

Products : Lamp driver 4kW + Housing
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Nedap Light Controls
PO Box 101
NL-7140 AC Groenlo
Netherlands

www.nedap-uv.com
info@nedap-uv.com

☎ +31(0)544.471111

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1. Introduction

This manual is for:

- Lamp driver 4kW + Housing

The Nedap 4kW lamp driver is a high frequency electronic lamp driver to start and drive medium pressure gas discharge lamps. The lamp driver controls the power of the lamp and has dimming capabilities.

1.1. Description

The 4kW lamp driver has a single phase mains input, lamp output and control connectors.

1.2. Usage

The electronic lamp driver may only be installed and operated by qualified technically trained people. lamps should be approved by Nedap prior to being used in combination with this lamp driver prototype.

2. Safety

Only qualified personnel may install and service this part.

Warning:

When used with UV Lamps, protective actions should be taken as UV radiation can irreversibly damage skin and eyes.

Some Lamps produce ozone, see lamp manufacturer's manual for safety instructions.

3. Installation

3.1. Mounting the lamp driver

The air flow for cooling may not be restricted.

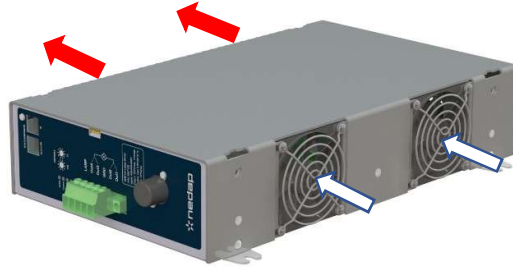


Fig 1) Air inlet and outlet lamp driver

3.2. Output connections

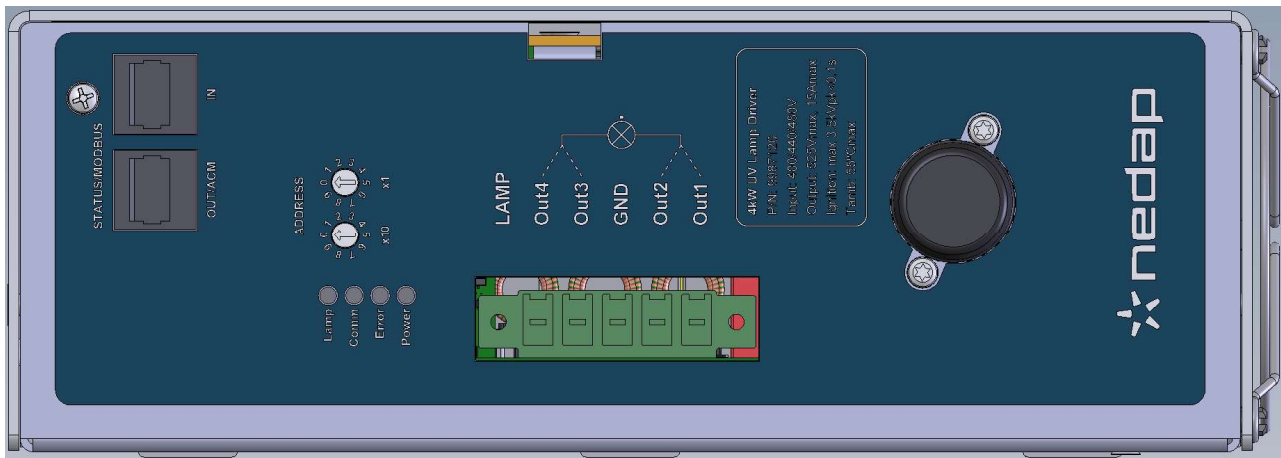


Fig 3) View Lamp output side

3.2.1. Connect lamp wiring : Lamp output

Lamp wiring size AWG 10-14,

Phoenix IPC 5/ 5-STF-7,62

Multiple output options, see 3.2.2.

For leakage current detection it is necessary to connect the earth connection to the lamp reactor.

