HUYGENS PROBE
CASSINI PROGRAM

GAS CHROMATOGRAPH MASS SPECTROMETER (GCMS)

ANNEX 2 TO EID PART B

GCMS TELECOMMANDS AND TELEMETRY FLIGHT MODEL VERSION

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GCMS TELECOMMAND FORMATS

INTRODUCTION

Scope. This document defines the telecommands and formats for the Huygens Probe GCMS instrument, for all mission phases. For more detailed information, refer to GCMS Software Users Manual and Software Requirements Document.

Data sub-categorization and formats have been chosen with a primary goal being the preservation of commonality between the two Cassini mass spectrometers, the INMS and the GCMS. Consequently, some data fields have been allocated more bits than required, so that location of fields within words is identical for both instruments. This has obvious cost benefits for development and maintenance of both the Flight and Ground Support systems.[1] Similarly, "spare" fields and bits are sometimes indicated where space is used in one instrument but not the other.

Stem Nomenclature. Commands to the GCMS instrument has been divided into the following categories:

1. Tuning & Adaptation Parameters (TAPs)
2. Computer Memory Patches (CMPs)
3. Ground Instrument Commands (GICs)
4. Ground Instrument Queries (GIQs)
5. Instrument Command Chain Uploads (ICCUs)

The alphanumeric telecommand "stems" (see JPL 699-205) will begin with one of the following letters (there is no numerical designation for Probe instruments):

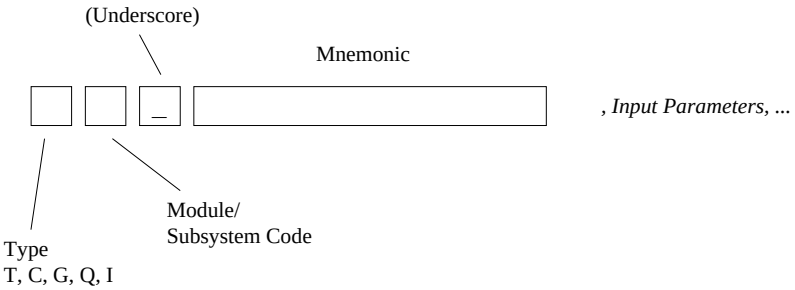
TAPs:	T
CMPs:	C
GICs:	G
GIQs:	Q
ICCUs:	I

Within the GCMS Flight Computer, telecommands are destined to subsystem processing sections as listed below. The letters under the "module code" column will be used in the fourth position in GCMS telecommand Stems.

Code	Module / Subsystem	Code	Module / Subsystem
D	DAC	P	Ion Pumps
E	EEPROM	U	USEQ Control
F	Filaments	V	Valves
H	Heater and Temperature Control	X	Other/misc.
I	ISS Control		

Telecommand stems will contain an underscore in the third position. The format is thus as follows:

[1] An example is the Ion Source Select field, which requires 3 bits for GCMS, but only 2 (or 1) bit for INMS; this field has been allocated 3 bits for both instruments.



As an example, a GCMS "GIC" command for USEQ Control to set the Step Increment is:

`GU_STEPINC,` *Serial#, amu, ISS*

Serial Numbers. A seven-bit *Serial Number* field exists in all telecommands, which is echoed in the telemetry "Ack" subpacket (see EID-B, section TM, §4.7). The value selected for this field in individual telecommands is not important: its purpose is to correlate TM to TC events.

Error Control. All GCMS telecommand packets are followed by a 16-bit CRC, computed as recommended by Spacecraft Data Link Communication standard (CCITT Recommendation V.41 polynomial $G(x) = x^{16} + x^{12} + x^5 + x^0$, with initial BCC of $FFFF_{16}$).

CONVENTIONS

Size of Words and Bytes. A "word" of memory shall be defined as being 16 bits. A "byte" of memory shall be defined as being 8 bits.

Bit Numbering. References to bit numbers count from right-to-left (bit 0 is the LSB). When referring to bits within an independent 8-bit byte, the MSB is bit 7 and the LSB is (again) bit 0.

Unless otherwise specified, when a 16-bit word is split into byte format the LSBs will reside in the second byte:

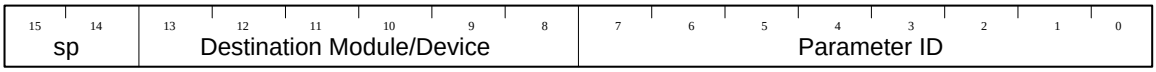
Hexadecimal and Binary Notation. Numbers represented in hexadecimal (base 16) and binary (base 2) will use the convention of ANSI/MIL-STD-1815A (Ada Language Reference Manual). In this convention, hex numbers are specified by the form 16#nnn#, where "nnn" is the hexadecimal number. Binary numbers are specified by the form 2#nnn#, where "nnn" is the binary number. As an example, the decimal number 14 would be represented in hex as 16#0E#, and in binary as 2#1110#. There is no standard or requirement regarding leading zeroes. Lower case letters within depictions of hex numbers represent variable digits.

TELECOMMAND DEFINITIONS

1. TAPs

TAPs (Tuning and Adaptation Parameters) are for one-shot loading of new parameters into non-volatile memory (EEPROM). TAPs may be used during the Ground, Cruise, and Flight mission phases. The OPCODE field for TAPs is 16#*ss*11# (where *ss* represents a variable serial number, echoed in TM acknowledge messages).

Each *"TAP Control/ID Word"* contains a *Destination Module/Device* field, and an optional *Parameter ID*. Together these indicate which parameter (or data record) to modify. TAP Control/ID Words format is as follows:



The Destination Module/Device field in the *TAP Control/ID Word* is defined as shown below. Depending upon the type of upload, there may be amplifying data further defining the parameters and/or records to be modified. All TAP commands are defined in the sections that follow.

