Instrument & OPUS Communication

of M10 and M15 Electronic

Version 2.0

1 Introduction

This description is destined to programmers interested in the dialogue between the EWS (Interfacing the M10 and M15) and OPUS (User application).

All communication between the EWS and OPUS is done on a standard *Webserver / Client* base. *The EWS is the Webserver. OPUS is the client*.

All data exchanges are made on HTTP level. OPUS communicates with the EWS on the same manner a browser would do. OPUS only sends requests to the Webserver. Even in the case where commands have to be sent *to* the EWS, it is done by adding the appropriate query to the *requested* HTML page.

The EWS also provides an *FTP server*, but which is *not used* by OPUS. It serves only for *Firmware updates*, by exchanging files on the EWS Flashdisk. This is usually done by using the *FCONF.EXE* utility or manually with a standard FTP client program.

2 Tags in HTML pages

After a page was read by OPUS, it searches for defined tags which point to the wanted information. Those tags are defined in a file called *EWSTAGS.H* which is common to the EWS and OPUS projects.

Each time a change is necessary in this file, then both projects should be synchronized and recompiled with the new version.

Example:
The tag in the source code is:
```
#define   HTG_LWN "KLWN"        // Laser Wavenumber
```

A HTML file may contain:
```
<TD>Laser Wavenumber</TD><TD ID=KLWN>15798</TD></TR>
```

OPUS searches for the tag **"<TD ID=KLWN>"** and finds the effective LWN value beside, i.e. 15798cm-1.

3 Special characters in queries

Non alphanumeric characters (**like &>-<=**) are not allowed to be sent on queries.
Replace them by the **"%"** sign followed by the *hex ASCII* code of the character.
Spaces are replaced by the sign "+".

Example:

http://MatrixLasVegas/cmd.htm?CNM=John+Wayne&SFM=big%26easy&SNM =Water&DEL=0&NSS=4&RES=4.0000&APT=0&CHN=8&DTC=16416

The following commands are sent with the above query:

CNM =   John Wayne
SFM =   big&easy
SNM =   Water
...

The behavior of the client has to be the same as a browser.

4 HTML Pages read by OPUS

4.1 The first contact

The first time OPUS takes contact with the EWS, it gets the page defined with the Tag *LINKS_PAGE*. The names of the rest of the HTML pages of interest are listed on this page.

There is a timeout based mechanism that requires OPUS to contact the EWS at least once per 15s of time interval. OPUS may read any page but it is mostly the *Status page.*

The EWS tells on the *Config* page who is the owner. If OPUS reads that *he is not himself the owner* then *no further page should be read* and no measurement is possible. Another OPUS is currently in contact with the busy EWS. The name of the owner may be displayed as a message to the user, in the OPUS application.

OPUS usually sends 2 additional parameters in the query requesting the page:
- *UTC=<current UTC time>*
- *IAM=<Name of Workstation>*

The query could be like this:

> *http://MatrixLasVegas/cfg.htm?UTC=990122253&IAM=WS%2dJMW*

With **UTC**, the clock of the EWS is synchronized with the OPUS workstation. The value to be sent is returned by the standard **C function time()**. The function returns the number of seconds elapsed since midnight (00:00:00), January 1, 1970, coordinated universal time. After the UTC time synchronization, the EWS may still have another time if the timezone is different of that of the OPUS workstation.

With **IAM**, OPUS informs the EWS who requests the ownership. If several OPUS instances on the same PC are running, then the transmitted name should be like:
e.g. **IAM=WS-JMW_<Process ID>**

The EWS beeps once OPUS has read successfully the *Config* page and has got ownership. OPUS then proceeds reading the *Status* page.

