**OBJECT:AKASH-NG GND LOOP BASE BAND ICD ver 1.1**

**MAILING LIST**

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**APPROVAL FOR RELEASE**

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| **Date** | 21/11/2018 | 22/11/2018 | 22/11/2018 |  |
| **Sign** |  |  |  |  |
|  |  |  |  |  |

**MODIFICATION**

|  |  |  |  |
| --- | --- | --- | --- |
| **Version** | **Date** | **Author** | **Description** |
| Ver1.0 | 21/11/2018 | Jagadish prasad | Initial Release ICD. |
| Ver 1.1 | 15/10/2019 | Fazal & Vinod | Based on test observation at Vdesign |
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**ICD FOR ENCODER AND DECODER**

INTRODUCTION:  
The 70 MHz IF is input to “cdma 127 code decoder". The Data is 36 bytes long initially at 10 Hz rate and is formatted using HDLC . Header 7E is added . Bit stuffing is done .The “CDMA 127 CODE DECODER” decodes the data and convert it to 72 bytes (ASCII) . STX and EXT are added to this 72 bytes data and is posted on RS422 UART Channel. The data of 10 bytes long at the end phase with 1000 Hz rate i.e 1 Byte in 1 msec as Packet-'F' with message ID as 0x06. To know the beginning of fast update data, the message ID is to be decoded from the previous packets received. The Posting is free running basis sending the alternate channels decoded data along with system health/status/diagnosis information.

RS422 OUTPUT DATA 72 Bytes - ASCII Format RS422 OUTPUT DATA 20 Bytes - ASCII Format

RS422 INPUT DATA 36 Bytes (36 Bytes data including CRC 2 Bytes)

70 MHz IF IN HDLC FRAME

(36 Bytes and 10 Bytes -

HEX Format)

ANT\_SEL

TX\_power1 & 2 (2 I/O)

70 MHz IF IN HDLC FRAME

(36 Bytes and 10 Bytes - HEX Format)

Cdma 127 CODE

Decoder - Channel1

Cdma 127 CODE

Decoder - Channel2

ICD interface

TRQ1

TRQ2

HDLC Framing and CDMA 1023 CODE 10 User TRANSMITTER

300 MHz IF OUT HDLC FRAME

(36 Bytes- HEX Format)

|  |  |  |
| --- | --- | --- |
| STX | 72 Bytes/20 Bytes | ETX |

FIGURE 1.0

## CDMA 127 CODE DECODER

IF INPUT = 70 Mhz

No of IF = 2

Wireless Data rate = 9600

Gold Code = 127

RF BW = 2.5 Mhz

Output data interface = RS422 ( DTM : UART 2 : TX for combined o/p from Ch1 and Ch2 data packets

Optional Health, status, Diag. posting = RS422 (Carrier Board: UART3: TX)

ICD input interface = RS422 ( DTM : UART2 : RX)

Mode = Asynchronous

UART BAUD rate = 115200 ( Start bit = 1, 8 bits , Stop bit= 1, No Parity)

Posting Method = Free Running Posting

Packet decoder Initial output = 34 Bytes DATA + 2 BYTES CHKSUM + 1 BYTE STATUS(0x0F->OK, 0xF0-> Not OK)

UART1:TX Posting = STX, CH, 74 Bytes in ASCII , ETX .

Packet decoder final output = 8 Bytes DATA + 2 BYTES CHKSUM + 1 BYTE STATUS(0x0F->OK, 0xF0-> Not OK)

UART1:TX Posting = STX, CH, 22 Bytes in ASCII , ETX .

FEC = ON /OFF

FEC BAUD = 4800.

The PACKET DECODER , checks for 0x7E , followed by 34 bytes, calculate the chksum and verifies it with received chksum. If CHKSUM is passed , then should add 0x0F, as Status byte and 0xF0 , if failed.

This makes total 37 Bytes in initial phase. The output in ASCII characters : TOTAL 77 CHARS.

The PACKET DECODER format switchover should take place based on received packet message\_ID Header, upon receiving as 0x06 i.e Down-Link Packet-'F', checks for 0x7E , followed by 8 Bytes, calculate the chksum and verifies it with received chksum. If CHKSUM is passed , then should add 0x0F, as Status byte and 0xF0 , if failed.

This makes total 11 Bytes in final phase. The output in ASCII characters : TOTAL 25 CHARS.

STX : 1 char ,

Channel\_number : 1 char ,

DATA : 68 chars/ 16 chars ,

CHKSUM\_MSB : 2 chars ,

CHKSUM\_LSB :2 Chars ,

STATUS :2 chars ,

ETX : 1 char.

## EXAMPLE

<STX>,<channal number> ,< D1,,,,,,,, D68/D16>,< CS1.1,CS1.2,CS2.1,CS2.2>,< ST1.1>,<ST1.2> ,< ETX>

CH : ASCII ‘0’ or ‘1’ for Channel 1 or Channel 2 of IF input .

