APPENDIX A
Installation and Operation Instructions for Electronic Ballasts by ZED GmbH

Read and understand all instructions in this documentation before installing or operating ballasts!

Important safety notice:
Risk of electric shock! Lethal high voltage occurs inside the ballast and at the ballast terminals. Please refer to the safety rules below. Additional safety rules and legal restrictions may apply depending on the country of operation.

Installation and Operation Instructions Summary

1. The ballast shall be operated only with UV lamps specified in the data sheet.
2. The ballast does not provide galvanic insulation from mains at the lamp terminals.
   In particular this applies for microprocessor controlled ballasts, where harmful voltage occurs at the lamp terminals even if the lamp is switched off.
3. If there is any damage (e.g. mechanical damage after transport) the device must not be operated.
4. Without prior written permission of manufacturer the ballasts may not be used for equipment that is used for medical treatment or for life saving measures.
5. The ballast shall only be installed by qualified personnel. All appropriate safety rules must be fulfilled.
6. The ballast is only intended for use in dry and chemically and biologically inactive environment.
7. The ballast has to be mounted upright with the mains terminals at the bottom side.
   It is recommended to mount the ballast at a thermal conductive heat dissipating base plate.
8. The ballast may only be wired according to the wiring diagram that is shown at the case.
   Lethal voltages at the complete system can result from contact between lamp and water.
   A separate protective grounding of the complete system is mandatory.
9. Make sure that the line voltage is within the tolerances given in the data sheet (either 100V AC ± 10%, 115V AC ± 10%, 200V AC ± 10% or 230V AC ± 10% according to the data sheet).
   Otherwise the ballast may be damaged.
10. Solid wires and flexible braid wires may be used for wiring. Only use wire gauges specified in the data sheet. The terminals are intended to clamp braid wires without wire termination. If wire termination is used make sure they comply with the terminal specifications. Wires may not be soldered (tinned). Check wiring for safe connection. This is especially advised after mechanical stress such as transport.
11. Make sure all applicable safety rules are fulfilled.
    Additional safety rules and legal restrictions may apply depending on the country of operation.
12. Make sure that, under any circumstance, imbalances in 3 phase line supply will not lead to line voltage outside the specified range.
13. Overvoltage at line terminals will damage the ballast, even if the overvoltage occurs just for short time.
14. Short circuits, wrong wiring or loose contacts may damage the ballast.
15. Never cut connections to the lamp while the ballast in operation. Danger of life!
16. After connecting to mains inrush current may reach high values up to 100A in the first 2ms and up to 15A in the first 15ms. Subsequently the current decreases quickly to the specified value. The inrush current depends on the value of the sinusoid line voltage at the moment of connection. It is recommended to connect/turn on groups of ballasts separately. We recommend slow-blow lead fuses for protection.
17. Do not mount the ballasts in an environment with high mechanical stress such as vibrating assemblies.
18. Make sure all wires, connectors and terminals provide sufficient insulation to each other with respect to earth ground.
    Under all circumstances keep water away from the whole electrical assembly. Watch out for water leaks.
19. The cable length between the ballast and the lamp must not exceed 2,9m.
20. The temperature at the t_c point, marked at the ballast must never exceed the value specified in the datasheet.
21. If ballasts are operated in parallel, EMI emissions and harmonic distortions may add up and exceed the limits, given in standards.
    In that case appropriate filters should be used. CE compliance is guaranteed only for operation of single ballasts.
22. Damaged lamps or lamps close to the end of lifetime may overload the ballast, possibly resulting in damage.
    Replacing lamps within the service interval, given by the lamp manufacturer is mandatory.
23. The load for the fault detecting contacts has to be kept within the limits specified in the datasheet. It is recommended to use parallel operation of contacts instead of serial operation in case of summarizing fault detection. The insulated contacts of the error relay do not provide protection against electric shock. All wires of the error control loop have to be installed with appropriate protection against contact according to applicable regulations. The wires of the error control loop shall never be accessed from outside the grounded cabinet without protection against contact. You may use insulation relays to access the control loop from outside the cabinet.
24. **Danger!** During ballast start up and in case of lamp defects or due to wrong lamp wiring, high voltages up to $1200V_{eff}$ may occur at the output terminals of the ballast. The duration of this high voltage may last for a couple of milliseconds until the internal protection circuits shuts down the ballast. After turning off and on line voltage ballast tries to ignite the lamp again, so, again, high voltages may occur.
25. Do not add any components like switches, capacitors or ignition devices to the wires in between the ballast and the lamp because this may destroy the ballast.
26. Preheat ballasts (-PH) are heating up the lamp filaments before igniting the lamp. Lamp ignition will happen after the specified preheat time. The preheat time is specified on the ballast label. Different behaviour applies for microprocessor controlled ballasts.
27. If operating step dimming ballasts (-SD) the lamp current can be reduced by applying an external DC voltage. During start up this DC control voltage must be at 0V DC, otherwise the ballast may be destroyed. For long lamp life it is recommended to operate the ballast for at least 10 minutes at 100% current before the lamp current is reduced. Even by following this recommendation lamp life may be shorted if operated in dimming mode. Avoid long lamp operation at a lamp surface temperature below the recommended value.
28. For more details refer to the following (or http://www.z-e-d.com).

