

Application Note - AN101

PlaneTRack data output of Eurocontrol Asterix formats

0. General

This Application Note describes the Asterix output format of Planevision Systems PlaneTRack devices with Asterix Output Option enabled.

0.1 Applicability of Application Note

Planevision Systems device	Applicable	Remark
PlaneTRack, all types	Yes	with Asterix Output Option enabled only

0.2 Record of Revisions

Version	Date of issue	Revision
1.0	24 Jan 2016	Initial release
1.1	26 Jan 2016	axudp.txt test output added
2.0	01 Jan 2017	V0.26 and new functions added

1. Basic format compliance

1.1 [Part 12] ADS-B messages per Asterix - CAT 021 V 0.23

Reference document:

<http://www.eurocontrol.int/sites/default/files/service/content/documents/nm/asterix/part1-cat021-asterix-ads-b-messages-part-12.pdf>

1.2 [Part 12] ADS-B messages per Asterix - CAT 021 V 0.26

Reference document:

<https://www.eurocontrol.int/sites/default/files/content/documents/nm/asterix/archives/asterix-cat021-asterix-ads-b-messages-part-12-v0.10-to-v0.26.zip>

1.3 [Part 20] Version Number Exchange per Asterix - CAT 247 V 1.2

Reference document:

<http://www.eurocontrol.int/sites/default/files/service//content/documents/nm/asterix/cat247-asterix-version-number-exchange-part-20.pdf>

Please refer to table **AN-101-2** for data items output by PlaneTRack.

1.4 [Part 16] CNS/ATM Ground Station and Service Status Reports - CAT 023 V 1.2

Reference document:

<http://www.eurocontrol.int/sites/default/files/content/documents/nm/asterix/cat023-asterix-cns-atm-ground-station-service-messages-part-16.pdf>

Please refer to table **AN-101-3** for data items output by PlaneTRack. A Service Statistics report (type 003 of I023/000) is not provided.

1.5 EUROCAE ED-129 - TECHNICAL SPECIFICATION FOR A 1090 MHz EXTENDED SQUITTER ADS-B GROUND STATION

This document references to Ground Stations that output V1.4 format. For CAT021 V0.23 output Appendix M of this document applies.

The *PlaneTRack* data output adheres to Appendix M of ED-129.

1.6. Format inconsistencies between Asterix CAT021 and ED-129

According to [SEVENTH MEETING OF THE SOUTHEAST ASIA AND BAY OF BENGAL SUB-REGIONAL ADS-B IMPLEMENTATION WORKING GROUP \(SEA/BOB ADS-B WG/7\) - ADS-B SYSTEM INTEROPERABILITY AND DATA HARMONIZATION IN APAC REGIONS](#) there are several format inconsistencies between Asterix CAT 021 and ED-129 Appendix M formats. Please refer to tables **AN-101-1/A** for details of *PlaneTRack* output data items.

2. Asterix CAT021 V.0.23/V0.26 format considerations

2.1 General

V0.23/V0.26 is a basic data format that supports transmissions of flight data that are received from aircraft transponders compliant with DO-260 (ADS-B Version 0). Though there are data item definitions provided (e.g. Final State Selected Altitude, Rate of Turn, Trajectory Intent etc) that can only be derived from transponders compliant with DO-260A (ADS-B Version 1) and/or DO-260B (ADS-B version 2), V0.23/V0.26 is not intended to be used in this way.

DO-260A and DO-260B data should be submitted with data formats CAT 021 V1.x resp. V2.x and higher. Please note that in general Asterix CAT 021 formats are not downwards or upwards compatible.

Also, please note that CAT 021 formats are intended to transport ADS-B data packets only. These data packets are derived from the ground reception of DF 17 or DF 18 (CF=0 or 1) or DF19 (AF=0) transponder messages. Though numerous data items are also available from ground interrogated Mode-S Elementary or Enhanced Surveillance messages (DF 4, 5, 20, 21) or intercepted ACAS messages (DF 0, 16) these data are to be transported by other Asterix formats, e.g. CAT 034 or CAT 048.

Exception: PlaneTRack Asterix CAT021 V0.26 makes use of Mode-S data for the field "Mode 3A/C code"

2.2 Compliance with ED-129

Eurocae ED-129 defines the specific data item inclusion and report assembly procedures in Appendix M.

PlaneTRack ADS-B receivers are compliant with the provisions of ED-129 Appendix M, i.e. V0.23. It should be noted that this format differs from V1.4 as described in ED-129 Chapter 3.10.

