

UNCLASSIFIED

INTERFACE DESIGN DOCUMENT (IDD)

For the

ELM-2026BF

For LLLR Demonstration Based on NCNC of CIWS project

To be finalized during System Integration

17 January 2023

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| REVISIONS | | | | | | | | | | | | | | | |
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| 2.2 | 20-04-2020 | Software ICD ELM-2026BF versions | | | | | | | | | | | | | |
| 2.4 | 11.01.2023 | Software ICD ELM-2026BF standalone configuration | | | | | | | | | | | | | |
| 2.5 | 12.01.2023 | Removing unused fields in ECCM and MFL report message and size update | | | | | | | | | | | | | |
| 2.6 | 17.01.2023 | Update size of MFL report and ECCM report TWS report is dynamic size message | | | | | | | | | | | | | |
| UNLESS OTHERWISE NOTED ALL PAGES ARE OF ORIGINAL ISSUE | | | | | | | | | | | | | | | |
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| APPROVAL: | | | | | | TITLE: Radar Interface with C2 | | | | | | | | | |

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1. SCOPE

1.1 Identification

The document defines the interface between the Radar system and the C2.

1.2 Document Overview

- The Message Descriptions and Data Elements sections will be defined in this document.
- The following information is defined per message in the Data Dictionary:
 - a. Unique message name/ID.
 - b. Message rate.
 - c. Message description.
 - d. Message source and destination
- The following information is defined per data element in the Data Dictionary:
 - Unique element name.
 - Element description.
 - Units of measure.
 - Limits/range of values (min/max).
 - Resolution in terms of least significant digit.
 - Data type and format (while a signed signal is defined it means TWO's complement).

Note: “LITTLE ENDIAN” is used within all messages in the system.