CS1.1: ASCII :chk sum msb of byte1 ( 7.. 4).

CS1.2: ASCII :chksum lsb of byte1 ( 3..0).

CS2.1: ASCII :chk sum msb of byte2 ( 7.. 4).

CS2.2: ASCII :chksumlsb of byte2 ( 3..0).

ST1.1 : ASCII: STATUS msb of byte ( 7 ..4).

ST1.1 : ASCII : STATUS lsb of byte ( 3 ..0).

## CDMA 1023 CODE ENCODER

IF OUTPUT = 300 Mhz

No of IF = 1

Wireless Data rate = 9600

Gold Code = 1023

**No of User = 10 User CDMA**

RF BW = 20 MHz

Encode input data interface = RS422 (DTM : UART1: RX)

UART Mode = Asynchronous

UART BAUD rate = 115200 ( Start bit = 1, 8 bits , Stop bit= 1, No Parity)

IF Output = (0 dBm)

FEC = ON /OFF

FEC BAUD = 4800.

ENCODER = Gold Code 1023 .

## DATA FORMAT:

DATA: {34 Bytes} : CHKSUM :{ 2 Bytes} ( MSB: LSB ) ( HEX FORMAT)

{STX} ,{ 36 Bytes} ,{ ETX}.

Remove STX and ETX, convert into HDLC format and transmit.

## CHKSUM CALCULATION FORMULA:

Unsigned addition of D1 to D34 into 16 bits. Convert into 2’s complement.

Note: The CHKSUM is to be calculated internally and over written. You will receive chksum 2 bytes as 0x00 and 0x00.

## ON AIR

{0x7E} ,{ D1 to D34} ,{ CHKSUM\_MSB, CHKSUM\_LSB } ( Bit stuffed) .

Note: D1 to D34 are in HEX format (BYTES).

## 

## CRC CALCULATION

**constant check : word := "1000000000000000" ; -- 0x8000;**

**constant crcpoly : word := "0001000000100001" ; -- 0x1021;**

crc : word ;

Variable tmp\_data : word ;

data\_in : input byte ;

The following loop is to be repeated for every byte (D1 to D34) to be transmitted (34 bytes).

**tmp\_data := data\_in & "00000000" ;**

**for j in 0 to 7 loop**

**xor1 := ((tmp\_data xor crc) and (check));**

**crc := crc(14 downto 0) & '0'; -- shift left 1 bit**

**if ( xor1(15) = '1' ) then**

**crc := crc xor crcpoly;**

**end if ;**

**tmp\_data := tmp\_data(14 downto 0 ) & '0';**

**end loop ;**

After 34th byte, the tmp\_data is to be copied to crc .

Crc.lsb is transmitted first followed by crc.msb

NOTE :

1. we are transmitting lsb bit of every byte .
2. crc lsb is transmitted first followed by crc msb .

# 1. Description:

The AKASH-NG Ground unit CDMA DECODER and ENCODER Block diagram is shown in fig 1.0.The block consists for 2 channel GOLD CODE 127 Decoder and 1 channel GOLD CODE 1023 Encoder. The data rate is 9600. Data consist of 34 bytes followed by 2 bytes of check sum. The wireless transmission always uses HDLC format. The Ground interface uses ASCII format with STX and ETX. The receiver is interfaced with GCU unit on RS-422 using asynchronous (UART) protocol. The Async-RS-422 is used for multiple purpose in AKASH-NG Ground unit. The Decoded Downlink data is sent to ground unit via UART channel 1 interface. UART channel no. 1 is also used for ICD communication.

## 1.1 Ground Transceiver Async-RS-422 ICD ( GTR)

The Async-RS-422 (UART. CH1. TX1) is used to output demodulated downlink data to GROUND CONTROL unit. Command Set is available to configure the ground system or get any health / diagnostics / status information.

Following parameters are finalized.

* Baud : 115.2 Kbps
* Data Bits: 8 Bits
* Parity: No Parity
* Stop Bits: 1 bit
* Flow Control: None.

TX

GTR

GCU

RX

DTM

GCU : GROUND CONTROL UNIT

GTR : GROUND TRANSCEIVER UNIT ( DTM)

