IES 4416
Onbord LED + CAM Controller

SYSTEM DESCRIPTION

Mobile ruggedized supply and control unit for up to 20 LED illumination heads and 10 high speed video cameras.

Revision RB16

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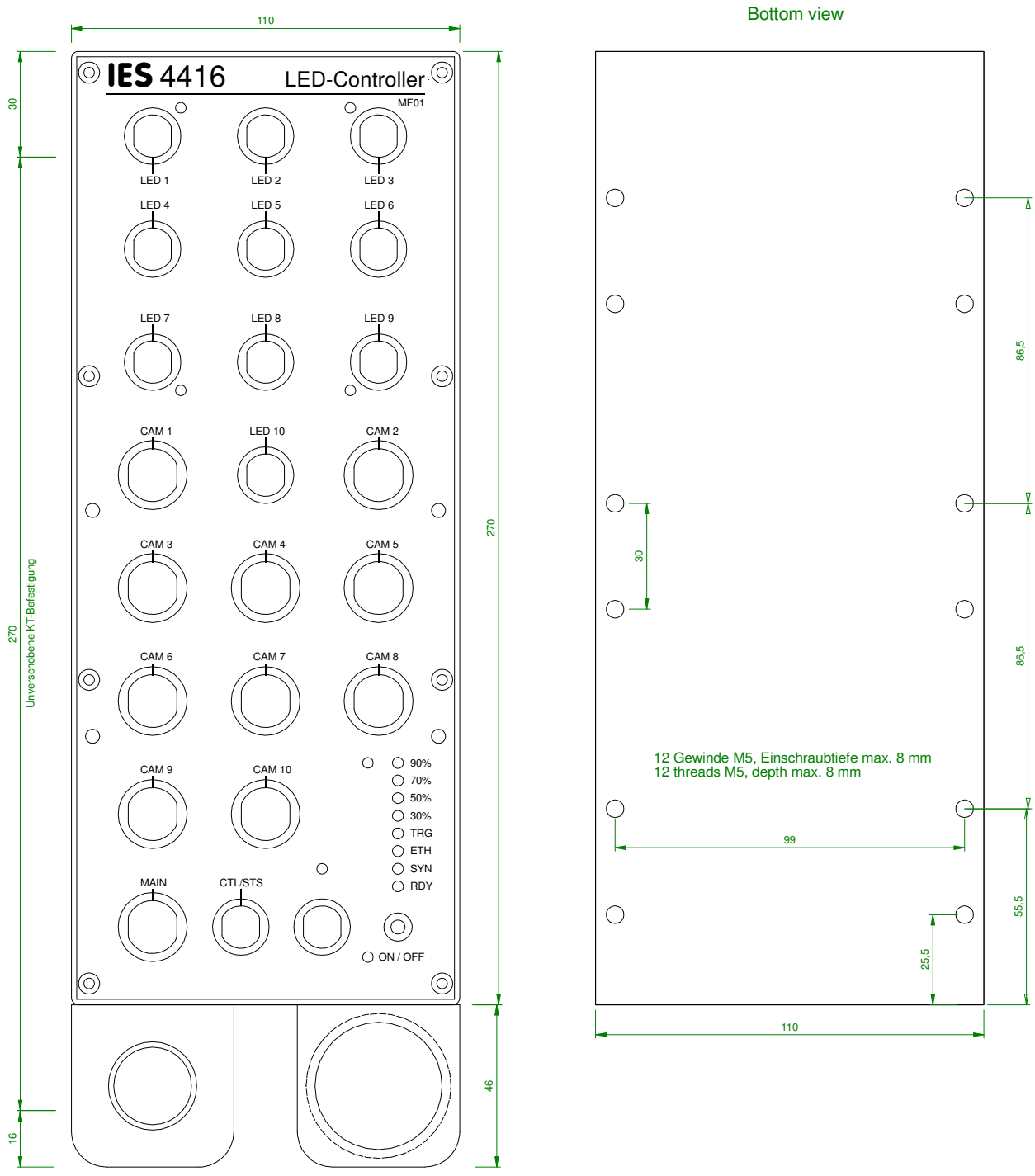
1 Overview

This onboard LED + CAM controller can supply energy and can control up to 20 LED illumination heads and up to 10 high speed video cameras. It is made for installation on bord of a vehicle and may be used in crash testing scenarios. It contains internal rechargeable batteries.

In its standard version it has a standard KT (Minidau) footprint. As an option, one or two "balconys" (see photograph, shown is the 5B balcony) below are available, that allow connection of a small or a full size **trailing cable** (Lemo 3B or Lemo 5B connectors).

