, P2V-5, R6D-1 |
| AN/APN-23 | Active Seeker used in KAY-1(XSAM-N-4)  |
| AN/APN-24 | Navigation Set   |
| AN/APN-25 | Doppler Navigator; manufactured by GPI   |
| AN/APN-26 | SG-Band (VHF) Beacon   |
| AN/APN-29 | SG-Band (VHF) Beacon   |
| AN/APN-30 | Radar Beacon   |
| AN/APN-33 | S-Band Beacon; replaced AN/APN-7 used in XSSM-N-8  |
| AN/APN-34 | Distance Measuring Radar used in C-97C, R6D-1  |
| AN/APN-35 | Radar Beacon   |
| AN/APN-36 | Radar Beacon   |
| AN/APN-37 | Radar Beacon   |
| AN/APN-38 | Radar Beacon   |
| AN/APN-39 | Radar Beacon   |
| AN/APN-40 | Radar Beacon   |
| AN/APN-41 | Missile Beacon for LTV-N-2 replaced AN/APN-33  |
| AN/APN-42 | Radar Altimeter used in WC-130, WB-47E, B-52   |
| AN/APN-45 | Tracking Radar Beacon used in DC-130A  |
| AN/APN-46 | Radar Beacon   |
| AN/APN-47 | Radar Beacon   |
| AN/APN-48 | Radar Beacon   |
| AN/APN-49 | Radar Beacon   |

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| AN/APN-50 | Navigation Radar; manufactured by Sperry  |
| AN/APN-52 | Radar Set   |
| AN/APN-54 | Radar Beacon  |
| AN/APN-55 | Radar Beacon (for missiles)   |
| AN/APN-56 | Navigation Radar; manufactured by Gould   |
| AN/APN-57 | Ground Position Indicator   |
| AN/APN-58 | Navigation Radar; manufactured by Sperry  |
| AN/APN-59 | Search & Weather Radar; manufactured by Sperry used in C-130, C-135, B-57, C-133, C-141, KC-97  |
| AN/APN-60 | S-Band Beacon used in B-52  |
| AN/APN-61 | Radar Beacon used in XF-85  |
| AN/APN-63 | S-Band (Receive)/L-Band (Transmit) Beacon; manufactured by Melpar   |
| AN/APN-66 | Doppler Navigation Radar used in SM-62, B-47  |
| AN/APN-67 | Doppler Set used in P6M-1, NC-121 "Project Magnet", USN helicopters; tested in P-2  |
| AN/APN-68 | IFF Beacon used with AN/APX-6   |
| AN/APN-69 | X-Band Rendezvous Beacon used in B-47, B-52, C-97, RB-57D, KC-135 used with AN/APN-59   |
| AN/APN-70 | LORAN; manufactured by Dayton Aviation Radio & Equip Corp used in B-50, C-54, C-119, C-121, RC-121D, C-130, C-135, P-2, P-3A, T-29C/D, Z-1, R6D-1 |
| AN/APN-71 | Flare-Out Unit  |
| AN/APN-75 | Rendezvous Radar used in B-47   |
| AN/APN-76 | Rendezvous Radar; manufactured by Olympic used in KC-97, B-47B/E  |
| AN/APN-77 | Doppler Set used in SZ-1B, USN helicopters  |
| AN/APN-78 | Doppler Set used in helicopters   |
| AN/APN-79 | Doppler Set manufactured by Teledyne Ryan used in helicopters   |
| AN/APN-81 | Doppler Set used in RB/WB-66, WB-50, C-130, KC-135  |
| AN/APN-82 | Doppler Navigation Radar (combination of AN/APN-81 and AN/ASN-6) used in EB/RB/WB-66, KC-135  |
| AN/APN-84 | SHORAN Set; manufactured by Hazeltine used in RC-130A   |

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| AN/APN-85  | Navigation Radar; manufactured by Hazeltine   |
| AN/APN-89  | Doppler Set; part of AN/ASQ-38 used in B-52E/G/H  |
| AN/APN-90  | Doppler Set   |
| AN/APN-91  | Tracking Beacon used in BQM-34C   |
| AN/APN-92  | Navigation Radar  |
| AN/APN-96  | Doppler Set   |
| AN/APN-97  | Doppler Set; manufactured by Ryan used in UH-2A, SH-3, SH-34J   |
| AN/APN-99  | Doppler Navigation Set (combination of AN/APN-81 and AN/ASN-7) used in B-52, AC-130A, KC-135  |
| AN/APN-100 | Radar Altimeter; manufactured by Litton used in CH-47A  |
| AN/APN-101 | Airborne Radar used in RF-4C, F-4E (possible confusion with AN/ARN-101)   |
| AN/APN-102 | Doppler Set; manufactured by GPI used in RB-47, WB-47E, RB-57F, WB-57F, F-100C/F, RF-101  |
| AN/APN-103 | Navigational Computer System  |
| AN/APN-105 | All-Weather Doppler Navigation System; manufactured by LFE used in F-105B/D, T-39B  |
| AN/APN-107 | Navigation Radar used in RB-57D   |
| AN/APN-108 | Doppler Set (derivative of AN/APN-89 with gyro components from AN/APN-81) used in B-52E   |
| AN/APN-109 | Altimeter; manufactured by Honeywell  |
| AN/APN-110 | Doppler Navigation Set used in B-58, F-100D/F, RF-101   |
| AN/APN-113 | Doppler Radar; part of AN/ASQ-42 used in B-58   |
| AN/APN-114 | Automatic Landing System used with AN/GSN-5; tested in TF-102   |
| AN/APN-115 | Navigation Radar; manufactured by General Electric  |
| AN/APN-116 | Doppler Set   |
| AN/APN-117 | Low-Level Radar Altimeter (in combination with AN/APN-22); manufactured by Electronic Assistance Corp used in A-6A, P-2, S-2, SH-3A, H-13H, CH-47A, HH-52, CH-53A |
| AN/APN-118 | Doppler Navigation Set  |
| AN/APN-119 | Doppler Set   |

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| AN/APN-120 | Radar Altimeter; planned for A-5, A-6A, but not produced   |
| AN/APN-122 | Doppler Navigation Set used in S-2, A-2, A-3, A-4, A-6, RA-5C, C-47, C-54, EC-121, E-2, TF-8, P-2, P-3, P-5  |
| AN/APN-126 | Doppler Set  |
| AN/APN-127 | Collision Warning System   |
| AN/APN-128 | Navigation Radar; manufactured by Teledyne used in C-130   |
| AN/APN-129 | Doppler Navigation System; manufactured by Teledyne used in OV-1A/B  |
| AN/APN-130 | Doppler Radar; manufactured by Teledyne Ryan used in UH-2, SH-3, SH-34J, CH-53D, Z-1   |
| AN/APN-131 | Doppler Navigation Radar used in F-105, T-39B, TF-8A   |
| AN/APN-132 | X-Band Beacon; manufactured by Motorola used in BQM-34A, QF-9G   |
| AN/APN-133 | High-Altitude Radar Altimeter (upgraded SCR-728) used in C-130, C-135  |
| AN/APN-134 | Ku-Band Beacon; manufactured by Bendix used in KC-135  |
| AN/APN-135 | X-Band Beacon (for in-flight refueling); manufactured by Bendix used in B-58   |
| AN/APN-136 | Ku-Band Beacon (for in-flight refueling); manufactured by Bendix used in B-58  |
| AN/APN-140 | Radar Altimeter  |
| AN/APN-141 | Low Altitude Radar Altimeter; manufactured by Bendix used in A/TA-4, A-6, A-7, C-2, C-130, C-141, E-2C, F-4, F-8, F-104, F-105, P-3, S-2, T-39, SH-3 |
| AN/APN-142 | Navigation Radar used in F-4C  |
| AN/APN-144 | Doppler Navigation Radar used in EC-121, VC-137  |
| AN/APN-145 | LORAN C Set used in RC-135D  |
| AN/APN-146 | Radar Altimeter  |
| AN/APN-147 | Doppler Navigation System; manufactured by Canadian Marconi used in AC-119, C-124C, C-130, WC-130B/E, RC-135A, WC-135B, C-135F, C-141                |
| AN/APN-148 | Doppler Navigation Radar used in F-105D/F  |
| AN/APN-149 | Terrain Avoidance Radar used in TF-8   |

