Specification

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Overview

This document lists all commands that are defined for the remote interface of HGA200 resp. HGA400.

The listed commands and arguments can be passed to the RIP/02 protocol driver. The driver will pass received commands to the overlaying application using the same format.

Some of the commands can only be sent from PC to HGA, others can only be used in the reverse direction. Some commands can be sent by both devices. In many cases two commands share the same command id value. These commands are typical a query command, which can only be sent by the PC side, and the corresponding command from the HGA, including the requested information.

Since the command set will grow during the development process, a revision level is introduced which denotes the implemented command set. This revision level is a number which is incremented every time the command set is extended. Each device can query the command set revision of its communication partner and issue an error message if a required command is not included in the other device's command set. The minimum revision level is denoted with every command in this document.

Specifications

Maximum Command Length

Due to small resources the maximum command length offered by the RIP/02 protocol cannot be used. There is a different maximum length depending on whether the HGA is running boot code or country dependent software.

Direction	Boot code	Country dependent
PC → HGA	2215 byte	1024 byte
HGA → PC	2215 byte	1024 byte

The denoted length data are pure parameter bytes passed to the RIP/02 driver, not including the command id byte.

Passing 16 bit Values

By definition 16 bit values are transferred LSB first.

Command Set Summary

Sort by Command ID

ID	Name	Direction
00h	ECHO	PC → HGA, HGA → PC
01h	PING	PC → HGA, HGA → PC
02h	DOWNLOAD MODE	PC → HGA
03h	FLASH READ	PC → HGA
03h	FLASH DATA	HGA → PC
04h	RESET	PC → HGA
05h	FLASH ERASE	PC → HGA
05h	FLASH ERASED	HGA → PC
06h	FLASH PROGRAM	PC → HGA
06h	FLASH PROGRAMMED	HGA → PC
07h	QUERY RPM CHIP ID	PC → HGA
07h	TELL RPM CHIP ID	HGA → PC
08h	QUERY RPM UES	PC → HGA
08h	TELL RPM UES	HGA → PC
09h	PLD PROGRAM	PC → HGA
09h	PLD PROGRAMMED	HGA → PC
0Ah	QUERY RPM PCB ID	PC → HGA
0Ah	TELL RPM PCB ID	HGA → PC
0Bh	EEPROM READ	PC → HGA
0Bh	EEPROM DATA	HGA → PC
0Ch	EEPROM WRITE	PC → HGA
0Ch	EEPROM WRITTEN	HGA → PC
0Dh	QUERY VERSION	PC → HGA
0Dh	TELL VERSION	HGA → PC
0Eh	QUERY RUN MODE	PC → HGA
0Eh	TELL RUN MODE	HGA → PC
0Fh	PLD VERIFY	PC → HGA
0Fh	PLD VERIFIED	HGA → PC
10h	PLD READ	PC → HGA
10h	PLD DATA	HGA → PC
11h	QUERY GAS VALUES	PC → HGA
11h	TELL GAS VALUES	HGA → PC
12h	QUERY ANALYZER STATUS	PC → HGA
12h	TELL ANALYZER STATUS	HGA → PC
13h	SET ZERO ENABLE	PC → HGA
13h	ZERO ENABLE DONE	HGA → PC
14h	CLEAR SYSERROR	PC → HGA
14h	SYSERROR CLEARED	HGA → PC
15h	ZERO ADJUST	PC → HGA
15h	ZERO STARTED	HGA → PC
16h	ENTER MEASUREMENT	PC → HGA
16h	MEASUREMENT PROCESS	HGA → PC
17h	ENTER LEAK CHECK	PC → HGA
17h	LEAK CHECK PROCESS	HGA → PC
18h	SET FUNCTION KEYS	PC → HGA
18h	FUNCTION KEYS DONE	HGA → PC
19h	ENTER HC RESIDUE TEST	PC → HGA
19h	HC RESIDUE TEST PROCESS	HGA → PC
1Ah	DATE TIME	PC → HGA
1Ah	TELL DATE TIME	HGA → PC

ID	Name	Direction
1Bh	ENGINE DATA	PC → HGA
1Bh	TELL ENGINE DATA	HGA → PC
1Ch	QUERY TESTER TYPE	PC → HGA
1Ch	TESTER TYPE DATA	HGA → PC
1Dh	SET TESTER TYPE	PC → HGA
1Dh	TESTER TYPE DONE	HGA → PC
1Eh	SET AUTO PURGE	PC → HGA
1Eh	AUTO PURGE DONE	HGA → PC
1Fh	PUMP GAS VALUES	PC → HGA
1Fh	PUMP GAS DATA	HGA → PC
20h	PUMP CONDENSAT VALUES	PC → HGA
20h	PUMP CONDENSAT DATA	HGA → PC
21h	VALVE 1 VALUES	PC → HGA
21h	VALVE 1 DATA	HGA → PC
22h	VALVE 2 VALUES	PC → HGA
22h	VALVE 2 DATA	HGA → PC
23h	SET AUTO FAN	PC → HGA
23h	AUTO FAN DONE	HGA → PC
24h	FAN VALUES	PC → HGA
24h	FAN DATA	HGA → PC
25h	LCD VALUES	PC → HGA
25h	LCD DATA	HGA → PC
26h	SET LED	PC → HGA
26h	LED DONE	HGA → PC
27h	LANGUAGE	PC → HGA
27h	TELL LANGUAGE DATA	HGA → PC

Sort by Function

Communication Test

Name	Direction	ID
ECHO	PC → HGA, HGA → PC	00h
PING	PC → HGA, HGA → PC	01h

Device Information

Name	Direction	ID
QUERY RPM CHIP ID	PC → HGA	07h
TELL RPM CHIP ID	HGA → PC	07h
QUERY RPM UES	PC → HGA	08h
TELL RPM UES	HGA → PC	08h
QUERY RPM PCB ID	PC → HGA	0Ah
TELL RPM PCB ID	HGA → PC	0Ah
QUERY VERSION	PC → HGA	0Dh
TELL VERSION	HGA → PC	0Dh
QUERY RUN MODE	PC → HGA	0Eh
TELL RUN MODE	HGA → PC	0Eh
QUERY ANALYZER STATUS	PC → HGA	12h
TELL ANALYZER STATUS	HGA → PC	12h
CLEAR SYSERROR	PC → HGA	14h
SYSERROR CLEARED	HGA → PC	14h
DATE TIME	PC → HGA	1Ah
TELL DATE TIME	HGA → PC	1Ah
ENGINE DATA	PC → HGA	1Bh
TELL ENGINE DATA	HGA → PC	1Bh
QUERY TESTER TYPE	PC → HGA	1Ch
TELL TYPE DATA	HGA → PC	1Ch
LANGUAGE	PC → HGA	27h
TELL LANGUAGE DATA	HGA → PC	27h

Download

Name	Direction	ID
DOWNLOAD MODE	PC → HGA	02h
FLASH READ	PC → HGA	03h
FLASH DATA	HGA → PC	03h
RESET	PC → HGA	04h
FLASH ERASE	PC → HGA	05h
FLASH ERASED	HGA → PC	05h
FLASH PROGRAM	PC → HGA	06h
FLASH PROGRAMMED	HGA → PC	06h
PLD PROGRAM	PC → HGA	09h
PLD PROGRAMMED	HGA → PC	09h
PLD VERIFY	PC → HGA	0Fh
PLD VERIFIED	HGA → PC	0Fh
PLD READ	PC → HGA	10h
PLD DATA	HGA → PC	10h

Configuration

Name	Direction	ID
EEPROM READ	PC → HGA	0Bh
EEPROM DATA	HGA → PC	0Bh
EEPROM WRITE	PC → HGA	0Ch
EEPROM WRITTEN	HGA → PC	0Ch

Measurement

Name	Direction	ID
QUERY GAS VALUES	PC → HGA	11h
TELL GAS VALUES	HGA → PC	11h
SET ZERO ENABLE	PC → HGA	13h
ZERO ENABLE DONE	HGA → PC	13h
ZERO ADJUST	PC → HGA	15h
ZERO STARTED	HGA → PC	15h
ENTER MEASUREMENT	PC → HGA	16h
MEASUREMENT PROCESS	HGA → PC	16h

Test

Name	Direction	ID
ENTER LEAK CHECK	PC → HGA	17h
LEAK CHECK PROCESS	HGA → PC	17h
ENTER HC RESIDUE TEST	PC → HGA	19h
HC RESIDUE TEST PROCESS	HGA → PC	19h

Device Controls

Name	Direction	ID
SET FUNCTION KEYS	PC → HGA	18h
FUNCTION KEYS SET	HGA → PC	18h
SET TESTER TYPE	PC → HGA	1Dh
TESTER TYPE SET	HGA → PC	1Dh
SET AUTO PURGE	PC → HGA	1Eh
AUTO PURGE DONE	HGA → PC	1Eh
PUMP GAS VALUES	PC → HGA	1Fh
PUMP GAS DATA	HGA → PC	1Fh
PUMP CONDENSAT VALUES	PC → HGA	20h
PUMP CONDENSAT DATA	HGA → PC	20h
VALVE 1 VALUES	PC → HGA	21h
VALVE 1 DATA	HGA → PC	21h
VALVE 2 VALUES	PC → HGA	22h
VALVE 2 DATA	HGA → PC	22h
SET AUTO FAN	PC → HGA	23h
AUTO FAN DONE	HGA → PC	23h
FAN VALUES	PC → HGA	24h
FAN DATA	HGA → PC	24h
LCD VALUES	PC → HGA	25h
LCD DATA	HGA → PC	25h
SET LED	PC → HGA	26h
LED SET	HGA → PC	26h

ECHO

Value	00h
ID	HGACMD_ECHO
HGA	PC_C_ECHO
Direction	PC $\rightarrow$ HGA, HGA $\rightarrow$ PC
Implementation	Boot, Country
Revision	0
Description	The ECHO command is sent as a response to a received echo command. The argument is copied exactly from the received command.

