Asterix category 021 - ADS-B Target Reports

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Preamble

Surveillance data exchange. ADS-B Target Reports.

Description of standard data items

I021/010 - Data Source Identification

Definition: Identification of the ADS-B station providing information.

Structure:

I021/010/SAC - *System Area Code*

- 8 bits [. . . . . .]
- raw value

I021/010/SIC - *System Identification Code*

- 8 bits [. . . . . .]
- raw value

Note:

- The up-to-date list of SACs is published on the EUROCONTROL ASTERIX Web Site (http://www.eurocontrol.int/services/system-area-code-list).

I021/020 - Emitter Category

Definition: Characteristics of the originating ADS-B unit.

Structure:

- 8 bits [. . . . . .]
- values:

  1: Light aircraft <= 7000 kg
  2: Reserved
  3: 7000 kg < Medium aircraft < 136000 kg
  4: Reserved
  5: 136000 kg <= Heavy aircraft
  6: Highly manoeuvrable (5g acceleration capability) and high speed (>400 knots cruise)
  7: Reserved
  8: Reserved
  9: Reserved
  10: Rotocraft
  11: Glider / sailplane
  12: Lighter-than-air
  13: Unmanned aerial vehicle
  14: Space / transatmospheric vehicle

15: Ultralight / handglider / paraglider
16: Parachutist / skydiver
17: Reserved
18: Reserved
19: Reserved
20: Surface emergency vehicle
21: Surface service vehicle
22: Fixed ground or tethered obstruction
23: Reserved
24: Reserved

I021/030 - Time of Day

Definition: Time of applicability (measurement) of the reported position, in the form of elapsed time since last midnight, expressed as UTC.

Structure:

- 24 bits [. . . . . .]
- unsigned quantity
- scaling factor: 1
- fractional bits: 7
- unit: ”s”
- LSB = $1/2^7$ s = $1/128$ s $\approx 7.8125e-3$ s

The time of the day value is reset to zero at every midnight.

I021/032 - Time of Day Accuracy

Definition: 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).

Structure:

- 8 bits [. . . . . .]
- unsigned quantity
- scaling factor: 1
- fractional bits: 8
- unit: ”s”
- LSB = $1/2^8$ s = $1/256$ s $\approx 3.90625e-3$ s

I021/040 - Target Report Descriptor

Definition: Type and characteristics of the data as transmitted by a system.

Structure:

I021/040/DCR - *Differential Correction*

- 1 bit [.]
- values:

  0: No differential correction (ADS-B)
  1: Differential correction (ADS-B)

I021/040/GBS - *Ground Bit Setting*

- 1 bit [.]
- values:

0: Ground Bit not set
1: Ground Bit set

I021/040/SIM - *Simulated Target*

- 1 bit [.]
- values:
  0: Actual target report
  1: Simulated target report

I021/040/TST - *Test Target*

- 1 bit [.]
- values:
  0: Default
  1: Test Target

I021/040/RAB - *Report Type*

- 1 bit [.]
- values:
  0: Report from target transponder
  1: Report from field monitor (fixed transponder)

I021/040/SAA - *Selected Altitude Available*

- 1 bit [.]
- values:
  0: Equipment capable to provide Selected Altitude
  1: Equipment not capable to provide Selected Altitude

I021/040/SPI - *Special Position Identification*

- 1 bit [.]
- values:
  0: Absence of SPI
  1: Special Position Identification

I021/040/(spare)

- 1 bit [.]

I021/040/ATP - *Address Type*

- 3 bits [. . .]
- values:
  0: Non unique address
  1: 24-Bit ICAO address
  2: Surface vehicle address
  3: Anonymous address
  4: Reserved for future use
  5: Reserved for future use
  6: Reserved for future use
  7: Reserved for future use

I021/040/ARC - *Altitude Reporting Capability*

- 2 bits [. .]
- values:
  0: Unknown
  1: 25 ft
  2: 100 ft

I021/040/(spare)

- 3 bits [. . .]

I021/080 - Target Address

Definition: Target address (emitter identifier) assigned uniquely to each target.

Structure:

- 24 bits [. . . . . .]
- raw value

I021/090 - Figure of Merit

Definition: ADS figure of merit (FOM) provided by the aircraft avionics.

