

## Service Manual

Technical  
Description and  
Service Instructions

for

**XENON 300**  
**MODEL 201331 20**  
**MODEL 201331 20-1**

Order No. SV3541

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## 0. General

Thank you for your expression of confidence in the KARL STORZ brand name. Like all of our other products, this product is the result of years of experience and great care in manufacture. You and your organization have decided in favor of a modern, high-quality piece of equipment from KARL STORZ.

KARL STORZ instruments and equipment are for use only by qualified medical personnel who are trained in their use. All electrical installations at the location of use should meet applicable national and local electrical codes.

Refer servicing to duly authorized KARL STORZ service personnel. Always use genuine replacement parts from KARL STORZ. To determine which replacement parts are required please refer to the enclosed replacement parts list. Repair and calibration of this device requires special tools and gauges; certain internal adjustments must not be altered.

For further information, please consult this service manual or contact:

*KARL STORZ GmbH & Co. KG*  
*Mittelstrasse 8, 78532 Tuttlingen*  
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and ask for Technical Services.

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All KARL STORZ instruments and equipment are warranted to be free from defects in workmanship and materials for **two (2) years** from date of sale, unless otherwise specified; any instruments or equipment with such defects during the applicable warranty period will be promptly repaired or replaced at no charge to the customer.

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  - repairs, modifications and/or alterations performed other than by KARL STORZ or a KARL STORZ authorized repair facility, or
  - use in combination with adapters and/or equipment, or use in any manner or medical procedure, other than those for which it is designed; and
- Any special, indirect and/or consequential damages of any kind and however caused arising from the sale or use of the instrument and/or equipment.

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KARL STORZ recommends that all equipment be checked and inspected once a year by KARL STORZ, or by an authorized agent. All services such as modifications, repairs, calibrations, and/or readjustments may only be performed by KARL STORZ or by an authorized agent.



**Caution:** *Repairs may only be performed by qualified technicians trained in electrical or electronic engineering, in compliance with the relevant occupational, safety and accident prevention regulations.*

***Always unplug the equipment before performing any repairs.***

***Safety Testing based on IEC 62353, IEC / UL 60601-1, whichever may apply, must be performed after servicing has been completed.***

By making the enclosed technical information available, KARL STORZ does not authorize any service or repair by unauthorized service personnel. Tampering with the instruments or equipment, or unauthorized service or repair of the device nullifies and voids the warranty.

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## Section 1.

# Instruction Manual

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## Section 2.

# Physical Design

Direction Sign:

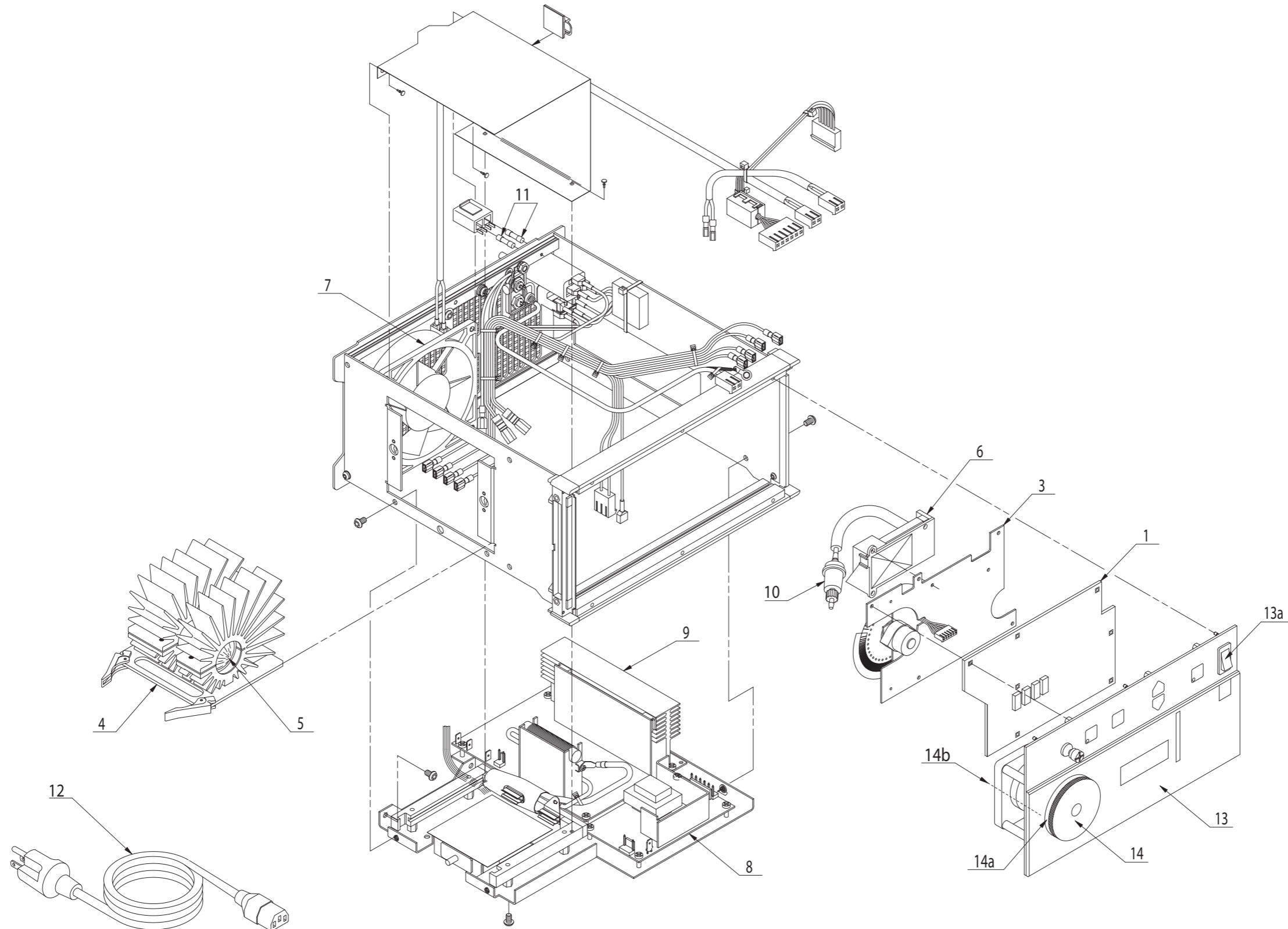
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## 2.1 XENON 300 model 201331 20

### 2.1.1 Exploded view of the XENON 300 model 201331 20



## 2.1.2 Spare parts of the XENON 300 model 201331 20

Position	Item description	Order no.
1	Combo board	no longer available <sup>3)</sup>
3	Attenuator assembly	no longer available <sup>3)</sup>
–	Attenuator disc, only	M17292
4	Lamp assembly, complete	20133027
5	Lamp	20133028
6	Antifog pump	M18108
7	Fan	M18127
8	Auxiliary power supply	Z09709
9	Lamp power supply	no longer available <sup>3)</sup>
10	Air filter	M18406
11	Power fuses 2 x T 4.0 AL / 250 V (220 VAC ... 240 VAC) <sup>1)</sup>	2027690
	Power fuses 2 x T 8.0 AL / 250 V (100 VAC ... 125 VAC) <sup>1)</sup>	2028090
	Power fuses 2 x T 2.5 AL / 250 V (220 VAC ... 240 VAC) <sup>2)</sup>	1059700
	Power fuses 2 x T 5.0 AL / 250 V (100 VAC ... 125 VAC) <sup>2)</sup>	1222890
12	Power cord (with ground lead)	400A
	Power cord (USA)	400B
13	Front panel	20133180
13a	Power switch without illumination	1168790
	Power switch with illumination	1163890
14	Light cable adapter incl. heat sink and screwed joint	20134080
–	Top cover	M00280
–	Door	M19299
–	Filter	M18406
–	LUER bulkhead	M18426
–	PCB lamp card	M18217
–	Lamp card contact	M17290
–	KARL STORZ-SCB® upgrade kit	20133119-1
14a	Adapter for 2108191 or 20134080	ET12-Z05831
14b	Locknut for M18202 or ET12-Z05831	M18203

**Note:** 14a and 14b are necessary if front panel will be replaced from plexi- in non-plexi-version.

### Important note:

When ordering replacement parts always provide the following data

**Item description**

**Order no.**

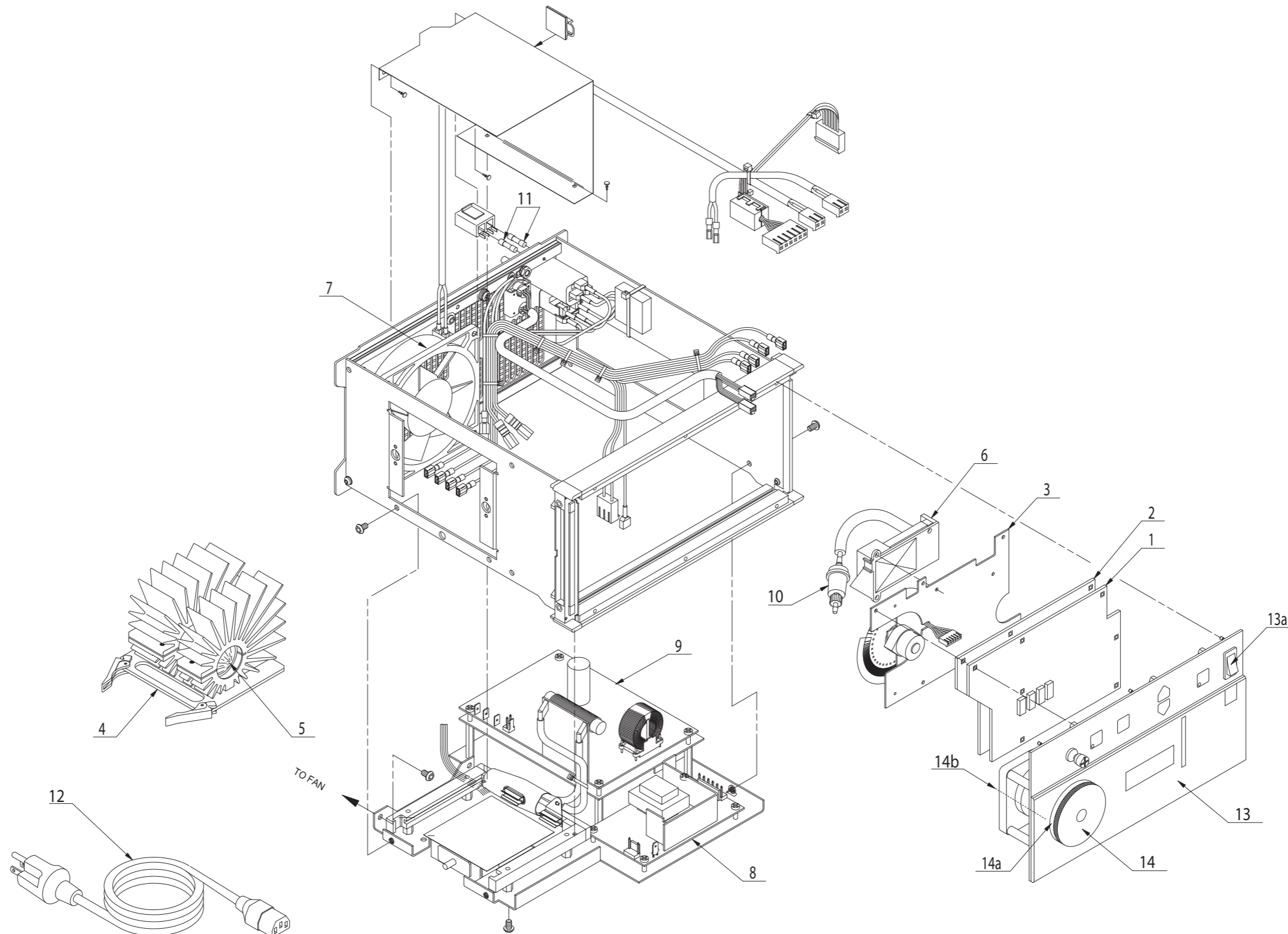
1) Valid up to serial no. BC0627677.

2) Valid as from serial no. BC0627916.

3) Please contact your Global Sales Administrator



### 2.2.2 Exploded view of the XENON 300 model 201331 20-1 (as from serial no. LF0612013)



### 2.2.3 Spare parts of the XENON 300 model 201331 20-1

Position	Item description	Order no.
1	Display board	20132183-1
2	Control board without EPROM	ET12-201331-1-29
	EPROM programmed	ET12-201331-1-31
	EPROM programmed, SCB	ET12-201331-1-17
3	Stepper motor at attenuator assembly	M19105
	Attenuator disc	M17292
	Motor mount for stepper motor at attenuator assembly	M19220
	Shield for attenuator assembly	M13281
	Jam nut for attenuator assembly	M18239
	Hub for attenuator assembly	M18240
	Interrupter assembly with stepper motorfor attenuator wheel assembly	ET12-201331-1-19
4	Lamp assembly, complete	20133027
5	Lamp	20133028
6	Antifog pump	M18108
7	Fan	M18127
8	Auxiliary power supply	Z09709
9	Lamp power supply (up to serial no. LF0612012)	no longer available <sup>3)</sup>
	Lamp power supply (as from serial no. LF0612013)	Z07559
10	Air filter	M18406
11	Power fuses 2 x T 4.0 AL / 250 V (220 VAC ... 240 VAC) <sup>1)</sup>	2027690
	Power fuses 2 x T 8.0 AL / 250 V (100 VAC ... 125 VAC) <sup>1)</sup>	2028090
	Power fuses 2 x T 2.5 AL / 250 V (220 VAC ... 240 VAC) <sup>2)</sup>	1059700
	Power fuses 2 x T 5.0 AL / 250 V (100 VAC ... 125 VAC) <sup>2)</sup>	1222890
12	Power cord (with ground lead)	400A
	Power cord (USA)	400B
13	Front panel	20133180
13a	Power switch without illumination	1168790
	Power switch with illumination	1163890
14	Light cable adapter incl. heat sink and screwed joint	20134080
-	Top cover	M00280
-	Door	M19299
-	Filter	M18406
-	LUER bulkhead	M18426
-	PCB lamp card	M18217
-	Lamp card contact	M17290
-	Mask for display board	M18464
14a <sup>1)</sup>	Adapter for 2108191 or 20134080	ET12-Z05831
14b <sup>1)</sup>	Locknut for M18202 or ET12-Z05831	M18203

**Important note:**

When ordering replacement parts always provide the following data

**Item description**

**Order no.**

1) Valid up to serial no. BC0627677.

2) Valid as from serial no. BC0627916.

3) Please contact your Global Sales Administrator

<sup>\*)</sup> 14a and 14b are necessary if replacing front panel from plexi- to non-plexi-version



## **Section 3.**

# **Descriptions of Operation and Circuit Diagrams**

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## 3.1 Description of XENON 300 operation

The 201331 20 / 201331 20-1 is a 300 Watt Xenon light source designed for use in general endoscopic surgery. The light source provides the illumination necessary for most endoscopic documentation requirements.

The Xenon lamp color temperature approximates bright sunlight and is considered unmatched for visual and photographic color rendition. Full intensity is reached immediately without a warm-up period.

The 201331 20 / 201331 20-1 Xenon light source is run at a constant power (about 300 W) and is dimmed by a microprocessor-controlled opto-mechanical attenuator. This ensures the greatest range of illumination without arc instability problems and the longest lamp lifetime.

The brightness of the 201331 20 / 201331 20-1 Xenon light source can be automatically controlled by any endoscopic video camera with automatic shutter.

## 3.2 Basic features

### 3.2.1 Manual brightness control

The brightness can be adjusted manually by means of buttons. The brightness can be temporarily reduced to very low (standby) for convenience when changing operating instruments.

### 3.2.2 Automatic video – XENON 300 model 201331 20

The light source controls the brightness of its light by measuring the video signal feedback from the video camera (supplied by the user). When the video signal is greater than optimum, the illuminator output is reduced (and vice-versa), preventing the loss of image quality. The micro-processor automatically detects the position of the endoscope image on the screen and will follow it (if it stays within the video field) to continue to monitor the brightness.

Video connectors (BNC type) are located on the rear of the device. Errant connections are impossible, since both connections are auto-terminating types.

Video communications for 201331 20-1 Xenon light sources is provided via the KARL STORZ Communication Bus (KARL STORZ-SCB®). KARL STORZ-SCB® connectors are provided at the rear of the device.

**Note:** *Manual or automatic mode is selected by pressing the "M" (Mode) button.*

### 3.2.3 Overheating indicator

If the operating temperature of the light source reaches 40 °C / 104 °F or more (and until it cools down to about 38 °C / 100.4 °C), the high speed circuit of the fan is activated. At about 55 °C / 131 °F the digital display on the front panel blinks E01 and HOT continuously and an audible alarm sounds. Returning the device to cooler temperatures (less than 55 °C / 131 °F) cancels the alarm and restores normal operation.

**Note:** *The light source will not cease functioning when an alarm sounds, but immediate action should be taken to ensure that permanent damage does not occur.*

## 3.3 Detailed description of operation

### 3.3.1 Video circuit operation – XENON 300 model 201331 20

The video inputs are IEC 60601 type BF isolated. The video connectors are fixed into a plastic insulator on the rear panel of the housing and the video circuitry is isolated on the control board by a four millimeter creepage gap.

Both video connectors are 75 Ohm self-terminating BNC connectors. The 201331 20 may be used at any point in the video chain without setting any termination switches.

The bar graph will show full brightness when the video camera is pointed at a dark image, and minimum brightness if the camera is pointed at a very bright image.

When using both camera and endoscope, the UP/DOWN BRIGHTNESS adjustment will set the brightness level of the video image while the bar graph will show the light output of the illuminator.

If the brightness adjust is set on VIDEO and there is no camera attached to the VIDEO IN connection, no adjustment by the light source will take place.

The video measurement area is set automatically by the microprocessor. Any image size can be accommodated.

When auto video is selected by pushing and releasing the M button on the front panel, the “D” lights and the brightness control level is indicated on the digital display on the front panel. The range is from -10 to +10 including zero (21 steps).

When the M button is pressed, the last position of manual brightness is stored. The brightness is returned to this level when the M button is toggled back to manual.

### 3.3.2 Switching functions

**Action:**

Push STANDBY momentarily

Push + button

Push - button

Push STANDBY button for 8 s

Push + button

Push + button

Push + button

Push + button

Push + button 15 times

Push + button

Push and hold M button

–

Hold STANDBY and “-” for more than 8 s

Hold STANDBY and “+” for more than 8 s

**Result:**

Standby LED illuminates.

Brightness goes to minimum.

Brightness increases.

Brightness decreases.

Display lamp hours (device is in service mode)

– Power ups,  $\div 10$

– Total device hours,  $\div 10$

– Present temperature (°C)

– Highest temperature reached (°C)

– Error codes E01 ... E15

– ROM version number

– Display A for 50 Hz operation

Meaning of error codes in digital displays:

– E 01 Overheat

– E 02 Motor problem

– E 03 Keyboard error (stuck button)

– E 04

.

reserved

.

