Communication Generals for Ballast Control - DIP-Switch Setting Generals

Alternatively local or remote control - selectable by DIP-switch

Generals

The microprocessor controlled electronic ballasts by ZED are provided with a set of control features. The ballast can be controlled locally or remotely via RS485:

- ⇨ turn on/off ballast
- ⇨ ballast status monitoring
- ⇨ set lamp current level during operation
- ⇨ preheat on/off
- ⇨ set preheat current level
- ⇨ select preheat time

Lamp Specific Ballast Settings

Each UV lamp requires specific ballast settings concerning preheat and lamp current values, which are defined for standard application according to the data of the lamp manufacturer.

- ⇨ **These settings should be ensured for optimal use of lamp and ballast.**

The lamp specific ballast settings are specified on the technical specification sheet of each ballast.

Ballast Control

The two operating modes - alternatively local control or remote control - are selected by the onboard DIP-switch. In local mode this switch is used for lamp specific ballast settings (see table below).

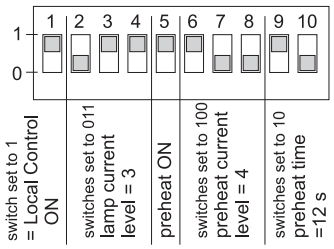
Local Control allows easy integration into existing systems. The ballasts behaviour is similar to classical ballasts, additionally a reduced set of control features is available:

- ⇨ automatic switch-on when connected to mains
- ⇨ operation current adjustable in 8 levels (0...7)
- ⇨ preheat on/off
- ⇨ preheat time (5s, 7s, 12s, 20s)
- ⇨ preheat current adjustable in 8 levels (0...7)

DIP-Switch Settings for Local Ballast Control

DIP switch number

		REMOTE ON (=Local OFF)	**Local ON**							
1	**control mode**	0	1							
		set DIP-switch no. 1 to "1" for local control by DIP-switch								
	lamp current level	level 0	level 1	level 2	level 3	level 4	level 5	level 6	level 7	
2		0	0	0	0	1	1	1	1	Example:
3		0	0	1	1	0	0	1	1	
4		0	1	0	1	0	1	0	1	
		set DIP-switches no. 2...4 for lamp current level								
	preheat enable	preheat off		preheat on						
5		0		1						
		set DIP-switch no. 5 to "1" (=ON) to enable preheat								
	preheat current level	level 0	level 1	level 2	level 3	level 4	level 5	level 6	level 7	
6		0	0	0	0	1	1	1	1	
7		0	0	1	1	0	0	1	1	
8		0	1	0	1	0	1	0	1	
		set DIP-switches no. 6...8 for preheat current level								
	preheat time	5s	7s	12s	20s					
9		0	0	1	1					
10		0	1	0	1					
		set DIP-switches no. 9...10 for preheat time								



Remote Operation - How to find the ballast on the serial bus

For each ballast an unique address for identification on the RS485 bus is needed. There will be no save operation if addresses are doubled on the bus. If a non-existing address is contacted a time out will occur.

The binary-coded ballast address is set by using the DIP-switches 3...10. Switch number 10 sets the least significant bit (lsb), representing the '1' , switch number 3 sets the most significant bit (msb), representing the '128'. The available address range is 0...255. Up to 256 devices (= control unit + ballasts + sensors + additional monitoring units) can be connected via one RS485 bus segment. It is not recommended to connect third party devices to the bus.

Lamp current specified in several levels

Although it is not recommended to dim UV lamps, there may be some reasons to raise or to lower the lamp current depending on the environmental situation.

The microprocessor controlled electronic ballasts by ZED offer an adjustment of the lamp current in 8 levels from level 0 (low) to level 7 (high).
According to the data of the lamp manufacturer one of these levels is identified as optimum for standard use, i.e. these settings may differ for standard operation with different lamps.

- ⇨ **Note: A permanent operation of UV-lamps with a decreased lamp current will lead to lamp degradation. The lamp might be destroyed if the lamp current is too high.**

A permanent operation of UV-lamps with low dimming value will lead to lamp degradation. To prevent this degradation the ballasts should be operated with the recommended lamp current level for a certain time periodically. Contact the lamp manufacturer for periode and duration of this "recycle-time".