Note: Important wiring parameters are specified under 7.1

3.2.2. Lamp output Voltage ranges

The 4kW lamp driver has total of four (4) lamp voltage ranges. This is to offer a solution for a wide range of different lamps (characteristics) that can be connected to this lamp driver and operated properly with high efficiency.

By a selecting a combination of two output terminals from the connector the desired power-setting is chosen. Please find in the table hereunder the possible /available options. Other combinations are not possible and will result in an error.

Range	Lamp output	Lamp voltage, Vrms	Current _(max) , Arms	Ignition _(typ.) , kV _{peak}
1	Out2 – Out3	270 - 315	14.8	1.85
2	Out2 – Out4	315 - 375	12.7	2.20
3	Out1 – Out3	375 - 440	10.6	2.60
4	Out1 – Out4	440 - 525	9.1	3.00

Table 1) Lamp output voltage ranges

3.3. Input connections

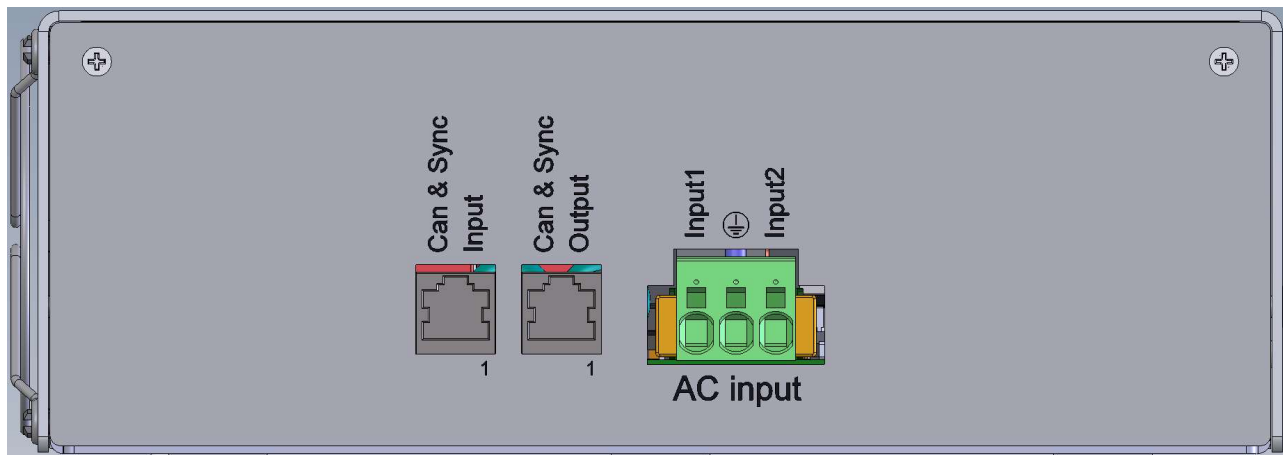


Fig 4) View AC input side

3.3.1. Input wiring connection: AC input, Ground

AC input connector: Input1 / Input2, for input voltage range see 3.3.2.

Grounding: wiring to ground connection

Input wiring AWG 10-14,

Phoenix SPC 5/ 3-STCL-7,62

The polarity does not matter.

3.3.2. AC input voltage range

Input rating	Input voltage range (Vrms)	Input line frequency (Hz)	Maximum output power (W)
400 - 480Vrms +/-10%	360 - 528	47 - 63	4000

Table 2) AC input voltage range

It is also possible to connect the lamp driver to an input voltage of 180-528V by setting the Full Range mode register. The maximum output power is then 1800W @ 180V input voltage, see figure5.