ECHO	Data

Obs: If the ECHO command is implemented on both sides, the command is infinitely sent between the two devices after the first issue of an ECHO.

PING

Value	01h
ID	HGACMD_PING
HGA	PC_C_NOP
Direction	PC → HGA, HGA → PC
Implementation	Boot, Country
Revision	0
Description	The PING command is not handled by the receiver. Since it is sent using the RIP/02 protocol, the sender will receive an ACK. A device can use this command to check the presence of the communication partner.

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PING
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DOWNLOAD MODE

Value	02h
ID	HGACMD_ DOWNLOAD
HGA	PC_C_GO_DOWNLOAD_MODE
Direction	PC $\rightarrow$ HGA
Implementation	Country
Revision	0
Description	This command lets the HGA switch to download mode, i.e. executing boot code.
	This command must be issued by the PC before a software download can be performed, header or footer text can be changed or a new PLD version can be written.
	The gas analyzer will not issue a notification when the jump to boot code is complete and communication has re-established.

DOWNLOAD MODE

FLASH READ

Value	03h
ID	HGACMD_FLASHREAD
HGA	PC_C_GET_FLASH_CODE
Direction	PC → HGA
Implementation	Boot, Country
Revision	0
Description	The command requests a flash memory dump.
	The gas analyzer responds with a FLASH DATA command.

READ	Bank	Addr	Count

The maximum block size requested by this command is 1kB. The requested block must fit in a 32kB memory bank. Addressing is done relative to the memory bank, valid addresses are between 0000h and 7FFFh.

Bank numbering is the same as in the controller's address space (from 0 to 14), requesting bank 15 will read the common area.

FLASH DATA

Value	03h
ID	HGACMD_FLASHDATA
HGA	PC_C_GET_FLASH_CODE
Direction	HGA $\rightarrow$ PC
Implementation	Boot, Country
Revision	0
Description	This command passes a memory dump of the flash memory. It is sent as a response to a FLASH READ command.

DATA	Data

The passed data relate to the previous FLASH READ command. No own address information are transferred.

RESET

Value	04h
ID	HGACMD_RESET
HGA	PC_C_RESET_FLASH
Direction	PC → HGA
Implementation	Boot, Country
Revision	0
Description	The RESET command lets the gas analyzer execute a software reset. Program execution then starts with boot code and switches to the country dependent code (if present in Flash Memory).
	The gas analyzer will not issue a notification when the software reset is complete and communication has re-established (running boot code or country dependent code).

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RESET
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This command is typically used to switch back to the country dependent program after programming the flash memory.

FLASH ERASE

Value	05h
ID	HGACMD_FLASHERASE
HGA	PC_C_ERASE_BLOCK_FLASH
Direction	PC → HGA
Implementation	Boot
Revision	0
Description	This command erases a sector in the flash memory. The HGA uses a flash EPROM Am29F040, organized as 8 sectors of 64kB. The sector to erase is selected by the sector number.
	The gas analyzer will issue a FLASH ERASED command when the erase process is complete.

ERASE	Seg. No.

Seg. No.	From Flash-addr.	Till Flash-addr.
1	010000h	01FFFFh
2	020000h	02FFFFh
3	030000h	03FFFFh
4	040000h	04FFFFh
5	050000h	05FFFFh
6	060000h	06FFFFh
7	070000h	07FFFFh

All other sector numbers, including sector 0, are illegal.

When calculating sector numbers, relations between flash memory address and the processor's memory space must be observed.

FLASH ERASED

Value	05h
ID	HGACMD_FLASHERASED
HGA	PC_C_ERASE_BLOCK_FLASH
Direction	HGA → PC
Implementation	Boot
Revision	0
Description	This command is issued by the gas analyzer when a sector in flash memory is erased.

ERASED	Stat

Stat	
00h	OK
12h	Timeout or invalid sector number

FLASH PROGRAM

Value	06h
ID	HGACMD_FLASHPROG
HGA	PC_C_PROG_BLOCK_FLASH
Direction	PC → HGA
Implementation	Boot
Revision	0
Description	This command will program a number of bytes in the flash memory. Memory cells must be erased before using this command.
	The gas analyzer responds with a FLASH PROGRAMMED command when programming has finished.

PROG	Addr	Select	Count	Data

Programming can only be done in one single block of 16kB at a time. Address is specified relative to this memory block. Valid addresses reach from 0000h till 3FFFh.

Due to maximum command length a maximum of 2kB can be programmed at a time.

Relations between flash memory addresses and bankswitching select codes can be taken from the following table.

Flash From	Till	Select-code		Flash From	till	Select-code
00000	03FFF	15		40000	43FFF	5
04000	07FFF	45		44000	47FFF	37
08000	0BFFF	14		48000	4BFFF	6
0C000	0FFFF	46		4C000	4FFFF	38
10000	13FFF	13		50000	53FFF	7
14000	17FFF	47		54000	57FFF	39
18000	1BFFF	0		58000	5BFFF	8
1C000	1FFFF	32		5C000	5FFFF	40
20000	23FFF	1		60000	63FFF	9
24000	27FFF	33		64000	67FFF	41
28000	2BFFF	2		68000	6BFFF	10
2C000	2FFFF	34		6C000	6FFFF	42
30000	33FFF	3		70000	73FFF	11
34000	37FFF	35		74000	77FFF	43
38000	3BFFF	4		78000	7BFFF	12
3C000	3FFFF	36		7C000	7FFFF	44

FLASH PROGRAMMED

Value	06h
ID	HGACMD_FLASHPROGD
HGA	PC_C_PROG_BLOCK_FLASH
Direction	HGA $\rightarrow$ PC
Implementation	Boot
Revision	0
Description	This command includes information about the previous programming process.
	The gas analyzer issues this command when a FLASH PROGRAM command has finished.

PROG	Stat

Stat	
00h	OK
19h	Timeout or invalid address specification

QUERY RPM CHIP ID

Value	07h
ID	HGACMD_QUERYRPCHIPID
HGA	PC_C_GET_ID_PLD_RPM
Direction	PC → HGA
Implementation	Boot, Country
Revision	0
Description	This command queries the type of the PLD used on the RPM board. The gas analyzer will respond with a TELL RPM CHIP ID command.

QUERY

TELL RPM CHIP ID

Value	07h
ID	HGACMD_TELLRPMCHIPID
HGA	PC_C_GET_ID_PLD_RPM
Direction	HGA → PC
Implementation	Boot, Country
Revision	0
Description	This command provides information about the type of PLD used on the RPM board. The command is usually sent s a response to a QUERY RPM CHIP ID command.

TELL	Type

The type parameter describes the type of PLD used on the RPM module.

Type	Meaning
01h	IspLSI 1016
0Bh	IspLSI 1016 E
21h	Error: no RPM board installed

QUERY RPM UES

Value	08h
ID	HGACMD_QUERYUES
HGA	PC_C_GET_UES_PLD_RPM
Direction	PC → HGA
Implementation	Boot, Country
Revision	0
Description	This command requests the content of the UES area of the RPM board's PLD. The UES area usually contains the version number of the PLD software, but this is not necessary for using this command. The gas analyzer will respond sending a TELL RPM UES command.

QUERY

TELL RPM UES

Value	08h
ID	HGACMD_TELLUES
HGA	PC_C_GET_UES_PLD_RPM
Direction	HGA → PC
Implementation	Boot, Country
Revision	0
Description	This command contains the content of the UES area of the RPM board's PLD. The command is normally sent as a response to a QUERY RPM UES command.

TELL	UES0	UES1	UES2	UES3	UES4	UES5	UES6	UES7

The command always contains 8 byte of the UES, regardless of the real size of the UES area. The UES size can be different in different PLDs.

If the command parameter consists of a single byte, an error is occurred. The single byte contains the error code.

Code	Meaning
21h	No RPM board installed

PLD PROGRAM

Value	09h
ID	HGACMD_PLDPROG
HGA	PC_C_PROG_PLD_RPM
Direction	PC → HGA
Implementation	Boot
Revision	0
Description	This command allows reprogramming of the RPM board's PLD. The whole content of the PLD is transferred in this command. The gas analyzer will respond with a PLD PROGRAMMED message when PLD programming is complete.

