

# Asterix category 021 - ADS-B Target Reports

**category:** 021

**edition:** 2.5

**date:** 2021-02-18

## Preamble

Surveillance data exchange. ADS-B Target Reports.

## Description of standard data items

### I021/008 - Aircraft Operational Status

definition: Identification of the operational services available in the aircraft while airborne.

Group

#### I021/008/RA - TCAS Resolution Advisory Active

Element

bit size: 1

Values:

**0:** TCAS II or ACAS RA not active

**1:** TCAS RA active

#### I021/008/TC - Target Trajectory Change Report Capability

Element

bit size: 2

Values:

**0:** No capability for Trajectory Change Reports

**1:** Support for TC+0 reports only

**2:** Support for multiple TC reports

**3:** Reserved

#### I021/008/TS - Target State Report Capability

Element

bit size: 1

Values:

**0:** No capability to support Target State Reports

**1:** Capable of supporting target State Reports

#### I021/008/ARV - Air-Referenced Velocity Report Capability

Element

bit size: 1

Values:

**0:** No capability to generate ARV-reports

**1:** Capable of generate ARV-reports

#### I021/008/CDTIA - Cockpit Display of Traffic Information Airborne

Element

bit size: 1

Values:

**0:** CDTI not operational

**1:** CDTI operational

#### I021/008/NOTTCAS - TCAS System Status

Element  
bit size: 1  
Values:  
    **0**: TCAS operational  
    **1**: TCAS not operational

#### **I021/008/SA - Single Antenna**

Element  
bit size: 1  
Values:  
    **0**: Antenna Diversity  
    **1**: Single Antenna only

**Note:**

- Additional Aircraft Status Information is available in the Reserved Expansion Field of Category 021.

#### **I021/010 - Data Source Identification**

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

Group

##### **I021/010/SAC - System Area Code**

Element  
bit size: 8  
Raw Content

##### **I021/010/SIC - System Identification Code**

Element  
bit size: 8  
Raw Content

**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>).

#### **I021/015 - Service Identification**

definition: Identification of the service provided to one or more users.

Element  
bit size: 8  
Raw Content

Notes:

1. The service identification is allocated by the system.
2. The service identification is also available in item I023/015 [Ref. 3].

#### **I021/016 - Service Management**

definition: Identification of services offered by a ground station (identified by a SIC code).

Element  
bit size: 8  
Unsigned quantity  
LSB =  $1/2 \text{ s} \approx 0.5 \text{ s}$   
unit: "s"

Notes:

1. This item contains the same information as item I023/101 in ASTERIX category 023 [Ref. 3]. Since not all service users receive category 023 data, this information has to be conveyed in category 021 as well.
2. If this item is due to be sent according to the encoding rule above, it shall be sent with the next target report

### **I021/020 - Emitter Category**

definition: Characteristics of the originating ADS-B unit.

Element

bit size: 8

Values:

- 0:** No ADS-B Emitter Category Information
- 1:** Light aircraft <= 15500 lbs
- 2:** 15500 lbs < small aircraft <75000 lbs
- 3:** 75000 lbs < medium a/c < 300000 lbs
- 4:** High Vortex Large
- 5:** 300000 lbs <= 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:** Cluster obstacle
- 24:** Line obstacle

### **I021/040 - Target Report Descriptor**

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

Extended

#### **I021/040/ATP - Address Type**

Element

bit size: 3

Values:

- 0:** 24-Bit ICAO address
- 1:** Duplicate 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**

Element

bit size: 2

Values:

- 0: 25 ft
- 1: 100 ft
- 2: Unknown
- 3: Invalid

### **I021/040/RC - Range Check**

Element

bit size: 1

Values:

- 0: Default
- 1: Range Check passed, CPR Validation pending

### **I021/040/RAB - Report Type**

Element

bit size: 1

Values:

- 0: Report from target transponder
- 1: Report from field monitor (fixed transponder)

*(FX) - extension bit*

### **I021/040/DCR - Differential Correction**

Element

bit size: 1

Values:

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

### **I021/040/GBS - Ground Bit Setting**

Element

bit size: 1

Values:

- 0: Ground Bit not set
- 1: Ground Bit set

### **I021/040/SIM - Simulated Target**

Element

bit size: 1

Values:

- 0: Actual target report
- 1: Simulated target report

### **I021/040/TST - Test Target**

Element

bit size: 1

Values:

- 0: Default
- 1: Test Target

### **I021/040/SAA - Selected Altitude Available**

Element

bit size: 1

Values:

- 0: Equipment capable to provide Selected Altitude
- 1: Equipment not capable to provide Selected Altitude

### **I021/040/CL - Confidence Level**

Element  
bit size: 2  
Values:  
    **0:** Report valid  
    **1:** Report suspect  
    **2:** No information  
    **3:** Reserved for future use

*(FX) - extension bit*

Spare bits: 1

#### **I021/040/LLC - List Lookup Check**

Element  
bit size: 1  
Values:  
    **0:** Default  
    **1:** List Lookup failed (see note)

#### **I021/040/IPC - Independent Position Check**

Element  
bit size: 1  
Values:  
    **0:** Default (see note)  
    **1:** Independent Position Check failed

#### **I021/040/NOGO - No-go Bit Status**

Element  
bit size: 1  
Values:  
    **0:** NOGO-bit not set  
    **1:** NOGO-bit set

#### **I021/040/CPR - Compact Position Reporting**

Element  
bit size: 1  
Values:  
    **0:** CPR Validation correct  
    **1:** CPR Validation failed

#### **I021/040/LDPJ - Local Decoding Position Jump**

Element  
bit size: 1  
Values:  
    **0:** LDPJ not detected  
    **1:** LDPJ detected

#### **I021/040/RCF - Range Check**

Element  
bit size: 1  
Values:  
    **0:** Default  
    **1:** Range Check failed

*(FX) - extension bit*

Notes:

1. Bit 3 indicates that the position reported by the target is within a credible range from the ground station. The range check is followed by the CPR validation to ensure that global and local position decoding both indicate valid position information. Bit 3=1 indicates that the range check was done, but the CPR validation is not yet completed. Once CPR validation is completed, Bit 3 will be reset to 0.