4.2 Opus links page

OPUS reads the names of the pages that are available on the instrument. Only the reference to this page (in the above example *opuslinks.htm*) is known before.
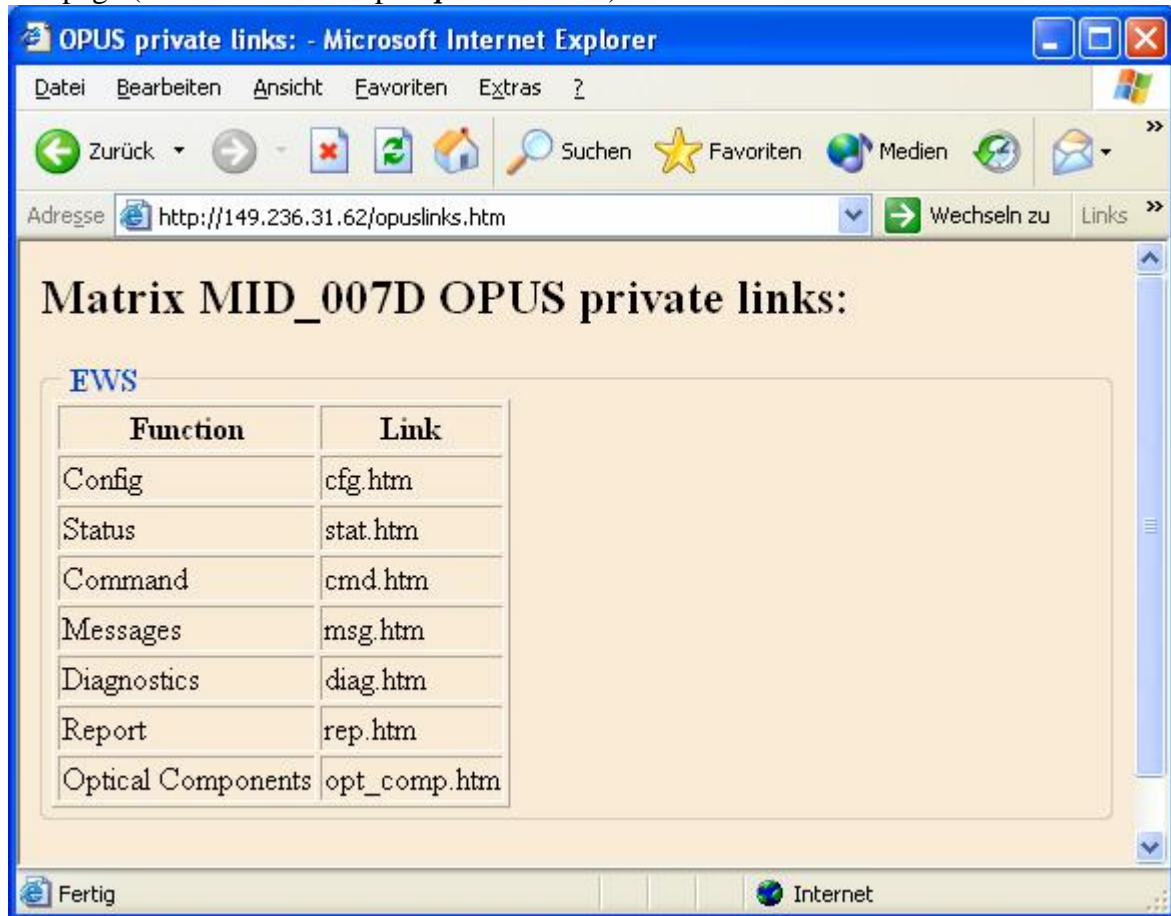
The name of the   *Config*   page is found with the Tag **HTG_CFG_PAGE**.
The name of the   *Status*   page is found with the Tag **HTG_MEAS_PAGE**.
The name of the   *Command*   page is found with the Tag **HTG_CMD_PAGE**.
The name of the   *Messages*   page is found with the Tag **HTG_ERR_PAGE**.
The name of the   *Diagnostics*   page is found with the Tag **HTG_DIAG_PAGE**.
The name of the   *Report*   page is found with the Tag **HTG_REP_PAGE**.
The name of the   *Optical Components* page is found with the Tag
HTG_DIRECT_CNTRL_PAGE.

The optical components page is an optional page.

Important note: Do not use directly the names of the HTML pages of the example above.
Only the information found indirectly with the above described tags is actual.

4.3 The Config page

The next page that OPUS reads is the *Config* page.

