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| AKASH-NG-ICD for TWO WAY DATA LINK System-ver 1.2 | **2019** |

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**ICD**

**FOR**

**TWO WAY DATA LINK SYSTEM (TWDL) OF**

**AKASH-NG**

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| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

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| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

CONTENTS

|  |  |  |
| --- | --- | --- |
| **1.** | **SCOPE** | 5 |
| **2.** | **APPLICABLE DOCUMENTS** | 6 |
| **3.** | **SYSTEM OVERVIEW** | 7 |
|  | **3.1** System Description | 7 |
|  | **3.1.1** Ground System | 7 |
|  | **3.1.2** On-board System | 8 |
|  | **3.2** Requirements of TWDL System | 8 |
|  | **3.3** Operations of TWDL System | 9 |
|  | **3.4** Data Structure and Format | 10 |
|  | **3.5** Protocol Summary | 11 |
| **4.** | **DATA EXCHANGE FOR TWDL** | 12 |
|  | **4.1** Messages between CCU/FCS Computer/FCS and Ground DL System | 13 |
|  | **4.2** Messages between Ground DL System and On-board DL System | 13 |
|  | **4.3** Messages between On-board DL System and OBC | 13 |
| **5.** | **MESSAGE DESCRIPTION** | 14 |
|  | **5.1** Messages between CCU/FCS Computer/FCS and Ground DL System | 14 |
|  | **5.1.1** Request for Ground TWDL Health | 14 |
|  | **5.1.2** Request for Ground TWDL Status | 14 |
|  | **5.1.3** TWDL Ground DL Configuration | 15 |
|  | **5.1.4** TWDL Ground DL Power Amplifier mode Configuration | 16 |
|  | **5.1.5** TWDL Ground DL Health | 17 |
|  | **5.1.6** TWDL Ground DL Status | 18 |
|  | **5.2** Messages between On-board DL system and OBC on 1553B | 20 |
|  | **5.2.1** TWDL On-board DLU Configuration | 21 |
|  | **5.2.2** TWDL On-board DLU Health | 22 |
|  | **5.2.3** TWDL On-board DLU Status | 23 |
|  | **5.2.4** TWDL On-board DL Power Amplifier mode Configuration | 25 |
|  | **5.2.5** TWDL On-board DL Tx Antenna Port Switch Command | 25 |
|  | **5.2.6** TWDL On-board DLU Version Control Message | 26 |
|  | **5.3** Uplink Messages from Ground to Missile | 27 |
|  | **5.3.1** Target Dwell Message (Pkt-A) from Ground to Missile | 27 |
|  | **5.3.2** TgtPlusMissile Dwell Message (Pkt-B) from Ground to Missile | 28 |
|  | **5.4** Downlink Messages from Missile to Ground | 29 |
|  | **5.4.1** Missile INS data Message (Pkt-C) from Missile to Ground | 29 |
|  | **5.4.2** SeekerPlusMissile INS data Message (Pkt-D&E) from Missile to Ground | 30 |
| **6.** | **DESCRIPTION OF DATA FIELDS** | 33 |
| **7.** | **APPENDIX - A : SYSTEM DESCRIPTION FOR TWO-WAY DATA LINK** | 39 |
| **8.** | **APPENDIX - B : ABBREVIATIONS** | 49 |

AKASH-NG-ICD FOR TWO WAY DATA LINK SYSTEM-VER 1.2 **2019**

1. SCOPE

This document specifies the data link interface of the Two Way Data Link (TWDL) system with the On-board Computer (OBC) and Launch Computer (LC). The TWDL System comprises of ground system which interacts with the LC providing the uplink data to the missile in flight. It also comprises of on-board system which interacts with the OBC of Missile and provides the downlink information in the specific format.

The Two-Way Data-Link System does the faithful trans-reception of the payload information as provided by LC & OBC. The payload interpretation is known between LC & OBC as per given APPENDIX-A.

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| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

1. APPLICABLE DOCUMENTS

The following are the applicable documents,

1. Preliminary Design Document on Secured 2-way RF Data link for AKASH-NG dated April

2017, RCI/8130/DOFI/AKASH-NG/TWDL/PDR

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| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

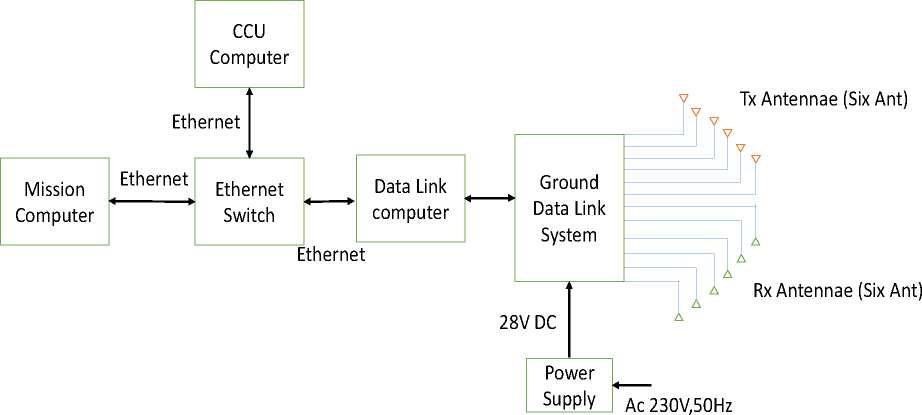
1. SYSTEM OVERVIEW
   1. System Description

The Two-Way wireless Data-Link (TWDL) system is used for the data communication between ground DL system and Missiles in flight of Akash-NG system for mid-course and terminal phase guidance. The ground to Missile up-link is used for target update data communication and Missile to ground downlink is for missile data communication. The data- link consists of a ground DL system, a AKASH-NG borne DL unit and their antenna assemblies.

* + 1. Ground System

The ground DL system and antennae are mounted in the CCU/FCS Vehicle and the CCU/FCS Computer/FCS provides target update track data for up-link communication to Missile which assists missile guidance during mid-course phase. The on-board DL unit will receive the data and provides these target update frames to OBC. The ground DL system consists of three transmitter chains with a pair of antennas for each Transmitters. One set (3 no's) of antenna will radiate in three directions and the other set (3 no's) of antenna will radiate in remaining three directions.

The up-link use a CDMA signal of 10 target update tracks data which is radiated in broadcast mode. The down-link follows a CDMA transmission protocol using FDD approach. Each individual ground DL station uses a single up-link and single down-link channel for both way data communication for an assigned mission.



From Generator

Fig 3.1: Ground Data Link System

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| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

3.1.2 On-board System

The on-board AKASH-NG DL unit consists of a RF transceiver and two transmit and two receive antennae in which one set mounted on belly and other set on rear tip of missile. At a given point on missile trajectory a particular antenna set on rear tip or belly may have better LOS with ground DL station than other. The down-link is used for communication of missile INS data and health parameter

Tx Antennas

to ground station.

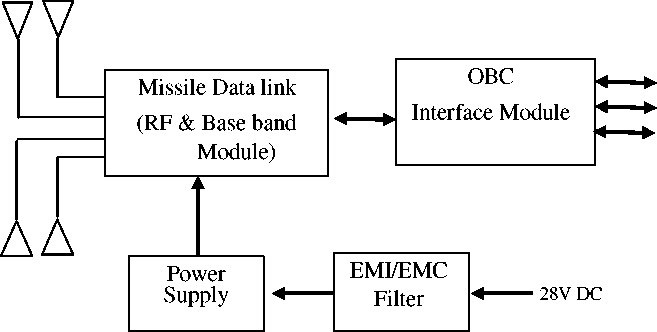
Fig 3.2: Missile Data Link System

RS 422 Control Port

RS 422 Monitor Port

1553 Mil Bus OBC

Rx Antennas



* 1. Requirements of TWDL System

1. No. of ground DL stations: 1 in one FU
2. No of simultaneous up/down links per ground DL station: 10 Max
3. Range of operation: 100 m to 30 Kms
4. Altitude of operation: 30 meters to 14 Kms
5. Ground data-link coverage:
6. Azimuth: 3600
7. Elevation: -50 to +650
8. Mission flight duration: 100 secs max
9. Line of sight (LOS) communication
10. ECCM features against standard ECM
11. Ground DL system and antennae to be mounted on Trailer (CCU) with other RF/microwave systems such as SRCR Radios, Satcom Systems, and GPS without mutual interference between each other.

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| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

* 1. Operations of TWDL System

The Ground DL computer receives the target update data frames of designated targets from CCU computer on gigabit Ethernet. The target track data is uplinked to appropriate missile(s) based on missile ID by illuminating all 6 sectors by ground DL transmitter. There are two time slots of 50mseceach for transmit function of the link. The 2 opposite facing transmit antennas (Set of 3) and corresponding transmitter chain is selected in a first time slot for transmission of 10 target's track data. The remaining opposite facing antenna (set of 3) and corresponding transmitter chain is selected in the next time slot and radiates the same 10 target's data. All 10 target data tracks are radiated twice (1800 each) to cover total 3600 azimuth.

The various functions of Ground DL system are listed below:

1. Login to AKASH-NG ground network.
2. Load the default DL parameters.
3. Accept Mission Specific Initialization information from Mission Computer.
4. Accept Assignments from Mission Computer and Set Data-Link Parameters accordingly.
5. Receive Target Track Data of mission specific Track IDs from the CCU Computer/FCS.
6. Reformat, encode and Up-link the Target Track Data to the assigned AKASH-NG(s).
7. Demodulate the down-link INS data and events from assigned AKASH-NG(s) and forward them to Mission Computer and MFR Computer for Bias Correction.
8. Perform Re-assignment and De-assignment as per Mission Computer command.
9. Validation of integrity of all data-link messages using CRC.
10. Periodic Health and Status reporting to Mission Computer.
11. Local storage of all received messages, events, status and health of system.

When the DL ground unit is powered up it performs a self-check and logs-on into the Mission computer. After successful logging, the Mission computer gives initialization data to the ground DL system.

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| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

The various functions of On-board DL system are listed below:

1. Power on command from MLP.
2. Load the default DL parameters.
3. Accept Mission Specific Initialization information from MLP as received from CCU.
4. Accept Assignments from MLP and Set Data-Link Parameters accordingly.
5. Receive Target Track Data of mission specific Track IDs from the CCU/FCS Computer.
6. Demodulate the up-link target data and commands received from Mission computer through Ground DL system and forward them to OBC.
7. Update TWDL Health and Status to OBC periodically for post flight analysis.
8. Demodulate the Missile data received after bias correction from CCU/FCS through Ground DL system and forward them to OBC.
9. Receive the Missile INS data from OBC, modulate and send it as the down-link data including missile events to Ground DL system.
10. Receive the Seeker data and Missile INS data from OBC, modulate and send it as the down-link data including missile events to Ground DL system.
11. Validation of integrity of all data-link messages using CRC.
    1. Data Structure and Format
12. Ten missile data packet (36 bytes/missile) will be uplinked in 50 msec with one set of antennae (3 No's) and the same data will be uplinked in next 50 msec with other set of antennae (3 no's). Hence the update rate for 10 missile data is 100 msec i.e. 10 Hz.
13. The forward link is synchronous CDMA and the reverse link is asynchronous FDD approach.
14. All data files are in BIG-ENDIAN(MSB First) format(unless specified explicitly).
15. Use of Offset and Scaling factor
    * + - 1. To Be Sent = (Val + Offset)/Scale

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| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

* + - * 1. To Be Used = (Scale \* Received) – Offset.
        2. Example if offset is 5, scale is 0.1 and Value is -1.9
        3. To Be Sent = (-1.9+5)/0.1 = 31
        4. To Be Used = (0.1\*31)-5= -1.9
  1. Protocol summary

1. On Power On, both Ground DL and On-board DL units will post the health of the units to CCU Computer and OBC respectively.
2. CCU/FCS will provide the Configuration parameters to Ground DL and On-board DL units comprising of Frequency index, Code index, FEC On/Off, PA mode etc.
3. Upon configuring with the required parameters, Ground DL and On-board DL units will post the status of configuration to CCU/FCS Computer and OBC respectively.
4. The validity of TWDL data will be checked by using a sub-address for each packet.
5. Data exchange of target information and missile downlink data will be in NED frame format.