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| AN/APN-150 | Radar Altimeter used in CH-3C, B-52, C-130, EC-130E, C-135  |
| AN/APN-151 | LORAN C Receiver; manufactured by ITT used in RC-135B, C-141A, H-3  |
| AN/APN-152 | LORAN C Receiver  |
| AN/APN-153 | Doppler Navigation Radar used in A-6, A-4, EA-6A/B, A-7, C-130G, E-2, P-3A, S-2E  |
| AN/APN-154 | X-Band Beacon Augmenter (Tracking Beacon); manufactured by Motorola used with AN/TPB-1, AN/TPQ-10 used in A-4, A-7, F-14, A-6, AH-1T, H-46, CH-53 |
| AN/APN-155 | Low Altitude Radar Altimeter; manufactured by Stewart-Warner used in F-4  |
| AN/APN-157 | LORAN C Receiver; manufactured by ITT used in C-130, RC-135B, C-141, P-3C, EP-3E  |
| AN/APN-158 | Weather Radar; manufactured by Collins used in HC-123B, U-8F, U-21A, CV-2   |
| AN/APN-159 | Radar Altimeter; manufactured by Stewart-Warner used in RF-4  |
| AN/APN-161 | High-Resolution Mapping Radar; manufactured by Sperry used in C-130   |
| AN/APN-162 | manufactured by Canadian Marconi  |
| AN/APN-163 | Doppler Navigation System   |
| AN/APN-165 | Terrain-Following/Ground-Mapping Radar; manufactured by Texas Instruments used in OV-1  |
| AN/APN-167 | Radar Altimeter; manufactured by Honeywell used in F/FB-111A  |
| AN/APN-168 | Doppler Radar; manufactured by Canadian Marconi used with AN/AYA-3 used in CH-53A, OV-1   |
| AN/APN-169 | Station-Keeping Radar; manufactured by Sierra Research used in C-130, C-141   |
| AN/APN-170 | Terrain Following Radar; manufactured by General Dynamics; tested in A-4C, B-52, B-58   |
| AN/APN-171 | Radar Altimeter; manufactured by Honeywell used in C-130, E-2C, SH-2F, SH-3H, OH-6A, CH-46, CH-53   |
| AN/APN-172 | Doppler Set; manufactured by Marconi used with AN/ASN-73 used in HH-53C, CH-53G   |

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| AN/APN-174 | Station-Keeping Subsystem; manufactured by Teledyne used in CH-46, CH-53  |
| AN/APN-175 | Doppler Radar used in C-130, CH-3B, HH-3E, MH-53  |
| AN/APN-176 | Radar Altimeter; manufactured by Texas Instruments used in FB-111A  |
| AN/APN-177 | Doppler Altimeter   |
| AN/APN-178 | Navigation Radar; manufactured by Sierra used in C-130  |
| AN/APN-179 | Doppler Navigation Radar; manufactured by Bendix used in EC-47  |
| AN/APN-180 | LORAN A Automatic Tracking Receiver used with AN/AYN-1 used in HH-3F  |
| AN/APN-181 | LORAN C/D Receiver  |
| AN/APN-182 | Doppler Radar Navigation System; manufactured by Ryan used with AN/AYK-2 used in SH-3H, CH-46, HH-46A/D, SH-2D, UH-2C, RH-53  |
| AN/APN-184 | Radar Altimeter; manufactured by Bendix used in C-130, Hawker P-1127 (UK)   |
| AN/APN-185 | Doppler Navigation Radar; manufactured by Singer-Kearfott used in FB-111A, A-7D, B-1A   |
| AN/APN-186 | Doppler System; tested in A-6 ILAAS (AN/ASQ-116)  |
| AN/APN-187 | Doppler Navigation Radar; manufactured by Singer-Kearfott used in P-3   |
| AN/APN-189 | Doppler Navigation Radar; manufactured by Marconi used in F-111D  |
| AN/APN-190 | Doppler Radar; manufactured by Singer-Kearfott used in A-7, AC-130E, F-111  |
| AN/APN-191 | Radar Altimeter used in A-7D  |
| AN/APN-192 | Short-Pulse Radar Altimeter; manufactured by Teledyne used in CH-47   |
| AN/APN-193 | Doppler Velocity Sensor; manufactured by Ryan   |
| AN/APN-194 | Radar Altimeter; manufactured by Honeywell used in F-14, A-6E, AH-1W, HH-60H, EA-6B, AV-8B, C-2A, P-3C, EP-3E, F/A-18, SH-60B/F, T-45A, TA-4J, TC-130G, S-3, A-4, A-7, A-10, B-1, TC-4C, QF-4, BQM-8D/F, MQM-8G, BQM-34S, AQM-34U, RGM/UGM-109B |

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| AN/APN-195 | Nose-Mounted Radar; manufactured by Collins used in SH-3D, HH-3E   |
| AN/APN-196 | Doppler Radar used in F-105  |
| AN/APN-197 | STATE Airborne Station; manufactured by Honeywell used with AN/TPN-21, AN/UPN-33; tested in C-123, C-131, T-39, CH-3                     |
| AN/APN-198 | Radar Altimeter; manufactured by Honeywell used in F-104G, AV-8, Sea King (UK), Lynx (UK)  |
| AN/APN-199 | LORAN Receiver; manufactured by Collins used in C-5A   |
| AN/APN-200 | Doppler Velocity Sensor; manufactured by Teledyne used in B-1, E-3, S-3  |
| AN/APN-201 | Radar Altimeter; manufactured by Hoffman Electronics used in S-3   |
| AN/APN-202 | Radar Beacon; manufactured by Motorola used with AN/SPN-46 ACLS (Automatic Carrier Landing System) used in AV-8B, F/A-18, S-3, C-2, P-3C |
| AN/APN-203 | Radar Altimeter; manufactured by Stewart-Warner used in T-43A  |
| AN/APN-205 | Doppler Radar; manufactured by Teledyne used in SH-2, SH-60B   |
| AN/APN-206 | Doppler Set used in B-1A   |
| AN/APN-208 | Doppler Navigation Radar; manufactured by Marconi used in HH-53H, Bell 412   |
| AN/APN-209 | Radar Altimeter; manufactured by Honeywell/Stewart-Warner used in AH-1F, UH-1V, CH-47D, OH-58C/D, H-60, T-43A                            |
| AN/APN-210 | Doppler Set; manufactured by Singer used in CH-53G   |
| AN/APN-211 | Navigation Radar; manufactured by Teledyne-Ryan used in helicopters  |
| AN/APN-213 | Doppler Velocity Sensor; manufactured by Litton (Teledyne-Ryan) used in E-3; tested in KC-135  |
| AN/APN-214 | Radar Altimeter  |
| AN/APN-215 | Weather & Search Radar; manufactured by Bendix/King used in RU-38A, U-21, C-130  |