It contains several section:

4.3.1 Instrument data

Instrument Type
Instrument Serial Number
Manufacture Date
Firmware Version
Engineering Change Level
Location
Owner/Company
Postal address
City
Country

4.3.2 General information

Current Date
Last power up date
Parameter file
Second Parameter file
Options Parameter file
Options Parameter file
Max Data Rate
Max Resolution
Max PLL
Max XAS
Xa Step
Laser Wavenumber
Focal Length
Absolute Peak Position

4.3.3 Runtime counters

Total run time Instrument
Time elapsed since last power up

4.3.4 Owner Information

Current client
Last owner
Are above addresses identical?
Is an OPUS currently connected?

4.3.5 User information from EWS.INI or USER.INI

Entries of section [USER] from EWS.INI (M15) or USER.INI (M10).

4.3.6 Embedded web server information

EWS15 Firmware Version
EWS15 CPU
Base RAM (KB)
Extended RAM (KB)
IP Address in file C:/EWS/TCPIP.INI (Dec)
IP Subnet Mask in file C:/EWS/TCPIP.INI (Dec)
GATEWAY in file C:/EWS/TCPIP.INI (Dec)
Instrument net name *
Hardware MAC ID (Hex)
TCPIP Settings from
Communication Format Code
EWS DIP Switch 1
EWS DIP Switch 2
EWS DIP Switch 3
EWS15 Board Serial Number

* only M10

4.3.7 SCT15 board data (only M15)

SCT15 Firmware Version
Loaded File 1
Loaded File 2
Loaded File 3

4.3.8 List of commands (and their available values) that the EWS is able to execute

The entries of combo commands are separated by @*!
E.g.

OPF	*!1=Open@*!2=Filter Polystyrene Foil@*!3=Filter NG11@*!4=Filter Polystyrene@*!5=Filter NG9@*!6=Filter NG4@
AAR	@string

4.3.9 Additional parameter for commands

For some commands exists additional parameter.

Command	DTC:	nonlinearity coefficients
	CHN:	laser wave number
	ITC:	laser wave number

E.g.

CHN	*!1=15800cm-1@
DTC	*!16416=600;1@
ITC	*!1=15800cm-1@

4.3.10 Auto accessory recognition data

This section contains additional data about devices and accessories from AAR.INI. It exist several groups: accessory, beamsplitter, detector, source, laser. All sections with all entries from AAR.INI are shown in this section. The entries are separated by @*!. If AAR.INI contains an entry unknown to instrument then the entry is anyway listed.

E.g.

Accessory	*!IDC=07BFE3F2@*!LOC=0x0@*!TYP=?@*!VBS=VBSAAR2.OBS@*!IDC=072BAD78@*!LOC=0x5B00@*!TYP=?@*!VBS=VBSAAR2.OBS@
Beamsplitter	*!IDC=072C1B21@*!LOC=0x01@*!TYP=Quartz@*!HFQ=15500@*!LFQ=3300@
Detector	*!IDC=DTRP007@*!LOC=0x4020@*!NAM=RT-DLaTGS@*!HFQ=7000@*!LFQ=180@
Source	*!IDC=00000002@*!LOC=0x64@*!TYP=NIR@*!HFQ=16000cm-1@*!LFQ=2000cm-1@*!LFT=4000@*!IDC=00000001@*!LOC=0x0@*!TYP=MIR@*!HFQ=10000cm-1@*!LFQ=30cm-1@*!LFT=44000@

4.3.11 List of available optical components (M15)

List of available optical components for display the beam path. The devices are defined in file *.HTM in folder OPT_COMF. The numbers are seperated by @.