Structure:

I021/090/AC - *ACAS Capabilities*

- 2 bits [. .]
- values:
  0: Unknown
  1: ACAS not operational
  2: ACAS operartional
  3: Invalid

I021/090/MN - *Multiple Navigation Aids*

- 2 bits [. .]
- values:
  0: Unknown
  1: Multiple Navigation not operational
  2: Multiple Navigation operartional
  3: Invalid

I021/090/DC - *Differencial Correction*

- 2 bits [. .]
- values:
  0: Unknown
  1: Differencial Correction
  2: NO Differencial Correction
  3: Invalid

I021/090/(spare)

- 6 bits [. . . . . .]

I021/090/PA - *Position Accuracy*

- 4 bits [. . . .]
- signed quantity
- scaling factor: 1
- fractional bits: 0
- LSB = 1

Note: bits-4/1 (PA) code the “Navigational Uncertainty Categories – Position” as described in the ADS-B MASPS [Ref. 3]

I021/095 - Velocity Accuracy

Definition: Velocity uncertainty category of the least accurate velocity

Structure:

- 8 bits [. . . . .]
- raw value

Note: bits-8/1 code the “Navigational Uncertainty Categories – Velocity” as described in the ADS-B MASPS [Ref. 3]

I021/110 - Trajectory Intent

Definition: Reports indicating the 4D intended trajectory of the aircraft.

Structure:

Compound item (FX)

I021/110/TIS - *Trajectory Intent Status*

Extended item.

I021/110/TIS/NAV

- 1 bit [.]
- values:
  0: Trajectory Intent Data is available for this aircraft
  1: Trajectory Intent Data is not available for this aircraft

I021/110/TIS/NVB

- 1 bit [.]
- values:
  0: Trajectory Intent Data is valid
  1: Trajectory Intent Data is not valid

I021/110/TIS/(spare)

- 5 bits [. . . . .]

(FX)

- extension bit
  0: End of data item
  1: Extension into next extent

I021/110/TID - *Trajectory Intent Data*

Repetitive item, repetition factor 8 bits.

I021/110/TID/TCA

- 1 bit [.]
- values:
  0: TCP number available
  1: TCP number not available

I021/110/TID/NC

- 1 bit [.]
- values:
  0: TCP compliance
  1: TCP non-compliance

I021/110/TID/TCPN
Trajectory Change Point number

- 6 bits [. . . . .]
- raw value

I021/110/TID/ALT - *Altitude in Two's Complement Form*

- 16 bits [. . . . .]
- signed quantity
- scaling factor: 10
- fractional bits: 0
- unit: "ft"
- LSB = 10 ft
- value $>= -1500$ ft
- value $<= 150000$ ft

I021/110/TID/LAT - *In WGS.84 in Two's Complement*

- 24 bits [. . . . .]
- signed quantity
- scaling factor: 180
- fractional bits: 23
- unit: "°"
- LSB = $180/2^{23}$ ° = $180/8388608$ ° $\approx 2.1457672119140625e-5$ °
- value $>= -90$ °
- value $<= 90$ °

I021/110/TID/LON - *In WGS.84 in Two's Complement*

- 24 bits [. . . . .]
- signed quantity
- scaling factor: 180
- fractional bits: 23
- unit: "°"
- LSB = $180/2^{23}$ ° = $180/8388608$ ° $\approx 2.1457672119140625e-5$ °
- value $>= -180$ °
- value < 180 °

I021/110/TID/PT - *Point Type*

- 4 bits [. . . .]
- values:
  - 0: Unknown
  - 1: Fly by waypoint (LT)
  - 2: Fly over waypoint (LT)
  - 3: Hold pattern (LT)
  - 4: Procedure hold (LT)
  - 5: Procedure turn (LT)
  - 6: RF leg (LT)
  - 7: Top of climb (VT)
  - 8: Top of descent (VT)
  - 9: Start of level (VT)
  - 10: Cross-over altitude (VT)
  - 11: Transition altitude (VT)

I021/110/TID/TD

- 2 bits [. .]
- values:
  - 0: N/A
  - 1: Turn right
  - 2: Turn left
  - 3: No turn

I021/110/TID/TRA
Turn Radius Availability

- 1 bit [.]
- values:
  0: TTR not available
  1: TTR available

I021/110/TID/TOA

- 1 bit [.]
- values:
  0: TOV available
  1: TOV not available

I021/110/TID/TOV - *Time Over Point*

- 24 bits [. . . . . .]
- unsigned quantity
- scaling factor: 1
- fractional bits: 0
- unit: ”s”
- LSB = 1 s