1.1 Mounting information

The drawing below shows the main measures. From the bottom threads at least 6 should be used. We also recommend the good practise of having a stopping edge on the users mounting plate, which can take the acceleration force.



2 Connectors and Front Panel elements

All connectors and user interface elements are located on the front panel.

2.1 MAIN connector

The MAIN connector is used to connect this device to the user´s existing infrastructure. Connections are:

- Power supply to internal charger
- Ethernet for communication
- Trigger input
- Sync input

The pinout is given in the table below.

Connector type in front panel: Lemo EGA.2B.318
Connector type for user cable: Lemo FGA.2B.318

Pin	Signal	Remark
1	Ethernet A-	
2	Ethernet D-	
3	Ethernet B-	
4	Ethernet B+	
5	Ethernet C+	
6		
7	+CHGSUP	Charger-Input 40-48 V, 1 A
8	+CHGSUP	as above
9	SYNC+	
10	SYNC-	
11	-CHGSUP	Device-GND and Charger-GND
12	-CHGSUP	as above
13	Ethernet A+	
14	Ethernet D+	
15	Ethernet C-	
16		
17	+T0	
18	-T0	
Case		

The input signals SYNC and T0 are of type RS-485. They are pulled to their respective quiet voltage levels by internal pullup resistors and therefore may be left open, if unused.

These inputs also accept TTL input signals. These must be referenced to GND. This table shows, how to connect a **TTL sync signal** to the MAIN connector:

TTL sync out from user´s equipment	MAIN Pin 9
TTL GND from user´s equipment	MAIN Pin 11

It would be possible to signal T0 with a closing contact between pins 17 and pin 11 - however this is not recommended, because it is an RS-485 input and not an explicit contact input. But it´s ok for testing purposes.

2.2 CTL/STS connector

The CTL/STS connector has control and status signals for exchange with external equipment. The signals are optoisolated and the couplers have internal current limiting circuity, so they can be driven from sources between 5 V and 24 V without additional resistors. Functions provided:

- START signal input to start the light
- READY output to signal ready status
- Remote front panel button control input

There is also an isolated 5 V voltage source provided on this connector. It makes it easy to use the optoisolated inputs from closing contacts.

The pinout is given in the table below.

Connector type in front panel: Lemo EGG.1B.308
Connector type for user cable: Lemo FGG.1B.308

Pin	Signal
1	Opto-Start K
2	ISO 0V
3	Opto RDY C
4	Opto RDY E
5	ISO +5 V
6	Opto Start A
7	Opto Setup light A
8	Opto Setup light K

2.3 AUX connector

The AUX connector is used for user specific extensions. There is no general description available or possible. In case of devices with no trailing cable "balcony", this connector is typically used to feed in the **camera power**.

2.4 LED head connector

The LED illumination heads are connected to the LED 1, LED 2 , ... output connectors. Each output connector can supply two LED heads, or one double LED head. Each output connector has one temperature supervising input channel.

If (downgraded) devices are not fully equipped with LED ports, then the lower connector numbers ar functional (starting at LED1) and the higher numbers are not functional.

The pinout is given in the table below.

Connector type in front panel: Lemo EGG.1B.306
Connector type for user cable: Lemo FGG.1B.306

Pin	Signal
1	LED A1
2	LED K1
3	LED A2
4	LED K2
5	NTC a
6	NTC b
Case	Screen

2.5 LED status markers

The status markers indicate

- Charge level of internal batteries
- Ethernet communication activity
- Sync input signal present
- Controller ready status

During charge (when external power supply is attached to MAIN connector) the highest charge level LED blinks. This indicates, charging takes place. The charging is complete, if all charge indication LED´s are ON.

Ethernet indicator is normally ON, and is blanked for a moment, if a command is received and processed.

Sync LED is ON, if a valid external sync signal is recognized.

Controller ready status is signalled, if battery is in good condition and no temperature is higher than the "ready level". See operating instructions for more on ready signalling.

2.6 Front panel button

The front panel button provides these functions:

- Switch ON the device (press short)
- Switch ON or OFF the light (press 1/2 second)
- Force device to use a default IP
- Switch OFF the device

Switching ON is simple, just press shortly.

Switching the light is done by pressing the button a bit longer, then release. Light is switched on at the lowest level on the first press (called setup light), then switched to full level on the second press, then switched off on the third press.

If pressed for a long time (around 6 seconds), the LED´s give feedback: All turned off exept RDY and ETH. Releasing the button at this moment will bring the device into DEFAULT IP mode. In this mode, the device has the following IP:

Default IP	**192.168.1.40**

This mode is indicated by blinking the ETH LED every second. It is usefull to discover and set up a device with unknow IP. The mode is ended by switching off the device.