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| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

1. Data Exchange for TWDL

The data exchange for TWDL comprises of the following routes,

1. Ground DL System to CCU/FCS Computer and vice-versa

1. Ground DL System to On-board DL System and vice-versa
2. On-board DL System to OBC and vice-versa

The following are the messages exchanged between various elements

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sr.  No | Message | Source | Destination | Remarks |
| 1. | TWDL Ground DL Configuration Command | CCU/FCS Computer | Ground DL System | CCU/FCS Computer sends Configuration to Ground DL |
| 2. | TWDL On-board DL Configuration Command | OBC | On-board DL System | CCU/FCS Computer sends Configuration to MLP. MLP in turn sends this to OBC for On-board DL system configuration |
| 3 | Target Dwell Message (Pkt-A) | CCU/FCS Computer/FCS | Ground DL System | Target update is sent from  CCU/FCS Computer through uplink |
| Ground DL System | On-board DL System |
| On-board DL System | OBC |
| 4. | TgtPlusMissile Dwell Message (Pkt-B) | CCU/FCS Computer/FCS | Ground DL System | Missile data for bias correction is sent from CCU/FCS Computer through uplink |
| Ground DL System | On-board DL System |
| On-board DL System | OBC |
| 5. | Missile INS data Message (Pky-C) | OBC | On-board DL System | Missile INS data is sent from OBC through downlink |
| On-board DL System | Ground DL System |
| Ground DL System | CCU/FCS Computer |
| 6. | SeekerPlusMissile INS data Message (Pkt-D&E) | OBC | On-board DL System | Seeker Plus Missile INS data is sent from OBC through downlink |
| On-board DL System | Ground DL System |
| Ground DL System | CCU/FCS Computer |
| 7. | TWDL Ground DL Health | Ground DL System | CCU/FCS Computer | Ground DL Health posted to CCU |
| 8. | TWDL On-board DL Health | On-board DL System | OBC | On-board DL Health posted to OBC |
| 9. | TWDL Ground DL Status | Ground DL System | CCU/FCS Computer | Ground DL Status posted to CCU |
| 10. | TWDL On-board DL Status | On-board DL System | OBC | On-board DL Status posted to OBC |

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| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

4.1Messages between CCU/FCS Computer/FCS and Ground DL System

The data exchange between CCU/FCS Computer/FCS and Ground DL System on Ethernet is

as follows,

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sr.  No | Message | Source | Destination | Size in bytes | Frequency |
| 1. | Request for Ground DL Health | CCU/FCS Computer/FCS | Ground DL System | 10 | Need Basis |
| 2. | Request for Ground DL Status | CCU/FCS Computer/FCS | Ground DL System | 10 | Need Basis |
| 3. | TWDL Ground DL Configuration Command | CCU/FCS Computer/FCS | Ground DL System | 50 | Need Basis |
| 4. | TWDL Ground DL Power Amplifier Mode Configuration Command | CCU/FCS Computer/FCS | Ground DL  System | 12 | Need Basis |
| 5. | Target Dwell Message (Pkt-A) | CCU/FCS Computer | Ground DL | 36 | 10Hz |
| 6. | TgtPlusMissile Dwell Message(Pkt-B) | CCU/FCS Computer | Ground DL | 36 | 10Hz |
| 7. | Missile INS Data Message (Pkt-C) | Ground DL System | CCU/FCS | 36 | 10Hz |
| 8. | SeekerPlusMsl INS Data (Pkt-D&E) | Ground DL System | CCU/FCS | 36 | 10Hz |
| 9. | TWDL Ground DL Health Response | Ground DL System | CCU/FCS | 28 | Need Basis |
| 10. | TWDL Ground DL Status Response | Ground DL System | CCU/FCS | 56 | Need Basis |

4.2Messages between Ground DL System and On-board DL System

The data exchange between Ground DL System and On-board DL System through RF is as

follows,

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Sr.  No | Message | Source | Destination | Category | Size in bytes | Freque ncy |
| 1. | Target Dwell Message (Pkt-A) | Ground DL | On-board DL | Uplink | 36 | 10Hz |
| 2. | TgtPlusMissile Dwell Message (Pkt-B) | Ground DL | On-board DL | Uplink | 36 | 10Hz |
| 3. | Missile INS Data Message (Pkt-C) | On-board DL | Ground DL | Downlink | 36 | 10Hz |
| 4. | SeekerPlusMsl INS Data (Pkt-D&E) | On-board DL | Ground DL | Downlink | 36 | 10Hz |

4.3Messages between On-board DL System and OBC

The On-board DL System is interfaced using MIL-STD-1553B with on-board computer (OBC). The main function of DL unit includes the demodulation of target update data and TgtPlusMissile's Position/Velocity data frames received on up-link and missile's INS data, health/events and seeker parameters on down-link. The internal messages flowing between OBC and On-board DL System on MIL-STD-1553B are listed in the table below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sr.  No | Message | Source | Destination | Size in bytes | Frequency |
| 1. | TWDL On-board DLU Configuration Command | OBC | On-board DL | 22 | Need Basis |

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| --- | --- |
| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

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| --- | --- | --- | --- | --- | --- |
| 2. | TWDL On-board DL Power Amplifier Mode Configuration Command | OBC | On-board DL | 12 | Need Basis |
| 3. | TWDL On-board DL Tx Antenna Port Switch Command | OBC | On-board DL | 12 | Need Basis |
| 4. | Target Dwell Message (Pkt-A) | On-board DL | OBC | 36 | 10Hz |
| 5. | TgtPlusMissile Dwell Message (Pkt-B) | On-board DL | OBC | 36 | 10Hz |
| 6. | Missile INS Data Message (Pkt-C) | OBC | On-board DL | 36 | 10Hz |
| 7. | SeekerPlusMsl INS Data (Pkt-D&E) | OBC | On-boa rd DL | 36 | 10Hz |
| 8. | TWDL On-board DLU Health | On-board DL | OBC | 28 | 1Hz |
| 9. | TWDL On-board DLU Status | On-boa rd DL | OBC | 28 | 1Hz |
| 10. | TWDL On-board DLU Version Control message | On-boa rd DL | OBC | 36 | Upon P/ON |

1. Message Description

The following are the details of the messages exchanged by TWDL during all the modes of

operation. All the messages between CCU and TWDL will have common header. Header size

is 10 bytes. The header is as given below**.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Byte** | **Field** | **Bytes** | **Data type** | **Description** |
| 0-3 | Time tag | 4 | UInt | System Time |
| 4 | Reserved | 1 | UChar |  |
| 5 | Message ID | 1 | UChar | Message id. |
| 6-7 | Message seq no | 2 | UShort | Starts at 0. Resets to zero at 65535 |
| 8-9 | Header CRC | 2 | UShort | CRC-16/AUG-CCITT, Poly:0x1021, Init:0x1DOF |

The following are the details of the messages exchanged by TWDL during all the modes of operation.

* 1. Messages between CCU/FCS Computer and Ground DL System on Ethernet
     1. Request for Ground TWDL Health

1. **Message Description:** This message is sent from CCU/FCS Computer to Ground TWDL on Ethernet to query health of Ground TWDL subsystem.
2. **Source:** CCU/FCS Computer

c. **Destination:** Ground DL System

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| --- | --- |
| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

1. **Trigger:** After power on based on requirement from CCU/FCS Computer

e. **Frequency:** Need Basis

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Byte** | **Field** | **Bytes** | **Data type** | **Description** |
| 0-9 | Common Header | 10 | - | Common Header with message id **0x05** |

5.1.2 Request for Ground TWDL Status

a. **Message Description:** This message is sent from CCU/FCS Computer to Ground TWDL on

Ethernet to query status of Ground TWDL subsystem.

1. **Source:** CCU/FCS Computer

c. **Destination:** Ground DL System

1. **Trigger:** After power on based on requirement from CCU/FCS Computer
2. **Frequency:** Need Basis

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Byte** | **Field** | **Bytes** | **Data type** | **Description** |
| 0-9 | Common Header | 10 | - | Common Header with message id **0x06** |

1. TWDL Ground DL Configuration
2. **Message Description:** This message is sent by CCU/FCS Computer to TWDL Ground DL System on Ethernet for loading the configuration i.e mission parameters for TWDL subsystem before lift-off. These parameters are mission specific and are calculated by CCU. These parameters are simultaneously loaded in the ground TWDL unit along with on-board TWDL unit during pre-lift-off condition.
3. **Source:** CCU/FCS Computer

c. **Destination:** Ground DL System

1. **Trigger:** after TWDL Power on and before lift-off
2. **Frequency:** Once during pre-lift-off / Need Basis
3. **Response:** TWDL Status message from Ground DL system after configuration (If configuration of these parameters affects the TWDL status)
4. **Response time**: 2ms

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| --- | --- |
| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Byte** | **Field** | **Bytes** | **Data type** | **Description** |
| 0-9 | Common Header | 10 | - | Header with message id **0x04**  id **0x06** |
| 10 | Up-link Frequency - Chain1 | 1 | UChar | Frequency Index [00-08] |
| 11 | Up-link Frequency - Chain2 | 1 | UChar | Frequency Index [00-08] |
| 12 | Down-link Frequency - M1 | 1 | UChar | Frequency Index [00-0C] |
| 13 | Down-link Frequency - M2 | 1 | UChar | Frequency Index [00-0C] |
| 14 | Down-link Frequency - M3 | 1 | UChar | Frequency Index [00-0C] |
| 15 | Down-link Frequency - M4 | 1 | UChar | Frequency Index [00-0C] |
| 16 | Down-link Frequency - M5 | 1 | UChar | Frequency Index [00-0C] |
| 17 | Down-link Frequency - M6 | 1 | UChar | Frequency Index [00-0C] |
| 18 | Down-link Frequency - M7 | 1 | UChar | Frequency Index [00-0C] |
| 19 | Down-link Frequency - M8 | 1 | UChar | Frequency Index [00-0C] |
| 20 | Down-link Frequency - M9 | 1 | UChar | Frequency Index [00-0C] |
| 21 | Down-link Frequency - M10 | 1 | UChar | Frequency Index [00-0C] |
| 22-23 | Down-link CDMA Code | 2 | UShort | DnCodeIndex [0000-000A] |
| 24-25 | Up-link CDMA Code - M1 | 2 | Ushort | UpCodeIndex [0000-000A] |
| 26-27 | Up-link CDMA Code - M2 | 2 | Ushort | UpCodeIndex [0000-000A] |
| 28-29 | Up-link CDMA Code - M3 | 2 | Ushort | UpCodeIndex [0000-000A] |
| 30-31 | Up-link CDMA Code - M4 | 2 | Ushort | UpCodeIndex [0000-000A] |
| 32-33 | Up-link CDMA Code - M5 | 2 | Ushort | UpCodeIndex [0000-000A] |
| 34-35 | Up-link CDMA Code - M6 | 2 | Ushort | UpCodeIndex [0000-000A] |
| 36-37 | Up-link CDMA Code - M7 | 2 | Ushort | UpCodeIndex [0000-000A] |
| 38-39 | Up-link CDMA Code - M8 | 2 | Ushort | UpCodeIndex [0000-000A] |
| 40-41 | Up-link CDMA Code - M9 | 2 | Ushort | UpCodeIndex [0000-000A] |
| 42-43 | Up-link CDMA Code - M10 | 2 | Ushort | UpCodeIndex [0000-000A] |
| 44-45 | Down -link FEC Selection (LSB) | 2 | Ushort | 0xXX00- (OFF) 0xXXFF-(ON) |
| Up -link FEC Selection (MSB) | 0x00XX -(OFF) 0xFFXX -(ON) |
| 46-47 | PA ON/Mute(OFF) | 2 | Ushort | 00XX- PA Mute(OFF)  FFXX-PA ON |
| Power level | FF01-PA ON in 1Watt  FF02- PA ON in 5Watt  FF03- PA ON in 10Watt  FF04- PA ON in 25Watt |
| 48-49 | Tx. Ant. Selection | 2 | UShort | 0X0000 – Tx1, 0XFFFF – Tx2 |
|  | Total | 50 |  |  |

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| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

1. TWDL Ground DL Power Amplifier mode Configuration
2. **Message Description:** This message is sent by CCU/FCS Computer to TWDL Ground DL System on Ethernet for loading the Ground DL Power Amplifier mode configuration i.e Low Power to High Power before lift-off or for a mission. These parameters are mission specific and are calculated by CCU. These parameters are simultaneously loaded in the ground TWDL unit along with on-board TWDL unit during pre-lift-off condition/mission.
3. **Source:** CCU/FCS Computer

c. **Destination:** Ground DL System

d. **Trigger:** after TWDL Power on and before lift-off

1. **Frequency:** Once during pre-lift-off / Need Basis
2. **Response:** TWDL Status message from Ground DL system after configuration (If configuration of these parameters affects the TWDL status)

g. **Response time**: 2ms

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Byte** | **Field** | **Bytes** | **Data type** | **Description** |
| 0-9 | Common Header | 10 | - | Header with Message id **0X0C** |
| 10-11 | PA ON/Mute(OFF) | 2 | Ushort | 00XX- PA Mute(OFF)  FFXX-PA ON |
| FF01-PA ON in 1Watt  FF02- PA ON in 5Watt  FF03- PA ON in 10Watt  FF04- PA ON in 25Watt |
| Power level |
|  | Total | 12 |  |  |

1. TWDL Ground DL Health Response/ Posting
2. **Message Description:** This message is sent by TWDL Ground DL System to CCU/FCS Computer on Ethernet periodically for sending health of TWDL subsystem.

