ICA Command description.

Issue: 1.5 HB: 2002-05-02

Red: Changed from issue 1.4

Blue: Not yet implemented in PIU and RSDB.

1.0 Scope.

This document describes all ICA commands briefly. It does not describe all effects caused by a command for the onboard operation or data processing. However, included are the command's verification mechanisms available.

2.0 General command structure.

The majority of the ICA commands consist of a single 16-bit command word. Only the two reprogramming commands (ZRP22212, ZRP22213) have one extra word (0xFEED) appended that serves as a security lock.

The command word is divided into 4 nibbles as:

The commands are divided into 4 groups defined as:

Class 3: N3 ≠ 0.   [N2+N1+N0]=12 bit parameter.
Class 2: N3=0. N2≠0.   [N1+N0]=8 bit parameter.
Class 1: N3=N2=0. N1≠0.   [N0]=4 bit parameter.
Class 0: N3=N2=N1=0.   Part of N0 may be allocated for a < 4-bit parameter.

The switch commands requiring a 1-bit parameter only, are a combination of class 0 and 1 and referred to as class 0. They are laid out as:
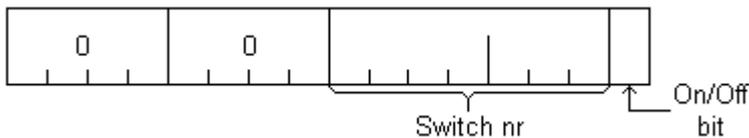
where nibble 1 (N1) may be 0,1 or 2. That gives a capacity of 23 switches. Note that switch nr 0 is not used in order to avoid an "all zeros" command. A few other "1-bit" commands also use this form.
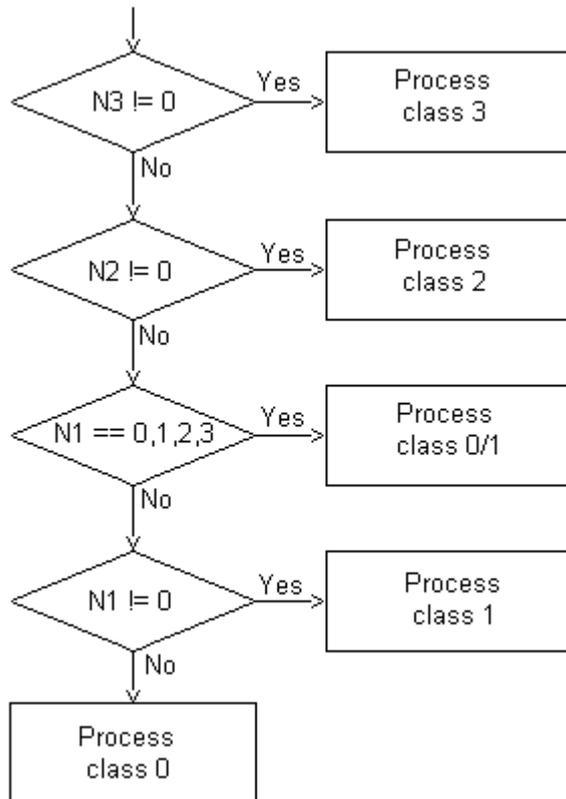
Other commands deviating from the single parameter concept are described under the header of the command in concern.

The commands are of basically two types referred to as Direct or Synchronized. The Direct commands are acted upon immediately on arrival at the experiment, while the Synchronized ones are buffered and processed at the end of the ongoing data acquisition cycle. An example is the Mcp HV reference. If changed in the middle of an acquisition cycle, the data in that set will be acquired during different conditions and may not represent "true" scientific effects.

Commands always direct is marked by **[D]** and the default synchronized ones with **[S]** below.

The command names refer to the RSDB. Also given is the parameter name if applicable.