Switching OFF the device is done by pressing the button long, approx 8 seconds (or more).The LED´s give feedback: All turned off.

Please note, that after 6 seconds the default IP mode is offered (LED feedback), and switching OFF requires to keep on pressing the button!

2.7 CAM1 to CAM10 port connector

Connector type in front panel: Lemo EGG.2B.318
Connector type for user cable: Lemo FGG.2B.318

Pin	Signal	Remark
1	Ethernet A-	
2	Ethernet D-	
3	Ethernet B-	
4	Ethernet B+	
5	Ethernet C+	
6	GPIOP	general purpose input
7	+SUP	CAM supply 20-32 V, fused 5 A
8	+SUP	as above
9	SYNC+	
10	SYNC-	
11	-SUP	RTN from CAM supply
12	-SUP	as above
13	Ethernet A+	

14	Ethernet D+	
15	Ethernet C-	
16	GPIOM	general purpose input
17	+TRG	
18	-TRG	
Case		

Same Pinout as in all IES camera control products.

2.8 Trailing cable connector Lemo 5B

Pin	Signal	Remark
1		
2	Ethernet-Screen (optional)	
3	Ethernet D-	
4	Ethernet D+	
5		
6	Ethernet A-	
7	Ethernet B-	
8	Ethernet C+	
9	Ethernet C-	
10	Ethernet B+	
11	Ethernet A+	
12	RTN 48V	
13	RTN 48V	
14	Data C 485 +	T0+, quiet level: 0 V
15	SUP 48V	
16	SUP 48V	
17	SUP 48V	
18	Data C 485 -	T0-, quiet level 5 V
19	RTN 48V	
20	-	
21	Data C Shield	
22	-	
23	-	
24	Data A 485+	+START light opto input
25	Data D 485 +	+SYNC RS-485
26	Data B 485+	+RDY opto output
27	-	
28	Data B 485-	-RDY opto output

29	Data D 485 -	-SYNC RS-485
30	Data A 485-	-START light opto input
31	Data A Shield	
32	Data D Shield	
33	Data B Shield	
34	CAM P	
35	CAM P	
36	Data E 485 +	+SETUP LIGHT opto input
37	CAM M	
38	CAM M	
39	CAM M	
40	Data E 485 -	-SETUP LIGHT opto input
41	CAM P	
42	CAM P	
43	Data E Shield	
44	CAM M	

Power pins	**Signal**
1	CAM M
2	CAM M
3	CAM P
4	CAM P

Remark: This is a big connector and during handling big forces and moments could be applied, but should be avoided. If the connector sits tight in its socket, please do not try turning, it is better to try loosen it by applying moderate forces to left and right alternating.

3 Functional Description

3.1 Unknown IP

If the devices IP is unknown, these are the possibilities:

- use DEFAULT IP mode, see 2.6
- use SRCH cmd from Diag4400 with ethernet broadcast in a small network
- use SRCH cmd from Diag4400 with device address "0000", e.g. together with broadcast

If still lost, device must be sent in to factory.

3.2 Setup light

High speed filming typically goes in parallel with a short term lighting demand. But for the set up of cameras and lenses more time is required. To prevent excessive heating up of LED heads, drawing energy out of batteries and heating up test objects it is wise to use a lower light light level, called setup light. This can be switched ON by command or by pressing the front panel button, and the percent level of light can be set using Diag4400 software.

A better concept for setting up cameras and lenses is to use the full light level, but a reduced frame rate like 100 fps. It means only a tenth of energy and heating, and also very convenient light level for the human eye. And, as the pictures are illuminated with the final parameters (shutter time, light level) you see what you get during the set up. No post-adjustment of lenses is to be done then.

The low frequency setup can be done by feeding in an external sync signal (e.g. from a camera), or by setting the internal frequency generator to 100 fps.

3.3 Starting the light

The light can be started by

- pressing the front panel button (once or twice)
- software command
- electrical signal or closing contact at CTL/STS connector (OPTO Start function)
- electrical signal or closing contact at same connector (RMT function)

The OPTO start function switches ON full light immediately. The RMT (remote) function is internally wired in parallel with the front panel button and thus all functions of this button can be done with an external signal. For example it would be possible to use a small user built operator panel with 6 meters cable as a remote control.

The duration of light ON can be selected between two possibilities. If "Start is signal controlled" is checked in Diag4400 software, then the light is ON as long as the external signal is active. The external signal directly controls on/off of the light. If this is unchecked, then the external signal acts as a start timer trigger and light is switched ON for a duration set by the timer value.

