Asterix category 010 - Transmission of Monosensor Surface Movement Data

category: 010

edition: 1.1

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Preamble

Surveillance data exchange.

Description of standard data items

I010/000 - Message Type

Definition: This Data Item allows for a more convenient handling of the messages at the receiver side by further defining the type of transaction.

Structure:

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

    1: Target Report
    2: Start of Update Cycle
    3: Periodic Status Message
    4: Event-triggered Status Message

Notes:

1. In applications where transactions of various types are exchanged, the Message Type Data Item facilitates the proper message handling at the receiver side.
2. All Message Type values are reserved for common standard use.
3. The list of items present for the four message types is defined in the following table. M stands for mandatory, O for optional, X for never present.

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```
Item Type [001, 002, 003, 004]
       [Target Report, Start of Update Cycle, Periodic Status Message, Event Status Message]

I010/000 Message Type M M M M
I010/010 Data Source Identifier M M M M
I010/020 Target Report Descriptor M X X X
I010/040 Measured Position in Polar Coordinates O X X X
I010/041 Position in WGS-84 Coordinates O X X X
I010/042 Position in Cartesian Coordinates O X X X
I010/060 Mode-3/A Code O X X X
I010/090 Flight Level in Binary Representation O X X X
I010/091 Measured Height O X X X
I010/131 Amplitude of Primary Plot O X X X
I010/140 Time of Day M M M M
I010/161 Track Number O X X X
I010/170 Track Status O X X X
```