Important Installation and Operation Instructions

A1. Power Consumption
The low pressure lamp ballasts are keeping any fluctuations in power in the lamps within narrow limits. This is only true for the specified power supply voltage range.

A2. Specified Power
The specified power of ballasts and lamps is based on comparable UV radiation of equivalent conventional ballast using choke inductor. Due to better efficiency the electrical lamp power is lower at high frequency operation. Also electronic ballasts have lower energy consumption compared to conventional ballasts (e.g. a 200W UV radiator system using conventional ballast consumes 200W electrical power, but electronic ballast uses only 160W electrical power).

A3. Efficiency
The efficiency of the ballast is determined by the ratio of the electrical power that is delivered to the lamp and the electrical power that is drawn from the power line. The efficiency of the ballasts, manufactured by ZED GmbH exceeds the value of 90%. The remaining power is transferred to heat and has to be dissipated from the ballast.

A4. Power Factor
Electronic ballasts do not have significant reactive power consumption. Expensive components for compensating of reactive power don't have to be added. The electronic ballasts do also have active power factor correction that keeps harmonic distortion of line current within limits, given by national and international standards.

A5. Notes on Wiring
A5.1. Types of lamp ballast connections
There are three different types of lamp connection to the ballast offered by ZED:
- instant start
  (two wires per lamp, -IS is added to the ballast name)
- rapid start
  (four wires per lamp, no additional preheating of the lamp electrodes before ignition)
- preheat start
  (four wires per lamp, preheating of the electrodes before lamp ignition, -PH is added to the ballast name)

Please be sure that the lamp fits to the ballast. Otherwise lamp can be damaged after short life time.

The terminals of ZED ballasts are intended to clamp rigid and flexible wires without wire termination. If wire termination is used make sure this complies with the terminal specification.
- Rigid wiring:
  - ⇨ may be inserted direct into the terminals without moving the release lever if specified wire gauge is used
- Flexible wiring (braid wires):
  - ⇨ may only be inserted direct into the terminals by pressing the release lever on the terminal
  - ⇨ may not be soldered (tinned)
    (This applies especially to screw terminals. The solder migrates into the contact, resulting in less reliable connection.)
  - ⇨ wire termination may be used, but this is actually not necessary

To check the wiring at the terminal try to pull out the cable gently. The terminal should not allow the wire to move. Please check data sheet of the ballast for wire gauge and peel-off instructions.

A5.2. Directions to Avoid Potential Problems
To avoid radio interference and to ensure maximum equipment's reliability in use, pay attention to the following notes when positioning the cables:
- ⇨ Keep the wiring between ballast and lamp (high frequency wires) as short as possible (to reduce electromagnetic interference and to minimise parasitic capacitances).
- ⇨ On no account trace mains wires and lamp wires in parallel or close to each other. Keep lamp wires and mains wires as far away from each other as possible (Minimum: 5-10 cm). This will avoid radio interference between mains and lamps leads.
- ⇨ To reduce radiated emissions at lamp wires it is recommended to trace a separate wire with size of 4mm² that is connected to earth ground in parallel to the lamp wires. Do not use multi-conductor cables including protective earth wires.
- ⇨ Keep mains cable short to reduce radio interference.
- ⇨ Do not place mains wires too close to the ballast unit or to the lamp (this applies particularly to through-wires).
- ⇨ Do not cross mains and lamp wires. If this is unavoidable, keep right angle in between the wires and keep a distance as far as possible in order to reduce high frequency coupling.