3.4 SYNC and CONT modes

The LED controllers may operate in SYNC mode or in CONT mode. The actual mode can be read with the command GMOD ("get mode"), which is answered with a string like "0000". These are two hex numbers 00 and 00 which reflect the settings für mode and sync edge.

To change the operating mode use command "SMODxxxx" (set mode"), where xxxx is the number from this table:

Mode	**xxxx**
Sync	0000
Cont	0101

For example send SMOD0000 to set sync mode.

3.5 External sync input

The devices have an internal frequency generator and feed the signal to cameras and light. They also have inputs for external sync signals. These can be fed in at connectors MAIN, 5B or CAM1, with MAIN/5B beeing connected in parallel and beeing the default. If CAM1 is to be used, see 3.6 to set the sync input multiplexer correctly.

LED controllers detect the external signal automatically. If detected, the yellow LED is switched on and the rising edge of the external signal is used to trigger an output pulse to cameras and lights. It means, that for every rising edge one sync pulse with the configured width (see Diag4400) is output. For example, if setting up 250 µs pulse width and applying an external signal of 1000 Hz, then the cameras and lights will see one pulse 250 µs every 1 ms. If lowering the external frequency to 100 Hz, the pulse width remains unchanged, so cameras and devices will see a pulse with 250 µs every 10 ms.

3.6 Special Functions

Some special functions are implemented into the LED controllers. These functions can be switched on or off using the Diag4400 software, see below. The bits are combined to form a number value. An example: If TLH function and ET0 function are wanted, this gives a value 1+4 = 5 to be stored into the device.

bit7	**bit6**	**bit5**	**bit4**	**bit3**	**bit2**	**bit1**	**bit0**
-	-	-	-	-	ET0	SYM	TLH

TLH Set Temperature limit high
Setting may be used for climate chamber operation. LED heads will NOT be switched off at elevated temperatures, when set. It is then a responsibility of user to ensure switching off before damages to LED head or illuminated objects can occur.

SYM Sync multiplexer
If set, the external sync signal is taken from CAM1 connector. If not set, the external sync signal is taken from MAIN (or 5B) connectors.

ET0 Emergency T0
When set, controller switches ON the light if a T0 signal is received. This provides some additional "feel well" in scenarios where long delays between start light and T0 may occur and thus a timer could unhappily may be timed out. A disadvantage of ET0 is, that light is switched ON repeatedly

during T0 test in preparation phase of a vehicle. This can potentially be harmfull for working personell, if they are close to the LED heads. Administrive rules should be set up for working people, if using this function.

3.7 Device shutdown timer

The LED controllers have an internal shutdown timer with a user settable value (see Diag4400). Devices will be ON as long as external power is applied. If no external power is present, timer counts down and finally switches off the device. This prevents (forgotten) devices from drawing the battery empty. A **special value 255** can be used for the timer: In this case the **shutdown is disabled** and it is in users responsibility to switch off device before the battery is empty!

4 Diag4400-Software

IES provides a free PC software named "Diag4400", which is primary intended for diagnostic purposes related to the LED controllers. It can also be used as a lightweight front end for controlling the light function (switch on/off). To obtain the latest revision, or report bugs and wishes, please contact office(at)ies-elektronikentwicklung.de.

The description is based on LED controller model IES 4416 with firmware QL16 or later and Diag4400 revision RB11 or later.

The software has one EXE file (Diag4400.exe) and one INI file (IES4400.ini). These both should be placed in a free to choose directory on a Windows PC. Microsofts DotNet 2.0 framework must be installed on that PC.

4.1 Finding and connecting LED-Controllers

At first, a proper INI file should be prepared (text editor). See an example below. The port setting (UDP) tells the software with what type of interface it should communicate with the controller. UDP is the default setting for ethernet communications.