**b. Source:** Ground DL System

**c. Destination:** CCU/FCS Computer/FCS

**d. Trigger:** After power on periodically based on requirement and on receiving Query from CCU/FCS Computer

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| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

1. **Frequency:** 1Hz

AKASH-NG-ICD FOR TWO WAY DATA LINK SYSTEM-VER 1.2 **2019**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Byte** | | **Field** | | **Bytes** | | **Data type** | | **Description** | | |
| 0-9 | | Common Header | | 10 | | - | | Header with Message id **0X55** | | |
| 10 | | Dual-Rx Index | | 1 | | UChar | | 1 to 5 | | |
| 11-12 | | Rx1to10 PLL lock | | 2 | | UShort | | 0xX000 - PLL Unlock; X3FF - PLL Lock | | |
| Tx -ch1&2 PLL lock | | 0x0XXX - PLL Unlock; 3XXX - PLL Lock | | |
| 13-14 | | Decoder 1 (LSB) track/acquisition | | 2 | | UShort | | 0xXX00 - Acquisition;0xXXFF - Track | | |
|  | | Decoder 2 (MSB) track/acquisition | | 0x00XX - Acquisition;0xFFXX - Track | | |
| 15-16 | | RX1 RSSI (LSB) | | 2 | | UShort | | 0xXX00 to OxXXFF | Value from 0 to 127 (decimal). 0 corresponds to maximum power.  127 corresponds to lowest power. | |
| RX2 RSSI (MSB) | | 0x00XX to OxFFXX |
| 17-18 | | TX Power | | 2 | | UShort | | Ox00XX Ground PA is OFF (Mute)  0xFF01 Ground PA ON in 1 Watt  0xFF02 Ground PA ON in 5 Watt  0xFF03 Ground PA ON in 10 Watt  0xFF04 Ground PA ON in 25 Watt | | |
| 19-20 | | RX1 Doppler | | 2 | | UShort | | Doppler frequency in rx1 received signal. | | |
| 21-22 | | RX2 Doppler | | 2 | | UShort | | Doppler frequency in rx2 received signal. | | |
| 23-24 | | RX1 Correlation Value | | 2 | | UShort | | Correlation value in rx1 channel. | | |
| 25-26 | | RX2 Correlation Value | | 2 | | Ushort | | Correlation value in rx2 channel. | | |
| 27-28 | | RF Switch Status | | 2 | | Ushort | | 0x0000 - RF Port1 Selected  OxFFFF - RF Port2 Selected | | |
|  | | Total | | 29 | |  | |  | | |

1. TWDL Ground DL Status Response/ Posting

**a. Message Description:** This message is sent by TWDL Ground DL System to

CCU/FCS Computer on Ethernet periodically for sending status of TWDL subsystem.

**b. Source:** Ground DL System

**c. Destination:** CCU/FCS Computer/FCS

**d. Trigger:** After power on periodically based on requirement and on receiving Query from CCU/FCS Computer/FCS

|  |  |
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| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

1. **Frequency:** 1Hz

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Byte** | **Field** | **Bytes** | **Data type** | **Description** |
| 0-9 | Common Header | 10 | - | Header with Message id **0X66** |
| 10 | Dual-Rx Index | 1 | UChar | 1 to 5 |
| 11 | Up-link Frequency - Chain1 | 1 | UChar | Frequency Index [00-08] |
| 12 | Up-link Frequency - Chain2 | 1 | UChar | Frequency Index [00-08] |
| 13 | Down-link Frequency - M1 | 1 | UChar | Frequency Index [00-0C] (M1) |
| 14 | Down-link Frequency - M2 | 1 | UChar | Frequency Index [00-0C] (M2) |
| 15 | Down-link Frequency - M3 | 1 | UChar | Frequency Index [00-0C] (M3) |
| 16 | Down-link Frequency - M4 | 1 | UChar | Frequency Index [00-0C] (M4) |
| 17 | Down-link Frequency - M5 | 1 | UChar | Frequency Index [00-0C] (M5) |
| 18 | Down-link Frequency - M6 | 1 | UChar | Frequency Index [00-0C] (M6) |
| 19 | Down-link Frequency - M7 | 1 | UChar | Frequency Index [00-0C] (M7) |
| 20 | Down-link Frequency - M8 | 1 | UChar | Frequency Index [00-0C] (M8) |
| 21 | Down-link Frequency - M9 | 1 | UChar | Frequency Index [00-0C] (M9) |
| 22 | Down-link Frequency - M10 | 1 | UChar | Frequency Index [00-0C] (M10) |
| 23-24 | Down Link CDMA Code | 2 | UShort | DnCodeIndex [0000-000A] |
| 25-26 | Up Link CDMA Code - M1 | 2 | UShort | UpCodeIndex [0000-000A] (M1) |
| 27-28 | Up Link CDMA Code - M2 | 2 | UShort | UpCodeIndex [0000-000A] (M2) |
| 29-30 | Up Link CDMA Code - M3 | 2 | UShort | UpCodeIndex [0000-000A] (M3) |
| 31-32 | Up Link CDMA Code - M4 | 2 | UShort | UpCodeIndex [0000-000A] (M4) |
| 33-34 | Up Link CDMA Code - M5 | 2 | UShort | UpCodeIndex [0000-000A] (M5) |
| 35-36 | Up Link CDMA Code - M6 | 2 | UShort | UpCodeIndex [0000-000A] (M6) |
| 37-38 | Up Link CDMA Code - M7 | 2 | UShort | UpCodeIndex [0000-000A] (M7) |
| 39-40 | Up Link CDMA Code - M8 | 2 | UShort | UpCodeIndex [0000-000A] (M8) |
| 41-42 | Up Link CDMA Code - M9 | 2 | UShort | UpCodeIndex [0000-000A] (M9) |
| 43-44 | Up Link CDMA Code - M10 | 2 | UShort | UpCodeIndex [0000-000A] (M10) |
| 45-46 | Tx Ant (RF Switch) Status | 2 | UShort | 0x0000 - RF Port1 Selected. 0xFFFF - RF Port2 Selected. |
| 47-48 | PA ON/Mute(Off) Status (MSB) | 2 | Ushort | 0x00XX Ground PA is Mute (OFF)  0xFFXX Ground PA is ON |
| TX Power Mode Index (LSB)  (TX power read out.) | 0xFF01 Ground PA ON in 1Watt  0xFF02 Ground PA ON in 5Watt 0xFF03 Ground PA ON in 10Watt  0xFF04 Ground PA ON in 25Watt |
| 49-50 | RX1 RSSI (LSB) | 2 | UShort | Rx1:0xXX00 to 0xXXFF  Rx2:0x00XX to 0xFFXX  Value from 0 to 127 (decimal). 0 corresponds to maximum power. 127 corresponds to lowest power. |
| RX2 RSSI (MSB) |

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| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

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| --- | --- | --- | --- | --- |
| **Byte** | **Field** | **Bytes** | **Data type** | **Description** |
| 51-52 | Rx1to10 PLL lock | 2 | UShort | X000 - PLL Unlock; X3FF - PLL Lock |
| Tx -ch1&2 PLL lock | 0XXX - PLL Unlock; 3XXX - PLL Lock |
| 53-54 | Decoder 1 (LSB) track/acquisition | 2 | UShort | 0xXX00 - Rx1 Acquisition;  0xXXFF - Rx1 Track |
| Decoder 2 (MSB) track/acquisition | 0x00XX - Rx2 Acquisition;  0xFFXX - Rx2 Track |
| 55-56 | Down -link FEC Selection (LSB) | 2 | UShort | 0xXX00 - (OFF)  0xXXFF - (ON) |
| Up -link FEC Selection (MSB) | 0x00XX - (OFF)  0xFFXX - (ON) |
|  | Total | 57 |  |  |

* 1. Messages between On-board DL system and OBC on 1553B

The following are the messages exchanged between Missile DL Unit to OBC and vice-versa on internal Mil-1553B Bus of the missile, OBC is the BC and Missile DL Unit acts as RT-2.

The table below shows, Rx/TX Sub addresses for OBC<-> Missile TWDL Unit

communications. RT Address is 0x02

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Data**  **Description** | **Words** | **Freq** | **Sub Add** | **Remarks** | **Remarks** |
| 1 | DL  Configuration  Command | 11 | Once | Rx-  01 | OBC sends the initialization data to DLU after power on | OBC to DLU |
| 2 | Missile INS Data Message (Pkt-C) SeekerPlusMsl INS Data (Pkt-D&E) | 18 | 10  Hz | Rx-  02 | OBC sends the INS data, Seeker data and various subsystem health to DLU | OBC to DLU |
| 3 | Reserved |  |  | Rx-  03 | Future use | OBC to DLU |
| 4 | PA Mute/PA mode selection command | 6 | Once | Rx-  04 | OBC sends the PA mode (ON/OFF and power level 1W/5W/10W/15W) | OBC to DLU |
| 5 | Tx Antenna port selection | 6 | Once | Rx-  05 | Transmit port selection by OBC | OBC to DLU |
| 6 | Reserved |  |  | Rx- 06 | Future use | OBC to DLU |
| 7 | Target Dwell or TgtPlusMissile Dwell data on Rx1 (Pkt-A or Pkt-B) | 18 | 10 Hz | Tx-  01 | DLU sends the target or TgtPlusMissile track position raw data received on Rx1 to OBC | DLU to OBC |

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| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Data**  **Description** | **Words** | **Freq** | **Sub Add** | **Remarks** | **Remarks** |
| 8 | Target Dwell or TgtPlusMissile Dwell data on Rx2 (Pkt-A or Pkt-B) | 18 | 10 Hz | Tx-  02 | DLU sends the target or TgtPlusMissile track position raw data received on Rx2 to OBC | DLU to OBC |
| 9 | Target or TgtPlusMissile Dwell data (error free) (Pkt-A or Pkt-B) | 18 | 10 Hz | Tx-  03 | DLU sends error free target or TgtPlusMissile track data to OBC | DLU to OBC |
| 10 | Reserved | 18 | 10 Hz | Tx-  04 | Future use | DLU to OBC |
| 11 | Reserved | 18 | 10 Hz | Tx-  05 | Future use | DLU to OBC |
| 12 | Reserved | 18 | 10 Hz | Tx-  06 | Future use | DLU to OBC |
| 13 | DLU Health (DLU-OBC) | 14 | 1 Hz | Tx-  07 | DLU provides DL unit health to OBC | DLU to OBC |
| 14 | DLU Status (DLU-OBC) | 14 | 1 Hz | Tx-  08 | DLU updates its present  DL Status and parameters to OBC | DLU to OBC |
| 15 | DLU Version Control Msg | 18 | Once | Tx-  09 | DLU ABBBDM\_DTM S/W, H/W version | DLU to OBC |

* + 1. TWDL On-board DLU Configuration

**a. Message Description:** This message is sent by OBC to TWDL on 1553B for loading the configuration i.e mission parameters for TWDL subsystem before lift-off. OBC receives this data from MLP which are computed at CCU/FCS based on specific mission. These parameters are simultaneously loaded in the ground TWDL unit along with on-board TWDL unit during pre-lift-off condition. This message is transmitted to Telemetry for recording.