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| AN/APN-217 | Doppler Radar Navigation Sensor; manufactured by Litton (Teledyne-Ryan) used in AH-1W, UH-1N, SH-2G, SH-3D, HH-3F, CH-46, CH-53E, MH-53E, RH-53D, HH-60H/J, SH-60B/F/J, V-22 |
| AN/APN-218 | Doppler Radar Navigation System; manufactured by Litton (Teledyne-Ryan) used in B-1B, B-52G/H, KC-135, C-130, F-111G   |
| AN/APN-220 | Doppler Radar; manufactured by Teledyne-Ryan   |
| AN/APN-221 | Doppler Radar (derived from AN/APN-208); manufactured by Marconi used in C-141, HH-53H, MH-53J   |
| AN/APN-222 | Radar Altimeter; manufactured by Honeywell used in C-130, E-6A   |
| AN/APN-224 | Radar Altimeter; manufactured by Honeywell used in B-52G/H, B-1B   |
| AN/APN-227 | Doppler Radar used in P-3C   |
| AN/APN-230 | Doppler Navigation Radar (improved AN/APN-218) used in B-1B  |
| AN/APN-231 | Radar Navigation System; manufactured by Teledyne-Ryan used in EA-6A   |
| AN/APN-232 | CARA (Combined Altitude Radar Altimeter); manufactured by Gould used in C-5, C-17, C-130, OC-135, C-141, F-16  |
| AN/APN-233 | Doppler Navigation Radar (developed from AN/APN-220); manufactured by Teledyne-Ryan used in C-2, OV-10D, CH-47, S-2, Alpha Jet (Germany), DHC-5                              |
| AN/APN-234 | Weather and SAR Radar (Model RDR-1400C; improved AN/APN-215); manufactured by Telephonics (originally by Bendix/King) used in P-3, C-2                                       |
| AN/APN-235 | Doppler Navigation Set (development of AN/APN-221) used in HH-60A  |
| AN/APN-236 | Doppler Radar System; manufactured by Teledyne   |
| AN/APN-237 | Ku-Band Terrain-Following Radar; manufactured by Texas-Instruments; part of AN/AAQ-13  |
| AN/APN-238 |  |

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| AN/APN-239 | Weather and SAR Radar (Model RDR-1400C, similar to AN/APN-234); manufactured by Telephonics (originally by Bendix/King) used in HH-60G, MH-60G |
| AN/APN-240 | Station-Keeping System; manufactured by Sierra Research; replaced AN/APN-169   |
| AN/APN-241 | Weather & Navigation Radar; manufactured by Northrop Grumman (Westinghouse) used in C-130H/J, C-27J, HS-748 (Australia)                        |
| AN/APN-242 | Weather & Navigation Radar; manufactured by Sperry; replacement for AN/APN-59  |
| AN/APN-243 | Station-Keeping Equipment; manufactured by Sierra Technologies used in C-17, C-130J  |
| AN/APN-244 | E-TCAS (Enhanced Traffic Alert Collision Avoidance System); manufactured by Honeywell (AlliedSignal) used in C-130E/H/J                        |
| AN/APN-245 | Radar Beacon used with ACLS (Automatic Carrier Landing System) AN/SPN-46 used in F/A-18  |
| AN/APN-501 | Doppler Radar used in C-141(?)   |
| AN/APN-503 | Doppler Radar used in CP-121 (Canada)  |
| AN/APN-509 | Radar Altimeter  |
| AN/APN-510 | Doppler Navigation System used in CP-140 (Canada)  |
| AN/APN-511 | Radar Altimeter  |
| AN/APN-512 | Radar Altimeter used in CC-130E/H (Canada)   |
| AN/APN-513 | Doppler Radar Navigation Set used in CH-124A (Canada)  |
| AN/APN-T6  | Radar Interpretation Trainer   |
| AN/APN-T8  | Doppler System Trainer used with C-5   |
| AN/APN-T10 | Radar Trainer used with C-5  |

#### AN/APQ - Airborne Multipurpose/Special Radars

| Model Number | Description  |
|--------------|--|
| AN/APQ-1     | Radar Jammer RT-26   |
| AN/APQ-2     | 450-750 MHz High Power Barrage Jamming Transmitter "Rug"; manufactured by General Motors (Delco Div.) used in PB4Y-2 |

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| AN/APQ-3  | S-Band Radar Receiver; later redesignated AN/APR-5   |
| AN/APQ-4  | Panoramic Radar Receiver; later redesignated AN/APR-6  |
| AN/APQ-5  | Low Level Radar Bombsight; manufactured by Western Electric used with AN/APS-2/3/15 used in B-24, B-25, B-32, PBJ, PBM |
| AN/APQ-7  | X-BAND Search & Bombing Radar "Eagle Mk.1"; manufactured by Western Electric used in B-17, B-24, B-25J, B-29, B-32     |
| AN/APQ-8  | Deception Radar "Spoofers"   |
| AN/APQ-9  | 475-585 MHz High Power Barrage Jamming Transmitter "Carpet III"; manufactured by General Motors (Delco Div.)           |
| AN/APQ-10 | X-Band High Altitude Bombing Radar "Eagle Mk.2"; manufactured by Western Electric used in B-29                         |
| AN/APQ-11 | Torpedo Launching Radar (formerly SCR-626)   |
| AN/APQ-12 | Torpedo & Bombing Radar (formerly SCR-631)   |
| AN/APQ-13 | X-Band Bombing Radar "Mickey" (British equivalent is H2X); manufactured by Western Electric used in B-29, B-32         |
| AN/APQ-14 | Radar "Moth-1"   |
| AN/APQ-15 | 88-162 MHz Radar Spoofing Transmitter "Moonshine"; manufactured by RRL   |
| AN/APQ-16 | Radar Bombing Aid  |
| AN/APQ-17 | Radar Jammer   |
| AN/APQ-19 | S-Band Search & Bombing Radar  |
| AN/APQ-20 | S-Band Radar Jammer; manufactured by RRL, Delmont Radio; uses AN/APA-41, AN/APR-10, AN/APT-10                          |
| AN/APQ-21 | Countermeasures Set; similar to AN/SPT-7   |
| AN/APQ-22 | Radar System   |
| AN/APQ-23 | X-Band High Altitude Bombing Radar used in B-29  |
| AN/APQ-24 | K-1 Radar Navigation & Bombing System used in B-36B, B-45A, B-50, B-66B  |
| AN/APQ-27 | Radar Jamming System; uses AN/APT-16 (2x), AN/APR-9  |

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| AN/APQ-29 | Radar Relay Set   |
| AN/APQ-31 | Bombing & Navigation Radar  |
| AN/APQ-32 | RT-119 Radar Jammer   |
| AN/APQ-33 | Countermeasures Set used in AC-119K   |
| AN/APQ-34 | K-Band Bombing Radar; manufactured by Western Electric  |
| AN/APQ-35 | X-Band Search, Fire Control & Tail-Warning Radar (components are AN/APS-21, AN/APS-28, AN/APG-26); manufactured by Westinghouse used in F3D, F2H, F3H |
| AN/APQ-36 | Search & Acquisition Radar; manufactured by Westinghouse used in F3D-2M, F7U-3M   |
| AN/APQ-39 | Weather Radar(?) used in B-52D  |
| AN/APQ-41 | X-Band Search & Intercept Radar (improved AN/APQ-35); manufactured by Westinghouse used in F3D-2, F2H-3   |
| AN/APQ-43 | Multipurpose Radar; designated AI22 in UK used in Javelin FAW.2/6 (UK)  |
| AN/APQ-46 | Radar Set; proposed for F3D-3   |
| AN/APQ-50 | X-Band Fighter Interceptor Radar; manufactured by Westinghouse used in F-4, F3H, F4D; planned for F12F  |
| AN/APQ-51 | X-Band Missile Radar; manufactured by Sperry used in F3H, F7U   |
| AN/APQ-54 | Chronograph Set (projectile velocity measuring equipment)   |
| AN/APQ-55 | K-Band Side-Looking Radar used in RF-4C   |
| AN/APQ-56 | Side-Looking, Real-Aperture Radar; manufactured by Westinghouse used in RB-57D, RB-47   |
| AN/APQ-57 | Millimeter-Wavelength Navigation Radar  |
| AN/APQ-58 | Millimeter-Wavelength Navigation Radar  |
| AN/APQ-59 | Side-Looking Airborne Radar; manufactured by Westinghouse   |
| AN/APQ-60 | Missile Illumination Radar; manufactured by Raytheon  |
| AN/APQ-62 | Side-Looking Radar  |
| AN/APQ-63 | Radar   |