Principle command decoding.

```
              ┌─────────────┐   Yes   ┌──────────────┐
              │  N3 != 0    ├────────>│  Process     │
              └──────┬──────┘         │  class 3     │
                     │ No             └──────────────┘
              ┌──────┴──────┐   Yes   ┌──────────────┐
              │  N2 != 0    ├────────>│  Process     │
              └──────┬──────┘         │  class 2     │
                     │ No             └──────────────┘
           ┌─────────┴────────┐  Yes  ┌──────────────┐
           │  N1 == 0,1,2,3   ├──────>│  Process     │
           └─────────┬────────┘       │  class 0/1   │
                     │ No             └──────────────┘
              ┌──────┴──────┐   Yes   ┌──────────────┐
              │  N1 != 0    ├────────>│  Process     │
              └──────┬──────┘         │  class 1     │
                     │ No             └──────────────┘
              ┌──────┴───────┐
              │  Process     │
              │  class 0     │
              └──────────────┘
```

Failing commands will generate an event message.

3.0 Command verification.

Included in the House Keeping (HK) is a return of the last received 16-bit command word NRPD2320. This implies that if more than one command is received during the time of a HK delivery (for RPC 32 seconds) only the last command seen will be returned. To detect that a new command return is transmitted the parameter NRPD2310 (1 bit) will toggle. When so, parameter NRPD2306 will give the command status: 0=Ok. 1=Parameter out of range. 2=Invalid. 3=Erroneous. Also if a command (not dependent on HK delivery) is not Ok, a command failure event will be transmitted. Apart from this many commands can be directly verified by the returned HK parameters. Commands not directly verifiable in HK can be verified in the science data stream. As a guideline, the HK is primarily devoted to experiment healthy checks. Commands that can not be directly verified in HK are harmless from safety point of view. They may, however, impact on the expected science return.

In the individual command description below, commands directly verifiable via HK have the "HK:" tag specified followed by the RSDB tm parameter LNAME and NAME.

In the command descriptions below the **XW:** refers to the ICA EGSE X-window command application window and is not applicable on S/C system level.
It consists of XW: Command group button: *Applicable command buttons.*

4.0 Class 0 (type 220).

The +28V switches statuses.
The +28V switch commands HK statuses are special by the fact that the switch status (On or Off) is the software status only (SW), while the +28V presence after the switch is the true hardware (HW) status. Ideally the switch status should be true hardware as well. But in the selection of one of the two (hard ware restrictions) the +28V present status was chosen as the HV switch status. When it comes to the end, the +28V presence is the important factor. Note that if the Main is off, the +28V will not be present on the Opto or Mcp even if those switches are on. The same is true for all presence status if the HV disable plug is in. See the symbolic drawing below.
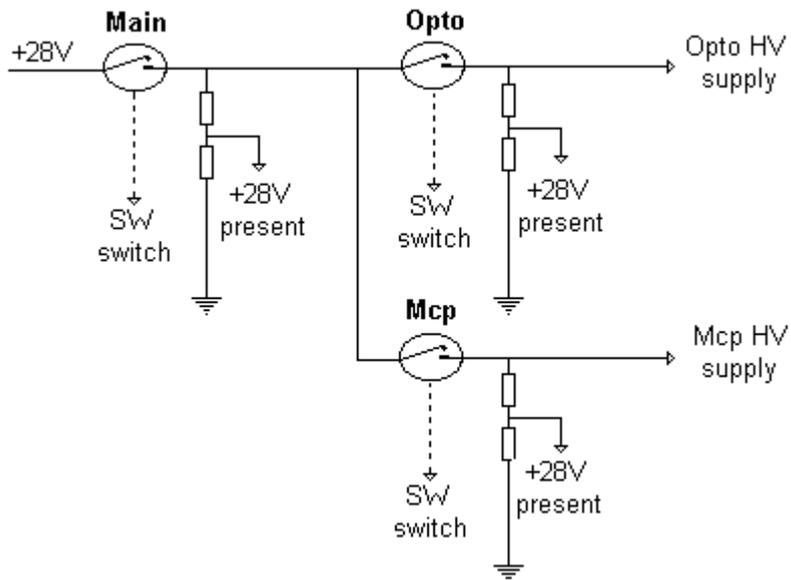
ZRP22001: Mcp +28 V switch.   **[D]**
Switches the +28V line to the Mcp high voltage supply ON or OFF. PRPG2001=1 or 0.
HK: Mcp +28V switch (SW) NRPD230F. *(The +28 V line present status (HW) NRPD2317).*
XW: HVswitch: *McpOn McpOff*