PROG	Mode	Data

The data area is a copy of the .isp file which is created with the PLD development tools. The mode parameter specifies the kind of program verification.

Value	Meaning
00h	No verify
01h	Verify without UES
02h	Verify including UES

PLD PROGRAMMED

Value	09h
ID	HGACMD_PLDPROGD
HGA	PC_C_PROG_PLD_RPM
Direction	HGA → PC
Implementation	Boot
Revision	0
Description	This command provides information about a previous PLD programming process. The command is usually sent as a response to a PLD PROGRAM command.

PROG'D	Stat

Stat	Meaning
00h	Ok
21h	No RPM board installed
22h	Wrong PLD type
23h	Wrong checksum in .isp file
24h	Verify error

QUERY RPM PCB ID

Value	0Ah
ID	HGACMD_QUERYPCBID
HGA	PC_C_GET_ID_RPM
Direction	PC $\rightarrow$ HGA
Implementation	Boot, Country
Revision	0
Description	This command requests information about the RPM PCB of the gas analyzer. The requested information will be returned with a TELL RPM PCB ID command.

QUERY

TELL RPM PCB ID

Value	0Ah
ID	HGACMD_TELLPCBID
HGA	PC_C_GET_RPM_ID
Direction	HGA → PC
Implementation	Boot, Country
Revision	0
Description	This command contains information about the RPM PCB. The command is typically sent as a response to a QUERY RPM PCB ID command.

TELL	ID

The parameter id is the identification code of the PCB used in the gas analyzer. The id bits are used as listed below:

Bit	Meaning
[2:0]	PCD id
[6:3]	unused
7	0: No RPM board installed
	1: RPM board installed

EEPROM READ

Value	0Bh
ID	HGACMD_EEREAD
HGA	PC_C_GET_EEPROM
Direction	PC → HGA
Implementation	Boot, Country
Revision	0
Description	This command requests for the content of the serial EEPROM in the gas analyzer. The requested information will be returned with a EEPROM DATA command.

READ	Addr	Count

The first address to read is determined by the Addr argument, Count denotes the number of words to be read.

EEPROM DATA

Value	0Bh
ID	HGACMD_EEDATA
HGA	PC_C_GET_EEPROM
Direction	HGA → PC
Implementation	Boot, Country
Revision	0
Description	This command contains the content of the serial EEPROM requested by a previous EEPROM READ command.

DATA	Data

The passed data relate to the previous EEPROM READ command. No own address information is transferred. If no data is transferred, address or length information maybe were wrong.

EEPROM WRITE

Value   0Ch

ID   HGACMD_EEWRITE

HGA   PC_C_SET_EEPROM

Direction   PC → HGA

Implementation   Boot, Country

Revision   0

Description   This command writes a block of data to the serial EEPROM in the HGA.

                 The gas analyzer sends a EEPROM WRITTEN command when the programming process is complete.

WRITE	Addr	Count	Data

The first address to write to is determined by the Addr argument, Count denotes the number of words to be programmed.

EEPROM WRITTEN

Value	0Ch
ID	HGACMD_EEWRITN
HGA	PC_C_SET_EEPROM
Direction	HGA → PC
Implementation	Boot, Country
Revision	0
Description	This command is issued by the gas analyzer when writing to the serial EEPROM caused by an EEPROM WRITE command is complete.

WRIT'N	Stat

Stat	
00h	OK
20h	Program verify error (verify after write) or illegal address

QUERY VERSION

Value	0Dh
ID	HGACMD_QUERYVER
HGA	PC_C_PARA_CPU
Direction	PC → HGA
Implementation	Boot, Country
Revision	0
Description	This command requests the version information. The gas analyzer responds to this command with a TELL VERSION command.

QUERY

TELL VERSION

Value   0Dh

ID   HGACMD_TELLVER

HGA   PC_C_PARA_CPU

Direction   HGA → PC

Implementation   Boot, Country

Revision   0

Description   This command contains information on software version of boot code and country dependent code, PLD version of RPM module, revision level of the command set and the serial number of the device.

                 This command is sent as a response to a QUERY VERSION command.

TELL	Country ver.	Boot ver.	PLD ver.	Rev.	S/N

The version of boot code and country dependent code are coded as ASCII and have always 6 characters. For version 16/01/00 the command passes the following sequence.

´1´	´6´	´0´	´1´	´0´	´0´
31h	36h	30h	31h	30h	30h

The PLD version is the 8 byte wide information stored in the UES of the PLD. It contains the ASCII/BCD coded IC number and the version number of the PLD firmware.

'P'	03h	64h	19h	00h	01h	'E'	Undef.
IC: P36419				Ver. 0001E			

Version suffix can either be 'E' (45h) for E-type PLDs or 00h for conventional PLDs. The PLD version is undefined if no RPM module is present.

Command set revision index is a single byte.

The serial number is passed as a 16 bit word.

QUERY RUN MODE

Value	0Eh
ID	HGACMD_QUERYRUNMODE
HGA	PC_C_GET_MODE
Direction	PC → HGA
Implementation	Boot, Country
Revision	0
Description	This command requests information whether the gas analyzer is execution boot code or country dependent code.
	The HGA responds to this command with a TELL RUN MODE command.

QUERY

TELL RUN MODE

Value	0Eh
ID	HGACMD_TELLRUNMODE
HGA	PC_C_GET_MODE
Direction	HGA $\rightarrow$ PC
Implementation	Boot, Country
Revision	0
Description	This command contains information whether the gas analyzer executes boot code or country dependent code.
	This command is typically sent as a response to a QUERY RUN MODE command.

TELL	Mode

Mode	
00h	Boot code
01h	County dependent code

PLD VERIFY

Value	0Fh
ID	HGACMD_PLDVERIFY
HGA	PC_C_VERIFY_PLD_RPM
Direction	PC → HGA
Implementation	Boot
Revision	0
Description	This command tells the gas analyzer to compare the content of the RPM PLD with the data included in this command. The gas analyzer will send a PLD VERIFIED command to return the result of the comparison.

VERIFY	Mode	Data

The data area is a copy of the .isp file which is created with the PLD development tools. The mode parameter specifies the kind of program verification.

Value	Meaning
01h	Verify without UES
02h	Verify including UES

PLD VERIFIED

Value	0Fh
ID	HGACMD_PLDVERIFIED
HGA	PC_C_VERIFY_PLD_RPM
Direction	HGA → PC
Implementation	Boot
Revision	0
Description	This command provides the result of a previous compare of the RPM board's PLD software.

VERIF'D	Stat

Stat	Meaning
00h	Ok
21h	No RPM board installed
23h	Wrong checksum in .isp file
24h	Verify error

PLD READ

Value	10h
ID	HGACMD_PLDREAD
HGA	PC_C_READ_PLD_RPM
Direction	PC → HGA
Implementation	Boot
Revision	0
Description	This command requests the gas analyzer to read out the content of the RPM board's PLD. The gas analyzer will respond with a PLD DATA command.

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READ
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PLD DATA

Value	10h
ID	HGACMD_PLDDATA
HGA	PC_C_READ_PLD_RPM
Direction	HGA → PC
Implementation	Boot
Revision	0
Description	This command contains the content of the RPM board's PLD.
	The PLD is completely read and the whole content is enclosed in this command. The command is usually sent as a response to a PLD READ command.

DATA	Data

The content is transmitted in the same format as the .isp files generated by the PLD development tools. If only a single byte is transmitted, this will be an error code.

Code	Meaning
21h	No RPM board installed

QUERY GAS VALUES

Value	11h
ID	HGACMD_QUERYGASVALUES
HGA	PC_C_GET_DATA
Direction	PC → HGA
Implementation	Country
Revision	1
Description	This command requests the actual gas values.
	The HGA responds to this command with a TELL GAS VALUES command.

QUERY	Select

The *Select* parameter contains a bit for every (gas) channel which can be delivered by the analyzer. The bit must be set for every channel that should be reported in the coresponding answer command.

Bit	Channel	Value	Mask
0	CO	0001h	0000 0000 0000 0001
1	HC	0002h	0000 0000 0000 0010
2	CO_2	0004h	0000 0000 0000 0100
3	O_2	0008h	0000 0000 0000 1000
4	NO	0010h	0000 0000 0001 0000
5	mini status	0020h	0000 0000 0010 0000
6	lambda	0040h	0000 0000 0100 0000
7	oil temperature	0080h	0000 0000 1000 0000
8	engine speed	0100h	0000 0001 0000 0000

mini status is a status word generated by the AMB and TGM.

TELL GAS VALUES

Value	11h
ID	HGACMD_TELLGASVALUES
HGA	PC_C_GET_DATA
Direction	HGA $\rightarrow$ PC
Implementation	Country
Revision	1
Description	This command reports the measured values. This command is typically sent as a response to a QUERY GAS VALUES command and contains all channels requested in that command.

