

1. Tools

- Service engineer mechanical tool kit
- mAs meter
- Multimeter
- Digital oscilloscope with 2-beam memory
- PC incl. 3.5" FDD, HW-dongle, serial interface cable, free RAM \geq 590 KB
- Service software "XRG SCOPE" Version 2.2 or higher
- Recommended PLCC extraction tool (AMP 822154-1) 2422 487 89772

2. Notes

Caution!

After the generator has been switched off, hazardous voltages are still applied to the d.c. intermediate circuits of the converter, the rotor control and the mA control.

These voltages are usually discharged within 1 minute to values which are no longer dangerous.

3. Strategy

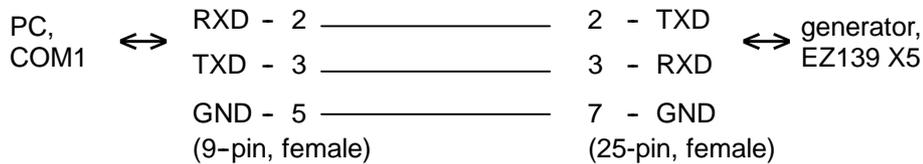
There are 3 categories of errors:

- The generator cannot be switched on at all or only for a short time.
 - See \Rightarrow 5. "Initialization phase of the generator"
 - \Rightarrow 6. "Switch-on not possible"
- The generator can be switched on but no error numbers are displayed on the operating desk.
 - For fault finding use the service PC.
 - See \Rightarrow 4. "Connecting the service PC"
 - \Rightarrow 5. "Initialization phase of the generator"
 - \Rightarrow 7. "Error numbers"
- Error messages are displayed on the desk.
 - For fault finding use the service PC.
 - See \Rightarrow 4. "Connecting the service PC"
 - \Rightarrow 7. "Error numbers"

4. Service-PC

4.1. Connection

- S Switch the generator on.
- S Provide the PC with the HW key and switch it on.
- S Connect the PC to X5 on EZ139 CENTRAL UNIT CU via a serial data cable.



4.2. Operation

For installation of generator firmware and newest service tools see "REPLACEMENT" chapter "Exchange of firmware ...".

- S Call the program with **xrgscope** or with **xrgscope lcd** for PC's with LCD screen.
 - S Enter you password
- The following menu line appears:

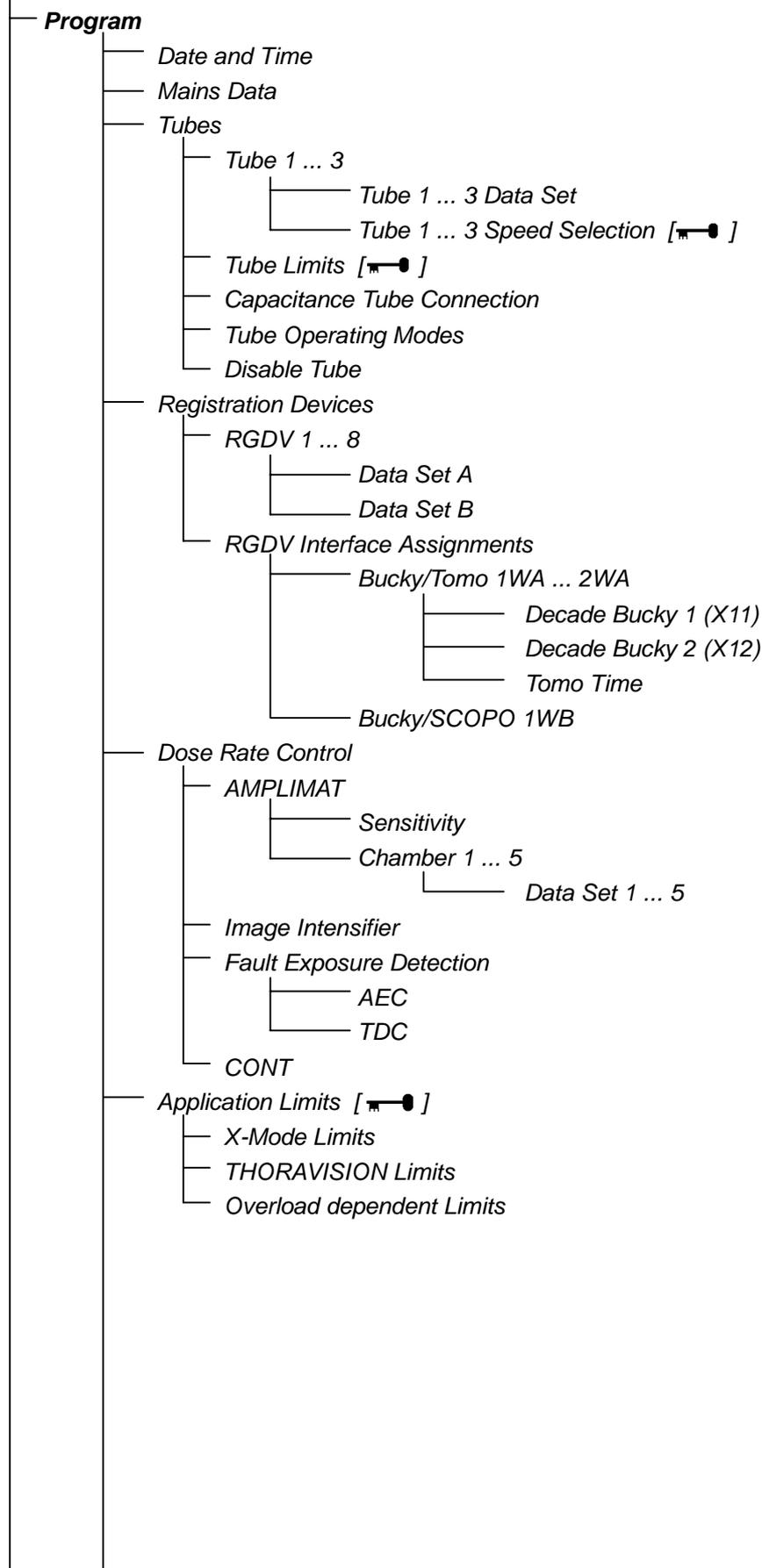
File	OPTIMUS	Select Unit	Options	Help
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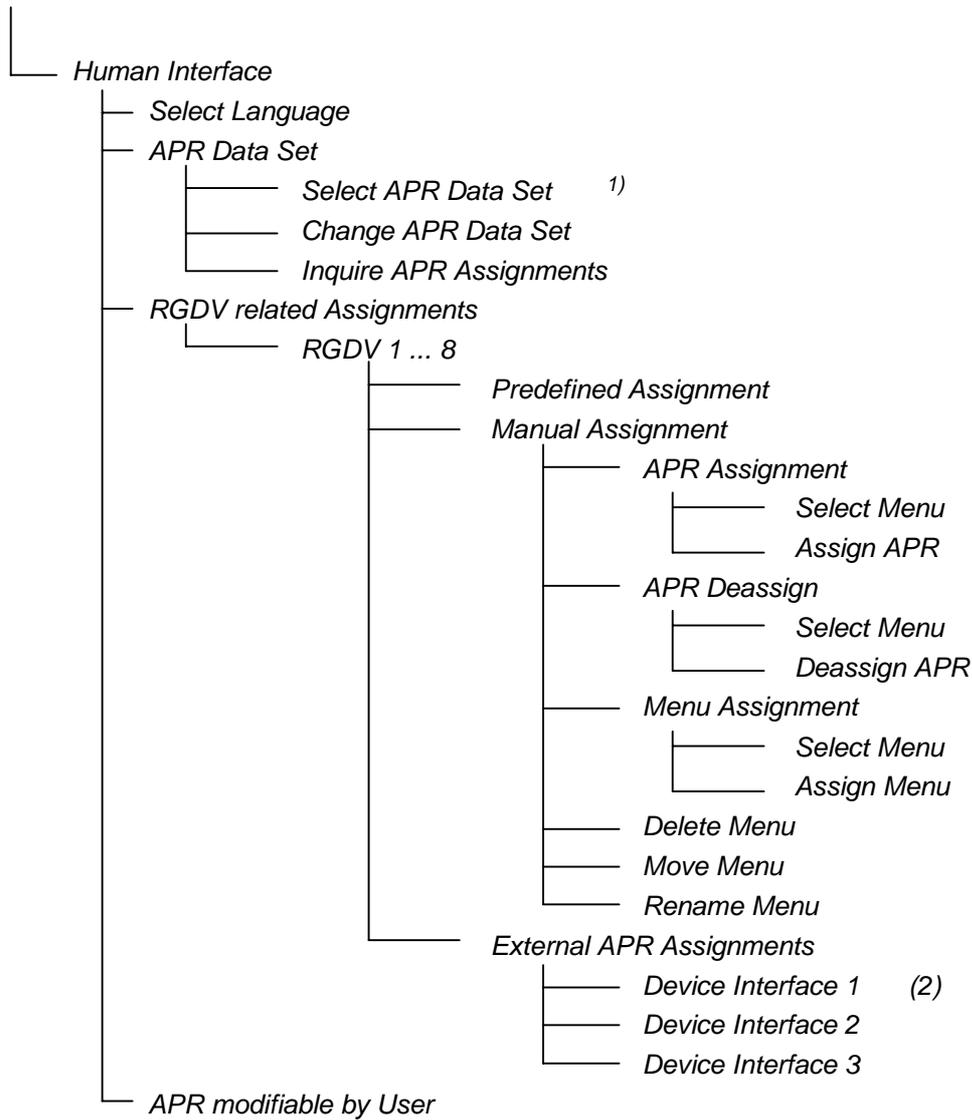
Note

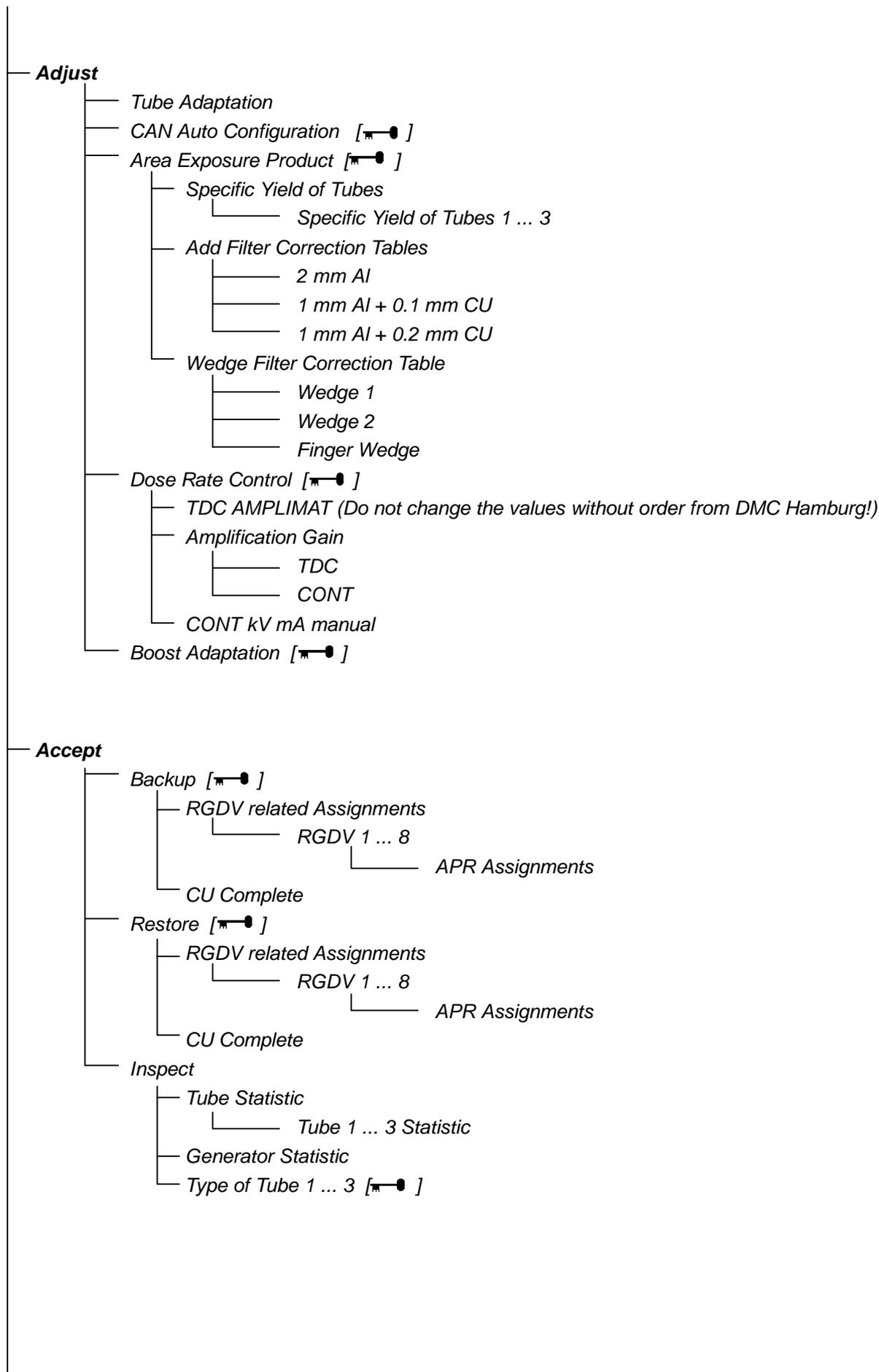
- Current data files, for instance, for online help, tube types, APR programming are available in BBS.
 Product: Generatoren Hamburg
 Download area: OPTIMUS
- If you call the installation program with **xrgscope** ? the possible starting parameters for the service program will be listed.