2. INTERFACE DESIGN

2.1 Interfaces Diagram

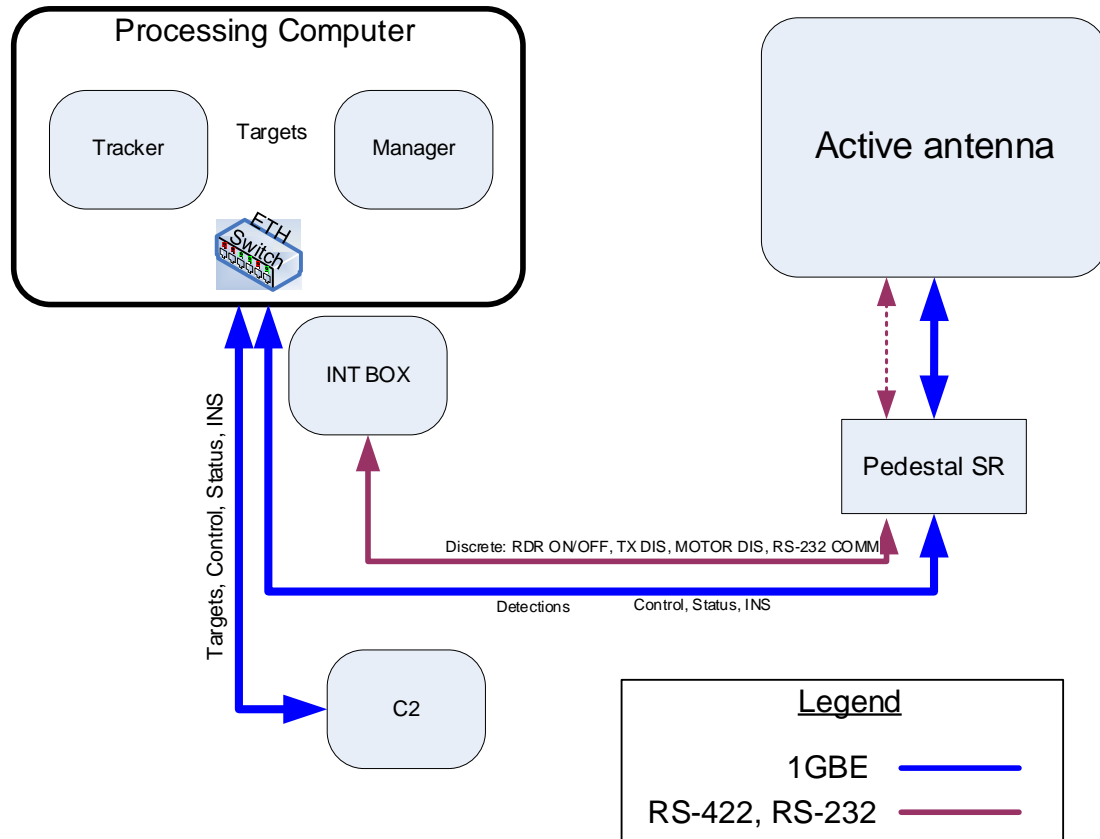


Figure 1- Schematic Interfaces Block Diagram

3. MESSAGES

The messages in the systems are divided into 2 parts: Header and Body. The header structure is identical for all messages and its length is fixed (See Table 4-1 below). The Body is of variable length. A header only message (without the body part) is valid.

Table 1: Message Header Format to Port 20030 to and from RP/Processing Computer

| SIGNAL NAME | SIZE (Bytes) | DESCRIPTION | |
|---------------------------|--------------|--|--|
| Message Prefix | 2 | Constant “DBCA” | |
| Message Source | 2 | 0x1 – RADAR 0x2 – C2 | |
| Message Type (ID) | 2 | 1-0xffff (See IDD) | |
| Body Length | 2 | 0 byte-4k bytes (Including Body and header) | |
| Message Sequential Number | 2 | 1-0xffff (Handled in cyclic manner incremented at interface level) | |
| Message Header SPARE | 2 | - | |

Table 2: Message Format

| SIGNAL NAME | SIZE (Bytes) | DESCRIPTION | |
|--------------|------------------|---------------------------------|--|
| HEADER | 12 / 20 | See Message Header Format above | |
| Message Body | 4bytes - 4k byte | See IDD for each message | |

Notes: All messages must be aligned to 32 bits.

Table 3: Messages Summary

| Message Type | Message Name | Message Rate | Source | Destination | Total Length | Remarks |
|---|--------------------|-----------------------------|-------------|-------------|--------------|----------------------|
| C2 TO RADAR RP / Processing Computer | | | | | | |
| 0x0101 | State Of Operation | 1Hz | C2 | RADAR RP/PC | 88 | |
| 0x0103 | INS data | On startup and upon request | C2 | RADAR RP/PC | 80 | Only at standby mode |
| 0x012C | Target delete | Upon request | C2 | RADAR RP/PC | 24 | |
| RADAR TO C2 | | | | | | |
| 0x0201 | Status Report | 1 Hz | RADAR RP/PC | C2 | 92 | |
| 0x0204 | TWS Targets Report | 1Hz in TWS, 10Hz in Acq | RADAR RP/PC | C2 | 19216 | Dynamic size |
| 0x0205 | MFL Report | 1 Hz | RADAR RP/PC | C2 | 336 | |
| 0x0206 | ECCM Report | 1 Hz | RADAR RP/PC | C2 | 272 | |
| 0x0582 | Antenna Position | 10Hz | RADAR RP/PC | C2 | 32 | |

Notes:

- Main mission control unit is referred as: MC, C2 or FCC. Functions are the same.
- The Radar shall open an UDP Server on port 20030. Connections shall be established on 1st message the Radar receives from C2.
- TWS Targets Report: All detected targets will be sent from Radar to MC every 1 second (until maximum of 120 targets).
- All messages **besides TWS Targets Report** message in this interface have constant length. Messages which contain array(s) will always be sent with the maximum possible size.
- System Power-Up sequence: Once powered on, the radar units are initiated, self-calibrating and performing BIT. If no critical errors found, radar is ready and goes into standby mode unless C2 commands otherwise.