2. Bits 8/6 (ATP): values 0, 2 and 3 depend on the value of the Control Field (CF) in the Downlink Format 18 Message as defined in the ADS-B MOPS (EUROCAE ED-102/RTCA DO-260, Ref [11] Table 2-7).  
CF=0 denotes a 24-bit ICAO address and shall be encoded with ATP=0.  
CF=1 denotes "another kind of address for the transmitting ADS-B participant: a self assigned "anonymous" address, a ground vehicle address, or a surface obstruction address".  
Thus, from the downlinked information it is not possible to distinguish between a "Surface Vehicle Address - ATP=2" or an "Anonymous Address - ATP=3".  
Therefore how CF=1 in the received 1090 MHz Extended Squitter is encoded in ATP shall be described in the ICD of the ASTERIX system.  
It should be noted, however, that EUROCAE Document ED-129B (the "Technical Specification for a 1090MHz Extended Squitter ADS-B Ground System", Ref. [12]) requires ATP to be set to "3" if CF=1. Therefore it is recommended that a value of CF=1 received in the Extended Squitter should be encoded as ATP=3.
3. Except for Bit 5 (NOGO), the second extension signals the reasons for which the report has been indicated as suspect (indication Confidence Level (CL) in the first extension).
4. Bit 7, if set to 1, indicates that a lookup in a Black-list/White-list identified that the target may be suspect.
5. Bit 6, if set to 1, indicates that the position reported by the target was validated by an independent means and a discrepancy was detected. If no independent position check is implemented, the default value "0" is to be used.
6. Bit 5 represents the setting of the GO/NOGO-bit as defined in item I023/100 of Category 023 [Ref. 2].
7. Bit 2 indicates that the Range Check failed, i.e. the target is reported outside the credible range for the Ground Station. For operational users such a target will be suppressed. In services used for monitoring the Ground Station, the target will be transmitted with bit 2 indicating the fault condition.

### **I021/070 - Mode 3/A Code in Octal Representation**

definition: Mode-3/A code converted into octal representation.

Group

Spare bits: 4

#### **I021/070/MODE3A - Mode-3/A Reply in Octal Representation**

Element

bit size: 12

Octal string (3-bits per char)

### **I021/071 - Time of Applicability for Position**

definition: Time of applicability of the reported position, in the form of elapsed time since last midnight, expressed as UTC.

Element

bit size: 24

Unsigned quantity

LSB =  $1/2^7$  s  $\approx 7.8125e - 3$  s

unit: "s"

Notes:

1. The time of applicability value is reset to zero at every midnight.
2. The time of applicability indicates the exact time at which the position transmitted in the target report is valid.

### **I021/072 - Time of Applicability for Velocity**

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

Element

bit size: 24

Unsigned quantity

LSB =  $1/2^7$  s  $\approx 7.8125e - 3$  s

unit: "s"

Notes:

1. The time of the applicability value is reset to zero at every midnight.
2. The time of applicability indicates the exact time at which the velocity information transmitted in the target report is valid.
3. This item will not be available in some ADS-B technologies.

### **I021/073 - Time of Message Reception for Position**

definition: Time of reception of the latest position squitter in the Ground Station, in the form of elapsed time since last midnight, expressed as UTC.

Element

bit size: 24

Unsigned quantity

LSB =  $1/2^7$  s  $\approx 7.8125e - 3$  s

unit: "s"

**Note:**

- The time of message reception value is reset to zero at every midnight.

### **I021/074 - Time of Message Reception of Position-High Precision**

definition: Time at which the latest ADS-B position information was received by the ground station, expressed as fraction of the second of the UTC Time.

Group

#### **I021/074/FSI - Full Second Indication**

Element

bit size: 2

Values:

**3:** Reserved

**2:** TOMRp whole seconds = (I021/073) Whole seconds - 1

**1:** TOMRp whole seconds = (I021/073) Whole seconds + 1

**0:** TOMRp whole seconds = (I021/073) Whole seconds

#### **I021/074/TOMRP - Fractional Part of the Time of Message Reception for Position in the Ground Station**

Element

bit size: 30

Unsigned quantity

LSB =  $1/2^{30}$  s  $\approx 9.31322574615478515625e - 10$  s

unit: "s"

## **I021/075 - Time of Message Reception for Velocity**

definition: Time of reception of the latest velocity squitter in the Ground Station, in the form of elapsed time since last midnight, expressed as UTC.

Element

bit size: 24

Unsigned quantity

LSB =  $1/2^7$  s  $\approx 7.8125e-3$  s

unit: "s"

### **Note:**

- The time of message reception value is reset to zero at every midnight.

## **I021/076 - Time of Message Reception of Velocity-High Precision**

definition: Time at which the latest ADS-B velocity information was received by the ground station, expressed as fraction of the second of the UTC Time.

Group

### **I021/076/FSI - Full Second Indication**

Element

bit size: 2

Values:

**3:** Reserved

**2:** TOMRp whole seconds = (I021/075) Whole seconds - 1

**1:** TOMRp whole seconds = (I021/075) Whole seconds + 1

**0:** TOMRp whole seconds = (I021/075) Whole seconds

### **I021/076/TOMRP - Fractional Part of the Time of Message Reception for Position in the Ground Station**

Element

bit size: 30

Unsigned quantity

LSB =  $1/2^{30}$  s  $\approx 9.31322574615478515625e-10$  s

unit: "s"

## **I021/077 - Time of ASTERIX Report Transmission**

definition: Time of the transmission of the ASTERIX category 021 report in the form of elapsed time since last midnight, expressed as UTC.