Input rating	Input voltage range (Vrms)	Input line frequency (Hz)	Maximum output power (W)
180Vrms	180	47 - 63	1800
200 - 480Vrms +/-10%	180 - 528	47 - 63	1800-4000
400 - 480Vrms +/-10%	360 - 528	47 - 63	4000

Table 3) AC input voltage range

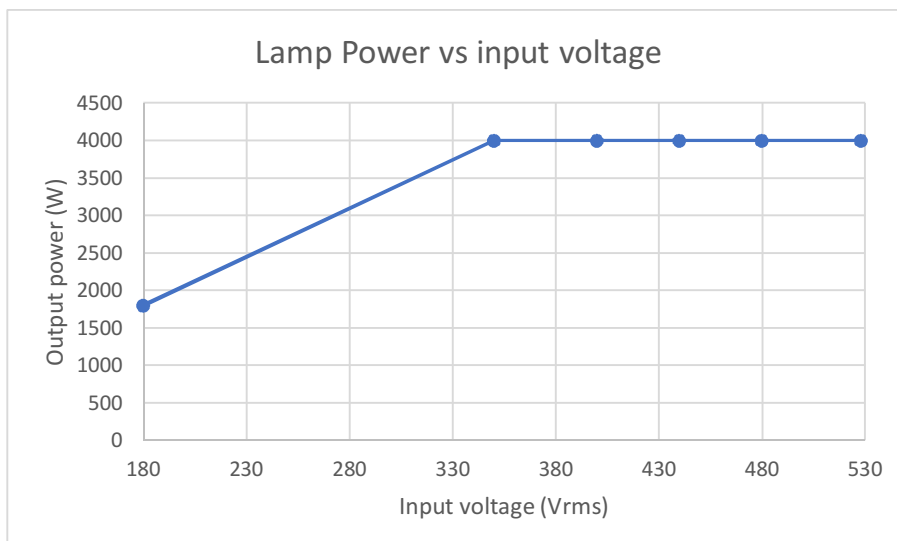


Figure 5) Maximum output power is depending on the input voltage

3.4. Control connections

See figure 3 and 4.

3.4.1. Connect control wiring : Can & Sync Input

Control connector:
Modular Jack 8/8

This function is not implemented yet, will be necessary for master/slave 8kW operation.

3.4.2. Connect control wiring : Can & Sync Output

Control connector:
Modular Jack 8/8

This function is not implemented yet, will be necessary for master/slave 8kW operation.

3.4.3. Baud rate setting

The 4kW lamp driver supports the following baud rate: 9600, 19200, 28800, 38400, 57600 and 115200. These baud rates can be selected using the Modbus protocol. The default baud rate is 115200.

3.4.4. Connect control wiring : Modbus Input

Control connector:
Modular Jack 8/8

3.4.5. Modbus Input connector

There are 2 Modbus interface connectors to daisy-chain the serial connection. Always connect the Modbus Input connector to PLC or a Modbus output connector. See figure 3 for pin 1.

pin	Name	Description
1	A	EIA/TIA-485 name
2	B	EIA/TIA-485 name
3	Common Return	Common ground for RS-485
4		
5	StatusNO1	Status relay NO contact1
6		
7	StatusNC1	Status relay NC contact1
8	StatusNC2	Status relay NC contact2

Table 4) Modbus Input interfacing pinning

3.4.6. Connect control wiring : Modbus Output

Control connector:
Modular Jack 8/8

3.4.7. Modbus Output connector

There are 2 Modbus interface connectors to daisy-chain the serial connection. Always connect the Modbus Output connector to a Modbus input connector. See figure 3 for pin 1.

pin	Name	Description
1	A	EIA/TIA-485 name
2	B	EIA/TIA-485 name
3	Common Return	Common ground for RS-485
4	+24V	+24V for optional ACM (Analog Control Module)
5	StatusNO2	Status relay NO contact2
6	+5V	+5V for optional ACM (Analog Control Module)
7	StatusNC1	Status relay NC contact1
8	StatusNC2	Status relay NC contact2

Table 5) Modbus Output interfacing pinning

3.4.8. BCD Rotary Switches

Warning: always select the address before the AC is switched on.

Warning: Always select address before AC is switched on

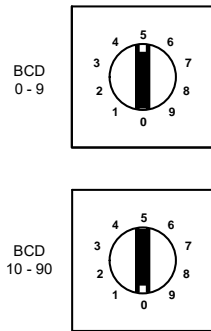


Figure 6) Example address = 05

By rotating the two BCD switches the Modbus address is selectable from 01 to 99.