3.1 Messages from C2 to Radar RP/PC (ETH/UDP - PORT 20030)

Table 4: Messages from C2 to Radar thru ETH

| TYPE (ID) | RATE | MESSAGE NAME | WORD NAME | FIELD NAME | DESCRIPTION | SIGNAL SIZE (BITS) | SIGNAL RANGE | RES |
|-----------|--------------------|---------------|------------------------------|---------------|---|--------------------|---|-----|
| 0x0101 | 1Hz or upon change | Radar Control | Radar state & mode selection | RDR_STATE | Radar commanded state. Note: Maintenance mode is for integration, by ELTA team. | 32 | 2-STBY 4-OPERATE | N/A |
| | | | | RDR_MODE | Radar commanded mode. | 32 | 2-AA_360 | N/A |
| | | | | TGT_TYPE_MODE | 1 – Test target =Aeromodel target, for possible use in trials. 2 – Static target repeater (ZDT in ELTA). For possible alignment of radar and optics. | 32 | 0- Normal 1- Test Target 2 - Repeater | N/A |
| | | | Radar Parameters | TX | Radar Transmit ON/OFF | 32 | 1-Transmit ON 0-Transmit OFF | N/A |
| | | | | DETECTION_RNG | Max range for target – radar will not report targets above this range. | 32 | 1=5 KM 2=10 KM 3=20 KM 4=60 KM | N/A |

| TYPE (ID) | RATE | MESSAGE NAME | WORD NAME | FIELD NAME | DESCRIPTION | SIGNAL SIZE (BITS) | SIGNAL RANGE | RES |
|-----------|------|--------------|--|-----------------------|---|--------------------|--|-------------|
| | | | | DETECTION_EL | Actual electronic scan center. Units = Deg. Relative to horizon. | float | -40..+90 | 0.5 degrees |
| | | | | SPARE | | 32 (Signed) | | |
| | | | | TVEL | Target velocity rejection threshold. High / Low pre-defined by user / C2 | 32 | 0 = HIGH 1 = LOW (default) | N/A |
| | | | | FREQ_BAND | Frequency Band Selection | 32 | 0-BAND A 1-BAND B 2-BAND C 3-BAND D 4-BAND E (default) 5-BAND F | N/A |
| | | | | FREQ_BAND_CHANGE | Frequency band change can be done automatic by radar or manually controlled by operator | 32 | 0 – Manual (default) 1 - Automatic | |
| | | | | N_VALID_BLANK_SECTORS | Number of sectors, that have valid data | 32 | 0..2 | |
| | | | Sector Data - this structure is always repeated 2 times | START_ANGLE | Sector start angle, relative to north | 32 (Signed) | 0 - 360 | degrees |
| | | | | END_ANGLE | Sector end angle, relative to north. Minimum sector size is 10 degrees | 32 (Signed) | 0 - 360 | degrees |
| | | | | SECTOR_TYPE | Disable transmission/reception within the sector | 32 | 2-INHIBIT | |
| | | | Target control | CLR_TWS_CMD | Clear TWS targets command (ONE SHOT) | 32 | 0=OFF (default) 1=ON | N/A |

| TYPE (ID) | RATE | MESSAGE NAME | WORD NAME | FIELD NAME | DESCRIPTION | SIGNAL SIZE (BITS) | SIGNAL RANGE | RES |
|---------------|---------------------|-----------------|---|-----------------|--|--------------------|-----------------|---------------|
| | | | Pedestal reached acquisition azimuth and elevation | ACQ_POS_REACHED | | 32 | 0 – Not reached | N/A |
| | | | | | | | | |
| 0x0103 | Upon request | INS Data | | | | | | |
| | | | Time Tag | INS_TIME_TAG | Time tag (TOD) of INS data | 32 | 0-24 hour | 1 millisecond |
| | | | Position | UTM_X | East Position Units: Meter | 32 (Signed) | 0..20000000 | 1 |
| | | | | UTM_Y | North Position Units: Meter | 32 (Signed) | 0..20000000 | 1 |
| | | | | UTM_Z | Altitude above sea level Positive Direction is UP Units: Meter | 32 (Signed) | -1000..+100000 | 1 |
| | | | | UTM_ZONE | Current Vehicle UTM Zone | 32 | 0-60 | 1 |
| | | | Angles (turret) | TRUE_HEADING | Heading angle relative to north. Positive direction is CW FROM NORTH Units: Degree | float | -180 to +180 | 0.01 degrees |
| | | | | ROLL | Roll. Positive direction is to the RIGHT Units: Degree | float | -180... +180 | 0.01 degrees |