Element

bit size: 24

Unsigned quantity

LSB =  $1/2^7$  s  $\approx 7.8125e-3$  s

unit: "s"

### **Note:**

- The time of ASTERIX report transmission value is reset to zero at every midnight.

## **I021/080 - Target Address**

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



Element  
bit size: 24  
Raw Content

Note:

- The type of address encoded in Data Item I021/080 is transmitted in the ATP indication in the Primary Subfield of Data Item I021/040.

## **I021/090 - Quality Indicators**

definition: ADS-B quality indicators transmitted by a/c according to MOPS version.  
Extended

### **I021/090/NUCRNACV - Navigation Uncertainty Category for Velocity NUCr or the Navigation Accuracy Category for Velocity NACv**

Element  
bit size: 3  
Raw Content

### **I021/090/NUCPNIC - Navigation Uncertainty Category for Position NUCp or Navigation Integrity Category NIC**

Element  
bit size: 4  
Raw Content

#### **Notes:**

1. Apart from the "PIC" item, all items are defined as per the respective link technology protocol version ("MOPS version", see I021/210).
2. The primary subfield is kept for backwards compatibility reasons. Version 2 NIC-values shall be mapped accordingly. This is required to ensure that downstream systems, which are not capable of interpreting extensions 2 and 3 (because they use an ASTERIX

*(FX) - extension bit*

### **I021/090/NICBARO - Navigation Integrity Category for Barometric Altitude**

Element  
bit size: 1  
Raw Content

### **I021/090/SIL - Surveillance (version 1) or Source (version 2) Integrity Level**

Element  
bit size: 2  
Raw Content

### **I021/090/NACP - Navigation Accuracy Category for Position**

Element  
bit size: 4  
Raw Content

*(FX) - extension bit*

Spare bits: 2

### **I021/090/SILS - SIL-Supplement**

Element  
bit size: 1  
Values:

**0:** Measured per flight-hour

1: Measured per sample

### **I021/090/SDA - Horizontal Position System Design Assurance Level (as Defined in Version 2)**

Element  
bit size: 2  
Raw Content

### **I021/090/GVA - Geometric Altitude Accuracy**

Element  
bit size: 2  
Raw Content

*(FX) - extension bit*

### **I021/090/PIC - Position Integrity Category**

Element  
bit size: 4  
Raw Content

Spare bits: 3

*(FX) - extension bit*

Notes:

1. Apart from the "PIC" item, all items are defined as per the respective link technology protocol version ("MOPS version", see I021/210).
2. The primary subfield is kept for backwards compatibility reasons. Version 2 NIC-values shall be mapped accordingly. This is required to ensure that downstream systems, which are not capable of interpreting extensions 2 and 3 (because they use an ASTERIX edition earlier than 2.0) still get the required information
3. "Version 1" or "Version 2" refers to the MOPS version as defined in data item I021/210, bits 6/4
4. "Version 2" refers to the MOPS version as defined in data item I021/210, bits 6/4
5. PIC=0 is defined for completeness only. In this case the third extension shall not be generated.
6. For ED102A/DO260B PIC values of 7 and 9, the NIC supplements for airborne messages (NIC supplements A/B) and surface messages (NIC supplements A/C) are listed. For ED102A/DO260B PIC=8, the NIC supplements A/B for airborne messages are listed. For DO260A PIC values of 7 and 8, the NIC supplement for airborne messages is shown in brackets. The aircraft air-ground status, and hence message type (airborne or surface), is derived from the GBS-bit in I021/040, 1 st extension.

## **I021/110 - Trajectory Intent**

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

Compound

### **I021/110/TIS - Trajectory Intent Status**

Extended

#### **I021/110/TIS/NAV**

Element  
bit size: 1  
Values:

- 0: Trajectory Intent Data is available for this aircraft
- 1: Trajectory Intent Data is not available for this aircraft

**I021/110/TIS/NVB**

Element

bit size: 1

Values:

**0:** Trajectory Intent Data is valid**1:** Trajectory Intent Data is not valid

Spare bits: 5

*(FX) - extension bit***I021/110/TID - Trajectory Intent Data**

Repetitive

Regular, 1 byte(s) REP field size.

Group

**I021/110/TID/TCA**

Element

bit size: 1

Values:

**0:** TCP number available**1:** TCP number not available**I021/110/TID/NC**

Element

bit size: 1

Values:

**0:** TCP compliance**1:** TCP non-compliance**I021/110/TID/TCPN**

description: Trajectory Change Point number

Element

bit size: 6

Raw Content

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

Element

bit size: 16

Signed quantity

LSB = 10 ft  $\approx$  10.0 ft

unit: "ft"

 $\geq -1500.0$  $\leq 150000.0$ **I021/110/TID/LAT - In WGS.84 in Two's Complement**

Element

bit size: 24

Signed quantity

LSB =  $180/2^{23} \text{ }^\circ \approx 2.1457672119140625e-5 \text{ }^\circ$ 

unit: "°"

 $\geq -90.0$  $\leq 90.0$ **I021/110/TID/LON - In WGS.84 in Two's Complement**

Element

bit size: 24

Signed quantity

LSB =  $180/2^{23} \text{ }^\circ \approx 2.1457672119140625e-5 \text{ }^\circ$ 

unit: "°"

 $\geq -180.0$  $< 180.0$ **I021/110/TID/PT - Point Type**

Element

bit size: 4

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**

Element  
bit size: 2  
Values:  
0: N/A  
1: Turn right  
2: Turn left  
3: No turn