The following deviations from ED-129 apply *inter alia*:

- Only CAT021 V0.23 or V0.26 messages are output
- Data driven modes are not available
- Limited BITE and Monitoring is available through the PlaneTRack web browser interface and CAT023 reports. An SNMP interface is available as option only. SNMP health check is limited to the availability of dual power supplies in such equipped devices.

- Maintenance mode is not provided. The device is always in operational mode.
- No "Initialisation" status is reported in CAT023 reports.
- Temperature reporting is available through web browser interface only (GPS status)
- Duplicate Mode S Address Processing is not available
- Range checks are not available
- Intervals for CAT023 and CAT247 transmissions cannot be selected independently but are the same as CAT021 intervals

2.3 Transmission Modes

PlaneTRack ADS-B receivers are compliant with the provisions of ED-129 Chapter 3.10.2.3, i.e. Periodic Reports are transmitted at a user configurable rate between 0.5 and 15 seconds.

Periodic Reports ("State Vector Reports" or "Position Reports") contain the Minimum Items according to ED-129 Table M-1A and Optional Items according to Table M-1B.

It should be noted that a State Vector Report is not transmitted as long as new position data have been received since the previous report, even when other data have changed. This requirement is due to the fact that only one type of timestamp (I021/030) is available in V0.23.

The transmission of Velocity Reports according ED-129 Table M-2 is not available. Those data items that are available are transmitted as Optional Items in the periodic State Vector Report.

Optional items are only added to the State Vector Report if they were updated since the previous report.

3. CAT 247 transmissions

This transmission provides the information about the actual CAT021, CAT023 and CAT247 versions used. One CAT247 packet is transmitted at the selected interval rate of CAT021 or the transmission can be switched off.

4. CAT 023 transmissions

This transmission provides the information about the current *PlaneTRack* device status with respect to the quality of the timestamp (GPS time available) and the selected periodic data rate. Two CAT023 reports 001 and 002 are transmitted at the selected interval rate of CAT021 or the transmission can be switched off.

5. Asterix Settings

PlaneTRack ADS-B-Receivers transmit Asterix data packets via a user configurable UDP/IP data interface (through Web Browser and Port 80 access). In the *Configuration | Settings* menu > *Output Settings* section the user can configure:

Asterix CAT021 V0.23/CAT023/CAT-247 Server Settings

SAC (hex)

SIC (hex)

Enable Transmission disabled enabled

Position State Vector Report (ED-129)

Transmission Interval [sec]

Destination server(s) IP (:Port)

Separate multiple entries by a comma

Station Identification and Options

SAC/SIC: enter the station identifier as a two-character hex string ("00" to "FF"). The SAC/SIC setting is usually obtained from the radar network operator. A general guidance about usage of the System Area Code (SAC) in ECAC international radar networks can be found here:

<https://www.eurocontrol.int/services/system-area-code-list>

By means of the higher bits of the System Identification Code (SIC) certain options can be controlled:

Control bit in SIC	Bit set (1)	Bit not set (0)
7	CAT021 V0.26 output	CAT021 V0.23 output
6	CAT023 and CAT247 frames not transmitted	CAT023 and CAT247 frames not transmitted
5	UDP transmissions block mode	UDP transmissions frame mode

Examples:

for a device with a nominal SIC code "01", the SIC code would be set accordingly:

CAT021 V0.26 output = "81"

CAT023 and CAT247 frames not transmitted = "41"

UDP transmissions block mode = "21"
CAT021 V0.26 output AND CAT023 and CAT247 frames not transmitted AND
UDP transmissions block mode = "E1"

The SIC is transmitted as entered, i.e. the control bits are not masked.

Enable Transmission

Switches the UDP transmitter on/off. The pseudo ASCII output is available independant from this setting.

Transmission Interval

Interval of UDP transmissions in secs from 0.5 to 15.

Destination server(s)

IP of destination server. Multiple servers can be entered like:

"10.11.12.13:9000,10.11.12.14:9000"

6. UDP Transport Layer

Multiple target addresses can be entered, separated by a comma. Multicast addressing formats are not available.

At the time of the selected interval one CAT247 frame and two CAT023 frames followed by those CAT021 frames, that are available, are transmitted.

Each Asterix frame shall be transmitted as one UDP packet.

Optionally a setting is available that shall transmit all Asterix frames available as one UDP block transmission.

