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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Optical amplifiers –
Part 6-1: Interfaces – Command set

Amplificateurs optiques –
Partie 6-1: Interfaces – Répertoire des commandes

IEC 61291-6-1:2008

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OPTICAL AMPLIFIERS –

Part 6-1: Interfaces – Command set

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The text of this standard is based on the following documents:

CDV	Report on voting
86C/803/CDV	86C/845/RVC

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 61291 series, published under the general title *Optical amplifiers* can be found on the IEC website.

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INTRODUCTION

Optical amplifiers are being developed and commercially deployed with an increasing degree of sophistication and functionality. Often, information is sent to the optical amplifier, or requested from it, in order to determine signal conditions, operating parameters, and to adjust the operational aspects of the optical amplifier. Currently, no International Standard exists in this area, yet the need for a common set of command statements to/from optical amplifiers has emerged.

This part of IEC 61291 proposes a set of command strings useful in controlling optical amplifiers. It is based on an existing set of commands widely used across the industry today. The standardization of this command set will result in broader market use of advanced designs of optical amplifiers, typically controlled by microprocessors. These advanced amplifier designs are needed for next generation optical networks, requiring adaptive provisioning of optical paths and intelligent configuration/reconfiguration for provision of telecommunications services in a dynamic environment.

This standard addresses the structure and content of the command set to control optical amplifiers. It does not cover the physical or hardware interface which is assumed to exist for communication of this command set to the optical amplifier. The specification of a physical interface will be the subject of a separate standard yet to be developed.

With the rapidly evolving technology, it is envisioned that this standard will be amended with additional commands and functionality as technology evolves, and will be updated on a periodic basis, incorporating all previous amendments and additions.

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OPTICAL AMPLIFIERS –

Part 6-1: Interfaces – Command set

1 Scope

This part of IEC 61291 describes the optical amplifier command set (OACS) for use in communicating with and controlling intelligent optical amplifiers. These amplifiers can receive and possibly respond to such commands by using resident firmware or may be optical amplifiers controlled by a microprocessor.

This standard addresses the structure and content of the command set to control optical amplifiers. It does not cover the physical or hardware interface, which is assumed to exist for communication of this command set to the optical amplifier. The specification of a physical interface will be the subject of a separate Part to be developed in the IEC 61291-6 series.

The command set described in this standard is intended to enable a user or host to retrieve the amplifier module's status and/or adjust its settings.

This standard lists all of the commands currently defined and supported within the OACS framework. The commands described cover a wide range of applications, and not all commands will be applicable to every amplifier. To determine the supported commands on an OACS compliant amplifier, please refer to the product specification supplied by the manufacturer.

All OACS compliant amplifiers support the full set of "universal" OACS commands. Other commands, usually specific to a design or implementation, may support some or all of the "optional" commands.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 8859-1: *Information technology – 8-bit single-byte coded graphic character sets – Part 1: Latin alphabet No. 1*

3 Abbreviations

The following abbreviations are used in this standard:

ASCII	American standard character for information interchange
DC	dispersion compensator
EDFA	erbium doped fibre amplifier
OACS	optical amplifier command set
TEC	thermo-electric cooler
VOA	variable optical attenuator

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4 General rules and concepts

4.1 Command set encoding language

All data sent to/from the module are encoded in 8-bit ASCII characters. Refer to ISO/IEC 8859-1.

4.2 Module initiated commands

The optical amplifier never sends an unsolicited response. Asynchronous notifications may be made, for example, by raising the appropriate “alarm” output hardware signal. However, the module may be configurable to send a prompt on power-on reset. This initial prompt may be preceded by one or more start-up messages.

4.3 Command set syntax structure

Commands consist of a command string, zero or more arguments, and end with a terminator. Command strings are case-insensitive. All commands have the following format:

COMMAND <argument_1> <argument_2> <argument_3> ……<CR><LF>

4.4 Command arguments

Arguments may be strings of letters, integers or floating-point numbers. Floating-point numbers shall be entered in fixed notation (e.g. 0.023 not 2.3e-2).

Command strings and arguments shall be separated by one or more separator characters. Separators shall be 8-bit ASCII space characters.

4.5 Command set terminators

The command terminator is <CR><LF>. In the case of <CR><LF>, the command is executed on receipt of the <CR> character and the <LF> character is ignored.

A successful command execution may be responded to with an “OK<CR><LF>” Unacknowledged commands may be responded to with a “??<CR><LF>”.