#### **I021/110/TID/TRA**

description: Turn Radius Availability  
Element  
bit size: 1  
Values:  
0: TTR not available  
1: TTR available

#### **I021/110/TID/TOA**

Element  
bit size: 1  
Values:  
0: TOV available  
1: TOV not available

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

Element  
bit size: 24  
Unsigned quantity  
LSB = 1 s  $\approx$  1.0 s  
unit: "s"

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

Element  
bit size: 16  
Unsigned quantity  
LSB = 1/100 NM  $\approx$  1.0e - 2 NM  
unit: "NM"  
 $\geq$  0.0  
 $\leq$  655.35

#### 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: Position in WGS-84 Co-ordinates.

Group

### **I021/130/LAT - Latitude**

Element

bit size: 24

Signed quantity

LSB =  $180/2^{23} \text{ }^\circ \approx 2.1457672119140625e-5 \text{ }^\circ$

unit: "°"

$\geq -90.0$

$\leq 90.0$

### **I021/130/LON - Longitude**

Element

bit size: 24

Signed quantity

LSB =  $180/2^{23} \text{ }^\circ \approx 2.1457672119140625e-5 \text{ }^\circ$

unit: "°"

$\geq -180.0$

$< 180.0$

Notes:

- Positive longitude indicates East. Positive latitude indicates North.

## **I021/131 - High-Resolution Position in WGS-84 Co-ordinates**

definition: Position in WGS-84 Co-ordinates in high resolution.

Group

### **I021/131/LAT - Latitude**

Element

bit size: 32

Signed quantity

LSB =  $180/2^{30} \text{ }^\circ \approx 1.676380634307861328125e-7 \text{ }^\circ$

unit: "°"

$\geq -90.0$

$\leq 90.0$

### **I021/131/LON - Longitude**

Element

bit size: 32

Signed quantity

LSB =  $180/2^{30} \text{ }^\circ \approx 1.676380634307861328125e-7 \text{ }^\circ$

unit: "°"

$\geq -180.0$

$< 180.0$

Notes:

- Positive longitude indicates East. Positive latitude indicates North.

## **I021/132 - Message Amplitude**

definition: Amplitude, in dBm, of ADS-B messages received by the ground station, coded in two's complement.

Element  
bit size: 8  
Signed quantity  
LSB = 1 dBm  $\approx$  1.0 dBm  
unit: "dBm"

**Note:**

- The value gives the amplitude of the latest received squitter.

**I021/140 - Geometric Height**

definition: Minimum height from a plane tangent to the earth's ellipsoid, defined by WGS-84, in two's complement form.

Element  
bit size: 16  
Signed quantity  
LSB =  $25/2^2$  ft  $\approx$  6.25 ft  
unit: "ft"  
 $\geq -1500.0$   
 $< 150000.0$

**Note:**

1. LSB is required to be less than 10 ft by ICAO.
2. A value of '0111111111111111' indicates that the aircraft transmits a "greater than" indication.

**I021/145 - Flight Level**

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

Element  
bit size: 16  
Signed quantity  
LSB =  $1/2^2$  FL  $\approx$  0.25 FL  
unit: "FL"  
 $\geq -15.0$   
 $< 1500.0$

**I021/146 - Selected Altitude**

definition: The Selected Altitude as provided by the avionics and corresponding either to the MCP/FCU Selected Altitude (the ATC cleared altitude entered by the flight crew into the avionics) or to the FMS Selected Altitude.

Group

**I021/146/SAS - Source Availability**

Element  
bit size: 1  
Values:  
    **0:** No source information provided  
    **1:** Source Information provided

**I021/146/S - Source**

Element  
bit size: 2  
Values:  
    **0:** Unknown  
    **1:** Aircraft Altitude (Holding Altitude)  
    **2:** MCP/FCU Selected Altitude  
    **3:** FMS Selected Altitude

#### **I021/146/ALT - Altitude**

Element  
bit size: 13  
Signed quantity  
LSB = 25 ft  $\approx$  25.0 ft  
unit: "ft"  
 $\geq -1300.0$   
 $< 100000.0$

#### Notes:

1. The Selected Altitude provided in this field is not necessarily the "Target Altitude" as defined by ICAO.
2. The value of "Source" (bits 15/14) indicating "unknown" or "Aircraft Altitude" is kept for backward compatibility as these indications are not provided by "version 2" systems as defined by data item I021/210, bits 6/4.
3. Vertical mode indications supporting the determination of the nature of the Selected Altitude are provided in the Reserved Expansion Field in the subfield NAV.

#### **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).

#### Group

##### **I021/148/MV - Manage Vertical Mode**

Element  
bit size: 1  
Values:  
    **0:** Not active or unknown  
    **1:** Active

##### **I021/148/AH - Altitude Hold Mode**

Element  
bit size: 1  
Values:  
    **0:** Not active or unknown  
    **1:** Active

##### **I021/148/AM - Approach Mode**

Element  
bit size: 1  
Values:  
    **0:** Not active or unknown  
    **1:** Active

##### **I021/148/ALT - Altitude**

Element  
bit size: 13  
Signed quantity

LSB = 25 ft  $\approx$  25.0 ft  
unit: "ft"  
 $\geq -1300.0$   
 $< 100000.0$

Notes:

- This item is kept for backward compatibility but shall not be used for "version 2" ADS-B systems (as defined by data item I021/210, bits 6/4) for which item 146 will be used to forward the MCP/FCU or the FMS selected altitude information. For "version 2" ADS-B systems, the vertical mode indications will be provided through the Reserved Expansion Field in the subfield NAV .