The remote operation mode allows enhanced ballast control:

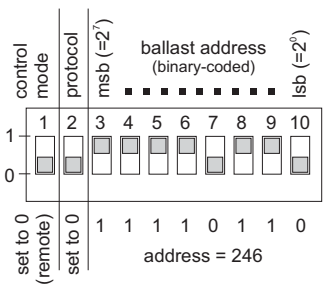
- ⇨ turn on and off the selected ballasts (ballasts have to be connected to mains to handle the power-up command)
- ⇨ turn on and off all connected ballasts via broadcast command (without acknowledge)
- ⇨ operation current adjustable in 8 levels (0...7)
- ⇨ operation current can be changed during ballast operation (e.g. depending on changes of environmental conditions)
- ⇨ preheat on/off
- ⇨ preheat time (1...12s, 15s, 18s, 20s)
- ⇨ preheat current adjustable in 8 levels (0...7)
- ⇨ status report: control of correct ballast and lamp operation

The control of the instruction execution and of the correct operation of the ballasts has to be assured by the control unit. Each instruction (besides broadcast commands) will be acknowledged by the appropriate ballast. For permanent control of the ballast state the control unit might scan the ballasts with the appropriate request.

DIP-Switch Settings for Ballast Remote Control:

DIP switch number

1	**control mode**	set to "0" for remote control via RS485							Example:
2	**protocol**	set to "0" (reserved for future enhancements)							
	address	0	1	2	...	127	128	...	255
3	address setting	0	0	0		0	1		1
4		0	0	0		1	0		1
5		0	0	0		1	0		1
6		0	0	0		1	0		1
7		0	0	0		1	0		1
8		0	0	0		1	0		1
9		0	0	1		1	0		1
10		0	1	0		1	0		1
		set DIP-switches no. 3...10 to assign the ballasts bus address							



Communication Generals for Ballast Control - Send Instructions

All control functions can be implemented via PLC (programmable logic controller), standard PC or dedicated control units incorporating a RS485 interface. ZED offers adaptable hardware solutions, e.g. the ZCon control unit series

The interface protocol is revealed and described in this paper. The open interface protocol allows integration in complex PLC- or PC-controlled UV-systems and third parties adaptions. A WINDOWS based control software "UV-Rack-Controller" is available for demonstration.

For programming and testing means emulation devices can be provided. These devices emulate the behaviour of the microprocessor controlled electronic ballasts without lamps connected.

Ballast Remote Control Details

Serial Line Settings for RS485 Communication:
- speed/transfer rate: 4800bd
- data bits: 8
- stop bits: 1
- parity: none
- flow control/handshake: none
- implicit CR in every LF: no
- CR->CR/LF on transmitt/receive: no

➪ **Note: Set the control units output driver to Tristate-Off after sending commands to assure receiption of ballasts acknowledge.**

➪ **It is not recommended to connect third party devices to the bus.**

Ballast State Definition
- 1 bit :
  0 = switch off
  1 = switch on (or change lamp current level, if already switched on)

If the ballast is already switched on, the switch-on instruction is used to initialize a change of the lamps current setting according to the following lamp current settings. The preheat settings given with the switch-on command cannot be changed during preheating.

Current Level Definition (for lamp and preheat)
- 3 bit for current level setting (linear characteristic of value changes):
  range: from 0 (=minimum current level) to 7 (=maximum current level)

Preheat Permission
- 1 bit:
  0 = preheat disabled
  1 = preheat enabled

Preheat Time Definition:
- 4 bit for preheat time settings
  0000 = not allowed
  0001 = 1s | ... | 1100 = 12s | 1101 = 15s | 1110 = 18s | 1111 = 20s

Ballasts Boot-Up Feature:
After connecting to mains the remote controlled ballasts will boot up to standby mode. During this booting up several informations will be given as plain ASCII-text to the RS485 bus:
- firmware version
- firmware versions date
- address settings

These informations can be used with advanced customized programs, e.g. for availability checks.