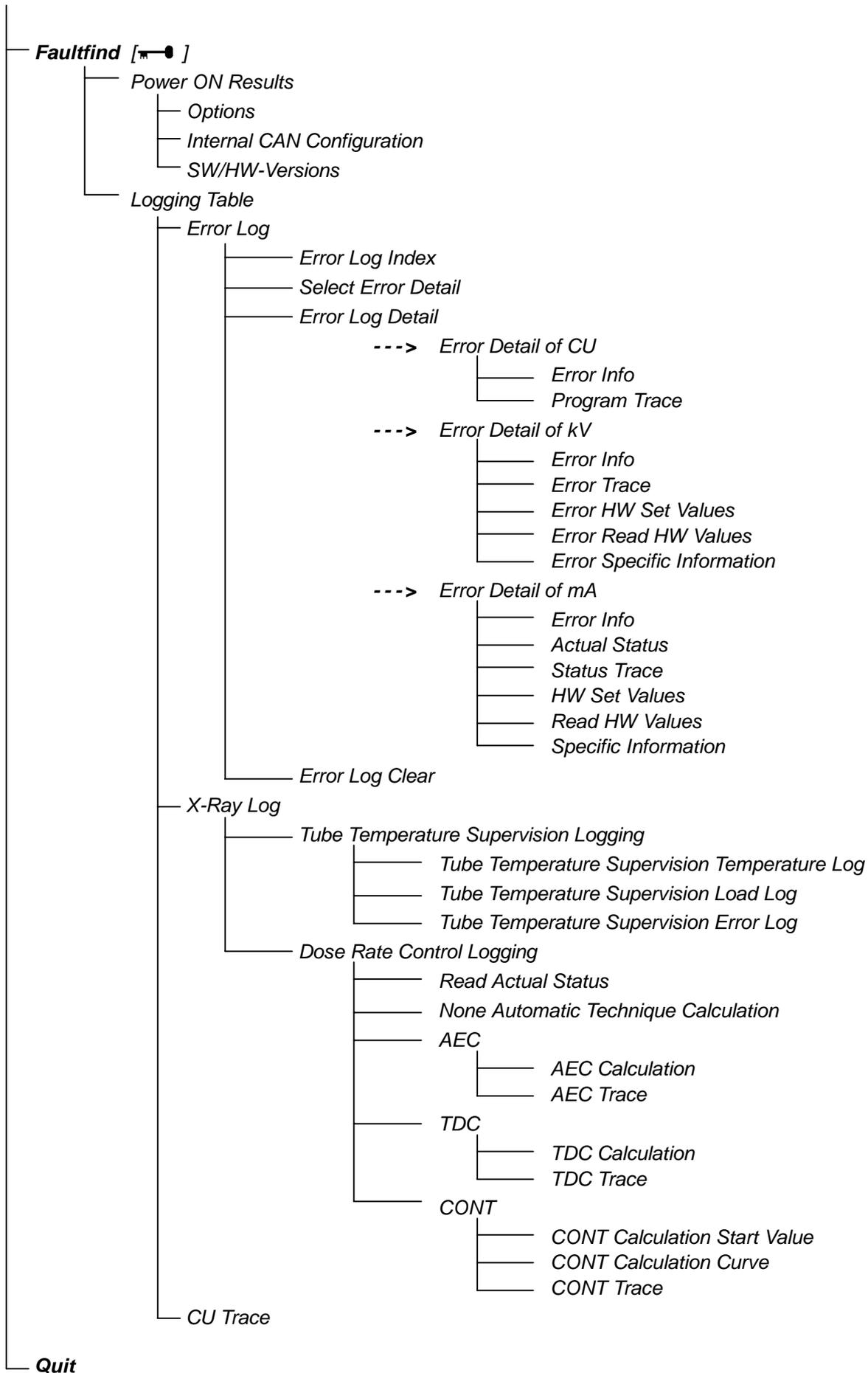
4.3. Menu structure

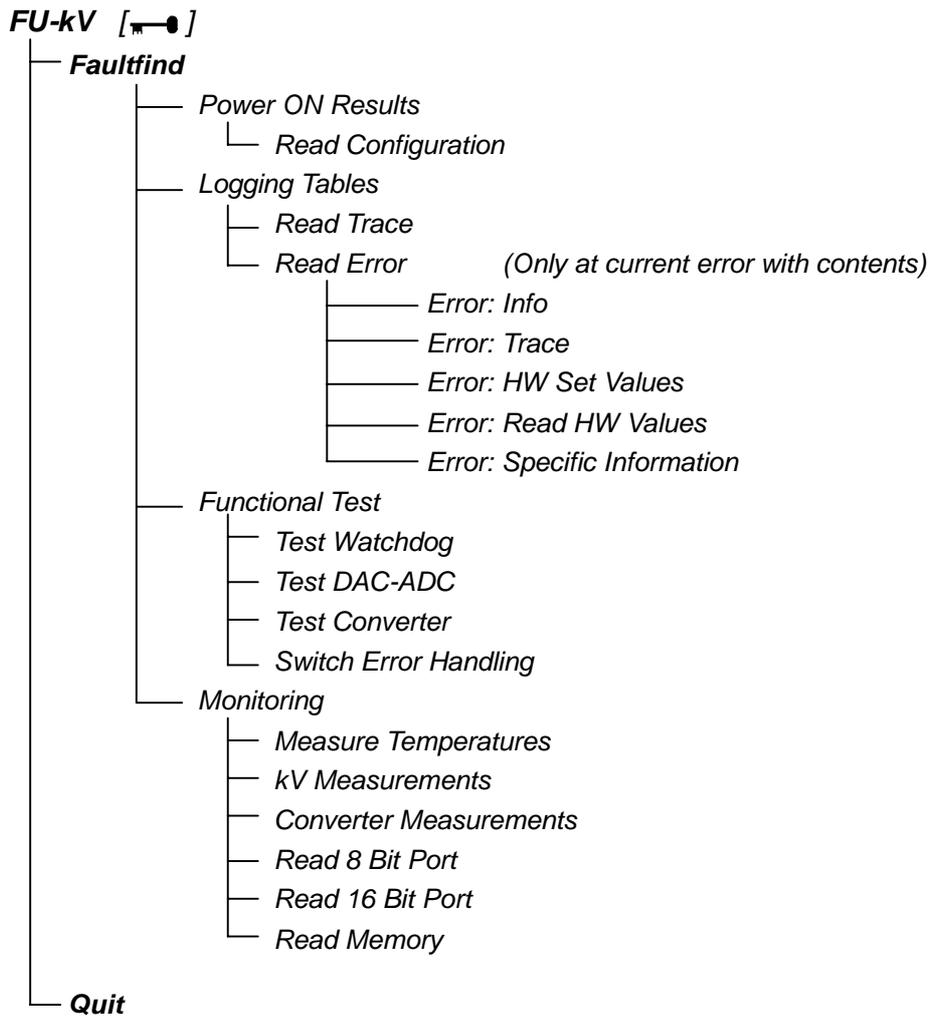
OPTIMUS (Release 3)

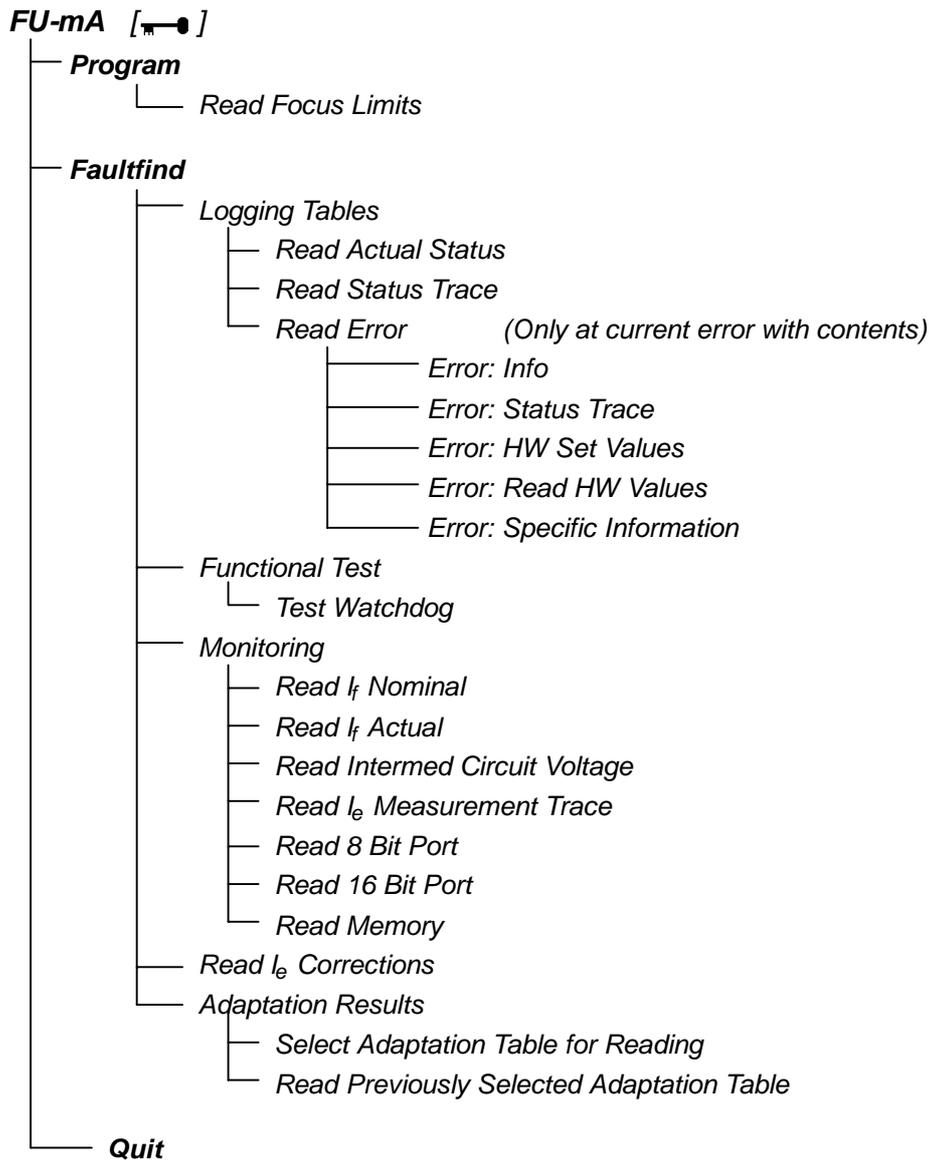












[] = A hardware key is required

4.4. Saving data on disk and restoring data

All configurations data and logging tables are stored in battery-buffered CMOS areas.

Therefore, these data should be saved on disk as a backup.

In case data get lost they can easily be restored in the CMOS areas after the error source has been eliminated.

Saving of data:

S Select menu **"Accept/ Backup/ CU Complete"**.

S Store the data on floppy disk "Generator configuration data" found in the service documentation.

Default file name: cubackup.tdl

Recommended file name: s/n of the generator, e.g. 960007.tdl

File size: approx. 500-700 kB

Transfer time: approx. 8 min.

S Recommendation:

In addition, save the APR programming individually for each RGDV via the menu **"Accept/ Backup/ RGDV related Assignments/ RGDV 1...8/ APR Assignment"** on floppy disk.

File name: apr_bak#.tdl # = RGDV - number

Assignment of film/screen combinations to the individual APRs is not saved in this procedure!

S Recommendation:

In addition, save the programmings for the film/screen combinations via the menu **"Program/ Dose Rate Control/ AMPLIMAT/ Chamber 1...5/ Data Set 1...5"** (manual processing) and store them with the SAVE function (F3 key) on floppy disk.

Recommended file name: drc##.tdl ## = chamber and data set number

Assignment of film/screen combinations to the individual APRs is not saved in this procedure!

Restoring of data:

Note

Before starting this procedure the CAN interface on EZ X43 must be disconnected if present (THORAVISION or Bucky TH with bucky controller). Wait 2 minutes for the generator to be ready to communicate with the PC.

S Select menu **"Accept/ Restore/ CU Complete"**.

S Restore the data from floppy disk.

Transfer time: approx. 15 min ... 50 min.

S Reset the generator.

S Program date and time.

Most of the programmings and logging tables can also be stored via the SAVE-function (button F3) of XRG SCOPE.

Some programmings can be restored via the LOAD-function (button F4).

- For service use, only keep the latest version of the backup.

- Never use a complete backup for a different generator.

- APR backups can also be loaded into other generators.

Since specific kV and mA reductions are also transferred, one should load APR backups only in generators of the same or a lower power class.

5. Initialization phase of the generator

5.1. Start-up sequence

Switch-on of the generator

|

Pulling-up of ENK 2

|

Selftest of ...

| ... control desk C: All display elements are switched on for a short moment.

| ... central unit EZ139:

| ... kV control EZ130: voltage E is measured in the d.c. intermediate circuit.

|

| ... mA control EZ119:

| ... basic interface EZ150:

| ... rotor control EY:

| ... universal I/O EWA/B 102:

| Indicating device: The red status LED of the associated printed-circuit board or assembly is illuminated.

|

|

When the selftests have successfully been completed, the status LED's are blinking.

|

The central unit establishes connection to each functional unit via the CAN bus.

|

| Indicating device: The red status LED of the associated printed-circuit board or assembly grows dark.

|

ENK1 is switched on.

|

The generator is internally ready.

|

The external ready circuits are checked (unit ready, door contact closed, thermal contact of the tube closed, tube not overloaded).

|

The green READY lamp in the operating desk is illuminated.

The generator is in the READY state.

5.2. Program status displayed on the operating panel

PHILIPS OPTIMUS	<ul style="list-style-type: none"> - No tube data loaded yet. - No RGDVs programmed yet. - No communication between desk and CU. - Possible error entries: 00B3, 00B6, 00BA ... F, 00B0, 00BT, 00BX, 00CJ, 00L1, 00PE, 00XB, 00XL, 03FD 															
70 kV 32.0 mAs Test	<ul style="list-style-type: none"> - Tube data loaded. - Selected focus not adapted. 															
70 kV 32.0 mAs Adap	<ul style="list-style-type: none"> - Status after calling up the adaptation mode. 															
40 kV 00.0 mAs Adap	<ul style="list-style-type: none"> - Start phase of adaptation mode. After the Ready signal appears the adaptation can be started up with the release switch. - Possible error entries after adaptation: 00BU, 00BV, 00X6 															
70 kV 320 mAs 100 ms	<ul style="list-style-type: none"> - Selected focus is adapted. - AEC/TDC technique: For the selected RGDV no measuring unit has been assigned yet. 															
70 kV 0 ▲ def1	<ul style="list-style-type: none"> - For the selected RGDV no film/screen combination has been programmed yet. 															
<table border="1"> <tr> <td data-bbox="137 1243 400 1283">Test APR</td> <td data-bbox="400 1243 555 1321" rowspan="2" style="background-color: #cccccc;"></td> <td data-bbox="555 1243 821 1283"></td> </tr> <tr> <td data-bbox="137 1283 400 1321"></td> <td data-bbox="555 1283 821 1321"></td> </tr> </table>	Test APR					<ul style="list-style-type: none"> - No APR data have yet been loaded onto the selected RGDV. 										
Test APR																
<table border="1"> <tr> <td data-bbox="137 1350 400 1400">81 kV</td> <td data-bbox="400 1350 555 1400">0 ▲</td> <td data-bbox="555 1350 821 1400">B100</td> </tr> <tr> <td colspan="3" data-bbox="137 1400 821 1440" style="background-color: #cccccc;"></td> </tr> <tr> <td data-bbox="137 1440 400 1480">skull axial</td> <td data-bbox="400 1440 555 1592" rowspan="4" style="background-color: #cccccc;"></td> <td data-bbox="555 1440 821 1480">crâne axial</td> </tr> <tr> <td data-bbox="137 1480 400 1520">Schädel ax.</td> <td data-bbox="555 1480 821 1520">cráneo axial</td> </tr> <tr> <td data-bbox="137 1520 400 1561"></td> <td data-bbox="555 1520 821 1561"></td> </tr> <tr> <td data-bbox="137 1561 400 1592"></td> <td data-bbox="555 1561 821 1592"></td> </tr> </table>	81 kV	0 ▲	B100				skull axial		crâne axial	Schädel ax.	cráneo axial					<ul style="list-style-type: none"> - Ready status. An APR with AEC technique has been selected.
81 kV	0 ▲	B100														
skull axial		crâne axial														
Schädel ax.		cráneo axial														

6. Switch-on problems

6.1. Switch-on not possible

See drawings: Z1-2.1 / 2.2 / 2.3
Z2-2

H1 on PCB EN100 is not illuminated.

- Error sources:
- ENF1 was released.
For fault-finding look in the error buffer.
 - ENF1 is not switched on.
 - Mains voltage, especially phase L3, is not present.
 - ENF2 was released.
Check: Low-voltage supply
Filament circuit
Tube extension
Rotor control
External current consumers
 - ENF2 is not switched on.
 - PCB EN100 or its connections are not okay.

H1 on PCB EN100 is illuminated.

- Error sources:
- The EMERGENCY-OFF circuit is open.
 - The operating desk is not connected.

6.2. No start up

- Error sources:
- EN 100 V1 is defective.
The generator receives a continuous reset via signal: reset sw/.
All red LEDs of the generator are illuminated.
Also see Z1-2.1.
Test: Remove link EZX44:14 --- EZX44:6.
 - No boot PROM present: EZ 139 D3 (see 5Z-1)
 - Flash PROMs EZ139 D4/D5 not correctly loaded.

7. Error numbers

7.1. Error classification

Errors:

- Errors are indicated by 4 digits.
- The first two digits indicate the functional unit FU reporting the error.
 - 00xx = CU-functional unit is concerned
 - 02xx = kV-functional unit is concerned
 - 03xx = mA-functional unit is concerned
- The last two letters indicate the error symptom.

Displayed errors (Errors and Fatal errors) :

- These errors are indicated on the display of the operating desk for the customer.
- The customer must call the service.
 - The customer can inform the service about the respective error number and the service can order the spare parts needed at an early stage of the maintenance procedure.

Not displayed errors (Warnings) :

- These errors are not relevant for the customer.
- In case an error of this category occurs frequently within a certain period of time, a displayed error can be generated.