1. **Source:** OBC

**c. Destination:** On-board TWDL

**d. Trigger:** after TWDL **e. Frequency:** Once when initiated by OBC on ground

1. **Response:** TWDL Status message from on-board TWDL subsystem after

configuration (If configuration of these parameters affects the TWDL status)

|  |  |
| --- | --- |
| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Word** | **Field** | **Bytes** | **Data type** | **Description** |
| 0-1 | Time tag | 4 | ULong | System Time |
| 2 | Missile ID (LSB) | 2 | UShort | Should be >=1 and <=10 |
| **Message ID (MSB)** | **0x07** |
| 3 | Message seq no | 2 | UShort | Starts at 0. Resets on 65535 |
| 4 | Up-link Rx Frequency (LSB) | 2 | UShort | Frequency Index [0000 - 0008] |
| Down-link Tx Frequency (MSB) | Frequency Index [0000 - 000C] |
| 5 | Up-link Rx CDMA Code | 2 | UShort | 1023 Code Index [0000 - 000A] |
| 6 | Down-link Tx CDMA Code | 2 | Ushort | 127 Code Index [0000 - 000A] |
| 7 | Up-link Rx FEC Selection (LSB) | 2 | Ushort | 0xXX00 -> Up-Link FEC (OFF) OxXXFF -> Up-Link FEC (ON) |
| Down-link Tx FEC Selection (MSB) | 0x00XX -> Dn-Link FEC (OFF) 0xFFXX -> Dn-Link FEC (ON) |
| 8 | Tx PA ON/OFF (MSB) | 2 | Ushort | 0x00XX- PA Mute(OFF)  0xFFXX- PA ON |
| Tx PA Power level (LSB) | 0xFF01- PA Power O/P 1Watt 0xFF02- PA Power O/P 5Watt 0xFF03- PA Power O/P 10Watt 0xFF04- PA Power O/P 15Watt |
| 9 | Tx. Ant. Selection | 2 | UShort | 0x0000 - RF Port1 Selected  OxFFFF - RF Port2 Selected |
| 10 | CRC | 2 | UShort | CRC-16/AUG-CCITT,  Poly:0x1021. Init:0x1DOF |
|  | Total (11 Words) | 22 |  |  |

* + 1. TWDL On-board DLU Health Posting

**a. Message Description:** This message is sent by TWDL On-board DL System to OBC on 1553B periodically for sending health of TWDL subsystem. This message shall be transmitted to telemetry ground station using on-board PCM unit for recording.

**b. Source:** On-board TWDL

1. **Destination:** OBC
2. **Trigger:** After power on periodically posted to OBC
3. **Frequency:** 1Hz

|  |  |
| --- | --- |
| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Word** | **Field** | **Bytes** | **Data type** | **Description** | |
| 0-1 | Time tag | 4 | ULong | System Time | |
| 2 | Missile ID (LSB) | 2 | UShort | Should be >=1 and <=10 | |
| **Message ID (MSB)** | **0x08** | |
| 3 | Message seq no | 2 | UShort | Starts at 0. Resets on 65535 | |
| 4 | Rx1 PLL lock | 2 | UShort | 0xXXX0 - PLL Unlock; 0xXXXF - PLL Lock | |
| Rx2 PLL lock | 0xXX0X - PLL Unlock; OxXXFX - PLL Lock | |
| Tx PLL lock | 0xX0XX - PLL Unlock; 0xXFXX - PLL Lock | |
| 5 | Decoder 1 track/acquisition (LSB) | 2 | UShort | 0xXX00 - Rx1 Acquisition  0xXXFF - Rx1 Track | |
| Decoder 2 track/acquisition (MSB) | UShort | 0x00XX - Rx2 Acquisition  0xFFXX - Rx2 Track | |
| 6 | RX1 RSSI (LSB) | 2 | UShort | 0xXX00 to  OxXXFF | Value from 0 to 127 (decimal). 0 corresponds to maximum power.  127 corresponds to lowest power. |
| RX2 RSSI (MSB) | 0x00XX to  OxFFXX |
| 7 | TX Power Mode | 2 | UShort | 0xFF01- PA ON in 1Watt  0xFF02- PA ON in 5Watt  0xFF03- PA ON in 10Watt  0xFF04- PA ON in 15Watt | |
| 8 | RX1 Doppler | 2 | UShort | Doppler frequency in rx1 received signal. | |
| 9 | RX2 Doppler | 2 | UShort | Doppler frequency in rx2 received signal. | |
| 10 | RX1 Correlation Value | 2 | UShort | Correlation value in rx1 channel. | |
| 11 | RX2 Correlation Value | 2 | Ushort | Correlation value in rx2 channel. | |
| 12 | Tx. Ant. Selection | 2 | Ushort | 0x0000 - RF Port1 Selected  OxFFFF - RF Port2 Selected | |
| 13 | CRC | 2 | UShort | CRC-16/AUG-CCITT, Poly:0x1021,  Init:0x1DOF | |
|  | Total (14 Words) | 28 |  |  | |

* + 1. TWDL On-board DLU Status Posting

**a. Message Description:** This message is sent by TWDL On-board DL System to OBC on 1553B periodically for sending status of TWDL subsystem. This message shall be transmitted through downlink to ground system and also relayed to telemetry ground station using on-board PCM unit for recording.

**b. Source:** On-board TWDL

1. **Destination:** OBC

|  |  |
| --- | --- |
| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

1. **Trigger:** After power on periodically posted to OBC

**e. Frequency:** 1Hz

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Word** | **Field** | **Bytes** | **Data type** | **Description** |
| 0-1 | Time tag | 4 | ULong | System Time |
| 2 | Missile ID (LSB) | 2 | UShort | Should be >=1 and <=10 |
| **Message ID (MSB)** | **0x09** |
| 3 | Message seq no | 2 | UShort | Starts at 0. Resets on 65535 |
| 4 | RX Frequency Index (LSB) | 2 | UShort | Frequency Index [0000 - 0008] |
| TX Frequency Index (MSB) | Frequency Index [0000 - 000C] |
| 5 | Up Link Rx Code Index | 2 | UShort | 1023 Code Index [0000 - 000A] |
| 6 | Down Link Tx Code Index | 2 | UShort | 127 Code Index [0000 - 000A] |
| 7 | Tx Ant. Selection Status | 2 | UShort | 0x0000 - RF Port1 Selected. OxFFFF - RF Port2 Selected. |
| 8 | Tx PA On/Mute(Off ) Status (MSB) | 2 | Ushort | 0x00XX - PA is Mute (OFF)  0xFFXX - PA is ON |
| Tx Power level Index (LSB) | 0xFF01 - PA ON in 1Watt  0xFF02 - PA ON in 5Watt  0xFF03 - PA ON in 10Watt  0xFF04 - PA ON in 15Watt |
| 9 | RX1 RSSI (LSB) | 2 | UShort | Rx1:0xXX00 to 0xXXFF  Rx2:0x00XX to 0xFFXX  Value from 0 to 127 (decimal). 0 corresponds to maximum power. 127 corresponds to lowest power. |
| RX2 RSSI (MSB) |
| 10 | RX1 Synthesizer lock | 2 | UShort | 0xXXX0 - Rx1 Synthesizer not locked.  0xXXXF - Rx1 Synthesizer locked |
| RX2 Synthesizer lock | 0xXX0X - Rx2 Synthesizer not locked.  0xXXFX - Rx2 Synthesizer locked |
| TX Synthesizer lock | 0xX0XX - Tx Synthesizer not locked.  0xXFXX - Tx Synthesizer locked. |
| 11 | Rx1 CDMA Decoder Status track/acquisition (LSB) | 2 | UShort | 0xXX00 - Rx1 Acquisition;  0xXXFF - Rx1 Track |
| Rx2 CDMA Decoder Status track/acquisition (MSB) | 0x00XX - Rx2 Acquisition;  0xFFXX - Rx2 Track |
| 12 | Up-link Rx FEC Selection (LSB) | 2 | UShort | 0xXX00 --- Up-Link FEC (OFF)  0xXXFF --- Up-Link FEC (ON) |
| Down-link Tx FEC Selection (MSB) | 0x00XX --- Dn-Link FEC (OFF)  0xFFXX --- Dn-Link FEC (ON) |
| 13 | CRC | 2 | UShort | CRC-16/AUG-CCITT, Poly:0x1021,  Init:0x1DOF |
|  | Total (14 Words) | 28 |  |  |

|  |  |
| --- | --- |
| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

* + 1. TWDL On-board DL Power Amplifier mode Configuration Command

**a. Message Description:** This message is sent by OBC to TWDL on 1553B for configuring the On-board DL Tx PA with different power level during pre-lift-off condition. This message is transmitted to Telemetry for recording.

**b. Source:** OBC

**c. Destination:** On-board TWDL

**d. Trigger:** after TWDL Power on and before lift-off

1. **Frequency:** Once when initiated by OBC on ground
2. **Response:** TWDL Status message from on-board TWDL subsystem after configuration (If configuration of these parameters affects the TWDL status)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Word** | **Field** | **Bytes** | **Data type** | **Description** |
| 0-1 | Time tag | 4 | ULong | System Time |
| 2 | Missile ID (LSB) | 2 | UShort | Should be >=1 and <=10 |
| **Message ID (MSB)** | **0x0A** |
| 3 | Message seq no | 2 | UShort | Starts at 0. Resets on 65535 |
| 4 | Tx PA ON/OFF (MSB) | 2 | Ushort | 0x00XX- PA Mute (OFF)  0xFFXX- PA ON |
| Tx PA Power level (LSB) | 0xFF01- PA Power O/P 1Watt 0xFF02- PA Power O/P 5Watt 0xFF03- PA Power O/P 10Watt 0xFF04- PA Power O/P 15Watt |
| 5 | CRC | 2 | UShort | CRC-16/AUG-CCITT,  Poly:0x1021, Init:0x1DOF |
|  | Total (6 Words) | 12 |  |  |

* + 1. TWDL On-board DL Tx Antenna Port Switch Command

**a. Message Description:** This message is sent by OBC to TWDL on 1553B for configuring the On-board DL Tx Switch port selection during post-lift-off condition.(During mission when vehicle reaches its apogee). This message is transmitted to Telemetry for recording.

**b. Source:** OBC

**c. Destination:** On-board TWDL

|  |  |
| --- | --- |
| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

**d. Trigger:** after TWDL Power on and after lift-off

**e. Frequency:** Once when initiated by OBC in air

1. **Response:** TWDL Status message from on-board TWDL subsystem after

configuration (If configuration of these parameters affects the TWDL status)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Word** | **Field** | **Bytes** | **Data type** | **Description** |
| 0-1 | Time tag | 4 | ULong | System Time |
| 2 | Missile ID (LSB) | 2 | UShort | Should be >=1 and <=10 |
| **Message ID (MSB)** | **0x0B** |
| 3 | Message seq no | 2 | UShort | Starts at 0. Resets on 65535 |
| 4 | Tx. Ant. Selection | 2 | UShort | 0x0000 - RF Portl Selected OxFFFF - RF Port2 Selected |
| 5 | CRC | 2 | UShort | CRC-16/AUG-CCITT,  Poly:0x1021, Init:0x1DOF |
|  | Total (6 Words) | 12 |  |  |

1. TWDL On-board DLU Version Control message

**a. Message Description:** This message is sent by On-board TWDL Unit to OBC on 1553B for providing the DLU H/W & S/W Version details. This message is transmitted to Telemetry for recording.

**b. Source:** On-board TWDL

1. **Destination:** OBC
2. **Trigger:** after TWDL Power on and before lift-off

**e. Frequency:** Once when initiated by OBC on ground

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Word** | **Field** | **Bytes** | **Data type** | **Description** |
| 0-1 | Time tag | 4 | ULong | System Time |
| 2 | Missile ID (LSB) | 2 | UShort | Should be >=1 and <=10 |
| **Message ID (MSB)** | **0x0F** |
| 3 | Message seq no | 2 | UShort | Starts at 0. Resets on 65535 |
| 4-6 | System Checksum | 6 | UShort | System Checksum |
| 7-16 | Reserved | 20 | UShort | Reserved |
| 17 | CRC | 2 | UShort | CRC-16/AUG-CCITT,  Poly:0x1021, Init:0x1DOF |
|  | Total (18 Words) | 36 |  |  |

|  |  |
| --- | --- |
| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

1. Uplink Messages from Ground to Missile

All the following messages will have the common header (size 10 bytes), as per the header format given in section 5 above. The messages will have two parts. A common header which contains the message id used between CCU and the ground TWDL. The payload part will be sent to the on-board TWDL.

|  |  |
| --- | --- |
| Bytes | Description |
| 0-9 | Common Header (between CCU and Ground TWDL) with unique Message ID and header CRC |
| - | Payload sent from Ground TWDL to on-board TWDL (contains payload CRC) |

1. Target Dwell Message **(Pkt-A)** from Ground to Missile

**a. Message Description:** This message is sent from ground to On-board TWDL which will be forwarded to OBC on 1553B periodically after demodulation. This contains the current target position update as tracked by the ground radar/CCU.

