Asterix category 021 - ADS-B Target Reports

category: 021

edition: 2.1

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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.

Structure:

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

- 1 bit [.]
- values:

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

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

- 2 bits [. .]
- 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*

- 1 bit [.]
- values:

  0: No capability to support Target State Reports
  1: Capable of supporting target State Reports

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

- 1 bit [.]
- values:

  0: No capability to generate ARV-reports
  1: Capable of generate ARV-reports

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

- 1 bit [.]
- values:

  0: CDTI not operational
  1: CDTI operational

I021/008/NOTTCAS - *TCAS System Status*

- 1 bit [.]
- values:

  0: TCAS operational
  1: TCAS not operational

I021/008/SA - *Single Antenna*

- 1 bit [.]
- 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.

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).

I021/015 - Service Identification

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

Structure:

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

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).

Structure:

- 8 bits [. . . . .]
- unsigned quantity
- unit: ”s”
- LSB = $1/2$ s ≈ 0.50 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.

Structure:

- 8 bits [. . . . .]
- 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.

Structure:

Extended item.

I021/040/ATP - *Address Type*

- 3 bits [. . .]
- 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*

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

I021/040/RC - *Range Check*

- 1 bit [.]
- values:
  - 0: Default
  - 1: Range Check passed, CPR Validation pending

I021/040/RAB - *Report Type*

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

(FX)

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

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/SAA - *Selected Altitude Available*

- 1 bit [.]
- values:

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

I021/040/CL - *Confidence Level*

- 2 bits [. .]
- values:

    0: Report valid
    1: Report suspect
    2: No information
    3: Reserved for future use

(FX)

- extension bit

    0: End of data item
    1: Extension into next extent

I021/040/(spare)

- 2 bits [. .]

I021/040/IPC - *Independent Position Check*

- 1 bit [.]
- values:

    0: Default (see note)
    1: Independent Position Check failed

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

- 1 bit [.]
- values:

    0: NOGO-bit not set
    1: NOGO-bit set

I021/040/CPR - *Compact Position Reporting*

- 1 bit [.]
- values:

  0: CPR Validation correct
  1: CPR Validation failed

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

- 1 bit [.]
- values:

  0: LDPJ not detected
  1: LDPJ detected

I021/040/RCF - *Range Check*

- 1 bit [.]
- values:

  0: Default
  1: Range Check failed

(FX)

- extension bit

  0: End of data item
  1: Extension into next extent

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. The second extension signals the reasons for which the report has been indicated as suspect (indication Confidence Level (CL) in the first extension).
3. 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.
4. 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.
5. Bit 5 represents the setting of the GO/NOGO-bit as defined in item I023/100 of category 023 [Ref. 3].

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

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

Structure:

I021/070/(spare)

- 4 bits [. . . .]

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

- 12 bits [. . . . . .]
- Octal string (3-bits per digit)

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.

Structure:

- 24 bits [. . . . . .]
- unsigned quantity
- unit: ”s”
- LSB = $1/2^7$ s $\approx 7.81e-3$ 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.

Structure:

- 24 bits [. . . . . .]
- unsigned quantity
- unit: ”s”
- LSB = $1/2^7$ s $\approx 7.81e-3$ 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.

Structure:

- 24 bits [. . . . . .]
- unsigned quantity
- unit: ”s”
- LSB = $1/2^7$ s $\approx 7.81e-3$ 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.

Structure:

I021/074/FSI - *Full Second Indication*

- 2 bits [. .]
- 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*

- 30 bits [. . . . . .]
- unsigned quantity
- unit: ”s”
- LSB = $1/2^30$ s $\approx 9.31e-10$ 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.

Structure:

- 24 bits [. . . . . .]
- unsigned quantity
- unit: ”s”
- LSB = $1/2^7$ s $\approx 7.81e-3$ 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.

Structure:

I021/076/FSI - *Full Second Indication*

- 2 bits [. .]
- 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*

- 30 bits [. . . . . .]
- unsigned quantity
- unit: ”s”
- LSB = $1/2^30$ s $\approx 9.31e-10$ 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.