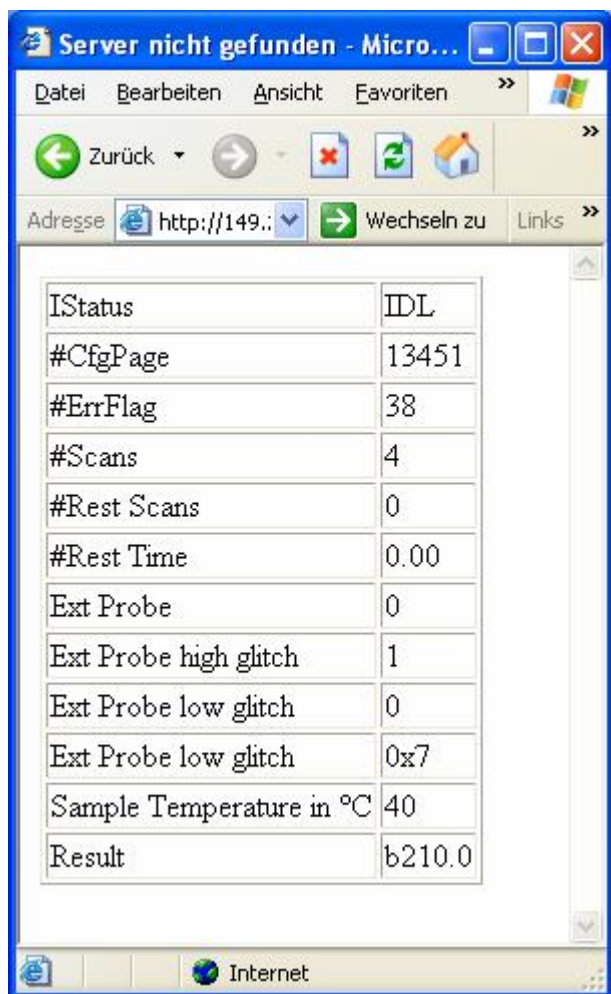| 4@5@6@7@8@9@10@11@12@13@14@16@17@19@20@21@22@23@24 |
|---|

@26@27@28@30@31@32@33@25@15@44@43@36@29@3@35@1@2@4 0@

4.3.12 Configuration change counter

This counter is incremented after every instrument configuration change.

| Cfg changed counter	22221

4.4 The Status page

The basic communication is that OPUS gets periodically page (typically each 2s) the EWS *Status*. This maintains the ownership of the instrument to OPUS. The *Status* page contains tags and information that tells if other pages have to be read:

IStatus	IDL
#CfgPage	13451
#ErrFlag	38
#Scans	4
#Rest Scans	0
#Rest Time	0.00
Ext Probe	0
Ext Probe high glitch	1
Ext Probe low glitch	0
Ext Probe low glitch	0x7
Sample Temperature in °C	40
Result	b210.0

- The code beside *IStatus* indicates the instrument status.
  Possible codes are to be found in EWSTAGS.H
- The number beside *#CfgPage* indicates the state of the counter of config changes.
  When reading the *Config page*, OPUS remembers this number. If it has changed, then it means that something has changed on the *Config page* and it needs to be actualized. It may happen when a new CAN device was hot plugged, when e.g. the LWN was modified or e.g. when a new peak location was stored.