TELL	Select	Validy	Channels

The *Select* parameter contains a bit for every (gas) channel which is contained in the command. The *Validy* parameter contains an error flag for each channel. The flag is set for an invalid gas value and is undefined for a channel which is not contained in the command. The *Select* and *Validy* bits are arranged as denoted in the QUERY GAS VALUES command.

The values are reported in the order given below, each as a 16bit signed integer . Engine speed is a 16bit unsigned integer, HC value is 32bit signed integer. The value is omitted for each channel which is not selected.

Channel	Format
CO	[%vol] * 100
HC	[ppm vol]
CO_2	[%vol] * 100
O_2	[%vol] * 100
NO	[ppm vol]
mini status	*bitmap*
lambda	[-] * 1000
oil temperature	[°C]
engine speed	[min^{-1}]

Mini status is a status word generated by the AMB and TGM. The meaning of the status bits is denoted below (according to specification from Sensors Inc.).

Bit	Meaning
0	low flow detected
1	(unused)
2	(unused)
3	data may not be accurate
4	zero recommended
5	high HC range (HC > 2000ppm hexane)
6	condensation warning
7	warm up in progress
8	HC out of range (-13 < HC_{hexane} < 2000)
9	CO out of range (-0.07 < CO < 10.00)
10	CO_2 out of range (-0.40 < CO_2 < 20.00)
11	O_2 out of range (-0.11 < O_2 < 21.70)
12	NO out of range (-32 < NO < 4000)
13	(reserved)
14	(reserved)
15	bench internal warning

QUERY ANALYZER STATUS

Value	12h
ID	HGACMD_QUERYANALYZERSTATUS
HGA	PC_C_GET_STATUS_HGA
Direction	PC → HGA
Implementation	Country
Revision	1
Description	This command requests information on analyzer status.
	The HGA responds to this command with a TELL ANALYZER STATUS command.

QUERY

TELL ANALYZER STATUS

Value	12h
ID	HGACMD_TELLANALYZERSTATUS
HGA	PC_C_GET_STATUS_HGA
Direction	HGA → PC
Implementation	Country
Revision	1
Description	This command contains information on analyzer status.
	This command is typically sent as a response to a QUERY ANALYZER STATUS command.

TELL	Status #1	Status #2	SysError

Status	Bit	Meaning
#1	0	System error, see SysError parameter for details
#1	1	Condensation warning
#1	2	Warning on calibration interval
#1	3	Calibration interval (CO, CO2, HC) has expired
#1	4	Calibration interval (NO) has expired
#1	5	NO transducer exhausted
#1	6	O_2 transducer weak
#1	7	O_2 transducer exhausted
#1	8	HC residue > 20ppm
#1	9	Leak check necessary
#1	10	Zero adjust needed
#1	11	Automatic zero adjust allowed
#1	12	Zero adjust in progress
#1	13	Warm up in progress
#1	14	Process pending (measurement, leak check, zero adjust)
#1	15	Automatic purge allowed
#2	0	Gas pump active
#2	1	Condensate pump active
#2	2	Valve (set for ambient air)
#2	3	Fan active
#2	4	LCD backlight active
#2	5	Keyboard self test failed
#2	6	Condensation sensor voltage out of range
#2	7	Condensation detection LED voltage out of range
#2	8	Supply voltage (5V) out of range
#2	9	Supply voltage (+12V) out of range
#2	10	Supply voltage (-12V) out of range
#2	11	CPU temperature out of range
#2	12	Ambient temperature out of range
#2	13	bench temperature sensor error
#2	14	CPU pressure transducer failure
#2	15	bench pressure transducer error

If *Status #1* bit 0 is set, the two status words are followed by the *SysError* parameter, which contains the system error code. Otherwise this byte is omitted.

Code	Meaning
02h	Bench communication: Command mismatch
03h	Bench communication: Wrong command mode
04h	Bench communication: Checksum error
07h	Bench communication: Transmit timeout
08h	Bench communication: Receive timeout
09h	Bench communication: NAK received
0Bh	Bench communication: Busy state timeout
0Ch	General error
13h	Condensation error (condensation warning for > 1 minute)
15h	Flow error at Gas In
16h	Flow error at ambient air inlet
17h	Flow error at calibration gas inlet
18h	Flow error at Gas Out
20h	Bench error: Condensation
21h	Bench error: General error
22h	Bench error: Beam strength (pollution)
23h	Message "Renew Filter" is displayed (for 2-stroke kit)

SET ZERO ENABLE

Value	13h
ID	HGACMD_SETZEROENABLE
HGA	PC_C_SET_AUTO_ZERO
Direction	PC → HGA
Implementation	Country
Revision	1
Description	This command enables or disables the execution of zero adjustment.
	The HGA responds to this command with a ZERO ENABLE DONE command.

SET	Enable

The *Enable* parameter specifies whether zero adjustment shall be enabled or disabled. If zero adjustment is disabled, all kind of zero requests (Analyzer auto zero request, zero command from PC) are ignored.

Enable	Meaning
0	Disable zero adjust
1	Enable zero adjust

ZERO ENABLE DONE

Value	13h
ID	HGACMD_ZEROENABLEDONE
HGA	PC_C_SET_AUTO_ZERO
Direction	HGA $\rightarrow$ PC
Implementation	Country
Revision	1
Description	This command reports changes in the permission of zero adjustment execution.
	The command is usually sent as a response to a SET ZERO ENABLE command.

DONE	Status

Status	Meaning
00h	Zero adjust disabled
01h	Zero adjust enabled
02h	Zero in progress, no changes are done.
FFh	Wrong argument in SET ZERO ENABLE command, no changes are done.

CLEAR SYSERROR

Value	14h
ID	HGACMD_CLEARSYSERROR
HGA	PC_C_ACK_SYSERR
Direction	PC → HGA
Implementation	Country
Revision	1
Description	This command clears an analyzer's system error message which is reported in the TELL ANALYZER STATUS command.
	The HGA responds to this command with a SYSERROR CLEARED command.

CLEAR	Error

The *Error* parameter specifies the error which shall be deleted. Error codes are listed with the TELL ANALYZER STATUS command description.

The *Error* parameter is actually ignored by the HGA but may be evaluated in future versions.

SYSERROR CLEARED

Value	14h
ID	HGACMD_SYSERRORCLEARED
HGA	PC_C_ACK_SYSERR
Direction	HGA $\rightarrow$ PC
Implementation	Country
Revision	1
Description	This command confirms the deletion of a system error message. The command is usually sent as a response to a CLEAR SYSERROR command.

CLR'd	Error

The *Error* parameter holds the system error code which was cleared by the CLEAR SYSERROR command. If no error was set, *Error* is set to zero.

ZERO ADJUST

Value	15h
ID	HGACMD_ZEROADJUST
HGA	PC_C_DO_ZERO
Direction	PC → HGA
Implementation	Country
Revision	1
Description	This command requests a zero adjust. The HGA responds to this command with a ZERO STARTED command.

```
ZERO
```

ZERO STARTED

Value	15h
ID	HGACMD_ZEROSTARTED
HGA	PC_C_DO_ZERO
Direction	HGA $\rightarrow$ PC
Implementation	Country
Revision	1
Description	This command confirms the start of a zero adjustment. The command is usually sent as a response to a ZERO ADJUST command.

START	Status

Status	Meaning
00h	Zero adjust will be executed
01h	Zero adjust is blocked by a preceding SET ZERO ENABLE command
02h	Zero adjust cannot be executed due to a system error
03h	Zero already in progress

ENTER MEASUREMENT

Value	16h
ID	HGACMD_ENTERMEASUREMENT
HGA	PC_P_MEASUREMENT
Direction	PC → HGA
Implementation	Country
Revision	1
Description	This command enters or leaves the measurement process. The HGA responds to this command with a MEASUREMENT PROCESS command.

ENTER	Start

Start	Meaning
00h	Leave process handling
01h	Enter process handling

MEASUREMENT PROCESS

Value	16h
ID	HGACMD_MEASUREMENT
HGA	PC_P_MEASUREMENT
Direction	HGA $\rightarrow$ PC
Implementation	Country
Revision	1
Description	This command reports changes in the execution of the measurement process. The command is usually sent as a response to a ENTER MEASUREMENT command.

MEAS	Start	Proc

The *Start* parameter is copied from the preceding ENTER MEASUREMENT command and contains information whether the processs shall be entered or left.

The *Proc* parameter holds the process identifier of the running process after execution of the ENTER MEASUREMENT command. Process identifiers are equivalent to the command IDs of the command that enters the process (e.g. 16h for measurement process). Zero is used to indicate no pending process.

ENTER LEAK CHECK

Value	17h
ID	HGACMD_ENTERLEAKCHECK
HGA	PC_P_LEAK_CHECK
Direction	PC → HGA
Implementation	Country
Revision	1
Description	This command enters or leaves the leak check process. The HGA responds to this command with a LEAK CHECK PROCESS command.