Structure:

- 24 bits [. . . . . .]
- unsigned quantity
- unit: ”s”
- LSB = $1/2^7$ s $\approx 7.81e-3$ 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.

Structure:

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

I021/090 - Quality Indicators

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

Structure:

Extended item.

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

- 3 bits [. . .]
- raw value

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

- 4 bits [. . . .]
- raw value

remark 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

0: End of data item
1: Extension into next extent

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

- 1 bit [.]
- raw value

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

- 2 bits [. .]
- raw value

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

- 4 bits [. . . .]
- raw value

(FX)

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

I021/090/(spare)

- 2 bits [. .]

I021/090/SILS - *SIL-Supplement*

- 1 bit [.]
- values:
  - 0: Measured per flight-hour
  - 1: Measured per sample

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

- 2 bits [. .]
- raw value

I021/090/GVA - *Geometric Altitude Accuracy*

- 2 bits [. .]
- raw value

(FX)

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

I021/090/PIC - *Position Integrity Category*

- 4 bits [. . . .]
- raw value

I021/090/(spare)

- 3 bits [. . .]

(FX)

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

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.

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
- 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
- unit: ”°”
- LSB = $180/2^{2}3$ ° $\approx 2.15e-5$ °
- value $>= -90$ °
- value $<= 90$ °

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

- 24 bits [. . . . . .]
- signed quantity
- unit: ”°”
- LSB = $180/2^{2}3$ ° $\approx 2.15e-5$ °
- 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
- unit: ”s”
- LSB = 1 s

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

- 16 bits [. . . . . .]
- unsigned quantity
- unit: ”NM”
- LSB = $1/100$ NM $\approx 1.00e-2$ NM
- value $>= 0$ NM
- value $<= 13107/20$ 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: Position in WGS-84 Co-ordinates.

Structure:

I021/130/LAT - *Latitude*

- 24 bits [. . . . . .]
- signed quantity
- unit: ”°”
- LSB = $180/2^23$ ° $\approx 2.15e-5$ °
- value $>= -90$ °
- value $<= 90$ °

I021/130/LON - *Longitude*

- 24 bits [. . . . . .]
- signed quantity
- unit: ”°”
- LSB = $180/2^23$ ° $\approx 2.15e-5$ °
- value $>= -180$ °
- value < 180 °

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.

Structure:

I021/131/LAT - *Latitude*

- 32 bits [. . . . . .]
- signed quantity
- unit: ”°”
- LSB = $180/2^{30}$ ° $\approx 1.68e-7$ °
- value $>= -90$ °
- value $<= 90$ °

I021/131/LON - *Longitude*

- 32 bits [. . . . . .]
- signed quantity
- unit: ”°”
- LSB = $180/2^{30}$ ° $\approx 1.68e-7$ °
- value $>= -180$ °
- value < 180 °

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.

Structure:

- 8 bits [. . . . . .]
- signed quantity
- unit: ”dBm”
- LSB = 1 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.

Structure:

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

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.

Structure:

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

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.

Structure:

I021/146/SAS - *Source Availability*

- 1 bit [.]
- values:

  0: No source information provided
  1: Source Information provided

I021/146/S - *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
- unit: "ft"
- LSB = 25 ft
- value $>= -1300$ ft
- value < 100000 ft

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).

Structure:

I021/148/MV - *Manage Vertical Mode*

- 1 bit [.]
- values:

  0: Not active or unknown
  1: Active

I021/148/AH - *Altitude Hold Mode*

- 1 bit [.]
- values:

  0: Not active or unknown
  1: Active

I021/148/AM - *Approach Mode*

- 1 bit [.]
- values:

  0: Not active or unknown
  1: Active

I021/148/ALT - *Altitude*

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

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).