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| AN/APQ-64 | Radar used in F5D with AAM-N-3/AIM-7B Sparrow II missile  |
| AN/APQ-65 | Interception Radar used in Aquilon 203 (French-built D.H. Vampire)  |
| AN/APQ-67 | Interception Radar; manufactured by Raytheon  |
| AN/APQ-68 | HIRAN used in RC-130A   |
| AN/APQ-69 | Experimental SLAR Pod for B-58; manufactured by Hughes  |
| AN/APQ-70 | Millimeter-Wavelength Navigation Radar  |
| AN/APQ-72 | X-Band Intercept Radar; manufactured by Westinghouse used in F-4 (replaced AN/APQ-50); tested in F3D      |
| AN/APQ-73 | Side-Looking Radar; planned for RS-70   |
| AN/APQ-74 | X-Band Missile Control Radar used with AN/APA-138, AN/APX-20, AN/APN-22                                   |
| AN/APQ-81 | Doppler Navigation Radar; manufactured by Northrop used in SM-62; planned for F6D and tested in A-3       |
| AN/APQ-83 | Fire-Control Radar; manufactured by Magnavox used in F-8D   |
| AN/APQ-84 | Radar used in F-8   |
| AN/APQ-86 | K-Band Side-Looking Surveillance & Mapping Radar; manufactured by Texas Instruments used in RL-23D, RU-8D |
| AN/APQ-88 | Tracking Radar; manufactured by Naval Avionics used in A-6 (replaced by AN/APQ-112)                       |
| AN/APQ-89 | Terrain Following Radar; tested in T-2  |
| AN/APQ-92 | Ku-Band Search Radar; manufactured by Norden used in A-6, EA-6B, AP-2H                                    |
| AN/APQ-93 | Synthetic-Aperture Ground-Mapping Radar   |
| AN/APQ-94 | Radar Set; manufactured by Magnavox used in F-8D/E, T-39D   |
| AN/APQ-95 | Collision Avoidance Radar used in helicopters   |
| AN/APQ-96 | Radar Set used in OV-10A  |
| AN/APQ-97 | K-Band Side-Looking Imaging Radar; manufactured by Westinghouse; tested in OV-1A, YEA-3, DC-6             |

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| AN/APQ-99  | J-Band Forward-Looking Multipurpose Radar; manufactured by Texas Instruments used in A-7A, RF-4B/C, RF-101   |
| AN/APQ-100 | Search & Mapping Radar; manufactured by Westinghouse used in F-4C, RF-101                                    |
| AN/APQ-101 | Terrain Following Radar; manufactured by Texas Instruments   |
| AN/APQ-102 | Side-Looking Mapping Radar; manufactured by Goodyear used in RB-57, RF-4B/C                                  |
| AN/APQ-103 | Search Radar; manufactured by Norden used in EA-6A, A-6B   |
| AN/APQ-104 | Radar Set; manufactured by Magnavox (similar to AN/APQ-94 used in F-8E(FN)                                   |
| AN/APQ-105 | Distance Integrating Set used in RC-135  |
| AN/APQ-107 | Radar Altimeter Warning System used with AN/APN-117 used in CH-47A, P-3A/C, EP-3E, S-2, SH-3H                |
| AN/APQ-108 | Mapping Radar (SAR?); developed by Conductron used in SR-71  |
| AN/APQ-109 | Fire Control & Search Radar; manufactured by Westinghouse used in F-4C/D/E                                   |
| AN/APQ-110 | Ku-Band Terrain Following Radar; manufactured by Texas Instruments used in RF-4C, F/FB-111                   |
| AN/APQ-111 | X-Band Altimeter-Recorder used with AN/ASQ-92 in KC-135  |
| AN/APQ-112 | Tracking Radar; manufactured by Norden used in A-6   |
| AN/APQ-113 | Ku-Band Search & Attack Radar; manufactured by General Electric used in F-111, F-5E                          |
| AN/APQ-114 | Ku-Band Attack Radar; manufactured by General Electric used in F/FB-111A, F-4, F-5E                          |
| AN/APQ-115 | Terrain Following Radar; manufactured by Texas Instruments used in "Combat Talon" C-130E, A-7A, F-111, RF-4C |
| AN/APQ-116 | Terrain Following Radar; manufactured by Texas Instruments used in A-7A/B/C, C-130                           |
| AN/APQ-117 | Terrain-Following & Attack Radar (development of AN/APQ-109) used in F-4D/E                                  |

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| AN/APQ-118 | Terrain Following Radar; manufactured by Norden used in MH-53H, AH-56A  |
| AN/APQ-119 | Ground Mapping & Interception Radar (modified AN/APQ-113); manufactured by General Electric used in F-111A/D  |
| AN/APQ-120 | X-Band Fire Control Radar; manufactured by Westinghouse used in F-4D/E/F/G  |
| AN/APQ-122 | X-Band Multimode (Terrain Mapping/Target Locating/Navigation/Weather) Radar; manufactured by Raytheon (Texas Instruments) used in MC-130E/H, KC-135A, RC-135A/C, T-43A, C-130, E-4B |
| AN/APQ-123 | used in F-111   |
| AN/APQ-124 | Navigation & Fire-Control Radar; manufactured by Magnavox used in F-8J  |
| AN/APQ-125 | Doppler Ranging Radar; manufactured by Magnavox used in F-8J  |
| AN/APQ-126 | J-Band Terrain Following Radar; manufactured by Raytheon (Texas Instruments) used in A-7D/E, T-39D, AC-130E, CH-53  |
| AN/APQ-127 | Forward Looking Radar; manufactured by Sperry-Rand used with AN/ASQ-116; tested in A-6  |
| AN/APQ-128 | J-Band Terrain Following Radar; manufactured by Sperry used in A-7D/E, F-111C/D   |
| AN/APQ-129 | Search Radar used in EA-6B  |
| AN/APQ-130 | Attack Radar; manufactured by Rockwell Autonetics used in F-111D  |
| AN/APQ-131 | Target Acquisition Radar; manufactured by Texas Instruments used in OP-2E   |
| AN/APQ-133 | X-Band Side Looking Tracking Radar; manufactured by Motorola used in AC-119K, C-130, AC-130   |
| AN/APQ-134 | Ku-Band Terrain Following Radar; manufactured by Texas Instruments used in F/FB-111A  |
| AN/APQ-135 | Sink-Rate Radar System used in A-4, F-4, F-8, C-130, CH-47  |
| AN/APQ-136 | Search Radar; manufactured by Texas Instruments used in AC-119K, AC-130A  |