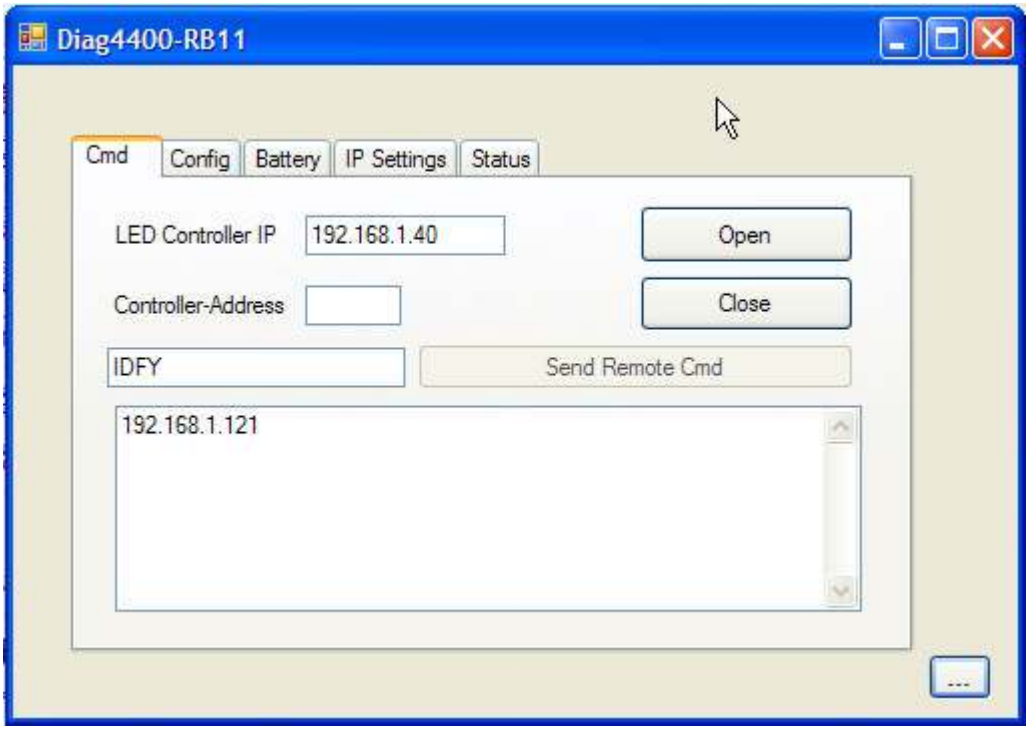
The [IPSEARCHLIST] provides a set of IP numbers and controller serial numbers. It should contain at least one entry.

```
[REMOTEPORT]
PORT=UDP

[IPSEARCHLIST]
DEVICE1=172.22.102.81 PK03
DEVICE2=192.168.1.40 PK40
DEVICE3=192.168.40.37 PK08
```

After program start, devices are searched according to this list. If **no controller is found** in the network, this error message is displayed:

In this case, after clicking OK, the software shows a CMD tab, where a manual connection can be established. Enter the IP address of an LED controller and the controllers serial number (like PK09) into the text field "Controller address"), then press "open".



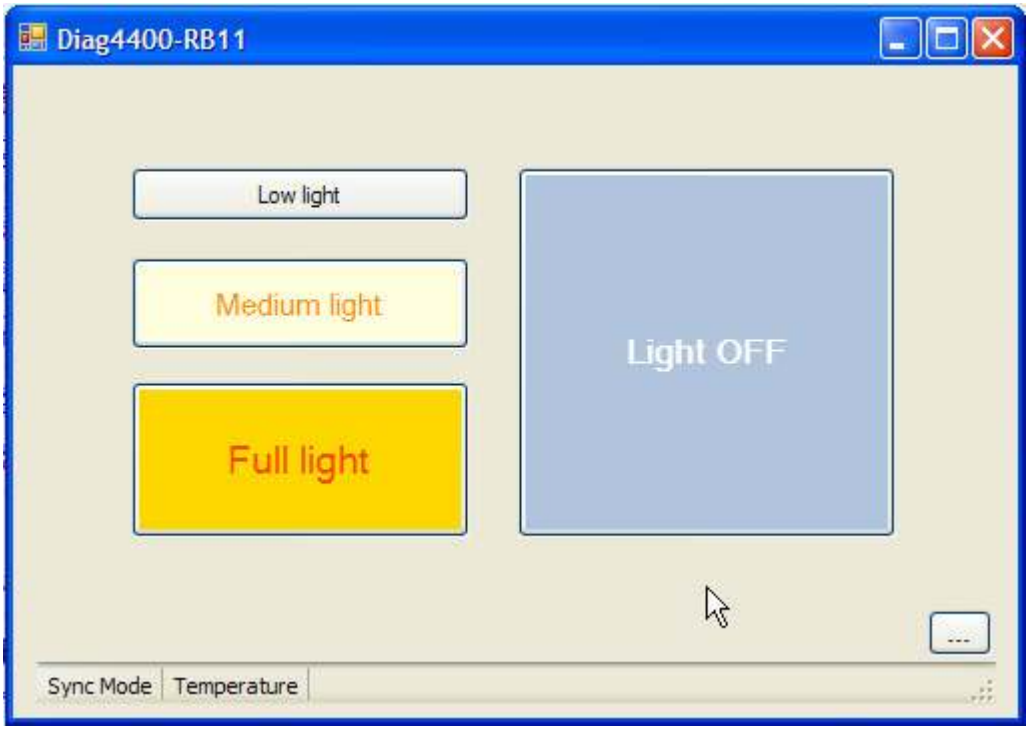
To check, if the device responds to commands, send a remote command like IDFY (identify), using the button "send remote cmd". The answers from the controller are displayed in the textfield at the bottom.