7.2. Error list

Sources of error codes indicated in the first two digits (hex):

00 ..	CU	central unit EZ139
01 ..	FU_DRC	dose rate control, control physically located on CU EZ139, parts of basic interface FU_CIE EZ150 also involved (Amplimat), FU_DRC also handles fluoro
02 ..	FU_kV	kV control EZ130
03 ..	FU_mA_a	1st mA control EZ119, handles 2 filaments
04 ..	FU_mA_b	2nd mA control, has been foreseen <ul style="list-style-type: none"> - to drive the third filament of a 3 focus tube (does not yet exist) - to feed a MRC tube in a mixed configuration SRO-MRC
05 ..	FU_mA_c	3rd mA control
06 ..	FU_mA_d	4th mA control
07 ..	FU_CIE	central interface extension EZ150
08 ..	FU_HI_a	human interface 1 C300
09 ..	FU_HI_b	2nd human interface
0A ..	(HEX)	will be changed to 10 .. (this is how they appear and how they are listed in the error list, same with 0B .. = 11 .. etc.
0A .. = 10 ..	FU_RC_a	1st rotor control high speed EY100
0B .. = 11 ..	FU_RC_b	2nd rotor control high speed (mixed use of SRO and MRC tubes, not yet foreseen Release 2 and 3)
0C .. = 12 ..	FU_RC_c	3rd rotor control high speed
0D .. = 13 ..	FU_ADAP_a	adapter decade cable for 4 aux. units RAD WA/1WA WA/1WA102
0E .. = 14 ..	FU_ADAP_b	ditto 2WA 2WA102
0F .. = 15 ..	FU_ADAP_c	ditto WB/1WB WB/1WB102
10 .. = 16 ..	FU_ADAP_d	ditto 2WB (not yet available) 2WB102
11 .. = 17 ..	FU_MDO	monitor data overlay (not yet available)
12 .. = 18 ..	FU_ANA	analog I/O interface

Class: Fatal error, Error, Warning

Error class explanation

00B0	E/W	CPU:	Error in application data service interface
00B1	E/W	CPU:	IIM was not expected by gen_order_list
00B2	E/W	CPU:	HI order is not expected - NO Member in display_tab
00B3	E/W	NVRAM:	data language selector is invalid
00B4	E/W	CPU:	message invalid in ADopmes
00B5	E/W	CPU:	Inputparameter out of range in ADsynta
00B6	E/W	NVRAM:	FU adap data for DI are invalid
00B7	E/W	CPU:	Message can not be send
00B8	E/W	NVRAM:	tomo mode switch can not be enabled
00BA	E/W	NVRAM:	data of RGDV are invalid
00BB	E/W	NVRAM:	basedata of RGU are invalid
00BC	E/W	NVRAM:	statedata of RGU are invalid
00BD	E/W	NVRAM:	data of APR are invalid
00BE	E/W	NVRAM:	data of active RGU are invalid
00BF	E/W	NVRAM:	data of RGKeys are invalid
00BG	E/W	APR:	no more lowest level menus available
00BH	E/W	APR:	display position collision
00BI	E/W	APR:	menu/APR mismatch in same level
00BJ	E/W	APR:	menu name not found
00BK	E/W	APR:	APR is assigned to a different RGDV
00BL	E/W	APR:	menu name already exists
00BM	E/W	APR:	max display position reached
00BN	E/W	APR:	APR not found in this menu
00BO	E/W	NVRAM:	data of menu tree are invalid
00BQ	E/W	CPU:	APR can not be modified
00BR	E/W	CPU:	APR is not assigned to an RGDV
00BS	E/W	APR:	The RGDV of the APR is not ready for operation
00BT	E/W	NVRAM:	data of APR characteristics are invalid
00BU	E/W		Adaptation paused due to missing load
00BV	E/W	CPU:	TTS status message during adaptation
00BW	E/W	APR:	APR not accepted by general calculation
00BX	E/W	NVRAM:	variofocus allowed invalid
00BY	E/W		RGDV order without active RGDV

Error	class	explanation
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00CB	W	CONF: Received IIM #1#2H unknown
00CC	W	CAN: frame-repeat-counter overflow (IIM #1#2H)
00CD	W	CAN: FU #1H not addressable
00CE	W	CAN: rx-signal conflict (FU #1H)
00CF	W	CAN: no RTR from FU #1H
00CG	W	CPU: domain tx response Mailbox type wrong
00CH	W	CPU: Invalid tbdor-Parameter FU_type
00CJ	W	CAN auto configuration successful (#1H)
00CK	W	CAN auto configuration without success (#1H)
00CL	W	CAN: FU #1H not addressable
00CM	W	CAN: FU #1H sent event and did not answer RTR
00CP	W	CAN: Max FU count exceeded
00CQ	W	SYSCAN: Radiography system is not responding
00CR	W	SYSCAN: Guarded connection failed
00CX	W	CAN: last-only-repeat-counter overflow (IIM #1#2H)
00CY	W	CAN: abort of rx of IIM #1#2H (unexp frame)
00CZ	W	CAN: unexpected frame received after IIM #1#2H
00DA	E/W	No CPU-Access to CAN-chip
00DB	W	CAN-chip reset not acknowledged
00DC	W	CAN-chip reset release not acknowledged
00DD	W	CAN-chip DPRAM check failed
00DE	E/W	unexpected CAN-chip int-pointer
00DF	W	CAN-chip state undefined
00DG	W	CAN-chip error-active after passive #1H
00DH	W	CAN-chip state error-passive #1H
00DI	E	CAN-chip state bus-off #1H
00DJ	W	CAN-chip state DPRAM-error
00DK	W	CAN-chip state DPRAM-error&passive
00DL	W	unexpected CAN-chip interrupt
00DM	W	CAN: frame error (code #1H)
00E0	E/W	iRMX exception #2#1H occurred.
00G0	E/W	variable in case statement has undefined value
00G1	E/W	condition_code <> OK after CALL to send
00G2	E/W	condition_code <> OK after CALL to init
00I1	E/W	CPU: Index to I/O-table is wrong
00I2	E/W	No interrupt reason on sig-bus

Error	class	explanation
00I3	E/W	No interrupt reason on XS-bus
00I4	E/W	One FU has a WD-error, scantime_TV is not programmed correctly See: XRGSCOPE --> OPTIMUS --> Program --> Dose rate control --> CONT: scantime_TV = 20.00 ms
00L1	E/W	GC: checksum error
00L2	E/W	GC: data access error
00L3	E/W	GC: limit data error
00L4	E/W	GC: limits inconsistent
00L5	E/W	GC: calculation error
00L6	E/W	GC: function not implemented
00M0	E/W	Unable to initialize FU(s) #1H, #2H, #3H, #4H, #5H, #6H
00M1	E/W	Configuration key is missing or defective
00M2	E/W	Unable to initialize the FU mA
00M3	E/W	No response at all from FU(s) #1H, #2H, #3H, #4H, #5H, #6H
00PA	E/W	CPU: IIM/MSD number unknown
00PB	E/W	CPU: technic mode unknown
00PC	E/W	CPU: value limit overflow
00PD	E/W	PC comm: unknown TDL proc id
00PE	E/W	NVRAM: DRC NV checksum error
00PF	E/W	CPU: equal kV-sets from CU comes twice
00PG	E/W	CPU: kV sequence don t increase
00PH	E/W	CPU: EDL isn t possible min_mA limit
00PI	E/W	CPU: DCALC Dr_curve has only one element
00PJ	E/W	CPU: DCALC Dr_curve has strange values
00PK	E/W	CPU: equal kV-sets from CU with equal mA
00PL	E/W	CPU: dose digits disturbance
00S*	Service	PCcomm: Service access trace
00S?	E	PCcomm: Unexpected error
00SA	E	PCcomm: Not enough space at destination segment
00SB	E	PCcomm: Base out of range
00SC	E	PCcomm: Value too large
00SD	E	PCcomm: Terminator not found
00SE	E	PCcomm: Error in description
00SF	E	PCcomm: Item type unknown
00SG	E	PCcomm: Internal type unknown
00SH	W	PCcomm: Value negative
00SI	E	PCcomm: Not enough space at destination buffer
00SJ	E	PCcomm: Syntax wrong

Error	class	explanation
00SK	E	PCcomm: String too long
00SL	W	PCcomm: String truncated
00SM	E	PCcomm: TDL segment overflow
00SN	E	PCcomm: FU Reference Table full
00SO	E	PCcomm: Node ID unknown
00SP	E	PCcomm: FU Code unknown
00SQ	E	PCcomm: Syntax error in node ID
00SR	W	PCcomm: No node ID found
00SS	E	PCcomm: Request not performed
00ST	E	PCcomm: RMX error
00SU	W	PCcomm: Enumeration element not found
00SV	E	PCcomm: Mail corrupted
00SW	E	PCcomm: Procedure ID unknown
00SX	E	PCcomm: FU mA incompatible
00SY	E	PCcomm: FU Off request failed
00SZ	E	PCcomm: Wrong response
00T?	E	TTS: Unexpected Error
00TA	E	TTS: Received Message unknown
00TB	E	TTS: Tube Supervision Error from FU kV; thermal switch of tube housing okay?
00TC	E	TTS: Internal TTS Error
00TD	E	TTS: Tube Number unknown
00TE	E	TTS: NVRAM Checksum Error
00TF	E	TTS: NVRAM unavailable
00TG	E	TTS: Tube overheated
00TH	W	TTS: Load Data Supply inconsistent
00X0	E/W	CPU: wrong timer id
00X1	E/W	CPU: wrong timer mode
00X2	E/W	CPU: wrong message type
00X3	E/W	CPU: DWORD does not fit into BYTE3
00X4	E/W	timeout of X-ray backup timer
00X5	E/W	timeout of X-ray rotation timer
00X6	E/W	timeout setting FUs, response missing
00X7	E/W	CPU: curve token is NO_TOKEN
00XA	E/W	NVRAM: switch table invalid
00XB	E/W	NVRAM: tube data rotation invalid
00XC	E/W	NVRAM: watch dog invalid

Error	class	explanation
00XD	E/W	NVRAM: konfi table invalid
00XE	E/W	NVRAM: test data invalid
00XF	E/W	NVRAM: RoCo data invalid
00XG	E/W	CPU: received IIM is unknown
00XH	E/W	CPU: received FU-type is unknown
00XI	E/W	init with FU-RoCo not OK
00XJ	E/W	exposure time too short
00XK	E/W	CPU: FUmA refuses set data
00XL	E/W	NVRAM: tube yield table invalid
00XM	E/W	NVRAM: add filter corr table invalid
00XN	E/W	NVRAM: wedge filter corr table invalid
00XO	E/W	exposure time too long
00XP	E/W	exposure time too long
00XQ	E/W	NVRAM: tube statistic data invalid
00XR	E/W	NVRAM: gsta data invalid
00XS	E/W	tube no in CU and FUKV different
00XT	E/W	rotation in CU and FURoCo FUCIE diff.
02AB	W	procedure called with wrong parameter
02AC	E	wrong index for table access
02AD	E	wrong do case entry
02AE	W	unknown IIM received
02AF	W	IIM parameter out of range
02CA	W	Error in CASE selector
02CB	W	A CAN message with wrong IIM-no (no recipient defined) received
02CC	W	multiple reception of the same CAN frame (transmitter ill)
02CE	W	unexpected signal value in CAN rx task
02CF	W	CAN bus timeout while domain transmission
02CG	W	token of CAN response mailbox is not a mailbox token
02CX	W	multiple rx of the same CAN last/only frame (transmitter ill)
02CY	W	aborted CAN domain receive (because of timeout or wrong signal)
02CZ	W	unexpected CAN domain frame received (outside IIM-reception)
02DA	W	no CPU access to the CAN controller
02DB	W	reset or release of the CAN controller was not acknowledged
02DD	W	check of the DPRAM of the CAN controller failed
02DE	W	unexpected interrupt pointer in the CAN controller
02DF	W	CAN controller state undefined

Error	class	explanation
02DG	W	CAN controller state ERROR ACTIVE after ERROR PASSIVE
02DH	W	CAN controller state ERROR PASSIVE
02DI	W	CAN controller state BUS OFF
02DJ	W	CAN controller state DPRAM ERROR
02DK	W	CAN controller state DPRAM ERROR and ERROR PASSIVE
02EA	E	interrupt 0: divide by zero
02EB	E	interrupt 1: single step
02EC	E	interrupt 2: NMI
02ED	E	interrupt 3: breakpoint
02EE	E	interrupt 4: overflow exception
02EF	E	interrupt 5: array bounds exception
02EG	E	interrupt 6: unused opcode
02EH	E	interrupt 7: ESC opcode
02EI	E	CAN connection to CU lost
02GA	W	interpolation not possible
02HA	W	kV nominal value out of range: $\pm (4 \% + 1 \text{ kV})$; 3 detections within 30 ms
02HB	E	kV nominal value out of range: $0 \text{ kV} > U > 170 \text{ kV}$
02HC	W	Z nominal value out of range: $\pm 1 \% \pm 0.2$; 3 detections within 30 ms; duty cycle range 3 %...30 %
02HD	E	Z nominal value out of range: $0 \% > Z > 50 \%$
02HE	W	kV value during standby too large: $> 3 \text{ kV}$ for $> 400 \text{ ms}$ after PREP
02HF	E	kV value during standby too large: $> 4 \text{ kV}$ for $> 400 \text{ ms}$ after PREP
02HG	W	kV actual value out of range: $\pm (4 \% + 1 \text{ kV})$; 2 detections within 20 ms
02HH	E	kV actual value out of range: $20 \text{ kV} > U > 170 \text{ kV}$; 3 detections within 30 ms
02HI	W	E value during standby out of range: $470 \text{ V} > E > 780 \text{ V}$; 3 detections within 30 ms
02HJ	E	E value during standby out of range: $450 \text{ V} > E > 800 \text{ V}$; 3 detections within 30 ms
02HK	W	E value during high tension out of range: $400 \text{ V} > E > 780 \text{ V}$; 3 detections within 30 ms
02HL	E	E value during high tension out of range: $350 \text{ V} > E > 800 \text{ V}$; 3 detections within 30 ms
02HM	W	converter 1 temperature out of range: $0 \text{ } _\text{C} > T > 85 \text{ } _\text{C}$; 3 detections within 30 ms
02HN	E	converter 1 temperature out of range: $0 \text{ } _\text{C} > T > 90 \text{ } _\text{C}$; 3 detections within 30 ms
02HO	W	converter 2 temperature out of range: $0 \text{ } _\text{C} > T > 85 \text{ } _\text{C}$; 3 detections within 30 ms
02HP	E	converter 2 temperature out of range: $0 \text{ } _\text{C} > T > 90 \text{ } _\text{C}$; 3 detections within 30 ms
02HQ	W	high tension tank temperature out of range: $0 \text{ } _\text{C} > T > 80 \text{ } _\text{C}$; 3 detections within 30 ms
02HR	E	high tension tank temperature out of range: $0 \text{ } _\text{C} > T > 85 \text{ } _\text{C}$; 3 detections within 30 ms
02HS	W	divider test cathode out of range: $45.5 \text{ kV} > U > 50.5 \text{ kV}$; 3 detections within 30 ms
02HT	E	divider test cathode out of range: $43 \text{ kV} > U > 53 \text{ kV}$; 3 detections within 30 ms

Error	class	explanation
02HU	W	divider test anode out of range: 45.5 kV > U > 50.5 kV; 3 detections within 30 ms
02HV	E	divider test anode out of range: 43 kV \approx U > 53 kV; 3 detections within 30 ms
02HW	W	kV anode out of range, asymmetric ? : \pm 15%; 2 detections within 20 ms
02HX	E	kV anode out of range, asymmetric ? : \pm 15%; 3 detections within 30 ms
02MA	E	state request not accepted because of grid mode
02MB	E	state request not accepted because of error state
02MC	W	state requested by CU unknown
02OA	E	RMX error: timeout
02OB	E	RMX error: memory
02OC	E	RMX error: busy
02OE	E	RMX error: limit
02OF	E	RMX error: context
02OG	E	RMX error: exist
02OH	E	RMX error: state
02OI	E	RMX error: not configured
02OJ	E	RMX error: interrupt saturation
02OK	E	RMX error: interrupt overflow
02OL	E	RMX error: transmission
02OM	E	RMX error: divide by zero
02ON	E	RMX error: overflow
02OO	E	RMX error: type
02OP	E	RMX error: parameter
02OQ	E	RMX error: bad call
02OR	E	RMX error: array bound
02OS	E	RMX error: NDP error
02OT	E	RMX error: illegal opcode
02OU	E	RMX error: emulator trap
02OV	E	RMX error: interrupt table limit
02OW	E	RMX error: CPU xfer data limit
02OX	E	RMX error: wrap around
02OY	E	RMX error: check exception
02OZ	E	RMX error: unknown
02RA	W	grid mode changeover requested during prep
02RB	W	tube switch requested during preparation
02RC	W	requested P out of range
02SA	W	Not enough space at the destination

Error	class	explanation
02SB	W	Base out of range
02SC	W	PC comm.: Value too large
02SD	W	Terminator not found
02SE	W	PC comm.: Error in description
02SF	W	PC comm.: Item type unknown
02SG	W	PC comm.: Internal type unknown
02SH	W	PC comm.: Value negative
02SI	W	PC comm.: No space at dest. buffer
02SJ	W	PC comm.: Syntax wrong
02SK	W	PC comm.: String too long
02SL	W	PC comm.: String truncated
02SO	W	PC comm.: Unknown Table ID Received
02SP	W	PC comm.: Access Level to Low
02SQ	W	PC comm.: Unknown Action Requested
02SR	W	PC comm.: Routing or Message Corrupt
02SS	W	Source Buffer to Small for Incoming Message
02ST	W	CAN Buffer to Small for Outgoing Message
02SU	W	PC comm.: Access. level is N_A
02UA	E	HW configuration identifier wrong
02UB	W	Set Up request received during preparation
02WA	W	wrong tube selected
02WB	E	wrong tube selected
02WC	W	EN X C signal faulty
02WD	E	EN X C signal faulty
02WE	W	wrong grid mode selected
02WF	E	wrong grid mode selected
02WG	W	tube arcing detected
02WH	E	tube arcing detected
02WI	W	kV over voltage detected
02WJ	E	kV over voltage detected
02WK	W	measuring not stable
02WL	E	Tube Supervision Error
02WM	E	Tube Supervision Error
03AA	W	Internal parameter error
03AB	W	Wrong parameter from CU
03AC	W	le-regulation active on two filaments; only in case of VARIOFOCUS