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 [. . . . . .]
- Depends on the value of `150/IM`.
- **In case of `150/IM == 0`:**
  - unsigned quantity
  - unit: ”NM/s”
  - LSB = $1/2^14$ NM/s $\approx 6.10e-5$ NM/s
- **In case of `150/IM == 1`:**
  - unsigned quantity
  - unit: ”Mach”
  - LSB = $1/1000$ Mach $\approx 1.00e-3$ Mach
- **Default:**
  - raw value

I021/151 - True Airspeed

Definition: True Air Speed.

Structure:

I021/151/RE - *Range Exceeded Indicator*

- 1 bit [.]
- values:

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

I021/151/TAS - *True Air Speed*

- 15 bits [. . . . . .]
- unsigned quantity
- unit: ”kt”
- LSB = 1 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).

Structure:

- 16 bits [. . . . . .]
- unsigned quantity
- unit: ”°”
- LSB = $360/2^16$ ° $\approx 5.49e-3$ °

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.

Structure:

I021/155/RE - *Range Exceeded Indicator*

- 1 bit [.]
- values:

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

I021/155/BVR - *Barometric Vertical Rate*

- 15 bits [. . . . .]
- signed quantity
- unit: "ft/min"
- LSB = $25/2^2$ ft/min ≈ 6.25 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.

Structure:

I021/157/RE - *Range Exceeded Indicator*

- 1 bit [.]
- values:

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

I021/157/GVR - *Geometric Vertical Rate*

- 15 bits [. . . . .]
- signed quantity
- unit: "ft/min"
- LSB = $25/2^2$ ft/min ≈ 6.25 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.

Structure:

I021/160/RE - *Range Exceeded Indicator*

- 1 bit [.]
- values:

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

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

- 15 bits [. . . . .]
- unsigned quantity
- unit: ”NM/s”
- LSB = $1/2^14$ NM/s $\approx 6.10e-5$ NM/s
- value $>= 0$ NM/s
- value < 2 NM/s

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

- 16 bits [. . . . .]
- unsigned quantity
- unit: ”°”
- LSB = $360/2^16$ ° $\approx 5.49e-3$ °

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.

Structure:

I021/161/(spare)

- 4 bits [. . . .]

I021/161/TRNUM - *Track Number*

- 12 bits [. . . . .]
- raw value

I021/165 - Track Angle Rate

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

Structure:

I021/165/(spare)

- 6 bits [. . . . . .]

I021/165/TAR - *Track Angle Rate*

- 10 bits [. . . . . .]
- signed quantity
- unit: "°/s"
- LSB = $1/2^5$ °/s $\approx 3.12e-2$ °/s
- value $>= -16$ °/s
- value $<= 16$ °/s

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.

Structure:

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

I021/200 - Target Status

Definition: Status of the target

Structure:

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

- 1 bit [.]
- values:

  0: No intent change active
  1: Intent change flag raised

I021/200/LNAV - *LNAV Mode*

- 1 bit [.]
- values:

  0: LNAV Mode engaged
  1: LNAV Mode not engaged

I021/200/(spare)

- 1 bit [.]

I021/200/PS - *Priority Status*

- 3 bits [. . .]
- 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*

- 2 bits [. .]
- 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.

I021/210 - MOPS Version

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

Structure:

I021/210/(spare)

- 1 bit [.]

I021/210/VNS - *Version Not Supported*

- 1 bit [.]
- 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*

- 3 bits [. . .]
- values:

    0: ED102/DO-260 [Ref. 8]
    1: DO-260A [Ref. 9]
    2: ED102A/DO-260B [Ref. 11]

I021/210/LTT - *Link Technology Type*

- 3 bits [. . .]
- 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.

I021/220 - Met Information

Definition: Meteorological information.

Structure:

Compound item (FX)

I021/220/WS - *Wind Speed*

- 16 bits [. . . . .]
- unsigned quantity
- unit: ”kt”
- LSB = 1 kt
- value >= 0 kt
- value <= 300 kt

I021/220/WD - *Wind Direction*

- 16 bits [. . . . .]
- unsigned quantity
- unit: ”°”
- LSB = 1 °
- value >= 1 °
- value <= 360 °

I021/220/TMP - *Temperature*

- 16 bits [. . . . .]
- signed quantity
- unit: ”°C”
- LSB = $1/2^2$ °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
- unit: "°"
- LSB = $1/100$ ° $\approx 1.00e-2$ °
- 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.