ZRP22002: Opto +28 V switch.   **[D]**
Switches the +28V line to the Opto high voltage supply ON or OFF. PRPG2002=1 or 0.
HK: Opto +28V switch (SW) NRPD230E. *(The +28 V line present status (HW) NRPD2316).*
XW: HVswitch: *OptoOn OptoOff*

ZRP22003: Main +28 V switch.   **[D]**
Switches the +28V line to the Mcp and the Opto switches ON or OFF. PRPG2003=1 or 0.
HK: Main +28V switch (SW) NRPD230D. *(The +28 V line present status (HW) NRPD2315).*
XW: HVswitch: *MainOn MainOff*

ZRP22004: Pacc. HV switch.   [D]
Sets the Post Acceleration HV reference to zero (OFF) or to its default value (ON). PRPG2004=1 or 0.
HK: Postacc. HV log. switch NRPD230C.
XW: HVswitch: *PaccOn PaccOff*

ZRP22005: Grid LV switch.   [D]
Sets the Grid LV reference to zero (OFF) or to its default value (ON). PRPG2005=1 or 0.
HK: Grid LV log. switch NRPD230B.
XW: HVswitch: *GridOn GridOff*

ZRP22006: Entr. HV switch.   [D]
Sets the Entrance HV reference to zero (OFF) or to its default value (ON). PRPG2006=1 or 0.
HK: Entrance HV log. switch NRPD230A.
XW: HVswitch: *EntOn EntOff*

ZRP22007: Defl. LV switch.   [D]
Sets the Deflection LV reference to zero (OFF) or to its default value (ON). PRPG2007=1 or 0.
HK: Deflection LV log. switch NRPD2309.
XW: HVswitch: *DfLvOn DfLvOff*

ZRP22008: Defl. HV switch.   [D]
Sets the Deflection HV reference to zero (OFF) or to its default value (ON). PRPG2008=1 or 0.
HK: Deflection HV log. switch NRPD2308.
XW: HVswitch: *DfHvOn DfHvOff*

ZRP22009: Direct command switch.   [D]
Enables or disables the default synchronized commands to direct. (See 2.0) PRPG2009=1 or 0.
HK: Direct command switch NRPD2370.
XW: Various: *DircOn DircOff*

ZRP22010: W/D enable/disable.   [D]
Enables or disables the Watch Dog circuitry. PRPG2010=1 or 0.
XW: Various: *WdogOn WdogOff*

ZRP22011: Gas enable/disable.   [D]
Enables or disables the ROSINA gas pressure automatic HV action. PRPG2011=1 or 0.
XW: Various: *GaspOn GaspOff*

ZRP22012: Thruster enable/disable.   [D]
Enables or disables the Thruster warning automatic HV action. PRPG2012=1 or 0.
XW: Keyboard only.

ZRP22014: Compression switch.   [S]
Enables or disables the data Compression. PRPG2014=1 or 0.
XW: Various: *CmprOn CmprOff*

ZRP22015: Alt. Pacc. switch.   [S]
Enables or disables the automatic Alternating Post acceleration. PRPG2015=1 or 0.
XW: HVswitch: *AltpOn AltpOff*

ZRP22016: Pacc. level.   [S]
Sets the Post acceleration level High or Low. PRPG2016=1 or 0.
HK: Pacc. Level NRPD2390.
XW: HVswitch: *PacHigh PacLow*

ZRP22017: Auto red. switch.   [S]
Enables or disables the Automatic data reduction scheme changes. PRPG2017=1 or 0.
XW: Various: *AutoOn AutoOff*

ZRP22018: Shadow enable/disable.   **[S]** *(Not yet implemented in PIU and RSDB).*
Enables or disables the zero out of imager sectors in shadow. PRPG2018=1 or 0.
XW: Various: *ShdwOn ShdwOff*

ZRP22019: Bad HV enable/disable.   **[S]** *(Not yet implemented in PIU and RSDB).*
Enables or disables the zero out of imagers when the entrance angle can not be reached for some
energy levels due to HV limitations. PRPG2019=1 or 0.
XW: Various: *BdhvOn BdhvOff*

ZRP22025: Next cmd. direct.   **[D]**
Flags that the next command should be direct even if of type synchronized. No parameter.
XW: SyncDir