Code	Destination Module / Device
16#00#	(spare)
16#01#	DAC
16#02#	(spare)
16#03#	ISS Control
16#04#	(spare)
16#05#	(spare)
16#06#	(spare)
16#07#	(spare)
16#08#	Temperature Control
16#09#	EEPROM Management
16#0A# +	(spares)

1.1 DAC Parameters.

1.1.1 STEM: TD_DACPARM

NAME: TAP to set DAC Parameters. (See also GD_DACPARM)

PURPOSE: To modify or tune "constant" (static) D/A control voltages.

COMMAND INPUT FIELDS: TD_DACPARM, *Serial#, Length, Parameter ID, Data Value*

Word		
0	16#*ss*11#	*Serial Number* = *ss* ; *OpCode* = TAP
1	16#0000#	*Dest_Mod* = DAC
2	16#0001#	*Length*: constant =1
3	16#xxxx#	*Index, Data*

The *Parameter ID* is an index, 1..24, into the 8-bit control table (see figure and table below). The *Length* word must be set to 0001. The *Data* byte contains the new DAC value.

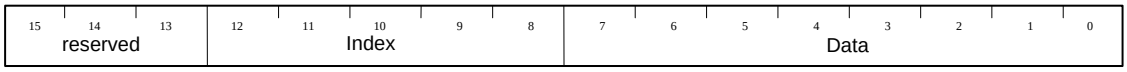


Figure 1.1.1-1 —
Format for Valve DAC Parameter Words

Table 1.1.1-1 —
DAC Signal/Index Correlation

Index	SIS Name
1	QR_A1_Ctrl
2	QR_A2_Ctrl
3	QR_B1_Ctrl
4	QR_B2_Ctrl
5	QR_A3_Ctrl
6	QR_A4_Ctrl
7	Beam_E2_C, Beam_E1_C
8	Beam_E4_C, Beam_E3_C
9	QR_B3_Ctrl
10	QR_B4_Ctrl
11	EP1_Ctrl
12	EP2_Ctrl

Index	SIS Name
13	EP3_Ctrl
14	EP4_Ctrl
15	Beam_E_C, Beam_E5_C
16	Thresh_2, Thresh_1
17	EM1_Ctrl
18	EM2_Ctrl
19	Lens_1_Ctrl
20	Lens_2_Ctrl
21	Lens_3_Ctrl
22	Lens_4_Ctrl
23	Pres2_Adj, Pres1_Adj
24	Th_Pow, ILIM_Adj

1.2 ISS Control --

1.2.1 STEM: `TI_ISSPARM`

NAME: TAP to set Ion Source Select Control Parameters

PURPOSE: (This TC has been descoped.)

1.3 EEPROM Management.

1.3.1 STEM: `TX_EEPROM`

NAME: TAP to set EEPROM Parameters

PURPOSE: To control EEPROM, including general EEPROM re-initialization, and re-initialization of ICCUs or TAPs.

COMMAND INPUT FIELDS: `TX_EEPROM`, *Serial#, Destination Module, Parameter ID, Length*

Word		
0	16#*ss*11#	*Serial Number* = *ss* ; *OpCode* = TAP
1	16#09*pp*#	*Destination Module* (09=EEPROM Mgmt) and *Parameter ID (pp)**
2	16#0001#	*Length* (# Data Words) : constant =1

* *Parameter ID :*

00 = Initialize EEPROM
01 = Refresh EEPROM
20 = Initialize/Erase ICCUs
21 = Initialize/Erase TAPs

Note: The *Length* word must be set to 0001.

1.4 Temperature Control.

1.4.1 STEM: `TH_TEMPCONT`

NAME: TAP to set GC Temperature Parameters

PURPOSE: To control threshold values for GC heaters.

COMMAND INPUT FIELDS: `TH_TEMPCONT`, *Serial#, Dest_Mod, Param ID, Upper, New Temp, Heater#*

Word
0 16#*ss*11# *Serial Number* = *ss* ; *OpCode* = TAP
1 16#0800# *Dest_Mod* = Temperature Control; *Param ID* = n/a
2 16#xxxx# Temperature Control Word: *Upper, New Temp, Heater#*

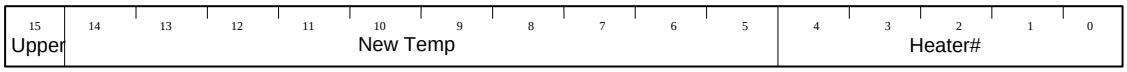


Figure 1.4.1-1 —
Format for Temperature Control Word

When the *Upper* field is set, the *New Temp* indicates the upper limit for closed-loop temperature control. When the *Upper* field is clear, the *New Temp* indicates the lower limit.

The *New Temp* field is a 10-bit number indicating the compare value for the associated A/D monitor word.

Note: Only heaters #5, 6 and 7 are valid for the *Heater#* field in this telecommand.

Table 1.4.1-1 —
GC Heater Numbering

#	Heater	
0	Inlet	
1	Cell 1	(illegal in
2	Cell 2	TH_TempCont
3	ACP line	telecommand)
4	Mass source cal	
5	GC 1	
6	GC 2	
7	GC 3	

2. GICs

GICs (Ground Instrument Commands) result in real-time modification of parameters within the uP, typically for adjustment of instrument control functions. GIQs also exist for the purpose of querying the instrument (e.g. for memory dumps).

GICs may be used during the Ground, Cruise, and Flight mission phases. The OPCODE field for GICs is 16#*ss*44#.

2.1 GICs for GCMS have been divided into two types. Primary GICs are defined in this section; section 4.2 defines "TAP GICs".