- The number beside **#Errflag** indicates the state of the counter of Error changes. When reading the **Config page**, OPUS remembers this number. If it has changed, then it means that something has changed on the **Message page** and it needs to be actualized. It may happen when an Error or Warning happened or when an Answer has arrived.
- The number beside **#Scans** is the state of the Scan counter during a measurement.
- The number beside **#Rest Scans** is the number of Scans still to be done during a measurement.
- The number beside **#Rest time** is the estimated time until the end of a measurement.
- **Ext Probe** shows the current state of external probe
- **Ext Probe high glitch** is 1 if a high glitch occurred since last status page read
- **Ext Probe low glitch** is 1 if a low glitch occurred since last status page read
- **Ext Probe glitches** shows several glitches of external probe
    - Bit 0 (value 1) rising edge detection during measurement
    - Bit 1 (value 2) falling edge detection during measurement
    - Bit 2 (value 4) high glitch occurred since last status page read
    - Bit 3 (value 8) low glitch occurred since last status page read
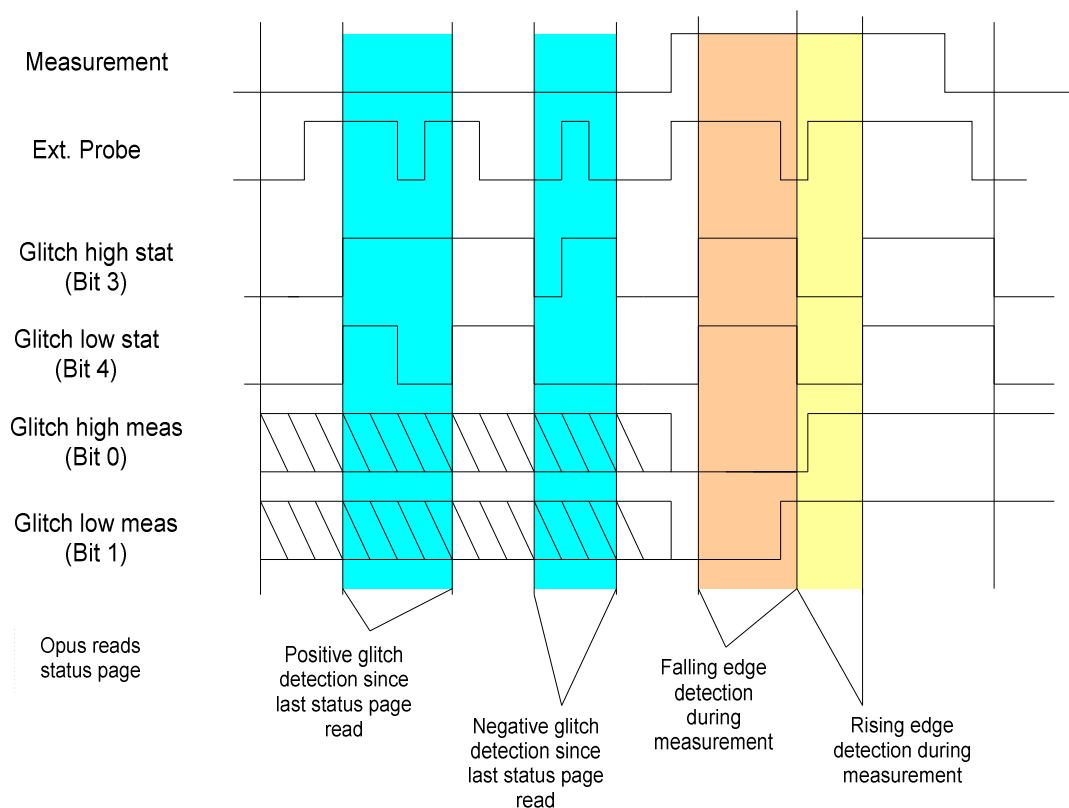
- The **sample temperature** is shown if a sample temperature controlling exist.
- The name beside **#Result** is the name of the data file (in OPUS format) that is available to be downloaded. The format of the result filename is:
    - **a1234.0**　for OPUS align mode measurements
    - **w1234.0**　for standard OPUS measurements
    - **b1234.0**　for browser measurements
    - **d12234.0**　for display during measurement
    - Note that if the file contains a **spectra**, then the first character is of **uppercase** type.

In sliced and compact mode or on display during measurement it's possible that up to 3 results files, (result- result2) exists.

4.5 The Command page

No information is to be obtained from this page. It serves only to send commands.

Example of a query initiating a measurement:

**http://MatrixLasVegas/cfg.htm?WRK=1&CNM=Jean%2dMichel+Weil&SNM=
Ana15&SFM=Matrix+Ana15+Triangle+wave+%26+Linux&RES=32&SRC=1&LPF
=10000&HPF=1&APT=0&CHN=8&DTC=16416&VEL=10000&AQM=17476&HFW=1500
0.0&LFW=0&PHR=32.000000&SON=0&PGN=0&DLY=5&DEL=0&COR=0&SOT=0&NSS
=1&GNS=1**

Note that the query begins with the general WRK command. It defines the type of the current job to be executed.
Note that not allowed, non alphanumeric characters have been converted, see §3 for details.

WRK=3   for OPUS align mode measurements
WRK=1   for standard OPUS measurements

See **#defines** in file *EWSTAGS.H* for other possibilities.

All commands have to be resent for each new measurement, even in Align mode.
The EWS knows permanently the status of the instrument and all connected devices. In the aim of no time lost, only those who are necessary are automatically forwarded. E.g. if an aperture wheel is connected, it will move only in case the requested position changes, even if the command **APT** is sent again and again each time.