3.4.9. Status LEDs

For visual diagnosis, communication status and device status is indicated by LEDs.

LED	State	Color
Communication	Switched on during frame reception or sending.	Yellow
Error	On: internal fault Flashing: TBD	Red
Device Status	On: device powered	Green
Lamp on	Off : Lamp driver in standby/idle state Flashing 0.1s on 0.1s off : Lamp driver in ignition state Flashing 0.1s on 2.0s off : Lamp driver in ignition cooldown state Flashing 1.0s on 1.0s off : Lamp driver in warmup state On : Lamp driver in run state	Blue

Table 6 LEDs status overview

3.5. External breaker

An external breaker can be applied in a system if required.

The Inrush current is 7.5A max @ 528V.

The maximum Input current will be 12A (note: the lamp driver is equipped with 20A internal fuses, non-replaceable).

4. Control of Lamp Driver

The 4kW lamp driver is controlled by Modbus only. To operate the 4kW lamp driver in analogue control, an ACM (Analogue Control Module) is required. This is a separate module which converts the analogue input signals to Modbus

For the Modbus protocol please refer to the manual "4kW Lamp Driver Modbus protocol ".

4.1. Switching lamp on/off

Before the lamp can be ignited some Modbus registers must be set: Maximum power, maximum run current, maximum warm-up current and the warm-up to run power level (80% default).

4.2. Dimming lamp

The output power of the lamp driver to operate and dim the lamp ranges from 400 to 4000W.

After switching the lamp on, dimming is only possible after the lamp warm-up phase, this will be the case when the lamp driver has reached 80% of the output power level. This threshold level (at t2 in figure 7) to go from lamp warm-up phase to run power regulation can be selected in register 2. Default level remains at 80%.

The change-over from warm-up to normal operation (power regulation), is indicated by the blue Lamp on/Lamp PWR Ok led and the Status Relay.

It's highly recommended by lamp manufacturers to run the lamp at maximum power for several minutes to reach the right lamp temperature before dimming of the lamp (please contact your lamp manufacturer for detailed information).

Re-ignition of lamp, after shutting off or extinguishing of the lamp, is only possible after sufficient cool down time of the lamp, depending on lamp and (cooling) system.