I021/110/TID/TTR - *TCP Turn Radius*

- 16 bits [. . . . . .]
- unsigned quantity
- scaling factor: 0.01
- fractional bits: 0
- unit: ”NM”
- LSB = 0.01 NM
- value $>= 0$ NM
- value $<= 655.35$ NM

Notes:

1. NC is set to one when the aircraft will not fly the path described by the TCP data.
2. TCP numbers start from zero.
3. LT = Lateral Type
4. VT = Vertical Type
5. TOV gives the estimated time before reaching the point. It is defined as the absolute time from midnight.
6. TOV is meaningful only if TOA is set to 1.

I021/130 - Position in WGS-84 Co-ordinates

Definition: Calculated Position in WGS-84 Co-ordinates with a resolution of 180/(2^25) degrees.

Structure:

I021/130/LAT - *Latitude*

- 32 bits [. . . . . .]
- signed quantity
- scaling factor: 180
- fractional bits: 25
- unit: ”°”
- LSB = $180/2^{25}$ ° = $180/33554432$ ° $\approx 5.364418029785156e-6$ °
- value $>= -90$ °
- value $<= 90$ °

I021/130/LON - *Longitude*

- 32 bits [. . . . . .]
- signed quantity

- scaling factor: 180
- fractional bits: 25
- unit: "°"
- LSB = $180/2^{25}$ ° = $180/33554432$ ° ≈ $5.364418029785156e-6$ °
- value >= -180 °
- value < 180 °

Notes:

1. Positive longitude indicates East. Positive latitude indicates North.
2. The LSB provides a resolution at least better than 0.6m.

I021/140 - Geometric Altitude

Definition: Vertical distance between the target and the projection of its position on the earth's ellipsoid, as defined by WGS84, in two's complement form.

Structure:

- 16 bits [. . . . . .]
- signed quantity
- scaling factor: 25
- fractional bits: 2
- unit: "ft"
- LSB = $25/2^2$ ft = $25/4$ ft ≈ 6.25 ft
- value >= -1500 ft
- value < 150000 ft

Note:

1. LSB is required to be less than 10 ft by ICAO.

I021/145 - Flight Level

Definition: Flight Level from barometric measurements,not QNH corrected, in two's complement form.

Structure:

- 16 bits [. . . . . .]
- signed quantity
- scaling factor: 1
- fractional bits: 2
- unit: "FL"
- LSB = $1/2^2$ FL = $1/4$ FL ≈ 0.25 FL
- value >= -15 FL
- value < 1500 FL

I021/146 - Intermediate State Selected Altitude

Definition: 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.

Structure:

I021/146/SAS - *Source Availability*

- 1 bit [.]

- values:
  - 0: No source information provided
  - 1: Source Information provided

I021/146/SRC - *Source*

- 2 bits [. .]
- values:
  - 0: Unknown
  - 1: Aircraft Altitude (Holding Altitude)
  - 2: MCP/FCU Selected Altitude
  - 3: FMS Selected Altitude

I021/146/ALT - *Altitude*

- 13 bits [. . . . . .]
- signed quantity
- scaling factor: 25
- fractional bits: 0
- unit: ”ft”
- LSB = 25 ft
- value $>= -1300$ ft
- value < 100000 ft

I021/148 - Final State Selected Altitude

Definition: The vertical intent value that corresponds with the ATC cleared altitude, as derived from the Altitude Control Panel (MCP/FCU).

Structure:

I021/148/MV - *Manage Vertical Mode*

- 1 bit [.]
- values:
  - 0: Not active
  - 1: Active

I021/148/AH - *Altitude Hold Mode*

- 1 bit [.]
- values:
  - 0: Not active
  - 1: Active

I021/148/AM - *Approach Mode*

- 1 bit [.]
- values:
  - 0: Not active
  - 1: Active

I021/148/ALT - *Altitude*

- 13 bits [. . . . . .]
- signed quantity
- scaling factor: 25
- fractional bits: 0
- unit: ”ft”
- LSB = 25 ft
- value $>= -1300$ ft
- value < 100000 ft

I021/150 - Air Speed

Definition: Calculated Air Speed (Element of Air Vector).