Command response consists of an optional response or error message. Error messages always start with the “?” character and normal responses do not. If a command completes normally and has no useful information to report, its response will be empty (no characters). Contents of error messages are not specified within this standard. The following are examples of some of the types of errors that are possible (this list is not all-inclusive):

?Unknown command 'REBOOT'

?Argument ‘x’ invalid

?Argument ‘5’ out of range [1,4]

?Not implemented

??

4.6 Module response prompt

All responses are followed by a prompt, which indicates that the module is ready to process another command. The default prompt is <CR><LF> “>”.

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4.7 Echo mode

By default, the module doesn't echo characters sent to it. However, if echo mode is enabled, printable 8-bit ASCII characters are echoed. Also, echo mode enables command-line editing using the backspace key (the backspaces are echoed if there are characters to delete).

5 Supported commands

Table 1 summarizes the software commands that are supported through the OACS interface. The description of software commands in Table 1 is normative while the commands are informative. There are two sets of commands that are currently being used in the industry. It is recommended that the user choose the commands from only one of the sets, i.e. either from set I or II, and not mix the commands from the two sets. For detailed command syntax and the corresponding response, see Clause 6 for the universal set of commands used by all OACS compliant optical amplifiers or Clause 7 for additional optional command sets.

Table 1 – Software commands (*page 1/2*)

Normative					Informative	
Description	**Type**		**Applicability**		**Command Set I**	**Command Set II**
	Read	Write	Universal	Optional		
Set alarm setpoints	x	x	x		ALRM	ALT, ALH
Display activated alarms	x		x		AST	ALO
Set alarm status mode	x	x	x		ASTM	ALS
Set baud rate	x	x	x		BAUD	BPS
Reboot firmware		x	x		BOOT	RBT
Set dispersion compensator parameters	x	x		x	DCM	DCS
Set command line echo	x	x	x		ECHO	ECH
Display signal gain	x		x		GAIN	APG
Set loss of signal mode	x	x	x		LOS	ASD
Set control mode	x	x	x		MODE	APS
Display module status	x		x		MST	AST
Display module case temperature	x		x		MT	CST
Display optimal flat gain setting	x			x	OFG	N/A
Display photodiode power	x		x		PD	PDP
Display input power	x		x		PIN	PDP
Display total output power	x		x		POUT	PDP
Display signal output power	x		x		PSIG	APP
Set pump power	x	x		x	PSP	LDP
Display pump status, set pump current	x	x	x		PUMP	LDC,LDT,LTS
Display pump power	x			x	PWR	LDP
Download protocol		x	x		RECV	UPD
Display reflected power at output	x			x	RFL	REF
Restore default settings		x	x		RST	RFD
Display per-stage signal gain	x			x	SGAIN	APG

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Table 1 (*continued, page 2/2*)

Normative					Informative	
Description	**Type**		**Applicability**		**Command Set I**	**Command Set II**
	Read	Write	Universal	Optional		
Set per-stage gain limit	x	x		x	SGLIM	GLM
Set per-stage control mode	x	x		x	SMODE	APS
Display per-stage status	x			x	SMST	APS
Display per-stage input power	x			x	SPIN	PDP
Set per-stage power limit	x	x		x	SPLIM	PLM
Display per-stage total output power	x			x	SPOUT	PDP
Display per-stage signal output power	x			x	SPSIG	APP
Display reflected power at stage output	x			x	SRFL	REF
Set output tilt	x	x		x	TILT	TLT
Display version information	x		x		VER	VER
Set VOA attenuation	x	x		x	VOA	VAS

6 Universal command set

This clause describes the syntax of commands in the two command sets I and II. The commands are informative. It is recommended that the user choose the commands from only one of the sets, i.e. either from set I or II, and not mix the commands from the two sets. Each command is shown with arguments in italics. All OACS compliant amplifiers shall support commands shown in this clause. Variations due to optional arguments are shown on separate lines. In the examples, a sample of communications is shown starting with the prompt from the module and ending with the prompt following the final command. Text sent to the module from the host is shown in bold (assumes echo mode is on).