OVERVIEW OF GICs:

Command	***Device/Parameter ID***	***Operation/Data***
No-op	16#0000#	serial#
(spare)	16#0001#	n/a
Apply All TAPs	16#0002#	serial#
Apply All ICCs	16#0003#	serial#
Apply All CMPs	16#0004#	serial#
Apply CMP #*x*	16#0005#	serial#, CMP#
ACP Open Window	16#0006#	serial#
ACP Close Window	16#0007#	serial#
TGO Boot	16#0008#	serial#
(spare)	16#0009#	n/a
(spare)	16#000A#	n/a
(spare)	16#000B#	n/a
(spare)	16#000C#	n/a
(spare)	16#000D#	n/a
Valve (n) Enable/Disable	16#000E#	serial#, Valve #, Ena/Disa
Valve (n) Open/Close	16#000F#	serial#, Valve #, Open/Close
Heater (n) Enable/Disable	16#0010#	serial#, Heater #, Ena/Disa
Heater (n) On/Off	16#0011#	serial#, Heater #, On/Off
Filament (n) On/Off (Ena/Disa)	16#0012#	serial#, Filament #, FOn, FEna, FCmd
Valve Squirt	16#0013#	serial#, Valve #
IPS (n) On/Off (Ena/Disa)	16#0014#	serial#, IPS #, IOn, IEna, ICmd
spare	16#0015#	n/a
spare	16#0016#	n/a
spare	16#0017#	n/a
Mass Sweep Mode (MSC 1-30)	16#0018#	serial#, various sweep parameters
spare	16#0019#	n/a
DAC Parameters	16#001A#	serial#, DAC control Vs
Force CDMU Status Word	16#001B#	serial#, CDMU ESW byte
spare	16#001C#	n/a
Raw I/O	16#001D#	serial#, port, data (16 bits ea)
spares	16#001E#..16#1F	n/a

Warm Boot	16#0020#	serial#
Cool Boot	16#0021#	serial#
DDB Acks ON	16#0022#	serial#
DDB Acks OFF	16#0023#	serial#
Turn-Off Request	16#0024#	serial#
spares	16#0025#..2F	n/a
Go TC	16#0030#	serial#

2.1.1 STEM: GX_NOOP

NAME: No-Operation

PURPOSE: Performs no functional command to GCMS other than to cause it to send an Acknowledge TM message in response to the TC.

COMMAND INPUT FIELDS: GX_NOOP, *Serial#*

Word		
0	16#*ss*44#	*Serial Number = ss* ; *OpCode* = GIC
1	16#0000#	*Device/Parameter ID* = No-op

2.1.2 STEM: GX_ACPOPEN

NAME: Open ACP Window

PURPOSE: Informs instrument to accept and process ACP sync pulses.

COMMAND INPUT FIELDS: GX_ACPOPEN, *Serial#*

Word		
0	16#*ss*44#	*Serial Number = ss* ; *OpCode* = GIC
1	16#0006#	*Device/Parameter ID* = ACP Open

Note: Internally generated instrument commands to control the ACP window, if active, will override ACP Window telecommands.

2.1.3 STEM: GX_ACPCLOSE

NAME: Close ACP Window

PURPOSE: Informs instrument to reject ACP sync pulses.

COMMAND INPUT FIELDS: GX_ACPCLOSE, *Serial#*

Word		
0	16#*ss*44#	*Serial Number = ss* ; *OpCode* = GIC
1	16#0007#	*Device/Parameter ID* = ACP Close

2.1.4 STEM: GX_TGOBOOT

NAME: Warm Boot

PURPOSE: Command the instrument Flight Computer to perform a warm boot.

COMMAND INPUT FIELDS: GX_TGOBOOT, *Serial#*

Word		
0	16#*ss*44#	*Serial Number = ss* ; *OpCode* = GIC
1	16#0008#	*Device/Parameter ID* = Warm Boot

2.1.4.1 Levels of Reboot.

The term "Cold Boot" refers to a condition where the micro-processor is brought on-line from a power-off state.

In a "TGO Boot" operation, the micro-processor is re-started by assertion of an external reset (hardware) signal, caused by expiration of the internal watchdog ("TGO") timer.

In a "Cool Boot" operation, the micro-processor is re-started by from PROM and jumping (setting the Instruction Counter register) to the 1750 initial vector address, 0000h.

In a "Warm Boot" operation, the micro-processor is re-started by remaining in RAM mode and jumping (setting the Instruction Counter register) to program initialization that is after the "PROM Shadowing" step.

The four "levels" of Flight Computer rebooting are summarized in the following table.

	Type	Cause	Description	CPU Reset	Mode
1	Cold	Power-on Reset	Complete re-boot from PROM following power-on.	YES	PROM
2	TGO	TC or CPU	CPU reset caused by expiration of "Watchdog" timer.	YES	PROM
3	Cool	TC	Telecommand causes reboot from PROM.	NO	PROM
4	Warm	TC	Telecommand causes restart program in RAM.	NO*	RAM*

* As of 1/19/96, the Warm Boot operation for GCMS remains in RAM mode and jumps to GCMS 1750 initial vector address, 0000h, which in turn switches back to PROM mode (TBC) and reloads RAM from PROM.

2.1.5 STEM: GV_VENADIS

NAME: Valve (n) Enable/Disable

PURPOSE: Designate a valve (1..32) to be enabled or disabled. (See table 2.1.5-1 for numbering.)

COMMAND INPUT FIELDS: GV_VENADIS, *Serial#, Valve_ID, Operation*

Word		
0	16#*ss*44#	*Serial Number = ss* ; *OpCode* = GIC
1	16#000E#	*Device/Parameter ID* = Valve Enable/Disable
2	16#xxxx#	Digital Control Operation/Data Word: *Valve ID, Operation.*

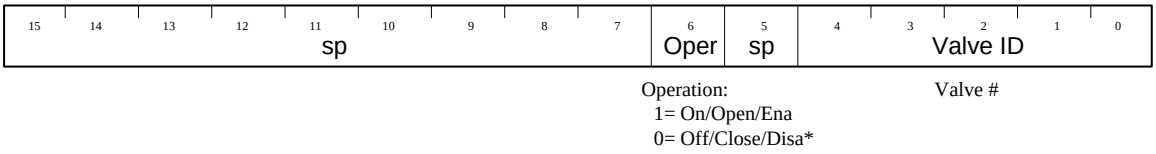


Figure 2.1.5-1 —
Format for Valve Digital Control Operation/Data Word

NOTE: When a Valve Disable command is received by the instrument, the indicated valve is disabled (no valve movement occurs as a result of the disable telecommand -- contrast to Heater, Filament and IPS disable TCs).