The interface control description for Async-RS-422 is described in Table 1.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sr.No** | **Message** | **Msg Id** | **Update** | **Direction** | **Action/**  **Responsibility** |
| 1 | Configuration Command | ‘2’ | Any time | GCU 🡪GTR | Both:  1023 codeTx + 127 code Rx |
| 2 | Up-Link Tx Fre. Selection | '1' | Any time | GCU 🡪GTR | Prog. TX synthesizer |
| 3 | Downlink Rx Freq. Selection **Chain-1** | ‘3’ | Any time | GCU 🡪GTR | Prog. RX1 synthesizer |
| 4 | Downlink Rx Freq. Selection **Chain-2**  **(Reserved)** | ‘4’ | Any time | GCU 🡪GTR | Prog. RX2 synthesizer |
| 5 | CDMA Codes Selection | ‘5’ | Any time | GCU 🡪GTR | Code (SEED) selection both TX and RX. Option to select TX/RX |
| 6 | FEC ON/OFF Selection | ‘6’ | Any time | GCU🡪GTR | FEC ON/OFF both TX / RX. |
| 7 | Tx PA ON/OFF (Mute) | '0' | Any time | GCU🡪GTR | Tx PA ON/OFF |
| 8 | Tx PowerMode Selection | ‘7’ | Any time | GCU🡪GTR | TX power mode |
| 9 | Tx Antenna Selection (Left/Right) | ‘8’ | Any time | GCU🡪GTR | TX antenna selection left or right. |
| 10 | Receive Data posting for Receiver 2 channels | ‘E’ | Any time | GTR🡪GCU | Control of data packet posting of receiver channel 1 and channel 2. |
| 11 | Data Request INS Data /Query | ‘B’ | Anytime | GCU 🡪 GTR | Both: 1023 code Tx + 127 code Rx. |
| 12 | Health Query Response | '9' | Anytime | GTR🡪GCU | Both: 1023 code Tx + 127 code Rx. |
| 13 | Status Query Response | 'A' | Anytime | GTR🡪GCU | Both: 1023 code Tx + 127 code Rx. |
| 14 | Diagnostic Query Response | 'D' | Anytime | GTR🡪GCU | Both: 1023 code Tx + 127 code Rx. |
| 15 | Down link selection | ‘C’ | Any time | GTR🡪GCU | Both: 1023 code Tx + 127 code Rx |

TABLE:1

Following message format is used for information exchange between GCU and GTR unit. Each message start with Start of Message <STX > and ends with End of Message <ETX> described in following table.

## 1.2. Message Format Example

|  |  |  |  |
| --- | --- | --- | --- |
| **Field Name** | **Byte(s)** | **Value/Range** | **Description** |
| <STX> | 1 | 0x02 | Start of Message |
| Message Id | 1 | ‘0’ to ‘C’ | -- |
| Message Data | x | -- | Definition given in subsequent paragraphs |
| Checksum | 2 | ‘0’’0’ to ‘F’’F’ | Checksum can be 00 to FF |
| <ETX> | 1 | 0x03 | End of Message |

**Table 2**

It may be noted that <STX> and <ETX> fields are non-printable ASCII characters and remaining fields including checksum is represented only by printable characters. The checksum is calculated for remaining fields and it is determined as per ‘intel’ hex format. The hexadecimal numbering system is used wherever applicable.