Wiring must be done according to applicable regulations (in Germany, for instance, VDE 0100, VDE 0107 etc.).

Additional insulation is required for through metal wiring. There should always be some insulation material or insulating sheath or a grommet or edge protection as appropriate.

The frame of the lamp must never be used for leading purposes nor must mains or lamp wires not come in contact with the frame of the lamp by bare wires, excessive striped wires or screws/sharp metal edges pointing through the insulation. This could result in electric shock and/or destruction of the ballast.

A5.3. Maximum Cable Length
The cable length shall not exceed 2.9m. If longer cables are necessary, this falls into

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the responsibility of the installer or system distributor.

If longer cables are used the compliance with the low voltage directive and with EMC regulations have to be checked individually.

If the installer or system provider can ensure that all requirements are met additional tests are necessary to make sure that a ballast can safely operated with longer cables:

- safe error lock-out
  after connecting the ballast to mains without a lamp connected, effective input power should be lower than 5W after 1 or 2 seconds
- only use 2 wires per cable
  If operating a lamp in 4 wire mode, use two cables - one for each end of lamp. The total coupling capacitance should be less than 3nF.
- test for safe ignition
  at low lamp temperatures and bad power supply conditions

A6. Mains Supply
A6.1. Generals

Make sure, that the ballast is properly connected to earth ground. Keep the line voltage within the specified limits of sinusoidal line voltage. The over voltage protection, provided in the line filter of the ballast is only intended to protect the ballast under regular line voltage conditions. In case of using a special mains supply, (e.g. IT-Net) the provider needs to provide sufficient overvoltage protection.

Over- or under voltage may damage the ballast. Low resistance wiring is required for mains supply. Due to high inrush current values difficulties with circuit breaker rating may occur. Depending on the type of ballast the inrush current may reach high values up to 100A in the first 2ms and up to 15A in the first 15ms. Subsequently the current decreases quickly to the specified value. The inrush current depends on the value of the sinusoid line voltage at the moment of connection. We recommend slow-blow lead fuses for protection. It is recommended to charge all three phases in case of large number of ballasts. Inrush current may also be reduced by delayed turning on groups of ballasts. In case of using relays to turn on the ballasts make sure that it can handle the high inrush current of the ballasts.

Large numbers of parallel operated ballasts may also cause problems with earth leakage currents. The added up leakage currents of line filter capacitors of parallel operated ballasts may trip the earth leakage circuit breaker.

The potential free contacts of the error relay do not provide protection against electric shock. All wires of the error control loop have to be installed with appropriate protection against contact according to applicable regulations. The wires of the error control loop should never be accessed from outside the grounded cabinet without protection against contact. You may use insulation relays to access the control loop from outside the cabinet.

A6.2. Inrush Current of 24V DC ZED Ballasts

In the ballast electrolytic caps with a total capacitance of up to 2000µF are connected to the input terminals. At the moment of connection to mains, these capacitors are being charged within a very short time. The resulting inrush current can reach values that are multiples of the rated current. The value depends on the impedance of the source, the length and gauge of the feed line and the behaviour of the switching device.

The consequences of inrush current can be:

- supply voltage drop and possible reset of digital hardware modules, connected to the same supply voltage
- overload and reduced lifetime of switching device
- electromagnetic disturbance around feed line
- fast circuit breaker may trip

Issues caused by high inrush current might be avoided by:

- using a separate power supply for each ballast.
  Wires between this power supply and the ballast should not be switched.
- usage of power supplies and switching devices such as relays that are rated for inrush current.
  Depending upon impedance of the power supply, of the feed line and of the switching device, the inrush current may reach values up to 160A.
- usage of semiconductor high side switches with internal current limiters for power line switching.
  The power supply rating should exceed the current limit of the high side switch. Make sure a protection module possibly built into the high side switch does fall due to inrush current. Use 30mAs, including safety margin, being transferred to the ballast during connection as a hint.

The usage of NTC resistors is not recommended to limit inrush current. Due to resulting high source impedance this could lead to multiple firing cycles and reduce the lifetime of the lamp connected.