Table 2.1.5-1 — Valve Numbering in TCs

#	Valve
0	IV
1	IVA
2	VAA
3	VAB

#	Valve
8	VD2
9	VD3
10	VD4
11	VD5*

#	Valve
16	VG2
17	VG3
18	VG4*
19	VL1

#	Valve
24	VS2
25	VS3
26	VS4*
27	VS5

4	VC1	12	VD6	20	VL2	28	VS6
5	VC2	13	VE	21	VL3	29	VS7
6	VC3	14	VG	22	VL4	30	VV
7	VD1	15	VG1	23	VS1	31	VZ

* - valve not used

2.1.6 STEM: GV_VOPCLOS

NAME: Valve (n) Open/Close

PURPOSE: Command a valve (1..32) to open or close in real time. Refer to figure 2.1.5-1 for format of control word. (See table 2.1.5-1 for valve numbering.)

COMMAND INPUT FIELDS: GV_VOPCLOS, *Serial#, Valve_ID, Operation*

Word
- 0 16#*ss*44# — *Serial Number = ss* ; *OpCode* = GIC
- 1 16#000F# — *Device/Parameter ID* = Valve Open/Close
- 2 16#xxxx# — Digital Control Operation/Data Word: *Valve #, Operation=Open/Close*

2.1.7 STEM: GH_HENADIS

NAME: Heater (n) Enable/Disable

PURPOSE: Designate a heater (1..8) to be enabled or disabled. (See table 2.1.7-1 for numbering.)

COMMAND INPUT FIELDS: GH_HENADIS, *Serial#, Heater_ID, Operation*

Word
- 0 16#*ss*44# — *Serial Number = ss* ; *OpCode* = GIC
- 1 16#0010# — *Device/Parameter ID* = Heater Enable/Disable
- 2 16#xxxx# — Digital Control Operation/Data Word: *Heater #, Operation*

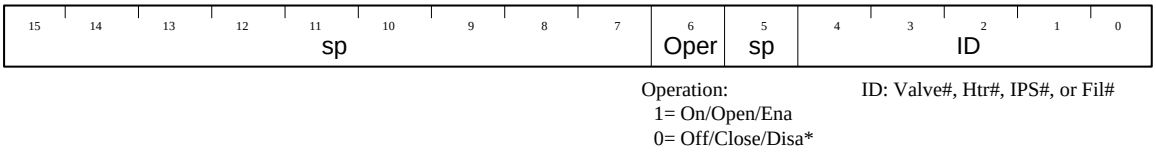


Figure 2.1.7-1 —
Format for Heater Digital Control Operation/Data Word

NOTE: When a Heater Disable command is received by the instrument, the indicated heater is turned off, and then disabled.

Table 2.1.7-1 —
Heater Numbering in TCs

#	Heater
0	Inlet
1	EC1
2	EC2
3	ACP

#	Heater
4	Cal
5	GC1
6	GC2
7	GC3

2.1.8 STEM: GH_HONOFF

NAME: Heater (n) On/Off

PURPOSE: Command a heater (1..8) ON or OFF in real time. Refer to figure 2.1.7-1 for format of control word. (See table 2.1.7-1 for numbering.)

COMMAND INPUT FIELDS: GH_HONOFF, *Serial#, Heater_ID, Operation*

Word
0 16#*ss*44# *Serial Number = ss* ; *OpCode* = GIC
1 16#0011# *Device/Parameter ID* = Heater Open/Close
2 16#xxxx# Digital Control Operation/Data Word: *Heater #, Operation*

2.1.9 STEM: GF_FONOFF

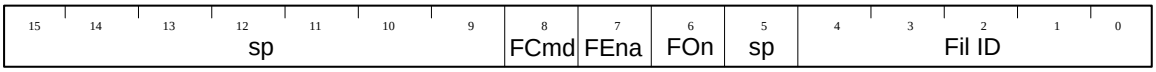
NAME: Filament (n) On/Off (or Enable/Disable)

PURPOSE: Command a filament ON or OFF in real time.

COMMAND INPUT FIELDS: GF_FONOFF, *Serial#, Filament_ID, Operation*

Word
0 16#*ss*44# *Serial Number = ss* ; *OpCode* = GIC
1 16#0012# *Device/Parameter ID* = Filament On/Off
2 16#xxxx# Filament Control Operation/Data Word: *Filament ID, FOn, FEna, FCmd*

When the *FCmd* bit is Set, this TC causes the specified filament (see table 2.1.9-1) to turn On or Off, according to the *FOn* bit. When the *FCmd* bit is Clear, this TC causes the specified filament to become Enabled or Disabled, according to the *Fena* bit.



Command:
1= On/Off
0= Enable/Disable

Fil#

Figure 2.1.9-1 —
Format for Filament Digital Control Operation/Data Word

NOTE: When a Filament Disable command is received by the instrument, the indicated filament is turned off, and then disabled.

Table 2.1.9-1 —
Filament Numbering in TCs

#	**Filament**
0	Direct
1	ACP
2	GC1
3	GC2
4	GC3
5	BA

2.1.10 STEM: GV_VSQUIRT

NAME: Valve Squirt

PURPOSE: To allow commanding of specified valve (1..32) to squirt (open/close) for the default duration. (See table 2.1.5-1 for numbering.) The default squirt duration is an AMB parameter (refer to GCMS SUM).

COMMAND INPUT FIELDS: GF_FILSEL, *Serial#, Filament_ID*

Word
0 16#*ss*44# *Serial Number = ss* ; *OpCode* = GIC
1 16#0013# *Device/Parameter ID* = Valve Squirt

2.1.11 STEM: GP_IPONOFF

NAME: IPS (n) On/Off

PURPOSE: Command an IPS ON or OFF in real time.