The complete list of the commands that the EWS makes available to OPUS, may be read on the OPUS *Config page*.

After the above query being sent, the EWS would initiate a measurement. OPUS then would continue to read periodically the *Status* page and display, in real-time, the measurement progress.

4.6 The Message page

This page has to be read once the *#Errflag* counter was incremented on the *Status* page.
Example:
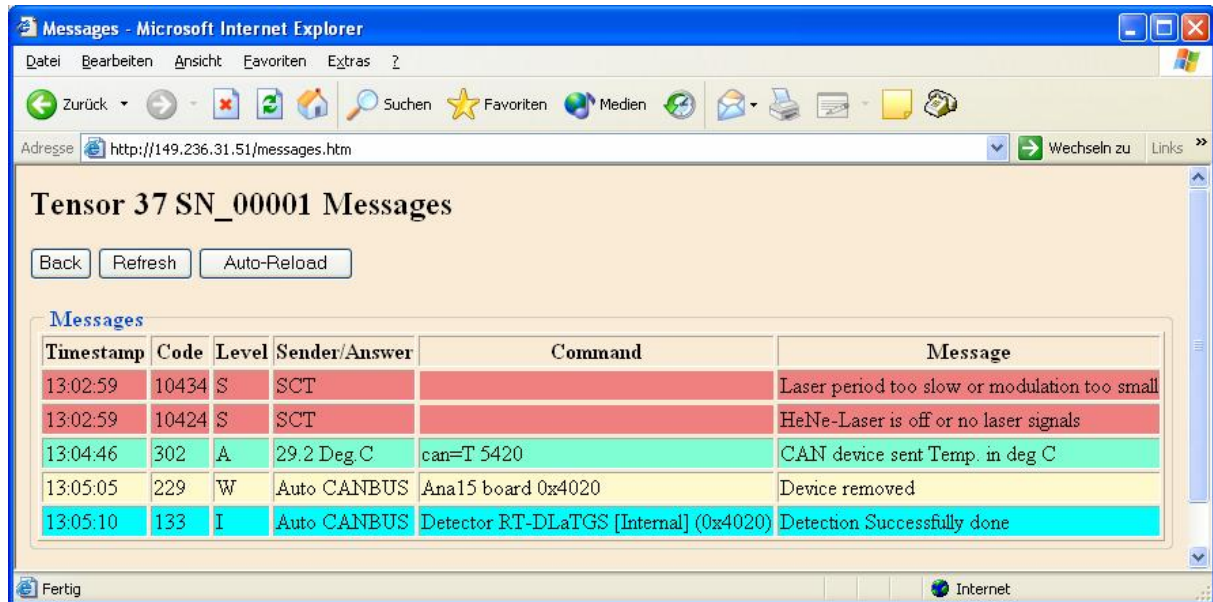
The *Timestamp* column indicates the time of creation of the event.

The *Code* is a unique code for this message type.

The *Level* indicated may be:

Nonstatic messages:

F	for	**Fatal Errors**
W	for	**Warnings** messages,
A	for	**Answers**,
I	for	**Information** messages,

Static messages (Does not disappear until the problem is solved or until the message erased by Opus!)

S	for	**Static Fatal Errors**
R	for	**Resettable Static Fatal Error**
V	for	**Static Warnings**
U	for	**ResettableWarnings**

Important note for non static messages:
If this character is *uppercase* like in the above example, then the message *should not be forwarded to the OPUS user*. It is only logged in the OPUS communication log buffer.
If this character is *lowercase* then the message is to be displayed in a *user message box*.

The *Command* is the reference of where from the message is originated.
The *Message* area describes the reason of the message event.

Important note:
All messages disappear automatically once they have been read by OPUS. By using this method, one message will only be transmitted once. *Static messages (Levels S,R,V,U) are the exception*, they are not automatically erased.

Warning: Tags may appear several times on this page, if more then 1 message is listed.