| TYPE (ID) | RATE | MESSAGE NAME | WORD NAME | FIELD NAME | DESCRIPTION | SIGNAL SIZE (BITS) | SIGNAL RANGE | RES |
|-----------|------|--------------|------------------------|------------|---|--------------------|--------------|--------------|
| | | | | PITCH | Pitch. Positive direction is UP Units: Degree | float | -90...+90 | 0.01 degrees |
| | | | Angular rates (turret) | YAW_RATE | Yaw Rate Positive direction is CW FROM NORTH Units: Deg/Sec | float | -180 to +180 | 0.01 degrees |
| | | | | ROLL_RATE | Roll Positive direction is to the RIGHT Units: Deg/Sec | float | -180... +180 | 0.01 degrees |
| | | | | PITCH_RATE | Pitch Positive direction is UP Units: Deg/Sec | float | -180... +180 | 0.01 degrees |
| | | | Velocity | AVN_VEL_X | Own Velocity – X axis. Units: Meter/Sec | float | -500..500 | 0.1 |
| | | | | AVN_VEL_Y | Own Velocity – Y axis. Units: Meter/Sec | float | -500..500 | 0.1 |
| | | | | AVN_VEL_Z | Own Velocity – Z axis. Units: Meter/Sec | float | -500..500 | 0.1 |
| | | | Spare | Spare | | float | | |
| | | | | Spare | | float | | |
| | | | | Spare | | float | | |

Note: in INS Data message only True Heading, Pitch and Roll data will be proceeded by the RADAR.

| TYPE (ID) | RATE | MESSAGE NAME | WORD NAME | FIELD NAME | DESCRIPTION | SIGNAL SIZE (BITS) | SIGNAL RANGE | RES |
|-----------|--------------|---------------|-----------|----------------|---|--------------------|--------------------------------|-----|
| 0x012C | Upon request | Target Delete | | | | | | |
| | | | | | | | | |
| | | | | valid | | 8 (Signed) | 1 | N/A |
| | | | | Spare[3] | | 8 (Signed) | 0 | N/A |
| | | | | Target_id | Target id | 32 (unsigned) | 1-240 | 1 |
| | | | | Delete command | The C2 can choose to delete one specific target or all existing targets | 32 (unsigned) | 1- Delete one 2- Delete all | 1,2 |

3.2 Messages from Radar to C2 (ETH/UDP - PORT 20030)

Table 5: Messages from Radar to C2

| TYPE (ID) | RATE | MESSAGE NAME | WORD NAME | FIELD NAME | DESCRIPTION | SIGNAL SIZE (BITS) | SIGNAL RANGE | RES |
|-----------|---------------------------|------------------|-------------------------|--------------------|--|--------------------|---|-----|
| 0x0201 | 1 Hz Or upon change | Status Report | Radar State Mode Report | RDR_STATE | Radar state report | 32 (unsigned) | 1- Init 2- Standby 3- Maintenance 4- Operate 5- Reset 8- IBIT 9 - Off | N/A |
| | | | | RDR_MODE | Radar mode report | 32 (unsigned) | 2-AA_360 | N/A |
| | | | | TGT_TYPE_MODE | | 32 | 0- Normal 1- Test Target 2 - Repeater | N/A |
| | | | Radar Parameters report | TX | Radar Transmit Flag. | 32 (unsigned) | 0-OFF 1-ON | N/A |
| | | | | Elevation_Coverage | 20 or 30 deg elevation coverage | 32 (unsigned) | 5 – 20 degrees 6 – 30 degrees | N/A |
| | | | | TGT_VEL_REJ_TRESH | Target velocity rejection threshold | 32 (unsigned) | 0-High 1-Low | N/A |
| | | | | FREQ_BAND | Frequency Band | 32 (unsigned) | 0-BAND A 1-BAND B 2-BAND C 3-BAND D 4-BAND E 5-BAND F | N/A |
| | | | | | | | | |