COMMAND INPUT FIELDS: GP_IPONOFF, *Serial#, IPS_ID, Operation*

Word
0 16#*ss*44# *Serial Number = ss* ; *OpCode* = GIC
1 16#0014# *Device/Parameter ID* = IPS On/Off
2 16#xxxx# Digital Control Operation/Data Word: *IPS ID, IOn, IEna, ICmd*

When the *ICmd* bit is Set, this TC causes the specified IPS to turn On or Off, according to the *IOn* bit. When the *ICmd* bit is Clear, this TC causes the specified IPS to become Enabled or Disabled, according to the *Iena* bit.

Valid values for the *IPS ID* are 0 and 1.

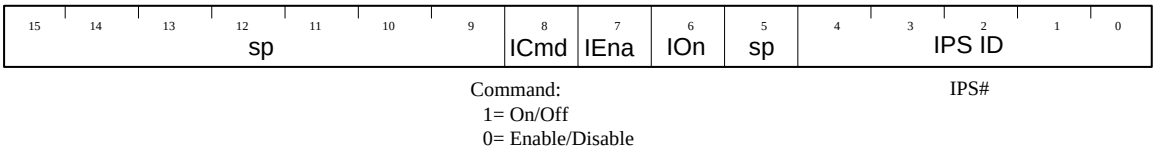


Figure 2.1.11-1 —
Format for IPS Digital Control Operation/Data Word

NOTE: When an IPS Disable command is received by the instrument, the indicated IPS is turned off, and then disabled.

2.1.12 STEM: GU_STEPINC

NAME: GIC to set USeq Set Mass Step Increment

PURPOSE: Modify the USeq/QP mass step increment value for any of the seven Ion Sources. (See Table 2.1.12-1 for Ion Source Numbering.)

COMMAND INPUT FIELDS: GU_STEPINC,*Serial#, amu, ISS*

Word

0	16#*ss*44#	*Serial Number* = *ss* ; *OpCode* = GIC
1	16#0018#	*Device/Parameter ID* = Mass Sweep Mode (MSC)
2	16#xxxx#	MSC# = 2; amu Step; ISS #

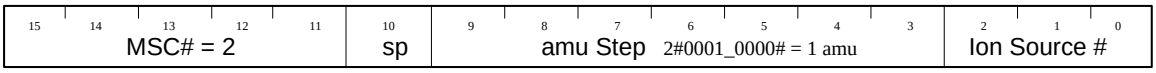


Figure 2.1.12-1 —
Format for MSC #2 Control Word

For GCMS, in all data fields that indicate *Ion Source,* the following values are assigned:

Table 2.1.12-1 —
Ion Source Numbering

#	**ISS**
0	None
1	Direct Source
2	ACP Direct (e.g. VL4)
3	GC1
4	GC2 (VC2)
5	GC3 (VC3)
6	Calibration Filament
7	invalid

Constraints/Notes:

Only mass steps of 1.0 amu (Unity resolution) 0.125 amu (Fractional resolution) are supported; thus, the only valid values for *amu step* are 10h and 02h (0001_0000b and 0000_0010b).

Any valid command changing the Mass Step Increment will reset the amu limits to "Full Sweep" (see GU_SWPLIM TC).

2.1.13 STEM: GU_SWPLIM

NAME: GIC to set USeq Sweep Limits for any of the seven Ion Sources. (See Table 2.1.12-1 for Ion Source Numbering.)

PURPOSE: Modify the USeq/QP sweep limits. "Short Sweep" modes are possible by using this command. (See GCMS SUM)

COMMAND INPUT FIELDS: GU_SWPLIM, *Serial#, MSC, ISS, X, Y*

Word

0	16#*ss*44#	*Serial Number* = *ss* ; *OpCode* = GIC
1	16#0018#	*Device/Parameter ID* = Mass Sweep Mode (MSC)
2	16#xxxx#	MSC# = 5; ISS #

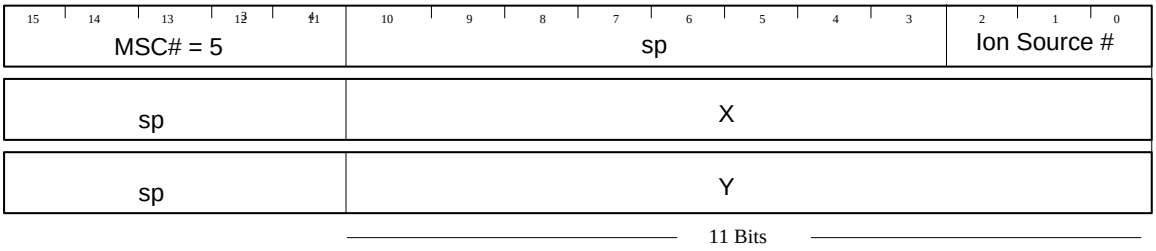


Figure 2.1.13-1 —
Format for MSC #5 Control Words

Constraints/Notes:

The instrument initializes in "Full Sweep" mode (2..141 amu). See also the GU_STEPINC TC.

Valid ranges for *X* (lower amu limit) and *Y* (upper amu limit) are 0 (TBC) and 142 (TBC), respectively.

2.1.14 STEM: GU_ASPARM

NAME: GIC to Set Alternating USeq Step Parameters

PURPOSE: To provide the ability for occasional Fractional Mode sweeps for any of the seven Ion Sources. (See Table 2.1.12-1 for Ion Source Numbering.)

COMMAND INPUT FIELDS: GU_ASPARM, *Serial#, MSC, ISS, US, FS, UR, FR*

Word

0	16#*ss*44#	*Serial Number* = *ss* ; *OpCode* = GIC
1	16#0018#	*Device/Parameter ID* = Mass Sweep Mode (MSC)
2	16#xxxx#	MSC# = 26; ISS #
3	*US, FS*	(not used)
4	*UR/10, FR*	*UR/10* = # unity sweeps to repeat ÷10; *FR* = # fractional sweeps to repeat

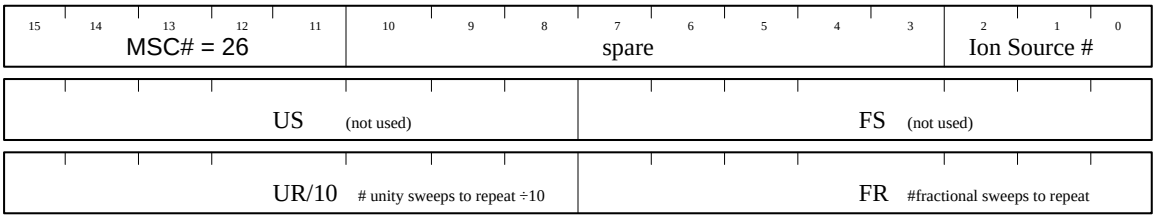


Figure 2.1.14-1 —
Format for MSC #26 (Alt Step) Control Words

Constraints/Notes:

The instrument initializes in "Full Sweep" mode (2..141 amu). See also the GU_STEPINC TC.