# 1.0. Configuration Message

**Description:** Mission specific GND LOOP DTM configuration data loaded by Data Link/Radar Computer.

**Direction:** GCU to GTR

**Application:** During pre-launch missile preparation phase (prior to mission).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field No** | **Name** | **Byte(s)**  **(CHAR)** | **Value/Range** | **Description** |
| 1 | <STX> | 1 | 0x02 | Start of Message |
| 2 | Message Id | 1 | ’2’ | -- |
| 3 | Uplink Tx spot Freq Selection | 2 | ‘0’’0’ to ‘0’’8’ | Frequency index  **Default🡪‘0’’0’** |
| 4 | Downlink Rx spot Freq Selection Chain 1 | 2 | ‘0’’0’ to ‘0’’C’ | Frequency index  **Default🡪‘0’’0’** |
| 5 | Downlink Rx spot Freq Selection Chain 2  Reserved | 2 | ‘0’’0’ to ‘0’’C’ | Frequency index  **Default🡪‘0’’0’** |
| 6 | CDMA 127 Code of Rx- Channel -1 | 2 | ’0’’0’ to’7’’F’ | Gold Code Index-1  **Default🡪’0’’1’** |
| 7 | CDMA 127 Code of Rx-Channel -2  Reserved | 2 | ’0’’0’ to’7’’F’ | Gold Code Index-1  **Default🡪’0’’1’** |
| 8 | CDMA 1023 code of TX channel-1 (User-1) | 3 | ‘0’’0’’0’ to ‘3’’F’’F’ | Gold Code Index-2  **Default🡪‘0’’0’’1’** |
| 9 | CDMA 1023 code of TX channel- 2 (User-2) | 3 | ‘0’’0’’0’ to ‘3’’F’’F’ | Gold Code Index-2  **Default🡪‘0’’0’’3’** |
| 10 | CDMA 1023 code of TX channel- 3 (User-3) | 3 | ‘0’’0’’0’ to ‘3’’F’’F’ | Gold Code Index-2  **Default🡪‘0’’0’’5’** |
| 11 | CDMA 1023 code of TX channel -4 (User-4) | 3 | ‘0’’0’’0’ to ‘3’’F’’F’ | Gold Code Index-2  **Default🡪‘0’’0’’7’** |
| 12 | CDMA 1023 code of TX channel -5 (User-5) | 3 | ‘0’’0’’0’ to ‘3’’F’’F’ | Gold Code Index-2  **Default🡪‘0’’0’’9’** |
| 13 | CDMA 1023 code of TX channel -6 (User-6) | 3 | ‘0’’0’’0’ to ‘3’’F’’F’ | Gold Code Index-2  **Default🡪‘0’’0’’B’** |
| 14 | CDMA 1023 code of TX channel -7 (User-7) | 3 | ‘0’’0’’0’ to ‘3’’F’’F’ | Gold Code Index-2  **Default🡪‘0’’0’’D’** |
| 15 | CDMA 1023 code of TX channel -8 (User-8) | 3 | ‘0’’0’’0’ to ‘3’’F’’F’ | Gold Code Index-2  **Default🡪‘0’’0’’F’** |
| 16 | CDMA 1023 code of TX channel -9 (User-9) | 3 | ‘0’’0’’0’ to ‘3’’F’’F’ | Gold Code Index-2  **Default🡪‘0’’1’’1’** |
| 17 | CDMA 1023 code of TX channel -10 (User-10) | 3 | ‘0’’0’’0’ to ‘3’’F’’F’ | Gold Code Index-2  **Default🡪‘0’’1’’3’** |
| 18 | RX FEC ON/OFF | 1 | ‘0’ or ‘1’ | ‘1’🡪FEC\_RX\_On,  ‘0’🡪FEC\_RX\_Off(**Default**) |
| 19 | TX FEC ON/OFF | 1 | '0’ or '1' | ‘1’🡪FEC\_TX\_On,  ‘0’🡪FEC\_TX\_Off(**Default**) |
| 20 | Tx PA ON/OFF (Mute) | 1 | '0' or '1' | ‘1’🡪 TX PA\_ON,  ‘0’🡪 TX PA\_OFF (Mute)(**Default**) |
| 21 | Tx Power Mode | 1 | ‘0’ to ‘3’ | 0🡪MUTE (**Default)**  1🡪 Low Power  2🡪Medium Power  3🡪igh Power |
| 22 | Tx Antenna Selection Top/Bottom | 1 | ‘0’ or ‘1’ | 0🡪Left (**Default**)  1🡪Right  2-> Free running 50msec ON/OFF |
| 23 | Checksum | 2 | ‘0’’0’ to ‘F’’F’ | Checksum can be 00 to FF |
| 24 | <ETX> | 1 | 0x03 | End of Message |

TABLE:3

**Total number of bytes = 50 (Including STX and ETX)**

# 2.0. Uplink Transmitter Spot Frequency Selection

**Description:** The index of particular frequency of operation of TX.

**Direction:** GCU 🡪GTR

**Application:** During data-link testing

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field No** | **Name** | **Byte(s)** | **Value/Range** | **Description** |
| 1 | <STX> | 1 | 0x02 | Start of Message |
| 2 | Message Id | 1 | ’1’ | -- |
| 3 | Frequency of Uplink Tx | 2 | ‘0’’0’ to ‘0’’8’ | Frequency index  **Default🡪 ‘0’’0’** |
| 4 | Checksum | 2 | ‘0’’0’ to ‘F’’F’ | Checksum can be 00 to FF |
| 5 | <ETX> | 1 | 0x03 | End of Message |

TABLE:4

**Total number of bytes = 7 (Including STX and ETX)**

# 3.0 Downlink Receiver Spot Frequency Selection - Channel1

**Description:** The index of particular frequency of operation of INS Rx -1.

**Direction:** GCU 🡪GTR

**Application:** During data-link testing

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field No** | **Name** | **Byte(s)** | **Value/Range** | **Description** |
| 1 | <STX> | 1 | 0x02 | Start of Message |
| 2 | Message Id | 1 | ’3’ | -- |
| 3 | Frequency of INS Data Rx | 2 | ‘0’’0’ to ‘0’’C’ | Frequency index  **Default🡪 ‘0’’0’** |
| 4 | Checksum | 2 | ‘0’’0’ to ‘F’’F’ | Checksum can be 00 to FF |
| 5 | <ETX> | 1 | 0x03 | End of Message |

TABLE:5

**Total number of bytes = 7 (Including STX and ETX)**

# 4.0 Downlink Receiver Spot Frequency Selection - Channel2

<<RESERVED>>

**Description:** The index of particular frequency of operation of INS Rx - 2.

**Direction:** GCU 🡪GTR

**Application:** During data-link testing

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field No** | **Name** | **Byte(s)** | **Value/Range** | **Description** |
| 1 | <STX> | 1 | 0x02 | Start of Message |
| 2 | Message Id | 1 | ’4’ | -- |
| 3 | Frequency of INS Data Rx | 2 | ‘0’’0’ to ‘0’’C’ | Frequency index  **Default🡪 ‘0’’0’** |
| 4 | Checksum | 2 | ‘0’’0’ to ‘F’’F’ | Checksum can be 00 to FF |
| 5 | <ETX> | 1 | 0x03 | End of Message |