| TYPE (ID) | RATE | MESSAGE NAME | WORD NAME | FIELD NAME | DESCRIPTION | SIGNAL SIZE (BITS) | SIGNAL RANGE | RES |
|-----------|------|--------------|--|-------------------|--|--------------------|-----------------------------|---------|
| | | | | FREQ_CHANGE_MODE | Frequency band change mode as requested by the operator | 32 | 0 – Manual 1 - Automatic | |
| | | | | DETECTION_EL_LOW | At TWS modes only. Reports '0' at all other modes. Actual electronic scan lower limit. Units = Deg. Relative to horizon. | 32 (Signed) | -40..+90 | degrees |
| | | | | DETECTION_EL_HIGH | At TWS modes only. Reports '0' at all other modes. Actual electronic scan upper limit. Units = Deg. Relative to horizon. | 32 (Signed) | -40..+90 | degrees |
| | | | | N_VALID_SECTORS | Number of sectors, received from C2 | 32 (signed) | 0..2 | |
| | | | Sector Data - this structure is always repeated 2 times | START_ANGLE | Sector start angle, relative to north | 32 (signed) | 0 to 360 | degrees |
| | | | | END_ANGLE | Sector end angle, relative to north | 32 (signed) | 0 to 360 | degrees |
| | | | | SECTOR_TYPE | Inside Blank sector – Turns channels off | 32 | 0 - Normal 1 - Blank | |
| | | | | Radar_pos_UTM_X | Radar UTM East Position | 32 (Signed) | 0..20000000 | 1 |

| TYPE (ID) | RATE | MESSAGE NAME | WORD NAME | FIELD NAME | DESCRIPTION | SIGNAL SIZE (BITS) | SIGNAL RANGE | RES |
|-----------|------|--------------------|--|-----------------|---|--------------------|--|-----|
| | | | | | Units: Meter | | | |
| | | | | Radar_pos_UTM_Y | Radar UTM North Position Units: Meter | 32 (Signed) | 0..20000000 | 1 |
| | | | | Radar_pos_UTM_Z | Radar altitude above sea level Positive Direction is UP , Units: Meter | float | -500..+10000 | 1 |
| | | | | | | | | |
| | | | | | | | | |
| 0x0204 | 1Hz | TWS Targets Report | Number of Targets | TOTAL_TGT_NUM | Total number of valid targets in message. 0 means no tracks. | 32 (unsigned) | 0...120 | N/A |
| | | | TWS target report (this structure is repeated up to 120 times) [120] | TARGET_TYPE | | 32 (unsigned) | 0 – AIR_NORMAL | N/A |
| | | | | TGT_ST | Target Status | 32 (unsigned) | 0-TRK_INIT 1-TRACK_UPDATE 2-TRACK_DELETE 3-TRACK_EXTRAP | N/A |
| | | | | SPARE | | 32 (unsigned) | | |