The *US/10* field is multiplied by 10 by the FC to obtain the *US* (number of unity sweeps) value.

When this TC is received with either *US/10* or *FR* = 0, Alt Step mode is terminated.

2.1.15 STEM: GU_ISSPREF

NAME: GIC to Select Ion Source Preference. (See Table 2.1.12-1 for Ion Source Numbering.)

PURPOSE: This Mass Sweep Command (MSC) selects which ISs are to be included in multiplexing (i.e., candidates for hi-pass threshold criteria). Like other 'digital' controls (valves, heaters, etc.), any ion source can be "disabled" from future selection, thus removing it as a multiplexing candidate. Note that there are two parameters describing each IS, "active" and "enabled." The "enabled" parameter is intended for normal, descent use, and will vary as the TDIC software traverses the ICC (refer to GCMS SUM). The "active" parameter, like those for heaters, valves, IPS, and Filaments, is for special control in the event that one of the ISs is deemed to be malfunctional and it becomes necessary to specify that it be ignored (by telecommanding it to the "inactive" state).

COMMAND INPUT FIELDS: GU_ISSPREF, *Serial#*, *MSC*, *Mode*, *Ena_Disa*, *Act_Inact*

Word	
0	16#*ss*44# — *Serial Number* = *ss* ; *OpCode* = GIC
1	16#0018# — *Device/Parameter ID* = Mass Sweep Mode (MSC)
2	16#xxxx# — MSC# = 29; Mode (1-3)
3	16#xxxx# — Enable/Active Control Word, Cmd Word

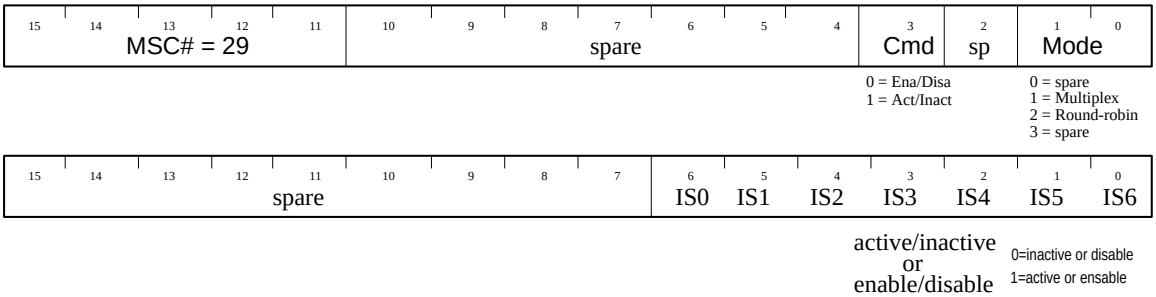


Figure 2.1.15-1 — Format for MSC #29 Control Words

2.1.16 STEM: GD_DACPARM

NAME: GIC to set DAC Parameters

PURPOSE: To allow dynamic tuning of the D/A control voltages. (See also TD_DACPARM)

COMMAND INPUT FIELDS: GD_DACPARM, *Serial#, Length, Parameter ID, Data Value*

TC Word #Data		Meaning
0	*ss*44	*Serial Number = ss* ; *OpCode* = GIC
1	001A	*Device/Parameter ID* = Modify DAC Parameters
2	16#0001#	*Length* (# Data Words) : constant =1
3	16#xxxx#	*Parameter ID, Data Byte*

The *Parameter ID* is the same as bits 3-7 of USeq DAC Control (refer to GCMS SIS), containing both DAC and CHAN (see figure in §1.1.1). The *Length* word must be set to 0001. The *Data* byte contains the new DAC value.

2.1.17 STEM: GX_CDMUSWO

NAME: GIC to Force CDMU ESW value

PURPOSE: For ground testing it is desirable to be able to force changes to the Experiment Status Word (ESW) that is sent to the CDMU.

COMMAND INPUT FIELDS: GX_CDMUSWO, *Serial#, Status_Word*

Word #Data	Meaning	
0	*ss*44	*Serial Number = ss* ; *OpCode* = GIC
1	001B	*Device/Parameter ID* = Force CDMU Status Word
2	xxxx	status word byte

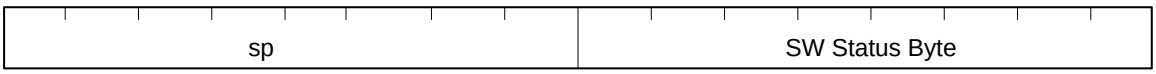


Figure 2.1.17-1 —
Format for GX_CDMUSO Control Word

During probe descent, the status word is read by the probe at 15 second intervals. The format of the CDMU Experiment Status word is described in the GCMS User's Guide. Eight bits are assigned to hard-wired electronics hardware circuitry, and the remaining eight bits are output by the instrument software. Note that there are two, one for each CDMU.

2.1.18 STEM: GX_RAWIO

NAME: GIC to Send Raw I/O

PURPOSE: To provide the ability to send any single I/O (output) data value to any 1750 output port.