ENTER	Mode

Mode	Meaning
00h	Leave process handling
01h	Enter process handling
02h	Read leak check process state

LEAK CHECK PROCESS

Value	17h
ID	HGACMD_LEAKCHECK
HGA	PC_P_LEAK_CHECK
Direction	HGA $\rightarrow$ PC
Implementation	Country
Revision	1
Description	This command reports changes in the execution of the leak check process. The command is usually sent as a response to a ENTER LEAK CHECK command.

LEAK	Mode	Proc	Status

The *Mode* parameter is copied from the preceding ENTER LEAK CHECK command and contains information whether the processs shall be entered, left or status read.

The *Proc* parameter holds the process identifier of the running process after execution of the ENTER LEAK CHECK command. Process identifiers are equivalent to the command IDs of the command that enters the process (e.g. 16h for measurement process). Zero is used to indicate no pending process.

The *Status* parameter reports the actual process state of the leak check process.There are three different ways to change from the actual leak check state in another state. The first method is to press a function key (KEY_ESC or KEY_OK) by the HGA. The second method is initiated through the SET FUNCTION KEYS command sending by the PC. This command permits the user to set the function keys by program. In some cases fhe change in another state goes automatically. The meaning of the process states is denoted below.

State Machine Leak Check

Code	State	Meaning	Leave State	Next State
01h	S_ENTRY	waiting of start or abort through user action	KEY_OK → KEY_ESC →	S_MAKE_PRESSURE if inlet free → leave process else → S_WAIT_INLET_FREE
02h	S_MAKE_PRESSURE	the pump produce low presssure	KEY_ESC → automatic →	S_ABORT if enough pressure → S_MAKE_MORE_PR not enough pressure → S_FAILURE
03h	S_MAKE_MORE_PR	the pump produce more low pressure	KEY_ESC → automatic →	S_ABORT S_QUIETING
04h	S_QUIETING	waiting 5 seconds for quieting	KEY_ESC → automatic →	S_ABORT if enough pressure → S_MEASURE not enough pressure → S_FAILURE
05h	S_MEASURE	calculate pressure difference	KEY_ESC → TEST OK → TEST NOT OK →	S_ABORT S_SUCCESS S_FAILURE
06h	S_SUCCESS	display leak check result	automatic →	if inlet free → leave process else → S_WAIT_INLET_FREE
07h	S_FAILURE	display leak check result	automatic →	S_ENTRY
08h	S_ABORT	display leak check abort	automatic →	S_ENTRY
09h	S_WAIT_INLET_FREE	wait until inlet is free	KEY_ESC or inlet is free →	leave process

SET FUNCTION KEYS

Value	18h
ID	HGACMD_SETFUNCTIONKEYS
HGA	PC_C_SET_KEY
Direction	PC → HGA
Implementation	Country
Revision	1
Description	This command permits the user to set the HGA function keys by program. The HGA responds to this command with a FUNCTION KEYS DONE command.

SET	Key

The *Key* parameter specifies the function keys from the HGA device. This keys can be set by pressing through the user directly at the HGA or with this command by software. The function keys have the following function.

Key	Meaning
0	NO_KEY
1	KEY_ESC
2	KEY_UP
4	KEY_DOWN
8	KEY_OK

FUNCTION KEYS DONE

Value	18h
ID	HGACMD_FUNCTIONKEYSDONE
HGA	PC_C_SET_KEY
Direction	HGA → PC
Implementation	Country
Revision	1
Description	This command reports the function key setting by software before.
	The command is usually sent as a response to a SET FUNCTION KEYS command.

DONE	Key

The *Key* parameter specifies the function key which was set with the SET FUNKTION KEYS command before.

ENTER HC RESIDUE TEST

Value   19h
ID   HGACMD_ENTERHCRESIDUETEST
HGA   PC_P_HC_RESIDUE_TEST
Direction   PC → HGA
Implementation   Country
Revision   1
Description   This command enters or leaves the HC residue test process. The HGA responds to this command with a HC RESIDUE TEST PROCESS command.

ENTER	Mode

Mode	Meaning
00h	Leave process handling
01h	Enter process handling
02h	Read HC residue test process state

HC RESIDUE TEST PROCESS

Value	19h
ID	HGACMD_HCRESIDUETESTPROCESS
HGA	PC_P_HC_RESIDUE_TEST
Direction	HGA → PC
Implementation	Country
Revision	1
Description	This command reports changes in the execution of the HC residue test process. The command is usually sent as a response to a ENTER HC RESIDUE TEST command.

HCRES	Mode	Proc	Status	HC-Probe	HC-Ambient

The *Mode* parameter is copied from the preceding ENTER HC RESIDUE TEST command and contains information whether the process shall be entered, left or status read.

The *Proc* parameter holds the process identifier of the running process after execution of the ENTER HC RESIDUE TEST command. Process identifiers are equivalent to the command IDs of the command that enters the process (e.g. 16h for measurement process). Zero is used to indicate no pending process.

The *Status* parameter reports the actual process state of the HC residue test process.There are three different ways to change from the actual test state in another state. The first method is to press a function key (KEY_ESC or KEY_OK) by the HGA. The second method is initiated through the SET FUNCTION KEYS command sending by the PC. This command permits the user to set the function keys by program. In some cases the change in another state goes automatically. The meaning of the process states are denoted below.

The *HC-Probe* parameter reports the measured HC residue value from the exhaust gas probe. The 16bit signed integer Value will be set to FFFFh at state 01h of the state machine and will be set to the measured HC residue value at the end of state 05h.

The *HC-Ambient* parameter reports the measured HC residue value from the ambient air inlet. The 16bit signed integer Value will be set to FFFFh at state 01h of the state machine and will be set to the measured HC residue value at the end of state 06h.

State Machine HC Residue Test

Code	State	Meaning	Leave State	Next State
00h	S_HC_RES_INACTIVE	the process was stopped or not started	automatic →	leave process
01h	S_HC_RES_ACTIVE	process started	KEY_ESC → automatic →	S_HC_RES_INACTIVE if warmup bench activ → S_HC_RES_ WAIT_WARMUP else → S_HC_RES_ENTRY
02h	S_HC_RES_ WAIT_WARMUP	waiting until warmup bench is active or abort	KEY_ESC → automatic →	S_HC_RES_INACTIVE S_HC_RES_ENTRY
03h	S_HC_RES_ENTRY	display test conditions; waiting of start test or abort test through the user	KEY_ESC → KEY_OK →	S_HC_RES_INACTIVE S_HC_RES_PURGE
04h	S_HC_RES_PURGE	purge the gas probe with ambient air for 10 seconds	KEY_ESC → automatic →	S_HC_RES_INACTIVE S_HC_RES_PROBE
05h	S_HC_RES_PROBE	measure the HC residue value in the exhaust gas probe	KEY_ESC → automatic →	S_HC_RES_INACTIVE if HC residue probe <= 20 ppm Hex. → S_HC_RES_SUCCESS else → S_HC_RES_AMBIENT
06h	S_HC_RES_AMBIENT	measure the HC residue value from the ambient air	KEY_ESC → automatic →	S_HC_RES_INACTIVE if (HC residue probe) – (HC residue amb. air) < 20 ppm Hex. → S_HC_RES_SUCCESS else → S_HC_RES_FAILURE
07h	S_HC_RES_FAILURE	display HC residue test result	KEY_ESC or KEY_OK →	S_HC_RES_INACTIVE
08h	S_HC_RES_SUCCESS	display HC residue test result for 3 seconds	automatic →	S_HC_RES_INACTIVE

DATE TIME

Value	1Ah
ID	HGACMD_DATETIME
HGA	PC_C_DATE_TIME
Direction	PC → HGA
Implementation	Country
Revision	1
Description	This command requests or sets the actual date and time from the HGA.
	The HGA responds to this command with a TELL DATE TIME command.

DATE/TIME	Mode	D/T-Format

The *Mode* parameter specifies whether date and time shall be read or write from or to the HGA .

The *D/T-Format* describes the date time format which is used by setting date and time from HGA in write mode. The value for seconds will be ignored and is always set to zero.

Mode	Action	D/T-Format	Data Type	Valid Values
00h	read date time	-	-	-
01h	write date time	Year	16bit unsigned integer	1999 .. 2080
		Month	byte	1 .. 12
		Day	byte	1 .. 31
		Hour	byte	0 .. 23
		Minute	byte	0 .. 59
		Second	byte	0 .. 59

TELL DATE TIME

Value	1Ah
ID	HGACMD_TELLDATETIME
HGA	PC_C_DATE_TIME
Direction	HGA → PC
Implementation	Country
Revision	1
Description	This command reports the actual date and time from the HGA. This command is typically sent as a response to a DATE TIME command.

TELL	Mode	D/T-Format	Error

The *Mode* parameter is copied from the preceding DATE TIME command and contains information whether the date and time shall be read or write from or to the HGA.

Mode	Action
00h	read date time
01h	write date time

The *D/T-Format* describes the date/time format for the HGA.