If the controllers serial number is not known, the special address "0000" can be used. Then, only one command, "SRCH", will give an answer, if a controller hears it. It sends its serial number, and from then on communication can be made with the proper address.

If the IP is not known, a **broadcast** into the network can be done (255.255.255.255). This may be rejected from your network. In smaller networks, or peer to peer cabling, you may use the broadcast plus the "0000" to find a device with absolutely no preliminary information of it. Only, the PC must be in the same network as the controller (a general requirement of ethernet networking).

If connection to an LED controller is finally established, press the button named "..." in the lower right edge of the form. This brings you to the normal start screen.

In the **normal case** (finding controller from INI list) after program start, the screen looks like this:



It is an operator panel for switching on/off the light.

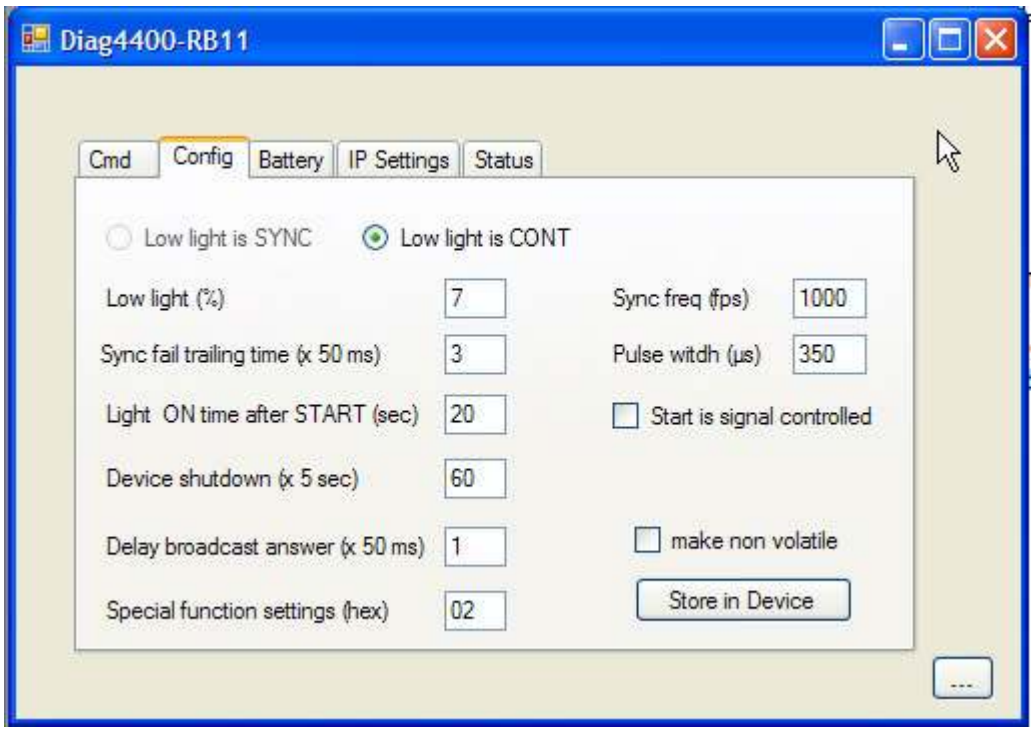
Access to the diagnostic functions is reached by pressing the "..." button in the lower right edge of the form.

4.2 CMD-Tab

The CMD tab was already mentioned. Experienced users may send commands to the controller from here and see the answers. Also, all buttons from all tabs of the software do the same, sending commands and processing the answers. The commands are always four big letters, like "IDFY", which is a mnemonic for the word "identify". The answers are shown in the big text box for manual evaluation. Text here can be marked and deleted ("delete all" from the mouse context menu), to clean up the area from time to time.

4.3 Config-Tab

This tab enables a lot of settings to be made.



Low light % sets up the intensity of the lowes light level, also called setup light.

Sync fail traillling time will keep the light switched on for some time after an external sync signals stops (potentially fails). It is a good feature for crash test scenarios, but it is unwanted at test stands, where a camera controls the light on/off by its sync output. Therefore it is configurabe by the user.