Error	class	explanation
03AI	W	Wrong IIM received
03BA	W	Coordinates not monotonous; boost adaptation error
03BB	W	No measurement values for adap. found
03CA	W	Error in CASE selector
03CB	W	A CAN message with wrong IIM-no (no recipient defined) received
03CC	W	multiple reception of the same CAN frame (transmitter ill)
03CE	W	unexpected signal value in CAN rx task
03CF	W	CAN bus timeout while domain transmission
03CG	W	token of CAN response mailbox is not a mailbox token
03CX	W	multiple rx of the same CAN last/only frame (transmitter ill)
03CY	W	aborted CAN domain receive (because of timeout or wrong signal)
03CZ	W	unexpected CAN domain frame received (outside IIM-reception)
03DA	W	no CPU access to the CAN controller
03DB	W	reset or release of the CAN controller was not acknowledged
03DD	W	check of the DPRAM of the CAN controller failed
03DE	W	unexpected interrupt pointer in the CAN controller
03DF	W	CAN controller state undefined
03DG	W	CAN controller state ERROR ACTIVE after ERROR PASSIVE
03DH	W	CAN controller state ERROR PASSIVE
03DI	W	CAN controller state BUS OFF
03DJ	W	CAN controller state DPRAM ERROR
03DK	W	CAN controller state DPRAM ERROR and ERROR PASSIVE
03EA	E	CPU interrupt 0
03EB	E	CPU interrupt 1
03ED	E	CPU interrupt 3
03EE	E	CPU interrupt 4
03EF	E	CPU interrupt 5
03EG	E	CPU interrupt 6
03EH	E	CPU interrupt 7
03EI	E	CAN is unable to send an error to CU
03FA	W	NVRAM: Invalid checksum
03FB	W	NVRAM: Standby filament not found
03FC	E	No NVRAM plugged in
03FD	W	NVRAM empty; battery?
03GA	E	Linint error
03GB	W	Real math. error: real underflow

Error	class	explanation
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03GC	W	Real math. error: real overflow
03GD	W	Real math. error: dword overflow
03GE	W	Real math. error: integer overflow
03GF	W	Real math. error: word overflow
03GG	W	Singular matrix
03HA	E	Unknown hardware
03HB	E/W	Intermediate circuit voltage < 200 V
03HF	W	Undefined analog input channel
03HG	W	If-actual out of tolerance
03HH	E	If setpoint too large
03HI	E	If-actual out of tolerance
03HJ	E	If-actual out of tolerance
03HK	W	If-nominal out of tolerance
03HL	E	If-nominal out of tolerance
03HM	E	If-nominal out of tolerance
03HN	E	No retrigger received from CU
03IA	W	Adaptation can not be completed
03IC	W	No le-adaptation measurement values
03ID	W	le-adaptation values not evaluable
03KA	W	Condi.-X-ray mode without mAs parameter
03MA	W	Undefined status
03MB	W	Status change not allowed
03MC	W	FU init data not expected
03OA	E	RMX exception: E\$TIME
03OB	E	RMX exception: E\$MEM
03OC	E	RMX exception: E\$BUSY
03OD	E	RMX exception: E\$LIMIT
03OE	E	RMX exception: E\$CONTEXT
03OF	E	RMX exception: E\$EXIST
03OG	E	RMX exception: E\$STATE
03OH	E	RMX exception: E\$NOT\$CONFIGURED
03OI	E	RMX exception: E\$INTERRUPT\$SATURATION
03OJ	E	RMX exception: E\$INTERRUPT\$OVERFLOW
03OK	E	RMX exception: E\$TRANSMISSION
03OL	E	RMX exception: E\$ZERO\$DIVIDE
03OM	E	RMX exception: E\$OVERFLOW

Error	class	explanation
03ON	E	RMX exception: E\$TYPE
03OO	E	RMX exception: E\$PARAM
03OP	E	RMX exception: E\$BAD\$CALL
03OQ	E	RMX exception: E\$ARRAY\$BOUND
03OR	E	RMX exception: E\$NDP\$ERROR
03OS	E	RMX exception: E\$ILLEGAL\$OPCODE
03OT	E	RMX exception: E\$EMULATOR\$TRAP
03OU	E	RMX exception: E\$INTERRUPT\$TABLE\$LIMIT
03OV	E	RMX exception: E\$CPUXFER\$DATA\$LIMIT
03OW	E	RMX exception: E\$SEG\$WRAP\$AROUND
03OX	E	RMX exception: E\$CHECK\$EXCEPTION
03OY	E	unknown RMX exception
03PA	E	le zero measured
03PB	W	le out of tolerance: $\pm 10\%$ ($le > 5\text{ mA}$, exp. time $\leq 44\text{ ms}$) or $\pm 3\%$ ($le > 5\text{ mA}$, exp. time $> 44\text{ ms}$)
03PC	E	le out of tolerance: $\pm 30\%$ ($le > 5\text{ mA}$, exp. time $> 44\text{ ms}$)
03PD	W	Setpoint for le-regulation incorrect
03PE	E	Emergency off! Grid not closed!
03PF	E	No kV discharged due to missing le
03SC	W	PC comm.: Value too large
03SE	W	PC comm.: Error in description
03SF	W	PC comm.: Item type unknown
03SG	W	PC comm.: Internal type unknown
03SH	W	PC comm.: Value negative
03SI	W	PC comm.: No space at dest. buffer
03SJ	W	PC comm.: Syntax wrong
03SK	W	PC comm.: String too long
03SL	W	PC comm.: String truncated
03SO	W	PC comm.: Unknown Table ID Received
03SP	W	PC comm.: Access Level to Low
03SQ	W	PC comm.: Unknown Action Requested
03SR	W	PC comm.: Routing or Message Corrupt
03SU	W	PC comm: Access. level is N_A (not available)
07CA	E	CAN: case-selector error
07CB	W	CAN: invalid CAN ID %u
07CC	E	CAN: frame rep. overflow IIM%u

Error	class	explanation
07CD	E	CAN: no RTR from CU
07CE	E	CAN: rx signal conflict IIM%u
07CF	E	CAN: tx timeout
07CI	W	CAN: IMPOSSIBLE ERROR
07CP	W	CAN: CPU: PXerr %d %s(%d)
07CR	W	CAN: CPU: message request fail
07CS	W	CAN: CPU: message send error
07CY	E	CAN: rx abort IIM%u
07CZ	W	CAN: unexpected frame (IIM%u)
07DA	E	CAN: chip access error
07DB	E	CAN: chip reset error
07DC	E	CAN: chip reset release error
07DE	W	CAN: illegal interrupt pointer
07DF	E	CAN: chip state undefined
07DG	W	CAN: chip err act. after pass.
07DH	W	CAN: chip state error passive
07DI	W	CAN: chip state bus-off
07DJ	E	CAN: chip DPRAM Error
07DK	W	CAN: chip DPRAM Error&passive
07DL	W	CAN: unexpected interrupt
07LA	W	CV received IIM unknown
07LB	W	RC Stator number out of range
07LC	W	RC Stator not available
07LD	E	RC Stator 1 readback failed
07LE	E	RC Stator 2 readback failed
07LF	E	RC Stator 3 readback failed
07LG	W	RC Speed value out of range
07LH	E	RC Speed set timeout
07LI	W	RC Maximal stator load exceeded
07LJ	E	RC Maximal rotation time exceeded
07LK	W	AM Amplimat chamber number out of range
07LL	W	AM Amplimat field number out of range
07LM	W	AM Amplimat delay value out of range
08CA	E	CAN: case-selector error
08CB	W	CAN: invalid CAN ID %u
08CC	E	CAN: frame rep. overflow IIM%u

Error	class	explanation
08CD	E	CAN: no RTR from CU
08CE	E	CAN: rx signal conflict IIM%u
08CF	E	CAN: tx timeout
08CI	W	CAN: IMPOSSIBLE ERROR
08CP	W	CAN: CPU: PXerr %d %s(%d)
08CR	W	CAN: CPU: message request fail
08CS	W	CAN: CPU: message send error
08CY	E	CAN: rx abort IIM%u
08CZ	W	CAN: unexpected frame (IIM%u)
08DA	E	CAN: chip access error
08DB	E	CAN: chip reset error
08DC	E	CAN: chip reset release error
08DE	W	CAN: illegal interrupt pointer
08DF	E	CAN: chip state undefined
08DG	W	CAN: chip err act. after pass.
08DH	W	CAN: chip state error passive
08DI	W	CAN: chip state bus-off
08DJ	E	CAN: chip DPRAM Error
08DK	W	CAN: chip DPRAM Error&passive
08DL	W	CAN: unexpected interrupt
08HA	E	no message receive displaytask
08HB	E	no message release displaytask
08HC	E	APR not found
08HD	E	offset in menu structure out of range
08HF	E	no message request for test task
08HG	E	no message send for test task
08HH	E	APR BUFFER FULL
08HI	E	no message send for ODD task
08HJ	E	no send message to CU from ODD
08HJ	E	no message send for Service task
08HK	E	Data error in CAN message
08IE	E	wrong setup IIM
08SA	E	no request domtxtask when scanning
08SB	E	no request domtxtask when testing
08SC	E	no send message to task2_sc
10CA	E	CAN: case-selector error

Error	class	explanation
10CB	W	CAN: invalid CAN ID %u
10CC	E	CAN: frame rep. overflow IIM%u
10CD	E	CAN: no RTR from CU
10CE	E	CAN: rx signal conflict IIM%u
10CF	E	CAN: tx timeout
10CI	W	CAN: IMPOSSIBLE ERROR
10CP	W	CAN: CPU: PXerr %d %s(%d)
10CR	W	CAN: CPU: message request fail
10CS	W	CAN: CPU: message send error
10CY	E	CAN: rx abort IIM%u
10CZ	W	CAN: unexpected frame (IIM%u)
10DA	E	CAN: chip access error
10DB	E	CAN: chip reset error
10DC	E	CAN: chip reset release error
10DE	W	CAN: illegal interrupt pointer
10DF	E	CAN: chip state undefined
10DG	W	CAN: chip err act. after pass.
10DH	W	CAN: chip state error passive
10DI	W	CAN: chip state bus-off
10DJ	E	CAN: chip DPRAM Error
10DK	W	CAN: chip DPRAM Error&passive
10DL	W	CAN: unexpected interrupt
10IF	W	initialization failed
10LA	W	acceleration count limit exceeded
10LC	W	current limit exceeded
10LH	E/W	intermediate current %u mA (>%u)
10LL	E/W	intermediate current %u mA (<%u)
10LO	E	intermediate voltage %u V (>%u)
10LT	E	temperature limit exceeded
10LU	E	intermediate voltage %u V (<%u)
10OE	W	CPU: PXROS error %d
10OF	W	CPU: PXROS error %d %s(%d)
10RC	E	rotation check failed
10RI	E	invalid rotation request : %u
10RM	E	rotation detector not present
10RT	W	rotation request timeout

Error	class	explanation
10TD	E	invalid data for tube %u
10TE	W	stator %u hardware error
10TF	E	stator %u switching failed
10TI	E	invalid stator request : %u
10TR	E	stator change with rotating anode
10UI	W	unknown message from CU: IIM %u
10UM	W	unexpected message from CU: IIM %u
10WT	W	CPU: watchdog timeout
10XX	W	IMPOSSIBLE ERROR
13CA	E	CAN: case-selector error
13CB	W	CAN: invalid CAN ID %u
13CC	E	CAN: frame rep. overflow IIM%u
13CD	E	CAN: no RTR from CU
13CE	E	CAN: rx signal conflict IIM%u
13CF	E	CAN: tx timeout
13CI	W	CAN: IMPOSSIBLE ERROR
13CP	W	CAN: CPU: PXerr %d %s(%d)
13CR	W	CAN: CPU: message request fail
13CS	W	CAN: CPU: message send error
13CY	E	CAN: rx abort IIM%u
13CZ	W	CAN: unexpected frame (IIM%u)
13DA	E	CAN: chip access error
13DB	E	CAN: chip reset error
13DC	E	CAN: chip reset release error
13DE	W	CAN: illegal interrupt pointer
13DF	E	CAN: chip state undefined
13DG	W	CAN: chip err act. after pass.
13DH	W	CAN: chip state error passive
13DI	W	CAN: chip state bus-off
13DJ	E	CAN: chip DPRAM Error
13DK	W	CAN: chip DPRAM Error&passive
13DL	W	CAN: unexpected interrupt
13LA	W	CV Received IIM unknown
13LB	W	IO Wrong bidirectional lines output value
13LC	W	TR TOMO value out of range
13LD	W	TR RGDV value out of range

Error	class	explanation
13LE	E	TR RGDV readback failed
13LF	W	TR Wrong sync contact value
13LG	W	TR Wrong handswitch enable value
13LH	E	PR S1/S2 switch active during startup
14CA	E	CAN: case-selector error
14CB	W	CAN: invalid CAN ID %u
14CC	E	CAN: frame rep. overflow IIM%u
14CD	E	CAN: no RTR from CU
14CE	E	CAN: rx signal conflict IIM%u
14CF	E	CAN: tx timeout
14CI	W	CAN: IMPOSSIBLE ERROR
14CP	W	CAN: CPU: PXerr %d %s(%d)
14CR	W	CAN: CPU: message request fail
14CS	W	CAN: CPU: message send error
14CY	E	CAN: rx abort IIM%u
14CZ	W	CAN: unexpected frame (IIM%u)
14DA	E	CAN: chip access error
14DB	E	CAN: chip reset error
14DC	E	CAN: chip reset release error
14DE	W	CAN: illegal interrupt pointer
14DF	E	CAN: chip state undefined
14DG	W	CAN: chip err act. after pass.
14DH	W	CAN: chip state error passive
14DI	W	CAN: chip state bus-off
14DJ	E	CAN: chip DPRAM Error
14DK	W	CAN: chip DPRAM Error&passive
14DL	W	CAN: unexpected interrupt
14LA	W	CV Received IIM unknown
14LB	W	IO Wrong bidirectional lines output value
14LC	W	TR TOMO value out of range
14LD	W	TR RGDV value out of range
14LE	E	TR RGDV readback failed
14LF	W	TR Wrong sync contact value
14LG	W	TR Wrong handswitch enable value
15CA	E	CAN: case-selector error
15CB	W	CAN: invalid CAN ID %u

Error	class	explanation
15CC	E	CAN: frame rep. overflow IIM%u
15CD	E	CAN: no RTR from CU
15CE	E	CAN: rx signal conflict IIM%u
15CF	E	CAN: tx timeout
15CI	W	CAN: IMPOSSIBLE ERROR
15CP	W	CAN: CPU: PXerr %d %s(%d)
15CR	W	CAN: CPU: message request fail
15CS	W	CAN: CPU: message send error
15CY	E	CAN: rx abort IIM%u
15CZ	W	CAN: unexpected frame (IIM%u)
15DA	E	CAN: chip access error
15DB	E	CAN: chip reset error
15DC	E	CAN: chip reset release error
15DE	W	CAN: illegal interrupt pointer
15DF	E	CAN: chip state undefined
15DG	W	CAN: chip err act. after pass.
15DH	W	CAN: chip state error passive
15DI	W	CAN: chip state bus-off
15DJ	E	CAN: chip DPRAM Error
15DK	W	CAN: chip DPRAM Error&passive
15DL	W	CAN: unexpected interrupt
15LA	W	CV Received IIM unknown
15LB	W	IO Wrong bidirectional lines output value
15LC	W	TR TOMO value out of range
15LD	W	TR RGDV value out of range
15LE	E	TR RGDV readback failed
15LF	W	TR Wrong sync contact value
15LG	W	TR Wrong handswitch enable value
16CA	E	CAN: case-selector error
16CB	W	CAN: invalid CAN ID %u
16CC	E	CAN: frame rep. overflow IIM%u
16CD	E	CAN: no RTR from CU
16CE	E	CAN: rx signal conflict IIM%u
16CF	E	CAN: tx timeout
16CI	W	CAN: IMPOSSIBLE ERROR
16CP	W	CAN: CPU: PXerr %d %s(%d)

Error	class	explanation
16CR	W	CAN: CPU: message request fail
16CS	W	CAN: CPU: message send error
16CY	E	CAN: rx abort IIM%u
16CZ	W	CAN: unexpected frame (IIM%u)
16DA	E	CAN: chip access error
16DB	E	CAN: chip reset error
16DC	E	CAN: chip reset release error
16DE	W	CAN: illegal interrupt pointer
16DF	E	CAN: chip state undefined
16DG	W	CAN: chip err act. after pass.
16DH	W	CAN: chip state error passive
16DI	W	CAN: chip state bus-off
16DJ	E	CAN: chip DPRAM Error
16DK	W	CAN: chip DPRAM Error&passive
16DL	W	CAN: unexpected interrupt
16LA	W	CV Received IIM unknown
16LB	W	IO Wrong bidirectional lines output value
16LC	W	TR TOMO value out of range
16LD	W	TR RGDV value out of range
16LE	E	TR RGDV readback failed
16LF	W	TR Wrong sync contact value
16LG	W	TR Wrong handswitch enable value

7.3. Elimination of error numbers

00PL:

The message 00PL (Error of the AEC signal) may be a "warning" or an error. This depends on the disturbance of the AEC signal. The AEC signal can be measured at pin EZ 150 X4 (signal) to EZ 150 X3 (see also Z1 " Basic interface ").