– E 07 SCB not connected

.

reserved

.

E 15

E is displayed if an error has occurred. A number is displayed otherwise.

Resets lamp hours and power up count.

Resets error flags and maximum temperature record.

## 3.4 Mechanical components of the XENON 300

### 3.4.1 Air pump

The air pump is operated by a 555 timer driving a Darlington transistor. The driving frequency is adjusted to the peak output flow with potentiometer R18 (this is the only adjustment on the control board). The microprocessor turns the pump on or off as commanded by the front panel switch.

### 3.4.2 Air filter

If the filter appears dirty or clogged, or if the pump is used routinely, a new filter should be installed (order no. M18406).

### 3.4.3 Fan

The fan is a 12 VDC fan, with power supplied by the auxiliary DC supply.

### 3.4.4 Lamp power supply

The lamp power supply contains the high voltage ignition module and then powers the Xenon lamp during operation.

### 3.4.5 Auxiliary power supply

Supplying  $\pm 12$  VDC and 5.1 VDC, the auxiliary power supply powers the control circuitry, air pump, and fan. All outputs are fully regulated.

### 3.4.6 Optical attenuator

This device attenuates the light output by controlling the position of a rotating disk in the light beam. On startup, the disk rotates until the optical interrupter module locates the home position. The disk then rotates until it reaches the position corresponding to 25%, for newer devices corresponding to 5% brightness.

### 3.4.7 300 W Xenon lamp

The 201331 20 / 201331 20-1 lamp runs at constant power. The output brightness is varied by positioning of the optical attenuator. This means the lamp lifetime is the same at any brightness level.

The lamp hours are read by pressing the standby button and holding it for more than eight seconds. If the lamp has run for 450 hours or more (90% of the lamp's warranted life of 500 hours), a lamp warning annunciator will light on the front panel, and remain lit while the light source is on.

When the lamp has run for 500 hours or more, a replace lamp annunciator will light on the front panel and remain lit until the lamp hours are reset, see *Section 3.3.2 Switching functions*.

THE LIGHT OUTPUT OF THE LAMP IS EXTREMELY HIGH. The exact focal point has been determined by experience to minimize problems (such as light-cable destruction) while providing maximum light output.

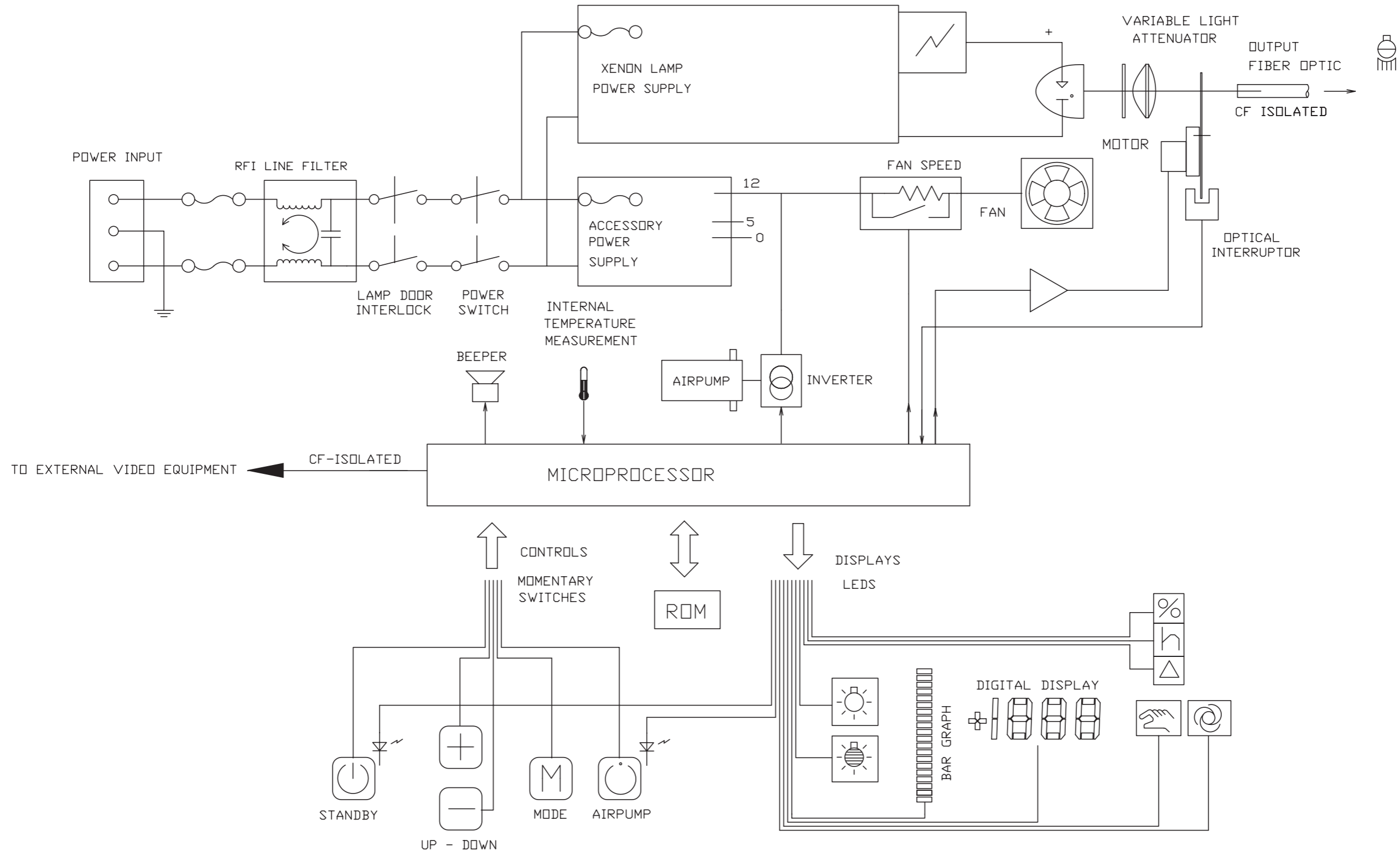


**Caution:** *Readjustment of this focal point is not recommended. It must be understood that moving the focal point may cause burning and destruction of some light guides, for which KARL STORZ GmbH & Co. KG cannot be held responsible.*

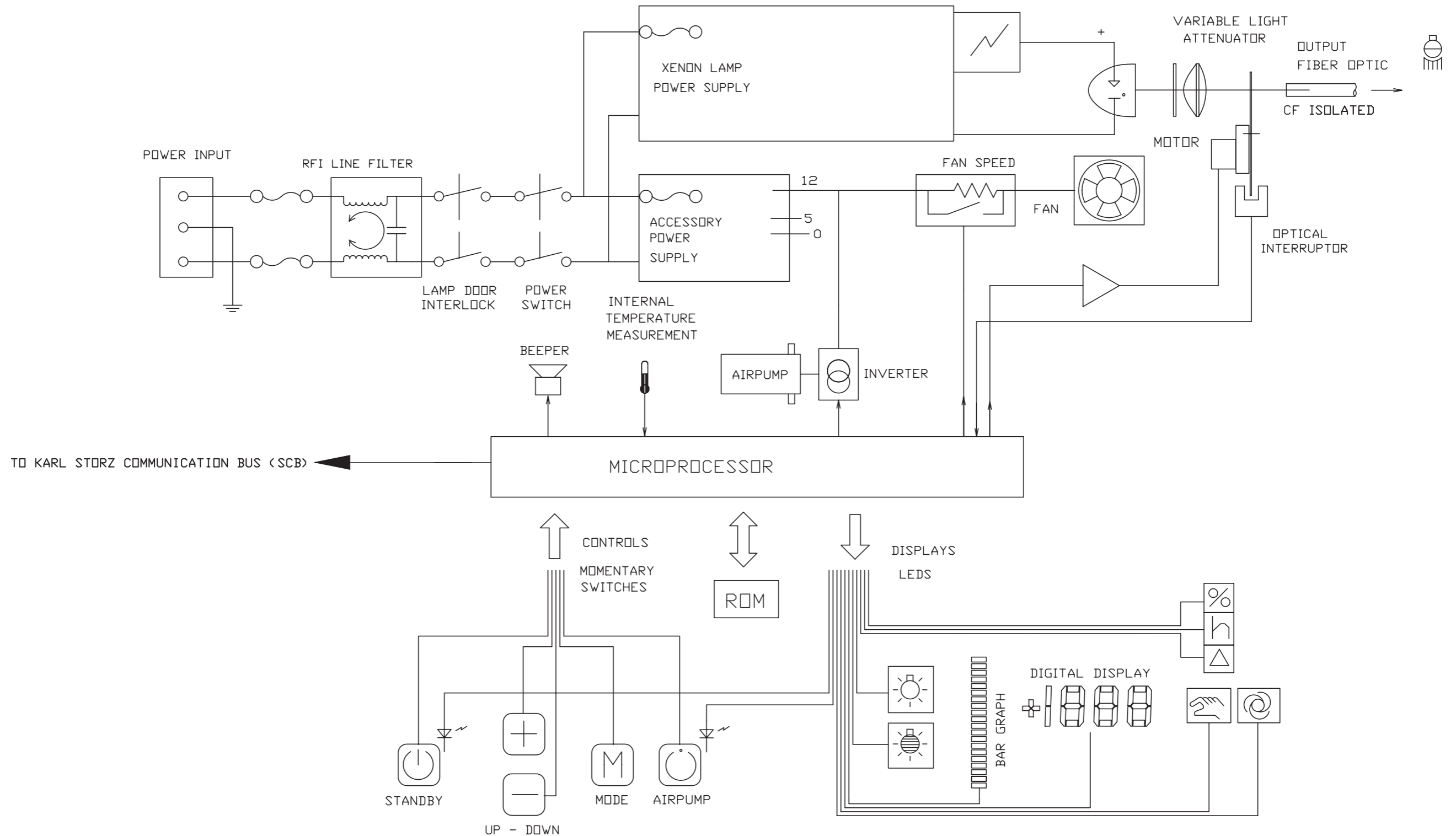
### 3.5 Electrical components of the XENON 300