**b. Source:** Ground TWDL

1. **Destination:** On-board TWDL and finally to OBC
2. **Trigger:** When target track update is available from ground
3. **Frequency:** 10Hz (max)

Common Header between Ground TWDL and CCU:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Byte** | **Field** | **Bytes** | **Data type** | **Description** |
| 0-3 | Time tag | 4 | UInt | System Time |
| 4 | Reserved | 1 | UChar |  |
| 5 | Message ID | 1 | UChar | Message id **0x01 (Pkt-A)** |
| 6-7 | Message seq no | 2 | UShort | Starts at 0. Resets to zero at 65535 |
| 8-9 | Message CRC | 2 | UShort | CRC-16/AUG-CCITT, Poly:0x1021, Init:0x1DOF |

Message between Ground TWDL and CCU:

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| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

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| --- | --- | --- | --- | --- | --- |
| **Byte** | **Field** | **Bytes** | **Word** | **Data type** | **Description** |
| 0-3 | Time tag | 4 | 0-1 | ULong | System Time |
| 4 | Missile ID (LSB) | 2 | 2 | UShort | Should be >=1 and <=10 |
| **5** | **Message ID (MSB)** | **0x01 (Pkt-A)** |
| 6 | RESERVED (LSB) | 2 | 3 | UShort |  |
| 7 | FU MLV ID (MSB)  MSB FU:6 LSB MLV:2 | FU=>0-63, MLV=>0-3 [7:2-1:0] |
| 8-9 | Payload seq no | 2 | 4 | UShort | Starts at 0. Resets on 65535 |
| 10-16 | Target position (NED in m) Xt, Yt, Zt  Bits-LSB(19, 19, 18)MSB | 7 | 5-15 |  | Scale Factor=1;  Offset 150e3 for Xm & Ym  Offset 60e3 for Zm |
| 17-21 | Target velocity (m/s)  Vxt, Vyt, Vzt  Bits-LSB(14, 13, 13)MSB | 5 |  | Scale Factor=1;  Offset 1500 |
| 22-24 | Target accln (m/s2)  Axt Ayt Azt  Bits-LSB(8, 8, 8)MSB | 3 |  | Scale Factor=1;  Offset 100 |
| 25-28 | Target position 𝜎 (m)  Xt Yt Zt  Bits-LSB(11, 11, 10)MSB | 4 |  | Scale Factor=1;  Offset 500 |
| 29-31 | Target velocity 𝜎(m/s)  Vxt, Vyt, Vzt  Bits-LSB(8, 8, 8)MSB | 3 |  | Scale Factor=1;  Offset 50 |
| 32 | Target type | 1 | 16 | UShort | 0-fighter aircraft  1-helicopter  2-Sub sonic cruise missile  3-Air to Surface missile  4- RPA  5-stand by  6-stand by  7-self destruction |
| 33 | Target RCS | 1 |  |
| 34-35 | Payload CRC | 2 | 17 | UShort | CRC-16/AUG-CCITT,  Poly:0x1021, Init:0x1DOF |
|  | Total (18 Words) | 36 |  |  |  |

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| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

1. TgtPlusMissile Dwell Message **(Pkt-B)** from Ground to Missile

**a. Message Description:** This message is sent from ground to On-board TWDL which will be forwarded to OBC on 1553B periodically after demodulation. This contains the current target and missile position update as tracked by the ground radar/CCU/FCS for bias correction. This data is also sent for the missile to utilize its position data in case of failure of INS.

**b. Source:** Ground TWDL

1. **Destination:** On-board TWDL and finally to OBC
2. **Trigger:** When missile track update is available from ground
3. **Frequency:** 10Hz

Common Header between Ground TWDL and CCU:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Byte** | **Field** | **Bytes** | **Data type** | **Description** |
| 0-3 | Time tag | 4 | UInt | System Time |
| 4 | Reserved | 1 | UChar |  |
| 5 | Message ID | 1 | UChar | Message id **0x02 (Pkt-B)** |
| 6-7 | Message seq no | 2 | UShort | Starts at 0. Resets to zero at 65535 |
| 8-9 | Message CRC | 2 | UShort | CRC-16/AUG-CCITT, Poly:0x1021, Init:0x1DOF |

Message between Ground TWDL and CCU:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Byte** | **Field** | **Bytes** | **Word** | **Data type** | **Description** | |
| 0-3 | Time tag | 4 | 0-1 | ULong | System Time | |
| 4 | Missile ID (LSB) | 2 | 2 | UShort | Should be >=1 and <=10 | |
| **5** | **Message ID (MSB)** |  |  |  | **0x02 (Pkt-B)** | |
| 6 | RESERVED (LSB) | 2 | 3 | UShort |  | |
| 7 | FU MLV ID (MSB) |  |  |  | FU=>0-63, MLV=>0-3 [7:2-1:0] | |
| 8-9 | Payload seq no | 2 | 4 | UShort | Starts at 0. Resets on 65535 | |
| 10-16 | Target position (NED in m)  Xt, Yt, Zt  Bits-LSB(19, 19, 18)MSB | 7 |  |  | Scale Factor=1;  Offset 150e3 for Xm & Ym  Offset 60e3 for Zm | |
| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | | | | | | **2019** | |

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| --- | --- | --- | --- | --- | --- |
| **Byte** | **Field** | **Bytes** | **Word** | **Data type** | **Description** |
| 17-21 | Target velocity (m/s)  Vxt Vyt Vzt  Bits-LSB(14, 13, 13)MSB | 5 | 5-16 |  | Scale Factor=1;  Offset 1500 |
| 22-28 | Missile position (NED in m)  Xm, Ym, Zm  Bits-LSB(19, 19, 18)MSB | 7 |  |  | Scale Factor=1;  Offset 150e3 for Xm & Ym  Offset 60e3 for Zm |
| 29-33 | Missile velocity (m/s)  Vxm Vym Vzm  Bits-LSB(14, 13, 13)MSB | 5 |  |  | Scale Factor=1;  Offset 1500 |
| 34-35 | Payload CRC | 2 | 17 | UShort | CRC-16/AUG-CCITT,  Poly:0x1021, Init:0x1DOF |
|  | Total (18 Words) | 36 |  |  |  |

**Note:** The above message can also be used for checking self-loop checks as part of phase checks with message ID ‘0' when not in operational mode. During this, the Target and Missile position, velocity information will be set to fixed/incremental data and OBC will loop same data through downlink for every message.

1. Downlink Messages from Missile to Ground

5.4.1 Missile INS data Message **(Pkt-C)** from Missile to Ground

**a.Message Description:** This message is sent from OBC to On-board TWDL on Mil- 1553 bus and then to ground TWDL over wireless medium which will be further forwarded to RADAR computer/CCU/FCS over Ethernet after demodulation. This contains the current missile position as measured by the on-board INS. This message also contains the missile events at that instant.

**b.Source:** On-board TWDL

1. **Destination:** Ground TWDL and finally to Radar computer/CCU/FCS **d.Trigger:** On lift-off
2. **Frequency:**10Hz

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| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

Common Header between Ground TWDL and CCU

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Byte** | **Field** | **Bytes** | **Data type** | **Description** |
| 0-3 | Time tag | 4 | UInt | System Time |
| 4 | Reserved | 1 | UChar |  |
| 5 | Message ID | 1 | UChar | Message id **0x33 (Pkt-C)** |
| 6-7 | Message seq no | 2 | UShort | Starts at 0. Resets to zero at 65535 |
| 8-9 | Message CRC | 2 | UShort | CRC-16/AUG-CCITT, Poly:0x1021, Init:0x1DOF |

Message between Ground TWDL and CCU:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Byte** | **Field** | **Bytes** | **Words** | **Data type** | **Description** |
| 0-1 | Time tag | 2 | 0 | UShort | System Time |
| 2 | Missile ID (LSB) | 2 | 1 | UShort | Should be >=1 and <=10 |
| 3 | FU MLV ID (MSB) | FU=>0-63, MLV=>0-3 [7:2-1:0] |
| 4 | Payload seq no (LSB) | 1 | 2 | UChar | Starts at 0. Resets on 255 |
| **5** | **Message ID (MSB)** | 1 | UChar | 0x03 (**Pkt-C)** |
| 6-12 | Missile position (NED in m)  Xm,Ym,Zm  Bits-LSB(19, 19, 18)MSB | 7 | 3-10 |  | Scale Factor=1;  Offset 150e3 for Xm & Ym  Offset 60e3 for Zm |
| 13-17 | Missile velocity (m/s)  Vxm Vym Vzm  Bits-LSB(14,13,13)MSB | 5 |  | Scale Factor=1;  Offset 1500 |
| 18-21 | Missile accln (m/s2)  Ax Ay Az  Bits-LSB(11,11,10)MSB | 4 |  | Scale Factor=1;  Offset 400 |
| 22-25 | Body rates (deg/s)  P q r  Bits-LSB(11,11,10)MSB | 4 | 11-16 |  | Scale Factor=1;  Offset 400 |
| 26-29 | Euler angles (deg)  Φ, θ, ψ  Bits-LSB(11,11,10)MSB | 4 |  | Scale Factor=1;  Offset: 180 for φ  Offset: 90 for θ and ψ |

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| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

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| --- | --- | --- | --- | --- | --- |
| 30-32 | Control effort (deg)  δ1, δ2, δ3, δ4  Bits-LSB(6,6,6,6)MSB | 3 |  |  | Scale Factor=1;  Offset 30 |
| 33 | MissileStaus\_SS\_Events ID | 1 | UChar  4 bit + 4 bit | 0 - Missile not healthy  1- Pre-launch  2- Launch phase  3- Packet C (Mid-course)  4- Packet D (Seeker phase: Seeker data)  5- Packet E (Seeker :  INS Data)  6- Packet F (RPF Phase) |
| 0-Seeker OFF  1-Seeker ON  2-seeker pointing  3-seeker acquisition  4-seeker tracking  5-seeker tracking  with range info  6-RPF ON  7-RPF Tracking  8-Warhead Initiation |
| 34-35 | Payload CRC | 2 | 17 | UShort | CRC-16/AUG-CCITT,  Poly:0x1021, Init:0x1DOF |
|  | Total (18 Words) | 36 |  |  |  |

Note: The above message can also be sent during self-loop checks as response to the uplink message with pre-defined (fixed/incremental) data for the missile position and velocity.

1. SeekerPlusMissile INS data Message **(Pkt-D)** from Missile to Ground

**a.Message Description:** This message is sent from OBC to On-board TWDL on Mil- 1553 bus and then to ground TWDL over wireless medium which will be further forwarded to RADAR computer/CCU/FCS over Ethernet after demodulation. This contains the current missile position as measured by the on-board INS and Seeker measurement parameters. This message also contains the missile events at that instant.

**b.Source:** On-board TWDL

1. **Destination:** Ground TWDL and finally to Radar computer/CCU/FCS **d.Trigger:** On lift-off
2. **Frequency:**10Hz

Header between Ground TWDL and CCU

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Byte** | **Field** | **Bytes** | **Data type** | **Description** |
| 0-3 | Time tag | 4 | UInt | System Time |
| 4 | Reserved | 1 | UChar |  |
| 5 | Message ID | 1 | UChar | Message id **0x43 (Pkt-D)** |
| 6-7 | Message seq no | 2 | UShort | Starts at 0. Resets to zero at 65535 |
| 8-9 | Message CRC | 2 | UShort | CRC-16/AUG-CCITT, Poly:0x1021, Init:0x1DOF |

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| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

**Pkt-D**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Byte** | **Field** | **Bytes** | **Word** | **Data type** | **Description** |
| 0-1 | Time tag | 2 | 0 | UShort | System Time |
| 2 | Missile ID (LSB) | 2 | 1 | UShort | Should be >=1 and <=10 |
| 3 | FU MLV ID (MSB) | FU=>0-63, MLV=>0-3 [7:2-1:0] |
| 4 | Message seq no (LSB) | 1 | 2 | UChar | Starts at 0. Resets on 255 |
| **5** | **Message ID (MSB)** | 1 | UChar | 0x04**(Pkt-D)** |
| 6-9 | Missile accln (m/s2)  Ax,Ay,Az  Bits-LSB(11,11,10)MSB | 4 | 3-4 |  | Scale Factor=1;  Offset 400 |
| 10-13 | Body rates (deg/s)  P q r  Bits-LSB(11,11,10)MSB | 4 | 5-6 |  | Scale Factor=1;  Offset 400 |
| 14-17 | Euler angles (deg)  Φ, θ, ψ  Bits-LSB(11,11,10)MSB | 4 | 7-8 |  | Scale Factor=1;  Offset: 180 for φ  Offset: 90 for θ and ψ |
| 18-20 | Control effort (deg)  δ1, δ2, δ3, δ4  Bits-LSB(6,6,6,6)MSB | 3 | 9-10 |  | Scale Factor=1;  Offset 20 |

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| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

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| --- | --- | --- | --- | --- | --- | --- |
| 21 | MissileStaus\_SS\_Events ID | 1 |  | UChar  4 bit + 4 bit | 0 - Missile not healthy  1- Pre-launch  2- Launch phase  3- Packet C (Mid-course)  4- Packet D (Seeker phase: Seeker data)  5- Packet E (Seeker :  INS Data)  6- Packet F (RPF Phase) | |
| 0-Seeker OFF  1-Seeker ON  2-seeker pointing  3-seeker acquisition  4-seeker tracking  5-seeker tracking  with range info  6-RPF ON  7-RPF Tracking  8-Warhead Initiation | |
| 22-33 | Seeker measurement R (m)  R\_dot (m/s)  GA\_El (deg) GA\_Az (deg) SLR\_El (deg/s) SLR\_Az (deg/s) BSE\_El (deg) BSE\_Az (deg)  Seeker flags  Bits-LSB(15,13,8,8,9,9,9,9,16)MSB | 12 | 11-16 |  | Range,Offset  0-20000, 0  -2000 to 0, 2000  -50 to +50, 50  -50 to +50, 50  -5 to +5, 5  -5 to +5, 5  -5 to +5, 5  -5 to +5, 5 | Resolution/Scale Factor  1  1  1  1  0.1  0.1  0.1  0.1 |
| 34-35 | CRC | 2 | 17 | UShort | CRC-16/AUG-CCITT,  Poly:0x1021, Init:0x1DOF | |
|  | Total (18 Words) | 36 |  |  |  | |

Note: The above message can also be sent during self-loop checks as response to

the uplink message with pre-defined (fixed/incremental) data for the missile position and velocity.