| TYPE (ID) | RATE | MESSAGE NAME | WORD NAME | FIELD NAME | DESCRIPTION | SIGNAL SIZE (BITS) | SIGNAL RANGE | RES |
|-----------|------|--------------|-----------|------------|--|--------------------|-----------------|--------|
| | | | | TGT_ID_INT | Radar internal Target ID | 32 (unsigned) | 1-240 | N/A |
| | | | | TGT_ID_EXT | Target ID (External) If radar acquired an external designated target, this will return the original ID designated by C2 | 32 (unsigned) | 0 | N/A |
| | | | | Tar_X | Target east position , <u>relative to radar position</u> | float | -40000 .. 40000 | meters |
| | | | | Tar_Y | Target north position , <u>relative to radar position</u> | float | -40000 .. 40000 | meters |
| | | | | Tar_Z | Target altitude , <u>relative to radar position</u> Positive Direction is UP | float | -5000..+20000 | meters |
| | | | | Tar_UTM_X | East Position Units:Meter | 32 (Signed) | 0..20000000 | 1 |
| | | | | Tar_UTM_Y | North Position Units:Meter | 32 (Signed) | 0..20000000 | 1 |
| | | | | Tar_UTM_Z | Altitude above sea level Positive Direction is UP Units:Meter | 32 (Signed) | -1000..+100000 | 1 |

| TYPE (ID) | RATE | MESSAGE NAME | WORD NAME | FIELD NAME | DESCRIPTION | SIGNAL SIZE (BITS) | SIGNAL RANGE | RES |
|-----------|------|--------------|-----------|----------------------|--|--------------------|----------------|---------------|
| | | | | Tar_UTM_zone | Target UTM Zone | 32 (signed) | 0-60 | 1 |
| | | | | Tar_Altitude | Altitude above sea level Positive Direction is UP | float | -500..+20000 | meters |
| | | | | Tar_Sigma Altitude | σ Altitude | float | -1000..+100000 | meters |
| | | | | Tar_Vx | Target Velocity – X axis. Units: Meter/Sec | float | -6000...6000 | 0.1 |
| | | | | Tar_Vy | Target Velocity – Y axis. Units: Meter/Sec | float | -6000...6000 | 0.1 |
| | | | | Tar_Vz | Target Velocity – Z axis. Units: Meter/Sec | float | -6000...6000 | 0.1 |
| | | | | TGT__EXTRAP_TIME | Time tag (TOD) of extrapolated target position (if extrapolated) | 32 (Unsigned) | 0-24 hour | 1 millisecond |
| | | | | Tar_LAST_UPDATE_TIME | Time tag (TOD) of last time the target was updated from real detection | 32 (Unsigned) | 0-24 hour | 1 millisecond |
| | | | | Tar_Range | Meters | float | 0..40000 | 1 |
| | | | | Tar_Sigma_Range | σ R (Meters) | float | 0..40000 | 1 |
| | | | | Tar_Azimuth | Az | float | -180..+180 | degrees |
| | | | | Tar_Sigma_Azimuth | σ Az | float | -180..+180 | degrees |
| | | | | Tar_Elevation | El | float | -40..+90 | degrees |

| TYPE (ID) | RATE | MESSAGE NAME | WORD NAME | FIELD NAME | DESCRIPTION | SIGNAL SIZE (BITS) | SIGNAL RANGE | RES |
|-----------|------|--------------|-----------|---------------------|---|--------------------|-----------------|----------------|
| | | | | Tar_Sigma_Elevation | σ El | float | -40..+90 | degrees |
| | | | | Tar_Velocity | True ground velocity | float | (-1200) - +1200 | m/sec |
| | | | | Tar_Sigma_Velocity | σ V | float | (-1200) - +1200 | m/sec |
| | | | | Tar_VLOS | LOS (Radial) velocity | float | (-1200) - +1200 | m/sec |
| | | | | Tar_Sigma_Vel_LOS | σ VLOS | float | (-1200) - +1200 | m/sec |
| | | | | Tar_VXLOS | Cross-LOS (Tangential) velocity | float | (-1200) - +1200 | m/sec |
| | | | | Tar_Sigma_Vel_XLOS | σ VXLOS | float | (-1200) - +1200 | m/sec |
| | | | | Tar_SNR | Target SNR | float | 0-100 | dB |
| | | | | Tar_Av_RCS | <u>Provision</u> for measured average radar cross section of a target [square-meters] | float | 0..150 | m ² |
| | | | | Tar_SD_to_EXT | Statistical distance to external designated target. | float | 0 | No units |
| | | | | Spare [6] | | float | | |
| | | | | | | | | |