A7. Temperature Considerations
A7.1. Ballast Lifetime and Temperature

Lifetime of ballasts is determined by the temperature and by the failure rate of electronic components. Electronic components might be destroyed by overheating, resulting in failure of the ballast. To avoid this, the maximum permitted temperature t_C, measured at the specified point on the ballast should not be exceeded. The t_C-temperature has to be checked individually for each ballast in a cabinet to ensure sufficient heat dissipation.

t_C (c stands for case or housing) is the maximum temperature permitted at the marked point on the ballast unit (see also EN 60598). This point is the t_C - test point under normal operating conditions at nominal input voltage or at the specified limits of the input voltage range respectively. In practice, t_C is the sum of heat generated by losses inside of the ballast and the ambient temperature. While heat is transferred to the ambient tC is always higher than the ambient temperature. Note that ambient temperature inside of closed cabinets may be higher than ambient temperature outside of cabinet.

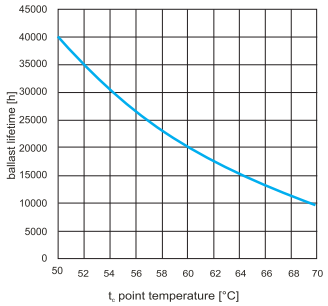

fig. A1:
Theoretical lifetime of electronic ballasts as function of temperature (reference: Radium)

Lifetime and reliability considerably depend on the operation temperature of the ballast. The thermal management of the ballast has to be designed very carefully. The ballast dissipates about 10% of electrical power as heat. Make sure the maximum Test Point Temperature tC will never be exceeded.

If the maximum permitted t_C is exceeded even by a few degrees, the life expectancy of the equipment will be drastically reduced. If t_C is exceeded by more than 10K the life time will be halved. If the t_C rises up more than 20K higher than the specified value (see data sheet) the equipment can be expected to fail. This is caused by the temperature limits of specific components such as electrolytic capacitors.

On the path from the ballast housing to environment heat transfer depends on thermal resistors. Stainless steel, Plastics and non moving air are bad thermal conductors. If these materials block the heat transfer it might take hours until thermal equilibrium conditions may allow measuring maximum Test Point Temperature t_C.

It is recommended to mount the ballast on a thermal conductive plate with maximum size. Avoid multiple thermal junctions with convection heat transfer. If possible allow forced air to remove dissipated heat in the cabinet.

It is recommended to provide thermal separation between lamp and ballast, e.g. by placing the ballast outside the lamp housing. The application of additional heat-dissipating measures may be useful. To provide maximum heat transfer the ballast should be mounted vertically with the mains terminals at the lower side. In addition, ensure that the surface on which the ballast is mounted, and any parts that touches the ballast housing are not in contact with external heat sources. Do not place the ballasts too close to each other in a cabinet. All appropriate safety rules must be fulfilled.

To ensure optimal lifetime and to have enough safety margin it is recommended to keep the Test Point Temperature t_C more than 10K below specified maximum value. Overheating will drastically shorten the lifetime of the ballast (see data sheet for details) or will cause failure.

A7.2. Temperature of Lamps

UV low pressure lamps are usually optimised for a particular tube wall temperature (see table A1). The table shows temperatures of a free-standing lamp at an ambient air temperature of 25°C. These are the temperatures at which the lamps have their nominal electrical properties and the highest radiation efficiency. Even small variations in temperature will influence the electrical and radiation properties.

If the temperature deviates significantly from the nominal value, the electrical behaviour will drastically change and the radiation density will drop seriously. In extreme cases the ballast and the lamp may be damaged. If the lamp temperature is too low, the lamp may not ignite or the radiation density may drop.

	low pressure	low pressure -HO	amalgam	amalgam - enhanced
lamp power	40W	80W	120W	140W
opt. temperature at tube surface	40°C	80°C	100°C	approx. 120°C
specific UV flux	0.5W/cm	1W/cm	1.5W/cm	1,8W/cm

table A1
Tube temperature for different low pressure lamps with 15mm tube diameter and 850mm lamp length (dimensions identical to G36T5L)

A8. Ignition
A8.1. Generals

Repeated rapid switching on and off can lead to failure of the ballast. Do not turn off and on the ballast within less than 10 seconds.

The mechanism that ignites the lamps is slower at lower temperatures. Starts will also become unreliable if input voltage is reduced. Parasitic wiring capacitances will affect ignition of lamp. Therefore the wires from ballast to lamp should be kept as short as possible.