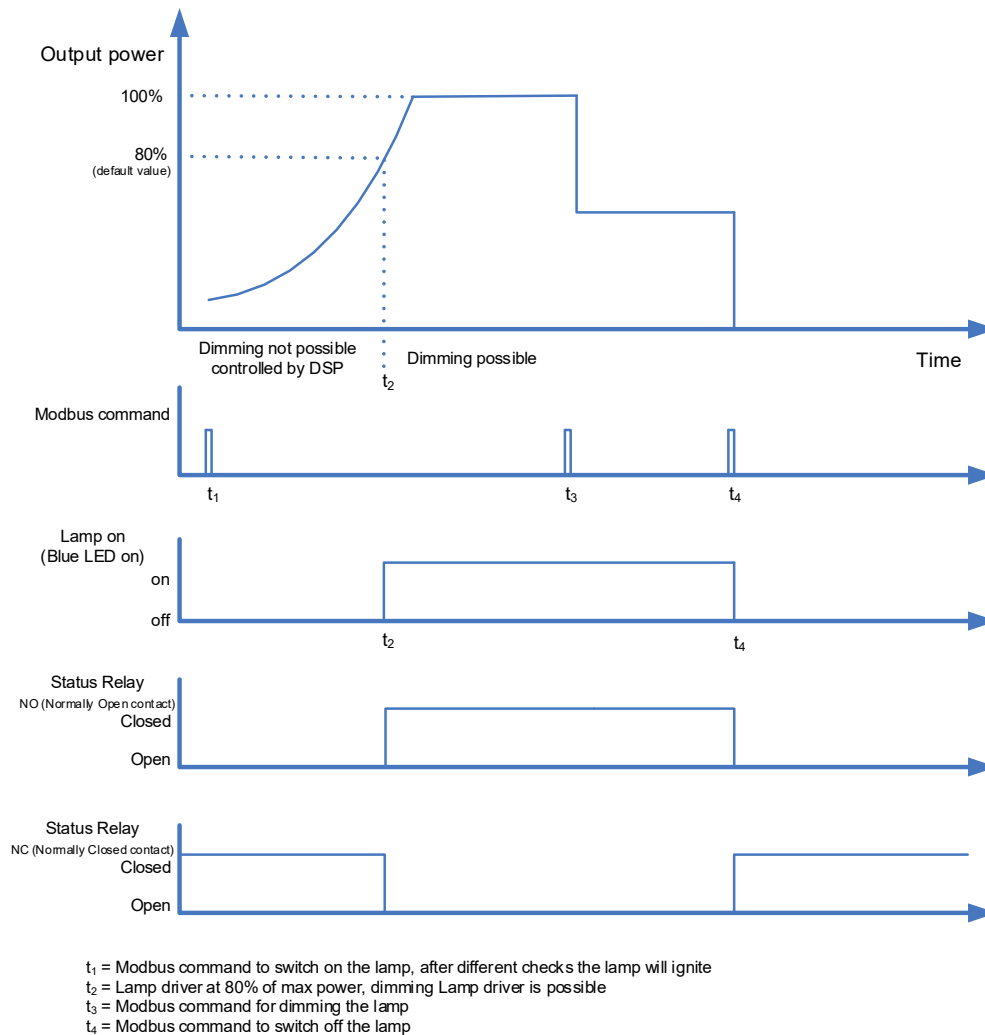


Figure 7) Switching lamp on and off

4.3. Status Relay : Lamp PWR Ok signal

When the lamp is switched on (t_1) and has reached the its Power level (t_2), the Status Relay signal becomes active. During the same time the Lamp on/ Lamp PWR Ok led goes on.

Over cooling the lamp (too much cooling) will result in a deviation of the lamp power. In the event of the deviation being more than the “warm-up to run power level” (80% by default) the Blue LED will be flashing 1s ON 1s OFF as well as a warning from the Modbus register. The Status Relay will stay active during this warning.

When the lamp power deviation is again above the 80%, the warning will disappear.

4.4. Error signals

Three categories of errors are defined:
(contrary to a warning, in the event of an error the lamp driver will switch off)

1. Lamp error.
2. System error.
3. Lamp Driver error.

4.4.1. Lamp Error

A lamp error will occur in the event of:

1. Lamp driver tries to ignite (0.5s) the lamp 100 times (1s interval) without success.
Possible causes:
 - a. Lamp still too hot.
 - b. Lamp defect.
 - c. Cable not connected.
2. When the lamp is switched on and does not reach the 80% of the output power level within 10 minutes. Possible causes:
 - a. Overcooling of the lamp.
 - b. Wrong lamp type.
 - c. Lamp defect.
 - d. Lamp end of life.
3. The Ground leakage current $>5\mu\text{A}$. Possible causes:
 - a. Impedance from Output connector to Ground too low.
 - b. Short to Ground.
4. The lamp driver detects a too high DC level on the output (lamp rectification detection). Solution will be to change the lamp.
5. Output voltage too high.
6. Lamp output power too high.

4.4.2. System Error

A system error will occur in case of:

1. Intake air temperature too high or too low. Low limit 0°C , High limit 55°C
2. Heatsink temperatures too high. High limit 90°C
3. Input voltage too high.
Remark when input voltage is below 352V (180V in Full rang mode) the lamp will be dimmed automatically in an attempt to maintain continues operation.

4.4.3. Lamp Driver Error

A lamp driver error will occur in case of:

1. Internal Lamp Driver error.

5. Service

5.1. Fan

Keep the airflow area open and clean for maximum cooling capacity.

To remove the fan, disconnect the AC-mains input power and wait at least 1 minute. The fan can be removed easily by using the tip of a flat screw driver (See figure 8). By taking turns top and bottom, push down the clips that holds the fan in place whilst carefully prying the fan out of the metal housing. Release the fan-wire-connector from the printed circuit board and remove the fan. Install the new fan in the reverse order of removal.