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| AN/APQ-137 | Moving Target Indicator Radar; manufactured by Emerson used in AH-1G   |
| AN/APQ-138 | Radar Set  |
| AN/APQ-139 | Ku-Band Multi-Mode Radar; manufactured by Texas Instruments used in B-57G  |
| AN/APQ-140 | J-Band Multi-Mode Scan Radar; manufactured by Raytheon (E-Systems); planned for B-1A; tested in KC-135                       |
| AN/APQ-141 | Terrain Following Radar; manufactured by Norden used in AH-56, HH-53 Pave Low  |
| AN/APQ-142 | Surveillance Radar "Quick Look I" used in RV-1C  |
| AN/APQ-144 | Ku-Band Attack Radar (improved AN/APQ-113); manufactured by General Electric used in F-111F, FB-111A                         |
| AN/APQ-145 | Mapping & Ranging Radar; manufactured by Stewart-Warner used in A-4E/F/N/S/SU  |
| AN/APQ-146 | Ku-Band Terrain Following Radar; manufactured by Texas Instruments used in F-111F  |
| AN/APQ-148 | J-Band Navigation & Attack Radar; manufactured by Norden used in A-6E, TC-4C   |
| AN/APQ-149 | Navigation & Fire Control Radar used in F-8  |
| AN/APQ-150 | Beacon Tracking Radar used in AC-130E/H  |
| AN/APQ-152 | Topographical Mapping Radar; manufactured by Goodyear used in RC-130   |
| AN/APQ-153 | I-Band Fire Control Radar; manufactured by System & Electronics Inc. (Emerson Electric) used in F-5E/F                       |
| AN/APQ-154 | Terrain-Following Radar; manufactured by Texas Instruments used in HH-53C  |
| AN/APQ-155 | Strategic Radar; manufactured by Northrop Grumman (Norden) used with AN/ASQ-176 used in B-52H                                |
| AN/APQ-156 | J-Band Navigation & Attack Radar (improved AN/APQ-148); manufactured by Northrop Grumman (Norden) used in A-6E, TC-4C        |
| AN/APQ-157 | I-Band Fire Control Radar (modified AN/APQ-153); manufactured by System & Electronics Inc. (Emerson Electric) used in F-5E/F |



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| AN/APQ-158 | Terrain Following Radar (improved AN/APQ-126); manufactured by Raytheon used in MH-53J   |
| AN/APQ-159 | I/J-Band Multipurpose Radar (improved AN/APQ-153); manufactured by System & Electronics Inc. (Emerson Electric) used in F-5E/F |
| AN/APQ-160 | Attack Radar used in EF-111A   |
| AN/APQ-161 | Attack Radar; manufactured by General Electric used in F-111F  |
| AN/APQ-162 | Forward Looking Radar (development of AN/APQ-99?) used in RF-4C  |
| AN/APQ-163 | Forward Looking Radar; manufactured by General Electric used in B-1  |
| AN/APQ-164 | Pulse Doppler I-Band Multimode Radar; manufactured by Northrop Grumman (Westinghouse) used in B-1B                             |
| AN/APQ-165 | Attack Radar; manufactured by Texas Instruments used in F-111C   |
| AN/APQ-166 | Strategic Radar used in B-52G/H  |
| AN/APQ-167 | Radar Set (development of AN/APQ-159); developed by ESCO used in T-47  |
| AN/APQ-168 | Multi-Mode Radar; manufactured by Raytheon (Texas Instruments) used in HH-60D, MH-60K; proposed for V-22                       |
| AN/APQ-169 | J-Band Attack Radar (upgraded AN/APQ-165); manufactured by Lockheed Martin (General Electric) used in F-111C                   |
| AN/APQ-170 | Terrain Following Radar; manufactured by System & Electronics used in MC-130H  |
| AN/APQ-171 | Attack & Terrain Following Radar (improved AN/APQ-128/146); manufactured by Raytheon (Texas Instruments) used in F-111C/F      |
| AN/APQ-172 | J-Band Terrain Following Radar (upgraded AN/APQ-99); manufactured by Raytheon (Texas Instruments) used in RF-4C                |
| AN/APQ-173 | Radar Set; manufactured by Norden; proposed for A-6F   |
| AN/APQ-174 | Multi-Mode Radar; manufactured by Raytheon used in MV-22, MH-60K, MH-47E; MH-53  |
| AN/APQ-175 | X/Ku-Band Multi-Mode Radar; manufactured by Systems & Electronics Inc. used in C-130E  |

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| AN/APQ-178 | used in E-2C (developmental item only?)  |
| AN/APQ-179 | Control Indicator Set (Display System) used in E-2C  |
| AN/APQ-180 | Pulse Doppler Attack Radar (modification of AN/APG-70); manufactured by Raytheon (Hughes) used in AC-130U                          |
| AN/APQ-181 | Synthetic Aperture J-Band Multi-Mode Radar; manufactured by Raytheon (Hughes) used in B-2A   |
| AN/APQ-183 | Multi-Mode Radar; manufactured by Northrop Grumman (Westinghouse); was planned for cancelled A-12A, a derivative was used in RQ-3A |
| AN/APQ-186 | Multi-Mode Radar (improved AN/APQ-174); manufactured by Raytheon used in CV-22   |
| AN/APQ-501 | Radar Altitude Warning System used in CP-140?; replaced AN/APQ-107   |
| AN/APQ-T1  | Trainer for Aircraft Gun Laying Radar  |
| AN/APQ-T10 | Bombing/Navigation Simulator used with B-52D   |
| AN/APQ-T11 | Bombing/Navigation Radar Trainer used with B-47, B-52, B-58  |
| AN/APQ-T12 | Bombing/Navigation Radar Trainer used with B-47, B-52, KC-97, KC-135   |

#### AN/APS - Airborne Search & Detection Radars

| Model Number | Description   |
|--------------|---|
| AN/APS-1     | X-Band Radar (conflicting references to purpose: either Mapping/Bombing or Tail-Warning)  |
| AN/APS-2     | S-Band Search Radar & Beacon used with AN/APQ-5 used in PBJ-1 (if w/o AN/APS-3), PBM-5S, PB4Y-2   |
| AN/APS-3     | X-Band Search & Bombing Radar used in PBJ-1, OA-10, PB4Y-6A, TBM-1D/3E, P-82F   |
| AN/APS-4     | X-Band Intercept Radar; manufactured by Western Electric used in C-47, C-117, P-38J, P-82D/F/H, AD, XBT2C-1, F4U-4E, F6F-3E/5E, SB2C-5, SBF-4E, TBF-3, TBM-3S; tested in JRB; British designation is AI Mk XV |
| AN/APS-5     | Intercept Radar (development of AN/APS-4); manufactured by Western Electric used in F4U-4N  |