## **I021/150 - Air Speed**

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

Group

### **I021/150/IM**

Element

bit size: 1

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)**

Element

bit size: 15

Depending on: (150/IM)

**(0):** Unsigned quantity

LSB =  $1/2^{14}$  NM/s  $\approx 6.103515625e - 5$  NM/s  
unit: "NM/s"

**(1):** Unsigned quantity

LSB =  $1/1000$  Mach  $\approx 1.0e - 3$  Mach  
unit: "Mach"

Default:

Raw Content

## **I021/151 - True Airspeed**

definition: True Air Speed.

Group

### **I021/151/RE - Range Exceeded Indicator**

Element

bit size: 1

Values:

- 0:** Value in defined range
- 1:** Value exceeds defined range

### **I021/151/TAS - True Air Speed**

Element

bit size: 15

Unsigned quantity

LSB = 1 kt  $\approx 1.0$  kt  
unit: "kt"

Notes:



- The RE-Bit, if set, indicates that the value to be transmitted is beyond the range defined for this specific data item and the applied technology. In this case the True Air Speed contains the maximum value that can be downloaded from the aircraft avionics and the RE-bit indicates that the actual value is greater than the value contained in the field.

## **I021/152 - Magnetic Heading**

definition: Magnetic Heading (Element of Air Vector).

Element

bit size: 16

Unsigned quantity

LSB =  $360/2^{16} \text{ }^\circ \approx 5.4931640625e - 3 \text{ }^\circ$

unit: "°"

Notes:

- True North Heading is defined in the Reserved Expansion Field in the subfield TNH.

## **I021/155 - Barometric Vertical Rate**

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

Group

### **I021/155/RE - Range Exceeded Indicator**

Element

bit size: 1

Values:

**0:** Value in defined range

**1:** Value exceeds defined range

### **I021/155/BVR - Barometric Vertical Rate**

Element

bit size: 15

Signed quantity

LSB =  $25/2^2 \text{ ft/min} \approx 6.25 \text{ ft/min}$

unit: "ft/min"

Notes:

- The RE-Bit, if set, indicates that the value to be transmitted is beyond the range defined for this specific data item and the applied technology. In this case the Barometric Vertical Rate contains the maximum value that can be downloaded from the aircraft avionics and the RE-bit indicates that the actual value is greater than the value contained in the field.

## **I021/157 - Geometric Vertical Rate**

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

Group

### **I021/157/RE - Range Exceeded Indicator**

Element

bit size: 1

Values:

- 0: Value in defined range
- 1: Value exceeds defined range

### **I021/157/GVR - Geometric Vertical Rate**

Element  
bit size: 15  
Signed quantity  
 $LSB = 25/2^2 \text{ ft/min} \approx 6.25 \text{ ft/min}$   
unit: "ft/min"

Notes:

- The RE-Bit, if set, indicates that the value to be transmitted is beyond the range defined for this specific data item and the applied technology. In this case the Geometric Vertical Rate contains the maximum value that can be downloaded from the aircraft avionics and the RE-bit indicates that the actual value is greater than the value contained in the field.

### **I021/160 - Airborne Ground Vector**

definition: Ground Speed and Track Angle elements of Airborne Ground Vector.

Group

#### **I021/160/RE - Range Exceeded Indicator**

Element  
bit size: 1  
Values:  

- 0: Value in defined range
- 1: Value exceeds defined range

#### **I021/160/GS - Ground Speed Referenced to WGS-84**

Element  
bit size: 15  
Unsigned quantity  
 $LSB = 1/2^{14} \text{ NM/s} \approx 6.103515625e - 5 \text{ NM/s}$   
unit: "NM/s"  
 $\geq 0.0$   
 $< 2.0$

#### **I021/160/TA - Track Angle Clockwise Reference to True North**

Element  
bit size: 16  
Unsigned quantity  
 $LSB = 360/2^{16} \text{ }^\circ \approx 5.4931640625e - 3 \text{ }^\circ$   
unit: "°"

Notes:

1. The RE-Bit, if set, indicates that the value to be transmitted is beyond the range defined for this specific data item and the applied technology. In this case the Ground Speed contains the maximum value that can be downloaded from the aircraft avionics and the RE-bit indicates that the actual value is greater than the value contained in the field.
2. The Surface Ground Vector format is defined in the Reserved Expansion Field in the subfield SGV.

### **I021/161 - Track Number**

definition: An integer value representing a unique reference to a track record within a particular track file.

Group

Spare bits: 4

**I021/161/TRNUM - Track Number**

Element

bit size: 12

Raw Content

**I021/165 - Track Angle Rate**

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

Group

Spare bits: 6

**I021/165/TAR - Track Angle Rate**

Element

bit size: 10

Signed quantity

LSB =  $1/2^5$  °/s  $\approx 3.125e-2$  °/s

unit: "°/s"

$\geq -16.0$

$\leq 16.0$

Notes:

1. A positive value represents a right turn, whereas a negative value represents a left turn.
2. Maximum value means Maximum value or above.
3. This item will not be transmitted for the technology 1090 MHz Extended Squitter.