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6.1 Command set I

Table 2 – Universal software command set I (informative) *(page 1/4)*

Sub-clause	Command	Description	Example
6.1.1	ALRM *x y* ALRM *x* ALRM	Displays information about alarms. The *x* parameter is the alarm name and can be one of the following: ILD: Pump overcurrent alarm TMP: Pump temperature alarm MTH: High module (case) temperature alarm MTL: Low module (case) temperature alarm CT: Coil temperature alarm LOS: Loss of signal (input) alarm (optional for Raman) LOP: Loss of output power (or gain) alarm RFL: Excessive reflected output power alarm (optional) LOS*n*: Loss of signal (input) alarm for stage *n* LOP*n*: Loss of output power (or gain) alarm for stage *n* RFL*n*: Excessive reflected output power alarm for stage *n* (optional) The *y* parameter specifies the alarm parameter to display and can be one of the following: STA: Current status SST: Set status THR: Threshold HYS: Hysteresis (relative to threshold) If *y* is omitted, all of the above parameters are displayed. If *x* is omitted, information for all alarms is displayed. If both *x* and *y* are omitted, all parameters for all alarms are displayed. NOTE See Annex B for additional comments on alarm functionality	>***alrm ild sta*** ALRM ILD STA: ON >***alrm lop1*** ALRM LOP1 STA: OFF ALRM LOP1 SST: ON ALRM LOP1 THR: 2.00 dB ALRM LOP1 HYS: 1.00 dB >***alrm thr*** ALRM LOS1 THR: -31.00 dBm ALRM LOS2 THR: -22.00 dBm ALRM CT THR: 2.0 C ALRM LOP1 THR: 0.50 dB ALRM LOP2 THR: 0.50 dB ALRM RFL2 THR: -20.00 dB ALRM ILD THR: 95.0 % ALRM TMP THR: 5.0 C ALRM MTH THR: 65.0 C ALRM MTL THR: -5.0 C >
	ALRM *x* THR *y* ALRM *x* HYS *y* ALRM *x* CLR	Sets threshold or hysteresis level for the specified alarm. *x* specifies the alarm name and *y* specifies the threshold or hysteresis level. Specifying “CLR” resets the alarm’s set status. *x* can be omitted when “CLR” is specified; in this case, all alarms’ set status are cleared	>***alrm lop1 thr 1.5*** >***alrm lop1 hys 0.7*** >***alrm lop1*** ALRM LOP1 STA: OFF ALRM LOP1 SST: ON ALRM LOP1 THR: 1.50 dB ALRM LOP1 HYS: 0.70 dB >
6.1.2	AST	Lists all alarms whose status is on. If alarm status mode is normal, alarms whose current status is on are listed. Alarms are not cleared until the alarming condition is cleared. If the alarm status mode is latching, alarms whose latching status is on are listed and their latching status is cleared if the alarming condition has cleared. If no alarms are on, the response is “OK”	>***ast*** AST: LOP2 ILD >***ast*** AST: OK >
6.1.3	ASTM N ASTM S ASTM	Sets alarm status mode to normal(N) or latching (S, for "set") mode. If the mode is omitted, the current mode is displayed	>***astm*** ASTM: S >***astm n*** >***astm*** ASTM: N >

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Table 2 *(continued, page 2/4)*

Sub-clause	Command	Description	Example
6.1.4	BAUD *x* BAUD	Sets baud rate to *x* bits per second. Allowed values are 9 600, 19 200, 38 400, 57 600, and 115 200. If no argument is provided, the current rate is displayed. Note that the baud rate change takes effect *after* the prompt in response to the command is sent	>***baud*** BAUD: 9600 >***baud 115200*** >
6.1.5	BOOT	Reboots the firmware	>***boot*** (startup messages) >
6.1.6	ECHO ON ECHO OFF ECHO	Sets command line echoing to "ON" or "OFF". If no argument is provided, the current setting is displayed	>***echo*** ECHO: ON >***echo off*** >***echo*** ECHO: OFF >
6.1.7	LOS *x* LOS	Specifies behaviour when the LOS alarm is active. Parameter *x* is one of the following: A: Pumps disabled in gain control, power control, and manual control modes. P: No effect in gain control mode, pumps disabled in power control and manual control modes. N: No effect in any mode. If *x* is not specified, the current LOS mode is displayed. For multistage EDFAs, the LOS mode applies to all stages in the same manner.	>***los*** LOS: A >***los p*** >***los*** LOS: P >
6.1.8	MODE *x y* MODE *x* MODE	Sets the control mode of the amplifier to *x* with setpoint *y*. Control modes are: G: Gain control mode: *y* is the gain setpoint in dB. For fixed-gain modules, *y* may be specified as "OFG" to set the optimal flat gain. P: Output power control mode: *y* is the output power setpoint in dBm. S: Stage control mode: *y* is not supplied. *Applies to multistage EDFAs only*. P: Pump power control mode: *y* is not supplied. Each pump is driven to the optical power specified by the PSP command. M: Manual pump control: *y* is not supplied. In this mode, each pump is driven at a fixed current specified by the PUMP ISP command or automatically controlled if set to AUTO. See the PUMP ISP command for details. D: Disable mode: *y* is not supplied. All pumps are shut off. NOTE Using MODE alone shows the current system mode and setpoint	>***mode*** MODE: G 23.00 dB >***mode g ofg*** >***mode*** MODE: G 22.65 dB >***mode p 10.78*** >***mode*** MODE: P 10.78 dBm >***mode d*** >***mode*** MODE: D >***mode s*** >***mode*** MODE: S >