ZRP22026: Deflection step.   **[S]**
Sets the Deflection HV to step mode, if fixed. No parameter.
Also see ZRP22201, ZRP22306 and ZRP22307.
XW: HVrefs: *DflStp*

ZRP22027: Entrance step.   **[S]**
Sets the Entrance HV to step mode, if fixed. No parameter.
Also see ZRP22202 and ZRP22308.
XW: HVrefs: *EntStp*

ZRP22028: Release V-cal format.   **[D]**
Will release the HV calibration format into the TM data stream. No parameter.
XW: Modes: *Vcal*

ZRP22035: Test WD reset.   **[D]**
Will test the Watch Dog circuitry (will cause reboot). No parameter.
XW: Tests: WDrset

ZRP22036: Empty Fifo.   **[S]**
Will empty the TM Fifo. No parameter.
XW: Various: *Efifo*

ZRP22037: Flush Fifo.   **[D]**
Will flush the TM Fifo if it contains less words than the size of the current SID block size. This is
performed by padding with zeros. No parameter.
XW: Various: *Ffifo*

ZRP22038: Boot PROM.   **[D]**
Will reboot with the code held in PROM. That is as on power on. No parameter.
XW: Various: *BootPRM*

ZRP22039: Imager test.   **[D]**
Will test the Imager memory. Valid in test mode only. No parameter.
XW: Tests: *ImgTst*

ZRP22040: Dummy cmd.   **[D]**
This is a no action command used to test the command link only. No parameter.
XW: Tests: *Dummy*

5.0 Class 1 (type 221).

ZRP22111: Boot EEP incl. context.   [D]
Will boot the code from an EEPROM section including the default context. PRPG2111=section (0-15).
XW: Various: *BtEEPcx*

ZRP22112: Test pattern.   [S]
Will write a test pattern into the Imager memory. PRPG2112=pattern nr. (0-15).
XW: Tests: *TstPtrn*

ZRP22113: Boot EEP excl. context.   [D]
Will boot the code from an EEPROM section excluding the default context. PRPG2113=section (0-15).
XW: Various: *BootEEP*

ZRP22114: RPC internal SID nr.   [D]
Sets the internal SID number. PRPG2114=SID nr (0-5).
HK: Sid type NRPD2311.
XW: SidType: *SidMin SidNrm SidBst SidCal SidSpc SidTst (SidIma, IMA only)*

ZRP22115: Default boot section.   [D]
Sets the default EEPROM boot section for the "Start command". PRPG2115=section (0-15).
See ZRP22315.
XW: Settings: *EEPdflt*

6.0 Class 2 (type 222).

ZRP22201: Deflection level.   [S]
Sets the Deflection HV level to a fixed table index. PRPG2201=index (0-95).
XW: HVrefs: *DflLev*

ZRP22202: Entrance level.   [S]
Sets the Entrance HV level to a fixed index. PRPG2202=index (0-15).
XW: HVrefs: *EntLev*

ZRP22203: SW start level.   [S]
Sets the Deflection HV table start index for solar wind modes. PRPG2203=index (0-64).
XW: Settings: *SWlevel*

ZRP22204: Gas pressure low.   [S]
Sets the ROSINA gas pressure low limit for automatic HV action. PRPG2204=pressure on the same form as delivered by ROSINA (0xme).
XW: Settings: *GasLow*

ZRP22205: Gas pressure high.   [S]
Sets the ROSINA gas pressure high limit for automatic HV action. PRPG2205=pressure on the same form as delivered by ROSINA (0xme).
XW: Settings: *GasHigh*

**ZRP22210: Mode.   [S]**
Sets the operational mode. PRPG2210=mode (0-39).
HK: Mode NRPD2300.
XW: Modes: *Test Cal1 Cal2 Fake*
          Idle Mspo Msis Mexm
          Nrm0-7 Har0-7 Exm0-7

ZRP22212: Reprog. all EEP sections.   [D]
Will reprogram all EEPROM sections from a given source (0-15=EEP section, 16=PROM). Valid in test and Idle modes only. PRPG2212=source.
XW: Keyboard only.