With using measuring chambers there are three possibilities to get the error "00PL"

1. The shielding of the measuring chamber has a connection to system ground (at the measuring chamber or interconnection)
2. In the cable to the measuring chamber is a missing ground connection. (This mistake is not possible with the ACL chamber type, PEI No. 9890 000 016xx.)
3. The measuring chamber is defective.

Localization and elimination of the error source:

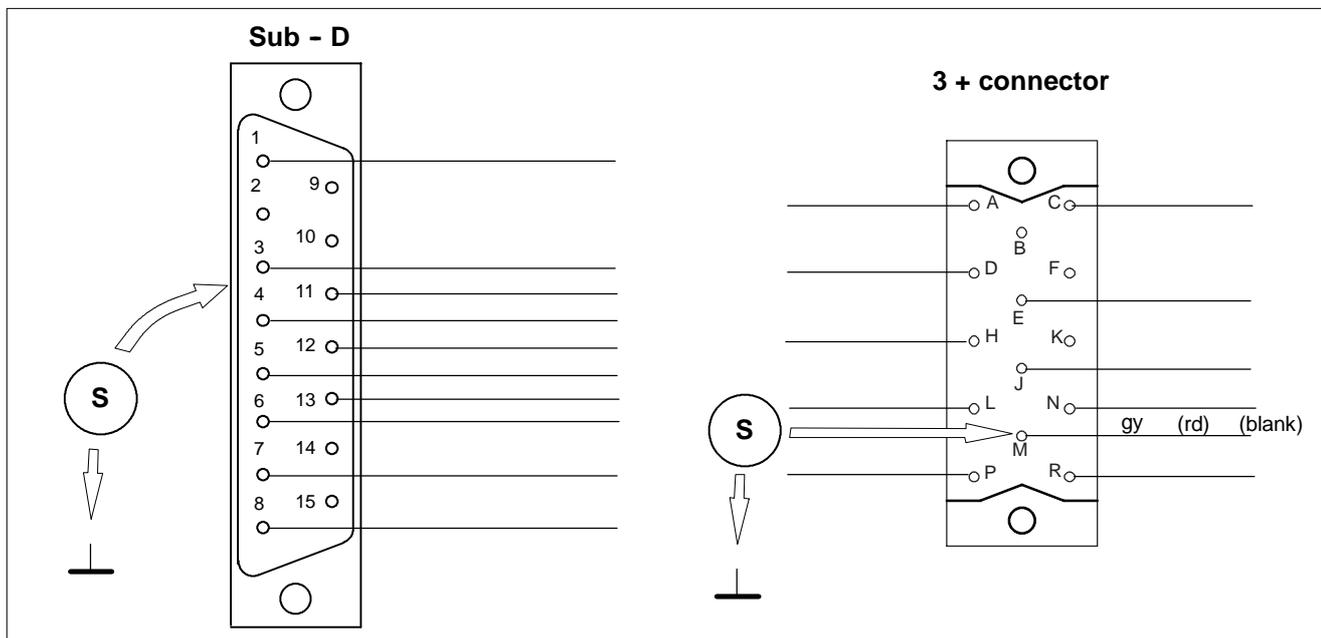
Re 1.)

S Remove the connector of the measuring chamber at generators side.

S Measure connection:

- "shielding" (sub - D connector) to system ground, or
- pin "M" (3+ connector, 14 pins) to system ground.

No connection must be present!



S Measure connection:

- "shielding" (D-sub connector) to chamber shielding or
- pin "M" (3+ connector 14 pins) to chamber shielding

The connection must be present.

Re 2.)

The connector of the measuring chamber at generators side has been removed.

S Measure the connection between pin "8" and pin "13" (D-sub connector). The connection must be present.

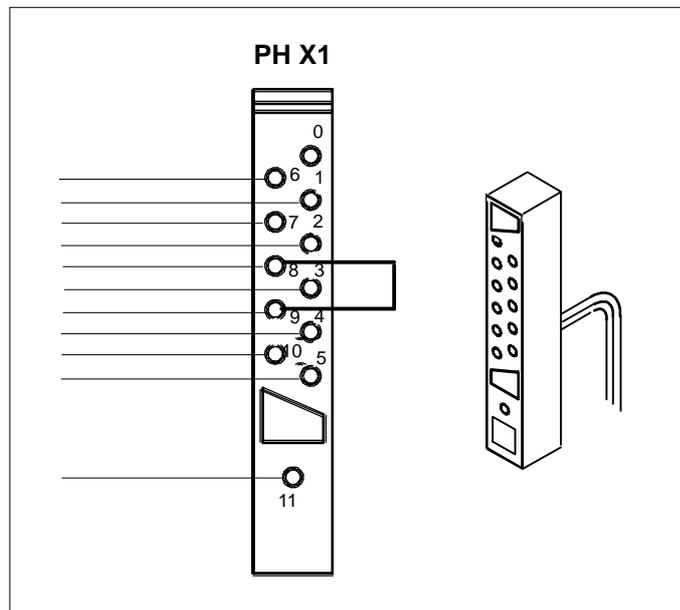
S If it is not, insert a link between pin "8" and "9" at the chamber cable at the chamber end as shown in the figure.

In this case the system is most probably operated with an old hybrid measuring chamber 9803 509 xxxxx instead of an ACL measuring chamber 9890 000 016xx.

In hybrid measuring chambers the connection between pin 8 - 9 is missing.

In case a 3+ connector (AMP 14 pin) is used, the connection pin N --- J is most probably missing since this connection is not present in hybrid measuring chambers.

To increase the interference protection it is advisable to establish the above mentioned connection at the chamber end of the chamber cable pin 8 --- 9 in addition to the connection in the adapter for the AMPLIMAT cable (see Z1 Basic interface).

Re 3.):

Use a "test chamber" and compare the function.

8. Power supply

Switch-on not possible:

- ENF1 not switched on (visual check).
- ENF1 released - check for damage before reactivating ENF1/2
(visual check, any smell ?)
- ENF2 not switched on (visual check).
- ENF2 released by

low-voltage supply	}	- check for damage before reactivating ENF 1/2 (visual check, any smell ?)
filament circuit		
tube extension		
external components supply.		
- "ON" circuit EN100 defective.

Phase supervision

a) Without mains adaptation transformer:

- Phase L1 is missing: Mains contactors ENK2 and ENK1 cannot be activated.
- Phase L2 is missing: The generator can be switched on but does not go into the READY state.
The filament-circuit supply is missing.
There is an error message from function unit kV.
- Phase L3 is missing: "ON" circuit without supply voltage.

Fault tracing:

Check leads and fuses up to the mains supply.

b) With mains adaptation transformer:

In case at least one phase at the primary end is missing, the generator cannot be switched on. If there is a problem concerning the leads at the secondary end, refer to a).

After switch-on or attempted switch-on:

The generator cannot be brought into the READY state (e.g. no desk display).

Check the low-voltage supply.

- ENF1 released:
 - Ground fault/short-circuit of one/several phase(s).
 - Check ENK2 and, if necessary, the contacts of ENK1.
 - Check the leads and the mains adaptation transformer.
 - Have contacts ENK2 or ENK1 dropped out?
 - Check visually. Be careful when doing so since the unit is still connected to mains.
- Missing voltage of intermediate circuit:
 - The damping resistors are unsoldered which was caused by overcurrent during switch-on.
 - Cause: Short-circuit in the converter, defective charging capacitors, mains-filter capacitors or rectifiers.
 - Unsoldering happens about 45 sec. after switch on.

The damping resistors are unsoldered because the converter was active and ENK1 was not switched on although activated by the software.

Probably termination of exposure.

This procedure can only happen once since the generator cannot go into STANDBY when intermediate-circuit voltage E is missing.

In case intermediate-circuit voltage E is present, ENK1 is activated by the software of the kV-control and remains activated for the complete time the unit is in operation.

In case of high impedance or when the tolerance of the symmetry resistors of the intermediate-circuit capacitor battery is too large, capacitors may be destroyed by overvoltage. In case ENK1 has already been activated, ENF1 will probably release.

ENF3 is released by the rotor control units.

The release of ENF2 switches the generator off since the supply voltage for the "ON" circuit and, consequently, the supply voltage of contactors ENK2 and ENK1 is interrupted.

9. Functional description of function unit mA

Tube data must be loaded as a data set from floppy disk via PC and central unit CU to into function unit mA.

The procedures described below cannot be carried out before the complete data set for the tube housing assembly is present in central unit CU.

Before the tube adaptation can be started, tube conditioning must be implemented.

With the present generator release the conditioning must be implemented manually.

Later on the conditioning program will take place automatically.

Before adaptation is started, the mA offset value of the mA measuring circuit will be determined.

This offset value consists of two components:

1. A current of 4 mA is impressed upon the mA measuring circuit which is used for continuous calibration (during STANDBY about once per minute).
2. In addition to this the kV measuring circuit delivers an offset current depending on the kV.

To measure this total value an exposure will be released with 40 kV with 500 mA filament current. The emission current measured is the correction value for all standard exposures (4 mA, measuring circuit current depending on the kV).

As opposed to the standby filament current value of the predecessor versions of generators, the standby filament current value of the OPTIMUS generator is not fixed.

It is determined for each focus individually. A 40 kV exposure is released with the focus to be measured while all other foci are switched off.

The filament current will be changed until an emission current of 100 μ A is obtained.

The associated filament current value is the individual standby filament current (1% to be subtracted so that the fluoroscopic current of any of the other foci is not affected).

The following adaptation program takes place fully automatically.

Based on 120 single exposures for each focus a data field is created in the CMOS of function unit mA. The adjustments for all other exposures are interpolated from this data field during operation.

During the adaptation procedure all limit values such as maximum filament current, maximum kV, maximum tube load, maximum output, current of the generator etc. are taken into account.

Boost adaptation

Boost time determination (positive boosting).

With the predecessor versions of generators, a **calculated boost current** was added to the exposure filament current for a **fixed time** of 400 ms.

With OPTIMUS generators the boost current is always fixed but with a **variable time**.

The amount of the boost current is the sum of the maximum filament current (of the respective filament) plus 2000 mA.

To determine the time values an exposure must be started at a kV stage from which on the filament current does not have to be increased anymore to obtain the max. kV dependent emission current.

As soon as the 100% kV value is reached, the filament current jumps from the STANDBY value to the maximum filament current plus 2000 mA. The emission current is measured every 2 ms until the maximum tube current or the maximum possible tube current is reached.

In case this procedure takes too long (warming up of the tube), the measurement is continued with a second exposure after a sufficient period of time has passed.

The measurement starts again at the value obtained last.

An innovation of the OPTIMUS generator is the determination of the **negative boosting** (blanking of the filament current).

The measurement is started at the same kV stage as for the positive boost time but with maximum filament current.

As soon as the 100% kV value is reached, the maximum filament current of the filament jumps down to 500 mA.

Every 2 ms the emission current is measured until a value of 100 μ A is obtained.

The values for the blanking times are required for techniques such as, for instance, cine.

A filament current value of 500 mA must not be exceeded for otherwise the output to supply a gridswitch box (which might be present) is too low.

The following procedure takes place after the generator has been switched on:

Function unit mA initializes itself and afterwards establishes connection with central unit CU via CAN.

For 3 seconds every focus is boosted with the respective specified maximum filament current. Then blanking of the filament current (500 mA) takes place for a variable period of time (derived from negative boost adaptation) to bring the filament current to the STANDBY value (large focus first, then small).

The change of the filament current value upon a change of the focus which was the usual routine for the predecessor versions of the OPTIMUS generator does no longer take place - all STANDBY values remain constant.

During operation the following procedure takes place after the release of PREP:

- The filament current is raised from the individual STANDBY filament current to the boost current.

The switch-on time of the boost current depends on the difference between STANDBY and the exposure (single boost) or intermediate filament (double boost) current.

Double boost:

- The intermediate filament current is a calculated value. It is calculated in such a way that the filament current and thus the filament temperature is brought to exposure level when the boost current is switched on for another 50 ms which the exposure command.
- During exposure the filament current is regulated as required.
- At the end of exposure the filament current is reduced to the minimum value of 500 mA (negative boosting) for a calculated time to bring it from the exposure to the STANDBY value.
- In case preparation is released, negative boosting takes place until heating can go on with the STANDBY filament current.

10. CAN bus

All the intelligent assemblies/pc boards communicate via the CAN bus. There they are connected in parallel to the two lines CAN_L (low) and CAN_H (high).

The data are serially transmitted in the form of so-called frames.

Levels in quiescent state against chassis:

- CAN_L: 2.5 V
- CAN_H: 2.5 V

Levels during data transmission against chassis:

- CAN_L: 0.50 ... 2.25 V
 - CAN_H: 2.75 ... 4.50 V
- } Both levels are opposite.
} The difference must be greater than 1.5 V!

Test points generator CAN:

- CAN_L: EZX71
- CAN_H: EZX72
- Chassis: EZX5

Test points system CAN:

- S_CAN_L: EZX42:2
- S_CAN_H: EZX42:7
- Chassis: EZX42:3

Reference: Z1-5.1, Z2-5.1/5.2

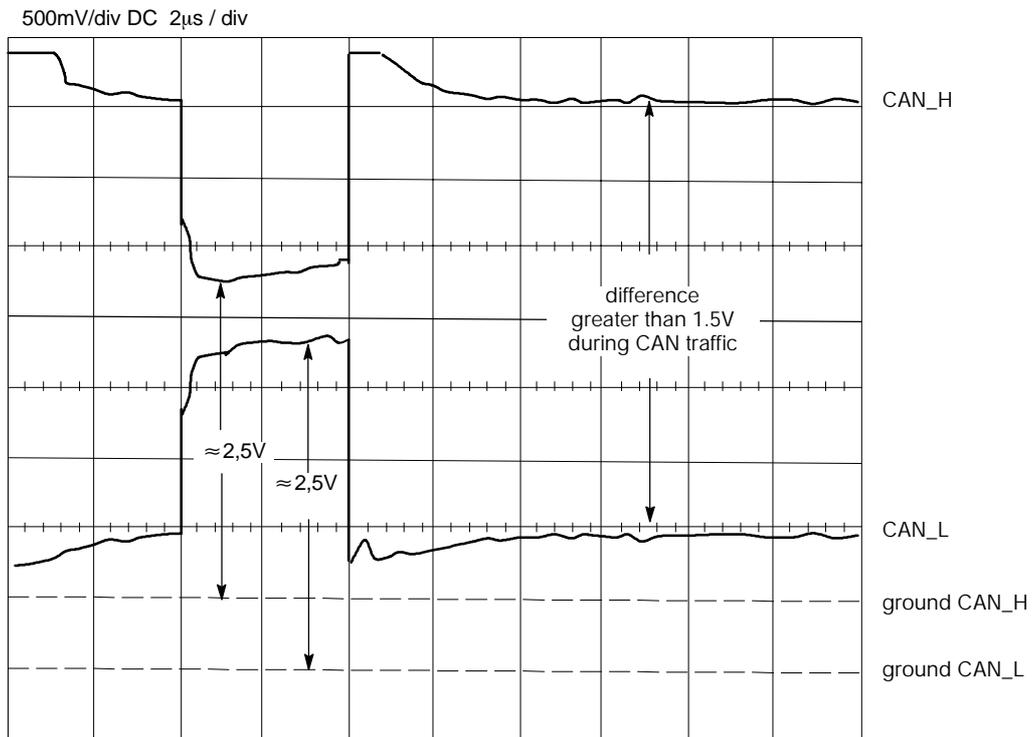
Symptoms of errors:

- The generator is inoperable.
- The red LED of one or more of the assemblies/pc boards is flashing.
- Parameter settings on the control desk are accepted and displayed with a considerable delay.
- In the error memory there are several entries which in the code begin with 00C (apart from 00CJ) or the error description contains a reference to signal conflicts.