```
I010/200 Calculated Track Velocity in Polar Coordinates O X X X
I010/202 Calculated Track Velocity in Cartesian Coordinates O X X X
I010/210 Calculated Acceleration O X X X
I010/220 Target Address O X X X
I010/245 Target Identification O X X X
I010/250 Mode S MB Data O X X X
I010/270 Target Size & Orientation O X X X
I010/280 Presence O X X X
I010/300 Vehicle Fleet Identification O X X X
I010/310 Pre-programmed Message O X X X
I010/500 Standard Deviation of Position O X X X
I010/550 System Status X O M M
```

I010/010 - Data Source Identifier

Definition: Identification of the system from which the data are received.

Structure:

I010/010/SAC - *System Area Code*

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

I010/010/SIC - *System Identification Code*

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

NOTE - The SAC is fixed to zero to indicate a data flow local to the airport.

I010/020 - Target Report Descriptor

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

Structure:

Extended item.

I010/020/TYP

- 3 bits [. . .]
- values:
  - 0: SSR multilateration
  - 1: Mode S multilateration
  - 2: ADS-B
  - 3: PSR
  - 4: Magnetic Loop System
  - 5: HF multilateration
  - 6: Not defined
  - 7: Other types

I010/020/DCR

- 1 bit [.]
- values:
  - 0: No differential correction (ADS-B)
  - 1: Differential correction (ADS-B)

I010/020/CHN

- 1 bit [.]
- values:

  0: Chain 1
  1: Chain 2

I010/020/GBS

- 1 bit [.]
- values:

  0: Transponder Ground bit not set
  1: Transponder Ground bit set

I010/020/CRT

- 1 bit [.]
- values:

  0: No Corrupted reply in multilateration
  1: Corrupted replies in multilateration

(FX)

- extension bit

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

I010/020/SIM

- 1 bit [.]
- values:

  0: Actual target report
  1: Simulated target report

I010/020/TST

- 1 bit [.]
- values:

  0: Default
  1: Test Target

I010/020/RAB

- 1 bit [.]
- values:

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

I010/020/LOP

- 2 bits [. .]
- values:

  0: Undetermined
  1: Loop start
  2: Loop finish

I010/020/TOT

- 2 bits [. .]

- values:
  - 0: Undetermined
  - 1: Aircraft
  - 2: Ground vehicle
  - 3: Helicopter

(FX)

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

I010/020/SPI

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

I010/020/(spare)

- 6 bits [. . . . . .]

(FX)

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

I010/040 - Measured Position in Polar Co-ordinates

Definition: Measured position of a target in local polar co-ordinates.

Structure:

I010/040/RHO - *RHO*

- 16 bits [. . . . . .]
- unsigned quantity
- scaling factor: 1
- fractional bits: 0
- unit: ”m”
- LSB = 1 m
- value $<= 65536$ m

I010/040/TH - *Theta*

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

I010/041 - Position in WGS-84 Co-ordinates

Definition: Position of a target in WGS-84 Co-ordinates.

Structure:

I010/041/LAT - *Latitude*

- 32 bits [. . . . . .]
- signed quantity
- scaling factor: 180
- fractional bits: 31
- unit: ”°”
- LSB = $180/2^{31}$ ° = $180/2147483648$ ° ≈ $8.381903171539307e-8$ °
- value >= -90 °
- value <= 90 °

I010/041/LON - *Longitude*

- 32 bits [. . . . . .]
- signed quantity
- scaling factor: 180
- fractional bits: 31
- unit: ”°”
- LSB = $180/2^{31}$ ° = $180/2147483648$ ° ≈ $8.381903171539307e-8$ °
- value >= -180 °
- value < 180 °

I010/042 - Position in Cartesian Co-ordinates

Definition: Position of a target in Cartesian co-ordinates, in two’s complement form.

Structure:

I010/042/X - *X Coordinate*

- 16 bits [. . . . . .]
- signed quantity
- scaling factor: 1
- fractional bits: 0
- unit: ”m”
- LSB = 1 m
- value >= -32768 m
- value <= 32768 m

I010/042/Y - *Y Coordinate*

- 16 bits [. . . . . .]
- signed quantity
- scaling factor: 1
- fractional bits: 0
- unit: ”m”
- LSB = 1 m
- value >= -32768 m
- value <= 32768 m

I010/060 - Mode-3/A Code in Octal Representation

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

Structure:

I010/060/V - *Validated*

- 1 bit [.]
- values:

  0: Code validated
  1: Code not validated

I010/060/G - *Garbled*

- 1 bit [.]
- values:

  0: Default
  1: Garbled code

I010/060/L

- 1 bit [.]
- values:

  0: Mode-3/A code derived from the reply of the transponder
  1: Mode-3/A code not extracted during the last scan

I010/060/(spare)

- 1 bit [.]

I010/060/MODE3A - *Mode-3/A Reply in Octal Representation*

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

Notes:

1. Bit 15 has no meaning in the case of a smoothed Mode-3/A code and is set to 0 for a calculated track. For Mode S, it is set to one when an error correction has been attempted.
2. For Mode S, bit 16 is normally set to zero, but can exceptionally be set to one to indicate a non-validated Mode-3/A code (e.g. alert condition detected, but new Mode-3/A code not successfully extracted).

I010/090 - Flight Level in Binary Representation

Definition: Flight Level (Mode C / Mode S Altitude) converted into binary two's complement representation.

Structure:

I010/090/V - *Validated*

- 1 bit [.]
- values:

  0: Code validated
  1: Code not validated

I010/090/G - *Garbled*

- 1 bit [.]
- values:

  0: Default
  1: Garbled code

I010/090/FL - *Flight Level*

- 14 bits [..............]
- signed quantity
- scaling factor: 1
- fractional bits: 2
- unit: "FL"
- LSB = $1/2^2$ FL = $1/4$ FL ≈ 0.25 FL

Notes:

1. The value shall be within the range described by ICAO Annex 10
2. For Mode S, bit 15 (G) is set to one when an error correction has been attempted.

I010/091 - Measured Height

Definition: Height above local 2D co-ordinate reference system (two's complement) based on direct measurements not related to barometric pressure.

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 $>= -204800$ ft
- value $<= 204800$ ft

I010/131 - Amplitude of Primary Plot

Definition: Amplitude of Primary Plot.

Structure:

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

Notes:

- The value is radar-dependent, 0 being the minimum detectable level for that radar.

I010/140 - Time of Day

Definition: Absolute time stamping 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

Notes:

- The time of day value is reset to zero each day at midnight.

I010/161 - Track Number

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

Structure:

I010/161/(spare)

- 4 bits [. . . .]

I010/161/TRK - *Track Number*

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

I010/170 - Track Status

Definition: Status of track.

Structure:

Extended item.

I010/170/CNF

- 1 bit [.]
- values:
  0: Confirmed track
  1: Track in initialisation phase

I010/170/TRE

- 1 bit [.]
- values:
  0: Default
  1: Last report for a track

I010/170/CST

- 2 bits [. .]
- values:
  0: No extrapolation
  1: Predictable extrapolation due to sensor refresh period (see NOTE)
  2: Predictable extrapolation in masked area
  3: Extrapolation due to unpredictable absence of detection

I010/170/MAH

- 1 bit [.]
- values:

  0: Default
  1: Horizontal manoeuvre

I010/170/TCC

- 1 bit [.]
- values:

  0: Tracking performed in 'Sensor Plane', i.e. neither slant range correction nor projection was applied
  1: Slant range correction and a suitable projection technique are used to track in a 2D.reference plane, tangential to the earth model at the Sensor Site co-ordinates

I010/170/STH

- 1 bit [.]
- values:

  0: Measured position
  1: Smoothed position

(FX)

- extension bit

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

I010/170/TOM

- 2 bits [. .]
- values:

  0: Unknown type of movement
  1: Taking-off
  2: Landing
  3: Other types of movement

I010/170/DOU

- 3 bits [. . .]
- values:

  0: No doubt
  1: Doubtful correlation (undetermined reason)
  2: Doubtful correlation in clutter
  3: Loss of accuracy
  4: Loss of accuracy in clutter
  5: Unstable track
  6: Previously coasted

I010/170/MRS

- 2 bits [. .]
- values:

  0: Merge or split indication undetermined
  1: Track merged by association to plot
  2: Track merged by non-association to plot
  3: Split track

(FX)

- extension bit

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

I010/170/GHO

- 1 bit [.]
- values:

  0: Default
  1: Ghost track

I010/170/(spare)

- 6 bits [. . . . . .]

(FX)

- extension bit

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

Notes:

1. Some sensors are not be able to scan the whole coverage in one refresh period. Therefore, track extrapolation is performed in un-scanned sectors. CST is then set to 01.