* + 1. Seeker Plus Missile INS data Message **(Pkt-E)** from Missile to Ground

1. **Description:** This message is sent from OBC to On-board TWDL on Mil- 1553 bus and then to ground TWDL over wireless medium which will be further forwarded to RADAR computer/CCU/FCS over Ethernet after demodulation. This contains the current missile position as measured by the on-board INS and Seeker measurement parameters. This message also contains the missile events at that instant.

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| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

**b.Source:** On-board TWDL

**c .Destination:** Ground TWDL and finally to Radar computer/CCU/FCS

**d.Trigger:** On lift-off

**e.Frequency:**10Hz

Header between Ground TWDL and CCU

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Byte** | **Field** | **Bytes** | **Data type** | **Description** |
| 0-3 | Time tag | 4 | UInt | System Time |
| 4 | Reserved | 1 | UChar |  |
| 5 | Message ID | 1 | UChar | Message id **0x53 (Pkt-E)** |
| 6-7 | Message seq no | 2 | UShort | Starts at 0. Resets to zero at 65535 |
| 8-9 | Message CRC | 2 | UShort | CRC-16/AUG-CCITT, Poly:0x1021, Init:0x1DOF |

Between Ground TWDL and CCU:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Byte** | **Field** | **Bytes** | **Word** | **Data type** | **Description** |
| 0-1 | Time tag | 2 | 0 | UShort | System Time |
| 2 | Missile ID (LSB) | 2 | 1 | UShort | Should be >=1 and <=10 |
| 3 | FU MLV ID (MSB) | FU=>0-63, MLV=>0-3 [7:2-1:0] |
| 4 | Message seq no (LSB) | 1 | 2 | UChar | Starts at 0. Resets on 255 |
| **5** | **Message ID (MSB)** | 1 | UChar | 0x**05 (Pkt-E)** |
| 6-12 | Missile position (NED in m)  Xm,Ym,Zm  Bits-LSB(19,19,18)MSB | 7 | 3-10 |  | Scale Factor=1;  Offset 150e3 for Xm & Ym  Offset 60e3 for Zm |
| 13-17 | Missile velocity (m/s)  Vxm Vym Vzm  Bits-LSB(14,13,13)MSB | 5 |  | Scale Factor=1;  Offset 1500 |
| 18-21 | Missile accln (m/s2)  Ax Ay Az  Bits-LSB(11,11,10)MSB | 4 |  |  | Scale Factor=1;  Offset 400 |
| 22-25 | Body rates(deg/s)  P, q, r  Bits-LSB (11,11,10) MSB | 4 | 11-12 |  | Scale Factor=1;  Offset 400 |
| 26-29 | Euler angles (deg)  Φ, θ, ψ  Bits-LSB(11,11,10)MSB | 4 | 13-14 |  | Scale Factor=1;  Offset: 180 for φ  Offset: 90 for θ and ψ |
| 30-32 | Control effort (deg)  δ1, δ2, δ3, δ4  Bits-LSB(6,6,6,6)MSB | 3 | 15-16 |  | Scale Factor=1;  Offset 30 |
| 33 | MissileStaus\_SS\_Events ID | 1 |  | UChar  4 bit + 4 bit | 0 - Missile not healthy  1- Pre-launch  2- Launch phase  3- Packet C (Mid-course)  4- Packet D (Seeker phase: Seeker data)  5- Packet E (Seeker :  INS Data)  6- Packet F (RPF Phase) |
|  | 0-Seeker OFF  1-Seeker ON  2-seeker pointing  3-seeker acquisition  4-seeker tracking  5-seeker tracking  with range info  6-RPF ON  7-RPF Tracking  8-Warhead Initiation |
| 34-35 | CRC | 2 | 17 | UShort | CRC-16/AUG-CCITT,  Poly:0x1021, Init:0x1DOF |
|  | Total (18 Words) | 36 |  |  |  |

Note: The above message can also be sent during self-loop checks as response to

the uplink message with pre-defined (fixed/incremental) data for the missile position and velocity.

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| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

1. DESCRIPTION OF DATA FIELDS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **S.No** | **Data Description** | **Parameters checked** | | **at MU TWDL system** | **Remarks** |
| 1 | DL Configuration |  | Time Tag | Should be > 0 | OBC to DLU |
|  | Command |  | Message ID | 0x07 |  |
|  |  |  | Missile ID | Should be >=1 and <=10 |  |
|  |  |  | Message Seq No | 0 to 65535 |  |
|  |  |  | CRC | CRC16 for received data from OBC |  |
| 2 | Missile INS Data Message |  | Time Tag | Should be > 0 | OBC to DLU |
|  | (Pkt-C) |  | Message ID | 0x03 |  |
|  | SeekerPlusMsl INS Data |  | Missile ID | Should be >=1 and <=10 |  |
|  | (Pkt-D&E) |  |  |  |  |
| 3 | PA Mute/PA mode |  | Time Tag | Should be > 0 | OBC to DLU |
|  | selection command |  | Message ID | 0x0A |  |
|  |  |  | Missile ID | Should be >=1 and <=10 |  |
|  |  |  | Message Seq No | 0 to 65535 |  |
|  |  |  | CRC | CRC16 for received data from OBC |  |
| 4 | Tx Antenna port |  | Time Tag | Should be > 0 | OBC to DLU |
|  | selection |  | Message ID | 0x0B |  |
|  |  |  | Message Seq No | 0 to 65535 |  |
|  |  |  | Missile ID | Should be >=1 and <=10 |  |
|  |  |  | CRC | CRC16 for received data from OBC |  |
| 5 | Target Dwell data on  Rx1 (Pkt-A) |  | Message ID 0x01 | | DLU to OBC |
| 6 | Target Dwell data on  Rx2 (Pkt-A) | Message ID 0x01 | | | DLU to OBC |
| 7 | TgtPlusMissile Dwell data on Rx1 (Pkt-B) | Message ID 0x02 | | | DLU to OBC |
| 8 | TgtPlusMissile Dwell data on Rx2 (Pkt-B) | Message ID 0x02 | | | DLU to OBC |
| 9 | Target Dwell data (error free) (Pkt-A) | Message ID 0x01 and  CRC16 validation on received data | | | DLU to OBC |
| 10 | TgtPlusMissile Dwell data (error free) (Pkt-B) | Message ID 0x02 and  CRC16 validation on received data | | | DLU to OBC |
| 11 | DLU Health Posting  (1 Hz) | Message ID 0x08 | | | DLU to OBC |
| 12 | DLU Status Posting  (1 Hz) | Message ID 0x09 | | | DLU to OBC |
| 13 | DLU Version Control Message Posting on DLU Power ON | Message ID 0x0F | | | DLU to OBC |

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| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

The table below shows, Rx/TX Sub addresses for OBC<-> TWDL communications. RT Address is 0x02

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Data Description** | **Words** | **Freq** | **Sub Add** | **Remarks** | **Remarks** |
| 1 | DL Configuration Command | 11 | Once | Rx-  01 | OBC sends the initialization data to DLU after power on | OBC to DLU |
| 2 | Missile INS Data  Message (Pkt-C)  SeekerPlusMsl INS  Data (Pkt-D&E) | 18 | 10 Hz | Rx-  02 | OBC sends the INS data and various subsystem health to DLU | OBC to DLU |
| 3 | Reserved |  |  | Rx-  03 | Future use | OBC to DLU |
| 4 | PA Mute/PA mode selection command | 6 | Once | Rx-  04 | OBC sends the PA mode (ON/OFF and different power level 1W/5W/ 10W/15W) | OBC to DLU |
| 5 | Tx Antenna port selection | 6 | Once | Rx-  05 | Transmit port selection by OBC | OBC to DLU |
| 6 | Reserved |  |  | Rx-  06 | Future use | OBC to DLU |
| 7 | Target Dwell or TgtPlusMissile Dwell data on Rx1  (Pkt-A or Pkt-B) | 18 | 10 Hz | Tx-  01 | DLU sends the target or TgtPlusMissile track position raw data received on Rx1 to OBC | DLU to OBC |
| 8 | Target Dwell or TgtPlusMissile Dwell data on Rx2  (Pkt-A or Pkt-B) | 18 | 10 Hz | Tx- 02 | DLU sends the target or TgtPlusMissile track position raw data received on Rx2 to OBC | DLU to OBC |
| 9 | Target Dwell or TgtPlusMissile Dwell data (error free)  (Pkt-A or Pkt-B) | 18 | 10 Hz | Tx- 03 | DLU sends error free target or TgtPlusMissile track data to OBC | DLU to OBC |
| 10 | Reserved |  |  | Tx- 04 | Future use | DLU to OBC |
| 11 | Reserved |  |  | Tx- 05 | Future use | DLU to OBC |
| 12 | Reserved |  |  | Tx- 06 | Future use | DLU to OBC |
| 13 | DLU Health (DLU-OBC) | 14 | 1 Hz | Tx- 07 | DLU provides DL unit health to OBC | DLU to OBC |
| 14 | DLU Status (DLU-OBC) | 14 | 1 Hz | Tx-  08 | DLU updates its present DL Status and parameters to OBC | DLU to OBC |
| 15 | DLU Version Control Msg | 18 | Once | Tx- 09 | DLU ABBBDM\_DTM S/W, H/W version | DLU to OBC |

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| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

**Down-Link Transmit Frequency mapping table for On-Board DLU**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sr.No** | **Index** | **Frequency** | **Remarks** |
| 1. | 0000 | F-Tx-0 | Default Frequency |
| 2. | 0001 | F-Tx-1 |  |
| 3. | 0002 | F-Tx-2 |  |
| 4. | 0003 | F-Tx-3 |  |
| 5. | 0004 | F-Tx-4 |  |
| 6. | 0005 | F-Tx-5 |  |
| 7. | 0006 | F-Tx-6 |  |
| 8. | 0007 | F-Tx-7 |  |
| 9. | 0008 | F-Tx-8 |  |
| 10. | 0009 | F-Tx-9 |  |
| 11. | 000A | F-Tx-10 |  |
| 12. | 000B | F-Tx-11 |  |
| 13. | 000C | F-Tx-12 |  |

**Up-Link Receive Frequency mapping table for On-Board DLU**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sr.No** | **Index** | **Frequency** | **Remarks** |
| 1. | 0000 | F-Rx-0 | Default Frequency |
| 2. | 0001 | F-Rx-1 |  |
| 3. | 0002 | F-Rx-2 |  |
| 4. | 0003 | F-Rx-3 |  |
| 5. | 0004 | F-Rx-4 |  |
| 6. | 0005 | F-Rx-5 |  |
| 7. | 0006 | F-Rx-6 |  |
| 8. | 0007 | F-Rx-7 |  |
| 9. | 0008 | F-Rx-8 |  |

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| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

**Up-Link Transmit Frequency mapping table for Ground DL System**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sr.No** | **Index** | **Frequency** | **Remarks** |
| 1. | 0000 | F-Tx-0 | Default Frequency |
| 2. | 0001 | F-Tx-1 |  |
| 3. | 0002 | F-Tx-2 |  |
| 4. | 0003 | F-Tx-3 |  |
| 5. | 0004 | F-Tx-4 |  |
| 6. | 0005 | F-Tx-5 |  |
| 7. | 0006 | F-Tx-6 |  |
| 8. | 0007 | F-Tx-7 |  |
| 9. | 0008 | F-Tx-8 |  |