#### 3.5.1 Block diagrams

##### 3.5.1.1 Block diagram of the XENON 300 model 201331 20

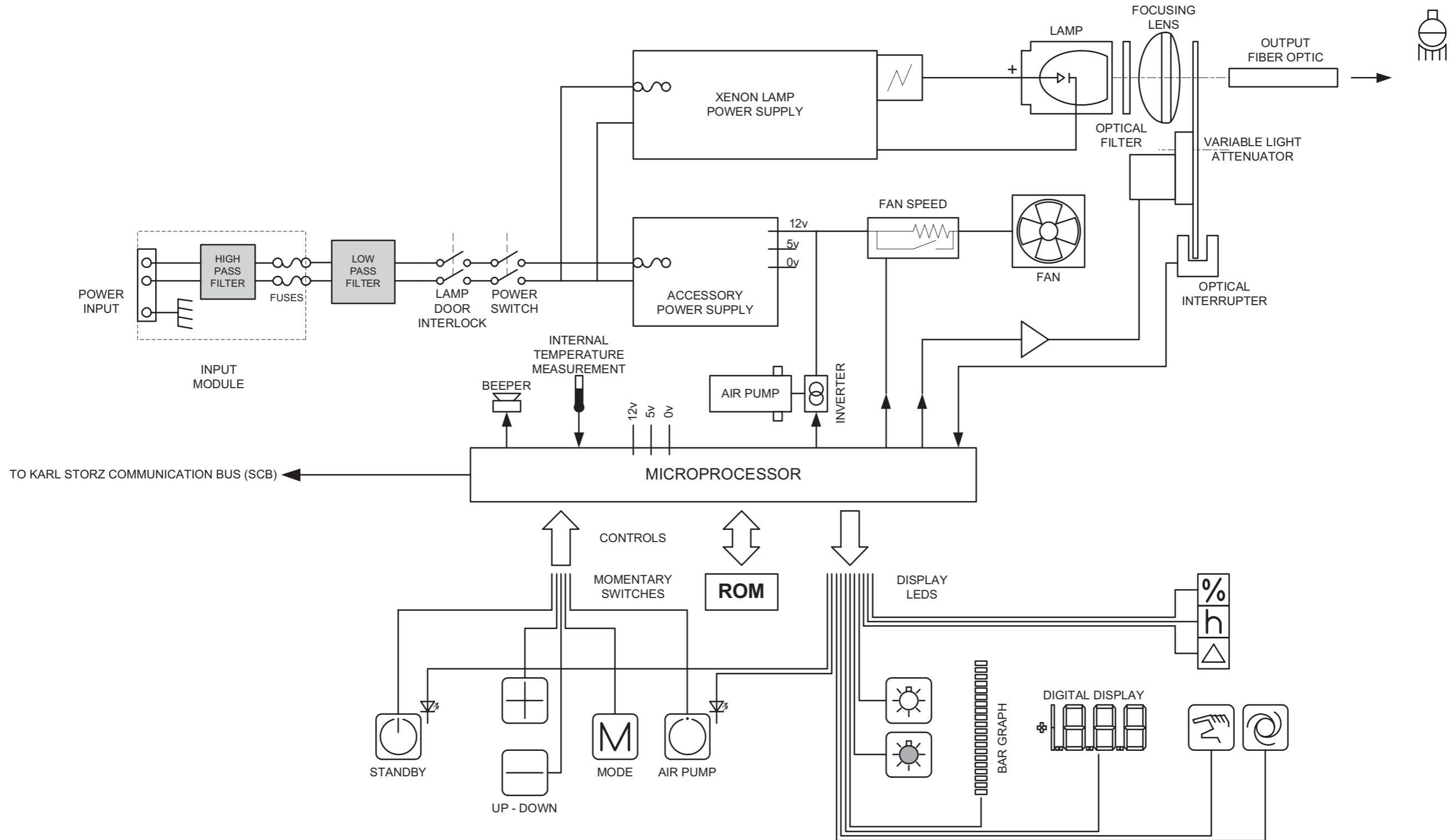


**3.5.1.2 Block diagram of the XENON 300 model 201331 20-1 (up to serial no. LF0612012)**



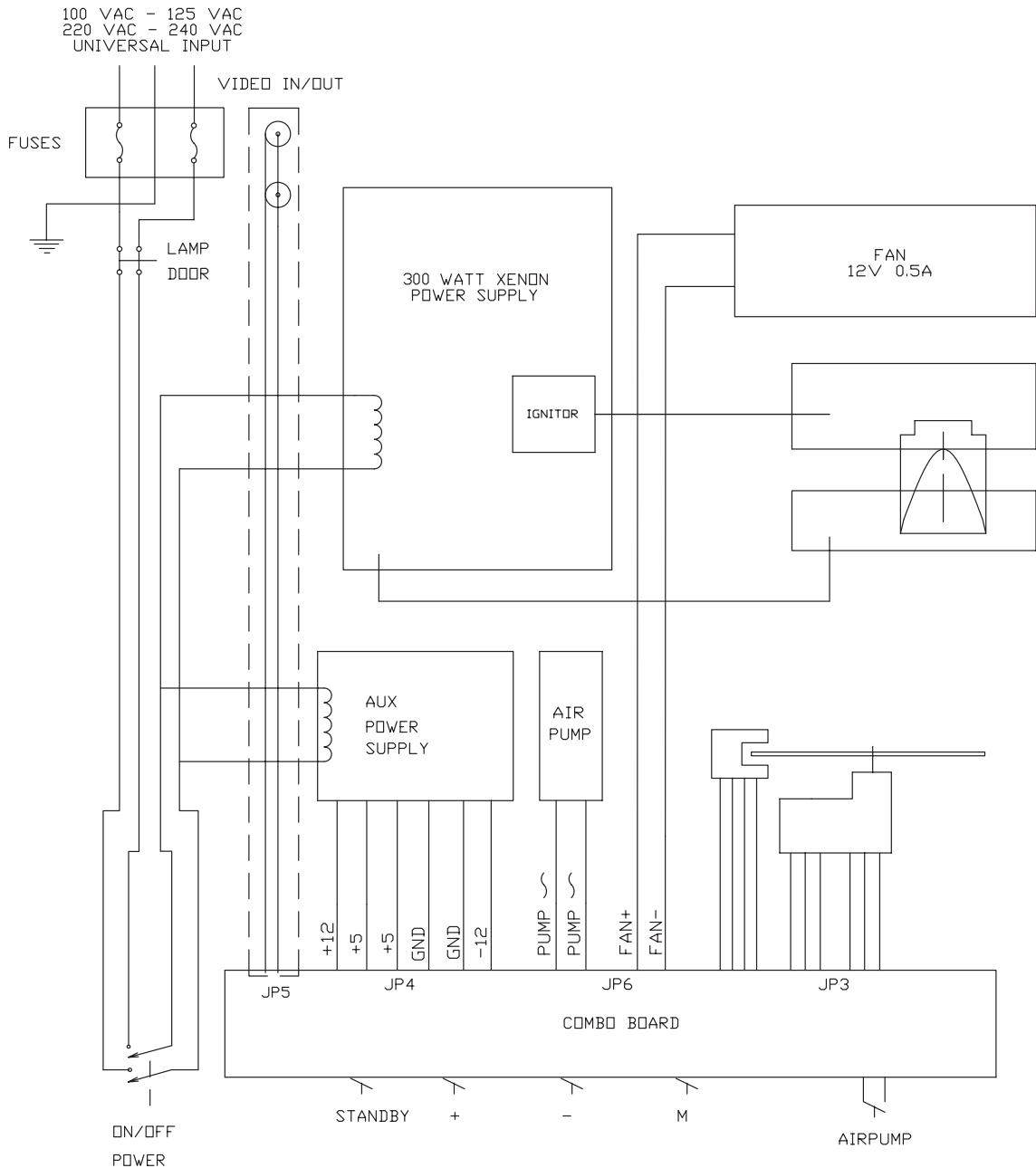


**3.5.1.3 Block diagram of the XENON 300 model 201331 20-1 (as from serial no. LF0612013)**

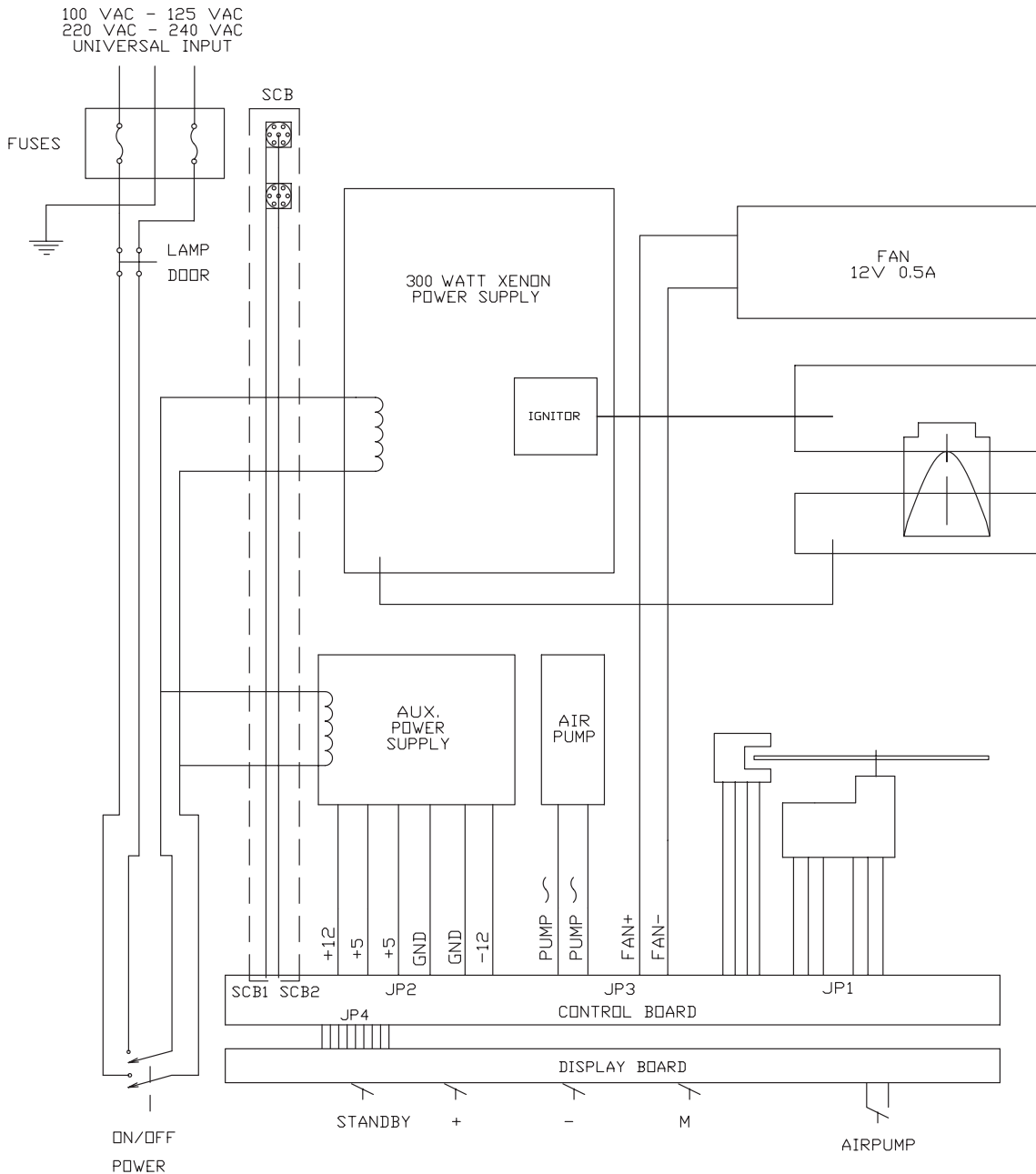


### 3.5.2 Wiring diagrams

#### 3.5.2.1 Wiring diagram of the XENON 300 model 201331 20

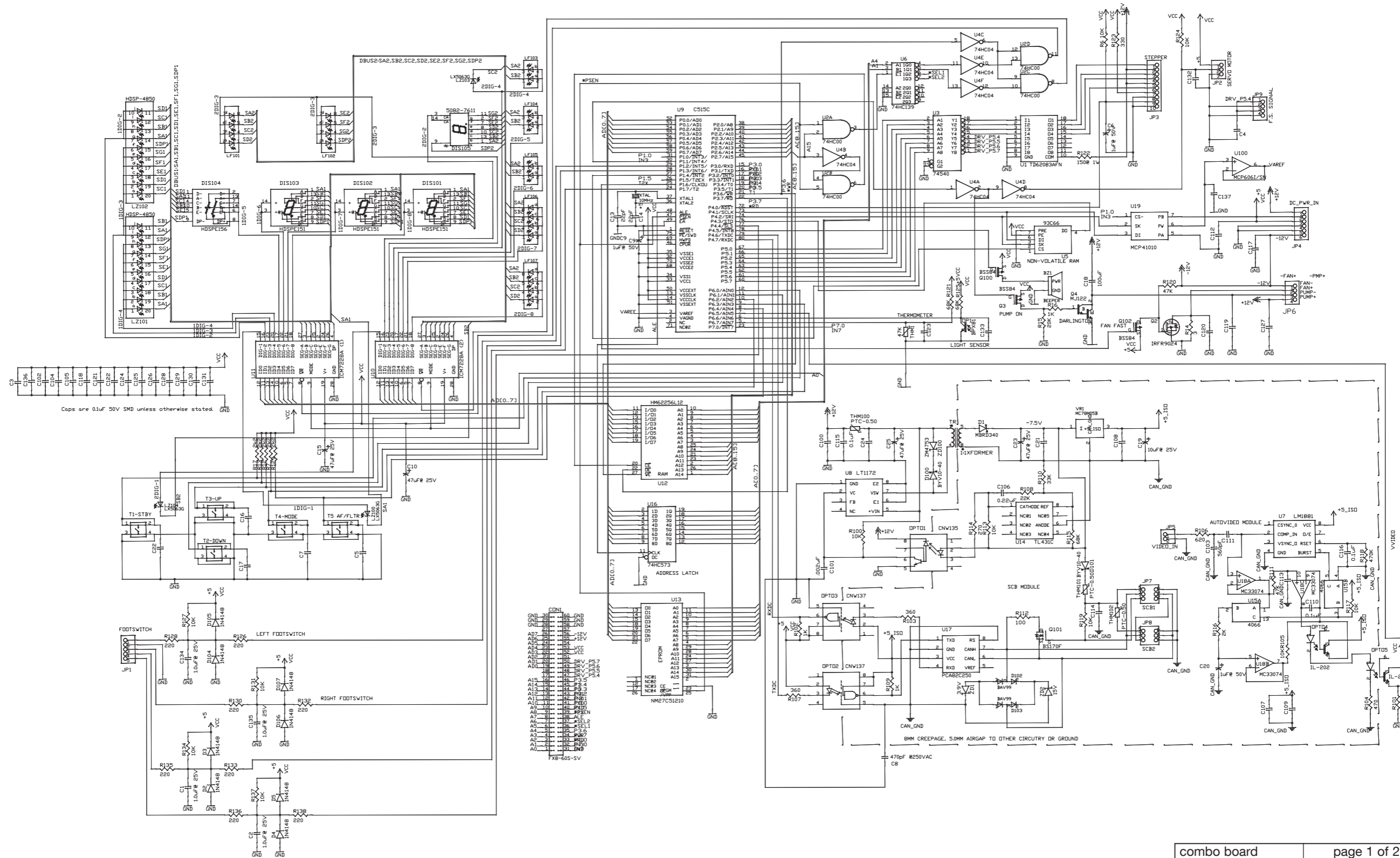


### 3.5.2.2 Wiring diagram of the XENON 300 model 201331 20-1



### 3.5.3 Combo board – XENON 300 model 201331 20

#### 3.5.3.1 Circuit diagram of the combo board – XENON 300 model 201331 20

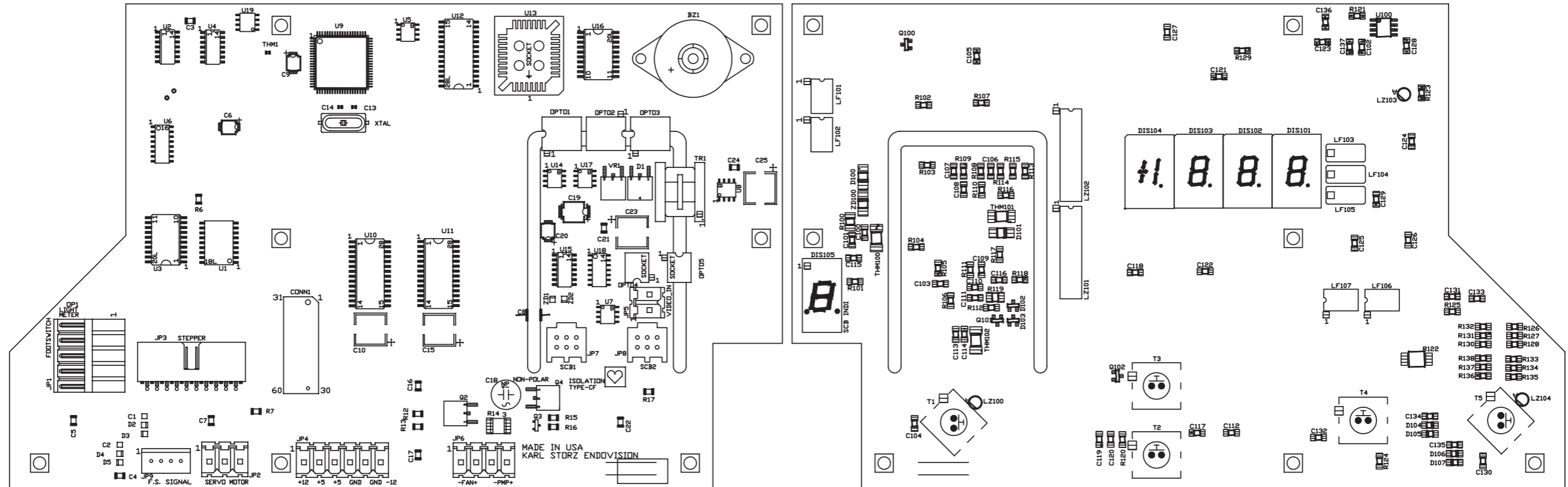




### 3.5.3.2 Component diagram of the combo board – XENON 300 model 201331 20

TOP/COMPONENT SIDE

BOTTOM/DISPLAY SIDE



### **3.5.4 Control board – XENON 300 model 201331 20-1**

#### **3.5.4.1 Brief description of control board operation – XENON 300 model 201331 20-1**

The control board contains a Siemens 80C535 (U1) microprocessor which reads the firmware program in a 27C256 ROM (U2). A nonvolatile 93CS46 RAM stores data (such as lamp hours) when the power is off. Control button status and display information feeds through a circuit board connector (JP4) to the display board.

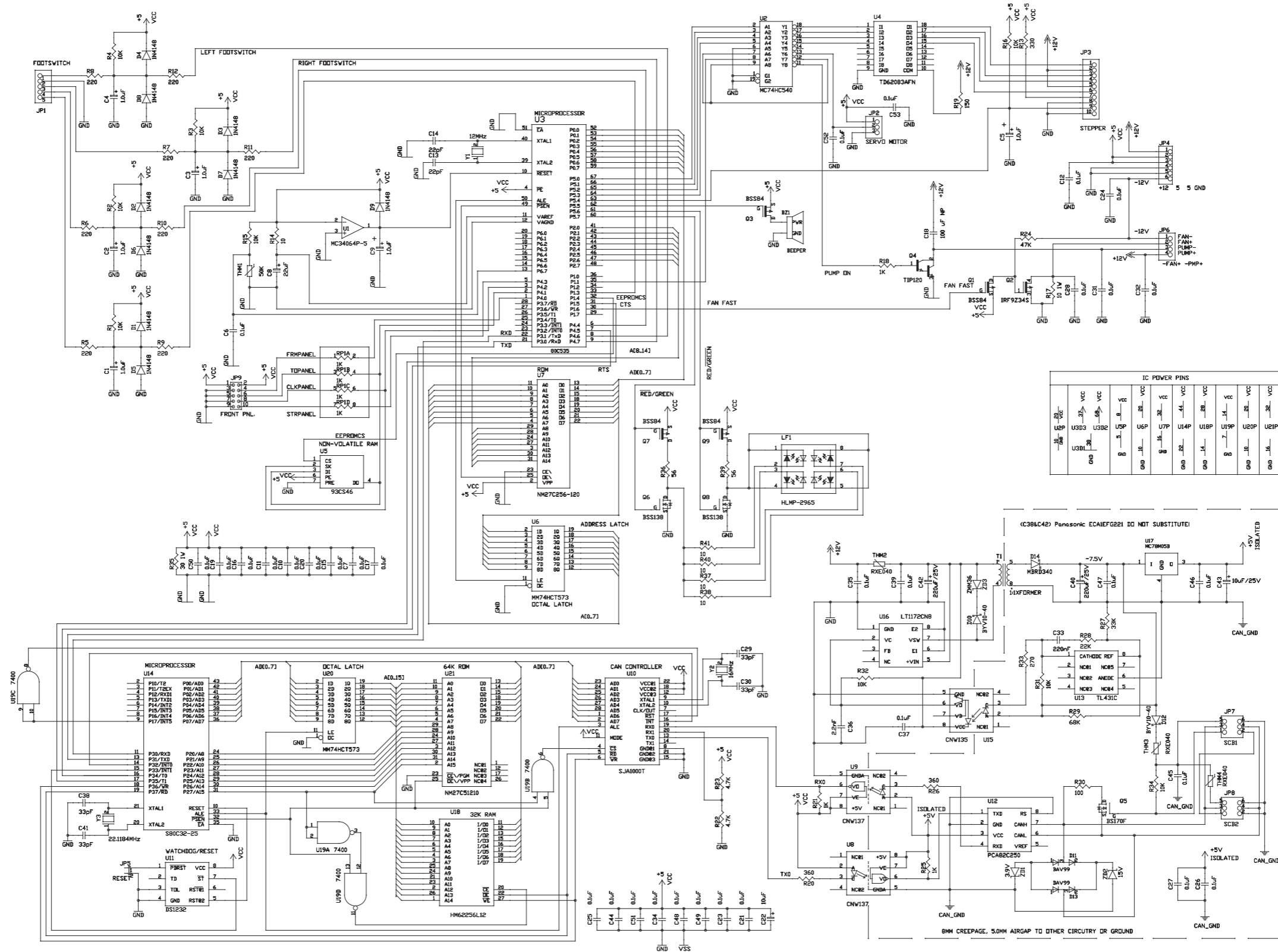
The control board contains a video image processing section. The power to this section comes from a 5 VDC – 5 VDC converter (U8) with high voltage isolation. Processed information from the video signal is fed to the microprocessor through U10 optical isolator.

The vibrating-armature antifog pump is driven by a 555 timer U6, and is turned on and off by the microprocessor.

The fan speed is normally limited to minimize noise. The microprocessor constantly monitors the internal temperature with a THM thermistor. If the temperature reaches 40 °C or above, the microprocessor turns on Q2 which causes the fan to run at maximum speed.

An audio beeper on the control circuit board provides an audible alarm when required.