2. Bit-8 (GHO) is used to signal that the track is suspected to have been generated by a fake target.

I010/200 - Calculated Track Velocity in Polar Co-ordinates

Definition: Calculated track velocity expressed in polar co-ordinates.

Structure:

I010/200/GSP - *Ground Speed*

- 16 bits [. . . . . .]
- 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
- value $<= 2$ NM/s

I010/200/TRA - *Track Angle*

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

I010/202 - Calculated Track Velocity in Cartesian Co-ordinates

Definition: Calculated track velocity expressed in Cartesian co-ordinates, in two's complement representation.

Structure:

I010/202/VX - *X Velocity*

- 16 bits [. . . . . .]
- signed quantity
- scaling factor: 1
- fractional bits: 4
- unit: "m/s"
- LSB = $1/2^4$ m/s = $1/16$ m/s $\approx 6.25e-2$ m/s
- value $>= -8192$ m/s
- value $<= 8192$ m/s

I010/202/VY - *Y Velocity*

- 16 bits [. . . . . .]
- signed quantity
- scaling factor: 1
- fractional bits: 4
- unit: "m/s"
- LSB = $1/2^4$ m/s = $1/16$ m/s $\approx 6.25e-2$ m/s
- value $>= -8192$ m/s
- value $<= 8192$ m/s

I010/210 - Calculated Acceleration

Definition: Calculated Acceleration of the target, in two's complement form.

Structure:

I010/210/AX - *X Acceleration*

- 8 bits [. . . . . .]
- signed quantity
- scaling factor: 1
- fractional bits: 4
- unit: "m/s2"
- LSB = $1/2^4$ m/s2 = $1/16$ m/s2 $\approx 6.25e-2$ m/s2
- value $>= -31$ m/s2
- value $<= 31$ m/s2

I010/210/AY - *Y Acceleration*

- 8 bits [. . . . . .]
- signed quantity
- scaling factor: 1
- fractional bits: 4
- unit: "m/s2"
- LSB = $1/2^4$ m/s2 = $1/16$ m/s2 $\approx 6.25e-2$ m/s2
- value $>= -31$ m/s2
- value $<= 31$ m/s2

I010/220 - Target Address

Definition: Target address (24-bits address) assigned uniquely to each Target.

Structure:

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

I010/245 - Target Identification

Definition: Target (aircraft or vehicle) identification in 8 characters.

Structure:

I010/245/STI

- 2 bits [. .]
- values:
  0: Callsign or registration downlinked from transponder
  1: Callsign not downlinked from transponder
  2: Registration not downlinked from transponder

I010/245/(spare)

- 6 bits [. . . . . .]

I010/245/CHR - *Characters 1-8 (Coded on 6 Bits Each) Defining Target Identification*

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

Notes:

- See ICAO document Annex 10, Volume I, Part I, section 3.8.2.9 for the coding rules.

I010/250 - Mode S MB Data

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

Structure:

Repetitive item, repetition factor 8 bits.

I010/250/MBDATA

56-bit message conveying Mode S Comm B message data

- 56 bits [`... 56 bits ...`]
- raw value

I010/250/BDS1

Comm B Data Buffer Store 1 Address

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

I010/250/BDS2

Comm B Data Buffer Store 2 Address

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

Notes:

- For the transmission of BDS20, item 245 is used.

I010/270 - Target Size and Orientation

Definition: Target size defined as length and width of the detected target, and orientation.

Structure:

Extended item.

I010/270/LENGTH - *Length*

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

(FX)

- extension bit

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

I010/270/ORIENTATION - *Orientation*

- 7 bits [. . . . . .]
- unsigned quantity
- scaling factor: 360
- fractional bits: 7
- unit: ”°”
- LSB = $360/2^7$ ° = $360/128$ ° ≈ 2.8125 °

(FX)

- extension bit

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

I010/270/WIDTH - *Width*

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

(FX)

- extension bit

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

Notes:

- The orientation gives the direction which the aircraft nose is pointing, relative to the Geographical North.

I010/280 - Presence

Definition: Positions of all elementary presences constituting a plot.

Structure:

Repetitive item, repetition factor 8 bits.

I010/280/DRHO

Difference between the radial distance of the plot centre and that of the presence.

- 8 bits [. . . . . .]
- signed quantity
- scaling factor: 1
- fractional bits: 0