D/T-Format	Data Type	Valid Values
Year	16 bit unsigned integer	1999 .. 2080
Month	byte	1 .. 12
Day	byte	1 .. 31
Hour	byte	0 .. 23
Minute	byte	0 .. 59
Second	byte	0 .. 59

The *Error* parameter spezifies the error which has been happend by the execution of the preceding DATE TIME command.

Error	Meaning
00h	no error
01h	error wrong date
02h	error wrong time
03h	error wrong date and time

ENGINE DATA

Value	1Bh
ID	HGACMD_ENGINEDATA
HGA	PC_C_ENGNE_DATA
Direction	PC $\rightarrow$ HGA
Implementation	Country
Revision	1
Description	This command requests or sets the engine data from the HGA.
	The HGA responds to this command with a TELL ENGINE DATA command.

ENGINE	Mode	Engine-Data-Format

The *Mode* parameter specifies whether the engine data shall be read or write from or to the HGA .

The *Engine-Data-Format* describes the engine data format which is used by setting engine data from HGA in write mode.

Mode	Action	Engine-Data-Format	Data Type	Valid Values
00h	read engine data	-	-	-
01h	write engine data	Fuel	byte	01h $\rightarrow$ Hexane
				02h $\rightarrow$ Propane
				03h $\rightarrow$ Methane
		Engine Type	byte	00h $\rightarrow$ Four-stroke
				01h $\rightarrow$ Two-stroke
				02h $\rightarrow$ DIS engine
				03h $\rightarrow$ Wankel engine
		Cylinders	byte	1 .. 255

TELL ENGINE DATA

Value	1Bh
ID	HGACMD_TELLENGINEDATA
HGA	PC_C_ENGINE_DATA
Direction	HGA → PC
Implementation	Country
Revision	1
Description	This command reports the actual engine adjustment from the HGA. This command is typically sent as a response to a ENGINE DATA command.

TELL	Mode	Engine-Data-Format	Error

The *Mode* parameter is copied from the preceding ENGINE DATA command and contains information whether the engine parameters shall be read or write from or to the HGA.

Mode	Action
00h	read engine data
01h	write engine data

The *Engine-Data-Format* describes the engine data format for the HGA.

Engine-Data-Format	Data Type	Valid Values
Fuel	byte	01h → Hexane
		02h → Propane
		03h → Methane
Engine Type	byte	00h → Four-stroke
		01h → Two-stroke
		02h → DIS engine
		03h → Wankel engine
Cylinders	byte	1 .. 255

The *Error* parameter spezifies the error which has been happend by the execution of the preceding ENGINE DATA command.

Error	Meaning
00h	no error
01h	error fuel
02h	error engine type

QUERY TESTER TYPE

Value	1Ch
ID	HGACMD_QUERYTESTERTYPE
HGA	PC_C_GET_TESTER_TYPE
Direction	PC → HGA
Implementation	Country
Revision	1
Description	This command requests information about the HGA device type.
	The HGA responds to this command with a TESTER TYPE DATA command.

QUERY

TESTER TYPE DATA

Value	1Ch
ID	HGACMD_TESTERTYPEDATA
HGA	PC_C_GET_TESTER_TYPE
Direction	HGA → PC
Implementation	Country
Revision	1
Description	This command contains information about the HGA device type.
	This command is typically sent as a response to a QUERY TESTER TYPE command..

DATA	Type	Status	Cal-Data

Type	Meaning
00h	Two-Gas-Analyser (HC,CO) or
	Three-Gas-Analyser (HC,CO,CO2)
01h	Four-Gas-Analyser (HC,CO,CO2,O2)
02h	Five-Gas-Analyser (HC,CO,CO2,O2,NO)

Status Bit	Meaning
0	if the O2 transducer is exhausted
	0 → the measured gas values are not blocked
	1 → all measured gas values are blocked
1	if the calibration interval is over
	0 → the measured gas values are not blocked
	1 → all measured gas values are blocked
2	if the last leak check was wrong
	or the last leak check was done 24 hours before
	0 → the measured gas values are not blocked
	1 → all measured gas values are blocked
3..7	for future use

Cal-Data	Data Type	Meaning
CAL-INT	16bit unsigned integer	Gas calibration interval in days for the IR-Analyser
CAL-WARN	byte	Warning interval in days before the gas calibration interval is over
CAL-NO-INT	16bit unsigned integer	Gas calibration interval in days for the NO transducer

SET TESTER TYPE

Value	1Dh
ID	HGACMD_SETTESTERTYPE
HGA	PC_C_SET_TESTER_TYPE
Direction	PC $\rightarrow$ HGA
Implementation	Country
Revision	1
Description	This command sets the HGA device type.
	The HGA responds to this command with a TESTER TYPE DONE command.

SET	Type

Type	Meaning
00h	Two-Gas-Analyser (HC,CO) or
	Three-Gas-Analyser (HC,CO,CO2)
01h	Four-Gas-Analyser (HC,CO,CO2,O2)
02h	Five-Gas-Analyser (HC,CO,CO2,O2,NO)

TESTER TYPE DONE

Value	1Dh
ID	HGACMD_TESTERTYPEDONE
HGA	PC_C_SET_TESTER_TYPE
Direction	HGA $\rightarrow$ PC
Implementation	Country
Revision	1
Description	This command confirms the HGA device type setting.
	The command is usually sent as a response to a SET TESTER TYPE command.

DONE	Type	Error

Type	Meaning
00h	Two-Gas-Analyser (HC,CO) or
	Three-Gas-Analyser (HC,CO,CO2)
01h	Four-Gas-Analyser (HC,CO,CO2,O2)
02h	Five-Gas-Analyser (HC,CO,CO2,O2,NO)

Error	Meaning
00h	no error $\rightarrow$ tester type set
01h	error wrong tester type $\rightarrow$ tester type not set

SET AUTO PURGE

Value	1Eh
ID	HGACMD_SETAUTOPURGE
HGA	PC_C_SET_AUTO_PURGE
Direction	PC → HGA
Implementation	Country
Revision	1
Description	This command sets the auto purge mode for the gas flow system in the HGA. The HGA responds to this command with a AUTO PURGE DONE command.

SET	Purge

The *Purge* parameter specifies whether the gas flow system shall be purged automatically or not. You can read the actual adjustment of this mode with the QUERY ANALYSER STATUS command.

An automatic purge of the gas flow system will be initiated by the following conditions:

- The user leaves the measurement menue manually or by software with the ENTER MEASUREMENT PROCESS command.
- After an executed analyser gas calibration.
- After an executed NO transducer calibration.
- After an executed leak check (but only the gas pump was ON before the leak check).
- During standby.

During an automatic purge of the gas flow system the gas pump is turned ON for 30 seconds and the valve is switched so that fresh air can be sucked in through the AMB. AIR inlet.

Purge	Meaning
00h	Auto purge disabled
01h	Auto purge enabled

AUTO PURGE DONE

Value	1Eh
ID	HGACMD_AUTOPURGEDONE
HGA	PC_C_SET_AUTO_PURGE
Direction	HGA → PC
Implementation	Country
Revision	1
Description	This command confirms the setting of the auto purge mode.
	The command is usually sent as a response to a SET AUTO PURGE command.

DONE	Purge	Status

The *Purge* parameter is copied from the preceding SET AUTO PURGE command and contains information whether the auto purge mode shall be enabled or disabled.

The *Status* parameter confirmes the setting of the purge mode.

Status	Meaning
00h	Auto purge disabled
01h	Auto purge enabled
FFh	Wrong argument in the SET AUTO PURGE command, no changes are done.

PUMP GAS VALUES

Value	1Fh
ID	HGACMD_PUMPGASVALUES
HGA	PC_C_PUMP_GAS
Direction	PC → HGA
Implementation	Country
Revision	1
Description	This command requests or sets the data for the gas pump in the HGA.
	The HGA responds to this command with a PUMP GAS DATA command.

PUMP	Mode	Pump-Data-Format

The *Mode* parameter specifies whether the gas pump data shall be read or write from or to the HGA .

The *Pump-Data-Format* describes the pump data format which is used by setting gas pump data from HGA in write mode.

Mode	Action	Pump-Data-Format	Data Type	Valid Values
00h	read gas pump data	-	-	-
01h	write gas pump data	state	byte	00h → pump turned OFF 01h → pump turned ON
02h	write gas pump data	power actual in %	byte	Pmin < power < Pmax look at PUMP GAS DATA command

Note:

Before you turn the pump ON you must disable the auto purge mode, because the enabled auto purge mode turns the pump automatically OFF. For more information look at the SET AUTO PURGE command.

PUMP GAS DATA

Value	1Fh
ID	HGACMD_PUMPGASDATA
HGA	PC_C_PUMP_GAS
Direction	HGA → PC
Implementation	Country
Revision	1
Description	This command reports the adjustment for the gas pump in the HGA.
	This command is typically sent as a response to a PUMP GAS VALUES command.

PUMP	Mode	Pump-Data-Format	Error

The *Mode* parameter is copied from the preceding PUMP GAS VALUES command and contains information whether the adjustments shall be read or write.