Light ON time after START sets the duration of an internal timer. Light will be switched off after this duration. START light cqan be done from an ethernet command or from a contact signal.

Device shutdown controls that the device will shut down (switch itself off) after some time of inactivity and when diconnected from external power supply. It prevents a forgotten device to draw the battery empty. A special value 255 can be used, if the device should never switch off. It is a responsibility of the user, to switch it off manually, after work is done.

Delay broadcast answer is a setting for helping to find devices with the SRCH command. All devices in an RS-485 network should be set to different delays, so after a broadcast they will respond one after another, making it likely to be found. If all devices would respond simultaneously, only garbage answers will be produced an finding is difficult.

Special function settings is a bitmask for special functions. These are device specific and explaned in the hardware chapters.

Sync freq is a setting for the internal sync generator.

Pulse width is a setting for the output pulse width of sync signal, that is given to the cameras and the LED light. Preferably use a pulse width lower than 50% of the frame period to have maximum power output from LED heads. If using more than 50% duty cycle, power is automatically reduced.

Start is signal controlled is a selection between timer control of LED light or direct control from a hardware signal. If not checked, the external START signal start the internal timer, which controls the light on duration. If checked, the external START signal controls the light output directly, so the duration of the signal is used for switching on the light (as opposed to the timer duration).

Make non volatile, if checked, makes the settings nonvolatile after the **Store in Device** button is clicked. If not checked, the **Store in Device** button sends the new settings to the device, and device uses them, but will forget the changes at power off. This volatility is good for experimenting, for temporary setups or when a controlling software sets up the LED controllers prior to each test. The non volatile storage option is good for stand alone applications.

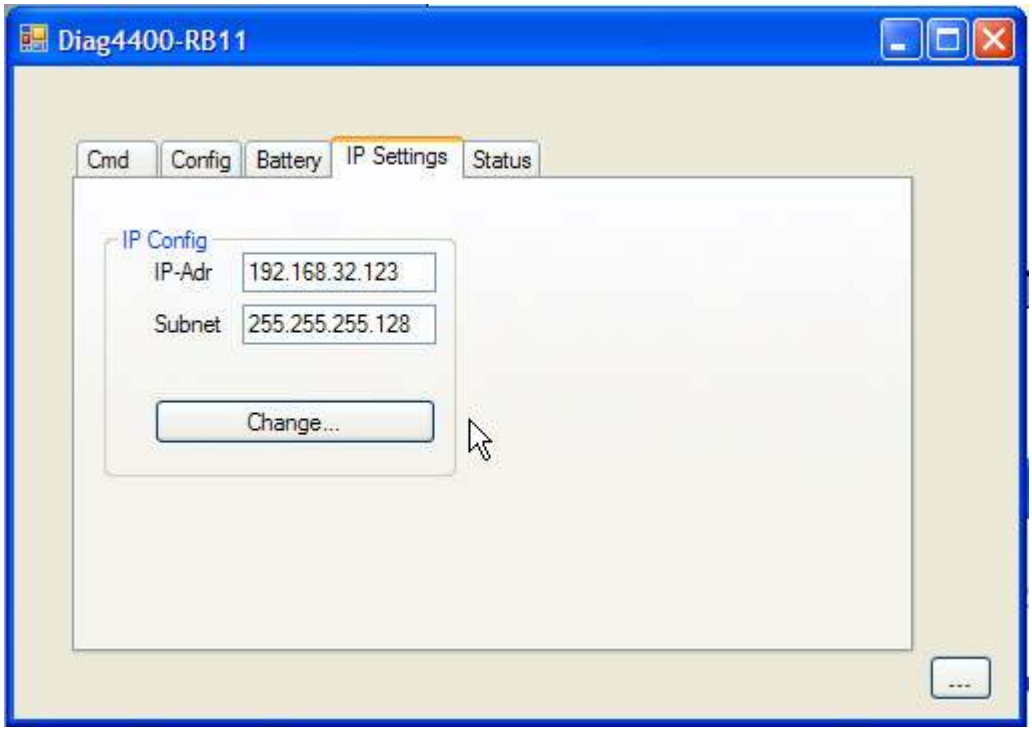
4.4 Battery-Tab

This tab shows the state of charge in percent, the load current and the individual cell voltages. Cell voltages are colored green, if they are in a normal range, and colored orange, if abnormal.
The values are only updated on entering the tab, not polled automatically.