TABLE:6

**Total number of bytes = 7 (Including STX and ETX)**

# 5.0 Selection of CDMA Codes of 1023 code Transmitter and 127 code Receiver

**Description:** The index of CDMA codes in Ch1 and Ch2 of INS Rx & Up-link 10 User Tx.

**Direction:** GCU 🡪GTR

**Application:** During data-link testing

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field No** | **Name** | **Byte(s)** | **Value/Range** | **Description** |
| 1 | <STX> | 1 | 0x02 | Start of Message |
| 2 | Message Id | 1 | ’5’ | -- |
| 3 | Rx Code Index 1 | 2 | ‘0’’0’ to “7” ‘’F’ | Gold 127 Code index for Ch1 **Default**🡪**01** |
| 4 | Rx Code Index 2  (reserved) | 2 | ‘0’’0’’ to ’’7’’F’ | Gold 127 Code index for Ch 2 **Default**🡪**01** |
| 5 | TX code index 1  (USER-1) | 3 | '0'‘0’’0’’ to ’3’F’’F’ | Gold 1023 Code index for Ch 1 **Default**🡪**001** |
| 6 | TX code index 2  (USER-2) | 3 | '0'‘0’’0’’ to ’3’F’’F’ | Gold 1023 Code index for Ch 2 **Default**🡪**003** |
| 7 | TX code index 3  (USER-3) | 3 | '0'‘0’’0’’ to ’3’F’’F’ | Gold 1023 Code index for Ch 3 **Default**🡪**005** |
| 8 | TX code index 4  (USER-4) | 3 | '0'‘0’’0’’ to ’3’F’’F’ | Gold 1023 Code index for Ch 4 **Default**🡪**007** |
| 9 | TX code index 5  (USER-5) | 3 | '0'‘0’’0’’ to ’3’F’’F’ | Gold 1023 Code index for Ch 5 **Default**🡪**009** |
| 10 | TX code index 6  (USER-6) | 3 | '0'‘0’’0’’ to ’3’F’’F’ | Gold 1023 Code index for Ch 6 **Default**🡪**00B** |
| 11 | TX code index 7  (USER-7) | 3 | '0'‘0’’0’’ to ’3’F’’F’ | Gold 1023 Code index for Ch 7 **Default**🡪**00D** |
| 12 | TX code index 8  (USER-8) | 3 | '0'‘0’’0’’ to ’3’F’’F’ | Gold 1023 Code index for Ch 8 **Default**🡪**00F** |
| 13 | TX code index 9  (USER-9) | 3 | '0'‘0’’0’’ to ’3’F’’F’ | Gold 1023 Code index for Ch 9 **Default**🡪**011** |
| 14 | TX code index 10  (USER-10) | 3 | '0'‘0’’0’’ to ’3’F’’F’ | Gold 1023 Code index for Ch 10 **Default**🡪**013** |
| 15 | Checksum | 2 | ‘0’’0’ to ‘F’’F’ | Checksum can be 00 to FF |
| 16 | <ETX> | 1 | 0x03 | End of Message |

TABLE:7

**Total number of bytes = 39 (Including STX and ETX).**

# 6.0 FEC Selection of 1023 code Transmitter and 127 code Receiver

**Description:** The selection i.e. FEC On/Off of INS Rx and Uplink Tx.

**Direction:** GCU 🡪GTR

**Application:** During data-link testing

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field No** | **Name** | **Byte(s)** | **Value/Range** | **Description** |
| 1 | <STX> | 1 | 0x02 | Start of Message |
| 2 | Message Id | 1 | ’6’ | -- |
| 3 | Dn-Link RX FEC On/Off | 1 | ‘1’ or ‘0’ | 1🡪On,  0🡪Off (**Default)** |
| 3 | Up-Link TX FEC On/Off | 1 | ‘1’ or ‘0’ | 1🡪On,  0🡪Off (**Default)** |
| 4 | Checksum | 2 | ‘0’’0’ to ‘F’’F’ | Checksum can be 00 to FF |
| 5 | <ETX> | 1 | 0x03 | End of Message |