COMMAND INPUT FIELDS: GX_RAWIO, *Serial#, Port, Data*

Word #Data	Meaning
0	*ss*44 *Serial Number = ss* ; *OpCode* = GIC
1	001B *Device/Parameter ID* = Raw I/O
2	xxxx Port
3	xxxx Data

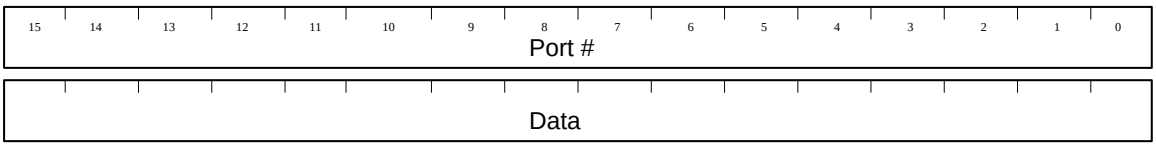


Figure 2.1.18-1 —
Format for Raw I/O Control Words

2.1.19 STEM: CX_MEMLOAD_TAP

NAME: TAP Memory Load Apply

PURPOSE: Apply all TAP uploads from EEPROM to operational (RAM) memory.

COMMAND INPUT FIELDS: GW_PARAMS, *Serial#, ID, Data* (TBC)

Word #Data	Meaning
0	*ss*44 *Serial Number = ss* ; *OpCode* = GIC
1	0002 *Device/Parameter ID* = Apply TAPs

2.1.20 STEM: CX_MEMLOAD_ICC

NAME: ICCU Memory Load Apply

PURPOSE: Apply all ICCU uploads from EEPROM to operational (RAM) memory.

COMMAND INPUT FIELDS: GW_PARAMS, *Serial#, ID, Data* (TBC)

Word #Data	Meaning
0	*ss*44 *Serial Number = ss* ; *OpCode* = GIC
1	0003 *Device/Parameter ID* = Apply ICCs

2.1.21 STEM: CX_MEMLOAD_CMP

NAME: Complete CMP Memory Load Apply

PURPOSE: Apply all CMP uploads from EEPROM to operational (RAM) memory.

COMMAND INPUT FIELDS: GW_PARAMS, *Serial#, ID, Data* (TBC)

Word	#Data	Meaning
0	*ss*44	*Serial Number* = *ss* ; *OpCode* = GIC
1	0004	*Device/Parameter ID* = Apply CMPs

2.1.22 STEM: CX_MEMLOAD_CMPX

NAME: Selected CMP Memory Load Apply

PURPOSE: Apply selected CMP upload from EEPROM to operational (RAM) memory.

COMMAND INPUT FIELDS: GW_PARAMS, *Serial#, ID, Data* (TBC)

Word	#Data	Meaning
0	*ss*44	*Serial Number* = *ss* ; *OpCode* = GIC
1	0002	*Device/Parameter ID* = Apply CMP 'x'
2	*nnnn*	CMP #

2.1.23 STEM: GX_WARMBOOT

NAME: Warm Boot

PURPOSE: Command the instrument Flight Computer to perform a "warm" boot (restart 1750 computer at startup location, 0000h).

COMMAND INPUT FIELDS: GX_WARMBOOT, *Serial#*

Word		
0	16#*ss*44#	*Serial Number* = *ss* ; *OpCode* = GIC
1	16#0020#	*Device/Parameter ID* = Warm Boot

See also §2.1.1.1 for a description of reboot "levels."

2.1.24 STEM: GX_COOLBOOT

NAME: Cool Boot

PURPOSE: Command the instrument Flight Computer to perform a "cool" boot (reboot from ROM).

COMMAND INPUT FIELDS: GX_COOLBOOT, *Serial#,*

Word		
0	16#*ss*44#	*Serial Number* = *ss* ; *OpCode* = GIC
1	16#0021#	*Device/Parameter ID* = Cool Boot

See also §2.1.1.1 for a description of reboot "levels."

2.1.25 STEM: GX_DDBACKS_ON

NAME: DDB Acks On

PURPOSE: Command the instrument Flight Computer to send Acknowledge TM for every DDB received (ground testing).

COMMAND INPUT FIELDS: GX_DDBACKS_ON, *Serial#*

Word	
0	16#*ss*44# *Serial Number = ss* ; *OpCode* = GIC
1	16#0022# *Device/Parameter ID* = DDB Acks On

2.1.26 STEM: GX_DDBACKS_OFF

NAME: DDB Acks Off

PURPOSE: Command the instrument Flight Computer to terminate DDB Acks after being commanded ON by GX_DDBACKS_ON.

COMMAND INPUT FIELDS: GX_DDBACKS_OFF, *Serial#*

Word	
0	16#*ss*44# *Serial Number = ss* ; *OpCode* = GIC
1	16#0023# *Device/Parameter ID* = DDB Acks Off

2.1.27 STEM: GX_TURNOFF

NAME: Turnoff Request

PURPOSE: Command the instrument Flight Computer to set the *Turnoff Request* bit in the ESW.

COMMAND INPUT FIELDS: GX_TURNOFF, *Serial#*

Word	
0	16#*ss*44# *Serial Number = ss* ; *OpCode* = GIC
1	16#0024# *Device/Parameter ID* = Turnoff Request

2.1.28 STEM: GX_GO_TC

NAME: Go GCMS

PURPOSE: Command the instrument Flight Computer to continue the sequence for the current mode.

COMMAND INPUT FIELDS: GX_GO_TC, *Serial#*

Word	
0	16#*ss*44# *Serial Number = ss* ; *OpCode* = GIC
1	16#0030# *Device/Parameter ID* = Go GCMS

3. ICCUs

Instrument Command Chains (ICCs) control the measurement sequences; The ability to upload new ICCs is provided through ICCUs. The ability to change measurement sequences during cruise is required primarily for the INMS instrument, but this flexibility is also desirable for GCMS. ICCUs may be used during the Ground, Cruise, and Flight mission phases. The OpCode field for ICCUs is 16#*ss*22#.

3.1 STEM: IC_ICCU

NAME: ICC Upload

PURPOSE: Allow modification of ICC tables.