**I021/170 - Target Identification**

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

Element

bit size: 48

ICAO string (6-bits per char)

**I021/200 - Target Status**

definition: Status of the target

Group

**I021/200/ICF - Intent Change Flag (see Note)**

Element

bit size: 1

Values:

**0:** No intent change active

**1:** Intent change flag raised

**I021/200/LNAV - LNAV Mode**

Element

bit size: 1

Values:

**0:** LNAV Mode engaged

**1:** LNAV Mode not engaged

**I021/200/ME - Military Emergency**

Element  
bit size: 1  
Values:  
    **0:** No military emergency  
    **1:** Military emergency

#### **I021/200/PS - Priority Status**

Element  
bit size: 3  
Values:  
    **0:** No emergency / not reported  
    **1:** General emergency  
    **2:** Lifeguard / medical emergency  
    **3:** Minimum fuel  
    **4:** No communications  
    **5:** Unlawful interference  
    **6:** DOWNED Aircraft

#### **I021/200/SS - Surveillance Status**

Element  
bit size: 2  
Values:  
    **0:** No condition reported  
    **1:** Permanent Alert (Emergency condition)  
    **2:** Temporary Alert (change in Mode 3/A Code other than emergency)  
    **3:** SPI set

Notes:

- Bit-8 (ICF), when set to “1” indicates that new information is available in the Mode S GICB registers 40, 41 or 42. As of MOPS Version 3 (see I021/210) as defined in Ref. [11] this flag is no longer used and shall be set to “0”.

#### **I021/210 - MOPS Version**

definition: Identification of the MOPS version used by a/c to supply ADS-B information.  
Group

Spare bits: 1

#### **I021/210/VNS - Version Not Supported**

Element  
bit size: 1  
Values:  
    **0:** The MOPS Version is supported by the GS  
    **1:** The MOPS Version is not supported by the GS

#### **I021/210/VN - Version Number**

Element  
bit size: 3  
Values:  
    **0:** ED102/DO-260 [Ref. 7]  
    **1:** DO-260A [Ref. 8]  
    **2:** ED102A/DO-260B [Ref. 10]  
    **3:** ED-102B/DO-260C [Ref. 11]

#### **I021/210/LTT - Link Technology Type**

Element  
bit size: 3  
Values:

- 0: Other
- 1: UAT
- 2: 1090 ES
- 3: VDL 4
- 4: Not assigned
- 5: Not assigned
- 6: Not assigned
- 7: Not assigned

Notes:

- VN sub-field shall contain a value describing the MOPS used by each aircraft. The versions of other link technologies are assumed to be in line with the 1090 ES MOPS versions and the corresponding MASPS versions.
- Bit 7 (VNS) when set to 1 indicates that the aircraft transmits a MOPS Version indication that is not supported by the Ground Station. However, since MOPS versions are supposed to be backwards compatible, the GS has attempted to interpret the message and achieved a credible result. The fact that the MOPS version received is not supported by the GS is submitted as additional information to subsequent processing systems.
- In Bits 6/4 (VN) the possibility has been added to indicate an Extended Squitter received from a "Version 3" ADS-B System conforming to Ref. [11]. This edition of the Category 021 Specification has NOT been extended to process additional data contained in VERSION 3 Extended Squitters. Thus, systems in line with this specification cannot benefit from the changes applied. Adding Version 3 to the permitted Version Numbers only permits to utilise the Version 3 Extended Squitters by decoding the information that can be encoded in the version of this specification.

## **I021/220 - Met Information**

definition: Meteorological information.

Compound

### **I021/220/WS - Wind Speed**

Element  
bit size: 16  
Unsigned quantity  
LSB = 1 kt  $\approx$  1.0 kt  
unit: "kt"  
 $\geq$  0.0  
 $\leq$  300.0

### **I021/220/WD - Wind Direction**

Element  
bit size: 16  
Unsigned quantity  
LSB = 1 °  $\approx$  1.0 °  
unit: "°"  
 $\geq$  1.0  
 $\leq$  360.0

### **I021/220/TMP - Temperature**

Element  
bit size: 16  
Signed quantity  
LSB =  $1/2^2$  °C  $\approx$  0.25 °C  
unit: "°C"  
 $\geq$  -100.0  
 $\leq$  100.0

### **I021/220/TRB - Turbulence**

Element  
bit size: 8  
Unsigned integer  
 $\geq 0.0$   
 $\leq 15.0$

### **I021/230 - Roll Angle**

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

Element  
bit size: 16  
Signed quantity  
 $\text{LSB} = 1/100^\circ \approx 1.0e-2^\circ$   
unit: "°"  
 $\geq -180.0$   
 $\leq 180.0$

Notes:

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

### **I021/250 - Mode S MB Data**

definition: Mode S Comm B data as extracted from the aircraft transponder.

Repetitive

Regular, 1 byte(s) REP field size.

Element  
bit size: 64  
BDS register with address

Notes:

1. For the transmission of BDS20, item 170 should be used.
2. For the transmission of BDS30, item 260 is used.

### **I021/260 - ACAS Resolution Advisory Report**

definition: Currently active Resolution Advisory (RA), if any, generated by the ACAS associated with the transponder transmitting the RA message and threat identity data.

Group

#### **I021/260/TYP - Message Type (= 28 for 1090 ES, Version 2)**

Element  
bit size: 5  
Raw Content

#### **I021/260/STYP - Message Sub-type (= 2 for 1090 ES, Version 2)**

Element  
bit size: 3  
Raw Content

#### **I021/260/ARA - Active Resolution Advisories**

Element  
bit size: 14  
Raw Content

#### **I021/260/RAC - RAC (RA Complement) Record**

Element  
bit size: 4  
Raw Content

#### **I021/260/RAT - RA Terminated**

Element  
bit size: 1  
Raw Content

#### **I021/260/MTE - Multiple Threat Encounter**

Element  
bit size: 1  
Raw Content

#### **I021/260/TTI - Threat Type Indicator**

Element  
bit size: 2  
Raw Content

#### **I021/260/TID - Threat Identity Data**

Element  
bit size: 26  
Raw Content

#### Notes:

1. Version denotes the MOPS version as defined in I021/210, bits 6/4
2. This data items copies the value of BDS register 6,1 for message type 28, subtype 2
3. The "TYP" and "STYP" items are implementation (i.e. link technology) dependent.
4. Refer to ICAO Annex 10 SARPs for detailed explanations [Ref. 5]

### **I021/271 - Surface Capabilities and Characteristics**

definition: Operational capabilities of the aircraft while on the ground.