I021/250 - Mode S MB Data

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

Structure:

Repetitive item, repetition factor 8 bits.

- 64 bits [`... 64 bits ...`]
- 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.

Structure:

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

- 5 bits [. . . . .]
- raw value

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

- 3 bits [. . .]
- raw value

I021/260/ARA - *Active Resolution Advisories*

- 14 bits [. . . . .]
- raw value

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

- 4 bits [. . . .]
- raw value

I021/260/RAT - *RA Terminated*

- 1 bit [.]
- raw value

I021/260/MTE - *Multiple Threat Encounter*

- 1 bit [.]
- raw value

I021/260/TTI - *Threat Type Indicator*

- 2 bits [..]
- raw value

I021/260/TID - *Threat Identity Data*

- 26 bits [..........................]
- raw value

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 6,2 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. 10]

I021/271 - Surface Capabilities and Characteristics

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

Structure:

Extended item.

I021/271/(spare)

- 2 bits [..]

I021/271/POA - *Position Offset Applied*

- 1 bit [.]
- 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*

- 1 bit [.]
- values:

  0: CDTI not operational
  1: CDTI operational

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

- 1 bit [.]
- values:

  0: >= 70 Watts
  1: < 70 Watts

I021/271/RAS - *Receiving ATC Services*

- 1 bit [.]
- values:

  0: Aircraft not receiving ATC-services
  1: Aircraft receiving ATC services

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

- 1 bit [.]
- values:

  0: IDENT switch not active
  1: IDENT switch active

(FX)

- extension bit

  0: End of data item
  1: Extension into next extent

I021/271/(spare)

- 4 bits [....]

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

- 4 bits [....]
- raw value

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. This data item is a variant of the “Extended length data field” as described in ASTERIX part1. The LSB in the first extension is not used as FX-bit.

I021/295 - Data Ages

Definition: Ages of the data provided.

Structure:

Compound item (FX)

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

Age of the information transmitted in item I021/008.

- 8 bits [........]
- unsigned quantity
- unit: ”s”
- LSB = $1/10$ s ≈ 0.10 s
- value $<= 51/2$ s

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

Age of the Target Report Descriptor, item I021/040

- 8 bits [........]
- unsigned quantity
- unit: ”s”

- LSB = $1/10$ s ≈ 0.10 s
- value $<= 51/2$ s

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

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

- 8 bits [. . . . .]
- unsigned quantity
- unit: ”s”
- LSB = $1/10$ s ≈ 0.10 s
- value $<= 51/2$ s

I021/295/QI - *Quality Indicators Age*

Age of the Quality Indicators, item I021/090

- 8 bits [. . . . .]
- unsigned quantity
- unit: ”s”
- LSB = $1/10$ s ≈ 0.10 s
- value $<= 51/2$ s

I021/295/TI1 - *Trajectory Intent Age*

Age of the Trajectory Intent information, item I021/110

- 8 bits [. . . . .]
- unsigned quantity
- unit: ”s”
- LSB = $1/10$ s ≈ 0.10 s
- value $<= 51/2$ s

I021/295/MAM - *Message Amplitude Age*

Age of the message amplitude, item I021/132

- 8 bits [. . . . .]
- unsigned quantity
- unit: ”s”
- LSB = $1/10$ s ≈ 0.10 s
- value $<= 51/2$ s

I021/295/GH - *Geometric Height Age*

Age of the Geometric Height, item 021/140

- 8 bits [. . . . .]
- unsigned quantity
- unit: ”s”
- LSB = $1/10$ s ≈ 0.10 s
- value $<= 51/2$ s

I021/295/FL - *Flight Level Age*

Age of the Flight Level, item I021/145

- 8 bits [. . . . .]
- unsigned quantity
- unit: ”s”
- LSB = $1/10$ s ≈ 0.10 s
- value $<= 51/2$ s

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

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

- 8 bits [. . . . .]