**Down-Link Receive Frequency mapping table for Ground DL System**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sr.No** | **Index** | **Frequency** | **Remarks** |
| 1. | 0000 | F-Rx-0 | Default Frequency |
| 2. | 0001 | F-Rx-1 |  |
| 3. | 0002 | F-Rx-2 |  |
| 4. | 0003 | F-Rx-3 |  |
| 5. | 0004 | F-Rx-4 |  |
| 6. | 0005 | F-Rx-5 |  |
| 7. | 0006 | F-Rx-6 |  |
| 8. | 0007 | F-Rx-7 |  |
| 9. | 0008 | F-Rx-8 |  |
| 10. | 0009 | F-Rx-9 |  |
| 11. | 000A | F-Rx-10 |  |
| 12. | 000B | F-Rx-11 |  |
| 13. | 000C | F-Rx-12 |  |

|  |  |
| --- | --- |
| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

**Up-Link Transmit CDMA Code mapping table for Ground DL System**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sr.No** | **CDMA Index GrTxCode** | **Assigned AKASH-NG** | **Remarks** |
| 1. | 0000 | AKASH-NG-M1-M10 | AKASH-NG-M1-M10 |
| 2. | 0001 | AKASH-NG-M1-M10 |  |
| 3. | 0002 | AKASH-NG-M1-M10 |  |
| 4. | 0003 | AKASH-NG-M1-M10 |  |
| 5. | 0004 | AKASH-NG-M1-M10 |  |
| 6. | 0005 | AKASH-NG-M1-M10 |  |
| 7. | 0006 | AKASH-NG-M1-M10 |  |
| 8. | 0007 | AKASH-NG-M1-M10 |  |
| 9. | 0008 | AKASH-NG-M1-M10 |  |
| 10. | 0009 | AKASH-NG-M1-M10 |  |
| 11. | 000A | AKASH-NG-M1-M10 |  |

**Down-Link Receive CDMA Code mapping table for Ground DL System**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sr.No** | **CDMA Index GrRxCode** | **Assigned AKASH-NG** | **Remarks** |
| 1. | 0000 | AKASH-NG-M1-M10 | AKASH-NG-M1-M10 |
| 2. | 0001 | AKASH-NG-M1-M10 |  |
| 3. | 0002 | AKASH-NG-M1-M10 |  |
| 4. | 0003 | AKASH-NG-M1-M10 |  |
| 5. | 0004 | AKASH-NG-M1-M10 |  |
| 6. | 0005 | AKASH-NG-M1-M10 |  |
| 7. | 0006 | AKASH-NG-M1-M10 |  |
| 8. | 0007 | AKASH-NG-M1-M10 |  |
| 9. | 0008 | AKASH-NG-M1-M10 |  |
| 10. | 0009 | AKASH-NG-M1-M10 |  |
| 11. | 000A | AKASH-NG-M1-M10 |  |

|  |  |
| --- | --- |
| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

**Up-Link Receive CDMA Code mapping table for On board DL System**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sr.No** | **CDMA Index MissRxCode** | **Assigned AKASH-NG** | **Remarks** |
| 1. | 0000 | AKASH-NG-M1-M10 | AKASH-NG-M1-M10 |
| 2. | 0001 | AKASH-NG-M1-M10 |  |
| 3. | 0002 | AKASH-NG-M1-M10 |  |
| 4. | 0003 | AKASH-NG-M1-M10 |  |
| 5. | 0004 | AKASH-NG-M1-M10 |  |
| 6. | 0005 | AKASH-NG-M1-M10 |  |
| 7. | 0006 | AKASH-NG-M1-M10 |  |
| 8. | 0007 | AKASH-NG-M1-M10 |  |
| 9. | 0008 | AKASH-NG-M1-M10 |  |
| 10. | 0009 | AKASH-NG-M1-M10 |  |
| 11. | 000A | AKASH-NG-M1-M10 |  |

**Down-Link Transmit CDMA Code mapping table for On board DL System**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sr.No** | **CDMA Index MissTxCode** | **Assigned AKASH-NG** | **Remarks** |
| 1. | 0000 | AKASH-NG-M1-M10 | AKASH-NG-M1-M10 |
| 2. | 0001 | AKASH-NG-M1-M10 |  |
| 3. | 0002 | AKASH-NG-M1-M10 |  |
| 4. | 0003 | AKASH-NG-M1-M10 |  |
| 5. | 0004 | AKASH-NG-M1-M10 |  |
| 6. | 0005 | AKASH-NG-M1-M10 |  |
| 7. | 0006 | AKASH-NG-M1-M10 |  |
| 8. | 0007 | AKASH-NG-M1-M10 |  |
| 9. | 0008 | AKASH-NG-M1-M10 |  |
| 10. | 0009 | AKASH-NG-M1-M10 |  |
| 11. | 000A | AKASH-NG-M1-M10 |  |

|  |  |
| --- | --- |
| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

1. APPENDIX - A : SYSTEMS DESCRIPTION FOR TWO-WAY DATA LINK

Uplink during mid-course @ 100 ms

Two packets are to be uplinked alternately at 100 ms interval. Time tag, missile messages and target parameters (position and velocity) are to be sent in the both the packets. Missile parameters (position and velocity) and target other parameters are to be sent alternately.

If missile parameters are not uplinked; then Packet - B can be discarded and only Packet - A will be uplinked at 100 ms interval.

Packet - A

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Sl. No. | Parameters | Range | Res | No. of bits | No of  Bytes | Remarks |
| 1 | Time tag | 0-200 | 0.005 | 8+8(D) = 16 | 2+2 |  |
| 2 | Missile ID | 0-63(FU)  0-3 (MLV)  0-5(Missile) | 1 | 6  2  3 | 2 | - |
| 3 | Message ID | 0-2 | 1 | 2 | 1+1 | 0- CDS   1. Packets A 2. Packets B |
| 4 | Message sequence No | 0-255  (0-65535) | 1 | 8+8 | 1+1 | There may be 1000 messages in 100 s with update rate of 100ms. For sequence no 0 to 255 can be used after that there will be repetition of sequence which shall be decoded based upon logic decided by designer. |
| 5 | Target position (NED in m) Xt Yt Zt | -150e3 to +150e3  -150e3 to +150e3 -60e3 to +60e3 | 1  1  1 | 1(S)+18 = 19  1(S)+18 = 19  1(S)+16 = 17 | 7 |  |
| 6 | Target velocity  (m/s)  Vxt  Vyt  Vzt | -1500 to +1500  -1500 to +1500  -1500 to +1500 | 1  1  1 | 1(S)+11 = 12  1(S)+11 = 12  1(S)+11 = 12 | 5 |  |
| 7 | Target accln  (m/s2)  Axt Ayt Azt | -100 to +100  -100 to +100  -100 to +100 | 1  1  1 | 1(S)+7 = 8  1(S)+7 = 8  1(S)+7 = 8 | 3 |  |

|  |  |
| --- | --- |
| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 8 | Target position ct (m) Xt Yt Zt | 0 to 500  0 to 500  0 to 500 | 1  1  1 | 9  9  9 | 4 |  |
| 9 | Target velocity ct (m/s)  Vxt  Vyt  Vzt | 0 to 50  0 to 50  0 to 50 | 1  1  1 | 6  6  6 | 3 |  |
| 10 | Target type | 0-7 | 1 | 3 | 1 | 0-fighter aircraft   1. helicopter 2. Sub sonic cruise missile 3. Air to Surface missile 4. RPA 5. stand by 6. stand by 7. self destruction |
| 11 | Target RCS |  |  |  | 1 |  |
| 12 | CRC | | | 16 | 2 |  |
|  | Total | | | | **36** |  |

|  |  |
| --- | --- |
| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

Packet - B

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Sl. No. | Parameters | Range | Res | No. of bits | No of  Bytes | Remarks |
| 1 | Time tag | 0-200 | 0.005 | 8+8(D) = 16 | 2+2 |  |
|  |  | 0-63(FU) |  | 6 | 2 |  |
| 2 | Missile ID | 0-3 (MLV) | 1 | 2 | - |
|  |  | 0-5(Missile) |  | 3 |  |  |
|  |  |  |  | 2 | 1+1 | 0- CDS |
| 3 | Message ID | 0-2 | 1 | 1. Packets A 2. Packets B |
|  |  |
|  | Message | 0-255 |  |  |  | There may be 1000 messages in 100 s with update rate of 100ms. For sequence no 0 to 255 can be |
| 4 | 1 | 8+8 | 1+1 | used after that there |
|  | sequence No | (0-65535) |  |  |  | will be repetition of sequence which shall be decoded based upon logic decided by designer. |
|  | Target position |  |  |  |  |  |
|  | (NED in m) |  |  |  |  |  |
| 5 | Xt | -150e3 to +150e3 | 1 | 1(S)+18 = 19 |  |  |
|  | Yt | -150e3 to +150e3 | 1 | 1(S)+18 = 19 | 7 |  |
|  | Zt | -60e3 to +60e3 | 1 | 1(S)+16 = 17 |  |  |
|  | Target velocity |  |  |  |  |  |
|  | (m/s) |  |  |  |  |  |
| 6 | Vxt | -1500 to +1500 | 1 | 1(S)+11 = 12 | 5 |  |
|  | Vyt | -1500 to +1500 | 1 | 1(S)+11 = 12 |  |
|  | Vzt | -1500 to +1500 | 1 | 1(S)+11 = 12 |  |  |
|  | Missile position |  |  |  |  |  |
|  | (NED in m) |  |  |  |  |  |
| 7 | Xm | -150e3 to +150e3 | 1 | 1(S)+18 = 19 |  |  |
|  | Ym | -150e3 to +150e3 | 1 | 1(S)+18 = 19 | 7 | Only if radar looks at |
|  | Zm | -60e3 to +60e3 | 1 | 1(S)+16 = 17 |  | the missile and INS |
|  | Missile velocity |  |  |  |  | can be corrected by |
|  | (m/s) |  |  |  |  | fusing radar data |
| 8 | Vxm | -1500 to +1500 | 1 | 1(S)+11 = 12 | 5 |  |
|  | Vym | -1500 to +1500 | 1 | 1(S)+11 = 12 |  |  |
|  | Vzm | -1500 to +1500 | 1 | 1(S)+11 = 12 |  |  |
| 9 | CRC | | | 16 | 2 |  |
|  | Total | | | | **36** |  |

|  |  |
| --- | --- |
| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

Downlink data (Packet -C)

Downlink @ 100 ms (During midcourse phase) Midcourse phase: @ 100 ms

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Sl.  No | Parameters | Range | Res | No. of bits | Bytes | Remarks |
| 1 | Time tag | 0-200 | 0.005 | 8+8(D) = 16 | 2 |  |
|  |  | 0-63(FU) |  | 6  2  3 |  |  |
| 2 | Missile ID | 0-3 (MLV)  0-5(Missile) | 1 | 2 |  |
| 3 | Message ID | 3-6 | 1 | 2 | 1 | 1. Packets C 2. Packets D 3. Packets E 4. Packets F |
|  |  |  |  |  |  | There may be 1000 messages in 100 s with update rate of |
| 4 | Message | 0-255 | 1 | 8 | 1 | 100ms. For sequence |
| sequence no |  | no 0 to 255 can be used after that there will be repetition of sequence |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  | Missile position |  |  |  |  |  |
|  | (NED in m) |  |  |  |  |  |
| 5 | Xm | -150e3 to +150e3 | 1 | 1(S)+18 = 19 |  |  |
|  | Ym | -150e3 to +150e3 | 1 | 1(S)+18 = 19 | 7 |  |
|  | Zm | -60e3 to +60e3 | 1 | 1(S)+16 = 17 |  |  |
|  | Missile velocity |  |  |  |  |  |
|  | (m/s) |  |  |  |  |  |
| 6 | Vxm | -1500 to +1500 | 1 | 1(S)+11 = 12 |  |  |
|  | Vym | -1500 to +1500 | 1 | 1(S)+11 = 12 | 5 |  |
|  | Vzm | -1500 to +1500 | 1 | 1(S)+11 = 12 |  |  |
|  | Missile accln |  |  |  |  |  |
|  | (m/s2) |  |  |  |  |  |
| 7 | Ax | -400 to +400 | 1 | 1(S)+9 = 10 |  |  |
|  | Ay | -400 to +400 | 1 | 1(S)+9 = 10 | 4 |  |
|  | Az | -400 to +400 | 1 | 1(S)+9 = 10 |  |  |
|  | Body rates (deg/s) |  |  |  |  |  |
| 8 | p | -400 to +400 | 1 | 1(S)+9 = 10 |  |  |
|  | q  r | -400 to +400 | 1 | 1(S)+9 = 10 | 4 |  |
|  | -400 to +400 | 1 | 1(S)+9 = 10 |  |  |
|  | Euler angles (deg) |  |  |  |  |  |
| 9 | 9 | -180 to +180 | 1 | 1(S)+8 = 9 |  |  |
| 0 | -90 to +90 | 1 | 1(S)+7 = 8 | 4 |  |
|  | V | -90 to +90 | 1 | 1(S)+7 = 8 |  |  |

|  |  |
| --- | --- |
| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 10 | Control effort (deg)  31  52  53  54 | -30 to +30  -30 to +30  -30 to +30  -30 to +30 | 1  1  1  1 | 1(S)+5 = 6  1(S)+5 = 6  1(S)+5 = 6  1(S)+5 = 6 | 3 |  |
| 11 | MissileStaus\_SS\_  Events ID | 0-6 | 1 | 3 | 1 | 0 - Missile not healthy   1. - Pre-launch 2. - Launch phase 3. - Packet C (Mid­course) 4. - Packet D (Seeker phase: Seeker data) 5. - Packet E (Seeker :   INS Data)   1. - Packet F (RPF Phase) |
|  |  | 0-8 | 1 | 4 | (4bit +  4bit) | 0-Seeker OFF   1. Seeker ON 2. seeker pointing 3. seeker acquisition 4. seeker tracking 5. seeker tracking   with range info   1. RPF ON 2. RPF Tracking 3. Warhead Initiation |
| 12 | CRC | | | 16 | 2 |  |
|  | Total | | | | **36** |  |

|  |  |
| --- | --- |
| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

Downlink @ 100ms (During terminal seeker phase)

Two packets (D & E) can be sent alternatively every 100ms. One contains seeker data and other INS navigation data.