Structure:

I021/150/IM

- 1 bit [.]
- values:

  0: Air Speed = IAS, LSB (Bit-1) = 2 -14 NM/s
  1: Air Speed = Mach, LSB (Bit-1) = 0.001

I021/150/AS - *Air Speed (IAS or Mach)*

- 15 bits [. . . . . .]
- Content of this item depends on the value of item `150/IM`.
  - **In case of `150/IM == 0`:**
    - unsigned quantity
    - scaling factor: 1
    - fractional bits: 14
    - unit: ”NM/s”
    - LSB = $1/2^{14}$ NM/s = $1/16384$ NM/s $\approx 6.103515625e-5$ NM/s
  - **In case of `150/IM == 1`:**
    - unsigned quantity
    - scaling factor: 0.001
    - fractional bits: 0
    - unit: ”Mach”
    - LSB = 0.001 Mach

I021/151 - True Airspeed

Definition: True Air Speed.

Structure:

- 16 bits [. . . . . .]
- unsigned quantity
- scaling factor: 1
- fractional bits: 0
- unit: ”kt”
- LSB = 1 kt

I021/152 - Magnetic Heading

Definition: Magnetic Heading (Element of Air Vector).

Structure:

- 16 bits [. . . . . .]
- unsigned quantity
- scaling factor: 360
- fractional bits: 16
- unit: ”°”
- LSB = $360/2^{16}$ ° = $360/65536$ ° $\approx 5.4931640625e-3$ °

I021/155 - Barometric Vertical Rate

Definition: Barometric Vertical Rate, in two's complement form.

Structure:

- 16 bits [. . . . . .]
- signed quantity
- scaling factor: 25
- fractional bits: 2
- unit: "ft/min"
- LSB = $25/2^2$ ft/min = $25/4$ ft/min ≈ 6.25 ft/min

I021/157 - Geometric Vertical Rate

Definition: Geometric Vertical Rate, in two's complement form, with reference to WGS-84.

Structure:

- 16 bits [. . . . . .]
- signed quantity
- scaling factor: 25
- fractional bits: 2
- unit: "ft/min"
- LSB = $25/2^2$ ft/min = $25/4$ ft/min ≈ 6.25 ft/min

I021/160 - Ground Vector

Definition: Ground Speed and Track Angle elements of Ground Vector.

Structure:

I021/160/GS - *Ground Speed in Two's Complement Form Referenced to WGS84*

- 16 bits [. . . . . .]
- signed quantity
- scaling factor: 1
- fractional bits: 14
- unit: "NM/s"
- LSB = $1/2^{14}$ NM/s = $1/16384$ NM/s $\approx 6.103515625e-5$ NM/s
- value $>= 0$ NM/s
- value < 2 NM/s

I021/160/TA - *Track Angle*

- 16 bits [. . . . . .]
- unsigned quantity
- scaling factor: 360
- fractional bits: 16
- unit: "°"
- LSB = $360/2^{16}$ ° = $360/65536$ ° $\approx 5.4931640625e-3$ °

I021/165 - Rate Of Turn

Definition: Rate of Turn, in two's complement form.

Structure:

Extended item.

I021/165/TI - *Turn Indicator*

- 2 bits [. .]
- values:
  - 0: Not available
  - 1: Left
  - 2: Right
  - 3: Straight

I021/165/(spare)

- 5 bits [. . . . .]

(FX)

- extension bit
  - 0: End of data item
  - 1: Extension into next extent

I021/165/ROT - *Rate of Turn*

- 7 bits [. . . . . .]
- signed quantity
- scaling factor: 1
- fractional bits: 2
- unit: "°/s"
- LSB = $1/2^2$ °/s = $1/4$ °/s ≈ 0.25 °/s
- value $<= 15$ °/s

(FX)

- extension bit
  - 0: End of data item
  - 1: Extension into next extent

Notes:

1. A positive value represents a right turn, whereas a negative value represents a left turn.
2. Value 15 means 15 °/s or above.

I021/170 - Target Identification

Definition: Target (aircraft or vehicle) identification in 8 characters, as reported by the target.

Structure:

- 48 bits [`... 48 bits ...`]
- ICAO string (6-bits per character)

I021/200 - Target Status

Definition: Status of the target

Structure:

- 8 bits [. . . . . .]
- values:
  - 0: No emergency / not reported
  - 1: General emergency
  - 2: Lifeguard / medical
  - 3: Minimum fuel
  - 4: No communications
  - 5: Unlawful interference

I021/210 - Link Technology Indicator

Definition: Indication of which ADS link technology has been used to send the target report.