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| AN/APS-6  | Intercept Radar (development of US Navy AIA radar); manufactured by Sperry used in P-38M, F2H-2N, F-82D, F6F-3N/5N, F7F-4N, F8F-1N/2N, F4U-4N/5N; tested in SNB-1  |
| AN/APS-7  | Search Radar (or Tail-Warning Radar?); manufactured by Westinghouse  |
| AN/APS-8  | Conflicting data! I have references for: ASW Search Radar used in P-2E wingtip pod; and Tracking Radar for KDB-1(MQM-39 used in AJ-2P  |
| AN/APS-9  | Search Radar used in FR-1N   |
| AN/APS-10 | X-Band Search Radar  |
| AN/APS-11 | Tail Warning Radar   |
| AN/APS-12 | Fire Control Radar   |
| AN/APS-13 | Tail Warning Radar used in P-38L, P-47D, P-51, P-61, P-63, P-82D, PBJ  |
| AN/APS-14 | Gun Laying Radar used in B-17, B-24  |
| AN/APS-15 | X-Band Bombing & Navigation Radar "Mickey" (equivalent to British "H2S"); manufactured by Philco used in B-29, PBM-3C/5/5E, B-17, B-24, PB4Y-2, PV-2, PBM-5S   |
| AN/APS-16 | L-Band Bomber Tail Warning Radar   |
| AN/APS-17 | S-Band Bomber Tail Warning Radar   |
| AN/APS-18 | Early Warning Radar (another source has this as Drone Radar used with AN/ARR-9)  |
| AN/APS-19 | X-Band Search & Intercept Radar; manufactured by Sperry used in AD-4N/5/6, F2H-2N, F4U-5N, F7F-4N, F8F-1N  |
| AN/APS-20 | S-Band Search & Early-Warning Radar; manufactured by Hazeltine/General Electric used with AN/ARW-35 and AN/ART-28 used in TBM-3W, WV-2, PB-1W, ZPG-2W(EZ-1), AF-2W, HR2S-1W, P-2, WB-29, RC-121C, Gannet (UK), Shackleton (UK) |
| AN/APS-21 | Search Radar; manufactured by Westinghouse; part of AN/APQ-35 used in F3D, Meteor NF (UK)  |
| AN/APS-23 | Search Radar; manufactured by Western Electric; part of AN/ASB-3 used in B-36, B-45C, B-47E, XB-48, B-50, B-52, C-130, C-135   |
| AN/APS-24 | Radar Set used with System 416L  |
| AN/APS-25 | Search Radar used in XF10F-1   |

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| AN/APS-27 | Search Radar used in B-52, RB-66, C-130, C-135   |
| AN/APS-28 | Search Radar used in F3D   |
| AN/APS-29 | Search Radar   |
| AN/APS-30 | Search Radar used in AF-2S   |
| AN/APS-31 | Search Radar; manufactured by Westinghouse used in P5M, PBM-3, A-1, P-2, U-16, AF-2S                                     |
| AN/APS-32 | Search Radar used in TBM-3   |
| AN/APS-33 | X-Band Search Radar used in S-2F, P4M, P2V-6, ZPG-1W, ZPK  |
| AN/APS-34 | Search Radar (similar to AN/APS-33)  |
| AN/APS-35 | Search & IFF Radar; manufactured by Philco?  |
| AN/APS-37 | Search Radar   |
| AN/APS-38 | Search Radar used in S-2   |
| AN/APS-42 | Weather Radar; manufactured by Bendix used in C-54, C-97, C-118, C-119, C-121, C-124, C-130, C-131                       |
| AN/APS-44 | Search Radar used in PB4Y-2, P-5   |
| AN/APS-45 | Height-Finding Radar; manufactured by Texas Instruments used in WV-2(EC-121)   |
| AN/APS-46 | Interception Radar used in F2H-2N  |
| AN/APS-48 | Unattended Radar   |
| AN/APS-49 | Rapid Scan Search Radar; manufactured by Hazeltine used for ASW  |
| AN/APS-50 | Search Radar; planned for F11F-1, but not used   |
| AN/APS-54 | Tail-Warning Radar System; manufactured by ITT used in B-47B/E, B-52, B-57, EB-66B, F-101A/C, F-105D, "EF-101B" (Canada) |
| AN/APS-57 | X-Band Search & Intercept Radar; manufactured by Western Electric used in Venom NF.3 (UK; designated AI Mk 21)           |
| AN/APS-59 | Search Radar used in CP-109 (Canada)   |
| AN/APS-60 | High-Altitude Mapping Radar used in NRB-57A  |
| AN/APS-61 | Monopulse Radar  |
| AN/APS-62 | Height-Finding Radar used in ZPG-2W/3W   |
| AN/APS-63 | Radar Set used in B-66, T-29, F-4C (tests?)  |
| AN/APS-64 | Search Radar used in WB-47E, B-52, RB-66B/C  |

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| AN/APS-67  | Search Radar Set; manufactured by Magnavox used in F-8B, S-2   |
| AN/APS-69  | Height-Finding Radar used in ZPG-2W, P-2   |
| AN/APS-70  | Early-Warning Radar; manufactured by General Electric used in P2V-6, EC-121, EZ-1C   |
| AN/APS-73  | X-Band Synthetic Aperture Radar; manufactured by Goodyear used in experimental pod for B-58; tested in C-97, C-135, RF-4C; ground-component in AN/GSQ-28 |
| AN/APS-75  | "SABRE" High-Resolution X-Band Side-Looking Radar; manufactured by General Electric; under consideration for B-70  |
| AN/APS-76  | Search Radar used in EC-121  |
| AN/APS-80  | Maritime Surveillance Radar; manufactured by Texas Instruments used in E-1B, P-3A/B, NP-3D, P5M-2  |
| AN/APS-81  | Search Radar used in B-52  |
| AN/APS-82  | Early Warning/Aircraft Direction Radar; manufactured by Hazeltine used in EC-121L, E-1B, E-2; tested in SH-3G  |
| AN/APS-84  | Tracking Radar used with QB-47   |
| AN/APS-85  | Side-Looking Surveillance Radar; manufactured by Motorola used with RL-23D, RU-8D  |
| AN/APS-87  | Early Warning Radar (development of AN/APS-82)   |
| AN/APS-88  | Search Radar; manufactured by Texas Instruments used in HU-16B, S-2  |
| AN/APS-91  | Early Warning Radar used in E-2  |
| AN/APS-92  | Radar Warning Receiver used in F-105D  |
| AN/APS-94  | Side-Looking Airborne Surveillance & Mapping Radar; manufactured by Motorola used in OV-1B/D, P-2, P-3, EA-6A, UH-1 ALARM, B-26                          |
| AN/APS-95  | Search & Warning Radar; manufactured by Hazeltine used in EC/RC-121  |
| AN/APS-96  | Air Surveillance Radar; manufactured by General Electric used in E-2A/B  |
| AN/APS-103 | Height Finding Radar used in EC/RC-121   |
| AN/APS-104 | Bombing/Navigation Radar System; part of AN/ASQ-48 used in B-52C/D   |

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| AN/APS-105 | Radar Homing & Warning System;<br>manufactured by Dalmo-Victor used in B-52   |
| AN/APS-107 | Radar Homing & Warning System;<br>manufactured by Bendix used for targeting<br>AGM-78 used in A-7D, F-105G, F-111A, F-4D;<br>improved version tested in F-4E  |
| AN/APS-108 | Search Radar; manufactured by<br>Motorola/Raytheon used in B-52D  |
| AN/APS-109 | Radar Homing & Warning System;<br>manufactured by Dalmo-Victor used in F-<br>111A/D/E/F, FB-111A  |
| AN/APS-111 | UHF Air Surveillance Radar (modified AN/APS-<br>96); manufactured by Lockheed Martin (General<br>Electric) used in E-2A   |
| AN/APS-112 | Early Warning Radar AWACS (development of<br>AN/APS-59)   |
| AN/APS-113 | Weather Radar; manufactured by Bendix;<br>manufactured by Bendix used in EC-47, UH-1  |
| AN/APS-115 | X-Band Sea Surveillance/ASW Radar;<br>manufactured by Raytheon (Texas Instruments)<br>used in P-3C, SH-2D   |
| AN/APS-116 | X-Band Sea Surveillance/ASW Radar;<br>manufactured by Raytheon (Texas Instruments)<br>used in EP-3E, S-3A, SH-3, CP-140 (Canada;<br>Canadian version called AN/APS-506), P-3C<br>(Australia); proposed for cancelled U-2EPX |
| AN/APS-117 | TIAS (Target Identification & Acquisition System)<br>for AGM-45 used in some A-4  |
| AN/APS-118 | TIAS (Target Identification & Acquisition System)<br>for AGM-78; manufactured by IBM used in A-6B<br>(Mod 1)  |
| AN/APS-119 | Weather Avoidance Search Radar used in HC-<br>130B  |
| AN/APS-120 | Air Surveillance Radar; manufactured by<br>General Electric used in E-2C  |
| AN/APS-121 | Radar Set   |
| AN/APS-122 | Search Radar used in YSH-2E   |
| AN/APS-123 | Search Radar used in S-2D   |
| AN/APS-124 | Sea Surveillance/ASW Radar; manufactured by<br>Raytheon used in SH-60B, YSH-2E; tested in SH-3  |