Once RPF locks on the target; only RPF data will be transmitted at 1ms interval.

Packet - D

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Sl. No. | Parameters | Range | Res | No. of bits | Bytes | Remarks |
| 1 | Time tag | 0-200 | 0.005 | 8+8(D) = 16 | 2 |  |
|  |  | 0-63(FU) |  | 6 |  |  |
| 2 | Missile ID | 0-3 (MLV) | 1 | 2 | 2 |  |
|  |  | 0-5(Missile) |  | 3 |  |  |
| 3 | Message ID | 3-6 | 1 | 2 | 1 | 1. Packets C 2. Packets D 3. Packets E 4. Packets F |
|  |  |  |  |  |  | There may be 1000 messages in 100 s with update rate of |
| 4 | Message | 0-255 | 1 | 8 | 1 | 100ms. For sequence |
| sequence no |  | no 0 to 255 can be used after that there will be repetition of sequence |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  | Missile accln |  |  |  |  |  |
| 5 | (m/s2)  Ax | -400 to +400 | 1 | 1(S)+9 = 10 | 4 |  |
| Ax  Ay  Az | -400 to +400 | 1 | 1(S)+9 = 10 |  |
|  | -400 to +400 | 1 | 1(S)+9 = 10 |  |  |
|  | Body rates |  |  |  |  |  |
| 6 | (deg/s)  p | -400 to +400  -400 to +400 | 1  1 | 1(S)+9 = 10  1(S)+9 = 10 | 4 |  |
|  | q  r | -400 to +400 | 1 | 1(S)+9 = 10 |  |  |
|  | Euler angles |  |  |  |  |  |
| 7 | (deg)  9 0  V | -180 to +180  -90 to +90 | 1  1 | 1(S)+8 = 9  1(S)+7 = 8 | 4 |  |
|  | -90 to +90 | 1 | 1(S)+7 = 8 |  |  |
|  | Control effort |  |  |  |  |  |
|  | (deg)  51  52  53  54 | -20 to +20 | 1 | 1(S)+5 = 6 | 3 |  |
| 8 | -20 to +20 | 1 | 1(S)+5 = 6 |  |
|  | -20 to +20 | 1 | 1(S)+5 = 6 |  |  |
|  | -20 to +20 | 1 | 1(S)+5 = 6 |  |  |

|  |  |
| --- | --- |
| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 9 | MissileStaus\_SS \_Events ID | 0-6 | 1 | 3 | 1 | 0 - Missile not healthy   1. - Pre-launch 2. - Launch phase 3. - Packet C (Mid­course) 4. - Packet D (Seeker phase: Seeker data) 5. - Packet E (Seeker : INS Data) 6. - Packet F (RPF   Phase) |
|  |  | 0-8 | 1 | 4 | (4bit +  4bit) | 0-Seeker OFF   1. Seeker ON 2. seeker pointing 3. seeker acquisition 4. seeker tracking 5. seeker tracking   with range info   1. RPF ON 2. RPF Tracking 3. Warhead Initiation |
| 10 | Seeker measurement R (m) R\_dot (m/s) GA\_El (deg) GA\_Az (deg) SLR\_El (deg/s) SLR\_Az (deg/s) BSE\_El (deg) BSE\_Az (deg) Seeker flags | 0-20000 -2000 to 0 -50 to +50 -50 to +50  -5 to +5 -5 to +5 -5 to +5 -5 to +5 | 1  1  1  1  0.1  0.1  0.1  0.1 | 15 1(S)+11 = 12  1(S)+6 = 7 1(S)+6 = 7  1(S)+3+4(D) = 8  1(S)+3+4(D) = 8  1(S)+3+4(D) = 8  1(S)+3+4(D) = 8 16 | 12 |  |
| 11 | CRC | | | 16 | 2 |  |
|  | Total | | | | **36** |  |

AKASH-NG-ICD FOR TWO WAY DATA LINK SYSTEM-VER 1.2 **2019**

Packet - E

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Sl. No. | Parameters | Range | Res | No. of bits | No of  Bytes | Remarks |
| 1 | Time tag | 0-200 | 0.005 | 8+8(D) = 16 | 2 |  |
|  |  | 0-63(FU) |  | 6  2  3 | 2 |  |
| 2 | Missile ID | 0-3 (MLV)  0-5(Missile) | 1 |  |
|  |
| 3 | Message ID | 3-6 | 1 | 2 | 1 | 1. Packets C 2. Packets D 3. Packets E 4. Packets F |
|  | Message |  |  |  | 1 | There may be 1000 messages in 100 s with update rate of 100ms. For |
| 4 | 0-255 | 1 | 8 | sequence no 0 to |
|  | sequence no |  |  |  |  | 255 can be used after that there will be repetition of sequence |
|  | Missile |  |  |  |  |  |
|  | position (NED |  |  |  |  |  |
| 5 | in m) Xm | -150e3 to +150e3 | 1 | 1(S)+18 = 19 | 7 |  |
|  | Xm  Ym | -150e3 to +150e3 | 1 | 1(S)+18 = 19 |  |
|  | Ym Zm | -60e3 to +60e3 | 1 | 1(S)+16 = 17 |  |  |
|  | Missile |  |  |  |  |  |
|  | velocity (m/s) |  |  |  |  |  |
| 6 | Vxm | -1500 to +1500 | 1 | 1(S)+11 = 12 | 5 |  |
|  | Vym | -1500 to +1500 | 1 | 1(S)+11 = 12 |  |  |
|  | Vzm | -1500 to +1500 | 1 | 1(S)+11 = 12 |  |  |
|  | Missile accln |  |  |  |  |  |
|  | (m/s2) |  |  |  |  |  |
| 7 | Ax | -400 to +400 | 1 | 1(S)+9 = 10 |  |  |
|  | Ay | -400 to +400 | 1 | 1(S)+9 = 10 | 4 |  |
|  | Az | -400 to +400 | 1 | 1(S)+9 = 10 |  |  |
|  | Body rates(deg/s) |  |  |  |  |  |
| 8 | p | -400 to +400 | 1 | 1(S)+9 = 10 | 4 |  |
|  | q | -400 to +400 | 1 | 1(S)+9 = 10 |  |  |
|  | r | -400 to +400 | 1 | 1(S)+9 = 10 |  |  |
|  | Euler angles |  |  |  |  |  |
| 9 | (deg)  9  0 | -180 to +180  -90 to +90 | 1  1 | 1(S)+8 = 9  1(S)+7 = 8 | 4 |  |
|  | -90 to +90 | 1 | 1(S)+7 = 8 |  |  |
|  | V |  |  |  |  |

|  |  |
| --- | --- |
| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 10 | Control effort (deg) 31  52  53  54 | -30 to +30  -30 to +30  -30 to +30  -30 to +30 | 1  1  1  1 | 1(S)+5 = 6  1(S)+5 = 6  1(S)+5 = 6  1(S)+5 = 6 | 3 |  |
| 11 | MissileStaus\_  SS\_Events ID | 0-6 | 1 | 3 | 1 | 0 - Missile not healthy   1. - Pre-launch 2. - Launch phase 3. - Packet C (Mid­course) 4. - Packet D (Seeker phase: Seeker data) 5. - Packet E (Seeker : INS Data) 6. - Packet F (RPF Phase) |
|  |  | 0-8 | 1 | 4 | (4bit +  4bit) | 0-Seeker OFF   1. Seeker ON 2. seeker pointing 3. seeker acquisition 4. seeker tracking 5. seeker tracking   with range info   1. RPF ON 2. RPF Tracking 3. Warhead Initiation |
| 12 | CRC | | | 16 | 2 |  |
|  | Total | | | | **36** |  |

|  |  |
| --- | --- |
| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

Downlink @ 1ms (During RPF phase)

Packet - F

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Sl. No. | Parameters | Range | Res | No. of bits | No of Bytes | Remarks |
| 1 | Missile ID  Message ID (6) | 0-3 (MLV) 0-5(Missile) Required 'F' | 1 | 2  3 | 1 |  |
| 2 | Miss Distance | 0-31 | 1 | 5 | 1 |  |
| 3 | CRC | Required |  |  |  |  |
|  | Total | | | | **2 Bytes** |  |

**TWDLS MESSAGE ID INDEX**

|  |  |  |
| --- | --- | --- |
| **Sr.No** | **MESSAGE ID**  **(6Th Byte of Every**  **Message)** | **DESCRIPTION** |
| 1 | 0x00 | RESERVED |
| 2 | 0x01 | UP-LINK Pkt-A TRANSMISSION |
| 3 | 0x02 | UP-LINK Pkt-B TRANSMISSION |
| 4 | 0xX3 | DOWN-LINK DATA Pkt RECEPTION  X= 0 - Missile not healthy  X= 1 - Pre-launch  X= 2 - Launch phase  X= 3 - Packet C (Mid-course)  X= 4 - Packet D (Seeker phase: Seeker data)  X= 5 - Packet E (Seeker : INS Data)  X= 6 - Packet F (RPF Phase) |
| 5 | 0x04 | GROUND DLS CONFIGURATION |
| 6 | 0x55 | GROUND DLS HEALTH RECEPTION |
| 7 | 0x66 | GROUND DLS STATUS RECEPTION |
| 8 | 0x07 | ON-BOARD DLS CONFIGURATION |
| 9 | 0x08 | ON-BOARD DLS HEALTH RECEPTION |
| 10 | 0x09 | ON-BOARD DLS STATUS RECEPTION |
| 11 | 0x0A | On-board DL Power Amplifier mode Configuration |
| 12 | 0x0B | On-board DL Tx Antenna Port Switch Command |
| 13 | 0x0C | Ground DL Power Amplifier mode Configuration |
| 14 | 0x0E | Ground DLS Version Control message  (Text Message with Version, Date, Size and Checksum to CCU) |
| 15 | 0x0F | On-board DLU Version Control message |

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| AKASH-NG-ICD for TWO WAY DATA LINK System-VER 1.2 | **2019** |

1. APPENDIX - B : ABBREVIATIONS

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| **TERM** | **ABBREVIATION** |
| CCU | Battery Multifunction CCU/FCS Vehicle |
| CDMA | Code Division Multiple Access |
| CRC | Cyclic Redundancy Check |
| CV | Combat Vehicle |
| DL | Data Link |
| DLU | Data Link Unit |
| ECCM | Electronic Counter Counter Measures |
| ECEF | Earth Centered Earth Fixed |
| NED | North-East-Down |
| ECM | Electronic Counter Measures |
| ENV | East North Vertical |
| FEC | Forward Error Correction |
| F-B | Front-Back |
| GMT | Greenwich Mean Time |
| GPS | Global Positioning System |
| ICD | Interface Control Document |
| IFF | Interrogation Friend or Foe |
| INS | Inertial Navigation System |
| MLP | Missile Launcher Processor |
| OBC | On-board Computer |
| LOS | Line Of Sight |
| LSB | Lease Significant Byte |
| L-R | Left-Right |
| MSB | Most Significant Byte |
| PCM | Pulse Code Modulation |
| AKASH-NG | Next Generation AKASH Missile |
| RF | Radio Frequency |
| TWDL | Two Way Data Link |
| UTC | Coordinated Universal Time |
| XOR | Exclusive-OR |