Extended

Spare bits: 2

#### **I021/271/POA - Position Offset Applied**

Element  
bit size: 1  
Values:

- 0:** Position transmitted is not ADS-B position reference point
- 1:** Position transmitted is the ADS-B position reference point

#### **I021/271/CDTIS - Cockpit Display of Traffic Information Surface**

Element  
bit size: 1  
Values:

- 0:** CDTI not operational
- 1:** CDTI operational

#### **I021/271/B2LOW - Class B2 Transmit Power Less Than 70 Watts**

Element  
bit size: 1  
Values:  
0:  $\geq 70$  Watts  
1:  $< 70$  Watts

### **I021/271/RAS - Receiving ATC Services**

Element  
bit size: 1  
Values:  
0: Aircraft not receiving ATC-services  
1: Aircraft receiving ATC services

### **I021/271/IDENT - Setting of IDENT Switch**

Element  
bit size: 1  
Values:  
0: IDENT switch not active  
1: IDENT switch active

*(FX) - extension bit*

### **I021/271/LW - Length and Width of the Aircraft**

Element  
bit size: 4  
Raw Content

Spare bits: 3

*(FX) - extension bit*

Notes:

1. Version 2 (as defined in I021/210, bits 6/4) data technology protocols encode "No Data or Unknown" with value 0. In this case data item I021/271, first extension is not generated.
2. As of edition 2.2 the structure of this data item has been changed. Edition 2.2 is not backwards compatible with previous editions.

## **I021/295 - Data Ages**

definition: Ages of the data provided.

Compound

### **I021/295/AOS - Aircraft Operational Status Age**

description: Age of the information transmitted in item I021/008.

Element  
bit size: 8  
Unsigned quantity  
 $\text{LSB} = 1/10 \text{ s} \approx 0.1 \text{ s}$   
unit: "s"  
 $\leq 25.5$

### **I021/295/TRD - Target Report Descriptor Age**

description: Age of the Target Report Descriptor, item I021/040

Element  
bit size: 8  
Unsigned quantity  
 $\text{LSB} = 1/10 \text{ s} \approx 0.1 \text{ s}$   
unit: "s"  
 $\leq 25.5$

### **I021/295/M3A - Mode 3/A Age**



description: Age of the Mode 3/A Code, item I021/070

Element  
bit size: 8  
Unsigned quantity  
LSB =  $1/10 \text{ s} \approx 0.1 \text{ s}$   
unit: "s"  
 $\leq 25.5$

#### **I021/295/QI - Quality Indicators Age**

description: Age of the Quality Indicators, item I021/090

Element  
bit size: 8  
Unsigned quantity  
LSB =  $1/10 \text{ s} \approx 0.1 \text{ s}$   
unit: "s"  
 $\leq 25.5$

#### **I021/295/II1 - Trajectory Intent Age**

description: Age of the Trajectory Intent information, item I021/110

Element  
bit size: 8  
Unsigned quantity  
LSB =  $1/10 \text{ s} \approx 0.1 \text{ s}$   
unit: "s"  
 $\leq 25.5$

#### **I021/295/MAM - Message Amplitude Age**

description: Age of the message amplitude, item I021/132

Element  
bit size: 8  
Unsigned quantity  
LSB =  $1/10 \text{ s} \approx 0.1 \text{ s}$   
unit: "s"  
 $\leq 25.5$

#### **I021/295/GH - Geometric Height Age**

description: Age of the Geometric Height, item 021/140

Element  
bit size: 8  
Unsigned quantity  
LSB =  $1/10 \text{ s} \approx 0.1 \text{ s}$   
unit: "s"  
 $\leq 25.5$

#### **I021/295/FL - Flight Level Age**

description: Age of the Flight Level, item I021/145

Element  
bit size: 8  
Unsigned quantity  
LSB =  $1/10 \text{ s} \approx 0.1 \text{ s}$   
unit: "s"  
 $\leq 25.5$

#### **I021/295/ISA - Intermediate State Selected Altitude Age**

description: Age of the Intermediate State Selected Altitude, item I021/146

Element  
bit size: 8  
Unsigned quantity  
LSB =  $1/10 \text{ s} \approx 0.1 \text{ s}$   
unit: "s"  
 $\leq 25.5$

### **I021/295/FSA - Final State Selected Altitude Age**

description: Age of the Final State Selected Altitude, item I021/148

Element  
bit size: 8  
Unsigned quantity  
LSB =  $1/10 \text{ s} \approx 0.1 \text{ s}$   
unit: "s"  
 $\leq 25.5$

### **I021/295/AS - Air Speed Age**

description: Age of the Air Speed, item I021/150

Element  
bit size: 8  
Unsigned quantity  
LSB =  $1/10 \text{ s} \approx 0.1 \text{ s}$   
unit: "s"  
 $\leq 25.5$

### **I021/295/TAS - True Air Speed Age**

description: Age of the True Air Speed, item I021/151

Element  
bit size: 8  
Unsigned quantity  
LSB =  $1/10 \text{ s} \approx 0.1 \text{ s}$   
unit: "s"  
 $\leq 25.5$

### **I021/295/MH - Magnetic Heading Age**

description: Age of the Magnetic Heading, item I021/152

Element  
bit size: 8  
Unsigned quantity  
LSB =  $1/10 \text{ s} \approx 0.1 \text{ s}$   
unit: "s"  
 $\leq 25.5$

### **I021/295/BVR - Barometric Vertical Rate Age**

description: Age of the Barometric Vertical Rate, item I021/155

Element  
bit size: 8  
Unsigned quantity  
LSB =  $1/10 \text{ s} \approx 0.1 \text{ s}$   
unit: "s"  
 $\leq 25.5$