### 3.5.4.2 Circuit diagram of the control board – XENON 300 model 201331 20-1





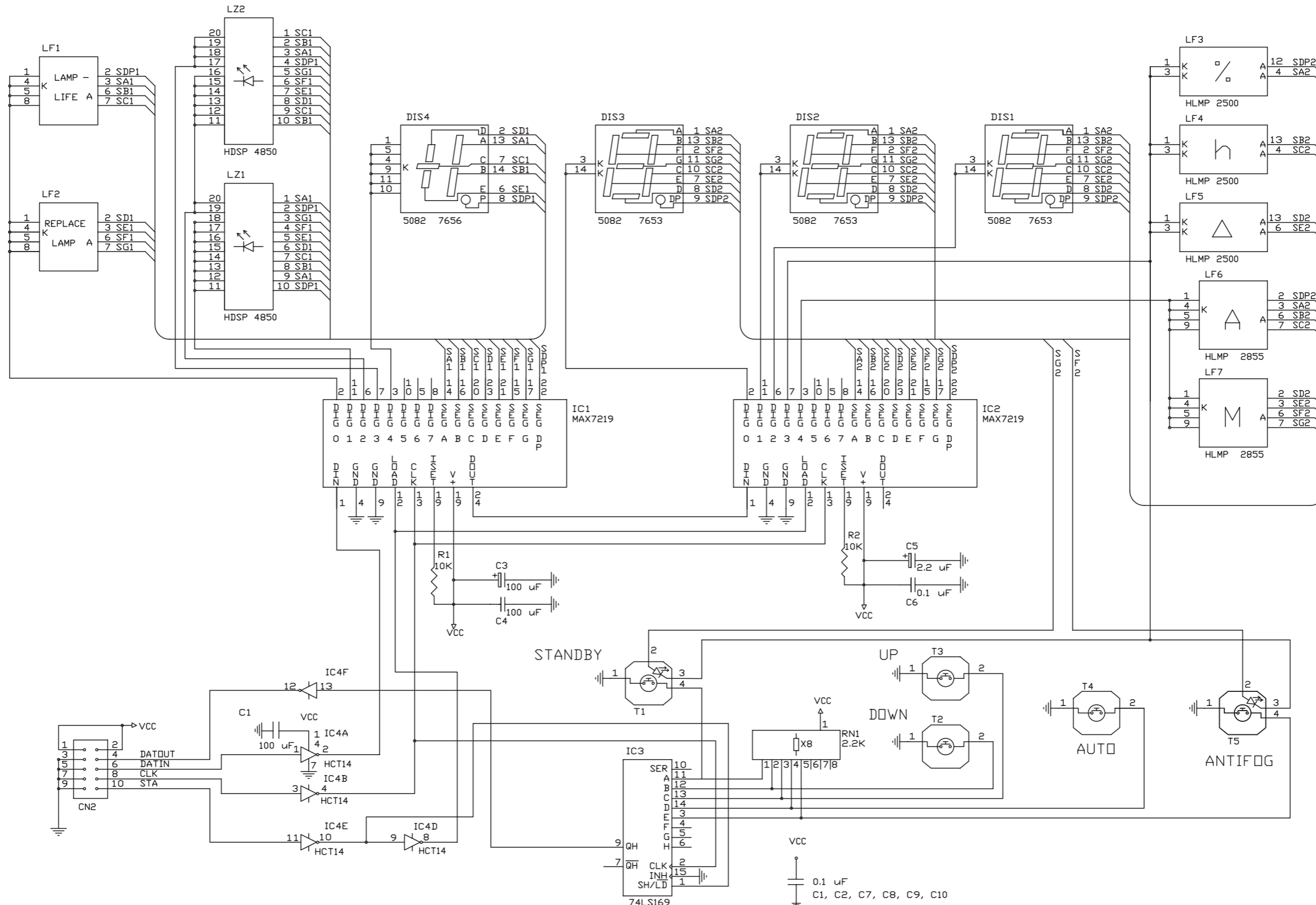


### **3.5.5 Display board – XENON 300 model 201331 20-1**

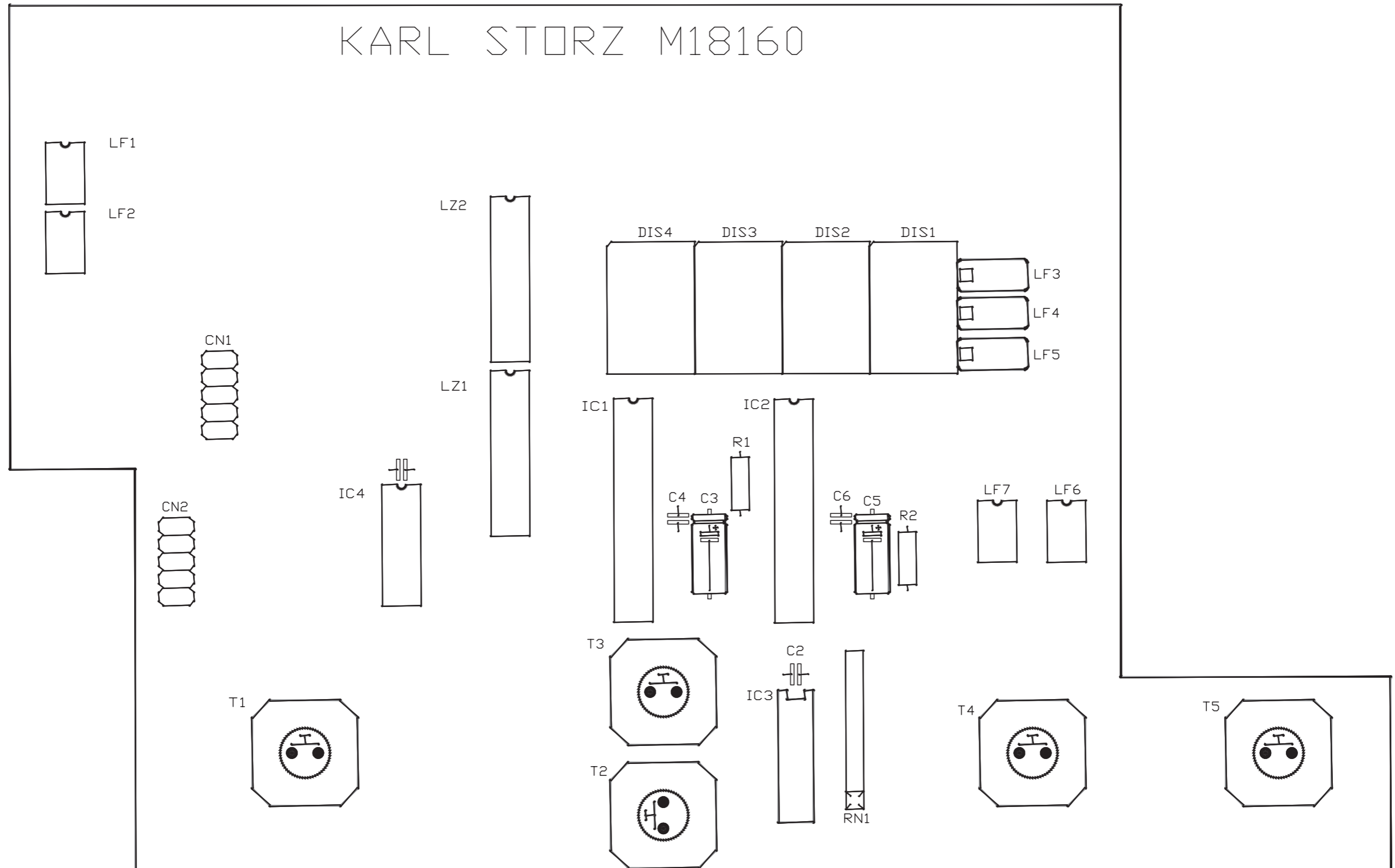
#### **3.5.5.1 Brief description of display board operation – XENON 300 model 201331 20-1**

The display board contains a digital LED display, an LED bargraph, several LED annunciators, and five momentary button switches. Data is sent to and from display board to the control board through a circuit board connector.

### 3.5.5.2 Circuit diagram of the display board – XENON 300 model 201331 20-1



### 3.5.5.3 Component diagram of the display board – XENON 300 model 201331 20-1

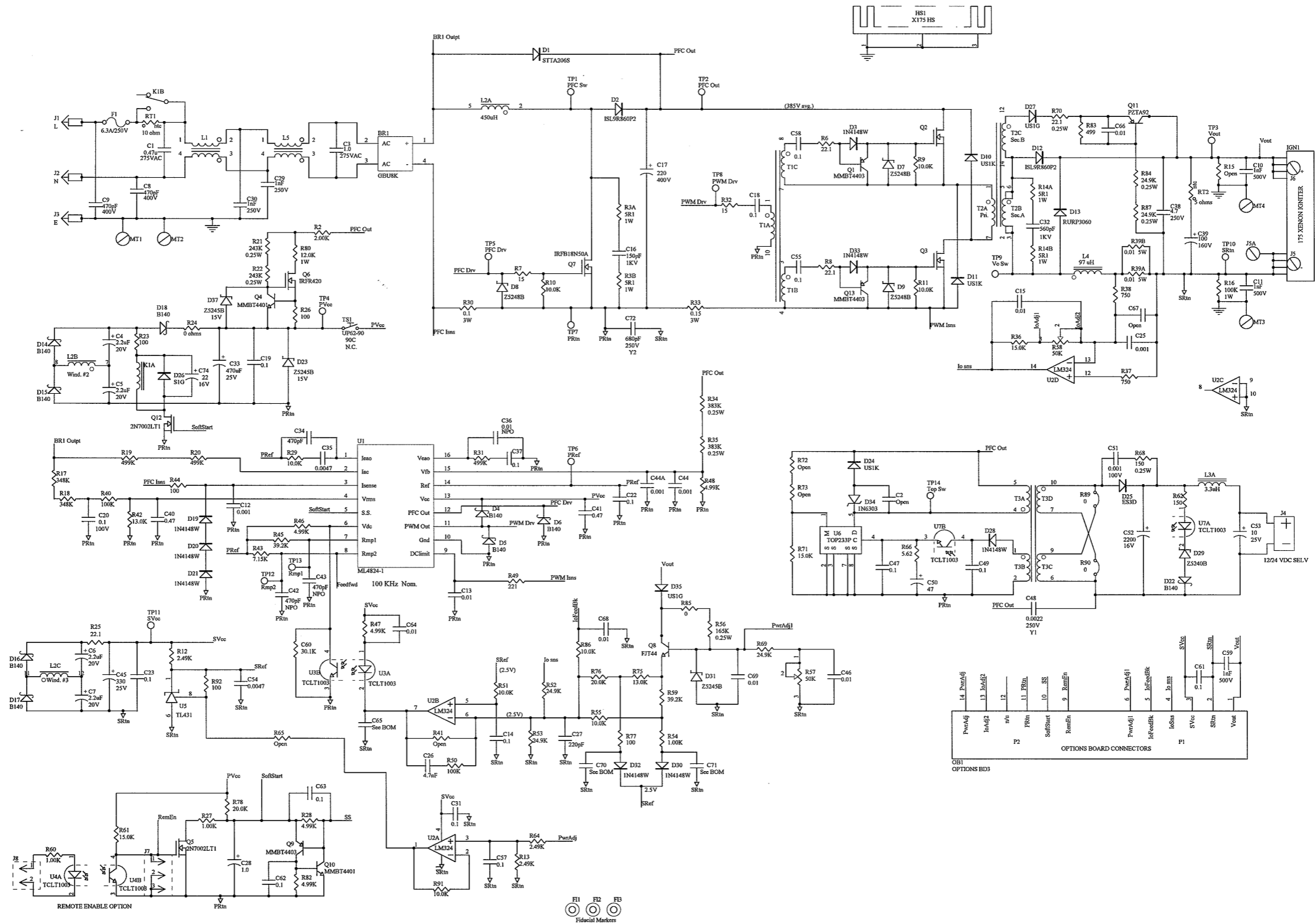


### **3.5.6 Lamp power supply**

#### **3.5.6.1 Brief description of lamp power supply operation**

The lamp power supply contains the high voltage ignition module and then powers the Xenon lamp during operation.

### 3.5.6.2 Circuit diagram of the lamp power supply (as from serial no. LF0612013)



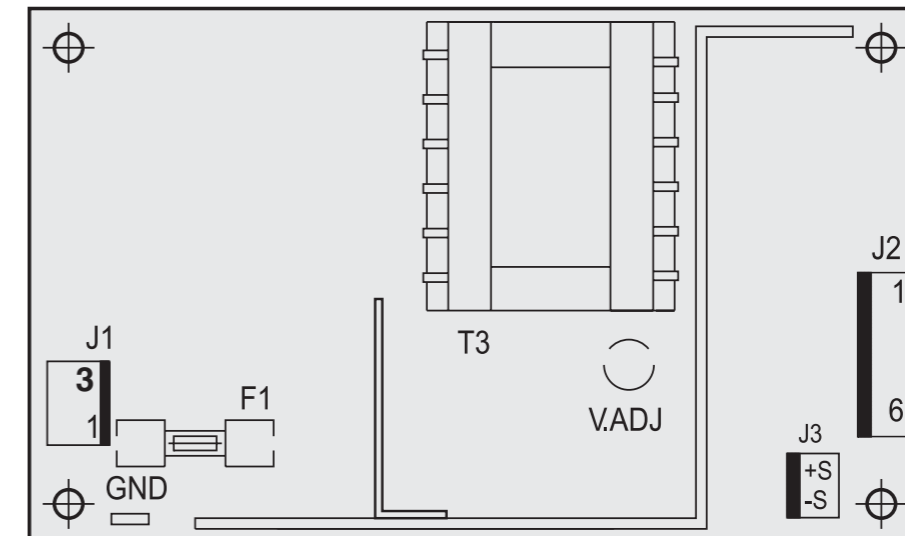
### 3.5.7 Auxiliary power supply

#### 3.5.7.1 Brief description of auxiliary power supply operation

A 40 W power supply unit (order no. Z09709) is used for the power supply to the electronics. Supplying  $\pm 12$  VDC and 5.1 VDC, the auxiliary power supply powers the control circuitry, air pump, and fan. All outputs are fully regulated. This power supply unit is authorized for use in medical devices:

- UL 2601-1
- EN 60601-1
- CSA22.2 No. 601

Pin Assignment	
<b>J1</b>	
PIN 1	AC line
PIN 3	AC neutral
<b>J2</b>	
PIN 1	+12 VDC
PIN 2	+5.1 VDC
PIN 3	+5.1 VDC
PIN 4	Common
PIN 5	Common
PIN 6	-12 VDC
<b>GND</b>	



## 3.6 Troubleshooting

### 3.6.1 Troubleshooting the XENON 300

#### Device won't power up (both light and display)

- Check the power cord and connections. Replace if necessary.
- Check for blown power fuse, see *Fuse blown*.
- Check power source.

#### Device powers lamp but front display panel isn't lit

- Check the auxiliary power supply to ensure it is supplying 5.1 VDC.
- Suspect faulty display board, see *Section 3.6.2 Component courses of action – Display board*.

#### Front display panel is lit, but lamp isn't lit

- Suspect faulty lamp power supply, see *Section 3.6.2 Component courses of action – Lamp power supply*.

#### Device suddenly shut down

- Suspect overheating. Check service mode for maximum temperature reached.
- Make sure the fan is working and vents are unobstructed.
- If the fan is not working, see *Fan will not run*.
- Measure the lamp wattage, see *General complaint of low brightness*. If it is not between 235 W and 300 W (normal), replace the lamp power supply.

#### Fuse blown

- Replace the fuse.
- Repeated replacement of fuses is an indication of a power supply component failure, see *Section 3.6.2 Component courses of action – Lamp power supply*.

#### Fan will not run

- Check the -12 VDC output from the auxiliary power supply and all connections, see *Section 3.6.2 Component courses of action – Auxiliary power supply*.
- Check the fan itself. Replace if necessary.
- Suspect faulty control board, see *Section 3.6.2 Component courses of action – Control board*.

#### Lamp will not start or stay lit

- Inspect the lamp. If the lamp window looks dirty or the reflector is damaged, replace the lamp.
- Check the lamp power supply, see *Section 3.6.2 Component courses of action – Lamp power supply*.

#### Light cannot be dimmed properly or attenuator will not initialize properly

- Check the optical attenuator mechanism for jamming or broken parts. Replace if necessary.
- Suspect faulty control board, see *Section 3.6.2 Component courses of action – Control board*.

#### General complaint of low brightness

- Examine all other parts in the optical system, including the light guide cable, the endoscope, the video camera and lenses.
- Check the lamp hours, see *Section 3.3.2 Switching functions*. If the lamp has been used for more than 500 hours, replace the lamp.
- Check the electrical and optical power of the lamp as described in *Section 5.2* and *Section 5.3 Testing and adjusting the lamp current*. Adjust if necessary.
- If the measurements are not within the stated ranges, the lamp may be defective and need to be replaced.

#### Light-guide input-end burning

- Check for inadequate cleaning of the cable, or use of a previously burned cable.
- Unsuitable light-guide; that is, a light-guide only suitable for low power use.



## 3.6.2 Component courses of action

**Note:** *An isolation transformer should be used with all AC-powered test equipment to prevent damaging the equipment or creating a safety hazard.*

### Lamp

- If the lamp fails before 500 hours, look for the following items to ensure no other problems were responsible. Replace the lamp.
  - Marked discoloration inside the lamp (usually caused by a seal leak).
  - Cracked window (caused by thermal shock).
  - Crazed or burned reflector. This can be caused by overheating or overcurrent, and is indicative of problems elsewhere.

### Optical attenuator

- Check for a defective drive motor. Replace if necessary.
- Suspect faulty control board, see *Control board*.

### Control board

- The following conditions (assuming supply voltages are present) would indicate that a control board is faulty:
  - Integrated circuits (chips) too hot to touch.
  - No oscillation present (9.8304 MHz) at U1-39.
  - No activity on address lines (A0, A1 ... A14).
  - No activity on data lines (DB0, DB1, DB2 ... DB7).
  - No activity on control lines (U2-22, U3-11).
  - No +5 VDC present at U1-10 (reset pin).
  - No +5 VDC present between U8-7 and U8-5.
- Satisfying the above conditions does not guarantee that the control board is functioning properly.
- Replace faulty or suspect control boards.

### Lamp power supply

- If possible, check the power supply by using a lamp known to be good.
- Check all connections.
- Replace the power supply and return the defective part for repair.

### Auxiliary power supply

- Check that the auxiliary power supply is providing +12 VDC, -12 VDC, and +5.1 VDC.
- If the microprocessor or display won't function, the 5.1 VDC could be faulty.
- If the attenuator won't function, the +12 VDC could be faulty.
- If the fan won't function, the -12 VDC could be faulty.
- Replace the power supply and return the defective part for repair.

### Display board

- If the entire display has failed, see *Auxiliary power supply*.
- If several LED segments are not lighting or light at the wrong time, or the display is scrambled, the microprocessor or associated circuitry has probably failed, see *Control board*.
- If the display scrambles sometimes, but works other times, check for a loose internal ground. If not, suspect a faulty control board, see *Control board*.
- Although component level repair is possible, most repairs will best be handled by circuit board replacement.

## 3.7 Technical data

XENON 300	201331 20 / 201331 20-1
Supply voltage	100 VAC ... 125 VAC / 220 VAC ... 240 VAC, ±10%
Power frequency	50 Hz / 60 Hz
Power consumption	700 VA <sup>1)</sup> / 450 VA <sup>2)</sup>
Power fuses <sup>1)</sup>	2 x T 4.0 AL / 250 V (220 VAC ... 240 VAC) 2 x T 8.0 AL / 250 V (100 VAC ... 125 VAC)
Power fuses <sup>2)</sup>	2 x T 2.5 AL / 250 V (220 VAC ... 240 VAC) 2 x T 5.0 AL / 250 V (100 VAC ... 125 VAC)
Lamp type	Xenon lamp, 300 W, 15 V
Lamp-rated voltage	10 VDC ... 15 VDC
Lamp-rated capacity	300 W (nominal)
Lamp-rated current	21 A (nominal)
Antifog air filtration	0.2 µm filter
Operating temperature	10 °C ... 40 °C (50 °F ... 104 °F)
Dimensions (w x h x d)	305 mm x 165 mm x 335 mm
Weight	7.96 kg
<i>Storage and transport conditions:</i>	
Storage temperature	0 °C ... 60 °C (32 °F ... 140 °F)
Humidity	5% ... 95%, rel. humidity, non-condensing
Atmospheric pressure	+500 hPa ... +1080 hPa

### Standard compliance

**According to IEC / UL 60601-1, EN 60601-1-2, CSA 601.1:**

Type of protection against electric shocks:

Protection Class I

Degree of protection against electric shocks:

Applied part of type BF<sup>4)</sup>  / CF<sup>5)</sup> 

**According to IEC 60601-1-2:2001:**



Please read the Electromagnetic Compatibility Information in the appendix of the instruction manual.

### Directive compliance

**According to Medical Device Directive (MDD):**

Medical device in Class II a

This medical device bears the CE mark according to MDD 93/42/EEC. A code number after the CE mark indicates the responsible notified body.



1) Valid up to serial no. BC0627677.

2) Valid as from serial no. BC0627916.

4) Older versions of the XENON 300.

5) Newer versions of the XENON 300.

## Section 4.

# Replacement of Individual Assemblies

Direction Sign:

- 1 ⇐ Instruction Manual
- 2 ⇐ Physical Design
- 3 ⇐ Descriptions of Operation and Circuit Diagrams
  - Testing and Adjustments ⇒ 5
  - Maintenance and Safety Checks ⇒ 6
  - Modifications and Supplements ⇒ 7
  - Appendix ⇒ 8

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## 4.1 Information about replacements

The device is fully adjusted and tested before it leaves the manufacturers. If the device fails, a test of the assemblies should be carried out by authorized KARL STORZ technical staff.