ZRP22213: Reprog. EEP sections.   [D]
Will reprogram an EEPROM section from a given source. The 8-bit parameter is split in 2 as:

0	13	Destination	Source
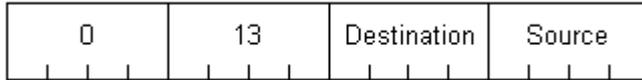
PRPD2513=source section (0-15)
PRPD2514=destination section (0-15)
If the source is equal to the destination the PROM memory is used as source.
Valid in test and Idle modes only.
XW: Keyboard only.

7.0 Class 3 (type 223).

ZRP22301: Opto reference.   [S]
Sets the Opto HV default reference. PRPG2301=reference (0-7).
HK: Opto HV default reference NRPD23A0.
XW: HVrefs: *OptoRef*

ZRP22302: Mcp reference.   [S]
Sets the Mcp HV default reference. PRPG2302=reference (0-15).
HK: Opto HV default reference NRPD23A0.
XW: HVrefs: *McpRef*

ZRP22303: Grid reference.   [S]
Sets the Grid LV reference. PRPG2303=reference (0-7).
HK: Grid LV reference NRPD2391.
XW: HVrefs: *GridRef*

ZRP22304: Pacc low ref.   [S]
Sets the Post acceleration low level HV reference. PRPG2304=reference (0-7).
HK: Pacc. Low level reference NRPD2371.
XW: HVrefs: *PacLow*

ZRP22305: Pacc high ref.   [S]
Sets the Post acceleration high level HV reference. PRPG2305=reference (0-7).
HK: Pacc. High level reference NRPD2381.
XW: HVrefs: *PacHigh*

ZRP22306: Deflection LV reference.   [S]
Sets the Deflection LV reference fixed. PRPG2306=reference (0-4095).
HK: Deflection LV reference NRPD2384.
XW: HVrefs: *DfLVrf*

ZRP22307: Deflection HV reference.   [S]
Sets the Deflection HV reference fixed. PRPG2307=reference (0-4095).
HK: Deflection HV reference NRPD2374.
XW: HVrefs: *DfHVrf*

ZRP22308: Entrance ref.   [S]
Sets the Entrance HV reference fixed. PRPG2308=reference (0-4095).
HK: Entrance HV reference NRPD2394.
XW: HVrefs: *EntRef*

ZRP22309: Noise reduction.   [S]
Sets the count threshold for integrations. PRPG2309=threshold (0-4095).
XW: Settings: *NoiseR*

ZRP22310: Fifo low mark.   [S]
Sets the TM fifo low watermark for auto reduction changes. PRPG2310=watermark (0-4095).
XW: Settings: *Fmin*

ZRP22311: Fifo high mark.   [S]
Sets the TM fifo high watermark for auto reduction changes. PRPG2311=watermark (0-4095).
XW: Settings: *Fmax*

ZRP22312: Fifo force mark.   [S]
Sets the TM fifo force watermark for auto reduction changes. PRPG2312=watermark (0-4095).
XW: Settings: *Fforce*

ZRP22313: Fifo clear mark.   [S]
Sets the TM fifo clear watermark for auto reduction changes. PRPG2313=watermark (0-4095).
XW: Settings: *Fclear*

ZRP22315: Start cmd.   [D]
This is a combination command that can configure the experiment in one go. The 12-bit parameter is
divided into four as:
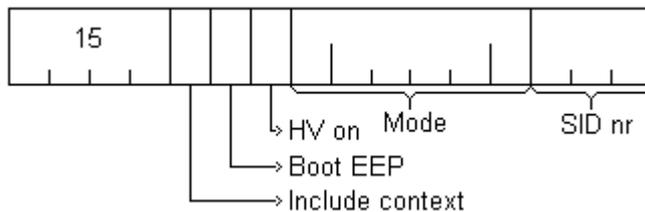
PRPD2501=SID nr. (0-5)
PRPD2502=Mode.   (0-39)
PRPD2503=HV on bit.
PRPD2504=Boot EEP default section bit. (See ZRP22115)
PRPD2505=Boot EEP including default context bit.
XW: Keyboard only.

ZRP22316: General 16-bit raw command.   [D/S] *(Not yet implemented in PIU and RSDB).*
Can send any 1 word 16-bit command word. PRPG2316=16-bit code.
XW: Keyboard only: *Type hex=cmd word in hex.*