COMMAND INPUT FIELDS: IC_ICCU, *Serial#, Starting Index, #Words, Data Word* (TBC)

0 *OpCode* (=16#*ss*22#) (indicates ICCU)
1 *ICC ID*
2 *Starting Index*
3 *# Data Words*
4 *Data Word* (1)
5 *Data Word* (i)
. . .
. . .
Data Word (n)
[*Error Control* (CRC)]

There are a total of 16 ICCs. Since each ICC actually consists of two tables (a *Device* and an *Operation* table), the ICCUs are split into 0-F and 10h-1Fh.

4. CMPs

The CMP (computer memory patch) memory load provides more flexibility than TAPs or ICCUs. CMPs may be used during the Ground, Cruise, and Flight mission phases. The OpCode field for CMPs is 16#*ss*33#.

4.1 STEM: CX_MEMLOAD

NAME: CMP (Memory Load)

PURPOSE: Allow modification of software data and code.

COMMAND INPUT FIELDS: CX_Memload, *Serial#, Destination, Function,* <*Parameters*>, *Data,* <*Data*>

General Format for CMP TCs:

TC Word #Data	Meaning	
0	*ss*33	*Serial Number = ss* ; *OpCode* = CMP
1	ddff	*Destination, Function**
2+	xxxx	*Data* (format depends upon function)

**Destination:*

1 = EEPROM
2 = RAM
3 = EEPROM & RAM

**Function:*

10 = Upload CMP to EEPROM
11 = Initialize/Erase all CMPs
12 = Erase CMP #xx.
13 = Inhibit Apply

B.1 Format for the "Upload CMP" TC (note that the FC software increments the CMP# for each new one):

TC Word #Data	Meaning	
0	*ss*33	*Serial Number = ss* ; *OpCode* = CMP
1	dd10	*Function* = Upload CMP
2	xxxx	*Starting Address*
3	nnnn	*Length* (number of words)
4	zzzz	*Data Word (1)*
5	zzzz	*Data Word (2)*
...	...	... ...

NOTE: The *Inhibit Apply* TC inhibits the software from applying any of the memory load data in EEPROM, including CMPs, TAPs, and ICCUs. The software waits 20s (TBC) before applying data from EEPROM, so the *Inhibit Apply* TC must be sent during that window.

5. GIQs

The Ground Instrument Query (GIQ) provides the ability to examine computer memory locations. The OpCode field for GIQs is 16#*ss*55#. GIQs consist of:

1. RAM Address Value Query
2. EEPROM Address Value Query
3. IORAM Address Value Query

5.1 STEM: QE_RAMDUMP

NAME: Query (RAM Dump)

PURPOSE: Allow inspection of RAM.

COMMAND INPUT FIELDS: QE_Ramdump, *Serial#, Start_Addr, Length*

TC Word #Data	Meaning	
4	*ss*55	*Serial Number = ss* ; *MLC Header* = GIQ
5	0001	*Query ID* = RAM Query
6	xxxx	*Start Address* (0..FFFF)
7	yyyy	*Length* (0..127_{10}) -- # Words

5.2 STEM: QE_EEPROMDUMP

NAME: Query (EEPROM Dump)

PURPOSE: Allow inspection of EEPROM.

COMMAND INPUT FIELDS: QE_Eepromdump, *Serial#, Start_Addr, Length*

TC Word #Data	Meaning	
4	*ss*55	*Serial Number = ss* ; *MLC Header* = GIQ
5	0002	*Query ID* = EEPROM Query
6	xxxx	*Start Address* (0..7FFF)
7	yyyy	*Length* (0..127_{10}) -- # Words

5.3 STEM: QE_IORAMDUMP

NAME: Query (IORAM Dump)

PURPOSE: Allow inspection of IORAM.

COMMAND INPUT FIELDS: QE_Ioramdump, *Serial#, Start_Addr, Length*

TC Word #Data	Meaning	
4	*ss*55	*Serial Number = ss* ; *MLC Header* = GIQ
5	0003	*Query ID* = IORAM Query
6	xxxx	*Start Address* (0..7FFF)
7	yyyy	*Length* (0..127_{10}) -- # Words

Abbreviations and Acronyms

amu	Atomic Mass Unit
ACP	Aerosol Collection Pyrolyzer
ALF	Assisted Load Format
BIT	Built-In Test
BIU	Bus Interface Unit
CDMU	Command and Data Management Unit
CMP	Computer Memory Patch
CW	Control Word
DAC	Digital-to-Analog Converter
DN	Design Note
EEPROM	Electronically Erasable PROM
EI	External Interrupt
EM	Engineering Model
FC	Flight Computer
FS	Fractional Sweeps
GC	Gas Chromatograph
GCMS	Gas Chromatograph Mass Spectrometer
GIC	Ground Instrument Command
GIQ	Ground Instrument Query
GSE	Ground Support Equipment
H/K	Housekeeping
HS	High Sensitivity
ICC	Instrument Command Chain
ICCU	Instrument Command Chain Upload
ID	Input Data, Identification
IDN	INMS Design Note
INMS	Ion and Neutral Mass Spectrometer
IOM	Intra-Office Memorandum
IP	Integration Period
IPS	Ion Pump Select, Ion Pump Supply
IS	Ion Source
ISS	Ion Source Select
LSB	Least Significant Bit
MLC	Memory Load Command
MSB	Most Significant Bit
MSC	Mass Sweep Command
MSW	Monitor/Status Word
QP	Quadrupole
PROM	Programmable Read-Only Memory
RAM	Random Access Memory
ROM	Read-Only Memory
S/C	Spacecraft
SIS	Software Interface Specification
SOM	System Operator's Manual
SPRL	Space Physics Research Laboratory

TAP	Tuning and Adaptation Parameter
TBC	To Be Confirmed
TBD	To Be Determined
TBS	To Be Supplied
TC	Telecommand
TDIC	Time-Driven Instrument Controller
T/H	Threshold
TM	Telemetry
US	Unity Sweeps
USeq	Micro Sequencer
VAC	Volts AC
VDC	Volts DC
uP	Microprocessor

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