### **I021/295/GVR - Geometric Vertical Rate Age**

description: Age of the Geometric Vertical Rate, item I021/157

Element  
bit size: 8  
Unsigned quantity  
LSB =  $1/10 \text{ s} \approx 0.1 \text{ s}$   
unit: "s"  
 $\leq 25.5$

### **I021/295/GV - Ground Vector Age**

description: Age of the Ground Vector, item I021/160

Element  
bit size: 8  
Unsigned quantity  
LSB =  $1/10 \text{ s} \approx 0.1 \text{ s}$   
unit: "s"  
 $\leq 25.5$

**I021/295/TAR - Track Angle Rate Age**

description: Age of the Track Angle Rate, item I021/165

Element  
bit size: 8  
Unsigned quantity  
LSB =  $1/10 \text{ s} \approx 0.1 \text{ s}$   
unit: "s"  
 $\leq 25.5$

**I021/295/TI2 - Target Identification Age**

description: Age of the Target Identification, item I021/170

Element  
bit size: 8  
Unsigned quantity  
LSB =  $1/10 \text{ s} \approx 0.1 \text{ s}$   
unit: "s"  
 $\leq 25.5$

**I021/295/TS - Target Status Age**

description: Age of the Target Status, item I021/200

Element  
bit size: 8  
Unsigned quantity  
LSB =  $1/10 \text{ s} \approx 0.1 \text{ s}$   
unit: "s"  
 $\leq 25.5$

**I021/295/MET - Met Information Age**

description: Age of the Meteorological Information, item I021/220

Element  
bit size: 8  
Unsigned quantity  
LSB =  $1/10 \text{ s} \approx 0.1 \text{ s}$   
unit: "s"  
 $\leq 25.5$

**I021/295/ROA - Roll Angle Age**

description: Age of the Roll Angle, item I021/230

Element  
bit size: 8  
Unsigned quantity  
LSB =  $1/10 \text{ s} \approx 0.1 \text{ s}$   
unit: "s"  
 $\leq 25.5$

**I021/295/ARA - ACAS Resolution Advisory Age**

description: Age of the latest update of an active ACAS Resolution Advisory, item I021/260

Element  
bit size: 8  
Unsigned quantity  
LSB =  $1/10 \text{ s} \approx 0.1 \text{ s}$   
unit: "s"  
 $\leq 25.5$

**I021/295/SCC - Surface Capabilities and Characteristics Age**

description: Age of the information on the surface capabilities and characteristics of the respective target, item I021/271

Element  
bit size: 8

Unsigned quantity  
LSB =  $1/10 \text{ s} \approx 0.1 \text{ s}$   
unit: "s"  
≤ 25.5

Notes:

- In all the subfields, the maximum value indicates "maximum value or above".

### **I021/400 - Receiver ID**

definition: Designator of Ground Station in Distributed System.

Element  
bit size: 8  
Raw Content

### **I021/RE - Reserved Expansion Field**

definition: Expansion  
Explicit (ReservedExpansion)

### **I021/SP - Special Purpose Field**

definition: Special Purpose Field  
Explicit (SpecialPurpose)

## **User Application Profile**

- 1: I021/010 - Data Source Identification
- 2: I021/040 - Target Report Descriptor
- 3: I021/161 - Track Number
- 4: I021/015 - Service Identification
- 5: I021/071 - Time of Applicability for Position
- 6: I021/130 - Position in WGS-84 Co-ordinates
- 7: I021/131 - High-Resolution Position in WGS-84 Co-ordinates
- (FX) - Field extension indicator
- 8: I021/072 - Time of Applicability for Velocity
- 9: I021/150 - Air Speed
- 10: I021/151 - True Airspeed
- 11: I021/080 - Target Address
- 12: I021/073 - Time of Message Reception for Position
- 13: I021/074 - Time of Message Reception of Position-High Precision
- 14: I021/075 - Time of Message Reception for Velocity
- (FX) - Field extension indicator
- 15: I021/076 - Time of Message Reception of Velocity-High Precision
- 16: I021/140 - Geometric Height
- 17: I021/090 - Quality Indicators
- 18: I021/210 - MOPS Version
- 19: I021/070 - Mode 3/A Code in Octal Representation
- 20: I021/230 - Roll Angle
- 21: I021/145 - Flight Level
- (FX) - Field extension indicator
- 22: I021/152 - Magnetic Heading
- 23: I021/200 - Target Status
- 24: I021/155 - Barometric Vertical Rate
- 25: I021/157 - Geometric Vertical Rate

- 26: I021/160 - Airborne Ground Vector
- 27: I021/165 - Track Angle Rate
- 28: I021/077 - Time of ASTERIX Report Transmission
- (FX) - Field extension indicator
- 29: I021/170 - Target Identification
- 30: I021/020 - Emitter Category
- 31: I021/220 - Met Information
- 32: I021/146 - Selected Altitude
- 33: I021/148 - Final State Selected Altitude
- 34: I021/110 - Trajectory Intent
- 35: I021/016 - Service Management
- (FX) - Field extension indicator
- 36: I021/008 - Aircraft Operational Status
- 37: I021/271 - Surface Capabilities and Characteristics
- 38: I021/132 - Message Amplitude
- 39: I021/250 - Mode S MB Data
- 40: I021/260 - ACAS Resolution Advisory Report
- 41: I021/400 - Receiver ID
- 42: I021/295 - Data Ages
- (FX) - Field extension indicator
- *Spare*
- *Spare*
- *Spare*
- *Spare*
- *Spare*
- 48: I021/RE - Reserved Expansion Field
- 49: I021/SP - Special Purpose Field
- (FX) - Field extension indicator