TABLE:8

**Total number of bytes = 7 (Including STX and ETX)**

# 7.0 Tx Power Amplifier ON/OFF (Mute) Command

<<RESERVED>>

**Description:** The Transmitter PA ON/OFF (Mute) selection message

**Direction:** GCU 🡪GTR

**Application:** During data-link testing

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field No** | **Name** | **Byte(s)** | **Value/Range** | **Description** |
| 1 | <STX> | 1 | 0x02 | Start of Message |
| 2 | Message Id | 1 | ’0’ | -- |
| 3 | Tx PA ON/OFF | 1 | ‘0’ or ‘1’ | 0🡪OFF (Mute) (**Default)**  1🡪ON |
| 4 | Checksum | 2 | ‘0’’0’ to ‘F’’F’ | Checksum can be 00 to FF |
| 5 | <ETX> | 1 | 0x03 | End of Message |

TABLE:9

**Total number of bytes = 6 (Including STX and ETX)**

# 8.0 Power Mode Selection of 1023 CODE Transmitter

**Description:** The Transmitter Mode selection message

**Direction:** GCU 🡪GTR

**Application:** During data-link testing

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field No** | **Name** | **Byte(s)** | **Value/Range** | **Description** |
| 1 | <STX> | 1 | 0x02 | Start of Message |
| 2 | Message Id | 1 | ’7’ | -- |
| 3 | Tx power mode | 1 | ‘0’ to ‘3’ | 0🡪 MUTE **(Default)**  1🡪 LOW POWER  2🡪MEDIUM POWER  3🡪HIGH POWER |
| 4 | Checksum | 2 | ‘0’’0’ to ‘F’’F’ | Checksum can be 00 to FF |
| 5 | <ETX> | 1 | 0x03 | End of Message |

TABLE:10

**Total number of bytes = 6 (Including STX and ETX)**

# 9.0 Transmit Antenna Selection

**Description:** A particular Transmit Antenna is selected by this message.

**Direction:** GCU 🡪GTR

**Application:** During data-link testing

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field No** | **Name** | **Byte(s)** | **Value/Range** | **Description** |
| 1 | <STX> | 1 | 0x02 | Start of Message |
| 2 | Message Id | 1 | ’ 8’ | -- |
| 3 | Tx Antenna Selection Left/Right | 1 | ‘0’ or ‘1’ or ‘2’ | 0🡪Left (**Default)**  1🡪Right  2- > Free running 50msec ON/OFF |
| 4 | Checksum | 2 | ‘0’’0’ to ‘F’’F’ | Checksum can be 00 to FF |
| 5 | <ETX> | 1 | 0x03 | End of Message |

TABLE:11

**Total number of bytes = 6 (Including STX and ETX)**

# 10.0 Rx INS Data Posting

# (Receive Data posting for Receiver 2 channels)

<<RESERVED>>

**Description: The decoded packet between ch1 and ch2 selection mode.**

**Direction:** GCU 🡪GTR

**Application:** During data-link testing

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field No** | **Name** | **Byte(s)** | **Value/Range** | **Description** |
| 1 | <STX> | 1 | 0x02 | Start of Message |
| 2 | Message Id | 1 | ’ E’ | -- |
| 3 | Channel select | 2 | '0''0' to '1''1' | 00🡪 (**Default Both)**  01🡪Ch1 ON and CH2 OFF.  10->Ch2 ON and CH1 OFF.  11->Select channel based on AGC. |
| 4 | Checksum | 2 | ‘0’’0’ to ‘F’’F’ | Checksum can be 00 to FF |
| 5 | <ETX> | 1 | 0x03 | End of Message |

TABLE:12

**Total number of bytes = 7 (Including STX and ETX)**

**\*default : Both ch1 and ch2 on uart2**

# 11.0 Data Request INS Data/Query

<<RESERVED>>

**Description:** Any data COMMAND, HEALTH, DIAGNOSTICS or STATUS

Message can be requested by this command.

**Direction:** GCU 🡪GTR

**Application:** To verify the Health, Diagnostics, Status and Plot information

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field No** | **Name** | **Byte(s)** | **Value/Range** | **Description** |
| 1 | <STX> | 1 | 0x02 | Start of Message |
| 2 | Message Id | 1 | ‘B’ |  |
| 3 | Query | 1 | ‘0’ to ‘6’ | ‘0’ 🡪 Rx INS Data ( C)  ‘1’ 🡪 Health (H)  ‘2’ 🡪 Diagnostic (D)  ‘3’ 🡪 Status (S)  ‘4’ 🡪 All C, H, D, S  ‘5’ 🡪 C, H, D  ‘6’ 🡪Freq and power plot |
| 4 | Checksum | 2 | ‘0’’0’ to ‘F’’F’ | Checksum can be 00 to FF |
| 5 | <ETX> | 1 | 0x03 | End of Message |