Send Instruction

byte #	byte 0								byte 1								byte 2								byte 3								byte 4								byte 5							
bit	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
name	start identifier		command identifier	broadcast identifier	direction identifier	not used	not used	address bit 7	data identifier	address bit 6	address bit 5	address bit 4	address bit 3	address bit 2	address bit 1	address bit 0	data identifier	not used	not used	ballast state	lamp current bit 2	lamp current bit 1	lamp current bit 0	preheat permission	data identifier	preheat value bit 2	preheat value bit 1	preheat value bit 0	preheat time bit 3	preheat time bit 2	preheat time bit 1	preheat time bit 0	data identifier	checksum bit 6	checksum bit 5	checksum bit 4	checksum bit 3	checksum bit 2	checksum bit 1	checksum bit 0	end of transmission identifier							
description	bit-string '10' marks start of transmission		0 = instruction	0 = addressed device/ 1= all connected devices	0 = to ballast			ballast address bit 7	0 = byte signed as data byte	ballast address bits 0...6							0 = byte signed as data byte	set to '0'	set to '0'	0 = switch off / 1 = on/set lamp current	lamp current level (0 = minimum level ...7 = maximum level)			0 = preheat off / 1 = preheat on	0 = byte signed as data byte	preheat current level (0 = minimum level ...7 = maximum level)			preheat time (0001...1100=1s...12s, 1101=15s, 1110=18s, 1111=20s)				0 = byte signed as data byte	checksum = (sum of all '1-bits' in byte 0...3) -1 C-program code for example: int i,j; unsigned char sum=0; for (i=0;i<4;i++){ for (j=0;j<8;j++){ if(Byte[i]&(1<<j)) sum++; } } sum--;								all set to 1 for end of transmission identification							
hex-value	(0x??)								(0x??)								(0x??)								(0x??)								(0x??)								0xFF							

Example:
switch on ballast at address #1, lamp current level 5, preheat current level 5, preheat time 15s

byte #	byte 0								byte 1								byte 2								byte 3								byte 4								byte 5							
bit	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	1	1	0	1	0	1	1	1	0	1	0	0	0	0	1	0	1	0	1	1	1	1	1	1	1	1
options	bit-string '10' marks start of transmission		0 = instruction	0 = addressed device only	0 = to ballast	ballast address = 1 (part 1)			0 = byte signed as data byte	ballast address = 1 (part 2)							0 = byte signed as data byte	set to '0'	set to '0'	1 = switch on	lamp current level = 5			1 = preheat on	0 = byte signed as data byte	preheat current level = 5			preheat time 1101=15s				0 = byte signed as data byte	checksum = (sum of all '1-bits' in byte 0...3) -1 = 1 (byte 0) + 1 (byte 1) + 4 (byte 2) + 5 (byte 3) -1 =10								all set to 1 for end of transmission identification							
hex-value	0x80								0x01								0x1B								0x5B								0x0A								0xFF							

Communication Generals for Ballast Control - Acknowledgement and Status Request

Ballasts Answer (Acknowledgement)

byte #	byte 0								byte 1								byte 2							
bit	1	0	0	0	1	0	0	1	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1	1
description	start identifier		command identifier	broadcast identifier	direction identifier	not used	not used	acknowledge	data identifier	checksum bit 6	checksum bit 5	checksum bit 4	checksum bit 3	checksum bit 2	checksum bit 1	checksum bit 0	end of transmission identifier							
options	bit-string '10' marks start of transmission		0 = response	0 = addressed device only	1 = from ballast	0	0	1 = acknowledged	0 = byte signed as data byte	checksum = (sum of all '1-bits' in byte 0) -1 = 3 (byte 0) -1 =2							all set to 1 for end of transmission identification							
hex-value	0x89								0x02								0xFF							

The byte string of the acknowledgement is fixed for all addresses: 0x89, 0x02, 0xFF.