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Table 2 *(continued, page 3/4)*

Sub-clause	Command	Description	Example
6.1.9	MST	Displays module status which is one or more of the following keywords: DIS: Module disabled due to amplifier disable input or alarm ES: Module in eyesafe mode due to eyesafe input or alarm. Eyesafe mode is a mode in which the optical power level is limited for eye safety concerns. LIM: Module gain or output power limited by SGLIM/SPLIM OK: Module is operating normally. For multistage EDFAs, the module status is the union (logical OR) of the all of the stages' status indications (see SMST in 7.8)	>***mst*** MST: DIS ES >***mst*** MST: OK >
6.1.10	MT	Displays module case temperature in degrees °C	>***mt*** MT: 45.6 C >
6.1.11	PD *x* PD	Displays power at photodiode *x* in dBm. Valid photodiode numbers range from 1 to the number of installed photodiodes. If the argument is omitted, all photodiode powers are displayed. Use of higher level commands such as PIN, SPOUT, VOA, etc. is recommended in lieu of the PD command. Photodiode numbering is not guaranteed to be consistent across designs. For example, on any given amplifier design the PIN command always reports input power whereas the “PD 1” command may report something else	>***pd 2*** PD 2: -6.08 dBm >***pd*** PD 1: -22.32 dBm PD 2: -6.08 dBm PD 3: -10.23 dBm PD 4: 11.01 dBm >
6.1.12	PIN POUT PSIG GAIN	Displays input power, total output power, signal output power, and signal gain. Signal power is total power less estimated ASE power.	>***pin*** PIN: -20.00 dBm >***pout*** POUT: 6.15 dBm >***psig*** PSIG: 5.00 dBm >***gain*** GAIN: 25.00 dB >
6.1.13	PUMP *x* ISP *z* PUMP *x* AUTO	Sets fixed current of *z* milliamps for pump *x*. If *x* is not specified, all pumps are set to this current. Setting a fixed pump current overrides automatic control of the pump which may compromise control. The AUTO parameter restores automatic pump control. This command is permitted only when the module is in manual mode (MODE M). Manual pump settings are temporary and are not preserved across power-on reset (they revert to ISP 0 after reset)	>***pump 2 isp 25.0*** >***pump 2 isp*** PUMP 2 ISP: 25.0 mA >***pump 2 auto*** >***pump 2 isp*** PUMP 2 ISP: AUTO >

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Table 2 *(continued, page 4/4)*

Sub-clause	Command	Description	Example
6.1.14	PUMP *x y* PUMP *x* PUMP	Displays status of pump *x*. Valid pump numbers range from 1 to the number of installed pumps. The *y* parameter specifies the information displayed and can be one of the following: ILD: Laser diode current in mA EOL: Laser diode end-of-life current in mA TMP: Pump temperature in degrees C ITC: TEC current in mA VTC: TEC voltage in V ISP: Pump current setpoint in mA	>***pump 2 ild*** PUMP 2 ILD: 102.7 mA >***pump 1*** PUMP 1 ILD: 167.5 mA PUMP 1 EOL: 350.0 mA PUMP 1 TMP: 25.1 C PUMP 1 ITC: 847.0 mA PUMP 1 VTC: 2.354 V PUMP 1 ISP: AUTO >
6.1.15	RECV *x*	Downloads file from the host system using the XMODEM file transfer protocol. The XMODEM protocol can be XMODEM 128 byte data, 2 byte CRC or XMODEM 1K byte data, 2 byte CRC. Parameter *x* indicates the type of file, which is vendor specific. Examples: FW: Downloads new firmware for the microcontroller S2: Download in S2 file format using ASCII transfer protocol	>***recv fw*** > >***recv s2*** >
6.1.16	RST	Resets all settings to factory default values. Usually, changes do not take effect until the microcontroller is rebooted by issuing the BOOT command. NOTE See Annex A for additional comments on RST functionality	>***rst*** >
6.1.17	VER	Display version information. This read-only command results in the amplifier responding with several lines of version and configuration information. The first 3 lines shall contain the information fields shown at right. Additional output lines may be added as agreed upon between amplifier supplier and customer. Explicit formatting requirements of any additional lines of output are not imposed by this document	>***ver*** Configuration: GenericEDFA Firmware Vers: 1.0.0 Serial Number: 123000010 >