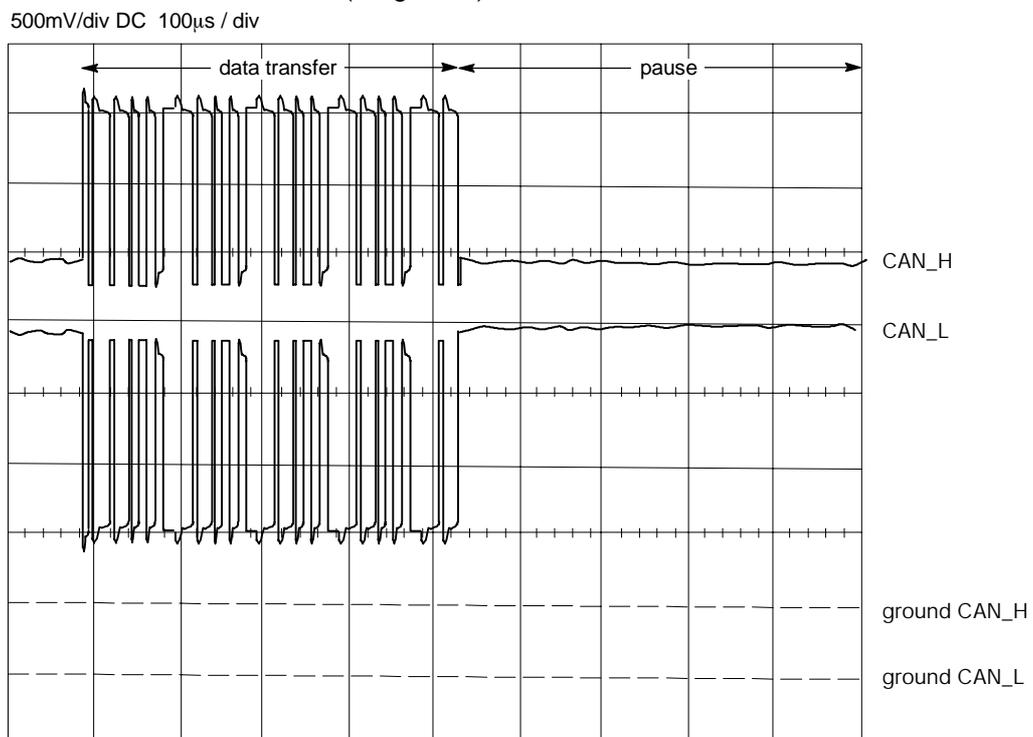
Error localization:

- Entries in the error memory clearly draw attention to the fact that the assembly and pcb are not communicating properly or not at all.
- Control measurement of CAN levels with an oscilloscope during data transmission and in the quiescent state. Data transmission is triggered by pressing any desk button. If the levels are outside the tolerance or are not symmetrical, the CAN driver of an assembly/pcb is faulty. Since all the users are connected to the bus in parallel, the troublemaker can only be found by disconnecting one user after another. Disconnection may only take place with the generator switched off.

CAN levels with a high temporal resolution:
(Diagram 1)



CAN levels with low temporal resolution:
(Diagram 2)



197H96

11. Incorrect exposure indicator

General causes:

On the control desk an incorrect exposure is indicated if an exposure cannot be terminated according to the parameters set. Frequent causes of underexposure are the following:

- The operator has let go of the release switch prematurely.
- Tomography time of the unit does not coincide with the exposure time of the generator. Permissible tolerance: $\pm 10\%$
- Measuring chamber incorrectly programmed, not connected or faulty.
Check the following:
 - RGDV programming
 - Programming of AMPLIMAT sensitivity
 - Programming of EZ150 Basic Interface (Gain, 15 V/40 V supply)
 - Programming of screen-film combination (Data Sets 1...5)
- The APR selected is not matched to the technique used or the screen-film combination.
Check the following:
 - APR programming

The standard APRs supplied have parameters which are generally matched to a 400-type screen-film combination. If the standard APRs are used, the exposure parameters will have to be changed according to the speed of the screen-film combination actually used.

This also applies if an automatic technique is programmed as the preferred technique. In automatic techniques the mAs and ms-parameters are used for Fault Exposure Detection.

Fault exposure detection AEC/TDC:

To protect patients there are 3 monitoring systems for automatic techniques:

1. Maximum mAs product
2. Maximum exposure time or backup time
3. Fault Exposure Detection

The maximum mAs product can be set via xrgscope.

The fault exposure detection can be switched on or off via xrgscope. Irrespective of this, fault exposure detection is not performed if levels fall below certain limits.

AEC/AECF limits:

- Maximum mAs product: 580 mAs (default)
- Maximum exposure time: 4 s
- Backup time AEC: Exposure time based on 10 times the mAs of the respective manual technique (kV-mAs). 4 s after overriding.
- Backup time AECF: 10 times the exposure time of the respective manual technique (kV-mAs).
- Fault Exposure Detection: $\leq 4\%$ dose at 10% backup time

Fault Exposure Detection is ignored under the following circumstances:

- Backup time: ≤ 100 ms (≤ 10 ms at 10%)
- Switch-off voltage (dose): ≤ 610 mV (≤ 24.4 mV at 4%)

If there is a fault an exposure is aborted after about 10% of backup time. If the Fault Exposure Detection fails to respond in the event of a fault, shutdown takes place after reaching backup time or maximum exposure time or max. mAs product.

TDC limits:

- Maximum mAs product: 580 mAs (default)
- Exposure time: 0.3 ... 6 s
- Fault Exposure Detection: $\leq 10 \dots 4\%$ dose for 10 times the sample time

$$\text{Dose minimum} = \frac{10 \times \text{sample time}}{\text{exposure time (corr.)}} \times 40\% \text{ nominal dose}$$
- Backup time: Exposure time
- Sample time: 25 ... 60 ms = 1% exposure time (corr.), min. 25 ms
- Sample steps: 12 ... 100

Fault Exposure Detection is ignored under the following circumstances:

- Exposure time: < 1 s

In the event of a fault the exposure is aborted after approx. 11 times Sample Time. If the Fault Exposure Detection fails to respond in the event of a fault, shutdown takes place after reaching the backup time or the max. mAs product.

The switch-off voltage should be at least 1.2 V to guarantee good TDC regulation. Program the higher gain factor on EZ150 BASIC INTERFACE ($\geq 4512\ 108\ 05964$) if necessary.

Programming possibilities:

- Menu "Program/ Application Limits/ **X-Mode Limits**":
 X-Ray Mode: AEC ... TDC Max. Current Time Product Limit: 580 mAs
- Menu "Program/ Dose Rate Control/ Fault Exposure Detection/ **AEC ... TDC**": on - off

Aids to fault finding:

Menu "Faultfind/ Logging Table/ X-Ray Log/ Dose Rate Control Logging/ ...

- .../ **Read Actual Status**": Technique and parameters of the last exposure
- .../ AEC/ **AEC Calculation**": Data of the selected APR with AEC or AECF
- .../ AEC/ **AEC Trace**": Control values of the last AEC exposure
- .../ TDC/ **TDC Calculation**": Data of the selected APR with TDC
- .../ TDC/ **TDC Trace**": Control values of the last TDC exposure

Adjustment possibilities:

- Menu "Adjust / Dose Rate Control / TDC AMPLIMAT":

P gain factor (def. 50):	}	Do not change any value here without order from DMC Hamburg!
i gain factor (def. 8):		
d gain factor (def. 5):		
min. sample time (def. 40) [ms]: 25 ... 65		

12. Mnemonic and routing list

Example:

MNEMONIC	explanation chain value measuring point trigger point remarks part of supply
----------	--

AC_0V_XG	mains supply 0 V X-ray generator ENX1102-EZX13:2-EZ102X1:DBZ4-EZ119X1:DBZ24 EZ14:2- EZ15:2-EWRX21:2
----------	--

AC_230V_L1	mains supply 230V AC phase 1 ENF3:L1-EZX13:1-EZX102X1:DBZ2 EZ14:1- EZ15:1-EWRX21:1-
------------	--

AC_230V_L2	mains supply 230V AC phase 2 ENF3:L2-EZX13:3-EZ119X1:DBZ26
------------	---

AV_HT_AN	high tension actual value anode side 0V...+3.75V 1V \approx 20kV measuring point EZ130X4
----------	--

AV_HT_CA	high tension actual value cathode side 0V...+3.75V 1V \approx 20kV measuring point EZ130X5
----------	--

AV_HT	high tension actual value 0...+7.5V 1V \approx 20kV measuring point EZ130X3
-------	---

CAN_H	generator CAN high active EZ119X2:C3-EZ130X2:C3-EZ139X2:C3-EZ150X2:C3-EZX44:10-EZX45:10-EZX46:10- -C300X1:10-EZX51:3-EZX151:3-EZX52:7-EZX72- EWAX51:10-EWAX52:10-EWA100X2:C3- 0V/5V measuring point EZX72 part of: XRG bus
-------	--

CAN_L	generator CAN low active EZ119X2:A3-EZ130X2:A3-EZ139X2:A3-EZ150X2:A3-EZX44:2-EZX45:2-EZX46:2- -C300X1:2-EZX51:2-EZX151:2- EZ152:2-EZX71- EWAX51:2-EWAX52:2-EWA100X2:A3- 0V/5V measuring point EZX71 part of: XRG bus
-------	---

CM_EX_SW_1	common for exposure switch of release decade 1 EWA100X1:C5-EWAX1:10-
------------	---

CM_EX_SW_2	common for exposure switch of release decade 2 EWA100X1:C7-EWAX2:10-
CM_EX_SW_3	common for exposure switch of release decade 3 EWA100X1:C9-EWAX3:10-
CM_EX_SW_4	common for exposure switch of release decade 4 EWA100X1:C11-EWAX4:10-
CM_SW	common for radiation indication EZ150X1:C29-EZX1:6-
CM_TH	common for thermal sensor of tube housing EZ130X1:C12-EZX3:7- (generator basis 4512 104 70202/70601 only) EZ130X1:C12-EZX3:4-
CM_TH_SW	common for tube housing switch EZ130X1:C11-EZX3:4- (generator basis 4512 104 70202/70601 only) EZ130X1:C11-EZX3:7-
CTRL_X/	control X-ray request command, system level EZ139X1:A4-EZX23:4-EZX45:5-EWAX51:5-EWAX52:5-EWA100X2:C25- 0V/15V measuring point: EZX85 part of: system signal bus
CTRL_X_C/	control X-ray request command, internal generator level EZ119X2:C6-EZ130X2:C6-EZ139X2:C6-EZ150X2:C6-EZX52:8- 0V/5V measuring point EZX74 driven by CU, active, if STOP_X_C/ not active, immediately inactive if STOP_X_C/ active, controls all non AEC exposures with exposure timer or AEC exposures with DRC timer HTON high tension on command (internal generator command) resp. 20/21 signal (external = old world) part of: XS/XRG bus
CU_CT1_1	cooling unit contact 1_1 EZ150X1:A22-EZX2:6-
CU_CT1_2	cooling unit contact 1_2 EZ150X1:C22-EZX2:7-
CV1_GND	converter power part 1 ground EZ130X1:AC8-EZX24:8/21-EQ100X1:8/21
CV1_GND_OL	converter power part 1 ground overload (generator basis \geq 4512 104 70203/70602) EZ130X1:A7-EZX24:20-EQ100X1:20
CV1_ID/	converter power part 1 identification EQ100X1:19-EZX24:19-EZ130X1:A6- open 5V, low active 0V

CV1_OL/	converter power part 1 overload EQ100X1:7-EZX24:7-EZ130X1:C7- open +26V, low active 0V
CV1_TM	converter power part 1 temperature EQ100X1:6-EZX24:6-EZ130X1:C6- 0.3...3.5V, 85 _C...0 _C
CV2_GND	converter power part 2 ground EZ130X1:AC29-EZX34:8/21-E2Q100X1:8/21
CV2_GND_OL	converter power part 2 ground overload (generator basis \geq 4512 104 70203/70602) EZ130X1:A28-EZX34:20-E2Q100X1:20
CV2_ID/	converter power part 2 identification E2Q100X1:19-EZX34:19-EZ130X1:A27- open 5V, low active 0V
CV2_OL	converter power part 2 overload E2Q100X1:7-EZX34:7-EZ130X1:C28- open +26V, low active 0V
CV2_TM	converter power part 2 temperature EZ130X1:C27-E2Q100X1:6-EZX34:6- 0.3...3.5V, 85 _C...0 _C
DR_BV_0V	dose rate (signal) reference of image intensifier EZX61:3-EZ139X2:C18- negative potential of II unit, 0V \pm 50mV against generator ground differential signal with DR_BV_SG part of: dose rate control
DR_BV_SG	dose rate signal of image intensifier EZX61:8-EZ139X2:A18- positive potential, 0...10V differential signal with DR_BV_0V part of: dose rate control
DR_FQ_NG	dose rate signal (pulses) negative EZX61:6-EZ139X2:C20- 0.1 μ R / pulse optocoupled interface, dose rate signal = pulsed frequency part of: dose rate control
DR_FQ_PO	dose rate signal (pulses) positive EZX61:1-EZ139X2:A20- 0.1 μ R / pulse optocoupled interface, dose rate signal = pulsed frequency part of: dose rate control

DR_TV_NT	dose rate of TV chain signal negative, fluoro regulation EZ139X2:C19- ± 12V minus polarity dual voltage differential signal +12V = 200% light, 0V = 100% light, - 12V = 50% light part of: dose rate control
DR_TV_PT	dose rate of TV chain signal positive, fluoro regulation EZ139X2:A19- ± 12V positive polarity dual voltage differential signal -12V = 200% light, 0V = 100% light, +12V = 50% light part of: dose rate control
DS_BV_0V	dose (signal ramp) reference of image intensifier EZ139X2C17- negative potential of II unit, 0V ± 50mV against generator ground differential signal with DS_BV_SG part of: dose rate control
DS_BV_SG	dose signal ramp of image intensifier signal EZ139X2:A17- 0...10V, polarity positive differential signal with DS_BV_0V part of: dose rate control
DS_MC_0V	dose (signal ramp) reference of selected measuring chamber EZ139X2:C16-EZ139X2:C16 negative potential of selected measuring chamber, 0V ± 50mV against generator ground differential signal with DS_MC_SG
DS_MC_SG	dose signal ramp of selected measuring chamber EZ139X2:A16-EZ139X2:A16- 0...12V differential signal with DS_MC_0V
E_NG_CV1/2	E value converter DC supply negative converter 1: EQ100X1:5-EZX24:5-EZ130X1:C5- converter 2: E2Q100X1:5-EZX34:5-EZ130X1:C26 (future releases) 0...-12V ≈ 0...-375V
E_PO_CV1/2	E value converter DC supply positive converter 1: EQ100X1:18-EZX24:18-EZ130X1:A5- converter 2: E2Q100X1:18-EZX34:18-EZ130X1:A26 (future releases) 0...+12V ≈ 0...+375V
EN_X/	enable X-ray, system level EZ139X1:C2-EZX10:1/3-EZX23:15-EZX45:11-EZX46:11-C300X1:11- -EWAX51:11-EWAX52:11-EWA100X2:C26- measuring point: EZX82, EZ139X9 part of: signal bus 0V/15V low active

EN_X_C/ enable X-ray, internal generator level
 EZ119X2:C7-EZ130X1:A9-EZ130X1:A30-EZ130X2:C7-EZ139X2:C7-EZ150X2:C7-EZX52:9-EZX76-
 0V/5V low active
 measuring point EZX76
 driven by CU if EN_X/ active (low)
 part of: XS/XRG bus

CV1 EN/ converter 1/2 enable
 CV2 EN/ converter 1: EZ130X1:A9-EZX24:22-EQ100X1:22-
 converter 2: EZ130X1:A30-EZX34:22-E2Q100X1:22-

EX_ON exposure on
 EWA100X2:A9-EWAX14:7-
 part of: exon old world

FD_C_CH1 central field measuring chamber 1
 EZ150X1:C4-EZX21:12-
 15V, $R_i = 220 \Omega$

FD_C_CH2 central field measuring chamber 2
 EZ150X1:A4-EZX22:12-
 15V, $R_i = 220 \Omega$

FD_C_CH3 central field measuring chamber 3
 EZ150X1:C10-EZX31:12-
 15V, $R_i = 220 \Omega$

FD_C_CH4 central field measuring chamber 4
 EZ150X1:A10-EZX32:12-
 15V, $R_i = 220 \Omega$

FD_C_CH5 central field measuring chamber 5
 EZ150X1:C16-EZX41:12-
 15V, $R_i = 220 \Omega$

FD_L_CH1 left field measuring chamber 1
 EZ150X1:C3-EZX21:11-
 15V, $R_i = 220 \Omega$