## 4.2 Tools required for replacing the individual assemblies

### – Control board and combo board

Torx screwdrivers  
6 mm nut driver  
Small flat blade screwdriver  
Phillips screwdriver

**Conductive work mat, wristband, ground cable**

### – Display board

Torx screwdrivers  
6 mm nut driver  
Small flat blade screwdriver  
Phillips screwdriver

**Conductive work mat, wristband, ground cable**

### – Attenuator assembly

Torx screwdrivers  
Small flat blade screwdriver  
Phillips screwdriver

**Conductive work mat, wristband, ground cable**

### – Lamp power supply

T10 Torx screwdriver  
T20 Torx screwdriver  
T25 Torx screwdriver  
Small flat blade screwdriver  
Phillips screwdriver  
Soft face mallet  
Needle nose pliers  
6 mm nut driver

**order no. 5610612**

**order no. 5625112**

**order no. 5625212**



**Caution:** *Always unplug the equipment before performing any repairs.*

*To prevent damage to the components caused by the build-up of electrostatic charges, we recommend that you connect yourself to ground via the wristband throughout servicing.*

*After servicing, a safety test, the leakage current and protective ground resistance measurements according to IEC 62353, IEC / UL 60601-1, CAN / CSA C22.2 NO 601.1, whichever may apply, are to be carried out.*

**– Auxiliary power supply**

T10 Torx screwdriver	<b>order no. 5610612</b>
T20 Torx screwdriver	<b>order no. 5625112</b>
T25 Torx screwdriver	<b>order no. 5625212</b>
Small flat blade screwdriver	
Soft face mallet	
Needle nose pliers	
Phillips screwdriver	

**Conductive work mat, wristband, ground cable**

**– Fan**

T20 Torx screwdriver	<b>order no. 5625112</b>
T25 Torx screwdriver	<b>order no. 5625212</b>
Small flat blade screwdriver	
Soft face mallet	
Needle nose pliers	
Phillips screwdriver	
Cutters	

**Conductive work mat, wristband, ground cable**

**– Air pump**

T10 Torx screwdriver	<b>order no. 5610612</b>
T20 Torx screwdriver	<b>order no. 5625112</b>
T25 Torx screwdriver	<b>order no. 5625212</b>
Small flat blade screwdriver	
Phillips screwdriver	
Soft face mallet	
Needle nose pliers	

**Conductive work mat, wristband, ground cable**

**– Lamp and lamp module**

Needle nose pliers	
7/64" hex driver	
T25 Torx screwdriver	<b>order no. 5625212</b>
Phillips screwdriver	
Thermal compound	

**Conductive work mat, wristband, ground cable**



**Caution:** *Always unplug the equipment before performing any repairs.*

*To prevent damage to the components caused by the build-up of electrostatic charges, we recommend that you connect yourself to ground via the wristband throughout servicing.*

*After servicing, a safety test, the leakage current and protective ground resistance measurements according to IEC 62353, IEC / UL 60601-1, CAN / CSA C22.2 NO 601.1, whichever may apply, are to be carried out. .*

## 4.3 Replacement of the control board / combo board

Refer to *Section 4.11 Figures for replacements – Figures 1 and 2.*

- a. Disconnect the device from its power source.
- b. Remove the endplates using a small flat blade screwdriver.
- c. Pull both bayonet locks to the right to disengage the front panel locking pins.
- d. Carefully pull the front panel forward and rest it on the bench top.
- e. Disconnect the air hose from the air pump outlet.
- f. Disconnect all cables and wires from the control board/combo board.
- g. Remove the six screws (M3 x 6) securing the shield to the front panel.
- h. Remove the shield. Be careful to avoid damaging the attenuator wheel.
- i. Remove the six hex standoffs (6 hex x M3 x 16 M-F) and screw (M3 x 6) securing the control board to the display board or for devices with combo board remove the seven standoffs.
- j. Separate the control board from the display board at the JP4 connector. For devices with combo board simply remove from the front panel.
- k. Replace the control board/combo board and reassemble in reverse order of disassembly.

## 4.4 Replacement of the display board

**Note:** *Not applicable to devices with combo board.*

Refer to *Section 4.11 Figures for replacements – Figures 1 and 2.*

- a. Disconnect the device from its power source.
- b. Remove the endplates using a small flat blade screwdriver.
- c. Pull both bayonet locks to the right to disengage the front panel locking pins.
- d. Carefully pull the front panel forward and rest on the bench top.
- e. Disconnect the air hose from the air pump outlet.
- f. Disconnect all cables and wires from the control board.
- g. Remove the six screws (M3 x 6) securing the shield to the front panel.
- h. Remove the shield. Be careful to avoid damaging the attenuator wheel.
- i. Remove the six hex standoffs (6 hex x M3 x 16 M-F) and screw (M3 x 6) securing the control board to the display board.
- j. Separate the control board from the display board at the JP4 connector. Note the location of the light shield.
- k. Remove the seven hex standoffs (6 hex x M3 x 8 F-F) securing the display board to the front panel.
- l. Remove the display board from the front panel.
- m. Replace the display board and reassemble in reverse order of disassembly.

## 4.5 Replacement of the attenuator assembly

Refer to *Section 4.11 Figures for replacements – Figures 1 and 3.*

- a. Disconnect the device from its power source.
- b. Remove the endplates using a small flat blade screwdriver.
- c. Pull both bayonet locks to the right to disengage the front panel locking pins.
- d. Carefully pull the front panel forward and rest on the bench top.
- e. Disconnect the air hose from the air pump outlet.
- f. Disconnect all cables and wires from the control board.
- g. Remove the six screws (M3 x 6) securing the shield to the front panel.
- h. Remove the shield. Be careful to avoid damaging the attenuator wheel.
- i. Remove two screws (M3.6 x 6), a flatwasher, and a lockwasher.
- j. Separate attenuator assembly from shield.
- k. Replace the attenuator assembly and reassemble in reverse order of disassembly.

## 4.6 Replacement of the lamp power supply

### 4.6.1 Lamp power supply – XENON 300 model 201331 20

Refer to *Section 4.11 Figures for replacements – Figures 1, 3 and 4.*

- a. Disconnect the device from its power source.
- b. Remove the endplates using a small flat blade screwdriver.
- c. Unfasten the quarter-turn fasteners securing the lamp door and remove it.
- d. Remove the five screws securing the top cover and remove it.
- e. Remove the two screws securing the bottom cover and remove it.
- f. Using the soft face mallet, gently tap top and bottom covers as required for removal.
- g. Remove the screws holding the power input module and disconnect the green/yellow ground wire. Slide the module and the line filter out to the access screw at the corner of the power supply.
- h. Disconnect the wires from the power switch and all wires going to the power supply, keep track of connections in order to re-assemble correctly. Push the harness out of the way.
- i. Remove the four screws securing the lamp power supply to the sub-chassis and carefully remove the power supply.
- j. Replace the lamp power supply and reassemble in reverse order of disassembly.

### 4.6.2 Lamp power supply – XENON 300 model 201331 20-1

Refer to *Section 4.11 Figures for replacements – Figures 1, 3 and 4.*

- a. Disconnect the device from its power source.
- b. Remove the endplates using a small flat blade screwdriver.
- c. Remove the lamp door.
- d. Remove the top cover.
- e. Remove the bottom cover.
- f. Disconnect all wires going to the lamp power supply.
- g. Remove the screws holding the lamp power supply to the inner chassis.
- h. Remove the screws holding the side panel nearest lamp power supply.
- i. Pull the side panel outward and remove the lamp power supply.
- j. Remove the standoffs from the lamp power supply and mount them on the replacement lamp power supply.
- k. Reassemble in reverse order of disassembly.

## 4.7 Replacement of the auxiliary power supply

Refer to *Section 4.11 Figures for replacements – Figures 1, 3, and 5.*

- a. Disconnect the device from its power source.
- b. Remove the endplates using a small flat blade screwdriver.
- c. Remove the lamp door.
- d. Remove the five screws securing the top cover and remove it.
- e. Remove the two screws securing the bottom cover and remove it.
- f. Using the soft face mallet, gently tap top and bottom covers as required for removal.
- g. Pull the bayonets holding the front panel and pull them partway out.
- h. Disconnect all wires from the auxiliary power supply.
- i. Remove the screws holding the auxiliary power supply and remove the auxiliary power supply.
- j. Replace the auxiliary power supply and reassemble in reverse order of disassembly.



## 4.8 Replacement of the fan

Refer to *Section 4.11 Figures for replacements – Figures 1, 3 and 5.*

- a. Disconnect the device from its power source.
- b. Remove the endplates using a small flat blade screwdriver.
- c. Unfasten the quarter-turn fasteners and remove the lamp door.
- d. Remove the lamp module.
- e. Remove the five screws holding the top cover and remove the top cover.
- f. Remove the two screws holding the bottom cover and remove the bottom cover.
- g. Remove the screws holding the lamp card guide.
- h. Remove the two screws holding the side panel and the rear panel on the lamp side.
- i. Slide the bayonets and lower the front panel.
- j. Disconnect all wires from the front panel and remove the front panel completely.
- k. Disconnect all wires from the fan.
- l. Remove the plastic rivets holding the Nomex shroud to the fan.
- m. Remove the two screws holding the fan to the inner chassis and screw the holding to the rear panel.
- n. Remove the fan.
- o. Replace the fan and reassemble in reverse order of disassembly.

## 4.9 Replacement of the air pump

Refer to *Section 4.11 Figures for replacements – Figures 1 and 3.*

- a. Disconnect the device from its power source.
- b. Remove the endplates using a small flat blade screwdriver.
- c. Slide the bayonets and lower the front panel.
- d. Disconnect all wires from the air pump.
- e. Disconnect the air tube from the air pump.
- f. Remove the three screws holding the air pump.
- g. Replace the air pump and reassemble in reverse order of disassembly.

## 4.10 Replacement of the lamp and lamp module

Refer to *Section 4.11 Figures for replacements – Figures 1 and 6.*

- a. Unfasten the quarter-turn fasteners securing the lamp door.
- b. Pull out the lamp card extractors and remove the lamp module.



**Caution:** *Do not look into the lamp or lightguide. Do not allow light from either the lightsource or the lightguide to shine directly on hands or other areas of the body; burns may occur.*

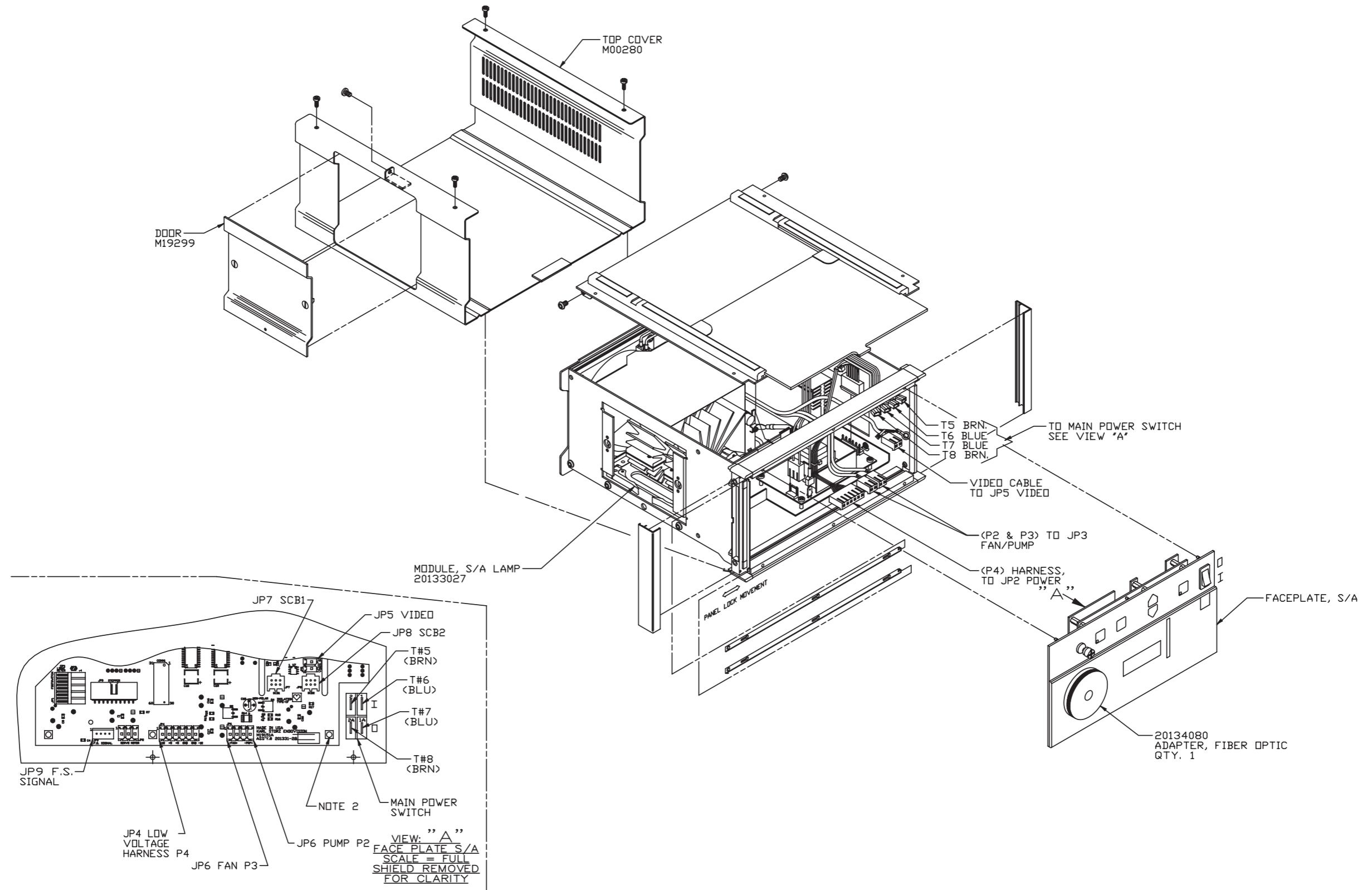
**Lamps are high pressure vessels and must be handled with care. When handling the lamp wear safety glasses and face shields to protect the face and gloves to prevent skin oil transfer. When working with an operating lamp, wear eye and face protection to prevent blindness or UV damage.**

- c. If a complete lamp module assembly has been purchased, install the new assembly at this point. Skip to step i.
- d. Remove the four screws (M4 x 12) securing the lamp assembly to the lamp card.
- e. Remove the three screws (6-32" x 1/2" socket head) securing the lamp to the anode heatsink.
- f. Loosen the screw clamping the heatsinks to the lamp.
- g. Carefully separate each heatsink from the lamp.
- h. Apply a thin coating of thermal compound around the inside circumference of the new heatsinks (both anode and cathode) as well as on the anode end surface.
- i. Install the lamp into the lamp heatsinks. Assemble the lamp assembly, then install the assembly into the device.
- j. Test and adjust as described in *Section 5.2* and *Section 5.3 Testing and adjusting the lamp current.*
- k. Reassemble in reverse order of disassembly.

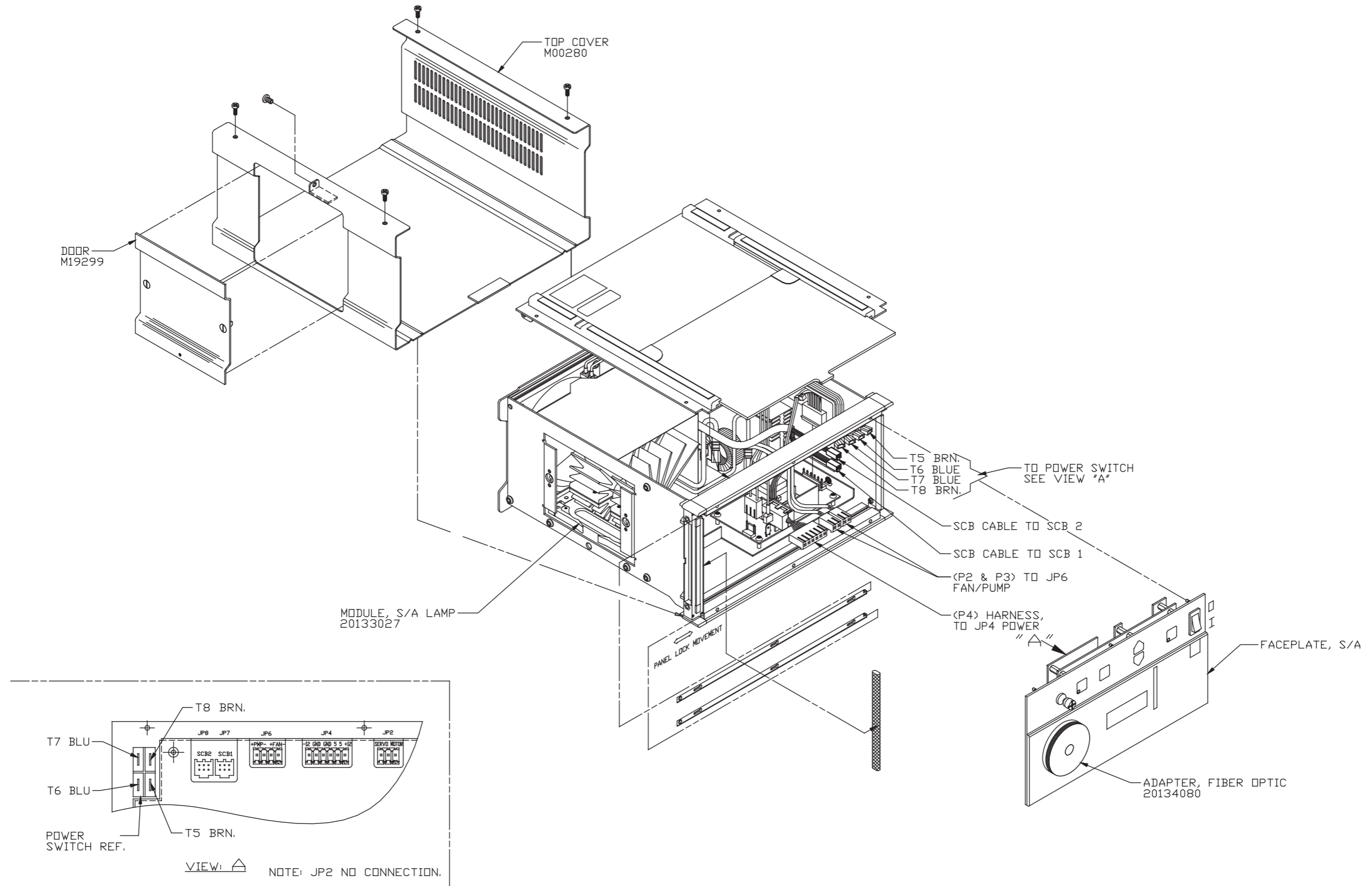
**Note:** *Torque the screws (M4 x 12) on the heatsinks to 1.24 Nm (11 in. lb). Do not overtorque!*