Structure:

I021/210/(spare)

- 3 bits [. . .]

I021/210/DTI - *Cockpit Display of Traffic Information*

- 1 bit [.]
- values:

  0: Unknown
  1: Aircraft equiped with CDTI

I021/210/MDS - *Mode-S Extended Squitter*

- 1 bit [.]
- values:

  0: Not used
  1: Used

I021/210/UAT - *UAT*

- 1 bit [.]
- values:

  0: Not used
  1: Used

I021/210/VDL - *VDL Mode 4*

- 1 bit [.]
- values:

  0: Not used
  1: Used

I021/210/OTR - *Other Technology*

- 1 bit [.]
- values:

  0: Not used
  1: Used

I021/220 - Met Information

Definition: Meteorological information.

Structure:

Compound item (FX)

I021/220/WS - *Wind Speed*

- 16 bits [. . . . .]
- unsigned quantity
- scaling factor: 1
- fractional bits: 0
- unit: ”kt”

- LSB = 1 kt
- value >= 0 kt
- value <= 300 kt

I021/220/WD - *Wind Direction*

- 16 bits [. . . . . .]
- unsigned quantity
- scaling factor: 1
- fractional bits: 0
- unit: "°"
- LSB = 1 °
- value >= 1 °
- value <= 360 °

I021/220/TMP - *Temperature*

- 16 bits [. . . . . .]
- signed quantity
- scaling factor: 1
- fractional bits: 2
- unit: "°C"
- LSB = $1/2^2$ °C = $1/4$ °C ≈ 0.25 °C
- value >= −100 °C
- value <= 100 °C

I021/220/TRB - *Turbulence*

- 8 bits [. . . . . .]
- unsigned integer
- value >= 0
- value <= 15

I021/230 - Roll Angle

Definition: The roll angle, in two's complement form, of an aircraft executing a turn.

Structure:

- 16 bits [. . . . . .]
- signed quantity
- scaling factor: 0.01
- fractional bits: 0
- unit: "°"
- LSB = 0.01 °
- value >= −180 °
- value <= 180 °

Notes:

1. Negative Value indicates "Left Wing Down".
2. Resolution provided by the technology "1090 MHz Extended Squitter" is 1 degree.

I021/RE - Reserved Expansion Field

Definition: Expansion

Structure:

Explicit item (RE)

I021/SP - Special Purpose Field

Definition: Special Purpose Field

Structure:

Explicit item (SP)

User Application Profile for Category 021

- (1) `I021/010` - Data Source Identification
- (2) `I021/040` - Target Report Descriptor
- (3) `I021/030` - Time of Day
- (4) `I021/130` - Position in WGS-84 Co-ordinates
- (5) `I021/080` - Target Address
- (6) `I021/140` - Geometric Altitude
- (7) `I021/090` - Figure of Merit
- `(FX)` - Field extension indicator
- (8) `I021/210` - Link Technology Indicator
- (9) `I021/230` - Roll Angle
- (10) `I021/145` - Flight Level
- (11) `I021/150` - Air Speed
- (12) `I021/151` - True Airspeed
- (13) `I021/152` - Magnetic Heading
- (14) `I021/155` - Barometric Vertical Rate
- `(FX)` - Field extension indicator
- (15) `I021/157` - Geometric Vertical Rate
- (16) `I021/160` - Ground Vector
- (17) `I021/165` - Rate Of Turn
- (18) `I021/170` - Target Identification
- (19) `I021/095` - Velocity Accuracy
- (20) `I021/032` - Time of Day Accuracy
- (21) `I021/200` - Target Status
- `(FX)` - Field extension indicator
- (22) `I021/020` - Emitter Category
- (23) `I021/220` - Met Information
- (24) `I021/146` - Intermediate State Selected Altitude
- (25) `I021/148` - Final State Selected Altitude
- (26) `I021/110` - Trajectory Intent
- (27) `(spare)`

- (28) (spare)
- (FX) - Field extension indicator
- (29) (spare)
- (30) (spare)
- (31) (spare)
- (32) (spare)
- (33) (spare)
- (34) I021/RE - Reserved Expansion Field
- (35) I021/SP - Special Purpose Field
- (FX) - Field extension indicator