|            |   |
|------------|---|
| AN/APS-125 | Pulse Doppler UHF Air Surveillance Radar; manufactured by Lockheed Martin (General Electric) used in E-2C, EC-130V; replaced AN/APS-120   |
| AN/APS-126 | Surface Search Radar used in P-3  |
| AN/APS-127 | Raytheon Sea Surveillance Radar; manufactured by Raytheon used in HU-25A/B, Gulfstream III (Denmark)  |
| AN/APS-128 | Sea Surveillance Radar; manufactured by Telephonics used in E-9A, P-95 (Brazil), D.3B (Spain)   |
| AN/APS-130 | Multimode Search Radar (derivative of AN/APG-156); manufactured by Northrop Grumman (Norden) used in EA-6B  |
| AN/APS-131 | Sideways Looking Sea Surveillance Radar; manufactured by Motorola used in HU-25B, C-130   |
| AN/APS-133 | X-Band Multifunction Radar; manufactured by Allied Signal (Model RDR-1F) used in EA-6A, C-5, KC-10, C-17, EC-24A, VC-25, C-130, C-141, E-3, E-4, E-6, E-8   |
| AN/APS-134 | Multimode Search Radar; manufactured by Raytheon (Texas Instruments) used in P-3B, EP-3E, HC-130H, CP-140A (Canada; Canadian version called AN/APS-507), Atlantique (Germany/France), P-3K (New Zealand), Fokker 50 Mk 2 (Singapore), CN-235MPA (Brunei), P-3C (South Korea)  |
| AN/APS-135 | Side-Looking Airborne Surveillance Radar; manufactured by Motorola used in HC-130H  |
| AN/APS-136 | I-Band MTI Radar; planned for EH-60C  |
| AN/APS-137 | Pulse Doppler X-Band Sea Surveillance/ASW Radar; manufactured by Raytheon used in: <ul style="list-style-type: none"> <li>- AN/APS-137(V)1: A-6E, S-3B</li> <li>- AN/APS-137(V)2: PHM2 Hydrofoil</li> <li>- AN/APS-137(V)3: P-3C</li> <li>- AN/APS-137(V)4: HC-130H</li> <li>- AN/APS-137(V)5: P-3C</li> <li>- AN/APS-137(V)6: ES-3A</li> <li>- AN/APS-137(V)? : EP-3E</li> </ul> |

|            |   |
|------------|---|
| AN/APS-138 | Pulse Doppler UHF Air Surveillance Radar (upgraded AN/APS-125); manufactured by Lockheed Martin (General Electric) used in E-2C; planned for P-3AEW       |
| AN/APS-139 | Pulse Doppler UHF Air Surveillance Radar (upgraded AN/APS-138); manufactured by Lockheed Martin used in E-2C(Grp.I)                                       |
| AN/APS-140 | I/J-Band Multimode Surveillance Radar (US version of AN/APS-504); manufactured by Litton Canada   |
| AN/APS-141 | I/J-Band Multimode Surveillance Radar (US version of AN/APS-504(V)3); manufactured by Litton Canada   |
| AN/APS-143 | X-Band Sea Surveillance Radar "Ocean Eye"; manufactured by Telephonics used in E-9A, S-2E, HU-25, SH-60, SH-2G (Australia, New Zealand), and in aerostats |
| AN/APS-144 | Pulse Doppler Ku-Band Land Surveillance Radar; manufactured by AIL used in EO-5, RQ-5A(BQM-155A); tested in C-27, UH-60A                                  |
| AN/APS-145 | Pulse Doppler UHF Air Surveillance Radar (upgraded AN/APS-139); manufactured by Lockheed Martin used in E-2C(Grp.II), EC-130V                             |
| AN/APS-146 | manufactured by Northrop Grumman; intended for EA-6B  |
| AN/APS-147 | Multi-Mode Surveillance Radar; manufactured by Telephonics used in MH-60R   |
| AN/APS-148 | "SeaVue" Lightweight Multi-Platform Sea/Land Surveillance Radar; manufactured by Raytheon   |
| AN/APS-149 | Pod-Mounted Surveillance Radar used on P-3C (to provide targeting coordinates of mobile targets for the AGM-84H)  |
| AN/APS-150 | Sea Surveillance Radar; modified AN/APS-115 (or AN/APS-137?) for use with C-130; probably used on HC-130H   |
| AN/APS-503 | I-Band Multimode Surveillance Radar; manufactured by Litton Canada used in CH-124   |
| AN/APS-504 | I/J-Band Multimode Surveillance Radar (improved AN/APS-503); manufactured by Litton Canada used in EC/RC-26D (AN/APS-504(V)5), CP-121                     |
| AN/APS-505 | Beacon-Equipped Multimode Radar   |



|            |  |
|------------|--|
| AN/APS-506 | Maritime Surveillance Radar (Canadian version of AN/APS-116); manufactured by Raytheon (Texas Instruments) used in CP-140  |
| AN/APS-507 | Maritime Surveillance Radar (Canadian version of AN/APS-134); manufactured by Raytheon (Texas Instruments) used in CP-140A |
| AN/APS-509 | Search Radar used in S-2T  |
| AN/APS-T1  | Air-to-Surface Vessel Radar Trainer  |
| AN/APS-T2  | Air-to-Surface Vessel Radar Trainer  |

#### **AN/APY - Airborne Surveillance Radars**

| <b>Model Number</b> | <b>Description</b>  |
|---------------------|---|
| AN/APY-1            | Pulse Doppler S-Band Air & Sea Surveillance Radar (AWACS); manufactured by Northrop Grumman used in E-3   |
| AN/APY-2            | Pulse Doppler S-Band Air & Sea Surveillance Radar (AWACS); manufactured by Northrop Grumman used in E-3   |
| AN/APY-3            | Sideways Looking Air-to-Ground Surveillance Radar (JSTARS); manufactured by Northrop Grumman used in E-8  |
| AN/APY-6            | Multi-Mode High Resolution Surveillance Radar; manufactured by Northrop Grumman; tested in NP-3C  |
| AN/APY-7            | Sideways Looking Air-to-Ground Surveillance Radar (improved AN/APY-3) used in E-8   |
| AN/APY-8            | "Lynx" SAR/GMTI (Synthetic Aperture Radar/Ground Moving Target Indicator); manufactured by General Atomics; tested in C-12, U-21 and others; planned for use in MQ-9A |
| AN/APY-9            | UHF Air Surveillance Radar; manufactured by Lockheed Martin used in E-2D  |
| AN/APY-10           | Maritime Surveillance Radar; manufactured by Raytheon used in P-8A  |
| AN/APY-12           | "Phoenix" SAR (Synthetic Aperture Radar)  |
| AN/APY-T1           | RMTS (Radar Maintenance Training Set); part of E-3 AWACS MTS (Maintenance Training System)  |
| AN/APY-T2           | ARMTS (Advanced Radar Maintenance Training Set); part of E-3 AWACS MTS (Maintenance Training System)  |

### 7.3.3. Model's Articulations Effect on RCS Data

Most man-made models (aircraft, tanks, trucks, etc.) have parts that can be articulated (flaps, turrets, rotating antennae, landing gears, etc). It is impractical to pre-compute and store within the CDB an RCS model for every possible position of those articulated parts taken individually. Instead, a CDB RCS model attribute provides the means to store an overall RCS variation effect, or otherwise called “scintillation effect”. The scintillation effect value is added to the RCS at run-time during movement of any of such articulated parts of the model. This is a parameter in the vector data attributes called “RCS\_SCINT” and this attribute can be used by the radar client-devices at runtime to provide a correlated (but approximated) variation level of the model RCS while any of its parts are articulated.