Sample of UDP output packets in packet mode (converted to ASCII hex):

```
F70014F01000000448B2031500  
17170102F7010217000BD8100001053F9700  
17000FF510000202053F9700000000  
15002DFFA1DB80100000300448B826202407144340087C00E0000708002B011E0274A4440815F9DB5820000000  
15002DFFA1DB80100000300448B827BCEA06B3784CA8911530000708054CFEB9082D416C4994B5414820000000
```

15002DFFA1DB80100000300448B224F1340851283C648B15D00007080579000006FC222210C238D38820020000

Sample of UDP output packets in block mode (converted to ASCII hex):

```
F70014F01000000448B203150017170102F7010217000BD8100001053F970017000FF510000202053F970000000015002DFFA1DB801
00000300448B826202407144340087C00E0000708002B011E0274A4440815F9DB582000000015002DFFA1DB80100000300448B827BC
EA06B3784CA8911530000708054CFEB9082D416C4994B541482000000015002DFFA1DB80100000300448B224F1340851283C648B15D
00007080579000006FC222210C238D38820020000
```

6. Web Browser Test Interface

The *PlaneTRack* device offers access to a pseudo-Asterix CSV-formatted output via a web browser port 80 for test purposes.

To access this output call ***http://<planetrack-ip:port>/asterix-021.0.23.txt***

This caller URL is also valid for V0.26 output.

The output is an ASCII hex representation of the binary Asterix output:

```
Planevision Systems Asterix CAT-021 V0.23 CAT-023 V1.2 CAT-247 V1.2 CSV
Output,3.0.160124,1453634027,,10.1669,53.5446,23.5363
F7,0014,*F0,1000,00,053F97,03150017170102F70102,<crLf>
17,000B,*D8,1000,01,053F97,00,<crLf>
17,000F,*F5,1000,02,02,053F97,0000,00,00,<crLf>
15,0025,*FF,*A1,*CA,1000,0030,053F97,25020207BB36,3C6307,1680,0006,08,05A0,FFF6,0638FDDD,00,00,<crLf>
15,0025,*FF,*A1,*CA,1000,0030,053F96,275EB607E8DD,4CA761,0D58,0006,08,0351,FF0B,06062C16,00,00,<crLf>
```

First line: Header line, with data items:

- 1) Plain language format descriptor
- 2) Format version
- 3) Unix time of output
- 4) left blank
- 5) GPS longitude of receiver
- 6) GPS latitude of receiver
- 7) GPS altitude of receiver (mtrs)

Further lines are ASCII hex representations of binary values with the following additions

"*" FSPEC field

", " delimiter after data items
<crlf> delimiter between different categories/data sets/flights

Once a periodic data transmission is started the first Asterix frame transmitted is always a CAT247 frame (F7 ...). unless disabled. Except for the "time of day" data (in italics) item the underlined contents of this frame is not changing and it can be used for synchronization purposes.

F70014F01000000448B203150017170102F70102

7. UDP test transmission

For test purposes a single UDP test transmission can be triggered from a web browser call:

http://<planetrack-ip:port>/axudp.txt

DISCLAIMERS

Planevision Systems ADS-B equipment is not intended and not certified for air traffic control, navigational or other aircraft on-board services or other life critical services and in no case may be used for any other but sole information purposes.

Planevision Systems ADS-B equipment Asterix data output is not intended and not certified for air traffic control, navigational or other aircraft on-board services or other life critical services and in no case may be used for any other but sole information purposes.

Table AN-101-1
PlaneTRack Asterix Cat021 V0.23 output data items - Compliance matrix

UAP Item (FRN)	Data Item	Name of Data Item	Definition of Data Item	Asterix 021 V0.23	ED-129 App M	Plane TRack
1	I021/010	Data Source Identification	Identification of the ADS-B station providing information	M	M	Y
22	I021/020	Emitter Category	Characteristics of the originating ADS-B unit	O	O	Y*
3	I021/030	Time of Day	Time of applicability (measurement) of the reported position, in the form of elapsed time since last midnight, expressed as UTC	M	M	Y
20	I021/032	Time of Day Accuracy	The maximum difference between the actual time of applicability of the reported position and the time reported in the Time of Day item (I021/030)	0	n/a	N
2	I021/040	Target Report Descriptor	Type and characteristics of the data as transmitted by a system	M	M	Y
5	I021/080	Target Address	Target address (emitter identifier) assigned uniquely to each target	M	M	Y
7	I021/090	Figure of Merit	ADS figure of merit (FOM) provided by the aircraft avionics	O	M	Y*
19	I021/095	Velocity Accuracy	Velocity uncertainty category of the least accurate velocity component	O	M	Y*
26	I021/110	Trajectory Intent	Reports indicating the 4D intended trajectory of the aircraft	0	n/a	N
4	I021/130	Position in WGS-84 coordinates	Position in WGS-84 Coordinates	O	M	Y
6	I021/140	Geometric Altitude	Minimum altitude from a plane tangent to the earth's ellipsoid, defined by WGS-84, in two's complement form	O	O	Y*
10	I021/145	Flight Level	Flight Level from barometric	O	M	Y*