Send Status Request

byte #	byte 0								byte 1								byte 2								byte 3							
bit name	1	0	1	0	0	ADR9	ADR8	ADR7	0	ADR6	ADR5	ADR4	ADR3	ADR2	ADR1	ADR0	0	CHK6	CHK5	CHK4	CHK3	CHK2	CHK1	CHK0	1	1	1	1	1	1	1	1
description	start identifier		command identifier	broadcast identifier	direction identifier	address bit 9	address bit 8	address bit 7	data identifier	address bit 6	address bit 5	address bit 4	address bit 3	address bit 2	address bit 1	address bit 0	data identifier	checksum bit 6	checksum bit 5	checksum bit 4	checksum bit 3	checksum bit 2	checksum bit 1	checksum bit 0	end of transmission identifier							
options	bit-string '10' marks start of transmission		1 = request	0 = addressed device	0 = to ballast	ballast address bits 7...9			0 = byte signed as data byte	ballast address bits 0...6							0 = byte signed as data byte	checksum = (sum of all '1-bits' in byte 0...1) -1							all set to 1 for end of transmission identification							
hex-value	(0x??)								(0x??)								(0x??)								0xFF							

Example:
send status request to ballast at address no. 1

byte #	byte 0								byte 1								byte 2								byte 3							
bit	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0
options	bit-string '10' marks start of transmission		1 = request	0 = addressed device only	0 = to ballast	ballast address bits 7...9			0 = byte signed as data byte	ballast address bits 0...6							0 = byte signed as data byte	checksum = (sum of all '1-bits' in byte 0...1) -1 = 2 (byte 0) + 1 (byte 1) -1 =2							all set to 1 for end of transmission identification							
hex-value	0xA0								0x01								0x02								0xFF							

Communication Generals for Ballast Control - Receive Status

Receive Status

byte #	byte 0								byte 1								byte 2								byte 3							
bit name	1	0	1	0	1	0	0	0	0	0	0	0	TYPE	PHST	LAS	LBS	0	CHK6	CHK5	CHK4	CHK3	CHK2	CHK1	CHK0	1	1	1	1	1	1	1	1
description	start identifier		command identifier	broadcast identifier	direction identifier	not used	not used	not used	data identifier	not used	not used	not used	ballast type	preheat state	channel A state	channel B state	data identifier	checksum bit 6	checksum bit 5	checksum bit 4	checksum bit 3	checksum bit 2	checksum bit 1	checksum bit 0	end of transmission identifier							
options	bit-string '10' marks start of transmission		1 = status	0 = addressed device	0 = to ballast / 1 = from ballast	set to '0'			0 = byte signed as data byte	set to '0			0 = single (A) / 1 = dual (A+B) lamp ballast	0 = preheat not active / 1 = currently preheating	0 = lamp A off / 1 = lamp A on	0 = lamp B off / 1 = lamp B on*	0 = byte signed as data byte	checksum = (sum of all '1-bits' in byte 0...1) -1							all set to 1 for end of transmission identification							
hex-value	(0x??)								(0x??)								(0x??)								0xFF							

* not used on single lamp ballasts

Example:
receive status from ballast at address no. 1 (dual lamp ballast)

byte #	byte 0								byte 1								byte 2								byte 3							
bit	1	0	1	0	1	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	1	1	0	1	1	1	1	1	1	1	1
options	bit-string '10' marks start of transmission		1 = status	0 = addressed device only	0 = to ballast / 1 = from ballast				0 = byte signed as data byte				0 = single (A) / 1 = dual (A+B) lamp ballast	0 = preheat not active / 1 = currently preheating	0 = lamp A off / 1 = lamp A on	0 = lamp B off / 1 = lamp B on	0 = byte signed as data byte	checksum = (sum of all '1-bits' in byte 0...1) -1							all set to 1 for end of transmission identification							
hex-value	0xA8								0x0E								0x06								0xFF							

shown answer: ballast is switched on, ballast is currently preheating, both lamps are connected

Status Feedback Interpretation:

byte #	byte 0								byte 1								
bits	1	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	dual ballast, both lamps off
	1	0	1	0	1	0	0	0	0	0	0	0	1	1	1	1	dual ballast, currently preheating, both lamps connected
	1	0	1	0	1	0	0	0	0	0	0	0	1	1	1	0	dual ballast, currently preheating, lamp A connected, lamp B off (= disconnected or defective)
	1	0	1	0	1	0	0	0	0	0	0	0	1	0	1	1	dual ballast, both lamps on
	1	0	1	0	1	0	0	0	0	0	0	0	1	0	1	0	dual ballast, lamp A on, lamp B off