### 4.11 Figures for replacements

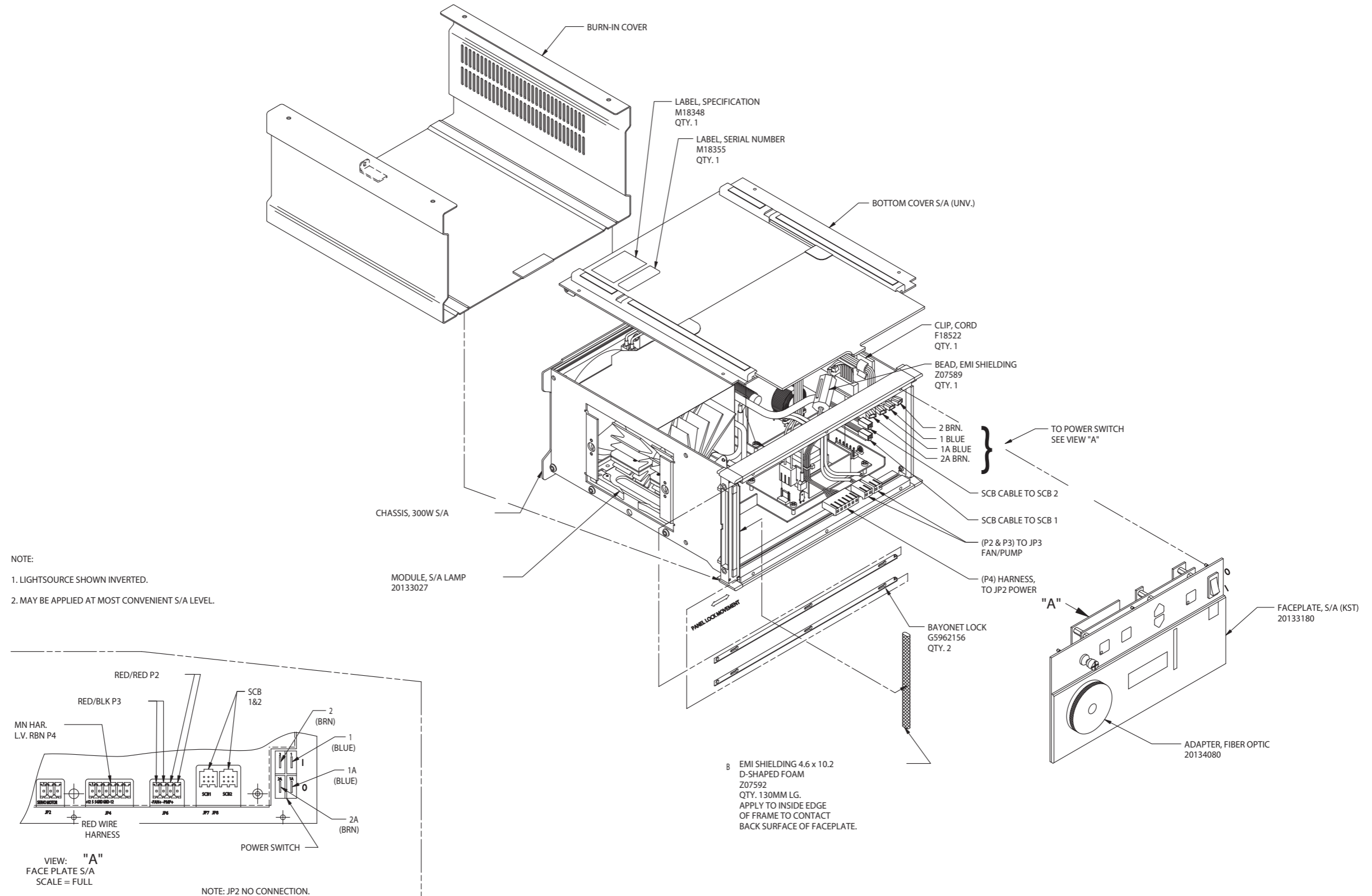
#### 4.11.1 Figure 1 – XENON 300 model 201331 20



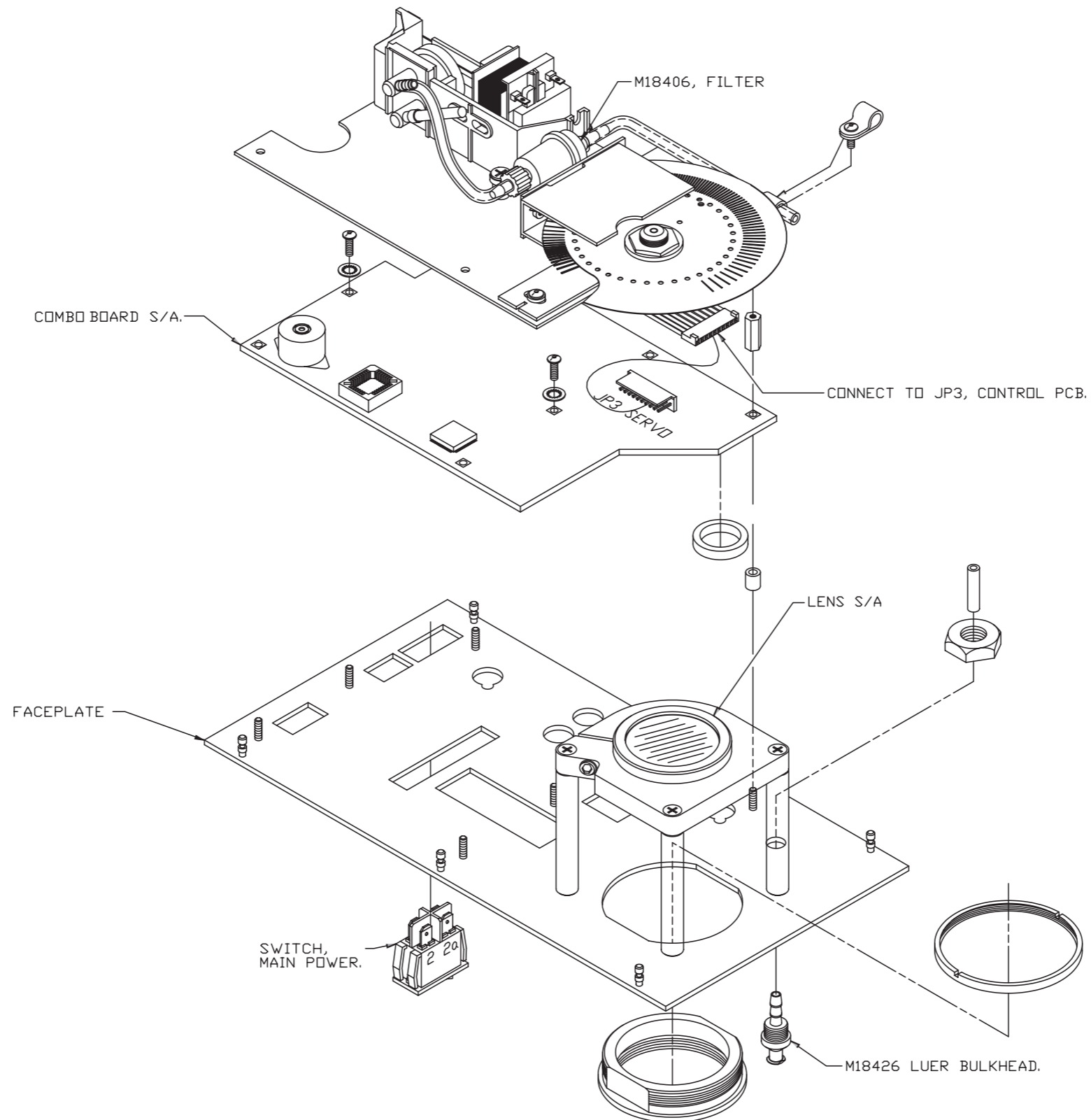
4.11.2 Figure 1 – XENON 300 model 201331 20-1 (up to serial no. LF0612012)



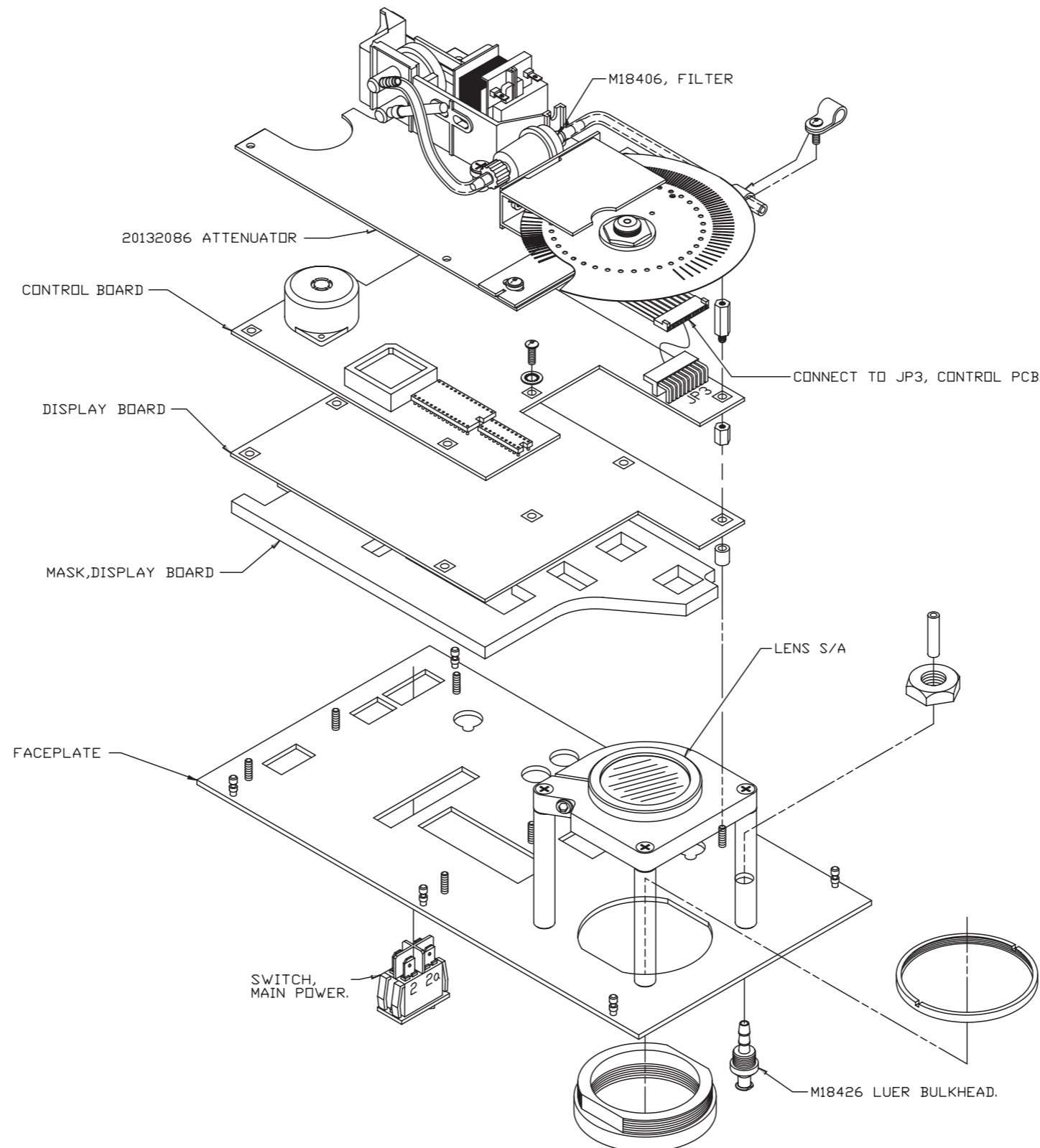
**4.11.3 Figure 1 – XENON 300 model 201331 20-1 (as from serial no. LF0612013)**



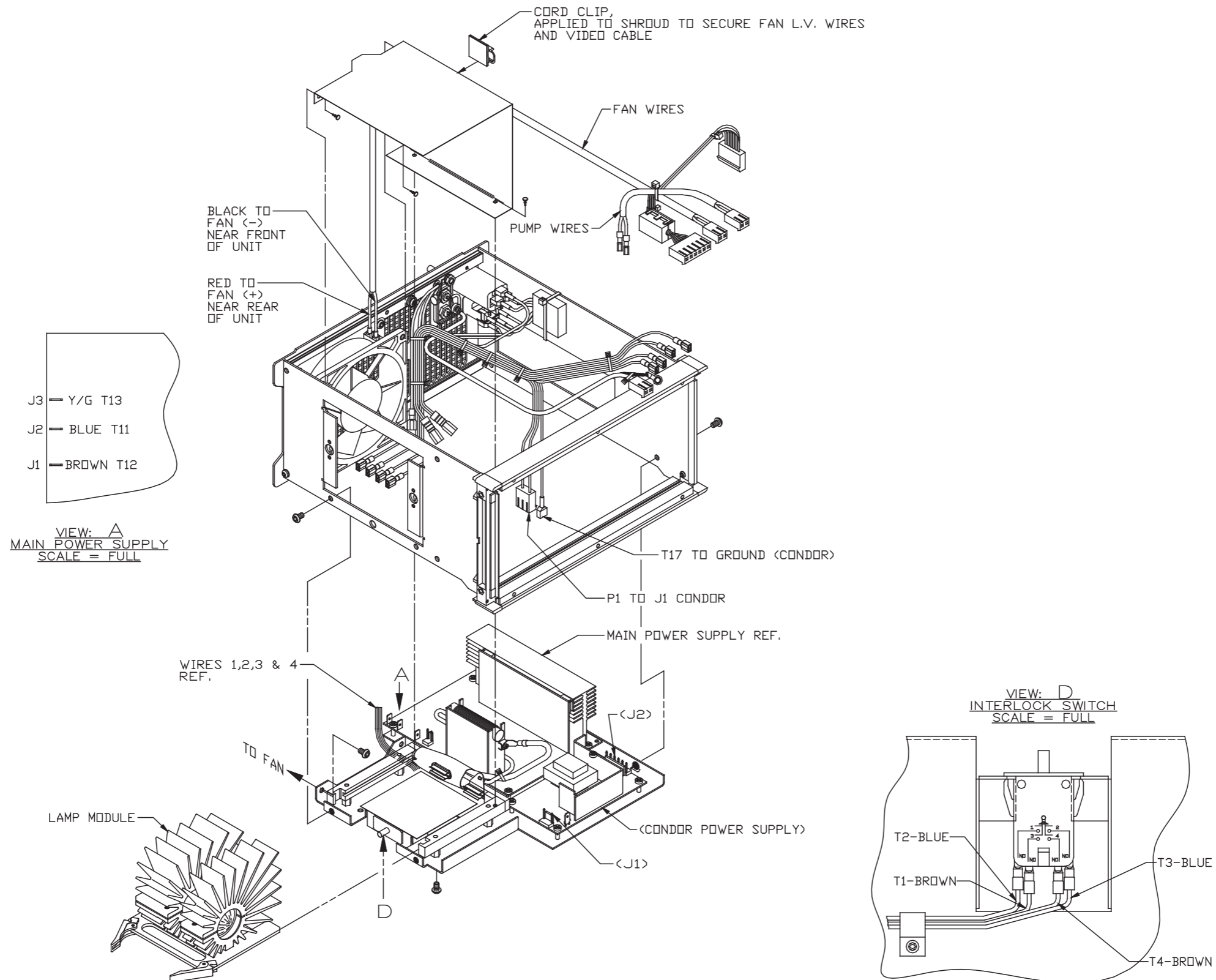
4.11.4 Figure 2 – XENON 300 model 201331 20



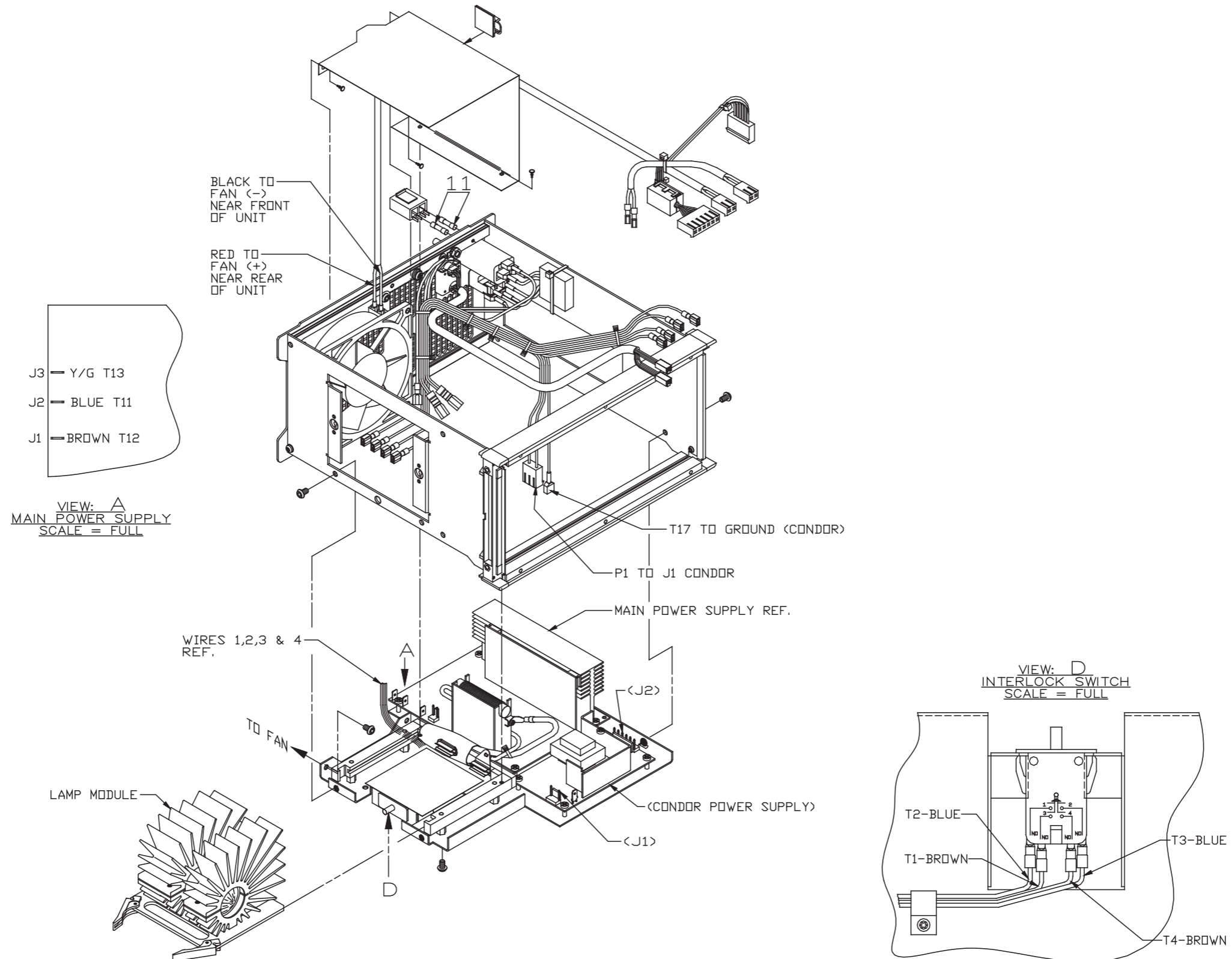
**4.11.5 Figure 2 – XENON 300 model 201331 20-1**