In case of defective lamp the ballast will go into shut down mode and the red LED will flash. If this happens the reason must be found. Repeated rapid switching on and off can lead to failure of the ballast.

Do not add any components like switches, capacitors or ignition devices to the wires in between the ballast and the lamp because this may destroy the ballast.

If operating step dimming ballasts (-SD) the lamp current can be reduced by applying external DC voltage. During start-up this DC control voltage must be at 0V DC, otherwise the ballast may be destroyed. For long lamp life it is recommended to operate the ballast for at least 10 minutes at 100% current before the lamp current is reduced. Even by following this recommendation lamp life may be shorted if lamp is operated in dimming mode. Avoid long lamp operation at a lamp surface temperature below the recommended value.

Depending upon the dimming level and the environmental temperature, it is recom-

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mended to periodically operate the lamp at 100% of the rated current (see "A10.1. Notes on lamp dimming"). The time schedule and duration of this procedure needs to be determined individually. This also applies for microprocessor controlled ballasts (see "A10. Ballasts with Variable Lamp Current").

A8.2. Ignition if using Pre-Heating Ballasts
('-PH' is added to model no.)
Many manufacturers of low pressure (amalgam) lamps recommend filament pre-heating if the lamp is ignited more than once per day. Pre-heating implies that the filaments are heated to the adequate emissive temperature just before the lamp ignites.

It is very important to keep the pre-heat parameters within the manufacturer specified limits. The pre-heat time and pre-heat current parameters are labeled on the ballast. Please ensure that these parameters match the lamp manufacturer specifications.

In order to prevent conditions that reduce the lifetime of the lamp, such as glow-mode operation, ZED ballasts keep the lamp voltage close to zero during filament pre-heating.

Attention! Various lamp manufacturers may specify different pre-heat and/or operating parameters for lamps with similar power ratings. The lifetime of lamps may be shortened if the pre-heat current and/or pre-heat time is not in accordance with the lamp manufacturer specified limits.

A9. Behavior of Fault Indicator Relay and LED

Warning: The insulated contacts of the error relay do not provide protection against electric shock. All wires of the error control loop have to be installed with appropriate protection against contact according to applicable regulations.

A9.1. Behavior of Fault Indicator Relay and LED
at standard ZED ballasts

- No fault operation:
  - ⇨ The relay is active after the line voltage is applied. The green LED lights up continuously.
- Fault - current interrupted in lamp or lamp cable:
  - ⇨ The red LED lights up continuously and the relay is deactivated.
- Fault - short circuit in cable, air inside of the lamp:
  - ⇨ The relay is active and the green LED lights up short time. After the ignition period, the relay is deactivated and the red LED lights up continuously.

A9.2. Behavior of Fault Indicator Relay and LED
in ballast series E-PH and H-PH during pre-heating and ignition

- No fault operation:
  - ⇨ The relay is active after the line voltage is applied (preheating in progress for some time). The green LED lights up continuously. After the pre-heat time, the relay falls off for a short time. If the lamp is on, the relay is active and the green LED is on.
- Fault - current interrupted in lamp or lamp cable:
  - ⇨ The red LED lights up continuously and the relay is deactivated.
- Fault - short circuit in cable:
  - ⇨ During the pre-heat time, the relay is active and the green LED lights up continuously. After the ignition period, the relay is deactivated and the red LED lights up continuously.

A9.3. Behavior of Fault Indicator Relay and LED
in microprocessor controlled ballasts (ZED models I-PH, T, U, W, V)

see "A10. Ballasts with Variable Lamp Current"

A10. Ballasts with Variable Lamp Current
(dimmable microprocessor controlled ballasts with RS485),
ZED Models I-PH, T, U, W, V