- unsigned quantity
- unit: ”s”
- LSB = $1/10$ s ≈ 0.10 s
- value $<= 51/2$ s

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

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

- 8 bits [. . . . .]
- unsigned quantity
- unit: ”s”
- LSB = $1/10$ s ≈ 0.10 s
- value $<= 51/2$ s

I021/295/AS - *Air Speed Age*

Age of the Air Speed, item I021/150

- 8 bits [. . . . .]
- unsigned quantity
- unit: ”s”
- LSB = $1/10$ s ≈ 0.10 s
- value $<= 51/2$ s

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

Age of the True Air Speed, item I021/151

- 8 bits [. . . . .]
- unsigned quantity
- unit: ”s”
- LSB = $1/10$ s ≈ 0.10 s
- value $<= 51/2$ s

I021/295/MH - *Magnetic Heading Age*

Age of the Magnetic Heading, item I021/152

- 8 bits [. . . . .]
- unsigned quantity
- unit: ”s”
- LSB = $1/10$ s ≈ 0.10 s
- value $<= 51/2$ s

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

Age of the Barometric Vertical Rate, item I021/155

- 8 bits [. . . . .]
- unsigned quantity
- unit: ”s”
- LSB = $1/10$ s ≈ 0.10 s
- value $<= 51/2$ s

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

Age of the Geometric Vertical Rate, item I021/157

- 8 bits [. . . . .]
- unsigned quantity
- unit: ”s”
- LSB = $1/10$ s ≈ 0.10 s
- value $<= 51/2$ s

I021/295/GV - *Ground Vector Age*

Age of the Ground Vector, item I021/160

- 8 bits [. . . . . .]
- unsigned quantity
- unit: ”s”
- LSB = $1/10$ s ≈ 0.10 s
- value $<= 51/2$ s

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

Age of the Track Angle Rate, item I021/165

- 8 bits [. . . . . .]
- unsigned quantity
- unit: ”s”
- LSB = $1/10$ s ≈ 0.10 s
- value $<= 51/2$ s

I021/295/TI2 - *Target Identification Age*

Age of the Target Identification, item I021/170

- 8 bits [. . . . . .]
- unsigned quantity
- unit: ”s”
- LSB = $1/10$ s ≈ 0.10 s
- value $<= 51/2$ s

I021/295/TS - *Target Status Age*

Age of the Target Status, item I021/200

- 8 bits [. . . . . .]
- unsigned quantity
- unit: ”s”
- LSB = $1/10$ s ≈ 0.10 s
- value $<= 51/2$ s

I021/295/MET - *Met Information Age*

Age of the Meteorological Information, item I021/220

- 8 bits [. . . . . .]
- unsigned quantity
- unit: ”s”
- LSB = $1/10$ s ≈ 0.10 s
- value $<= 51/2$ s

I021/295/ROA - *Roll Angle Age*

Age of the Roll Angle, item I021/230

- 8 bits [. . . . . .]
- unsigned quantity
- unit: ”s”
- LSB = $1/10$ s ≈ 0.10 s
- value $<= 51/2$ s

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

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

- 8 bits [. . . . . .]
- unsigned quantity
- unit: ”s”
- LSB = $1/10$ s ≈ 0.10 s
- value $<= 51/2$ s

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

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

- 8 bits [. . . . .]
- unsigned quantity
- unit: ”s”
- LSB = $1/10$ s ≈ 0.10 s
- value $<= 51/2$ s

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.

Structure:

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

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) `I021/161` - 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
- (43) (spare)
- (44) (spare)
- (45) (spare)
- (46) (spare)
- (47) (spare)
- (48) I021/RE - Reserved Expansion Field
- (49) I021/SP - Special Purpose Field
- (FX) - Field extension indicator