4.11.6 Figure 3 – XENON 300 model 201331 20

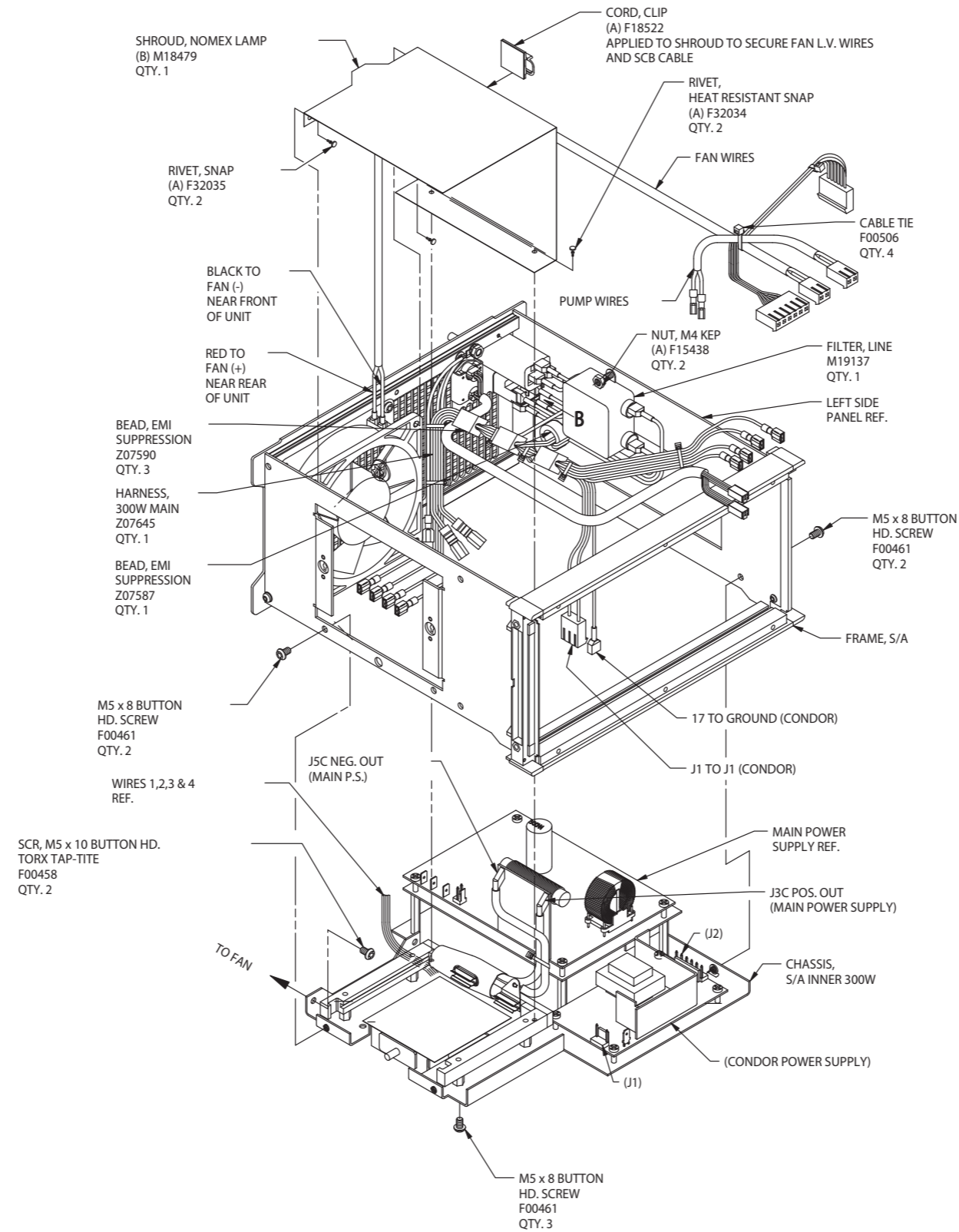


4.11.7 Figure 3 – XENON 300 model 201331 20-1 (up to serial no. LF0612012)

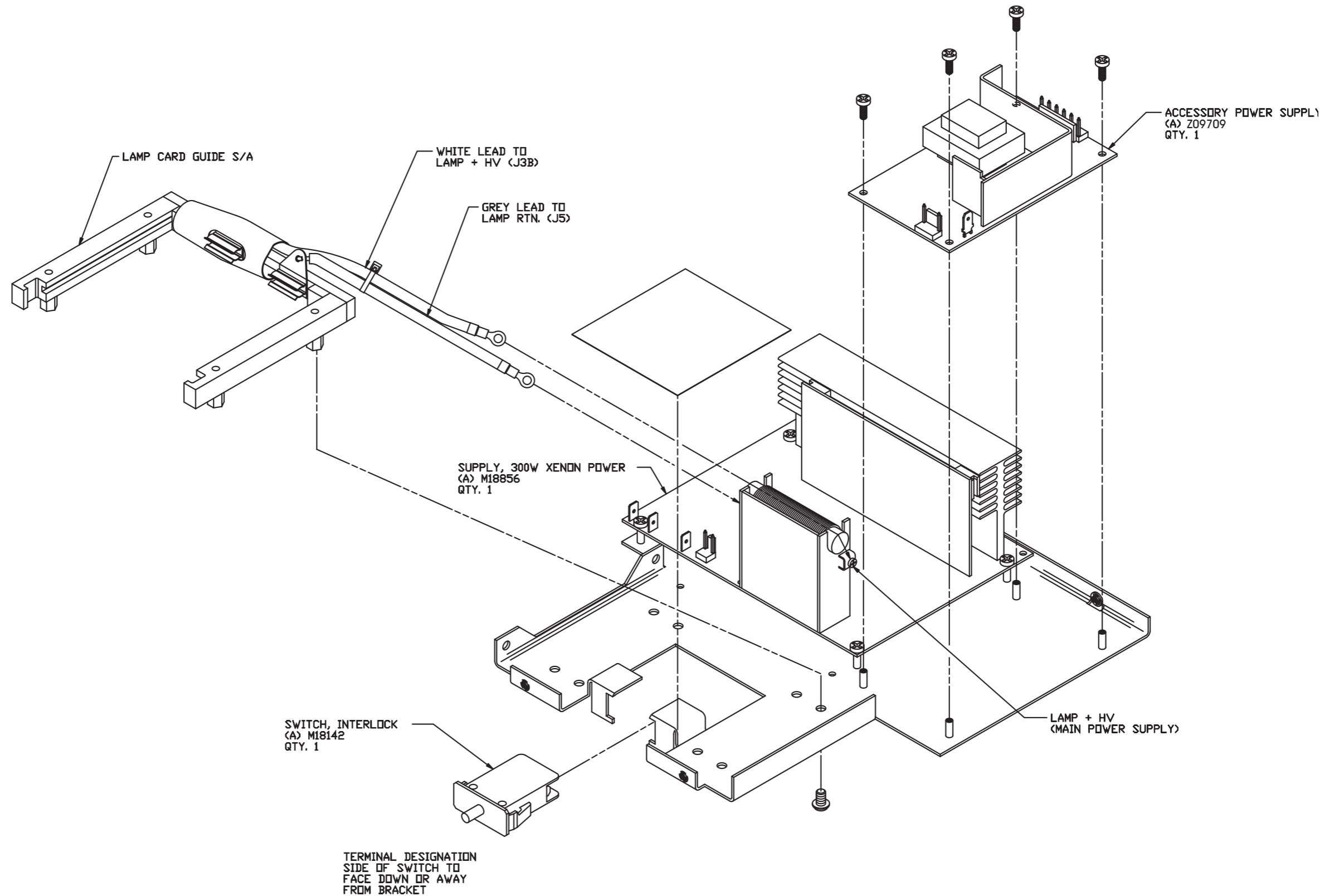




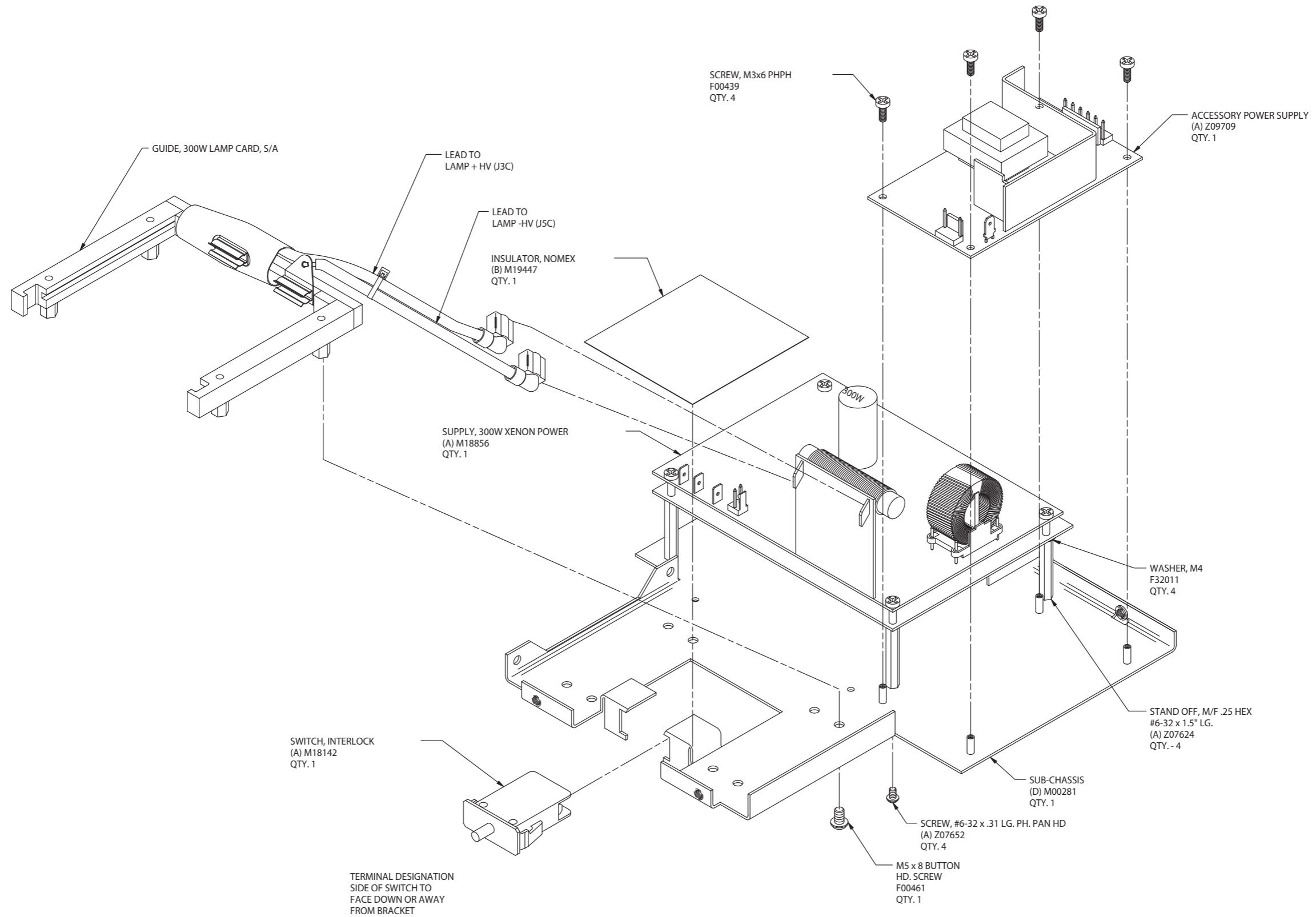
4.11.8 Figure 3 – XENON 300 model 201331 20-1 (as from serial no. LF0612013)



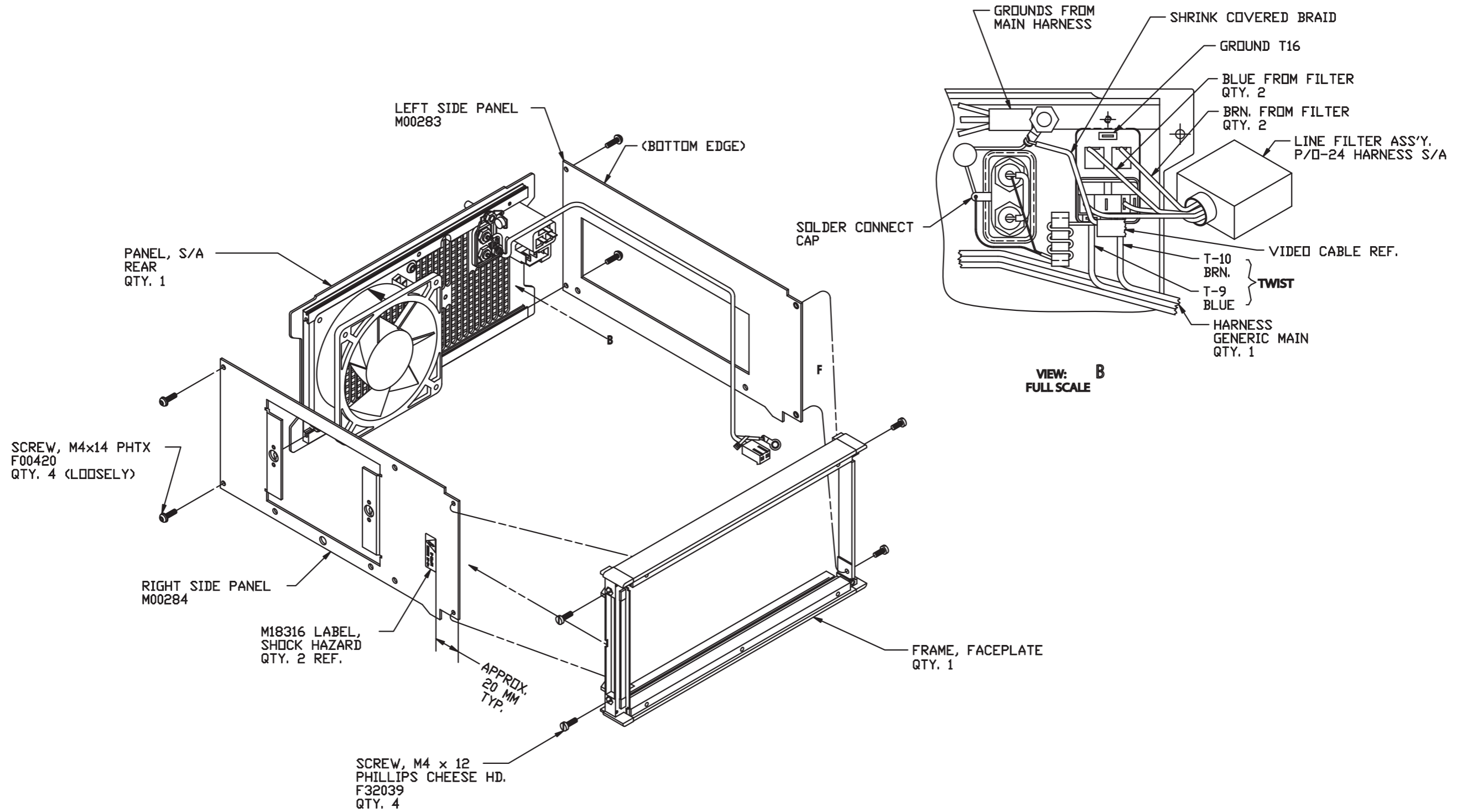
**4.11.9 Figure 4 – XENON 300 models 201331 20 and 201331 20-1 (up to serial no. LF0612012)**



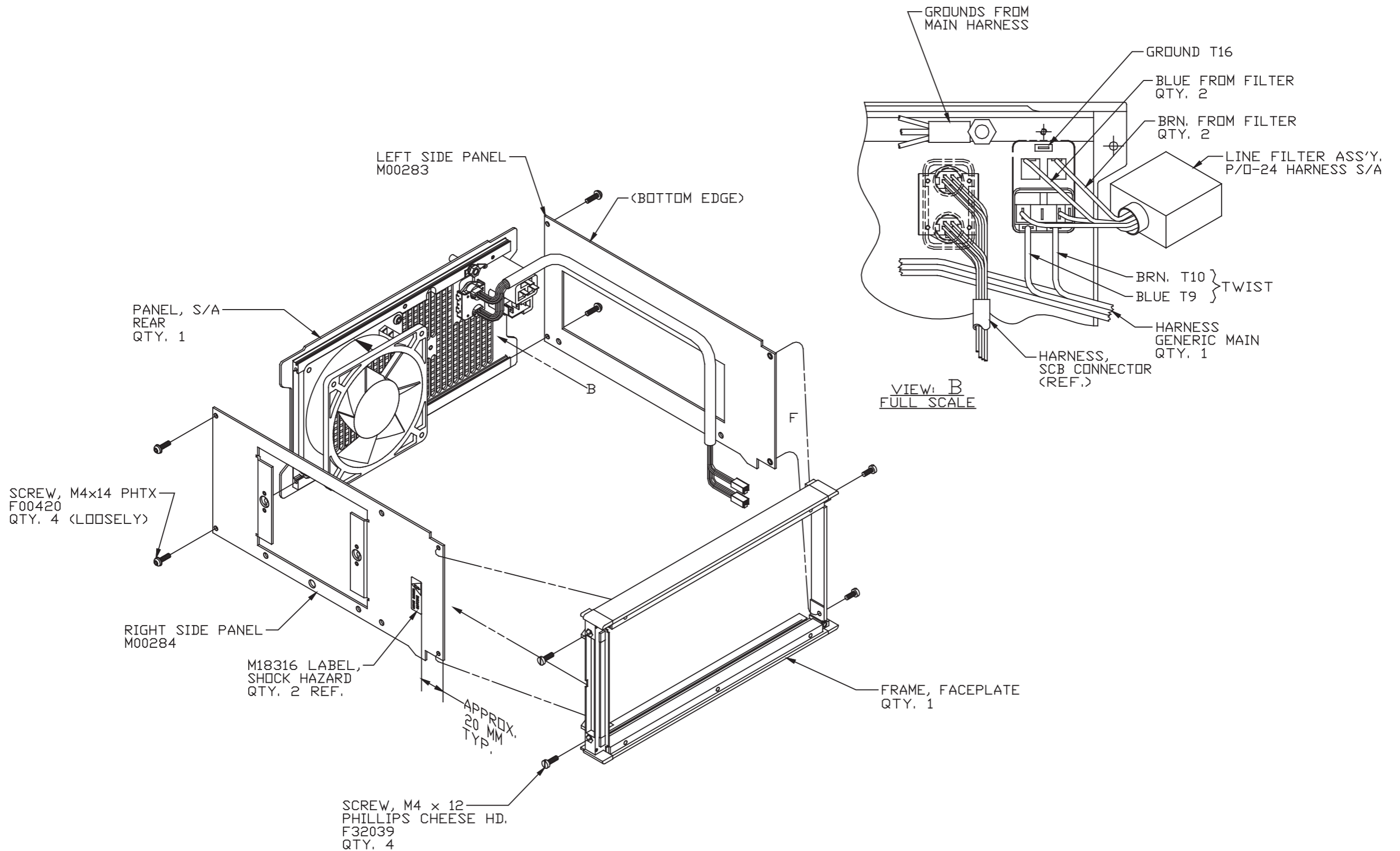
4.11.10 Figure 4 – XENON 300 model 201331 20-1 (as from serial no. LF0612013)