If the transfered *Mode* argument is unknown, the Error byte will be set to 01h and only this two bytes (Mode and Error) shall be transmit.

Mode	Action	Pump-Data-Format	Data Type	Valid Values	Error
00h	read	state	byte	00h → pump turned OFF 01h → pump turned ON	01h → wrong mode argument
		power actual in % Pmin in % Pmax in % Pdef in %	byte byte byte byte	Pmin < power < Pmax 0 .. 100 0 .. 100 0 .. 100	
01h	write	state	byte	00h → pump turned OFF 01h → pump turned ON	00h → no error 01h → wrong mode argument 02h → wrong state
02h	write	power actual in %	byte	Pmin < power < Pmax	00h → no error 01h → wrong mode argument 02h → wrong power

PUMP CONDENSAT VALUES

Value   20h

ID   HGACMD_PUMPCONDENSATVALUES

HGA   PC_C_PUMP_CONDENSAT

Direction   PC → HGA

Implementation   Country

Revision   1

Description   This command requests or sets the data for the condensation pump in the HGA.

                  The HGA responds to this command with a PUMP CONDENSAT DATA command.

PUMP	Mode	Pump-Data-Format

The *Mode* parameter specifies whether the condensation pump data shall be read or write from or to the HGA .

The *Pump-Data-Format* describes the pump data format which is used by setting condensation pump data from HGA in write mode.

Mode	Action	Pump-Data-Format	Data Type	Valid Values
00h	read pump data	-	-	-
01h	write pump data	state	byte	00h → pump turned OFF 01h → pump turned ON
02h	write pump data	power actual in %	byte	P_{min} < power < P_{max} look at PUMP CONDENSAT DATA command

Note:

Before you turn the pump ON you must disable the auto purge mode, because the enabled auto purge mode turns the pump automatically OFF. For more information look at the SET AUTO PURGE command.

PUMP CONDENSAT DATA

Value	20h
ID	HGACMD_PUMPCONDENSATDATA
HGA	PC_C_PUMP_CONDENSAT
Direction	HGA → PC
Implementation	Country
Revision	1
Description	This command reports the adjustment for the condensation pump in the HGA.
	This command is typically sent as a response to a PUMP CONDENSAT VALUES command.

PUMP	Mode	Pump-Data-Format	Error

The *Mode* parameter is copied from the preceding PUMP CONDENSAT VALUES command and contains information whether the adjustments shall be read or write.

If the transfered *Mode* argument is unknown, the Error byte will be set to 01h and only this two bytes (Mode and Error) shall be transmit.

Mode	Action	Pump-Data-Format	Data Type	Valid Values	Error
00h	read	state	byte	00h → pump turned OFF 01h → pump turned ON	01h → wrong mode argument
		power actual in %	byte	Pmin < power < Pmax	
		Pmin in %	byte	0 .. 100	
		Pmax in %	byte	0 .. 100	
		Pdef in %	byte	0 .. 100	
01h	write	state	byte	00h → pump turned OFF 01h → pump turned ON	00h → no error 01h → wrong mode argument 02h → wrong state
02h	write	power actual in %	byte	Pmin < power < Pmax	00h → no error 01h → wrong mode argument 02h → wrong power

VALVE 1 VALUES

Value	21h
ID	HGACMD_VALVE1VALUES
HGA	PC_C_VALVE_1
Direction	PC → HGA
Implementation	Country
Revision	1
Description	This command requests or sets the data for the main valve in the HGA.
	The HGA responds to this command with a VALVE 1 DATA command.

VALVE	Mode	Valve-Data-Format

The *Mode* parameter specifies whether the valve data shall be read or write from or to the HGA .

The *Valve-Data-Format* describes the valve data format which is used by setting valve data from HGA in write mode.

Mode	Action	Valve-Data-Format	Data Type	Valid Values
00h	read valve data	-	-	-
01h	write valve data	position	byte	00h → position gas measurement 01h → position fresh air
02h	write valve data	power actual in %	byte	Pmin < power < Pmax look at VALVE 1 DATA command

Note:

An condensation error causes the valve automatically to switch in position fresh air, because condensation can demage the microbench.

Before you switch the valve in position fresh air you must disable the auto purge mode, because the enabled auto purge mode switches the valve automatically in positon gas measurement. For more information look at the SET AUTO PURGE command.

VALVE 1 DATA

Value	21h
ID	HGACMD_VALVE1DATA
HGA	PC_C_VALVE_1
Direction	HGA → PC
Implementation	Country
Revision	1
Description	This command reports the adjustment for the main valve in the HGA.
	This command is typically sent as a response to a VALVE 1 VALUES command.

VALVE	Mode	Valve-Data-Format	Error

The *Mode* parameter is copied from the preceding VALVE 1 VALUES command and contains information whether the adjustments shall be read or write.

If the transfered *Mode* argument is unknown, the Error byte will be set to 01h and only this two bytes (Mode and Error) shall be transmit.

Mode	Action	Valve-Data-Format	Data Type	Valid Values	Error
00h	read	position	byte	00h → position gas measurement 01h → position fresh air	01h → wrong mode argument
		power actual in %	byte	Pmin < power < Pmax	
		Pmin in %	byte	0 .. 100	
		Pmax in %	byte	0 .. 100	
		Pdef in %	byte	0 .. 100	
01h	write	position	byte	00h → position gas measurement 01h → position fresh air	00h → no error 01h → wrong mode argument 02h → wrong pos
02h	write	power actual in %	byte	Pmin < power < Pmax	00h → no error 01h → wrong mode argument 02h → wrong power

VALVE 2 VALUES

Value	22h
ID	HGACMD_VALVE2VALUES
HGA	PC_C_VALVE_2
Direction	PC → HGA
Implementation	Country
Revision	1
Description	This command requests or sets the data for the second valve (prescription in some countries such as Netherlands) in the HGA.
	The HGA responds to this command with a VALVE 2 DATA command.

VALVE	Mode	Valve-Data-Format

The *Mode* parameter specifies whether the valve data shall be read or write from or to the HGA .

The *Valve-Data-Format* describes the valve data format which is used by setting valve data from HGA in write mode.

Mode	Action	Valve-Data-Format	Data Type	Valid Values
00h	read valve data	-	-	-
01h	write valve data	position	byte	00h → position fresh air inlet 01h → position cal. gas inlet
02h	write valve data	power actual in %	byte	Pmin < power < Pmax look at VALVE 2 DATA command

VALVE 2 DATA

Value	22h
ID	HGACMD_VALVE2DATA
HGA	PC_C_VALVE_2
Direction	HGA → PC
Implementation	Country
Revision	1
Description	This command reports the adjustment for the second valve (prescription in some countries such as Netherlands) in the HGA.
	This command is typically sent as a response to a VALVE 2 VALUES command.

VALVE	Mode	Valve-Data-Format	Error

The *Mode* parameter is copied from the preceding VALVE 2 VALUES command and contains information whether the adjustments shall be read or write.

If the transfered *Mode* argument is unknown, the Error byte will be set to 01h and only this two bytes (Mode and Error) shall be transmit.

Mode	Action	Valve-Data-Format	Data Type	Valid Values	Error
00h	read	position	byte	00h → position fresh air inlet 01h → position cal. gas inlet	01h → wrong mode argument
		power actual in %	byte	Pmin < power < Pmax	
		Pmin in %	byte	0 .. 100	
		Pmax in %	byte	0 .. 100	
		Pdef in %	byte	0 .. 100	
01h	write	position	byte	00h → position fresh air inlet 01h → position cal gas inlet	00h → no error 01h → wrong mode argument 02h → wrong pos.
02h	write	power actual in %	byte	Pmin < power < Pmax	00h → no error 01h → wrong mode argument 02h → wrong power

SET AUTO FAN

Value	23h
ID	HGACMD_SETAUTOFAN
HGA	PC_C_SET_AUTO_FAN
Direction	PC $\rightarrow$ HGA
Implementation	Country
Revision	1
Description	This command sets the auto fan mode in the HGA. The HGA responds to this command with a AUTO FAN DONE command.

SET	Fan

The *Fan* parameter specifies whether the fan shall be controlled automatically or not. You can't read the actual adjustment of this mode with the QUERY ANALYSER STATUS command.

The automatic fan mode controls the fan under the following conditions:

- Temperature > 30 °C turns the fan ON.
- Temperature < 25 °C turns the fan OFF.

Fan	Meaning
00h	Automatic fan disabled
01h	Automatic fan enabled

Note:

After power on the auto fan mode is enabled.

AUTO FAN DONE

Value	23h
ID	HGACMD_AUTOFANDONE
HGA	PC_C_SET_AUTO_FAN
Direction	HGA $\rightarrow$ PC
Implementation	Country
Revision	1
Description	This command confirms the setting of the auto fan mode.
	The command is usually sent as a response to a SET AUTO FAN command.

DONE	Status

The *Status* parameter confirmes the setting of the auto fan mode.