4.7 The Diagnostics page
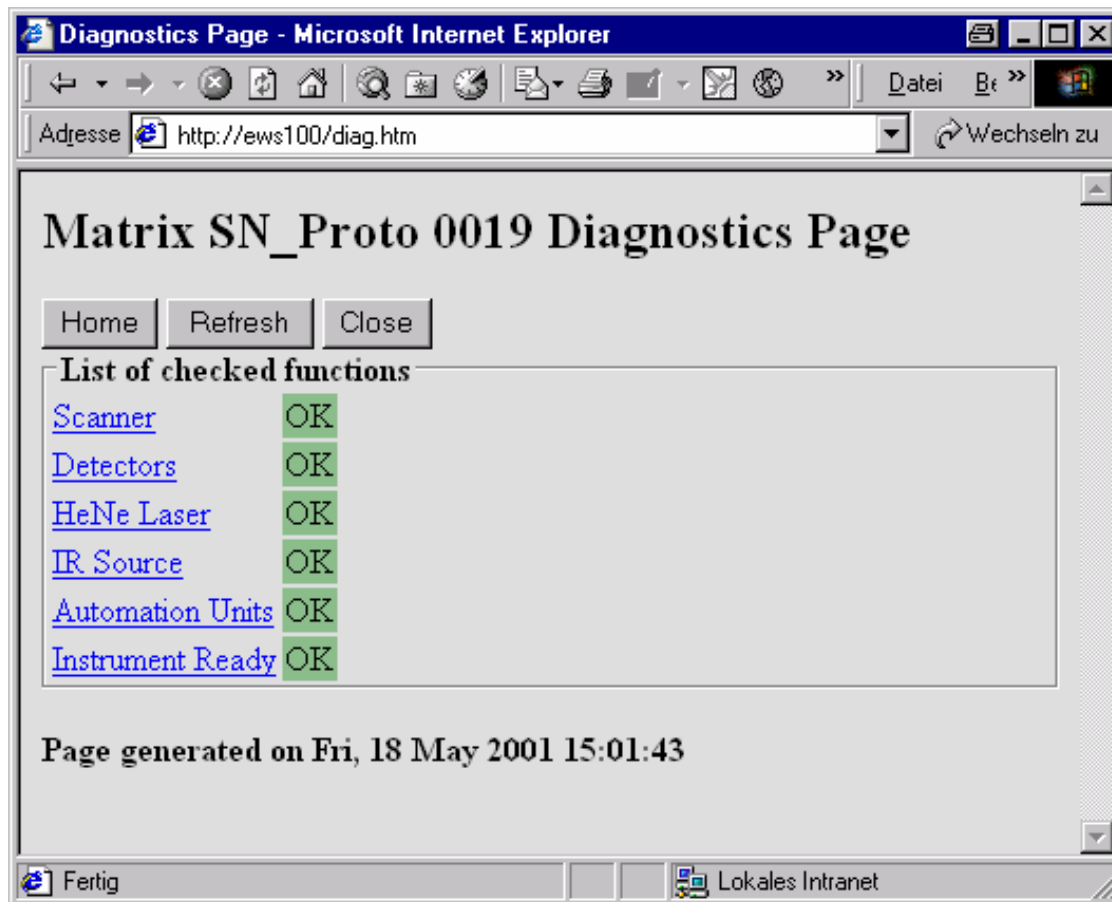
This *Diagnostics page* has to be displayed by OPUS on user request.
OPUS opens a new browser like window (without buttons and toolbar) where this page is displayed.

4.8 The Report page

This page contains a *full diagnostics and configuration report* useful for remote Service. It has to be displayed by OPUS on user request. A *print button* allows to get a printout which may be sent by fax.
OPUS shows this page in a new browser window like for the Diagnostics page.

Listed sections on report page:
>   Instrument data
>   General information
>   Runtime counters
>   Owner Information
>   User information from EWS.INI
>   Embedded web server information
>   SCT15 board data (only M15)
>   Logbuffer
>   List of checked functions
>   Scanner diagnostic
>   Detector diagnostic
>   Raman laser diagnostic (only M15)
>   Ready Status
>   Laser diagnostic
>   Source diagnostic
>   List of commands with current status
>   Automation units diagnostic
>   List of commands (and their available values) that the EWS is able to execute
>   Additional parameter for commands
>   Auto accessory recognition data
>   List of available optical components
>   Listing of EWS.INI
>   Listing of TCPIP.INI
>   Listing of AAR.INI

4.9 The optical components page (only M15)

This optional page contains data about optical components for beam path display. The firmware read the HTML file *.HTM in folder /OPT_CONF/ and display it without any modification.