6.2 Command set II

Table 3 – Universal software command set II (informative) *(page 1/4)*

Sub-clause	Command	Description	Example
6.2.1	ALT *x*	Displays alarm threshold level Sets alarm threshold level *x* is the number assigned by alarm. It is the alarm of the following contents: Input alarm Reflection alarm OUT alarm LD current alarm LD temperature alarm Case temperature alarm EDF heater temperature alarm	>ATL 2 20C >
	ALT *x y*	*y* and *z* is sets alarm value	>ATL 2 20 OK >

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Table 3 *(continued, page 2/4)*

Sub-clause	Command	Description	Example
6.2.2	ALH *x*	Displays alarm hysteresis value Sets alarm hysteresis value *x* is the number assigned by alarm. It is the alarm of the following contents: Input alarm Reflection alarm OUT alarm LD current alarm LD temperature alarm Case temperature alarm EDF heater temperature alarm	>LTH 2 0.2C >
	ALH *x y*	*y* is alarm sets level	>LTH 2 0.2 OK >
6.2.3	ALS *x*	Display alarm sticky/normal mode Sets alarm sticky/normal mode *x* is the number assigned by alarm. It is the alarm of the following contents: Input alarm Reflection alarm OUT alarm LD current alarm LD temperature alarm Case temperature alarm EDF heater temperature alarm	>ALS 1 0 >
	ALS *x y*	*y* is mode number <0>alarm normal <1>alarm holding <2>alarm un-holding	>ALS 1 1 OK >
6.2.4	ALO *x*	If the alarm is generated, a numerical value will also be displayed. *x* is the number assigned by alarm. It is the alarm of the following contents: Input alarm Reflection alarm OUT alarm LD current alarm LD temperature alarm Case temperature alarm EDF heater temperature alarm	>ALO 9 status: ALM LD1 32.5C >
6.2.5	APG *x*	Displays amplifier signal gain *x* is stage number <1>:Stage 1 <2>:Stage 2 <0>:Module total	>APG 2 15.0dB >
6.2.6	APP *x*	Displays ASE compensated signal power *x* is stage number. <1>:Stage 1 <2>:Stage 2	>APP 2 15.0dBm >
6.2.7	APS *x*	Displays operating mode Sets operating mode and level *x* is stage number <1>:Stage 1 <2>:Stage 2 <0>:total gain	>APS 1 AGC 15.0dB >

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Table 3 *(continued, page 3/4)*

Sub-clause	Command	Description	Example
	APS x y z	y is mode number <G>:AGC mode (constant gain control) <L>:ALC mode (constant output level control) <C>:ACC mode (constant Id current control) <P>:APC mode (constant LD output power control)	>APS 2 G 15.0 OK >
6.2.8	ASD	Set loss of signal mode	
6.2.9	AST *x*	Displays amplifier status *x* is stage number <1>:Stage 1 <2>:Stage 2 <Return value> <LCA>LD current alarm <LTA>LD temperature alarm <LOA>input alarm <OPA>OUT alarm <OGA>gain alarm <REA> reflection alarm <EFA>EDF temperature alarm <CSA>case temperature alarm	>AST LTA OPA EFA CSA >
6.2.10	BPS BPS *x*	Displays communication speed Sets communication speed to x bits-per-second *x* is communication speed <9600>:9600bps <19200>:19200bps <38400>:38400bps <57600>:57600bps <115200>:115200bps	>BPS 9600bps > >BPS 9600 OK
6.2.11	CST	Displays EDFA case temperature	>CST 36.5C >
6.2.12	ECH ECH *x*	Displays serial port echo mode Sets serial port echo *x* is mode number <0> echo off <1> echo on	>ECH ECHO ON > >ECH 0 OK >ECH 1 OK >
6.2.13	LDC *x*	Displays pump currents *x* is LD number <1>:LD1 <2>:LD2	>LDC 1 320.2mA >
6.2.14	LDP *x*	Displays pump power *x* is LD number <1>:LD1 <2>:LD2	>LDP 3 120.2mW >
6.2.15	LDT *x*	Displays pump laser temperature *x* is LD number <1>:LD1 <2>:LD2	>LDT 2 24.9C >
6.2.16	LTS *x*	Displays pump laser control temperature Sets pump laser control temperature *x* is LD number <1>:LD1 <2>:LD2	>LTS 2 25.0C >

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