FD_L_CH2 left field measuring chamber 2
 EZ150X1:A3-EZX22:11-
 15V, $R_i = 220 \Omega$

FD_L_CH3 left field measuring chamber 3
 EZ150X1:C9-EZX31:11-
 15V, $R_i = 220 \Omega$

FD_L_CH4 left field measuring chamber 4
 EZ150X1:A9-EZX32:11
 15V, $R_i = 220 \Omega$

FD_L_CH5	left field measuring chamber 5 EZ150X1:C15-EZX41:11- 15V, $R_i = 220 \Omega$
FD_R_CH1	right field measuring chamber 1 EZ150X1:C5-EZX21:3 15V, $R_i = 220 \Omega$
FD_R_CH2	right field measuring chamber 2 EZ150X1:A5-EZX22:3- 15V, $R_i = 220 \Omega$
FD_R_CH3	right field measuring chamber 3 EZ150X1:C11-EZX31:3- 15V, $R_i = 220 \Omega$
FD_R_CH4	right field measuring chamber 4 EZ150X1:A11-EZX32:3- 15V, $R_i = 220 \Omega$
FD_R_CH5	right field measuring chamber 5 EZ150X1:C17-EZX41:3- 15V, $R_i = 220 \Omega$
FI_TF1_1	filament transformer 1 line 1 EZ119X1:DBZ4-EZX12:1-EG106X15:1- max. 300Veff or $\pm 150V$ against ground, 100...20kHz
FI_TF1_2	filament transformer 1 line 2 EZ119X1:DBZ6-EZX12:2-EG106X15:2- max 300Veff or $\pm 150V$ against ground, 100...20kHz
FI_TF2_1	filament transformer 2 line 1 EZ119X1:DBZ8-EZX12:4-EG106X15:4 max. 300Veff or $\pm 150V$ against ground, 100...20kHz
FI_TF2_2	filament transformer 2 line 2 EZ119X1:DBZ10-EZX12:5-EG106X15:5- max. 300Veff or $\pm 150V$ against ground, 100...20kHz
GND	
GND_15V	ground (+15V) for desk handswitch C300X3:1/2/6-
GNDC S_CAN_GND	CAN bus ground EZ139X1:C17-EZX42:3/6-EZX43:3/6-EZX44:9- part of: system CAN

GNDS signal bus ground
 PO_0V EZ139X1:AC1-EZX23:1/14-EZX44:15-EZX45:15-EWAX51:15-EWAX52:15-
 part of: signal bus
 negative

HT_AN high tension anode side actual value
 EG100X14:2-EZX35:2-EZ130X1:C17-
 0...+10V \approx 0...+100 kV

HT_AN_GND high tension anode side ground
 EG100X14:10-EZX35:10-EZ130X1:A17-
 0V

HT_CA high tension cathode side actual value
 EG100X14:1-EZX35:1-EZ130X1:C16-
 0...-10V \approx 0...-100kV

HT_CA_GND high tension cathode side ground
 EG100X14:9-EZX35:9--EZ130X1:A16
 0V

I1_1 IGBT1 power part 1 EQ100 = 4512 108 05882
 I1_1/ IGBT1 power part 1 EQ100 \geq 4512 108 08621 *
 EZ130X1:C1-EZX24:1-EQ100X1:1-

I1_1/ IGBT1 power part 1 EQ100 = 4512 108 05882
 I1_1 IGBT1 power part 1 EQ100 \geq 4512 108 08621 *
 EZ130X1:A1-EZX24:14-EQ100X1:14-
 value: on = 3.7V off = 1.2V against ground * = X10
 measuring point EQ100 R25 end to X1 * EQ100 X6

I1_2 IGBT2 power part 1 EQ100 = 4512 108 05882
 I1_2/ IGBT2 power part 1 EQ100 \geq 4512 108 08621 *
 EZ130X1:C2-EZX24:2-EQ100X1:2-

I1_2/ IGBT2 power part 1 EQ100 = 4512 108 05882
 I1_2 IGBT2 power part 1 EQ100 \geq 4512 108 08621 *
 EZ130X1:A2-EZX24:15-EQ100X1:15-
 value: on = 3.7V off = 1.2V against ground * = X10
 measuring point EQ100 R27 end to X1 * EQ100 X7

I1_3 IGBT3 power part 1 EQ100 = 4512 108 05882
 I1_3/ IGBT3 power part 1 EQ100 \geq 4512 108 08621 *
 EZ130X1:C3-EZX24:3-EQ100X1:3-

I1_3/ IGBT3 power part 1 EQ100 = 4512 108 05882
 I1_3 IGBT3 power part 1 EQ100 \geq 4512 108 08621 *
 EZ130X1:A3-EZX24:16-EQ100X1:16-
 value: on = 3.7V off = 1.2V against ground * = X10
 measuring point EQ100 R29 end to X1 * EQ100 X8

I1_4 IGBT4 power part 1 EQ100 = 4512 108 05882
 I1_4/ IGBT4 power part 1 EQ100 ≥ 4512 108 08621 *
 EZ130X1:C4-EZX24:4-EQ100X1:4-

I1_4/ IGBT4 power part 1 EQ100 = 4512 108 05882
 I1_4 IGBT4 power part 1 EQ100 ≥ 4512 108 08621 *
 EZ130X1:A4-EZX24:17-EQ100X1:17-
 value: on = 3.7V off = 1.2V against ground * = X10
 measuring point EQ100 R31 end to X1 * EQ100 X9

I2_1 IGBT1 power part 2 E2Q100 = 4512 108 05882
 I2_1/ IGBT1 power part 2 E2Q100 ≥ 4512 108 08621 *
 EZ130X1:C22-EZX34:1-E2Q100X1:1-

I2_1/ IGBT1 power part 2 E2Q100 = 4512 108 05882
 I2_1 IGBT1 power part 2 E2Q100 ≥ 4512 108 08621 *
 EZ130X1:A22-EZX34:14-E2Q100X1:14
 value: on = 3.7V off = 1.2V against ground * = X10
 measuring point EQ100 R25 end to X1 * E2Q100 X6

I2_2 IGBT2 power part 2 E2Q100 = 4512 108 05882
 I2_2/ IGBT2 power part 2 E2Q100 ≥ 4512 108 08621 *
 EZ130X1:C23-EZX34:2-E2Q100X1:2-

I2_2/ IGBT2 power part 2 E2Q100 = 4512 108 05882
 I2_2 IGBT2 power part 2 E2Q100 ≥ 4512 108 08621 *
 EZ130X1:A23-EZX34:15-E2Q100X1:15-
 value: on = 3.7V off = 1.2V against ground * = X10
 measuring point EQ100 R27 end to X1 * E2Q100 X7

I2_3 IGBT3 power part 2 E2Q100 = 4512 108 05882
 I2_3/ IGBT3 power part 2 E2Q100 ≥ 4512 108 08621 *
 EZ130X1:C24-EZX34:3-E2Q100X1:3-

I2_3/ IGBT3 power part 2 E2Q100 = 4512 108 05882
 I2_3 IGBT3 power part 2 E2Q100 ≥ 4512 108 08621 *
 EZ130X1:A24-EZX34:16-E2Q100X1:16-
 value: on = 3.7V off = 1.2V against ground * = X10
 measuring point EQ100 R29 end to X1 * E2Q100 X8

I2_4 IGBT4 power part 2 E2Q100 = 4512 108 05882
 I2_4/ IGBT4 power part 2 E2Q100 ≥ 4512 108 08621 *
 EZ130X1:C25-EZX34:4-E2Q100X1:4-

I2_4/ IGBT4 power part 2 E2Q100 = 4512 108 05882
 I2_4 IGBT4 power part 2 E2Q100 ≥ 4512 108 08621 *
 EZ130X1:A25-EZX34:17-E2Q100X1:17-
 value: on = 3.7V off = 1.2V against ground * = X10
 measuring point EQ100 R31 end to X1 * E2Q100 X9

IT_0V emitter 0V exposure on signal
 EWA100X2:C9-EWAX14:9-
 part of: exon old world

lu	stator current U of Low Speed Rotor Control low speed measuring point EYAX22
lw	stator current W of Low Speed Rotor Control low speed measuring point EYAX21
MN_EM_OF	mains power emergency off EZ4:1-EZ47:6-EN100X1:6-
MN_ON	mains on C300X1:6-EZ46:6-EZ47:2-EN100X1:2-EZ44:14-
NG_15V	- 15 V supply Vee EZ102X2:DBZ24-EZ119X2:AC12-EZ130X2:AC12-EZ139X2:AC12-EZ150C2:AC12-EZ21/22/31/32/41:6-EZ35:15- EZ51:8-EZ151:8-EG100X14:15- EZ31:6-EZ32 -14.5V -15.5V
NR_PR_X/	not ready preparing for X-ray (low active) EZ139X1:A3-EZ23:3-EZ45:4-EZ46:4-C300X1:4- -EWAX51:4-EWAX52:4-EWA100X2:A24- driven by CU measuring point: EZ83 part of: signal bus
PO_12V	+ 12 V supply EN100X1:1-EZ47:1-EZ46:7-C300X1:7-
PO_15V	+ 15 V supply Vdd EZ102X2:DBZ22-EZ119X2:AC11-EZ130X2:AC11-EZ139X2:AC11 -EZ150X2:AC11-EZ2:8/9-EZ35:7-EZ44:12/13-EZ46:5 -EZ51:7-EG100X14:7-C300X1:5 -EZ21/22/31/32/41:5 only generator basis 4512 104 70202/70601 -EZ151:7 generator basis \geq 4512 104 70203/70602 +14.5V +15.5V
PO_15/40V	+ 15 V or + 40 V supply for measuring chamber EZ150X1:A20-EZ21/22/31/32/41:5
PO_26V	+ 26 V supply EZ102X2:DBZ28-EZ119X2:AC14-EZ130X2:AC14-EZ139X2:AC14 -EZ150X2:AC14-EZ1:5-EZ2:3-EZ3:9-EZ11:1-EZ17:1-EZ18:1-EWAX1:4- -EWAX2:4-EWAX3:4-EWAX4:4-EWAX41:1-EWAX23:9-EWAX24:5-EWA100X2:A14-EWA100X2:C14- -EQ100X2:1-E2Q100X2:1-
PO_26V_1	+ 26 V supply optional EZ102X2:DBZ32-EZ19:1-EZ20:1- EZ8:1 generator basis \geq 4512 104 70203/70602
PO_26V_RE	+ 26 V supply reverse EWA11-EWA12-EWAX1/2/3/4:4-EWAX42:1- if generator and system release voltage are of the same polarity PO_26V_RE = +26V, if not PO_26V_RE = 0V against -24V

PO_26V_SW	+ 26 V supply switched EZ102X1:D32-EZX7:1-EM1 generator basis \geq 4512 104 70203/70602
PO_400V	+ 400 V supply measuring chamber EZ150X1:AC1-EZX21/22/31/32/41:1- +400V , Ri=100k
PO_5V	+ 5 V supply Vcc EZ102X2:DBZ2/4/6-EZ119X2:AC1/2-EZ130X2:AC1/2-EZ139X2:AC1/2-EZ150X2:AC1/2-EZX46:9-C300X1:9- EZX51:4/5/6-EZX151:4/5/6 +4.74V +5.25V
PO_V	signal bus supply EZX23:13/25-EZX44:5-EZX45:7-EWAX51/52:7- EWA100X2:AC27-EZ139X1:AC6- Vsgn part of: signal bus
POWERFAIL/	power fail signal of power supply EZ102X1:D30-EZ139X1:A10-
PW_ON_NG	DC supply relay power on negative EZ130X1:A15-EZX47:9-EN100X1:9- 0V/+15V, low active
PW_ON_PO	DC supply relay power on positive EZ130X1:C15-EZX47:4-EN100X1:4- +15V
RC_ON/	rotor control on EZ150X1:A25-EZX51:1-
RC_RD/	rotor control ready EYAX1:9(low speed)-EXZ51:9-EZ150X1:C25- measuring point EYAX25 low speed rotor control
RC_ST_2/	rotor control stator 2 EZ150X1:A26-EZX16:1(low speed)-EY100X3:1(high speed)-EWGX14:1
RC_ST_3/	rotor control stator 3 EZ150X1:C26-EZX16:2(low speed)-EY100X3:2(high speed)-EWGX14:2-EWGX15:1-E1WGX14:1
RD_MN_ON	ready mains power on C300X1:14-EZX46:14-EZX47:7-EN100X1:7-
RD_PR_X NR_PR_X/	ready preparing for X-ray or not ready preparing for X-ray (low active) EZ139X1:A3-EZX23:3-EZX45:4-EZX46:4-C300X1:4- -EWAX51:4-EWAX52:4-EWA100X2:A24- driven by CU measuring point: EZX83 part of: signal bus
REL_CH1	release (reset integrator) chamber 1 EZ150X1:C6-EZX21:4-

REL_CH2	release (reset integrator) chamber 2 EZ150X1:A6-EZX22:4-
REL_CH3	release (reset integrator) chamber 3 EZ150X1:C12-EZX31:4-
REL_CH4	release (reset integrator) chamber 4 EZ150X1:A12-EZX32:4-
REL_CH5	release (reset integrator) chamber 5 EZ150X1:C18-EZX41:4-
RESET_C/	system RESET command EZ130X2:A6-EZ119X2:A6-EZ139X2:A6-EZ150X2:A6-EZX45:3-EZX46:3-C300X1:3- -EZX51:10-EZX52:3-EZX73-EWAX51:3-EWAX52:3-EWA100X1:A6- 0V/5V measuring point EZX73 driven by CU, active (low) if: EZ139 S1 activated, RESET_SW/ active, threatening power supply drop in, watchdog alarm, switch on (button), resets FU's drop in, part of: XS/XRG bus
RESET_SW/	signal bus reset, generator reset EZX23:2-EZX44:6-EZ139X1:A2- low active $\tau \geq 200\text{ms}$ ($\tau = 8.41$ WP) resets CU measuring point: EZX81 part of: signal bus
RF_0V_CH1	0V reference value measuring chamber 1 EZX21:8-EZ150X1:C8- differential signal with SIGN_CH1
RF_0V_CH2	0V reference value measuring chamber 2 EZX22:8-EZ150X1:A8- differential signal with SIGN_CH2
RF_0V_CH3	0V reference value measuring chamber 3 EZX31:8-EZ150X1:C14- differential signal with SIGN_CH3
RF_0V_CH4	0V reference value measuring chamber 4 EZX32:8-EZ150X1:A14- differential signal with SIGN_CH4
RF_0V_CH5	0V reference value measuring chamber 5 EZX41:8-EZ150X1:C20- differential signal with SIGN_CH5
RG_DV_1	registration device 1 selected EWA100X1:C4-EWAX1:5-

RG_DV_2	registration device 2 selected EWA100X1:A7-EWAX2:5-
RG_DV_3	registration device 3 selected EWA100X1:A9-EWAX3:5-
RG_DV_4	registration device 4 selected EWA100X1:A11-EWAX4:5-
RM_DR_0V	room door contact 0V EZ150X1:C28-EZX1:10-
RM_DR_CT	room door contact EZ1:8-EZ150X1:A28-
RQ_SN_X/	request synchronization of X-ray EZ139X1:C3- -EWAX51:12-EWAX52:12-EWA100X2:A25- measuring point: EZX84 part of: signal bus
RQ_XG_EX	request X-ray generator for exposure EWAX1/2/3/4:1-EWA100X1:A3
RQ_XG_FL	request X-ray generator for fluoroscopy EWAX1/2/3/4:6-EWA100X1:A5
RQ_XG_PR_1	request X-ray generator for preparation EWAX1:3-EWA100X1:A4-
RQ_XG_PR_2	request X-ray generator for preparation EWAX2:3-EWA100X1:C6-
RQ_XG_PR_3	request X-ray generator for preparation EWAX3:3-EWA100X1:C8-
RQ_XG_PR_4	request X-ray generator for preparation EWAX4:3-EWA100X1:C10-
RX_CAN_1	system CAN 1 optional EZ139X1:C15- part of: system CAN
RX_CAN_2	system CAN 2 optional EZ139X1:C16-EZX42:2-EZX43:2- part of: system CAN
S_CAN_L (CAN_N)	system CAN low active EZ139X1:C16-EZX42:2-EZX43:2- part of: system CAN