5 Measurement sequence

5.1 Measurement with 1 result file (only M15)

This sequence is standard sequence for M15 electronic.

Step	Action by		Reaction Instrument	Shown instrument status
	OPUS	Internal Instrument		
1	requests status page		serves status page	Idle / error
2	Opus sends measurement commandlist		Instr. Decodes commands list and execute command list	Setting parameter
2.1		Command list executed	Optional wait for delay after device change	Setting parameter
2.2		End of delay	Starts internal measurement sequence: Splits WRK command to _SP,_ME,_GP*,_GR*	Setting parameter
2.3		Start of internal measurement sequence with setting parameter (_SP)	Check of plausibility of parameters	Setting parameter
2.4		End of setting parameter (_SP)	Start next step of internal measurement sequence _ME	Setting parameter
2.5		Start of _ME and DLY>0	Optional wait for delay	Waiting
2.6		End of delay and SON=ON	Optional wait for probe trigger	Waiting probe
2.7		Probe trigger occurred	Scanning	Scanning
2.8		End of scanning (_ME)	Create result file (_GR)	Scanning
	OPUS requests every 0.5 seconds the status page during steps 2.1 to 2.7		serves status page	Current state
2.9		Result file ready (_GR)	Idle	Idle
3	requests status page		serves status page with name of result file	Idle
4	Requests result page		Serves result page	Idle

5.2 **Measurement with several result files**

The sequence is equal for compact, sliced, display during measurement.
This is the standard sequence for M10.

Step	Action by		Reaction Instrument	Shown instrument status
	OPUS	Internal Instrument		
1	requests status page		serves status page	Idle / error
2	Opus sends measurement commandlist		Instr. Decodes commands list and execute command list	Setting parameter
2.1		Command list executed	Optional wait for delay (DLY) after device change	Setting parameter
2.2		End of delay	Starts internal measurement sequence: Splits WRK command to _SP,_ME,_GR*	Setting parameter
2.3		Start of internal measurement sequence with setting parameter (_SP)	Check of plausibility of parameters	Setting parameter
2.4		End of setting parameter (_SP)	Start next step of internal measurement sequence _ME	Setting parameter
2.4		Start of _ME and DEL>0	Optional wait for delay (DEL). Waiting time = DEL - DLY	Waiting
2.5		End of wait for delay and SON=ON	Optional wait for probe trigger	Waiting probe
2.6		probe trigger occurred	Scanning (_ME)	Scanning
	OPUS requests every 0.5 seconds the status page during steps 2.1 to 2.6		serves status page	Current state
2.7		Result file ready (_GP M15)	Scanning (_GP M15)	Scanning but files waiting
2.8	requests status page		Scanning and serves status page with name of result file	Scanning but files waiting

	Title:	EWS / OPUS communication		
2.9	requests result page		Scanning and Serves result page	Scanning but files waiting
2.10		End of serve of result file	Scanning	Scanning or Scanning but files waiting
2.11		Result file ready (_GP M15)	Scanning (_GP M15)	Scanning but files waiting
2.12	requests status page		Scanning and serves status page with name of result file	Scanning but files waiting
2.13	requests result page		Scanning and Serves result page	Scanning but files waiting
2.14		End of serve of result file	Scanning	Scanning or Scanning but files waiting
	The steps 2.11 to 2.14 can arbitrarily often repeat themselves			
2.15		End of scanning (_GP M15) (_ME M10)	Start next step of internal measurement sequence : Create last result file (_GR M15)	Scanning or Scanning but files waiting
2.16		Last result file ready (_GR M15) (_ME M10)	Idle	Idle
3	requests status page		serves status page with name of result file	Idle
4	Requests result page		Serves result page	Idle
	The steps 3 to 4 can max repeat twice			