| TYPE (ID) | RATE | MESSAGE NAME | WORD NAME | FIELD NAME | DESCRIPTION | SIGNAL SIZE (BITS) | SIGNAL RANGE | RES |
|-----------|--------------------------|--------------|--|--------------------|--|--------------------|--|--|
| 0x0205 | 1HZ Or Upon Change | MFL Report | MFL_COUNT | MFL_COUNT | Number of MFLs in message. 0 Means no MFLs | 32 (Unsigned) | 0..20 | N/A |
| | | | MFL_REPORT (This structure is duplicated 20 times) [20] | MFL_ID | MFL ID, based on a MFL table. Specifies the failed test. | 32 (Unsigned) | 0..20 | N/A |
| | | | | FAILED_TEST_RESULT | Reports the measured result of the failed test specified in MFL_ID (if relevant) | 32 (signed) | -200..200 | N/A Results measured in different units |
| | | | | LRU_ID | LRU ID | 16 (Unsigned) | SYSTEM = 0 RP = 1 (when relevant) ANT = 2 Processing computer = 3 (when relevant) | N/A |
| | | | | MFL_SEVERITY | Severity of the MFL | 16 (Unsigned) | INFORMATION= 1 WARNING= 2 FAIL = 3 | N/A |
| | | | | MFL_TIME | MFL appearance time | 32 (Unsigned) | 0-24 hour | 1 millisecond |
| | | | | | | | | |
| 0x0206 | 1HZ Or Upon Change | ECCM Report | | Jammer count | Number of jammed sectors | 32 (Unsigned) | 0..16 | |

| TYPE (ID) | RATE | MESSAGE NAME | WORD NAME | FIELD NAME | DESCRIPTION | SIGNAL SIZE (BITS) | SIGNAL RANGE | RES |
|-----------|------|--------------|---------------------------|---------------------|--|--------------------|--|---------|
| | | | Jammer Report [16] | JAMMER_TYPE | <p>2 types of ECCM indications</p> <p>Jammed sectors will be reported in TWS mode only, as <u>Side Lobe Jammer</u> only.</p> <p>In STT/Manual/ACQ: MLJ will report a jammed sector to antenna direction. SLJ will report no jammed sector/ Will report Jammer type</p> | 32 (unsigned) | 0 – No_jam 1 – Main_Lobe_Jam 2 – Side_Lobe_Jam | N/A |
| | | | | JAMMED_SECTOR_START | Jammed Sector start angle | 32 (signed) | (-180)-180 | degrees |
| | | | | JAMMED_SECTOR_END | Jammed Sector end angle | 32 (signed) | (-180)-180 | degrees |
| | | | | Frequency status | | 32 | 0 – Default 1 – Occurred 2 – Recommended (At manual freq. control) | |

| TYPE (ID) | RATE | MESSAGE NAME | WORD NAME | FIELD NAME | DESCRIPTION | SIGNAL SIZE (BITS) | SIGNAL RANGE | RES |
|---------------|---------------------------|-------------------------|----------------------|---------------------------|---|--------------------|---------------|------------|
| | | | | | | | | |
| 0x0207 | Upon connect to C2 | Maintenance | Radar version | SW_Version | SW package version | float | 0..100 | 0.1 |
| | | | | ANT_DIG_FW_version | Antenna firmware version | float | 0..100 | 0.1 |
| | | | Spare [6] | | | float | | |
| 0x0582 | 10Hz | Antenna Position | | | | | | |
| | | | | Spare[4] | | 32 (unsigned) | | |
| | | | | Antenna_azimuth | In order to convert to degrees. AntAzDeg = Antenna_azimuth *360 /2^16 | 32 (unsigned) | 0-65536 | 2^16/360 |