TABLE:13

**Total number of bytes = 6 (Including STX and ETX)**

# 12.0 Health Query Response

**Description:** The health of GND LOOP DTM unit

**Direction:** GTR🡪 GCU.

**Application:** During mission and data-link testing

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field No** | **Name** | **Byte(s)** | **Value/Range** | **Description** |
| 1 | <STX> | 1 | 0x02 | Start of Message |
| 2 | Message Id | 1 | ’9’ | -- |
| 3 | RX1 PLL LOCK STATUS. | 1 | ‘0’ or ‘1’ | 0🡪Un Locked  1🡪Locked |
| 4 | RX2 PLL LOCK STATUS.  (Reserved) | 1 | ‘0’ or ‘1’ | 0🡪Un Locked  1🡪Locked |
| 5 | TX PLL LOCK | 1 | ‘0’ or ‘1’ | 0🡪Un Locked  1🡪Locked |
| 6 | RESERVED | 1 | - | - |
| 7 | AGC1 RSS1 | 3 | ‘0’’0’’0’ to ‘F’’F’’F’ | RSSI Value CH1 |
| 8 | AGC2 RSSI | 3 | ‘0’’0’’0’ to ‘F’’F’’F’ | RSSI Value CH2 |
| 9 | Correlator1 State | 1 | ‘0’ or ‘1’ | 0 🡪Acquisition  1 🡪Tracking |
| 9 | Correlator2 State | 1 | ‘0’ or ‘1’ | 0 🡪Acquisition  1 🡪Tracking |
| 10 | Checksum | 2 | ‘0’’0’ to ‘F’’F’ | Checksum can be 00 to FF |
| 11 | <ETX> | 1 | 0x03 | End of Message |

TABLE:14

Total number of bytes = 17 (Including STX and ETX)

# 13.0 Status Query Response

**Description:** Status of GND LOOP DTM configuration

**Direction:** GTR🡪GCU.

**Application:** During data-link testing.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field No** | **Name** | **Byte(s)** | **Value/Range** | **Description** |
| 1 | <STX> | 1 | 0x02 | Start of Message |
| 2 | Message Id | 1 | ’A’ | -- |
| 3 | Rx CH1 track status | 1 | ‘'0' or '1' | 0-> Acquisition.  1-> Tracking. |
| 4 | Rx CH2 track status  (Reserved) | 1 | '0' or '1' | 0-> Acquisition.  1-> Tracking. |
| 5 | CODE SEED RX CH1 | 2 | ‘0’’0’’ to ‘7’’F’ | 127 Gold Code Index for CH1  **(Default ‘0’‘1’)** |
| 6 | CODE SEED RX CH2  (Reserved) | 2 | ‘0’’0’’ to ‘7’’F’ | 127 Gold Code Index for CH2  **(Default ‘0’‘1’)** |
| 7 | TX CODE SEED 1  (USER-1) | 3 | '0'‘0’’0’’ to '3'‘F’’F’ | 1023 Gold Code Index for CH1 **(Default '0'‘0’‘1’)** |
| 8 | TX CODE SEED 2  (USER-2) | 3 | '0'‘0’’0’’ to '3'‘F’’F’ | 1023 Gold Code Index for CH2 **(Default '0'‘0’‘3’)** |
| 9 | TX CODE SEED 3  (USER-3) | 3 | '0'‘0’’0’’ to '3'‘F’’F’ | 1023 Gold Code Index for CH3 **(Default '0'‘0’‘5’)** |
| 10 | TX CODE SEED 4  (USER-4) | 3 | '0'‘0’’0’’ to '3'‘F’’F’ | 1023 Gold Code Index for CH4 **(Default '0'‘0’‘7’)** |
| 11 | TX CODE SEED 5  (USER-5) | 3 | '0'‘0’’0’’ to '3'‘F’’F’ | 1023 Gold Code Index for CH5 **(Default '0'‘0’‘9’)** |
| 12 | TX CODE SEED 6  (USER-6) | 3 | '0'‘0’’0’’ to '3'‘F’’F’ | 1023 Gold Code Index for CH6 **(Default '0'‘0’‘B’)** |
| 13 | TX CODE SEED 7  (USER-7) | 3 | '0'‘0’’0’’ to '3'‘F’’F’ | 1023 Gold Code Index for CH7 **(Default '0'‘0’‘D’)** |
| 14 | TX CODE SEED 8  (USER-8) | 3 | '0'‘0’’0’’ to '3'‘F’’F’ | 1023 Gold Code Index for CH8 **(Default '0'‘0’‘F’)** |
| 15 | TX CODE SEED 9  (USER-9) | 3 | '0'‘0’’0’’ to '3'‘F’’F’ | 1023 Gold Code Index for CH9 **(Default '0'‘1’‘1’)** |
| 16 | TX CODE SEED 10  (USER-10) | 3 | '0'‘0’’0’’ to '3'‘F’’F’ | 1023 Gold Code Index for CH10 **(Default '0'‘1’‘3’)** |
| 17 | RX FEC ON/OFF | 1 | ‘0’ or ‘1’ | 0 ->OFF,  1 ->ON,  **Default ->OFF.** |
| 18 | TX FEC ON/OFF | 1 | ‘0’ or ‘1’ | 0 ->OFF,  1 ->ON,  **Default ->OFF.** |
| 19 | CH1 data Post | 1 | ‘1’ or ‘0’ | 1🡪On, 0🡪Off(**Default -> ON**) |
| 20 | CH2 data Post | 1 | ‘1’ or ‘0’ | 1🡪On, 0🡪Off(**Default-> ON**) |
| 21 | Healthier received signal status indicator. | 1 | '1' or '0' | 0 for CH1 and 1 for CH2  (based on RSSI) |
| 22 | RX1 C-band  LD status | 1 | '1' or '0' | 0->unlock.  1->lock. |
| 23 | RX2 C-band  LD status  (Reserved) | 1 | '1' or '0' | 0->unlock.  1->lock. |
| 24 | TX C-band LD status | 1 | '1' or '0' | 0->unlock.  1->lock. |
| 25 | TX PA ON/OFF | 1 | ‘0’ or ‘1’ | 0 ->OFF (Mute),  1 ->ON,  **Default ->OFF.**  **(Based on PA input pin from PA)** |
| 26 | TX power Level | 1 | ‘0’ to ‘3’ | 0🡪 MUTE(**Default)**  1🡪 Low power  2🡪Medium power  3🡪High power |
| 27 | TX Antenna Selection | 1 | ‘0’ to ‘2’ | 0-> left  1->right  2-Free running 50msec ON/OFF |
| 28 | Rx1 pll index | 2 | 0’’0’ to ‘0’’C’ | RX frequencies Index value |
| 29 | Rx2 pll index  (Reserved) | 2 | 0’’0’ to ‘0’’C’ | RX frequencies Index value |
| 30 | Tx pll index | 2 | 0’’0’ to ‘0’’8’ | TX frequencies Index value |
| 31 | Checksum | 2 | ‘0’’0’ to ‘F’’F’ | Checksum can be 00 to FF |
| 32 | <ETX> | 1 | 0x03 | End of Message |