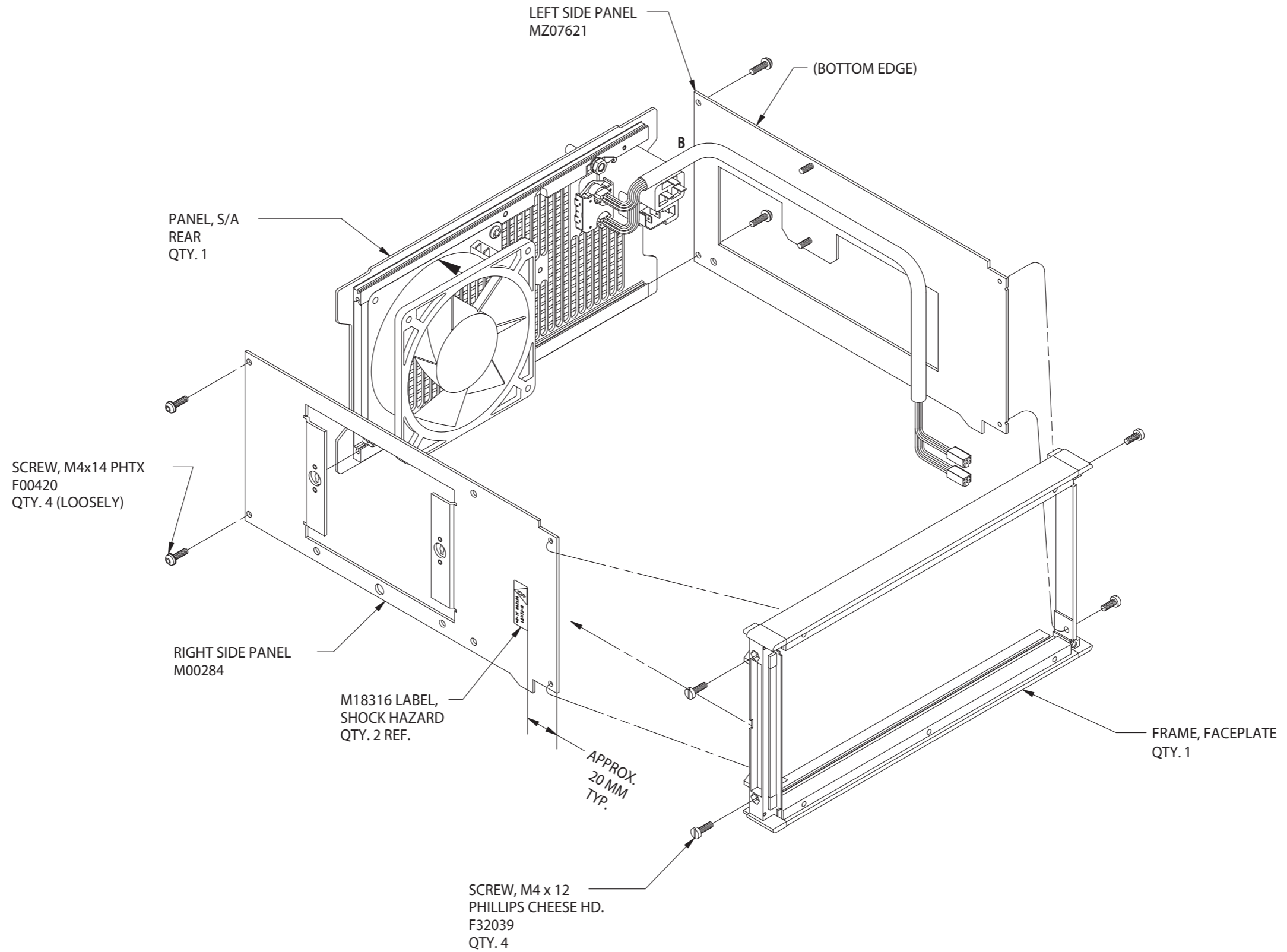
4.11.11 Figure 5 – XENON 300 model 201331 20



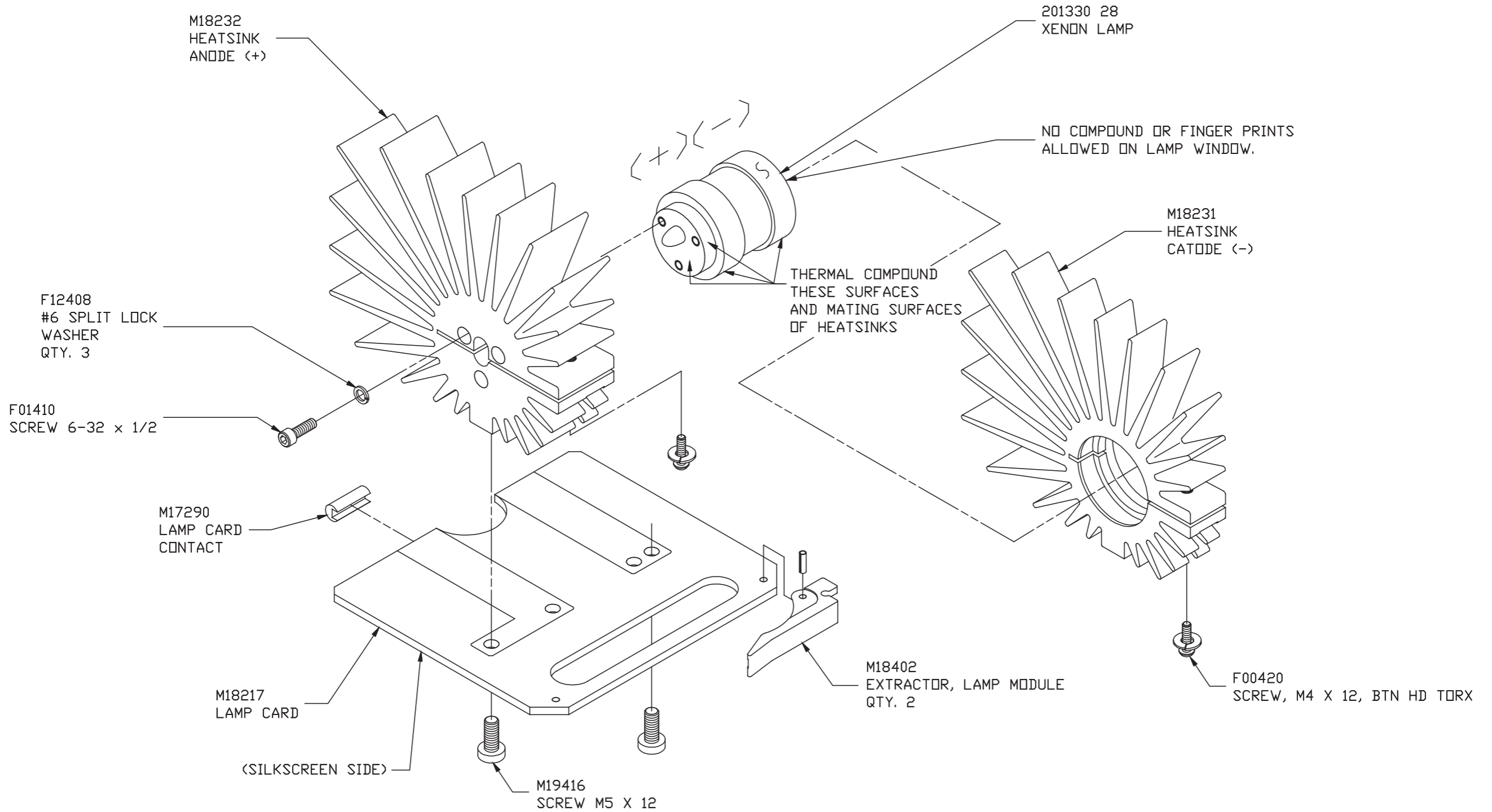
**4.11.12 Figure 5 – XENON 300 model 201331 20-1 (up to serial no. LF0612012)**



4.11.13 Figure 5 – XENON 300 model 201331 20-1 (as from serial no. LF0612013)



4.11.14 Figure 6 – XENON 300 models 201331 20 and 201331 20-1



## Section 5.

# Testing and Adjustments

Direction Sign:

- 1 ⇐ Instruction Manual
- 2 ⇐ Physical Design
- 3 ⇐ Descriptions of Operation and Circuit Diagrams
- 4 ⇐ Replacement of Individual Assemblies
- Maintenance and Safety Checks ⇒ 6
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## Contents 5. Testing and Adjustments

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5.2	Testing and adjusting the lamp current – XENON 300 models <b>201331 20</b> and <b>201331 20-1</b> (up to serial no. LF0612012) .....	5-2
5.3	Testing and adjusting the lamp current – XENON 300 model <b>201331 20-1</b> (as from serial no. LF0612013) .....	5-2

## 5.1 Equipment required for the individual settings

**Note:** *The device is fully adjusted and tested before it leaves the manufacturers. Readjustment should only be carried out by qualified technical staff.*

- Current probe (Tektronix A622 or equivalent)
- Digital voltmeter
- Small flat blade screwdriver
- Phillips screwdriver

## 5.2 Testing and adjusting the lamp current – XENON 300 models 201331 20 and 201331 20-1 (up to serial no. LF0612012)

- a. Disconnect the device from AC power and remove the top and bottom covers.
- b. Connect AC power and turn on the power switch.
- c. Clamp a current probe on the lamp return wire (longest white wire going to J5B NEG.OUT), with the probe connected to a DVM per manufacturer's instructions.
- d. Read and record the current. The current should be 17 A ... 21 A.
- e. Connect the DVM across the lamp leads and measure and record the lamp voltage.
- f. Lamp power (product of current and voltage) should be 300 W (max.). Adjust the lamp current as required with the current adjustment (R16) on the lamp power supply to maintain the lamp power below the specified maximum limit.
- g. Turn the power off and disconnect the device from the AC source. Reinstall the front panel.

## 5.3 Testing and adjusting the lamp current – XENON 300 model 201331 20-1 (as from serial no. LF0612013)

- a. Disconnect the device from AC power and remove the top and bottom covers.
- b. Connect AC power and turn on the power switch.
- c. Clamp a current probe on the lamp return wire (longest white wire going to J5B NEG.OUT), with the probe connected to a DVM per manufacturer's instructions.
- d. Read and record the current. The current should be 18 A ... 20 A.
- e. Connect the DVM across the lamp leads and measure and record the lamp voltage.
- f. Lamp power (product of current and voltage) should be 235 W ... 300 W (max.). Adjust the lamp current as required with the current adjustment (R58) on the lamp power supply to maintain the lamp power below the specified maximum limit.
- g. Turn the power off and disconnect the device from the AC source. Reinstall the front panel.



**Caution:** *Always unplug the equipment before performing any repairs.*

*To prevent damage to the components caused by the build-up of electrostatic charges, we recommend that you connect yourself to ground via the wristband throughout servicing.*

*After servicing, a safety test, the leakage current and protective ground resistance measurements according to IEC 62353, IEC / UL 60601-1, CAN / CSA C22.2 NO 601.1, whichever may apply, are to be carried out.*

## **Section 6.**

# **Maintenance and Safety Checks**

Direction Sign:


- 1 ⇐ Instruction Manual
- 2 ⇐ Physical Design
- 3 ⇐ Descriptions of Operation and Circuit Diagrams
- 4 ⇐ Replacement of Individual Assemblies
- 5 ⇐ Testing and Adjustments
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## Contents 6. Maintenance and Safety Checks

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6.3.3	Interior cleaning .....	6-4
6.4	Servicing and repair .....	6-4
6.5	Fuse replacement .....	6-4

## 6.1 Safety checks

We recommend carrying out safety checks at least once a year.


Work to be carried out	Remark
<p>■ <b>Visual inspection</b></p> <ul style="list-style-type: none"> <li>– Housing and accessories</li> <li>– Inscriptions, manufacturer's identification plate data</li> <li>– CE mark, KARL STORZ inspection label</li> <li>– Instruction manual</li> <li>– Power fuses<sup>7)</sup></li> <li>– Displays</li> </ul> <p>■ <b>Test for proper operation</b></p> <ul style="list-style-type: none"> <li>– Power switch</li> <li>– Power supply</li> <li>– Standby button</li> <li>– Manual intensity control buttons</li> <li>– MANUAL / AUTO select button</li> <li>– Intensity control via video signal<sup>8)</sup></li> <li>– Signal transmission via BNC socket VIDEO OUT<sup>9)</sup></li> <li>– Fan</li> <li>– Antifog pump ON / OFF switch</li> <li>– Antifog pump</li> <li>– Signal transmission KARL STORZ-SCB<sup>®</sup> terminals<sup>9)</sup></li> <li>– Drawer for short instruction manual</li> </ul> <p>■ <b>Electric safety measurements<sup>10)</sup></b>  <b>(IEC 62353)</b></p> <ul style="list-style-type: none"> <li>– Protective ground resistance: (with power cord)           <math>\leq 0.3 \Omega</math></li> <li>– Earth leakage current:       <math>\leq 1.0 \text{ mA}</math></li> <li>– Touch current:               <math>\leq 0.5 \text{ mA}</math></li> <li>– Patient leakage current:   <math>\leq 0.5 \text{ mA}</math></li> <li>– Patient leakage current:   <math>\leq 5.0 \text{ mA}</math> (line voltage on the applied part)</li> </ul>	<p>no external damage correct, legible, clean, wipeable, securely attached</p> <p>fixed to the housing present</p> <p>correct ratings, undamaged, securely positioned,</p> <p>functions perfectly within the stated voltage range (100 VAC ... 125 VAC / 220 VAC ... 240 VAC)</p> <p>± buttons M button</p>

7) For correct power fuse ratings see Section 3.7 Technical data.

8) XENON 300 model 201331 20 only.

9) XENON 300 model 201331 20-1 only.

10) Older versions of the XENON 300 (applied part type BF).

Work to be carried out	Remark
<p>■ <b>Electric safety measurements<sup>11)</sup></b> </p> <p><b>(IEC 62353)</b></p> <ul style="list-style-type: none"> <li>- Protective ground resistance: (with power cord) <math>\leq 0.3 \Omega</math></li> <li>- Earth leakage current: <math>\leq 1.00 \text{ mA}</math></li> <li>- Touch current: <math>\leq 0.50 \text{ mA}</math></li> <li>- Patient leakage current: <math>\leq 0.05 \text{ mA}</math></li> <li>- Patient leakage current: <math>\leq 0.05 \text{ mA}</math> (line voltage on the applied part)</li> </ul>	



**Caution:** *Always unplug the equipment before performing any repairs.*  
*After servicing, a safety test, the leakage current and protective ground resistance measurements according to IEC 62353, IEC / UL 60601-1, CAN / CSA C22.2 NO 601.1, whichever may apply, are to be carried out.*

## 6.2 Safety devices



*For further information about safety devices and instructions please see instruction manual.*

## 6.3 Maintenance operations

Performance of preventive maintenance is not essential. Regular maintenance can, however, contribute to identifying potential problems before they become serious, thus enhancing the instrument's reliability and extending its useful operating life.

Maintenance services can be obtained from your local representative or from the manufacturer.

Regardless of the accident prevention regulations or testing intervals for medical instruments prescribed in different countries, we recommend a safety check of the device at least once a year.

### 6.3.1 Lamp replacement

When the lamp has operated for 450 hours or more (90% of the warranted life of 500 hours) a lamp warning indicator will light on the front panel, and remain lit when the light source is on. When the lamp has operated for 500 hours or more, a replace lamp indicator will light on the front panel. For lamp replacement instructions see *Section 4.10 Replacement of the lamp and lamp module*. The lamp operating hours can be shown by pressing the standby button for eight seconds (diagnostic mode). The lamp hours will be indicated on the display.

<sup>11)</sup> Newer versions of the XENON 300 (applied part type CF).

## 6.3.2 Air filter replacement

Air flow may diminish with time if the air pump is used frequently. Replace the filter by removing the front panel as described in *Section 4.3 Replacement of the control board / combo board*. Disconnect the filter tubing and unscrew the cable clamp holding the filter to the front panel as required using a Phillips screwdriver. Install a new filter (order no. M18406) and reinstall the front panel.

## 6.3.3 Interior cleaning

Depending on the cleanliness of the operating environment, removal of dust from the interior of the device may be required periodically. Remove the top cover as described in *Section 4.3 Replacement of the control board / combo board*. Open the lamp door and remove the lamp module as described in *Section 4.10 Replacement of the lamp and lamp module*. Suct out the dust using vacuum. Carefully clean the light attenuator disc with a brush. Reinstall the lamp module, close the lamp door, and reinstall the top cover.

## 6.4 Servicing and repair

Defective equipment should be serviced and repaired by factory trained technicians and replacement parts must be ordered from KARL STORZ.

Third party substitutions may result in noncompliance of this product with its original specifications.

KARL STORZ maintains a repair and replacement warehouse which is normally adequate to ensure prompt replacement of damaged telescopes and instruments. Under the repair and replacement plan, you receive an identical as-new instrument and are only charged the repair costs for the defective instrument. For telescopes, you receive a guarantee of 1 year, and for instruments 6 months.

For fiberscopes and equipment, individual repair is necessary. Usually to bridge the repair period, you will receive a device on loan which you then return to KARL STORZ as soon as you receive the repaired device.

In Germany you can refer repairs direct to

**KARL STORZ GmbH & Co. KG**  
**Repair Service Dept.**  
**Take-off Gewerbepark 83**  
**D-78579 Neuhausen**  
**Phone: +49 (0)7461 708-980**  
**Fax: +49 (0)7461 708-75500**

In other countries please contact your local KARL STORZ branch or authorized dealer.

## 6.5 Fuse replacement



*For detailed information please see instruction manual.*

## Section 7.

# Modifications and Supplements

Direction Sign:

- 1 ⇐ Instruction Manual
- 2 ⇐ Physical Design
- 3 ⇐ Descriptions of Operation and Circuit Diagrams
- 4 ⇐ Replacement of Individual Assemblies
- 5 ⇐ Testing and Adjustments
- 6 ⇐ Maintenance and Safety Checks
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## **Section 8.**

# **Appendix**

Direction Sign:

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- 4 ⇐ Replacement of Individual Assemblies
- 5 ⇐ Testing and Adjustments
- 6 ⇐ Maintenance and Safety Checks
- 7 ⇐ Modifications and Supplements

## Test report - Safety Check

Article number

Serial number

### Visual inspection

Housing and accessories

Labeling

Identification plate data

Instruction manual

Power fuses<sup>7)</sup>

Displays

### Electrical safety (IEC 62353) <sup>10) 11)</sup>



Protective ground resistance  
(with power cord)

≤ 0.30 Ω

≤ 0.3 Ω

Earth leakage current

≤ 1.00 mA

≤ 1.00 mA

Touch current

≤ 0.50 mA

≤ 0.50 mA

Patient leakage current

≤ 0.50 mA

≤ 0.05 mA

≤ 5.00 mA

≤ 0.05 mA

### Proper operation

Power switch

Power supply

100 VAC ... 125 VAC

220 VAC ... 240 VAC

Standby button

Manual intensity control buttons

MANUAL / AUTO select button

Intensity control via video signal<sup>8)</sup>

Signal transmission via BNC socket VIDEO OUT<sup>8)</sup>

Fan

Antifog pump ON / OFF switch

Antifog pump

Signal transmission via KARL STORZ SCB<sup>®</sup> terminals<sup>9)</sup>

Drawer for instruction manual

Date

Checked by

Signature

7) For correct power fuse ratings see Section 3.7 Technical data.

9) XENON 300 model 201331 20-1 only.

11) Newer versions of the XENON 300 (applied part type CF).

8) XENON 300 model 201331 20 only.

10) Older versions of the XENON 300 (applied part type BF).

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