Status	Meaning
00h	Automatic fan disabled
01h	Automatic fan enabled

FAN VALUES

Value	24h
ID	HGACMD_FANVALUES
HGA	PC_C_FAN
Direction	PC → HGA
Implementation	Country
Revision	1
Description	This command requests or sets the data for the fan in the HGA.
	The HGA responds to this command with a FAN DATA command.

FAN	Mode	Fan-Data-Format

The *Mode* parameter specifies whether the fan data shall be read or write from or to the HGA.

The *Fan-Data-Format* describes the fan data format which is used by setting fan data from HGA in write mode.

Mode	Action	Fan-Data-Format	Data Type	Valid Values
00h	read fan data	-	-	-
01h	write fan data	state	byte	00h → fan turned OFF
				01h → fan turned ON
02h	write fan data	power actual in %	byte	Pmin < power < Pmax look at FAN DATA command

Note:

Before you turn the fan ON or OFF you must disable the auto fan mode, because the enabled auto fan mode turns the fan automatically (dependent on temperature) ON or OFF. For more information look at the SET AUTO FAN command.

FAN DATA

Value   24h

ID   HGACMD_FANDATA

HGA   PC_C_FAN

Direction   HGA → PC

Implementation   Country

Revision   1

Description   This command reports the adjustment for the fan in the HGA.

                   This command is typically sent as a response to a FAN VALUES command.

FAN	Mode	Fan-Data-Format	Error

The *Mode* parameter is copied from the preceding FAN VALUES command and contains information whether the adjustments shall be read or write.

If the transfered *Mode* argument is unknown, the Error byte will be set to 01h and only this two bytes (Mode and Error) shall be transmit.

Mode	Action	Fan-Data-Format	Data Type	Valid Values	Error
00h	read	state	byte	00h → fan turned OFF 01h → fan turned ON	01h → wrong mode argument
		power actual in %	byte	Pmin < power < Pmax	
		Pmin in %	byte	0 .. 100	
		Pmax in %	byte	0 .. 100	
		Pdef in %	byte	0 .. 100	
01h	write	state	byte	00h → fan turned OFF 01h → fan turned ON	00h → no error 01h → wrong mode argument 02h → wrong state
02h	write	power actual in %	byte	Pmin < power < Pmax	00h → no error 01h → wrong mode argument 02h → wrong power

LCD VALUES

Value	25h
ID	HGACMD_LCDVALUES
HGA	PC_C_LCD
Direction	PC → HGA
Implementation	Country
Revision	1
Description	This command requests or sets the data for the LC Display in the HGA.
	The HGA responds to this command with a LCD DATA command.

LCD	Mode	LCD-Data-Format

The *Mode* parameter specifies whether the LC Display data shall be read or write from or to the HGA .

The *LCD-Data-Format* describes the LCD data format which is used by setting LCD data from HGA in write mode.

Mode	Action	LCD-Data-Format	Data Type	Valid Values
00h	read LCD data	-	-	-
01h	write LCD data	state	byte	00h → LCD lighting OFF
				01h → LCD lighting ON
02h	write LCD data	LCD contrast in %	byte	Cmin < contrast < Cmax
				look at LCD DATA
				command

LCD DATA

Value	25h
ID	HGACMD_LCDDATA
HGA	PC_C_LCD
Direction	HGA → PC
Implementation	Country
Revision	1
Description	This command reports the adjustment for the LC Display in the HGA.
	This command is typically sent as a response to a LCD VALUES command.

LCD	Mode	LCD-Data-Format	Error

The *Mode* parameter is copied from the preceding LCD VALUES command and contains information whether the adjustments shall be read or write.

If the transfered *Mode* argument is unknown, the Error byte will be set to 01h and only this two bytes (Mode and Error) shall be transmit.

Mode	Action	LCD-Data-Format	Data Type	Valid Values	Error
00h	read	state	byte	00h → LCD lighting OFF 01h → LCD lighting ON	01h → wrong mode argument
		LCD contrast in % Cmin in % Cmax in % Cdef in %	byte byte byte byte	Cmin < contrast < Cmax 0 .. 100 0 .. 100 0 .. 100	
01h	write	state	byte	00h → LCD contrast OFF 01h → LCD contrast ON	00h → no error 01h → wrong mode argument 02h → wrong state
02h	write	LCD contrast in %	byte	Cmin < contrast < Cmax	00h → no error 01h → wrong mode argument 02h → wrong contr.

SET LED

Value	26h
ID	HGACMD_SETLED
HGA	PC_C_LED
Direction	PC → HGA
Implementation	Country
Revision	1
Description	This command requests or sets the status luminescence diodes (four LED's) in the HGA.
	The HGA responds to this command with a LED DONE command.

LED	Mode	Select

The *Mode* parameter specifies whether the LED's shall be read or write from or to the HGA .

The *Select* parameter contains a bit for every LED which is contained in the command in write mode. The bit must be set for every LED which should be set by the HGA.

Mode	Action	Data Type	Bit Mask
00h	read LED data	-	-
01h	write LED data	byte	xxxx0001 → LED 1
			xxxx0010 → LED 2
			xxxx0100 → LED 3
			xxxx1000 → LED 4

Note:

The x bits in the Bit Mask are ignored.

LED DONE

Value	26h
ID	HGACMD_LEDDONE
HGA	PC_C_LED
Direction	HGA → PC
Implementation	Country
Revision	1
Description	This command reports the adjustment for the status luminescence diodes (four LED's) in the HGA.
	This command is typically sent as a response to a SET LED command.

LED	Mode	Bit Mask

The *Mode* parameter is copied from the preceding SET LED command and contains information whether the adjustments shall be read or write.

If the transfered *Mode* argument is unknown, the HGA sets this argument to 0h an transmits the actual LED settings.

The *Bit Mask* parameter contains a bit for every LED which is contained in the command. The coresponding bit is set to one for diode ON and zero for diode OFF.

Mode	Action
00h	read LED's data
01h	write LED's data

Bit Mask
xxxx0001 → LED 1
xxxx0010 → LED 2
xxxx0100 → LED 3
xxxx1000 → LED 4

Note:

The x bits in the Bit Mask are ignored.

LANGUAGE

Value	27h
ID	HGACMD_LANGUAGE
HGA	PC_C_LANGUAGE
Direction	PC → HGA
Implementation	Country
Revision	1
Description	This command requests or sets the language in the HGA 400.
	The HGA responds to this command with a TELL LANGUAGE DATA command.

LANGUAGE	Mode	Select

The *Mode* parameter specifies whether the Language data shall be read or write from or to the HGA

The *Select* parameter specifies which language should be used from hga to communicate with the user.

Mode	Action	Select	Valid Values
00h	read language data	-	-
01h	write language	language	0 .. number of languages-1

TELL LANGUAGE DATA

Value	27h
ID	HGACMD_TELLLANGUAGEDATA
HGA	PC_C_LANGUAGE
Direction	HGA → PC
Implementation	Country
Revision	1
Description	This command reports the language adjustment in the HGA 400.
	This command is typically sent as a response to a LANGUAGE command.

TELL	Mode	Language-Data	Error

The *Mode* parameter is copied from the preceding LANGUAGE command and contains information whether the language parameters shall be read or write from or to the HGA.

If the transfered *Mode* argument is unknown, the Error byte will be set to 01h and only this two bytes (Mode and Error) shall be transmit.

Mode	Action	Language-Data	Valid Values	Error

00h	read	language	0 .. number of languages-1
			
			a) multinational software
			  (Version 16/xx/xx)
			  0 → English
			  1 → German
			  2 → Hungarian
			  3 → Lithuanian
			  4 → Spanish
			  5 → new languages added
			b) for other software
			  (Version YY/xx/xx)
			  0 → YY
			  1 → English
			  2 → German
				01h →
				wrong mode argument

		number of languages	1 .. 15	
01h	write	language	0 .. number of languages-1	00h → no error 01h → wrong mode argument 02h → wrong language

Document revision

Date	Name	Changes
24.09.1998	MV	- First version
22.04.1999	MV	- TellRunMode: Parameter changed - QueryGasValues/TellGasValues added - QueryAnalyzerStatus/TellAnalyzerStatus added - SetZeroEnable/ZeroEnableDone added - ClearSysError/SysErrorCleared added - ZeroAdjust/ZeroStarted added - EnterMeasurement/MeasurementProcess added
10.05.1999	MV	- TellGasValues: HC value changed from 16bit to 32bit
29.06.1999	KW	- EnterLeakCheck/LeakCheckProcess added - SetFunctionKeys/FunctionKeysDone added - EnterHCResidueTest/HCResidueTestProcess added - DateTime/TellDateTime added - EngineData/TellEngineData added - QueryTesterType/TesterTypeData added - SetTesterType/TesterTypeDone added - SetAutoPurge/AutoPurgeDone added - PumpGasValues/PumpGasData added - PumpCondensatValues/PumpCondansatData added - Valve1Values/Valve1Data added - Valve2Values/Valve2Data added - SetAutoFan/AutoFanDone added - FanValues/FanData added - LCDValues/LCDData added - SetLED/LEDDone added - Language/TellLanguageData added