TABLE:15

**Total number of bytes = 58 (Including STX and ETX)**

# 14.0 Diagnostic Query Response

**Description:** Command setting for threshold.

**Direction:** GTR🡪GCU.

**Application:** To monitor the parameters, frequency, power, correlation factor and Average values.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Field No | Name | Byte(s) | Value/Range | Description |
| 1 | <STX> | 1 | 0x02 | Start of Message |
| 2 | Message Id | 1 | ‘D’ | --- |
| 3 | Channel num | 1 | ‘1’ or ‘2’ | ‘1’🡪CH1 Diagnostic  ‘2’🡪CH2 Diagnostic |
| 4 | RX Frequency | 8 | ‘0’’0’’0’’0’’0’’0’’0’’0’  ‘F’’F’’F’’F’‘F’’F’’F’’F’ | Tuning Frequency value of CH1 OR CH2 |
| 5 | Average Power | 3 | ‘0’‘0’’0’ to ‘F’’F’’F’ | Average power value of CH1 or CH2 |
| 6 | Maximum Power | 3 | ‘0’‘0’’0’ to ‘F’’F’’F’ | Maximum Power value of CH1 or CH2. |
| 7 | Minimum Power | 3 | ‘0’‘0’’0’ to ‘F’’F’’F’ | Minimum power value of CH1 or CH2 |
| 8 | Correlation factor | 3 | ‘0’’0’’0’ to ‘F’’F’’F’ | Correlation factor Value |
| 9 | V average | 2 | ‘0’’0’ to ‘F’’F’ | V average value |
| 10 | Checksum | 2 | ‘0’’0’ to ‘F’’F’ | Checksum can be 00 to FF |
| 11 | <ETX> | 1 | 0x03 | End of message |

TABLE:16

**Total number of bytes = 28 (Including STX and ETX).**

# 15.0 DOWN\_LINK\_MODE

<< RESERVED>>

**Description:** decoded downlink INS Data packets/Command packets and health message data..

**Direction:** GTR🡪GCU.

**Application:** To verify the Health, Diagnostics, Status and Plot information

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field No** | **Name** | **Byte(s)** | **Value/Range** | **Description** |
| 1 | <STX> | 1 | 0x02 | Start of Message |
| 2 | Message Id | 1 | ‘C’ |  |
| 3 | Query | 1 | ‘0’ to ‘4’ | 0--> INS Data Packets.**(Default**) 1-> INS Data packets and Health. 2-> INS Data Packets, Health and status. 3->S top data posting  4-> Start data posting from previous mode. |
| 4 | Checksum | 2 | ‘0’’0’ to ‘F’’F’ | Checksum can be 00 to FF |
| 5 | <ETX> | 1 | 0x03 | End of Message |

TABLE:17

**Total number of bytes = 6 (Including STX and ETX).**

----------------------------------------------------------------------END-----------------------------------------------------------------------------------