Note: re-position the fan wiring exactly in the same way as the original fan wiring!

Figure 8 Removing fan

Spare part number (fan including plastic clips and connector: Nedap P/N TBD (contact Nedap).

6. Electrical characteristics

Technical Data

Specifications subject to change without notice

Input

Mains voltage:	: 1 phase 360 - 528 Vrms Pout=4000W : 1 phase 180 - 360 Vrms Pout=1800-4000W, see Fig 5
Input line freq.	: 47 - 63 Hz
Input current	: 12 A max.
Inrush current	: 7.5 A max (at input voltage 528 Vrms)
Power Factor	: > 0.98 (at 1-4kW) @ multiple of 3 drivers distributed over 3 phases
Current THD	: < 5% typ.
Power Saving Mode	: If Input voltage is below 352V (180V in full range mode) the output power will be dimmed to attempt to continue operation. Below 300V (150V in full range mode) the lamp driver will switch off.
Standby power	: < 5 Watt

Output

Power	: controlled within 5%, 400 – 4000 W		
Voltage range	: Multiple output options		
	Lamp voltage	Current_(max)	Ignition_(typ)
	270-315Vrms	14.8A	1.85 kV _{peak}
	315-375Vrms	12.7A	2.20 kV _{peak}
	375-440Vrms	10.6A	2.60 kV _{peak}
	440-525Vrms	9.1A	3.00 kV _{peak}

Frequency	: 40-240kHz
Warm-up current	: 110% of current _(max)
Crest factor	: < 1.6
Dimming	: down to 10%
Efficiency	: >95% typ.
Ignition duration	: 0.5s
Ignition attempts	: 100 attempts with 1 seconds interval (no hot restrike)

Protections	: output open / short output overvoltage input under/over voltage temperature GND leakage Lamp rectification
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Cooling	: Forced air cooling
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Operating conditions:

Temperature	: 0° - +55° C
Relative humidity	: 25 – 95% non-condensing

Non-operating conditions:

Temperature	: -25° - + 70° C
Rel. humidity	: 20 – 95% non-condensing

EMC	: EN 55015: 2013 EN 301 489-1 V2.2.2 EN 301 489-17 V3.2.0 EN 61000-3-2: 2114 EN 61000-3-3: 2013 DNV Standard for Certification 2.4: 2016 FCC 47 CFR Part 15B (US) Incl. ICES-003 (Canada) FCC 47 CFR Part 18
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Electrical safety	: cUL1029 EN61347
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CE Marking	: Yes
IP rating	: IP20
Weight	: 7.3 kg
Dimensions	: 422 x 274 x 87 mm
Production process	: in accordance with ISO9001 and applicable standards
RoHS compliant	: Yes