The microprocessor controlled ballasts allow adjusting the operating current and pre-heat settings within a given range. These ballasts can be operated in Local Mode or in Remote Mode:

	local-mode	remote-mode
description	The setup for current level, pre-heat parameter etc. is done via DIP Switch. The ballast starts immediately after line voltage is applied. In case of failure detection the ballast enters a safety mode with all lamps off. To reset the ballast, line voltage needs to be turned off for a short time.	Settings can be changed via RS485 Bus. Address is set via DIP Switch. Standby and operation mode as well as status monitoring can be commanded via RS485 Bus.After error detection a start command will reset the ballast.
start up procedure	• set DIP-switches to desired parameters • turn line voltage on • internal initialization • pre-heating (if selected) • ignition • lamp operation	• set DIP-switches to desired address • turn line voltage on • internal initialization • waiting for commands via RS485 Bus
LED indicator	• lamp off: continuous red light, green LED off • internal initialization: after line voltage is turned on: red and green LED flash 1 or 2 times, then red LED turns on continuously· • pre-heating: green LED flashes, red LED is off· • lamp operation: green LED is on, red LED is off· • safety mode after error: lamp off, red LED on, green LED off· • line voltage off, malfunction: both LED off	
relay status	• lamp off: relay deactivated· • pre-heating: relay activated· • lamp operation: relay activated; after pre-heating and during ignition relay may fall off for a short time· • safety mode after error: relay deactivated· • line voltage off, malfunction: relay deactivated	
		Status of operation can be requested via RS485 Bus any time

table A2
Behavior of microprocessor controlled ballasts

Warning: Even if lamp is not operated, lamp contacts may be connected to line voltage. Always disconnect line voltage before servicing the unit. The insulated contacts of the error relay do not provide protection against electric shock. All wires of the error control loop have to be installed with appropriate protection against contact according to applicable regulations.

A10.1. Notes on lamp dimming
ZED ballasts I-PH, T, U, W, V as well as -SD models allow to adjust lamp power via changing lamp current.

In general, the adjustment of lamp current should be used only to optimize the lamp operation over the ambient conditions in accordance with specific applications.

If using ZED ballasts I-PH, T, U, W, V lamp current can be adjusted in a range of 50...120% of the rated lamp current. Please note that lamp power is not directly proportional to lamp current. For example, at 50% lamp current, lamp power may only drop to a value of 80%. The actual lamp power depends upon the specific lamp characteristics as well as the ambient conditions. See table A3 for an example: EVG2x300/2,1 A -PH with Heraeus lamp NNI300/147XL (free-standing operation in air at ambient temperature 25°C)

Lamp Current	Lamp Power	Dimming Setting
1.306A	208.0W	0 (50%)
1.447A	225.0W	1 (60%)
1.598A	244.0W	2 (70%)
1.716A	259.0W	3 (80%)
1.876A	279.0W	4 (90%)
1.995A	294.0W	5 (100%)
2.146A	313.0W	6 (110%)
2.270A	328.0W	7 (120%)

table A3
Measured lamp power depending upon lamp current (NNI300/147XL and EVG2x300/2,1 A -PH)

Note: For different lamps the recommended settings may be in the range from 80-120% - printed on label (or see data sheet). To prevent premature aging, it is recommended to operate the lamps at 100% (or at rated lamp current) for at least 5...8 min after ignition. Subsequently, the lamp current can be adjusted to lower values. If lamp current is too low during lamp warm up the Amalgam process inside the lamp might become ineffective or might even stop. This might lead to low UVC efficiency. Furthermore, the lamp may be destroyed.

Depending upon the dimming level and the environmental temperature, it is recommended to periodically operate the lamp at 100% of the rated current (or at rated lamp current). The time schedule and duration of this procedure needs to be determined individually.

Note: Operating normal low pressure lamps (Non-Amalgam lamps) at reduced current might lead to mercury condensation at cold spots. This can cause premature aging or failure of lamp.

A11. CE Symbol
The CE symbol on the ballast is an indication of compliance with the low voltage guideline and electromagnetic compatibility regulations.

A11.1. Summary

- ⇨ The CE symbol is an administrative symbol, not a symbol of safety or quality.
- ⇨ The CE symbol is based on the manufacturer's own statement rather than an inspection by an independent testing laboratory.
- ⇨ The ballast is a device that is designed to keep the limits for EMI emissions for industrial environment. There may be interference with some sensitive equipment in household situations.
- ⇨ There is no obligation of CE certification on ballasts installed as components.
- ⇨ Because the customer or installer/system provider of the equipment using the ballast carries the responsibility for connecting the device to the lamp, he is obliged to concern himself with the CE conformity of the equipment when complete.
- ⇨ The measured EMI interference is valid only for one single ballast. If multiple ballasts are operated in parallel higher values for emission may occur and additional components for EMI suppression may be necessary.