			measurements, not QNH corrected, in two's complement form			
24	I021/146	Intermediate State Selected Altitude	The short-term vertical intent as described by either the FMS selected altitude, the Altitude Control Panel Selected Altitude, or the current aircraft altitude according to the aircraft's mode of flight	0	0	N
25	I021/148	Final State Selected Altitude	The vertical intent value that corresponds with the ATC cleared altitude, as derived from the Altitude Control Panel	0	n/a	N
11	I021/150	Air Speed	Calculated Air Speed (Element of Air Vector)	0	M*	Y*
12	I021/151	True Air Speed	True Air Speed	0	M*	Y*
13	I021/152	Magnetic Heading	Magnetic Heading (Element of Air Vector)	0	0	Y*
14	I021/155	Barometric Vertical Rate	Barometric Vertical Rate, in two's complement form	0	0	Y*
15	I021/157	Geometric Vertical Rate	Geometric Vertical Rate Definition : Geometric Vertical Rate, in two's complement form, with reference to WGS-84	0	0	Y*
16	I021/160	Ground Vector	Ground Speed and Track Angle elements of Ground Vector	0	M*	Y*
17	I021/165	Rate of Turn	Rate of Turn, in two's complement form.	0	n/a	N
18	I021/170	Target Identification	Target (aircraft or vehicle) identification in 8 characters, as reported by the target	0	M	Y*
21	I021/200	Target Status	Status of the target	0	M	Y
8	I021/210	Link Technology Indicator	Indication of which ADS link technology has been used to send the target report	M	M	Y
23	I021/220	Met Report	Meteorological information	0	n/a	N

10	I021/230	Roll Angle	The roll angle, in two's complement form, of an aircraft executing a turn	0	n/a	N
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Legend:

0 - optional

M - Mandatory

M* - either Air Speed, Heading or Ground Vector are mandatory

Y - always transmitted

Y* - transmitted when data available

N - never transmitted

Table AN-101-1A
Additional / changed PlaneTRack Asterix Cat021 V0.26 output data items -
Compliance matrix

UAP Item (FRN)	Data Item	Name of Data Item	Definition of Data Item	Asterix 021 V0.26	ED-129 App M	PlaneT Rack
27	I021/070	Mode 3/A Code	Mode-3/A code converted into octal representation	O	-	Y
28	I021/131	Signal Amplitude	Relative strength of received signal	O	-	Y*

0 - optional

Y - always transmitted

Y* - always transmitted, but set to "0"

Note that this item was changed in V0.26 to yield a four-times higher position resolution compared to V0.23:

4	I021/130	Position in WGS-84 coordinates	Position in WGS-84 Coordinates	O	M	Y
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Table AN-101-2
PlaneTRack Asterix Cat247 V1.2 output data items - Compliance Matrix

UAP data item (FRN)	Data item	Data Item Description	Asterix CAT023 V1.2 Report 001	PlaneTRack
1	I247/010	Data Source Identifier	M	Y
2	I247/015	Service Identification	O	Y
3	I247/140	Time of Day	M	Y
4	I247/550	Version number report	M	Y

Legend:

O - optional

M - Mandatory

Y - always transmitted

**Table AN-101-3
PlaneTRack Asterix Cat023 V1.2 output data items - Compliance Matrix**

UAP data item (FRN)	Data item	Data Item Description	Asterix CAT023 V1.2 Report 001	PlaneTRack	Asterix CAT023 V1.2 Report 002	PlaneTRack
1	I023/010	Data Source Identifier	M	Y	M	Y
2	I023/000	Report Type	M	Y	M	Y
3	I023/015	Service Type and Identification	-	N	M	Y
4	I023/070	Time of Day	M	Y	M	Y
5	I023/100	Ground Station Status	M	Y	-	N
6	I023/101	Service Configuration	-	N	M	Y
7	I023/200	Operational Range	0	N	0	N
8	I023/110	Service Status	-	N	M	Y
9	I023/120	Service Statistics	-	N	-	N

Legend:

O - optional

M - Mandatory

Y - always transmitted

N - never transmitted