Appendixes

6.1. Appendix A : FAQ

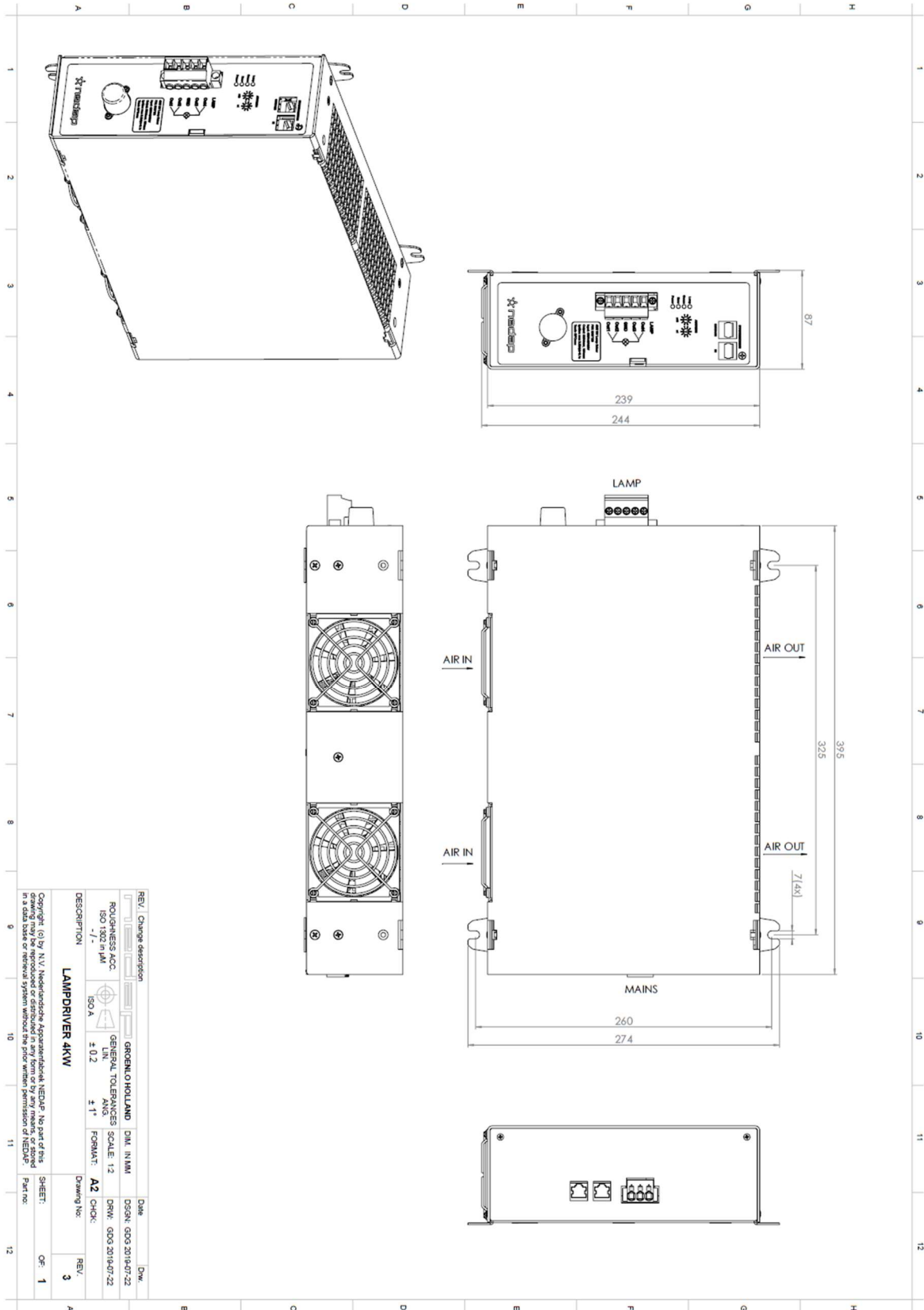
- What kind of lamp cable can be advised?

The cable must fulfill the following minimum specification:

- 3 wires 14 AWG, jacketed
- 600 V
- Temperature class 105 °C, depending on ambient / application
- Stranded and preferably shielded
- Total cable capacitance < 3 nF measured at 100 kHz
- UL approved (Category avlv2)
- Approved by Nedap is: TBD

6.2. Appendix C : Mechanical drawing with dimensions

The dimensions are in mm.



6.3. Mounting options

Mounting bracket for cabinet assembly



Connection bracket for tandem assembly



7. FCC and ISED declarations

Compliance statement (part 15.19)

This device complies with part 15 and part 18 of the FCC Rules and to RSS of ISED.

Operation is subject to the following two conditions:

- (1) this device may not cause harmful interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation.

Déclaration Conformité

Cet appareil se conforme aux normes RSS exemptés de licence du ISED.

L'opération est soumise aux deux conditions suivantes

- (1) cet appareil ne doit causer aucune interférence, et
- (2) cet appareil doit accepter n'importe quelle interférence, y compris l'interférence qui peut causer une opération non prévue de cet appareil.

Warning (part 15.21)

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

RF Exposure (OET Bulletin 65)

To comply with FCC RF exposure requirements for mobile transmitting devices, this transmitter should only be used or installed at locations where there is at least 20cm separation distance between the antenna and all persons.