However, the level of interference depends not only on the ballast but also on the arrangement of the lamp and the ballast, on the construction of the equipment and particularly on the wiring.

Electromagnetic interference includes the radiated and conducted emissions of the equipment under test that can affect other equipment that is connected to the same line supply or that is placed in the near surrounding .To ensure that very different consumers of electric power can all use their equipment at the same time, it is necessary for every device to keep certain limits of electromagnetic interference. There are two signal paths of interference known as radiated interference via electromagnetic field and conducted interference, mainly distributed via line conductors.

A11.2. Conducted Interference
Conducted interference is caused by non linear load characteristic, creating non sinusoidal currents which affect power quality and large transients caused by high frequency switch mode operation. By using high quality line filters interferences can be kept within a level that is given by standards.

By using a ballast in a system the condition for distributing interference is changed considerably. Therefore it is recommended to follow the installation guide to avoid unnecessary high levels of interference.

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A11.3. Radiated interference
Due to nonlinear component characteristic and due to fast transients inside the ballast high frequency distortions are generated that may be radiated by the wiring of the ballast. The EMI line filter will attenuate these distortions so it can not be radiated by line cables. But the wiring between the ballast and the lamp may act as an antenna that radiates unwanted RF energy. The preferred frequencies, the signal level and the way the radiation leaves the unit depend among other things on the length and the arrangement of the wiring.

Ferrite beats may be used to attenuate these distortions. To provide optimal attenuation all wires that lead to one lamp have to be wound around one ferrite beat. Check the notes on operation and the notes on wiring (see section A.5) to provide optimum suppression of radiated emissions.
The operating agency (customer) is responsible to make sure that the quality of the mains supply voltage meets the limits, given by legal regulation.

The operating agency (customer) is responsible to make sure that the quality of the mains supply voltage meets the limits, given by legal regulation.

A12. Special Notes on Installation and Operation
Although ZED ballasts are designed, manufactured and tested with highest possible consciousness, a ballast may fail due to defective electronic parts or extreme situations. If using ballasts in applications requiring high reliability (close to 100%) it is advised provide redundancy.

The manufacturer cannot be held responsible for any damages or losses that are caused by malfunction of ballasts.

Electronic ballasts are highly sensitive complex electronic modules. It has to behandled with care by installation and servicing personnel.

In general attention should be paid to the following notes:

- In case of high content of harmonic distortions in the AC line voltage the Power-Factor-Corrector of ballast may fail in operation what could cause the ballast to fail. If this happens an appropriate line filter should be supplied.
- If the line voltage conditions are unknown, it is recommended to provide additional filters and overvoltage protectors precautionary.
- Take particular care when wiring up the cables between ballast and lamp. The ballast can fail early if there are poor contacts or sparks in between the wires. Take care for the maximum temperatures given for the individual components (cables, terminals).
- Avoid long parallel wires, shielded wires and tracing the wires in a shielding cover (metal tubes). This might increase parasitic capacitances, resulting in poor ignition of lamp. The same applies if screened cables are used.
- Do not connect or disconnect any wires while the ballast is under voltage.
- Ballasts incorporating active power factor correction (all devices greater 25W) cannot be dimmed by changes of supply voltage in the specified range neither by phase controlled modulation of line voltage. If the line voltage is not within the specified limits, the ballast may be damaged.
- The electronic ballast will shut down under the following fault condition:
  - lamp not sealed tight
  - raised lamp voltage due to old lamps
  - no lamp connected to ballast
- Warranty is void if the equipment was opened or taken apart. Using the electronic ballast without its housing will damage the unit due to overheating of power components.
- Any alteration to the equipment as delivered voids warranty. CE conformity will also be lost.
- Technical data of lamp and ballast must match to each other. Attempts to use ballasts with other lamps than specified for this particular ballast will possibly lead to failure. Furthermore, the warranty is void. Only lamp and ballast combinations, approved by manufacturer may be used. Also replacing a lamp by a similar type from a different manufacturer needs to be approved by manufacturer due to possibly different electric parameters.
- Keep away from the unit any wires or equipment other than required to operate the ballast and the lamp.

A13. General Notes

- All dimensions and technical data may vary within small tolerances as usual in practice.
- We reserve the right to make changes to technical and delivery details.
- The instructions above are based on our experience and are for information only.
- No warranty for completeness and correctness of details.