For example, for a tank in the process of rotating its turret, the radar simulation client would take its overall RCS (based on aspect angles) and add the scintillation factor on the end-result RCS value to slightly alter the RCS to introduce the turning turret effect while the part is moving. While this adds an approximation factor on the RCS, it provides a coherent and correlated variation level to all clients using the RCS data set layer. The “RCS\_SCINT” is therefore the value that represents a scaling factor of RCS noise that would be superimposed while the part is being articulated.

[2] <https://en.wikipedia.org/wiki/Shapefile>

# Annex A: Conformance Class Abstract Test Suite (Normative): OGC CDB Radar Cross Section (RCS)

This section describes conformance test for the OGC CDB Radar Cross Section model. These abstract test cases describe the conformance criteria for verifying the structure and content of any data store claiming conformance to this CDB Best Practice.

The conformance class id is “http://opengis.net/spec/CDB/1.0/core/lod-hierarchy/conf/” and all of the other conformance tests URLs are created in this path. Another issue that the reader should pay attention to is the test method. When the test method is assigned with “Visual”, it means that the purpose of the test should be “visually” investigate the file contents, image, or other content.

## A.1. General RCS Implementation

The following conformance test is designed to determine if a RCS instance is a CDB implementation is a Shapefile.

|                        |   |
|------------------------|---|
| <b>Test identifier</b> | /conf/core-radar/storage  |
| <b>Requirement</b>     | req/cdb-radar/storage   |
| <b>Dependency</b>      | Shapefile specification   |
| <b>Test purpose</b>    | Verify that the RCS model is stored as a series of Esri’s ShapeFiles in accordance with the Esri Shapefile Specification. |
| <b>Test method</b>     | Visual inspection. Pass if verified   |
| <b>Test type</b>       | Conformance   |

## A.2. Shapefile Point Vertices

This test determines that for each of those Shapefile point vertices, the X component represent the azimuth angle (equivalent to longitude) and the Y component represent the elevation angle (equivalent to latitude); the RCS value (and other attributes) are stored in the instance attributes within the DBF file.-azimuth.

|                        |   |
|------------------------|---|
| <b>Test identifier</b> | /conf/core-radar/storage-vertices   |
| <b>Requirement</b>     | req/cdb-radar/storage-vertices  |
| <b>Dependency</b>      | Shapefile specification   |
| <b>Test purpose</b>    | Verify that point vertices follow the requirement for representing an RCS instance. |
| <b>Test method</b>     | Visual inspection. Pass if verified   |
| <b>Test type</b>       | Conformance   |

## A.3. Model Signature Significant Angle

Test to determine if the eight prescribed values for azimuth and elevation increments are used for specifying the Model Signature Significant Angle.

|                        |  |
|------------------------|--|
| <b>Test identifier</b> | /conf/core-radar/storage-sig-angle   |
| <b>Requirement</b>     | req/cdb-radar/storage-sig-angle  |
| <b>Dependency</b>      | Table showing ModelSignature LOD level number and the ModelSignature Significant Angle |
| <b>Test purpose</b>    | Verify that the 8 values are used  |
| <b>Test method</b>     | Check values against <a href="#">Table 7-1</a> .                                       |
| <b>Test type</b>       | Conformance  |

## A.4. RCS Attributes

Test for conformance that the RCS data for each distinct RCS representation model has two different types of attributes; RCS model class attributes and RCS instance attributes as defined below.

|                        |   |
|------------------------|---|
| <b>Test identifier</b> | /conf/core-radar/attributes   |
| <b>Requirement</b>     | req/cdb-radar/attributes  |
| <b>Dependency</b>      | Rules defined in <a href="#">Section 7.3.1.1</a> of this document.  |
| <b>Test purpose</b>    | Verify that each distinct RCS representation model has two different types of attributes: RCS model class attributes and RCS instance attributes. |
| <b>Test method</b>     | Check values against rules defined in <a href="#">Section 7.3.1.1</a> .   |
| <b>Test type</b>       | Conformance   |

## A.5. RCS Storage Files

Test that a single RCS model in the CDB data store consists of the data files.

- One \*.shp main file that provides the geometric aspect (Points) for each data instance of a RCS model.
- Two \*.dbf files (one instance-level on a per RCS Shape basis, and one class-level at the RCS model level) that collectively provide the attribution for all of the possible RCS models of a given RCS Model.
- One \*.shx index file that stores the file offsets and content lengths for each of the records of the main \*.shp file. The only purpose of this file is to provide a simple means for clients to step through the individual records of the \*.shp file (i.e., it contains no CDB modeled data).

|                        |                                |
|------------------------|--------------------------------|
| <b>Test identifier</b> | /conf/core-radar/storage-files |
| <b>Requirement</b>     | req/cdb-radar/storage-files    |

|                     |  |
|---------------------|--|
| <b>Dependency</b>   | Shapefile specification  |
| <b>Test purpose</b> | Verify that a single RCS model in the CDB data store consists of the data files: <ul style="list-style-type: none"> <li>• One *.shp,</li> <li>• two *.dbf, and</li> <li>• one *.shx</li> </ul> |
| <b>Test method</b>  | Visual inspection.   |
| <b>Test type</b>    | Conformance  |

## A.6. RCS Storage Files - Variant

Test that each variant of the RCS model in the Shapefile has a 10-character string attribute called "RCS\_VARI". The string may contain the specific Radar model number (and possibly its frequency band L-Band, S-Band, X-Band, Ku-Band) for which this RCS variant applies to. The suggested string convention for this field is as described in AN/APA to AN/APD - Equipment Listing. [http://www.designation-systems.net/usmilav/jetds/an-apa2apd.html#\\_APA](http://www.designation-systems.net/usmilav/jetds/an-apa2apd.html#_APA).

|                        |  |
|------------------------|--|
| <b>Test identifier</b> | /conf/core-radar/rcs-vari  |
| <b>Requirement</b>     | req/cdb-radar/rcs-vari   |
| <b>Dependency</b>      | Shapefile specification and Reference as given above.  |
| <b>Test purpose</b>    | Verify that each variant of the RCS model in the Shapefile has a 10-character string attribute called "RCS_VARI" |
| <b>Test method</b>     | Visual inspection.   |
| <b>Test type</b>       | Conformance  |

## Annex B: Revision History

| Date       | Release      | Editor  | Primary clauses modified | Description   |
|------------|--------------|---------|--------------------------|---|
| 2016-02-06 | Draft        | C. Reed | Many                     | Ready for OAB review                                |
| 2016-12-06 | Vote version | C. Reed | Various                  | Generalize as many ShapeFile references as possible |
| 2016-10-06 | 1.0          | C. Reed | Various                  | Final edits for publication                         |
| 2016-11-21 | 1.0          | C. Reed |                          | Ready for publication                               |
| 2017-12-28 | 1,1          | C. Reed | Various                  | Minor edits and changes to URI identifiers for 1.1. |
| 2019-11-05 | 1.2          | C. Reed | Various                  | Minor edits for version 1.2                         |