4.5 IP-Settings -Tab

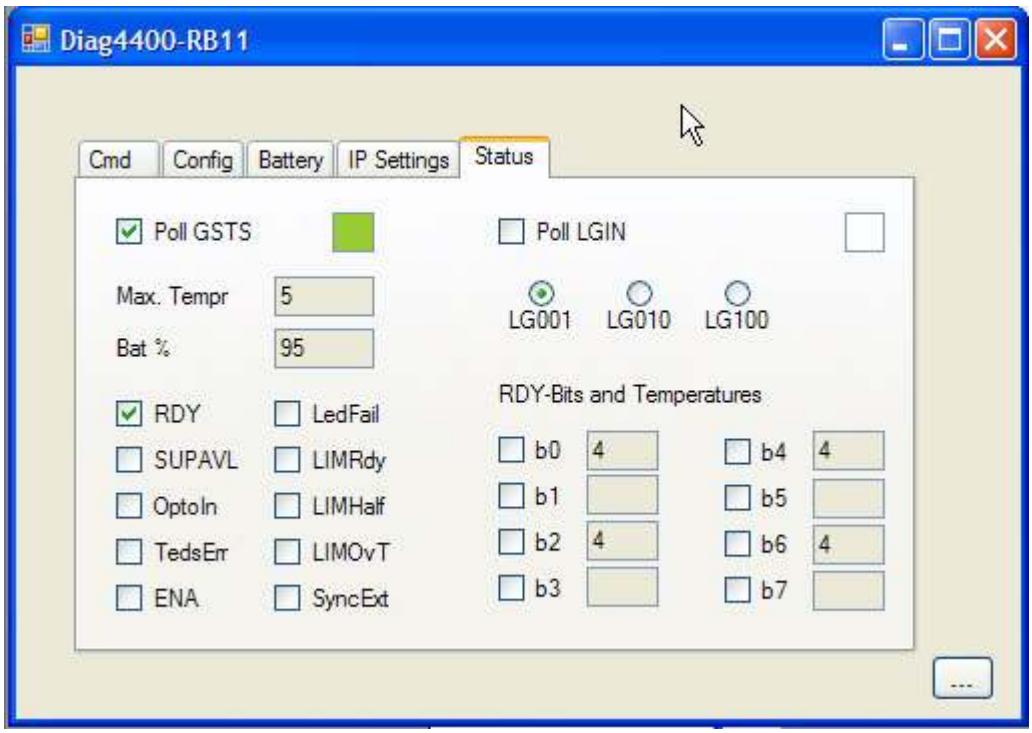
This tab displays the IP setting of the device. It may be changed and written into the device using the "change..." button. A password dialog comes up. The password is currently empty.

After a change and write into the device, the device keeps using its old IP until a fresh power up is done.



4.6 Status -Tab

This tab provides status information about the LED controller. The status is read from the device on entering the tab (when displayed first). It is also possible to periodically update the status by checking the Poll GSTS and/or PollLGIN boxes. The periodical refresh causes communication traffic every second and fills the "answer" textbox (on CMD tab) quickly. It is not a general problem, but may not be wanted for diagnostic purposes. This is why polling can/must be checked yes/no.



Polling GSTS (GSTS is the command used for this poll, it is a mnemonic for "get status") delivers
- the maximum temperature of all connected LED heads

- the state of charge of the battery
- the ready state of the device
- a SUPAVL flag indicating external power supply is present
- status of OPTO IN input (signal from CTL/STS connector), used for switching on the light
- error indication for config memory (Teds)
- ENA flag, if set, the light is logically ON, but may be dark, if waiting for sync signal
- LED fail flag, indicating an LED head failed to illuminate (requires proper setup SLJB)
- temperature limit flags (see functional description)
- SYNCEXT flag indicating an external sync signal

Polling LGIN (lamp group information) delivers the temperatures for every LED head and the so called "ready bits" for every LED head. This bit is set, if the light is illuminated.

The LED controller 4416 has three lamp groups, LG001, LG010 and LG100. The diag software polls all three (if polling is checked), but displays only the one selected to keep the display compact.

5 CE Conformity

We,

IES Ingenieurbüro für Elektronikentwicklung und Spezialgerätebau Dr.-Ing. U. Bahr
In den Waashainen 2
38108 Braunschweig
Germany

hereby declare in sole responsibility, that our product

IES 4416 LED Controller

complies in conception and production with the following EU standards

2014/30/EG (EMC)

Applied standards:

EN 61000-6-2

EN 61000-6-4

If any modifications are applied from the end user, this declaration is invalid.

2016-06-01
(Date)

(Dr.-Ing. U. Bahr, company owner)