S_CAN_H (CAN_P)	system CAN high active EZ139X1:A16-EZX42:7-EZX43:7- part of: system CAN
S_CAN_PO	system CAN supply EZ42:9-EZX43:9-EZX44:4-EZ139X1:A17- Vcan part of: system CAN
SI_PH_ID SI_PH/	single phase identifier EN100X1:5-EZX47:5-EZ130X1:C14-
SIGN_CH1	signal ramp of measuring chamber 1 EZ21:7-EZ150X1:C7- 0...12V (24V out of range possible) differential signal with FR_0V_CH1
SIGN_CH2	signal ramp of measuring chamber 2 EZ22:7-EZ150X1:A7- 0...12V (24V out of range possible) differential signal with RF_0V_CH2
SIGN_CH3	signal ramp of measuring chamber 3 EZ31:7-EZ150X1:C13- 0...12V (24V out of range possible) differential signal with RF_0V_CH3
SIGN_CH4	signal ramp of measuring chamber 4 EZ32:7-EZ150X1:A13- 0...12V (24V out of range possible) differential signal with RF_0V_CH4
SIGN_CH5	signal ramp of measuring chamber 5 EZ41:7-EZ150X1:C19- 0...12V (24V out of range possible) differential signal with RF_0V_CH5
SL_CO_1	select correction 1 (thickness) EWA100X1:A32-EWAX24:8-
SL_CO_2	select correction 2 (thickness) EWA100X1:C32-EWAX24:9-
SL_PG_1	select ext APRT program 1 EWA100X1:A28-EWAX23:1-
SL_PG_2	select ext APRT program 2 EWA100X1:C28-EWAX23:2-
SL_PG_3	select ext APRT program 3 EWA100X1:A29-EWAX23:3-

SL_PG_4	select ext APRT program 4 EWA100X1:C29-EWAX23:4-
SL_PG_5	select ext APRT program 5 EWA100X1:A30-EWAX23:5-
SL_PG_6	select ext APRT program 6 EWA100X1:C30-EWAX23:6-
SL_PG_7	select ext APRT program 7 EWA100X1:A31-EWAX23:7-
SL_PG_8	select ext APRT program 8 EWA100X1:C31-EWAX23:8-
SL_TO_TM_1	select tomo time 1 EWAX21:1-EWA100X1:A24-
SL_TO_TM_2	select tomo time 2 EWAX21:2-EWA100X1:C24-
SL_TO_TM_3	select tomo time 3 EWAX21:3-EWA100X1:A25-
SL_TO_TM_4	select tomo time 4 EWAX21:4-EWA100X1:C25-
SL_TO_TM_5	select tomo time 5 EWAX21:5-EWA100X1:A26-
SL_TO_TM_6	select tomo time 6 EWAX21:6-EWA100X1:C26-
SL_TO_TM_7	select tomo time 7 EWAX21:7-EWA100X1:A27-
SL_TO_TM_8	select tomo time 8 EWAX21:8-EWA100X1:C27-
SL_XG_TO	select X-ray generator for tomography EWAX11:3-EWAX12:3-EWA100X1:C18-
STOP_X_C/	stop X-ray command, X-ray off from FU EZ119X2:A7-EZ130X2:A7-EZ150X2:A7-EZX52:4-EZ139X2:A7- 0V/5V measuring point EZX75 inactivates CTRL_X_C/ EXOF exposure off command part of: XS/XRG bus
STU	stator line U EYAX2:2(low speed)-EY100X6:2/EY100X46:2(high speed)-EWGK11/K12:1 part of: low/high speed rotor control

STV	stator line V = common EYAX2:3(low speed)-EY100X6:3/EY100X47:1(high speed)-EWGK11/K12:3 part of: low/high speed rotor control
STW	stator line W EYAX2:4(low speed)-EY100X6:4/EY100X47:2(high speed)-EWGK11/K12:5 part of: low/high speed rotor control
SW_BU_1	switch bucky EWAX11:10-EWA100C1:C19- part of: bucky ready contact
SW_BU_2	switch bucky 2 (EWA or EWB) or 4 (EWB) EWAX12:10-EWA100X1:A21- -EWB100X1:A21-EWBX12:10- part of: bucky ready contact
SW_SF_CF_1	switch side field to central field bucky measuring chamber EWAX11:1-EWA100X1:A18-
SW_SF_CF_2	switch side field to central field bucky measuring chamber 2 (EWA or EWB) or 4 (EWB) EWAX12:1-EWA100X1:A20-
SW_TO_1	switch tomography 1 EWAX11:5-EWA100X1:A19- part of: tomo ready contact
SW_TO_2	switch tomography 2 EWAX12:5-EWA100X1:C20- part of: tomo ready contact
SW_UN_EX	radiation indication EZ150X1:A29-EZX1:4-
TB_2/	tube 2 selected EZ130X1:A13-EZX11:2-EWGX11:2 0V/15V, low active
TB_2_RT	tube 2 selection check EWGX11:3-EZX11:3-EZ130X1:A10 0V/5V, low active
TB_3/	tube 3 selected EZ130X1:C13-EZX11:5-EWGX11:5-EWGX12:2 0V/15V, low active
TB_3_RT	tube 3 selection check E2WGX11:3-E1WGX12:3-E1WGX11:6-EZX11:6-EZ130X1:C10- 0V/5V, low active
TB_CU_FR_NG	tube current frequency negative EG100X14:14-EZX35:14-EZ119X1:BZ32- -15V against ground

TB_CU_FR_PO	tube current frequency positive EG100X16:6-EZX35:6-EZ119X1:BZ30- 15V against ground, frequency: 1 kHz \approx 2 mA, 0...1500mA 500kHz/A
TH_OL	tube housing overload EZX3:6-EZ130X1:A12- (generator basis 4512 104 70202/70601 only) EZX3:3-EZ130X1:A12- 0...5V
TH_OL_SW/	tube housing overload switch EZX3:3-EZ130X1:A11- (generator basis 4512 104 70202/70601 only) EZX3:6-EZ130X1:A11- 0V/26V, low active
TO_MO_PG	tomo mode programmed EWA100X1:A17-EWAX22:9-
TO_PG_1	tomo program 1 EWA100X1:A13-EWAX22:1-
TO_PG_2	tomo program 2 EWA100X1:C13-EWAX22:2-
TO_PG_3	tomo program 3 EWA100X1:A14-EWAX22:3-
TO_PG_4	tomo program 4 EWA100X1:C14-EWAX22:4-
TO_PG_5	tomo program 5 EWA100X1:A15-EWAX22:5-
TO_PG_6	tomo program 6 EWA100X1:C15-EWAX22:6-
TO_PG_7	tomo program 7 EWA100X1:A16-EWAX22:7-
TO_PG_8	tomo program 8 EWA100X1:C16-EWAX22:8-
TO_PG_SL	tomo program selected EWA100X1:C17-EWAX22:10-
TP_HT_GND	temperature high tension tank ground EZ130X1:A19-EZX35:12-EG100X14:4-
TP_HT_SG	temperature signal high tension tank EG100X14:12-EZX35:4-EZ130X1:C19- 0...5V +25 _C(12k Ω)...+100 _C(950 Ω)

V15C S_CAN_PO	system CAN supply EZ42:9-EZ43:9-EZ44:4-EZ139X1:A17- Vcan part of: system CAN
V15S PO_V	signal bus supply EZ23:13/25-EZ44:5-EZ45:7-EWAX51/52:7- EWA100X2:AC27-EZ139X1:AC6- Vsgn part of: signal bus
X_ACT/	signal bus X-ray active EZ139X1:A5-EZ23:5-EZ45:6-EWAX51/52:6-EWA100X2:C24- driven by CU, X_ACT_S/ status dependent, old: EXON signal measuring point: EZX86 part of: signal bus 0V/15V
X_ACT_S/	X-Ray active signal, kV > 75% nominal value or "fluoroscopy technique" high tension on EZ119X2:A8-EZ130X2:A8-EZ139X2:A8-EZ150X2:A8-EZX52:5- 0V/5V measuring point EZX77 HTON (high tension on) or FLON (fluoroscopy high tension on) signal part of: XS/XRG bus, controls X_ACT/ status
XG_RD_EX_1	X-ray generator ready for exposure request EWA100X1:C3-EWAX1:2-
XG_RD_EX_2	X-ray generator ready for exposure request EWA100X1:A6-EWAX2:2-
XG_RD_EX_3	X-ray generator ready for exposure request EWA100X1:A8-EWAX3:2-
XG_RD_EX_4	X-ray generator ready for exposure request EWA100X1:A10-EWAX4:2-

13. OPTIMUS AEC switch-off philosophy

The philosophy behind the switch-off behaviour in the Optimus Release 2.1 + 3 is the following (additional explanation to the graphics 3Z-20):

Every APR using the AEC technique as the preferred technique must have mAs, mA-s or mAs-s parameters in the background. These should almost match the typical organ related dose to the selected film-screen-combination. It is said that a film which got at least 40% of the desired density can be used for diagnosis.

If now the AEC exposure is started two supervisions are active with the aim of not giving unnecessary dose (or you simply get a proper AEC exposure):

- 1) The organ dependent background mAs value is multiplied with 10. If the exposure is not finished at $10 \cdot mAs_{backup}$ the generator will stop. One must expect that something went wrong if the exposure exceeded 10 times the typical mAs value. This exposure has not been cut off by the supervision 2.
- 2) With the $10 \cdot mAs_{backup}$ a kV and filament load dependent backup **time** is calculated by DRC (dose rate control). At 10% of this time value DRC checks if at least 4% of the desired dose has been detected by the measuring chamber. If the 4% limit will not be increased, the exposure will be switched off. The minimum of 40% density can not be obtained during the remaining backup time.

This 4% dose detection is automatically off, if the film-screen-combination is too sensitive (>400 speed systems). The 4% value will be too small to be reliable for a measurement.

With overriding the supervision will be switched off. Explanation see documentation.

How to test the limits of 600 mAs or 4000ms in AEC technique Release 2.1 Optimus:

One has to bypass the 4% detection and the background mAs value must be high enough to reach 600 mAs.

The 4% detection can be switched off with modifying the value Dose of FSC [μ Gy]:

- S Type in a value of 1 (which is equal to a 1000 speed system) in the Dose of FSC data field of any of the programmed film screen combinations.
- S Now select any APR and increase the background mAs value to 100 mAs.
- S Close the collimator or cover the chamber with led.

The AEC exposure will stop at a value which is always below 600 mAs, a typical limit is 588 mAs.

With the modified parameters the 4000 ms test can be carried out.

- S Select the modified APR on the control desk and go to Select APR and Change APR with the PC.
- S Reduce the Ie max factor: to 5% and transmit the APR screen.
- S Select the APR button again, the modified data are active now.
- S Select the small focal spot.
- S Switch an AEC exposure. It should last 4000 ms.
- S Change all modifications back to normal.

The supervision can be switched on or off, programming path:

XRGSCOPE - Optimus (XRG90) - Programming - Dose Rate Control - AMPLIMAT - Fault Exposure Detection - AEC or TDC - on/off.

Explanation see documentation.

Precalculation tables of the exposure which is actually displayed on the control desk can be seen on the PC under:

XRGSCOPE - Optimus (XRG90) - Faultfind - X-Ray Log - Dose Rate Control Logging - etc.

Explanation see documentation.

14. Explanation for table 3Z-22: AEC fault exposure detection strategy

The major intention having a fault exposure detection is to prevent from unnecessary radiation for the patient in case of a malfunction of the installation or a mistake in the use of the X-ray equipment.

List of terms:

AEC	=	Automatic Exposure Control
APR100	=	APR program with a less sensible film screen combination of 100 speed, originally parameters as programmed
APR100*	=	same as APR100, but parameter(s) modified on the control desk (overriding)
APR800	=	APR program with a very sensible film screen combination of 800 speed, originally parameters as programmed
APR800*	=	same as APR800, but parameter(s) modified on the control desk (overriding)
600mAs	=	is the programmed mAs limit for AEC exposures (can be changed, should comply with the local regulations)
4000ms	=	is the max time limit of AEC exposures (cannot be changed)
	1	= point of the mAs dependent APR backup time, which is calculated from the 10 x (typical) organ mAs value of the APR
	2	= max mAs limit for AEC exposures (can be changed)
	3	= max exposure time limit of 4000ms (cannot be changed)
	4	= 10% (of the APR backup) time point
	5	= 10% backup time point of the max exposure time limit (4000ms) = always 400ms

To explain the difference in switching the fault exposure detection **on** or **off** a very sensible (800 speed system) and a less sensible (100 speed system) film screen combination have been chosen.

AEC fault exposure detection = ON

The factors determining whether the 4% dose value at 10% of the APR backup time will be checked are

- the 10% backup time value > 10ms
- the expected 4% density voltage value > 20mV.

In case of APR100 the check could be done, because the density voltage values are high enough.

The density voltage at 10% of the backup time would be too small to be measured for APR800, therefore the exposure will be continued up to the 10 x APR mAs value. The exposure will finally be terminated at 600mAs, if the APR mAs value is ≥ 60 mAs.

With APR100* the exposure will be terminated at 10% of the max backup time, which is 4000ms for all AEC exposures after overriding of any APR parameters. (The 600 mAs limit will not switch off the exposure, 1500 mA emission current is not available).

With APR800* the exposure will be terminated either at 600mAs or 4000ms, depending on which of the limits will be reached first.

AEC fault exposure detection = OFF

APR100 and APR800 exposures have the same termination point at 10 x APR mAs. The exposure will finally be terminated at 600mAs, if the APR mAs value is ≥ 60 mAs.

APR100* and APR800* exposures will be terminated either at 600mAs or at 4000ms, depending on which of the limits will be reached first.

15. Explanations on programming the generator

15.1. OPTIMUS \ Program \ Dose Rate Control \ CONT:

- **scantime_TV [ms]:** [20.000]:

20 ms = default. 20 ms must be programmed for all TV chains with a scantime \leq 20 ms.

In case a TV chain has a longer scantime, program the actual scantime value:

scantime_TV [ms]: [20.000] for scantime of TV chain \leq 20 ms

scantime_TV [ms]: [xx.xxx]for scantime of TV chain = xx.xxx ms $>$ 20 ms

- **scantime_TV valid:** Yes (default)

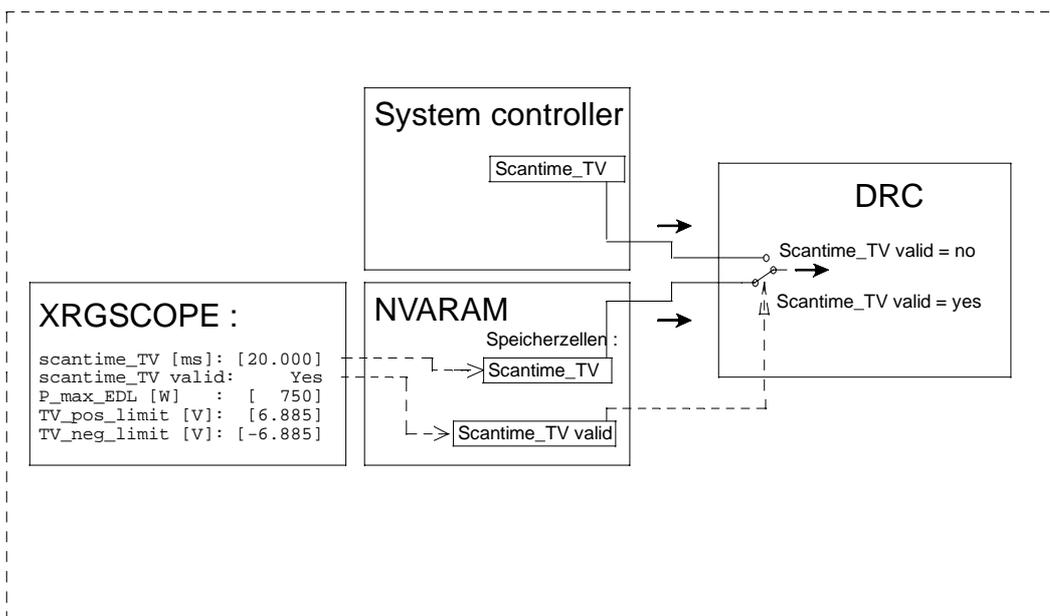
With Yes the programmed variable "scantime_TV [ms]" is used for the control in functional unit dose-rate control (DRC).

At the moment only this value is possible.

With No the programmed variable "scantime_TV [ms]" is **not** used for the control in functional unit dose-rate control (DRC). The variable is delivered by the system controller.

This version is a future option. At the moment it is not possible.

Also see the sketch explaining this program settings:



16. Printed-circuit boards

16.1. Low-voltage power supply / EZ 102

Also see Z1-2.3 "Low-voltage power supply".

LEDs H2 through H5 indicate whether the supply voltages are present.

The low-voltage power supplies of PCB EZ 102 are short circuit proof. Therefore it is most likely that in case one of the LEDs grows dark one of the external consumers and not the PCB itself is the cause of the error.

It is recommended that one after the other all consumers be disconnected from the respective power supply until the LED is illuminated again.

The last consumer that was removed has probably caused the short-circuit.