- unit: ”m”
- LSB = 1 m
- value >= −127 m
- value <= 127 m

I010/280/DTHETA

Difference between the azimuth of the plot centre and that of the presence.

- 8 bits [. . . . . .]
- signed quantity
- scaling factor: 0.15
- fractional bits: 0
- unit: ”°”
- LSB = 0.15 °
- value >= −19.05 °
- value <= 19.05 °

I010/300 - Vehicle Fleet Identification

Definition: Vehicle fleet identification number.

Structure:

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

  0: Unknown
  1: ATC equipment maintenance
  2: Airport maintenance
  3: Fire
  4: Bird scarer
  5: Snow plough
  6: Runway sweeper
  7: Emergency
  8: Police
  9: Bus
  10: Tug (push/tow)
  11: Grass cutter
  12: Fuel
  13: Baggage
  14: Catering
  15: Aircraft maintenance
  16: Flyco (follow me)

I010/310 - Pre-programmed Message

Definition: Number related to a pre-programmed message that can be transmitted by a vehicle.

Structure:

I010/310/TRB

- 1 bit [.]
- values:

  0: Default
  1: In Trouble

I010/310/MSG

- 7 bits [. . . . .]
- values:

  1: Towing aircraft
  2: “Follow me” operation
  3: Runway check
  4: Emergency operation (fire, medical...)
  5: Work in progress (maintenance, birds scarer, sweepers...)

I010/500 - Standard Deviation of Position

Definition: Standard Deviation of Position

Structure:

I010/500/DEVX - *Standard Deviation of X Component*

- 8 bits [. . . . .]
- unsigned quantity
- scaling factor: 1
- fractional bits: 2
- unit: ”m”
- LSB = $1/2^2$ m = $1/4$ m ≈ 0.25 m

I010/500/DEVY - *Standard Deviation of Y Component*

- 8 bits [. . . . .]
- unsigned quantity
- scaling factor: 1
- fractional bits: 2
- unit: ”m”
- LSB = $1/2^2$ m = $1/4$ m ≈ 0.25 m

I010/500/COVXY - *Covariance in Two’s Complement Form*

- 16 bits [. . . . .]
- signed quantity
- scaling factor: 1
- fractional bits: 2
- unit: ”m”
- LSB = $1/2^2$ m = $1/4$ m ≈ 0.25 m

I010/550 - System Status

Definition: Information concerning the configuration and status of a System.

Structure:

I010/550/NOGO - *Operational Release Status of the System*

- 2 bits [. .]
- values:

  0: Operational
  1: Degraded
  2: NOGO

I010/550/OVL - *Overload Indicator*

- 1 bit [.]
- values:

  0: No overload
  1: Overload

I010/550/TSV - *Time Source Validity*

- 1 bit [.]
- values:

  0: Valid
  1: Invalid

I010/550/DIV

- 1 bit [.]
- values:

  0: Normal Operation
  1: Diversity degraded

I010/550/TTF

- 1 bit [.]
- values:

  0: Test Target Operative
  1: Test Target Failure

I010/550/(spare)

- 2 bits [. .]

Notes:

- For a radar, bit-4 (DIV) is set to zero either when diversity is not used, or when diversity is used and operational.

I010/RE - Reserved Expansion Field

Definition: Expansion

Structure:

Explicit item (RE)

I010/SP - Special Purpose Field

Definition: Special Purpose Field
Structure:
Explicit item (SP)

User Application Profile for Category 010

- (1) `I010/010` - Data Source Identifier
- (2) `I010/000` - Message Type
- (3) `I010/020` - Target Report Descriptor
- (4) `I010/140` - Time of Day
- (5) `I010/041` - Position in WGS-84 Co-ordinates
- (6) `I010/040` - Measured Position in Polar Co-ordinates
- (7) `I010/042` - Position in Cartesian Co-ordinates
- `(FX)` - Field extension indicator
- (8) `I010/200` - Calculated Track Velocity in Polar Co-ordinates
- (9) `I010/202` - Calculated Track Velocity in Cartesian Co-ordinates
- (10) `I010/161` - Track Number
- (11) `I010/170` - Track Status
- (12) `I010/060` - Mode-3/A Code in Octal Representation
- (13) `I010/220` - Target Address
- (14) `I010/245` - Target Identification
- `(FX)` - Field extension indicator
- (15) `I010/250` - Mode S MB Data
- (16) `I010/300` - Vehicle Fleet Identification
- (17) `I010/090` - Flight Level in Binary Representation
- (18) `I010/091` - Measured Height
- (19) `I010/270` - Target Size and Orientation
- (20) `I010/550` - System Status
- (21) `I010/310` - Pre-programmed Message
- `(FX)` - Field extension indicator
- (22) `I010/500` - Standard Deviation of Position
- (23) `I010/280` - Presence
- (24) `I010/131` - Amplitude of Primary Plot
- (25) `I010/210` - Calculated Acceleration
- (26) `(spare)`
- (27) `I010/SP` - Special Purpose Field
- (28) `I010/RE` - Reserved Expansion Field
- `(FX)` - Field extension indicator